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CRETACEOUS FLORA
OF
GENESEE, ALBERTA

D.M.BRAYTON
1953

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CRETACEOUS FLORA OF GENESEE, ALBERTA

A DISSERTATION

SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES
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OF MASTER OF SCIENCE

FACULTY OF ARTS AND SCIENCE

DEPARTMENT OF GEOLOGY

BY

DARRYL MERRITT BRAYTON, B.A.

EDMONTON, ALBERTA.

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TABLE OF CONTENTS

	Page
Preface.....	i
Acknowledgements.....	ii
Chapter 1 Stratigraphic Relations of the Genesee Flora	
1. The Edmonton Formation.....	1
2. The Kneehills tuff.....	2
3. Local Aspects of the Fossiliferous Beds of Genesee.....	4
4. The Lance Formation.....	6
Geological Map of Genesee Area.....	14a
5. The Position of the Genesee Flora.....	15
Correlation sheet of Edmonton Formation.....	16a
Chapter 2	
1. The Genesee Assemblage.....	17
2. Evidence of Lance age from the Flora	18
3. Climatic conditions indicated by the Genesee Flora.....	20
Chapter 3 Formal Description of Flora	
Introductory Statement.....	23
Phylum Pteridophyta	
Order Filicales	
Family Osmundaceae	
<u>Osmunda</u> sp.....	23
Phylum Spermatophyta	
Group Coniferales	
Family Cupressaceae	
<u>Sequoiites</u> <u>lanceodorfii</u>	25
<u>Sequoiites</u> <u>artus</u>	26
<u>Elatocladus</u> <u>ungeri</u>	26
<u>Elatocladus</u> <u>intermedius</u>	27
Class Angiospermae	
Dicotyledones	
Order Fagales	
Family Betulaceae	
<u>Alnus</u> <u>serrata</u>	28
<u>Betulites</u> sp.....	28
Order Salicales	
Family Salicaceae	
<u>Populus</u> <u>elliptica</u>	29
<u>Populus</u> sp. cf. <u>Populus</u> <u>elliptica</u>	29
Order Hamamelidales	
Family Cercidiphyllaceae	
<u>Trochodendroides</u> <u>arctica</u>	30
<u>Trochodendroides</u> sp. (a) cf. <u>T. arctica</u> ...	32
<u>Trochodendroides</u> sp. (b) cf. <u>T. arctica</u>	32
<u>Trochodendroides</u> sp. (c) cf. <u>T. arctica</u> ...	33
<u>Trochodendroides</u> sp. (d) cf. <u>T. arctica</u> ...	33
<u>Cercidiphyllum</u> <u>ellipticum</u>	34
Order Platanales	

Table of Contents (cont'd)

	Page
Family Platanaceae	
<u>Platanus raynoldsii integrifolia</u>	35
<u>Protophyllum</u> ? sp.....	35
Order Ranales	
Family Anonaceae	
<u>Anona robusta</u>	36
Family Menispermaceae	
<u>Menispermites</u> sp.....	37
<u>Menispermites</u> sp. (a).....	37
<u>Menispermites</u> cf. <u>septentrionalis</u>	37
<u>Dombeyopsis nebrascensis</u> or	
<u>Menispermites</u> sp. (b).....	38
<u>Dombeyopsis nebrascensis</u>	39
<u>Dombeyopsis colgatensis</u>	40
Order Rhamnales	
Family Rhamnaceae	
<u>Rhamnites ovatus</u>	40
<u>Zizyphoides mackayi</u>	41
Family Vitaceae	
<u>Vitis stantoni</u>	41
Order Umbellales	
Family Avaliaceae	
<u>Aralia alexoensis</u>	42
Order Rubiales	
Family Caprifoliaceae	
<u>Viburnum simile</u>	43
Order Malvales	
Family Tiliaceae	
<u>Grewia yikonensis</u>	44
Class Monocotyledones	
Order Pananales	
Family Typhaceae	
<u>Typha</u> sp.....	44
Glossary of Botanical Terms.	
Plates 1-38, pp. following Glossary.	
Index to Plates, pp. following Plates.	
Bibliography.	

ABSTRACT

A well-preserved fossil flora of 31 species has been collected from a tuff bed of the Edmonton formation near Genesee, Alberta from the latest upper Cretaceous Triceratops zone. The dicotyledons, Anona robusta Lesq., Dombeyopsis colgatensis Brown, Trochodendroides arctica Heer, and Vitis stantoni Knowlton indicate direct correlation with type section Lance beds of Wyoming. Additional upper Cretaceous forms include Menispermites cf. septentrionalis, Grewiopsis wukonensis Hollick, Protophyllum sp. Martin and Betulites sp.. Sequoiites langsdorfii (Brongniart) Heer is reported for the first time from pre-Tertiary beds. The Genesee assemblage indicates a cool temperate flora.

PREFACE

This thesis contains a description of an upper Cretaceous flora from the upper part of the Edmonton formation (Lance equivalent in part ?) of Maestrichtian (?) age, found along the banks of the North Saskatchewan River near Genesee, Alberta, about 40 miles upstream from Edmonton.

The subject material for this thesis had already been collected by the University of Alberta and afforded an excellent opportunity to describe species from one horizon in the upper Edmonton formation. W.A. Bell (Geol. Surv. Bull., No. 13, 1949.) has done a study on both Cretaceous and Paleocene flora of Western Canada, and this study brackets the Genesee floral horizon. The Genesee flora, however, contains additional important genera and species worthy of description.

Both flora and floral micro-structures such as spore cases, spores, pollen grains and cuticles are relatively abundant in the continental upper Cretaceous deposits of Western Canada. Hence there is an opportunity for an extensive paleobotanical study of Cretaceous and eventually other flora with the ultimate goal of figured specimens for correlative work.

ACKNOWLEDGEMENTS

The writer wishes to express his sincerest appreciation to all members of the Department of Geology, and to the members of the Department of Botany, University of Alberta for their assistance and guidance as to the method and manner in which this study should be pursued.

The writer wishes especially to express his appreciation for the assistance rendered him by Dr. P.S. Warren, who assembled the Genesee flora; and also the writer's deepest appreciation to Dr. C.R. Stelck, under whose direction and guidance this thesis was written.

R.J. Mason has given assistance in the photographic procedure for the plates.

Introduction

The purpose of this study is to investigate the effects of the proposed system on the performance of the system. The study is divided into two main parts: a theoretical analysis and an experimental evaluation. The theoretical analysis is based on the principles of the system and the results of previous studies. The experimental evaluation is based on the results of a series of experiments conducted on a real system. The results of the study are presented in the following sections. The first section presents the theoretical analysis, which shows that the proposed system can improve the performance of the system. The second section presents the experimental evaluation, which shows that the proposed system can improve the performance of the system in a real environment. The results of the study are summarized in the following table:

Parameter	Proposed System	Reference System
Performance	Improved	Baseline
Stability	Improved	Baseline
Reliability	Improved	Baseline

CHAPTER 1

STRATIGRAPHIC RELATIONS OF THE GENESEE FLORA

1. THE EDMONTON FORMATION

The flora from Genesee, Alberta occurs in the Edmonton formation. Tyrrell described and named the Edmonton formation as "soft whitish sandstones and white or grey, often arenaceous clays, with bands and nodules of clay ironstone and numerous seams of lignites". (Tyrrell 1887, p. 127 E).....

" The top of the formation is marked by an extensive coal deposit.... The bottom of the series lies conformably on the Pierre shales, without any sharp line of demarcation between the two" (idid, p. 132 E) The Pierre shales referred to belong to the Bearpaw formation, and the upper most coal deposit is known as the Ardley seam. Williams and Dyer (1930, p.44) amplify the above descriptions from southern Alberta as follows: "The composition of the Edmonton beds varies greatly both laterally and vertically. The formation consists of thin alternating beds of white and pale grey, argillaceous sands, arenaceous shales, carbonaceous shales and coal. There are thin pure beds of bentonite as well as bentonitic shales and sandstones".

In the Plains region, the Edmonton has been assigned a maximum thickness of 1,225 feet (Allan, J.A., 1924, p. 38), and a mean of about 1,000 feet. From wells drilled, the thickness of the Edmonton in the vicinity of the outcrop area near Genesee, Alberta, is ^{calculated to be} approximately 1,500 feet.

The Edmonton formation has been divided into an upper, middle and lower portion.* The dividing line between upper and middle member is determined by a lithologic marker bed known as the Kneehills tuff.

* J.O.G. Sanderson, Research Council of Alberta, Report No.13, 1945.

2. THE KNEEHILLS TUFF

This volcanic tuff horizon was outlined by J.O. Sanderson in the Drumheller area in 1924. The tuff in this area forms a convenient and widespread boundary plane separating the Upper and Middle members of the Edmonton formation. The Middle Edmonton member is composed of all the beds from the top of the Drumheller marine tongue up to the top of the bentonitic shale containing the tuff beds. The uppermost bed of the Middle member is a dark grey to mauve- black shale, which included near its base the thin persistent tuff layer. It is underlain by a prominent white bentonitic sandstone. The tuff bed occurring in the upper mauve shale is ~~here~~ named the Kneehills[^] tuff because of its numerous outcrops on Kneehills Creek and its branches.

"x
The tuff is a pale grey, massive rock of very fine grain; seldom over 8 inches in thickness. The ash^(tuff) bed is not entirely continuous, but it is nearly so. The rock is hard and can be trimmed like an igneous rock; when struck with the hammer it rings. The ash layer does not weather readily but breaks into sharp edged, angular fragments and forms a surface talus. The ash was deposited underwater and in some cases shows a roughly horizontal fracture, but more usually is without sign of any structure or bedding. The appearance and properties of the ash are uniform wherever it has been observed. A similar thin stratum of ash was discovered by Sanderson in the Cypress Hills, in rocks which are apparently of the same age as those enclosing the Kneehills tuff."

The volcanic ash of the Red Deer region and that from Cypress Hills has been analysed for the various oxides and have proved to be

Δ *Twp 32, RGEs 25-26, W 1th M.*

x. J.A. Allan & J.O.G. Sanderson, Research Council of Alberta, Report No 13, 1945.

THE HISTORY OF THE

REIGN OF KING CHARLES THE FIRST

IN WHICH ARE CONTAINED THE

REMARKABLE PASSES OF HIS LIFE

AND THE CAUSES OF HIS DEATH

BY SAMUEL JOHNSON

IN TWO VOLUMES

LONDON: Printed by J. B. 1704

THE SECOND VOLUME

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very similar and of singular composition. (J.A. Allan and J.O.G. Sanderson, Research Council of Alberta, Report No. 13, p. 69, 1945).

	Drumheller	Cypress Hills
SiO ₂	87.0	89.6
Al ₂ O ₃	4.8	3.2
CaO	1.5	1.2
MgO	2.0	2.0
K ₂ O	0.7	0.4
Na ₂ O	0.9	0.4
Ignition loss	2.8	3.4

(Analysed by Wm. Gerrie, Toronto University, 1927.)

The remarkably high percentage of silica in this rock is difficult to explain. No unaltered extrusive rock contains so much silica and so little alumina. The maximum percentage of silica observed in 5 analysis of pumicites by H.S. Washington, (U.S. Geol. Surv., Prof. Paper 14, 1903) is 79.48, while the minimum percentage of alumina in pumicate was found to be 11.60. The suggestion is made here that the ash was high in silica as deposited and very porous, and that since deposition the pore space has been taken up by secondary silica in the form of chalcedony or opal, leached from the adjacent beds.

Microscopically, the Kneehills tuff is seen to be made up of minute, fresh mineral fragments, quartz and feldspar mainly, with varying proportions of altered glass all set in a felty groundmass which is isotropic to dimly anisotropic. It is thought that the ground mass is made up essentially of devitrified glass along with minute masses of fibres of redeposited chalcedonic or opaline silica. The characteristic shape of glass " shards"; long, stringy fragments, crescentic bits of angular particles showing reenterant angles; may be noted among the grains that remain isotropic under cross nicols.

The rock is commonly vuggy, the vugs being either filled or lined with chalcedon^y, or lined with chalcedony and filled with bentonite. Occur^rences of the latter kind, suggest the derivation of the colloidal clay bentonite from decomposed volcanic glass.

The origin of the Kneehills ash is not as yet known. Its fine size makes it possible that the volcanoes from which it was ejected may have been hundreds of miles away. J. Udden ("The Mechanical Composition of Wind Deposits", Augustana Library Publication No. 1, p. 65, 1898) has shown experimentally that dust particles from $1/64$ to $1/36$ mm. diameter may be carried 1000 miles by moderately strong winds. The larger particles of the Edmonton ash are from $1/20$ to $1/36$ mm. diameter. Volcanos which were active during Edmonton time are known in Montana and possibly west of the Rocky Mountains.

The Kneehills tuff correlative has been found in various other localities besides the two above mentioned areas. This tuff bed is known from the vicinity of Whitecourt on the Athabaska River. In the latitude of Genesee the Kneehills tuff outcrops 25 miles east of Genesee, on Strawberry Creek a tributary of the North Saskatchewan River about 140 miles northwest of Drumheller.

3. LOCAL ASPECTS OF THE FOSSILIFEROUS BEDS OF GENESEE

In as much as the Kneehills tuff outcrops to the east of Genesee and the Paleocene contact lies to the west of Genesee it may be assumed that the Genesee flora belongs to the upper member of the Edmonton formation.

Professor E.W. Berry, (Trans. Roy. Soc. Can., Vol. 20, Sec. IV, p. 189, 1926) has determined a number of fossil plants from the upper part of the Edmonton, collected from various parts of Alberta,

which are in collections at the University of Alberta. One of these collections include the following from the Pembina River at Evansburg, 30 miles northwest of Genesee.

(Industrial Research Council, Report 19, pp. 22-23, 1928)

Glyptostrobus europaeus (Brong.) Heer

Typha sp. Penhallow

Musophyllum sp.

Palmaecarpon truncatum Lesq.

Platanus aceroides Lesq.

Platanus aceroides latifolia Knowlton

Populus arctica Heer

Populus speciosa Ward

Aralia natata Lesq.

Viburnum nordenskioldi Ward

Viburnum newberryanum Ward

The above flora is less than 50 feet below the top of the Edmonton.

In the Drumheller area, the Ardley coal seam occurs near the top of the Edmonton formation and lies in the upper Edmonton member. The coal seam lies about 150-240 feet above the Kneehills tuff bed and 50-140 feet below the top of the Edmonton. Correlatives of the Ardley seam outcrop on the North Saskatchewan river, west of Genesee, Alberta, where it is termed the " Big Seam". Other terminology is used for the Ardley correlative such as the " Pembina " seam near Evansburg; and the " Wabamum" seam which outcrops in the vicinity of Lake Wabamum, west of Edmonton. The Big Seam also outcrops just downstream from the Genesee floral locality in a local flexure (Slump?) known as the coal arch. This places the Genesee in subjacent proximity to the Ardley seam. During the 1946 field season C.M. Sternberg, (Geological Survey, Paper 47-1) found the reptile Triceratops in the upper Edmonton member, below the Ardley seam and above the Kneehills tuff. This showed Sanderson's division between Middle and Upper Edmonton members

to represent a distinct faunal break. The Ornithischia^Δ, especially the Ceratopsia, evolved very rapidly and, therefore, are splendid horizon markers. Triceratops is a well known genus from the Lance formation of Wyoming, and its presence in the Upper Edmonton beds shows that this member must be considered a Lance equivalent. Parts of three skulls of Triceratops were collected between the tuff bed and the Ardley coal seam. One specimen of Triceratops was collected approximately 55 feet above the tuff bed. Teeth of Leptoceratops, vertebrae and limb bones of Thescelosaurus, phalanges of Ornithomimus, and a skeleton of Tyrano^Δsaurus? were collected or observed. Tyrannosaurus lay 45 feet below the Ardley seam. Hadrosaurus appear to be very scarce, no remains were seen in the Upper Edmonton member, whereas in all lower beds Hadrosaurs are by far the most common forms. Thescelosaurus edmontonensis has been determined to have come from the Upper Edmonton member near the base of the thick sandstone bed just above the tuff. No bones of Thescelosaurus have ever been observed below this tuff bed. A skull of the Lance genus Ankylosaurus and a fragmentary skeleton of Leptoceratops gracilis have both come from above the tuff bed. Only one known Middle Edmonton Ornithischian^Δ genus, that is, Anatosaurus continued to Lance time.

The presence of Triceratops, Tyrannosaurus, Thescelosaurus, and Ankylosaurus in the Upper Edmonton shows conclusively that these beds are of Lance age.

4. THE LANCE FORMATION

The Lance Creek area was first brought into scientific literature by J.B. Hatcher, (American Journal of Science, 3rd. ser., Vol. 45,

Δ C.M. Sternberg, Geol. Surv. Paper 47-1, 1947

135-144, 1893); who had collected a large suite of dinosaur remains there between 1889 and 1895. Before the publication of Hatcher's paper, O.C. Marsh, (American Journal of Science, 3a series, Vol. 37, 334, 1889-----) had described several species of Triceratops (originally called Ceratops) and other vertebrates from Hatcher's collections; he had failed, however, to specify the locality from which these specimens had been obtained, other than they were, "from the Ceratops beds in Wyoming." It remained for Hatcher to locate the area, and to describe in detail the lithological characters and sketch the areal boundaries of the beds which had yielded dinosaur remains. Regarding the stratigraphic position of the " Ceratops beds", Hatcher stated: " All the beds of the entire section are conformable, and bear evidence of continuous deposition, from the Fort Pierre shales up through the Fox Hills sandstones and the overlying freshwater Ceratops beds".

T.W. Stanton and F.H. Knowlton visited the area and made collections of invertebrates and plants from both the " Ceratops beds" and adjacent strata. The reports on this visit were published in 1897. (Geol. Soc. Amer. Vol. 8, 127-156, 1897) At this time Knowlton regarded the plants as indicative of the " true Laramie" age of the " Ceratops beds", that is, equivalent to the Upper Cretaceous Laramie formation of the Denver basin, and of the same age as the plant-bearing " Black Buttes beds" of southwestern Wyoming. The stratigraphic section, as observed by Stanton and Knowlton, showed a conformable sequence from the Pierre shales up through the Fox Hills sandstone, the " Ceratops beds" and finally

the " Fort Union group". The " Fort Union" age of the beds overlying the " Ceratops beds" was determined through plant evidence and on the absence of dinosaur remains.

— In 1909, F.H. Knowlton changed his opinion concerning both the stratigraphic relations and age of the Lance beds. He concluded.... " 'Lance Creek beds' of Wyoming, their stratigraphic and paleontologic equivalents elsewhere, are to be regarded as constituting the lower member of the Fort Union formation and are Eocene in age", from later investigations it was discovered that there was a mixing of floras.^x Although the obviously mixed collection of Lance Creek specimens did not add any appreciable weight to his argument, Knowlton was by this time thoroughly convinced by accumulated evidence from elsewhere that the flora of the " Ceratops beds" and their supposed equivalents elsewhere could not be distinguished from the Fort Union flora.

— In 1910, T.W. Stanton first applied the name Lance formation to the " Ceratops beds"^a. At this time he also estimated the thickness of the Lance formation at 2,100 to 2,200 feet.

Within the next few years the controversy concerning the Cretaceous-Tertiary boundary in the western interior reached its climax.

In the summer of 1914, R.S. Lull visited the Lance Creek area, and subsequently published an excellent summary of the known vertebrate remains, (Amer. Jour. Sci., 4th series, Vol. 40, 319-348, 1915.) both mammalian and dinosaurian which had been collected from the Lance formation of the region. The chief contribution of this report was

^x E. DORE. LANCE CREEK FLORA OF THE ROCKY MOUNTAIN REGION. 1905
^a Lance Creek, Area, Niobrara County, Wyoming

the observation that the mammalian remains had been collected from the same zone that had yielded the dinosaur remains, and were uniformly distributed throughout the entire Lance formation. Emphasizing the relationship of the mammals, Lull regarded these as substantiating the testimony of the dinosaurs for the Mesozoic age of the beds.

The Lance mammalian fauna is regarded by G.G. Simpson, (Mem. Peabody Mus. Nat. Hist., Vol. 3, part 1, 97-139, 146, 149, 150, 1929.) as of latest Cretaceous age. The dinosaurs of the area were again discussed in 1930 by L. Russell, (Proc. Amer. Philos. Soc., Vol. 69, 139-141, 1930.) who listed the 19 species known and discussed their relation to other faunas. He concluded that the Lance formation, as originally defined in the Lance Creek area, is equivalent in Montana and Dakotas to only the Hell Creek beds, and that the Tullock and Cannonball should be provisionally included in the Paleocene. That the Tullock and Ludlow beds, generally regarded as the upper member of the Lance formation in regions to the north of the Lance Creek area, are of early Paleocene age has recently been substantiated by foraminiferal studies of the marine Cannonball^A beds, which interfinger westward into the Ludlow.

The systematic position of the Lance species, in so far as it is believed to be determined, is shown in the following list: (E. Dorf, Contributions to Paleontology, 97-98, 1942.)

PTERIDOPHYTA

Filicales

Polypodiaceae

Asplenites tenellum

Woodwardia ? crenata

Salviniaceae

Salvinia? sp.
Position uncertain
Filicites knowltoni

Equisetales
Equisetaceae
Equisetum sp.

Lycopodiales
Selaginellaceae?
Selaginella? falcata

SPERMATOPHYTA

Gymnospermae
Ginkgoales
Ginkgoaceae
Ginkgo adiantoides
Coniferales
Taxodiaceae
Sequoia dakotensis
Araucariaceae
Araucarites longifolia

Angiospermae
Monocotyledons
Typhaceae
Typha sp.
Cyperaceae
Cyperacites sp.
Palmae
Sabalites eocenica
Sabalites montana
Araceae
Pistia corrugata
Cannaceae
Canna? magnifolia

Dicotyledons
Salicaceae
Salix lancensis
Saliciphyllum wyomingensis
Fagaceae
Dryophyllum subfalcatum
Quercophyllum gardneri
Moraceae
Ficus planticostata
Platanaceae
Platanophyllum montanum
Platanophyllum platanoides
Aristolochiaceae
Aristolochites brittoni
Lauraceae
Laurophyllum coloradensis

Laurophyllum meeki
Laurophyllum salicifolium
Laurophyllum wardiana

Cercidiphyllaceae

Cercidiphyllum arcticum
Cercidiphyllum ellipticum

Nymphaeaceae

Nelumbo tenuifolia
Nymphaeites browni
Nymphaeites dawsoni

Menispermaceae

Menispermites belli
Menispermites cockerelli
Menispermites knightii

Magnoliaceae

Magnoliophyllum cordatum

Anacardiaceae

Pistacia eriensis

Vitaceae

Vitis stantoni

Tiliaceae

Grewiopsis saportana

Dilleniaceae

Dillenites cleburni

Myrtaceae

Myrtophyllum torreyi

Araliaceae

Araliaephyllum artocarpoides

Cornaceae

Cornophyllum wardii

Aleaceae

Fraxinus leii

Bignoniaceae

Dombeyopsis colgatensis
Dombeyopsis obtusa
Dombeyopsis trivialis

Caprifoliaceae

Viburnum marginatum
Viburnum montanum

Position Uncertain

Anona? robusta
Apeibopsis? discolor
Celastrus? taurinensis
Celastrus? affine
Cinnamomum? affine
Cissus? lobato-crenata
Ficus? ceratops
Ficus? trinervis
Quercus? viburnifolia
Rhamnus? minutus
Trapa? microphylla
Phyllites trifoliatus
Phyllites sp.

Phyllites sp.
Phyllites sp.
Carpites lancensis
Carpites ulmiformis
Carpites verrucosus
Carpites walcotti
Carpites sp.
Carpites sp.
Palaeoaster inquirenda

The foregoing list carries some species in common with those found in the Edmonton formation of Western Canada as revealed in the following selected compilations.

The flora found in the Edmonton formation in the Drumheller has been listed by Allan and Sanderson as follows: (Research Council of Alberta, Report 13, pp. 92-93, 1945.)

PTERIDOPHYTA

Equisetaceae
Equisetum s. nov.
Onoclea sensibilis foliilis Newberry

SPERMATOPHYTA

Gymnospermae
Cycadaceae
Cycad sp.
Ginkgoaceae
Ginkgo laramiensis Ward
Taxaceae
Taxites olriki Heer
Salisburia sp.
Pinaceae
Anietites tyrrelli Dawson
Sequoia reichenbachii (Geinitz) Heer
Sequoia nordenskioldii Heer
Sequoia langsdoeffii (Brongniart) Heer
Taxodium occidentale Newberry
Glyptostrobus sp.

Angiospermae

Lemnaceae
Lemna scutata Dawson
Family-?
Carpites (fruit)
Salicaceae
Populus cuneata Newberry
Populus acerifolia
Populus newberryi Cockerell

Populus amblyrhynchum Ward
Populus arctica Heer
Populus richardsoni Heer
Fagaceae
Castania sp.
Moraceae
Ficus russelli Knowlton
Platanaceae
Platanus newberryana Heer
Platanus nobilis Newberry
Hippocastanaceae
Aesculus antiquus Dawson
Sapindaceae
Sapindus affinis Newberry
Stercoloaceae
Pterospermites sp.
Hydrocaryaceae
Trapa borealis Heer
Trapa? microphylla Lesq.

The flora listed above is apparently from an aggregate collected from both above and below the Kneehills tuff.

However, Bell^x claims that the Edmonton formation carries two floras, which lie respectively below and above the Kneehills tuff member which has been correlated lithologically with the Battle (Blackmud) formation of southeastern Alberta. The lower flora indicates an age approximately that of the Fox Hills formation of Montana, whereas the Upper Edmonton flora is correlated with the flora of the Lance formation of Wyoming. Composite lists taken from Bell, from several localities reveals this postulated division of the Edmonton flora.

The known flora is limited to about 24 species, distributed among 14 families and 20 genera. Equisitae are represented by 1 species, ferns by 2, cycadophytes by 3, ginkgophytes by 3, conifers by 6, and dicotyledons by 10. Of the conifers, Sequoiites and Elaton/cladus intermedius are particularly abundant in the lower part of the formation. Among dictyledonous trees Platanus is a common

x W.A. Bell, Geol. Surv. Bull. No. 13, pp 19-20, 1949

 

genus in the upper part of the formation. Dombeyopsis and Vitis are plentiful and widespread in the lower part, but, if the species concerned are correctly referred to these genera, they are presumably climbing plants and not arboreous.

The flora of the lower part of the Edmonton has 18 species, namely:

Equisetum perlaevigatum Cockerell
Nilssonsonia sp.
Nilssonsonia serotina Heer
Ginkgoites sp.
Carpolithus (Ginkgoites?) fultoni Bell
Carpolithus (Ginkgoites?) kneehillensis Bell
Torreyites tyrrellii Dawson
Cunninghamhamiostrobos ? sp.
Sequoiites artus Bell
Sequoiites dakotensis Brown
Elatocladus intermedius Hollick
Thuites interruptus Newberry
Juniperites gracilis
Trochodendroides arctica Heer
Jenkinsella arctica Heer
Dombeyopsis nebrascensis Newberry
Nymphaeites angulatus Newberry
Vitis stantoni Brown

Although none of these species if taken singly, is of value for precise age determination, the assemblage as a whole is most characteristic of formations having an age approximately that of the Fox Hills of the United States. Some of the species are of value for correlating other formations, as, for example, the Brazeau within the province. The most important species for this purpose are: Equisetum perlaevigatum, Nilssonsonia serotina, Sequoiites artus, Elatocladus intermedius, and Dombeyopsis nebrascensis. The age of the lower Edmonton is fixed by that of the Lance equivalent above and of the marine Bearpaw below.

The upper Edmonton (Lance equivalent) flora comprises:

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Filicites knowltoni Dorf
Carpolithus (Cycadinocarpus?) ceratops Knowlton
Sequoiites dakotensis Brown
Platanus raynoldsii intergrifolia Lesq.
Platanaphyllum sp.
Anona robusta Lesq.
Nymphaeites angulatus Newberry
Vitis stantoni Knowlton
Fraxinus leii Berry

Of these 9 species, 3, namely, Sequoiites dakotensis, Nymphaeites angulatus, and Vitis stantoni, occur in the lower Edmonton. Platanus raynoldsii intergrifolia is probably also too long-ranging to be of much value for refined age correlation. There remain only four diagnostic species, viz.: Filicites knowltoni, Carpolithus ceratops, Anona robusta, and Fraxinus leii. These are all characteristic forms in the Lance formation, and two of the most diagnostic forms, Carpolithus ceratops and Fraxinus leii occur in the Frenchman formation. It is concluded therefore that the upper part of the Edmonton formation is equivalent in age to the Frenchman formation of Saskatchewan and to the Lance formation of Wyoming.

5. THE POSITION OF THE GENESEE FLORA

The Genesee floral collection studied was collected from one horizon in the upper Edmonton formation. This horizon is bracketed by the " Big Seam" above and the Kneehills tuff below; thus the Genesee floral horizon occurs within the limits of the upper Edmonton formation as defined at Drumheller by Sanderson. The " Big Seam" is approximately 120 feet below the Paleocene-Cretaceous contact on the basis of assumed regional dip of 20 feet/mile and the Genesee floral horizon is around 160 feet below the Paleocene-Cretaceous contact. Therefore the Genesee floral horizon occurs approximately 40 feet below the " Big Seam", and around 180 feet above the Kneehills tuff.

The stratigraphic position of Triceratops , in the Drumheller area, is from about 70 feet below the Ardley seam to about 55 feet above the Kneehills tuff. ~~at Genesee, Alberta.~~ The equivalent interval (Triceratops zone) of the upper Edmonton formation in the Genesee area would include the Genesee floral horizon. Dinosaur tracks occur above the "Pembina" coal seam to the northwest; therefore the flora would not belong to the latest portion of the Triceratops zone, but should be assigned a position about midway in the Triceratops zone, as preserved from erosion in the Genesee area.

Correlation Sheet of Edmonton Formation

Plains of southwest Alberta	Plains of southeast Alberta	West-central Alberta		Saunders and Wapiti Groups	Montana	Characteristic plants	Ages
		Plains	Foothills				
Porcupine Hills Willow Creek (upper)	Ravenscrag	Paskapoo	Paskapoo and post-Brazeau beds	Entrance conglom.	Fort Union	Platanus Basilobata Onoclea hebridica Elatocladus nordenskioldi	Thanetian
		Montian?
Willow Creek (lower)	Frenchman	Upper	Kneehills tuff	Brazeau	Hell Creek	Anona robusta Fraxinus leii	Danian (absent?)
St. Mary River	Battle	Edmonton	Lower		Fox Hills Colgate member	Nilssonina serotina Elatocladus intermedius Torreyites tyrrellii	Maestrichtian
	Whitemud						
	Eastend						
Upper Cretaceous	St. Mary River						

Paleocene

Upper Cretaceous

1. THE GENESEE ASSEMBLAGE

The collected flora from Genesee, Alberta present in the Geological Museum at the University of Alberta consists of around 400 specimens. Many species of the Genesee flora are known elsewhere in the late Cretaceous and even the early Tertiary deposits of North America, from the Rocky Mountain region and Alaska areas. Sequoiites langsdorfii (Brongniart) Heer is the most prevalent species constituting more than 1/3 of the collection. There are 63 specimens of Populus elliptica Newberry amounting to 1/5 of the collection and ^{this} was the most prevalent of the Angiosperms. The genus Trochodendroides is represented by 34 specimens and is the next most abundant Angiosperm. It is interesting to note that of the Angiosperms, the two most prevalent species are very closely related in regard to leaf form, venation and other leaf characters. The following species which accounted for the remainder, with the number of collected specimens bracketed (under $\frac{1}{2}$ of the collection) are listed as follows:

<u>Typha</u> sp. Dorf	(11)
<u>Elatocladus intermedius</u> Hollick	(10)
<u>Cercidiphyllum ellipticum</u> Newberry	(10)
<u>Dombeyopsis</u> cf. <u>nebrascensis</u> Newberry	
or	
<u>Menispermites</u> sp.	(9)
<u>Vitis stantoni</u> (Knowlton) Brown	(6)
<u>Dombeyopsis nebrascensis</u> Newberry	(5)
<u>Sequoiites artus</u> n. sp. Bell	(5)
<u>Viburnum simile</u> Knowlton	(5)
<u>Aralia alexoensis</u> n. sp. Bell	(5)
<u>Platanus raynoldsii integrifolia</u> Lesq.	(5)
<u>Menispermites</u> sp.	(4)
<u>Populus</u> species cf. <u>Populus elliptica</u> Newberry	(3)
<u>Zizyphoides mackayi</u> n. sp. Bell	(3)
<u>Betulites</u> sp.	(2)
<u>Protophyllum</u> ? sp. Martin	(2)
<u>Elatocladus olriki</u> Heer	(2)

Menispermities cf. septentrionalis Hollick (1)
Menispermities sp. (1)
Anona robusta Lesq. (1)
Grewiopsis yukonensis Hollick (1)
Dombeyopsis colgatensis Brown (1)
Rhamnites ovatus Penhallow (1)
Osmunda sp. (1)

Of the species of Angiosperms listed above by far an overwhelming majority show palmate venation and camptodromus pattern. However this writer hesitates to assume this distribution for natural statistics as the postulate immediately arises "Do the palmate species tend to preserve better than the pinnate forms?" The collection dealt with was made for museum purposes and it is known that hundreds of specimens were left at the collecting locality without further assessment other than that of state of preservation.

2. EVIDENCE OF LANCE AGE FROM THE FLORA ITSELF

Most of the identifiable species from Genesee flora have been reported from the Upper Cretaceous of North America. Although the Genesee flora contains species which are also present in the Paleocene, there are characteristic species which are considered restricted to Lance age elsewhere in North America. The short ranging species, which are considered most reliable for correlation purposes (i.e. found in the Lance formation and formations that are definitely Lance in age for example Colgate, Hell Creek, Medicine Bow, Laramie (part) and Frenchman) and are present in Genesee floral assemblage, are listed below:

Anona? robusta Lesq.
Dombeyopsis colgatensis Brown

Gercidiphyllum arcticum = Trochodendroides arctica Heer is found in the type Lance formation but is restricted elsewhere to Paleocene age.

 

Vitis stantoni Knowlton is found in beds which overlie the Laramie part such as the Arapahoe- Denver and Dawson formations, the Lance age of which has been established for a least their lower parts on the basis of Triceratops dinosaurs, (R.S. Lull op. cit., 3,7, 1933.) Correlations with the upper Cretaceous beds of Alaska may be made by the following species; Menispermites cf. septentrionalis; Grewio-opsis yukonensis Hollick, Protophyllum sp. Martin, and Betulites sp. Species which have not yet been reported from Tertiary strata are as follows: (Geol. Soc. of Am., Mem. 51, 1952.)

Elatocladus intermedius Hollick
Sequoiites artus n. sp. Bell
Viburnum simile Knowlton

The flora of the Genesee horizon comprises only 8 species which are considered diagnostic for correlation purposes. This analysis is, of course, very suggestive of Lance age, but cannot be considered conclusive, because of the small number of species in the assemblage. However, the number of species of Lance age might have been larger had the collection been made with Lance forms as the primary objective. Fortunately the pre-Tertiary position of the floral suite is well established by the occurrence of Dinosaur tracks (University of Alberta, Museum specimen, No. 467) above the " Pembina seam" on the Pembina river, and the Pembina floral suite carries almost identical element with those found in the Genesee floral suite. This would appear indicative that the Genesee floral suite was of latest upper Cretaceous age. The suggestion of latest upper Cretaceous age would seem to be supported by floral evidence also, as the number of species found of Paleocene age (elsewhere) is relatively high (17 species.) It is interesting to note also that Sequoiites

langsдорffii (Brongniart) Heer has not been reported from upper Cretaceous strata elsewhere.

In summation the Genesee species which are the best direct index of Lance age of the Genesee suite area follows: (E. Dorf, Contrib. to Paleontology 122, 1942.)

Anona? robusta Lesq.
Dombeyopsis colgatensis Brown

In addition to these restricted species, there are others of wider stratigraphic range so far known in abundance only in floras of Lance age in Cretaceous beds.

Trochodendroides arctica Heer
Vitis stantoni (Knowlton) Brown

3. CLIMATIC CONDITIONS INDICATED BY THE GENESEE FLORA

There are two methods of employing fossil plants as indicators of climatic conditions of the past, both methods apply only to floras of late Mesozoic or Cenozoic time. These are (1) an analysis of the structural characters of the dicotyledonous leaves (chiefly size, venation, texture, and marginal characters) as compared with modern leaves against known climatic requirements; and (2) a generic and specific comparison of fossil species with living forms whose climatic requirements are known, on the assumption that the past conditions were analagous to those under which the majority of the closely related living species grow.

Table 1^x

Leaf characters of dicotyledons, showing relative percentage in each category.

Flora	Margin		Length		Venation	
	Entire	Non-entire	Over 10 cm.	Under 10 cm.	Pinnate	Palmate
<u>Temperate:</u>						
Muir Woods						
22 species	23	77	27	73	77	23
Bridge Creek						
20 species	15	85	30	70	70	30
<u>Warm Temperate to Subtropical:</u>						
Weaverville						
36 species	47	53	60	40	60	40
Lance						
46 species	54	46	41	59	54	46
<u>Subtropical to tropics</u>						
Goshen						
49 species	61	39	53	47	82	18
Panama						
41 species	88	12	56	44	83	17
Genesee flora	48	52	15	85	18	82

A comparison of the Genesee flora with respect to marginal characters with other floras in the table would seem to indicate a warm temperate climate. Indications based on length show a distinct lack of specimens over 10 cm. in length and fits closest to the Muir Woods condition which is a cool climatic condition. The very high percentage of palmate specimens can only be attributed to the fact that the flora was intended as a museum collection; however a relatively high percentage (44-46) in the table indicates a warm temperate condition. The preponderance of Sequoiites lansderffii (Brongniart) Heer would seem to indicate a cool temperate condition to have existed.

The use of modern correlatives in attempting to determine the climatic conditions of Lance time is indicated as follows:

^x Upper Cret. Floras of Rocky Mtn. Region - E. Dettl. p. 101, 1942

Fossil species	Modern correlatives	Mod. Distribution			
		C.T.	W.T.	S.T.	T.
<i>Sequoiites langsdorfii</i>	<i>Sequoia</i>	X	X		
<i>Populus elliptica</i>	<i>Populus</i>	X	X	X	
<i>Trochodendroides</i>					
<i>artica</i>	<i>Cercidiphyllum</i>	X	X	X	
<i>Typha</i> sp.	<i>Typha</i>	X	X		
<i>Elatocladus</i>					
<i>intermedius</i>		X	X		
<i>Cercidiphyllum</i>					
<i>ellipticum</i>	<i>Cercidiphyllum</i>	X	X	X	
<i>Dombeyopsis</i>					
<i>nebrascensis?</i>	<i>Menispermaceae</i>	X	X	X	X
<i>Vitis stantoni</i>	<i>Vitis</i>	X	X	X	X
<i>Menispermites</i>	<i>Menispermaceae</i>	X	X	X	X
<i>Sequoiites artus</i>	<i>Sequoia</i>	X	X		
<i>Viburnum simile</i>	<i>Viburnum</i>	X	X	X	
		11	11	7	3
C.T.- cool temperate	S.T.-sub-tropical				
W.T.-warm temperate	T.- tropical				

It may be at once observed from the totals of the above list that the floral assemblage is cool temperate to warm temperate. From the above table only 7 species of the modern correlatives also grow in subtropical regions and only 3 species grow in the tropic region. The great preponderance of Sequoiites langsdorfii, Populus cf. elliptica, and Trochodendroides are seemingly indicative of cool to warm climatic conditions at that time.

In summary it may be stated that the leaf characters and the distribution of modern correlatives of the Genesee species as well as the absence or scarcity of typically tropical and subtropical genera, point to cool to warm climatic conditions of growth, more nearly approaching the former. That is, the overall climatic indication would be that of the latitude of about Southern Ontario.

 

1. FORMAL DESCRIPTION OF FLORA
INTRODUCTORY STATEMENT

Fossil leaves, stems and cones in the continental upper Cretaceous strata of Western Canada are relatively abundant. An examination of the upper Cretaceous from Genesee has revealed that the available descriptive literature of this flora is still incomplete and for this reason the writer has no apology for describing this excellent flora from Genesee in considerable detail.

This chapter deals with the formal description of some of the upper Cretaceous forms (Lance age) collected from one horizon in the upper Edmonton, near Genesee, Alberta. The species of flora figured and described in this paper, represent only a portion of the species present in the Genesee floral horizon and probably do not include some of the species which have been figured as typical Lance flora elsewhere.

Recently, Dr. Adriance Foster of the University of California has studied the minute details of living leaves by rendering them transparent and mounting them in plastic on glass slides. Dr. Arthur A. Meyerhoff (Abstract 1953, Official Program of the Geological Society of America Cordilleran Section.)(Palo Alto, California) utilizing this method, recently completed a study of the leaves of 90 taxa of living representative of the Betulaceae (birch family) from all parts of the world.

Of 350 specimens studied, Meyerhoff studied 150 characters microscopically and macroscopically. Eight of the 150 characters were found very important in leaf identification in the Betulaceae. These characters are: nature of the midrib, the leaf

THE

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margin, the lowest secondary veins, secondary vein endings, the leaf base, the pattern of the tertiary veins, the angle of departure of tertiary veins from larger veins, and the distribution and appearance of the minor or net vein endings. Certain measurement ratios were also found helpful.

Use of the characters mentioned, in combination with lesser characters, were applied to five fossil leaf taxa and tentative conclusions regarding the usefulness of Foster's methods were drawn. Meyerhoff was able to identify accurately the five fossil taxa, of which some had been misidentified. This study showed that the comparison of fossils with transparent slides of living taxa is a much more accurate method of identification than comparison with leaves on herbarium sheets. Future studies should employ extensive use of these slides to insure reliable determinations of fossil leaf genera and species.

The present study of the Genesee flora indicates that Foster and Meyerhoffs' methods may be used successfully in paleobotanical studies of other genera such as those contained in the upper Cretaceous floras.

Phylum Pteridophyta

Order Filicales

Family Osmundaceae

Genus Osmunda Linne

Osmunda sp.

Frond with leaflets arranged alternately on the rachis. Leaflet rectangular with rounded apex, decurrent on stem, margin crenate-serrate; nervation pinnate secondaries alternate, dichot-

omus branching occurs within $1/3$ of the vein's length, each branch produced again, branches dichotomously, the final veinlets may or may not anastomose with the adjacent veinlets from the secondaries above and below. From each secondary 4 veinlets eventually reach the marginal teeth. Leaflet length 1.9 cm., width 6 mm.

Described specimen (No. C-3-4-Z, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Phylum Spermatophyta

Group Coniferales

Family Cupressaceae

Sequoiites langsdorfii (Brongniart) Heer

Plate 4, figure 2; Plate 16, figure 3; Plate 25, figure 3; Plate 30, figure 1,2; Plate 31, figure 1,2; Plate 32, figure 2; Plate 33, figure 1,4; Plate 34, figure 1; Plate 35, figure 1,2; Plate 36, figure 1; Plate 37, figure 1,3,4; Plate 38, figure 1,2.

Sterile foliage, branched. Leaf narrow, commonly alternately disposed, slightly constricted at the base. Identified usually by its apparent opposite and distichously disposed leaves that have decurrent, somewhat contracted bases; twisting of the decurrent leaves into one plane is commonly revealed by raised lines running from the bases of the leaves obliquely across the axis of the shoot.

Figured specimens, (Nos. C-3-2B', I-1, Z-M, C-3-7-C, C-3-7-D, C-3-4-F, C-3-6N, C-3-6O, C-3-6M, C-3-6-M', C-3-6K, C-3-6A, C-3-6B in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton

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The fifth of these is the fact that the
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formation.

Sequoiites artus (~~n. sp.~~) Bell

Plate 9, figure 2; Plate 32, figure 1, 3.

Synonymy: Sequoia nordenskioldi Berry pars (von Heer),
Geol. Surv., Canada, Mem. 182, p. 18, 1935).

Branch foliage, with pseudo-distichous, narrow, sessile, moderately decurrent, nearly straight-sided, acutely pointed, relatively thick leaves. Leaves, 0.75 to 1.75 mm. wide and up to 1.2 cm. long, little constricted at base. Midrib, relatively broad, and generally well marked. Associated cones, which may belong to this species, are similar to those of Sequoia dakotensis Brown.

Remarks: to separate from Sequoiites langsдорфii this form has narrower and seemingly thicker leaves, which are commonly alternately disposed and less constricted at the base.

Figured specimens (Nos. C-3-4Z, C-3-6-L, are in the Paleobotanical collection at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Elatocladus ungeri Heer

Plate 36, figure 2,3; Plate 37, figure 2.

Sterile foliage, profusely branched at acute angles. Leaves acicular, decurrent, up to 5 or 6 mm. long by 0.5 mm. wide, oblique to highly ascending, mucronately tipped, nearly straight to slightly falcate, not constricted at base, a few at base of branchlets shorter (about 1mm long) and more or less falcate. Female cones,^x terminal, oval, about 1 cm. long by 6 mm. broad, with 4 or 5 peltate

x W.A. Bell op. cit. - p48

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or distally expanded scales on each side of axis in a median section; each scale 3 or 3.5 mm. broad by 2.5 mm. long including stalk of 1.5 mm.

Figured specimens (Nos. C-3-4-Y, C-3-4-X, C-3-1-A, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Elatocladus intermedius Hollick

Plate 22, figure 1; Plate 33, figure 2,3.

Sterile shoots, unbranched or rarely so; leaves spirally disposed but distichously arranged, commonly rather distant, narrow, about 45 degrees to axis or more spreading, up to 3 cm. long by 1.5 mm. broad, linear, with nearly parallel sides and acute apices, contracted at base to a pseudo-petiole, non-decurrent. Axis below basal insertion of leaf is commonly marked by one or two raised lines parallel with the axial borders. Midrib, generally distinct, relatively broad. Surface of leaves, when well preserved, marked by microscopic, longitudinal striae.

Figured specimens (Nos. E-1, C-3-5-C, C-3-6-E, C-3-6D, C-3-6-F, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Class Angiospermae

 

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Alnus serrata Newberry

Plate 25, figure 5.

Leaf rounded rectangular, with slightly cordate base, coarsely and simply toothed above, absence of teeth on basal portion of leaf. A short simple basal vein at 80 degrees to midrib present below the main secondaries: secondaries (5 on this specimen) about 9 pairs, alternate 40 degrees to midrib, lowest more spreading; lower ones with 2 or 3 abaxial branches, upper ones with a single branch; commonly deflected at the point of branching, the branches run into the teeth. Tertiaries are transverse to secondaries and percurrent, some may be once divided. Length 10 cm. Width 7.6 cm.

Figured specimen (No. B-1, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Genus Betula Linnaeus

Betulites sp.

Plate 12, figure 1; Plate 17, figure 3; Plate 20, figure 1.

Leaf ellipticulate-ovoid, apex acute, 11 cm. long 8.4 cm. wide, coarsely dentate, rounded base; petiole strong, nervation crespodromus, alternate 10 pairs of secondaries, one pair of weaker sub-basal veins. The upper secondaries branched once, the lowest secondaries with six abaxially branches. Tertiary venation percurrent to once divided.

Figured specimens (Nos. C-3-2-E', C-3-2-R, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

REPORT ON THE
PROGRESS OF THE
WORK DURING THE
YEAR 1900

The work of the Commission during the year 1900 has been characterized by a steady and continuous progress in all the various branches of the investigation. The most important results have been the completion of the first series of experiments on the effect of temperature on the rate of reaction, and the discovery of a new reaction product. The work on the effect of temperature on the rate of reaction has been continued, and the results have been published in the *Journal of the Chemical Society*. The discovery of a new reaction product has been published in the *Journal of the Chemical Society*.

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Order Salicales

Family Salicaceae

Populus elliptica Newberry

Plate 5, figure 1; Plate 13, figure 1; Plate 15, figure 2; Plate 17, figure 2; Plate 19, figure 1; Plate 25, figure 1,4; Plate 27, figure 5; Plate 28, figure 2; Plate 34, figure 2,3.

Leaf, petiolate, ovate, broadest in lateral dimension, 6.1 cm. in length exclusive of petiole, by 7 cm. in width across the middle, apex, bluntly rounded, rounded to truncate base; margin crenulate-dentate to sinuate above, entire below; nervation quinquepalmate, campto-craspedodrome; primary laterals, highly ascending with 5 to 6 abaxial branches which are looped; exterior slightly sinuous with 4 to 6 abaxial branches which loop with one another and also send veinlets to the margin; the midrib has tertiaries which simulate secondaries and anastomize with weak adaxial tertiaries from the primary secondaries. Tertiary venation is percurrent or may be once divided. The overall reticulate pattern of the veinlets is composed of irregular polygonal areas.

Figured specimens (Nos. C-3-2A, I-1, K-1, L-1, C-3-5-H, C-3-5C, C-3-1-A, C-3-8-E, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Populus sp. cf. Populus elliptica Newberry

Plate 2, figure 1; Plate 3, figure 1; Plate 9, figure 1.

Leaf petiolate, ovate, 5.7 cm. in length, exclusive of petiole, by 6 cm. in width; margin sinuate, apex, obtuse, base rounded;

THE HISTORY OF THE

REIGN OF

CHARLES THE FIRST

IN WHICH ARE CONTAINED THE MOST IMPORTANT AND INTERESTING
EVENTS OF HIS REIGN, FROM HIS MARRIAGE TO HIS DEATH.

BY JOHN HUME, ESQ.

IN TWO VOLUMES. THE FIRST.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE SECOND VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE THIRD VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE FOURTH VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE FIFTH VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE SIXTH VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE SEVENTH VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE EIGHTH VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

THE NINTH VOLUME.

LONDON: Printed by J. Sturges, at the Golden-Anchor, in St. Dun-
stons-Parish, 1719.

nervation palmate, dominantly camptodromous, midrib strong, slightly flexuous and tapering, tertiaries(simulating secondaries) given off from distal portion; primary laterals very highly ascending, acrodromes, having adaxial branches which join with tertiaries from the midrib also having 4 or more abaxial branches which loop within the margin and also send veinlets to loop with the external laterals; external laterals weaker, parallel to the margin, with abaxial branches which loop within the margin, the external lateral anastomises with the abaxial branches from the primary lateral; short veinlets run from the looped external lateral to the margin of the lead. The tertiaries produce a network pattern of irregular polygonal areas, the quaternaries produce a finer pattern of polygonal areas.

Figured specimens (Nos. C-3-5E, C-3-8-A1, C-3-2A', in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Order Hamamelidales

Family Cercidiphyllaceae

Trochodendroides arctica Heer

Plate 5, figure 2; Plate 11, figure 1; Plate 15, figure 1, Plate 19, figure 2; Plate 24, figure 4; Plate 29, figure 1.

Synonymy: Populus arctica Heer, Flora Fossilis Arctica, vol. I, p. 137, Pl. II, figs. 14, 15a (1868).

Populus richardsoni Heer, Idem, p. 137, Pl. XXIII, figs. 2a, 3 (1868).

Populus hookeri Heer, Idem, p. 137, Pl. XXI, fig.

16 (1868).

Hedera macclurii Heer, Idem, p. 138, Pl. XXI, fig.

17a (1868).

Populus arctica Dawson, Roy. Soc., Canada, Trans.,
vol. IV, sec. IV, Pl. I, fig. 8 (1887); Idem, vol. VII, sec. IV,
Pl. X, figs. 2,4 (1890).

Populus richardsoni Dawson, Roy. Soc., Canada, vol.
IV, sec. IV, p. 27 (1887).

Populus hookeri Dawson, Roy. Soc., Canada, Trans.,
vol. VII, sec. IV, Pl. X, fig. 5 (1890).

Populus obtrita Dawson, Roy. Soc., Canada, Trans.,
vol. VIII, sec. IV, p. 8, text fig. 12 (1891).

Trochodendroides arctica Berry, Geol. Sur., Canada,
Bull. 42, p. 109, Pl. XIII, figs 1-4 (1926).

Trochodendroides speciosa Berry, Nat. Mus., Canada,
Bull. 63, p. 22, Pl. V, fig. 8 (1930).

Trochodendroides cuneata Berry, Nat. Mus., Canada,
Bull. 63, p. 20, Pl. V, figs. 2,3 (1930); Geol. Surv., Canada,
Mem. 182, p. 34, Pl. VI, figs. 1-6 (1935).

Grewiopsis mclearnii Berry, Geol. Surv., Canada,
Mem. 182, p. 50, Pl. XII, fig. 3; Pl. XIV, fig. A (1935).
TRICHODENDROIDES ARCTICA BELL, GEOL. SURV. BULL. #13 P. 56 PL. IV fig. 2 PL. XVI fig. 3
PL. IX fig. 4

Leaf orbicular to slightly elliptical, margin smooth, apex
acute, base cuneate and decurrent. Nervation palmate, midrib
slightly flexuous, tapering slightly to the apex. Primary laterals
very highly ascending, acrodromous with adaxial percurrent tertiaries,
and abaxial branches which loop well within the border, external
lateral relatively highly ascending, looping with the abaxial

 

branches of the primary secondaries. Quaternaries produce a pattern of irregular polygonal areas.

Figured specimens (Nos. F-1, D-1, C-4, 1-A, C-3-5D, C-3-5-B, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Trochodendroides sp. (a) cf. Trochodendroides arctica Heer

Plate 12, figure 2; Plate 4, figure 3.

Leaf ovate, petiole, with acute apex and cordate base, margin crenate with upward pointing fine spinuous teeth into which veinlets run, base smooth. Nervation, palmate, acrodromus, midrib relatively strong; primary laterals, highly ascending, having abaxial branches which are campto-craspedodromus; external laterals with campto-craspedodromus branches. Tertiaries not perserved. Length 5.6 cm, width 5.1 cm.

Figured specimens (Nos. C-3-2C', C-3-7-B, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Trochodendroides sp. (b) cf. Trochodendroides arctica Heer

Plate 1, figure 1; Plate 9, figure 3; Plate 13, figure 2; Plate 25, figure 2.

Leaf elliptical with acute apex and rounded base, slightly undulating border with spinuous teeth or margin crenulate-undulate, with smooth base, petiolate. Nervation, palmate, midrib, strong, straight, tapering to the apex; primary laterals, highly ascending acrodromus, with branches which anastomise with tertiary

 

branches of the midrib, abaxial branches also given off the primary laterals which loop well within the border and also join with the weak external laterals. Quaternary veinations produces a pattern of irregular polygonal areas.

Figured specimens (Nos. A-5, C-3-8-Z, I-1, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Trochodendroides sp. (c) cf. Trochodendroides arctica Heer

Plate 14, figure 1; Plate 17, figure 4; Plate 24, figure 1; Plate 27, figure 2,4; Plate 28, figure 1.

Leaf ovate-elliptical with lanceolate apex and rounded base, margin serrate. Nervation palmate, midrib straight, slightly tapering to the apex, primary laterals highly ascending acrodromus, possessing abaxial branches which unite with the external laterals giving a looped appearance. Tertiary pattern is polygonal areas, and the quaternary pattern is finer, smaller polygonal areas. Length 4.8 cm., width 3.1 cm.

Figured specimens (Nos. C-3-5A, B-1, C-3-4A, Z/Z, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Trochodendroides sp. (d) cf. Trochodendroides arctica Heer

Plate 27, figure 1.

Leaf very elliptical, with acute apex and rounded cuneate base; margin crenate-serrate to crenate-undulate; nervation palmate, midrib straight and tapering to the apex; primary

The first of these is the fact that the
 
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lateral very highly ascending, acrodromus with adaxial tertiaries which are percurrent with weak secondaries from the midribs, also abaxial branches are present which loop well within the margin. The external laterals are very weak, paralleling the margin and sending off very weak veinlets which loop just within the margin. Length 5.8 cm., width 3.8 cm.

Figured specimens (Nos. G-1, F-1, A-1, C-3-40, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Cercidiphyllum ellipticum Newberry

SYNONYMY - E. DUFF, UPLIFT FLOORS OF ROCKY MTN REGION'S P. 140 PL. 10. fig 2, 4

Leaf, petiolate, elliptical-lanceolate, with obtuse bluntly pointed apex and cuneate, decurrent base; trinerved palmate with an additional pair of much thinner, external, laterals. Margin smooth at base, crenate-serrate to crenate-undulate above. Midvein well marked to apex. First pair of primary laterals nearly as strong as midrib, rising from top of petiole, highly ascending acrodromus. A few thin highly ascending abaxial branches loop within the border. External primary laterals, very thin, ascending looping near below the middle of the leaf with secondaries from the first pair of laterals. Midvein, with ascending tertiaries that simulate secondaries. Tertiaries inosculating and forming an open net work which contains an equally strong network of nervilles.

Described

~~Figured~~ specimens (Nos. K-M, C-E, Z-Y, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

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Order Platanales

Family Platanaceae

Platanus raynoldsii integrifolia Lesq.

Plate 6, figure 1; Plate 7, figure 2; Plate 11, figure 2; Plate 23, figure 1,2.

Leaf, sub-orbicular, lobed, undulate-crenate margin. The marginal crenae, when well preserved, are capped by a minute mucro at the ends of the veins. The primary laterals are opposite and arise well above the top of the petiole. There is a variable number of basilar, tertiary, camptodromous veins below the primary laterals. The blade of the leaf would be about 20 cm. long and about the same in width. The primary laterals rise at an angle of 35 degrees to the midrib. The leaf is decurrent on the petiole; the petiole is missing. The quaternaries form a loose network of polygonal cells and the smaller veinlets a finer pattern of polygonal cells.

Figured specimens (Nos. C-3-2H', C-3-2G', L-1, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Protophyllum ? sp. Hollick

Plate 10, figure 1.

Fragment of a large, oblong, pinnate-veined, sharply dentate leaf apparently belongs to a species of Protophyllum, as indicated by the broadly spreading, backward bent, lower secondary nerves-- a feature that is characteristic of the genus.

The conspicuously dentate margin serves to differentiate it from most of the larger species of the genus; otherwise it might be

THE HISTORY OF THE

REPUBLIC OF THE UNITED STATES

OF AMERICA

FROM THE FIRST SETTLEMENTS TO THE PRESENT TIME

BY J. H. HARRIS

NEW YORK: PUBLISHED BY J. H. HARRIS, 1852

THE HISTORY OF THE REPUBLIC OF THE UNITED STATES, FROM THE FIRST SETTLEMENTS TO THE PRESENT TIME, BY J. H. HARRIS. NEW YORK: PUBLISHED BY J. H. HARRIS, 1852. This work is a comprehensive history of the United States, covering the period from the first settlements to the present time. It is written in a clear and concise style, and is suitable for both the general reader and the student. The author, J. H. Harris, is a well-known historian and writer. The book is published by J. H. Harris, and is available in both hardcover and paperback editions. The price of the hardcover edition is \$1.50, and the price of the paperback edition is \$0.75. The book is a valuable addition to any library or collection of books on the history of the United States.

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taken for a form of Protophyllum sternbergii Lesq.

The sinuous midrib is strong and tapers toward the apex. Secondaries are strong and alternate and 10-12 in number; they arise at 40-45 degrees to the midrib, and are looped and craspedodromous, sending a veinlet to each tooth. The basal secondaries, have 5 or more abaxial branches which are camptodromous and craspedodromous. Tertiaries are relatively strong and percurrent. Length 13 cm., width 9.4 cm.

Figured specimen (No. C-3-4B, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Order Ranales

Family Anonaceae

Anona robusta Lesq.

SYNONYMY- WABELL GEOL. SURV. BILL. #13 PG 67 PL. XV FIG 6

Leaf, elliptical;; apex, acute; margin , denticulate, entire for variable distance from petiole, non-decurrent on petiole; petiole, heavy. Midrib, strong, tapers rapidly toward the apex. Secondaries, 10 pairs, alternate, camptodromus, which in the basal part of the leaf are more crowded than those above and attached at much broader angles to the midrib. Tertiaries are transverse and percurrent, some once divided, those near the margin enter the teeth.

There are a pair of veinlets below the basal secondaries which appear to parallel the margin.

~~Figured~~ ^{Described}

Figured specimen No. 2, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

the first of these is the fact that the
 system is not a simple one, and that it is not
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 give the value of the function for all values of
 the argument.

Family Menispermaceae

Genus Menispermites Lesq.

Menispermites sp.

Plate 8, figure 1.

Leaves, ovate-acuminate, base rounded, apex acute, petiole, peltate; border crenulate, primary nerves palmately five, the middle one straight, the upper lateral ones somewhat stronger than the lower, highly ascending and curving inwards, branching and anastomosing with the branches of the middle nerve, which are few and distant from the base; upper laterals with six abaxial branches which are craspedodrome, the lower laterals arising at much greater angle to midrib and also possessing 6 to 7 craspedodromus branches. Length 11 cm., width 9.2 cm.

~~Described~~
~~Figured~~ specimen (No. C-3-2M, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Menispermites sp. (a)

Leaf of unknown form and dimensions, petiolate, nervation, palmate, may be peltate, five equally strong radiating primaries, external pair of lateral primaries with strong (craspedodromus ?) abaxial branches. Remaining laterals strong percurrent tertiaries which produces a chevron pattern.

~~Described~~
~~Figured~~ specimens (Nos. C-3-8BB, C-3-8D, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Menispermites cf. septentrionalis Hollick

THE
HISTORICAL
AND
GEOGRAPHICAL

DESCRIPTION

OF THE
COUNTY OF
SURREY
IN THE
THIRTEENTH
CENTURY
BY
J. H. COLEMAN
F.R.S.
AND
J. H. COLEMAN
F.R.S.
WITH
A
PREFACE
BY
J. H. COLEMAN
F.R.S.
AND
J. H. COLEMAN
F.R.S.
LONDON
PRINTED BY
JOHN JOHNSON
ST. PAULS CHURCH-YARD
1843

Leaf of unknown form and dimensions, peltate; nervation palmate, radiating, consisting of a straight midrib, a pair of major ascending lateral primaries, and lower spreading ones that become successively shorter and weaker, with strong abaxial branches.

Figured specimen (No. C-3-2-X, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Dombeyopsis nebrascensis Newberry
or
Menispermites sp. (b)

Plate 22, figure 2; Plate 27, figure 3.

Leaf, orbicular, petiole, absent, widest above middle, tendency to trilobing, slightly cordate base. Margin entire at base, crenate-sinuate to crenate-dentate above. Venation, 5 palmate, mainly craspedodromus. Midrib, moderately strong, slightly flexuous. First pair of lateral primaries, as strong as midrib, rising at top of petiole, strongly ascending to meet upper half of margin, curved somewhat upward, may be flexuous; external lateral primaries, thinner than the others, meeting the margin near, or below the middle of the leaf, or may loop with branches from the primaries above. The first lateral primaries have 4 craspedodromus, in part camptodromus abaxial branches. Secondaries, 3 or 4 pairs, opposite to alternate, craspedodromus. Tertiaries, mainly bowed, one divided or percurrent. Quaternaries form a loose network of polygonal cells. Length 8.1 cm., width 10.1 cm.

Figured specimens (Nos. N-1, C-3-4-C, in the Paleobotanical

1870
 
26. John Z. Smith

collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Dombeyopsis nebrascensis Newberry

Plate 13, figure 2.

Leaves, very variable, obovate to orbicular to elliptical, long-petiolate, generally widest at, or above, middle, rarely obscurely trilobed, cuneate or rounded-cuneate to truncate at base. Margin, entire at base, crenate-sinuate to crenate-dentate above. Venation, 3 to 5 palmate, mainly craspedodromus. Midvein, moderately strong, straight or slightly flexuous. First pair of lateral primaries, about as strong as midrib, generally rising to top of petiole, more rarely suprabasilar, strongly ascending to meet upper half of margin, generally somewhat curved inwards, and commonly somewhat flexuous; external pair of lateral primaries, thinner than the others, meeting margin near, or below the middle of leaf, or more generally looping with branches from the primaries above. The first lateral primaries have 4 to 6 craspedodromus, or in part camptodromus, branches on outer side. Connected with the external primaries are looped or camptodromus tertiaries. Secondaries, 3 or 4 pairs, opposite to alternate, craspedodromus. Tertiaries, mainly bowed, once divided or percurrent. Quaternaries form a loose network of polygonal (mainly quadrangular) cells enclosing a finer network of nervilles.

Figured specimens (Nos. C-3-7A, 1/K, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Dombeyopsis colgatensis Brown

Plate 24, figure 2.
SYNOPSIS OF THE FLORA OF THE CRETACEOUS PERIOD, PL 10, fig 1, d

Leaf, orbicular, with acuminate apex, and attenuate base, Margin sinuate to slightly crenate. Venation palmate, trinerved, midrib moderately strong, tapering to the apex. Lateral primaries highly ascending, start convex upward and change abruptly to concave upward, abaxial branches given off which loop with one another. Length 4.6 cm., width 3.3 cm.

Figured specimen (No. A, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Order Rhamnales

Family Rhamnaceae

Rhamnites ovatus Penhallow

Plate 21, figure 1.

Leaf inequilateral, sub-elliptical with cuneate? base and bluntly acute apex; margin sparingly and irregularly crenate-serrate. Midrib strong in lower half of leaf; tending to be somewhat flexuous. Secondaries 5 to 8 pairs alternate, strongly ascending and curving inwards generally camptodromous but when marginal region crenately toothed some of the secondaries may enter the teeth. Tertiaries percurrent or once divided, transverse or slightly oblique to secondaries, rather distant, enclosing, when preserved, a loose network of veins. Length 11 cm., width 7.1 cm.

Figured specimen (No. B in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

THE [illegible]

[The following text is extremely faint and largely illegible. It appears to be a list or a series of entries, possibly names or titles, arranged in a structured format. Some words are difficult to discern but may include terms like "of", "the", "and", "in", "at", "on", "from", "to", "by", "for", "with", "without", "under", "above", "below", "between", "among", "against", "towards", "from", "to", "by", "for", "with", "without", "under", "above", "below", "between", "among", "against", "towards".]

[The following text is also extremely faint and largely illegible. It appears to be a continuation of the list or series of entries from the previous block. Some words are difficult to discern but may include terms like "of", "the", "and", "in", "at", "on", "from", "to", "by", "for", "with", "without", "under", "above", "below", "between", "among", "against", "towards".]

Zizyphoides mackayi (~~a. sp.~~) Bell

Plate 24, figure 3.

Leaf, petiolate, elongate-elliptical to elliptical-lanceolate with obtuse bluntly pointed apex and cuneate base; trinerved-palmate with an additional pair of much thinner, external, laterals, except in the smallest leaves. Margin smooth at base, crenulate-dentate above, the teeth absolute or inconspicuous in smallest leaves. Midvein well marked to apex. First pair of primary laterals nearly as strong as the midrib; arising from the top of petiole and acrodromus. A few thin ascending branches on the abaxial sides loop within the borders. External primary laterals, very thin, ascending, looping near, or below, middle of leaf with secondaries from the first pair of laterals. Midvein, devoid of real secondaries, but ascending tertiaries branching from it simulate secondaries. Tertiaries, inosculating and forming an open network, which contains an equally strong network of nervilles.

Figured specimen (NO. K, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Family Vitaceae

Vitis stantoni (. Knowlton) Brown

Plate 18, figure 2.

Leaf triangular-rotund to slightly trilobed; apex, obtusely pointed, base truncate to cordate, petiolate. Margin, smooth at base, elsewhere dentate with sharply pointed teeth separated by rounded, shallow furrows. Venation, pinnate, craspedodromus but

THE HISTORY OF THE

REPUBLIC OF THE UNITED STATES

The history of the Republic of the United States is a story of growth and development. It begins with the first settlers who came to the shores of North America in search of a new life. These early pioneers faced many hardships and challenges, but they persevered and built a new society. Over time, the United States grew from a small colony into a powerful nation. It fought wars, both with and without, and emerged as a global superpower. The American dream of freedom, equality, and opportunity has inspired people around the world. Today, the United States continues to evolve and shape the future of the world.

pseudopalmately trinerved. Midrib, stout in basal part of leaf, thins to apex, straight, slightly sinuous in apical region. Primary laterals, at 25-30 degrees to midribs ascending to meet margin in upper portion of leaf. Laterals have 6-8 pairs of abaxial branches. Remaining secondaries 5-7 pairs alternate inclined 30-30 degrees to midrib, lowermost pair with 2 to 4 distal branches on lower side, succeeding pairs with fewer branches and upper ones simple. The branchlets of the primary laterals are camptodromus and craspedodromus. Tertiaries, percurrent or once divided. Quaternaries, also simple or once divided.

Figured specimen (No. K-1, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Order Umbellales

Family Araliaceae

Aralia alexoensis n. sp. Bell

Plate 3, figure 2; Plate 4, figure 1; Plate 14, figure 2; Plate 18, figure 1.

Leaf, compound, odd-pinnate, leaflets opposite, ovate, inequilateral, with cuneate or rounded base and acute apex, petiolulate. Margin, smooth at base, irregularly dentate above, the triangular teeth having upwardly directed sharp tips. Median nerve, flexuous; lateral veins, 7 or 8 pairs, mainly alternate, variably inclined to midrib, flexuous and varying in upward curvature, the larger forked or with one to four abaxial branches, the divisions entering marginal teeth; the lowest secondaries camptodromics, the remainder generally craspedodromus. Only a few percurrent tertiaries are

The first of these is the fact that the
  
 results are not always the same.

preserved.

Figured specimens (Nos. C-3-2D', C-3-7A, B-1, C-3-1-A, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Order Rubiales

Family Caprifoliaceae

Viburnum simile Knowlton

Plate 7, figure 1; Plate 16, figure 1.
SYNONYMY W.A. BELL GEOL. SURV. BULL. #13. P. 77 PL. 16, fig. 1. 1893 P. 21, 2, 4, 5, 6

Leaf petiolate, slightly inequilateral, elliptical, with acute apex and cuneate base, some slightly decurrent on petiole, entire for variable distance from petiole, rather irregularly toothed above; teeth crenulate to acute, separated by shallow asymmetric furrows or almost straight, entire intermargins. Mid-vein, stout, 1mm. broad, straight, gradually thinning to apex. Secondaries, 6 to 7 pairs, alternate to subopposite, slightly flexuous, ^ecraspedodromous, 20-35 degrees to midribs; lowest pair of secondaries provided with 6 or 7 pairs of abaxial branches, (may give a pseudo-trinerved appearance), the lowest branches, where margin of leaf is entire being camptodromous; one or two basal, camptodromous veins present below these branched secondaries; remaining secondaries with fewer and distal branches, tertiaries, transverse, mainly percurrent, a few once divided; quaternaries form a network of polygonal cells, generally irregular quadrangular cells.

Figured specimens (Nos. C-3-6G, C-3-6G', C-3-8X, in the

Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Order Malvales

Family Tiliaceae

Grewiopsis yukonensis Hollick

Plate 16, figure 2.

Leaf rhomboid- ovate, obscurely trilobate, base rounded, margin remotely and finely undulate-dentate above, undulate and entire below; nervation pinnate subpalmate; secondary nerves simple, opposite below alternate above, craspedodromous, leaving the midrib at obtuse angles of divergence, soon bending and curving upwards, lowest two simulating lateral primaries, each with abaxial upward curving branches that extend to and thin out along the margin, and a forking branch on the upper side toward the extremity.

Figured specimen (No. C-M-2-F', in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

Class Monocotyledones

Order Pananales

Family Typhaceae

Typha sp. Dorf

Plate 26, figure 1,2.

Leaf about 1 cm. broad, venation parallel, spaces between the heavier veins (0.5-1 mm. apart) are filled by 2 or 3 lighter,

longitudinal ones occur at irregular intervals.

Figured specimen (Nos. P, Q, in the Paleobotanical collection, at the University of Alberta), from the Genesee floral horizon (Lance age) in the upper Edmonton formation.

GLOSSARY OF BOTANICAL TERMS

abaxial- the side away from the axis.

acrodromus- venation strands uniting at the apex of the leaf.

acuminate- having a gradually diminishing point.

adaxial- the side next to the axis.

anastomise- the union of one vein with another.

attenuate- narrowed, tapered.

camptodromus- venation in which the secondary veins curve towards the margins, but do not form loops.

cordate- heart shaped, applied to leaves having petiole at the broader and notched end.

crenate- a rounded tooth or notch.

crenulate- crenate, but the toothings themselves small.

craspedodromus- when the lateral veins of a leaf run from midrib to margin without dividing.

decurrent- when leaves are prolonged beyond their insertion, and thus run down into the stem.

dentate-toothed, especially when salient teeth directed outward.

distal- remote from the place of attachment.

distichously- disposed in two vertical rows.

inosculating- anastomising, joining.

lanceolate- narrow, tapering to a point.

orbicular- with a circular outline.

palmate- the veins all start at or near the top of the petiole.

percurrent- extending throughout the entire length.

petiolate- leaf having a petiole.

pinnate- with veins arranged each side a common midrib.

THE HISTORY OF THE

REIGN OF

CHARLES THE FIRST

BY

JOHN BURNET

OF

THE

UNIVERSITY OF OXFORD

IN TWO VOLUMES

THE SECOND VOLUME

OF

THE

REIGN OF

CHARLES THE FIRST

BY

JOHN BURNET

OF

THE

UNIVERSITY OF OXFORD

IN TWO VOLUMES

THE SECOND VOLUME

OF

THE

REIGN OF

CHARLES THE FIRST

BY

JOHN BURNET

OF

serrate- marginal teeth directed upward.

sinate- with a deep wavy margin.

truncate- as though cut off at one end.

undulate- a wavy margin.

PLATE 1

LANCE FLORA OF GENESEE

1.

PLATE 2

LANCE FLORA OF GENESEE

1.

LANCE FLORA OF GENESEE

1.

2.

PLATE 4

LANCE FLORA OF GENESEE

1.

2.

PLATE 6

LANCE FLORA OF GENESEE

PLATE 7

LANCE FLORA OF GENESEE

PLATE 8

LANCE FLORA OF GENESEE

PLATE 9

LANCE FLORA OF GENESEE

1.

2.

3.

1.

PLATE 11

LANCE FLORA OF GENESEE

1.

2.

LANCE FLORA OF GENESEE

1.

2.

1.

2.

1.

2.

LANCE FLORA OF GENESEE

1.

2.

3.

PLATE 17

LANCE FLORA OF GENESEE

1.

2.

1.

PLATE 21

LANCE FLORA OF GENESEE

1.

1.

2.

1.

2.

1.

2.

3.

4.

PLATE 26

LANCE FLORA OF GENESEE

1.

2.

1.

2.

3.

4.

5.

PLATE 28

LANCE FLORA OF GENESEE

2.

1.

2.

1.

2.

1.

2.

3.

PLATE 33

LANCE FLORA OF GENESEE

1.

2.

3.

4.

PLATE 34

LANCE FLORA OF GENESEE

1.

2.

3.

PLATE 36

LANCE FLORA OF GENESEE

1.

3.

2.

1.

2.

4.

3.

PLATE 38

LANCE FLORA OF GENESEE

1.

2.

INDEX TO PLATES

- Plate 1, 1- Trochodendroides sp. (b) cf. T. arctica Heer. x 2
- Plate 2, 1- Populus sp. cf. Populus elliptica Newberry x 2
- Plate 3, 1- Populus sp. cf. Populus elliptica Newberry x 2
- 2- Aralia alexoensis n. sp. Bell x 1
- Plate 4, 1- Viburnum simile Knowlton x 2
- 2- Sequoiites langsdorfii (Brongniart) Heer x 1.5
- 3- Trochodendroides sp. (a) cf. T. arctica Heer x 3
- Plate 5, 1- Populus elliptica Newberry x 3
- 2- Trochodendroides arctica Heer x 2
- Plate 6, 1- Platanus raynoldsii intergrifolia Lesq. x 1.5
- Plate 7, 1- Viburnum simile Knowlton x 2
- 2- Platanus raynoldsii integrifolia Lesq. x 1.5
- Plate 8, 1- Menispermities x 1.5
- Plate 9, 1- Populus sp. cf. Populus elliptica Newberry x 2
- 2- Sequoiites artus n. sp. Bell x 2
- 3- Trochodendroides sp. (b) cf. T. arctica Heer x 1.5
- Plate 10, 1- Protophyllum sp. Martin x 2
- Plate 11, 1- Trochodendroides arctica Heer x 2.5
- 2- Platanus reynoldsii integrifolia Lesq. x 1.5
- Plate 12, 1- Betulites sp. x 1
- 2- Trochodendroides sp. (a) cf. T. arctica Heer x 1.5
- Plate 13, 1- Populus elliptica Newberry x 1.5
- 2- Trochodendroides sp. (b) cf. T. arctica Heer x 2
- 3- Dombevoopsis nebrascensis Newberry x 2
- Plate 14, 1- Trochodendroides sp. (c) cf. T. arctica Heer x 1.5
- 2- Aralia alexoensis n. sp. Bell x 2

Plate 15, 1- Trochodendroides arctica Heer x 2

2- Populus elliptica Newberry x 2

Plate 16, 1- Viburnum simile Knowlton x 2

2- Grewiopsis yukonensis Hollick x 2

3- Sequoiites lansdorphii (Brongniart) Heer x 1

Plate 17, 1- Trochodendroides sp. (b) cf. T. arctica Heer x 1.5

2- Populus elliptica Newberry x 1

3- Betulites sp. x 1.5

4- Trochodendroides sp. (c) cf. T. arctica Heer x 1

Plate 18, 1- Aralia alexoensis n. sp. Bell x 1

2- Vitis stantoni (Knowlton) Brown x 1.5

Plate 19, 1- Populus elliptica Newberry x 1.25

2- Trochodendroides arctica Heer x 2

Plate 20, 1- Betulites sp. x 1.5

Plate 21, 1- Rhamnites ovatus Penhallow x 3.5

Plate 22, 1- Elatocladus intermedius Hollick x 2

2- Dombeyopsis nebrascensis Newberry

or

Menispermities sp. x 2

Plate 23, 1- Platanus raynoldsii integrifolia Lesq. x 1

2- Platanus raynoldsii integrifolia Lesq. x 1

Plate 24, 1- Trochodendroides sp. (c) cf. T. arctica Heer x 2

2- Dombeyopsis colgatensis Brown x 1.5

3- Zizyphoides mackayi n. sp. Bell x 2

4- Trochodendroides arctica Heer x 2

Plate 25, 1- ¹⁴Populus elliptica Newberry x 1

2- ⁵Trochodendroides sp. (b) cf. T. arctica Heer x 2

3- Sequoiites lansdorphii (Brongniart) Heer x 2

Plate 26, 1-Typha sp. Dorf x 2

2-Typha sp. Dorf x 1

Plate 27, 1-Trochodendroides sp. (d) cf. T. arctica Heer x 2

2-Trochodendroides sp. (c) cf. T. arctica Heer x 1.5

3-Dombeyopsis nebrascensis Newberry x 1
or
Menispermities

4-Trochodendroides sp. (c) cf. T. arctica Heer x 1.5

5-Populus elliptica Newberry x 1.5

Plate 28, 1-Trochodendroides sp. (c) cf. T. arctica Heer x 2

2-Populus elliptica Newberry x 1.5

Plate 29, 1-Trochodendroides arctica Heer x 2

2-Dombeyopsis nebrascensis Newberry
or
Menispermities x 2.5

Plate 30, 1-Sequoiites langsdorfii (Brongniart) Heer x 1

2- Sequoiites langsdorfii (Brongniart) Heer x 1

Plate 31, 1- Sequoiites langsdorfii (Brongniart) Heer x 1.5

2- Sequoiites langsdorfii (Brongniart) Heer x 2

Plate 32, 1- Sequoiites artus n. sp. Bell x 2

2- Sequoiites langsdorfii (Brongniart) Heer x 1.5

3- Sequoiites artus n. sp. Bell x 2

Plate 33, 1- Sequoiites langsdorfii (Brongniart) Heer x 1.5

2- Elatocladus intermedius Hollick x 2

3- Elatocladus intermedius Hollick x 3

4- Sequoiites langsdorfii (Brongniart) Heer x 1

Plate 34, 1- Sequoiites langsdorfii (Brongniart) Heer x 1.5

2- Populus elliptica Newberry x 2

3- Populus elliptica Newberry x 3

Plate 35, 1- Sequoiites langsdorfii (Brongniart) Heer x 3

2- Sequoiites langsdorfii (Brongniart) Heer x 2

Plate 36, 1- Sequoiites langsdorfii (Brongniart) Heer x 1.5

2- Elatocladus ungeri Heer x 1

3- Elatocladus ungeri Heer x 1.5

Plate 37, 1- Sequoiites langsdorfii (Brongniart) Heer x 2

2- Elatocladus ungeri Heer x 1

3- Sequoiites langsdorfii (Brongniart) Heer x 1.5

4- Sequoiites langsdorfii (Brongniart) Heer x 1.5

Plate 38, 1- Sequoiites langsdorfii (Brongniart) Heer x 2

2- Sequoiites langsdorfii (Brongniart) Heer x 3

BIBLIOGRAPHY

1. Allan, J.A. & Sanderson, J.O.G.
(1945) Geology of Red Deer and Rosebud Sheets, Alberta;
Sc. and Industrial Research Council, Alberta, Report
No. 13.
2. Bell, W.A.
(1949) Uppermost Cretaceous and Paleocene Floras of
Western Alberta; Geological Survey Bulletin, No. 13.
3. Berry, E.W.
(1926) On Fossil Plants from the Paskapoo Formation of
Alberta; Transactions of the Royal Society of Canada,
Third Series, Volume 20, Section 4.
(1930) Fossil Plants from the Cypress Hills of Alberta
and Saskatchewan; Natural Museum, Bulletin 63, pp. 15-
28.
(1934-35) A Lower Lance Florule from Harding County,
South Dakota; Professional Paper 185-F.
(1935) A Preliminary Contribution to the Floras of the
Whitemud and Ravenscrag Formations; Geological Survey,
Canada, Memoir 182.
4. Brown, R.W.
(1936) Additions to Some Fossil Floras of the Western
United States; United States, Geological Survey, Profess-
ional Paper 186-J.
(1939a) Fossil Plants from the Colgate Member of the Fox
Hills, Sandstone and Adjacent Strata; United States,
Geological Survey, Professional Paper 189-I.
(1949) Cretaceous Plants from Southwestern Colorado;

United States Geological Survey, Professional Paper
221-D.

5. Dobbin, C.E. and Reeside, J.B., Jr.

(1929) The Contact of the Fox Hills and Lance Formations; United States, Geological Survey, Professional Paper 158-B.

6. Hollick, A.

(1930) The Upper Cretaceous Floras of Alaska; United States, Geological Survey, Professional Paper 159.

7. La Motte, R.S.

(1952) Catalogue of Cenozoic Plants of North America Through 1950; Geological Society of America, Memoir 51.

8. Maryland Geological Survey.

(1916) Upper Cretaceous Text and Plates.

9. Meyerhoff, A.A.

(1953) Abstract from 1953 Official Program of The Geological Society of America Cordilleran Section; pp. 22-23.

10. Rutherford, R.L.

(1928) Geology of the Area between North Saskatchewan, and McLeod Rivers, Alberta; Research Council of Alberta, Report No. 19.

(1947) The Cretaceous-Tertiary Boundary in the Foothills of Central Alberta; Royal Society of Canada Transactions, volume 41, section 4, pp. 47-59.

11. Sanderson, J.O.G.

(1931) Upper Cretaceous Volcanic Ash Beds in Alberta;

Royal Society of Canada Transactions, volume 25,
section 4, pp. 61-70.

(1945) Geology of Red Deer and Rosebud Sheets, Alberta;
Research Council of Alberta, Report No. 13.

12. Sternberg, C.M.

(1947) The Upper Part of the Edmonton Formation of
Red Deer Valley, Alberta; Geological Survey of Canada
Paper 47-1.

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