The Canadian Field-Naturalist

VOL. XLV OTTAWA, CANADA, SEPTEMBER, 1931 No. 6

AN ANNOTATED LIST OF VASCULAR PLANTS COLLECTED ON THE NORTH SHORE OF THE GULF OF ST. LAWRENCE, 1927-1930

By HARRISON F. LEWIS

COLLECTION of vascular plants on the north shore of the Gulf of St. Lawrence was carried on by the writer in the summers of 1927 and 1928 in connection with botanical studies in the Graduate School of Cornell University. The collections made in those years, together with a few supplementary ones made in the summer of 1929 and 1930, are reported on in this paper.

I am much indebted to Mr. Howard H. Cleaves, who was my companion in the summer of 1927, and to Mr. E. C. Abbe, who was my companion in the summer of 1929, for aid in the field. Certain collections made by Mr. Abbe alone while a member of my party are included herewith by his kind permission and are duly credited to him. I am also under obligation to Dr. Arthur A. Allen and to Mr. C. G. Watson for aid in the field for shorter periods, in 1928.

The identifications of the plants collected were made in the Botanical Department of Cornell University and in the National Herbarium of Canada. I was thus very fortunate in having, in this work, the advice and assistance of Dr. K. M. Wiegand, of Cornell, and of Dr. M. O. Malte, of the National Herbarium, and I take pleasure in acknowledging my deep obligation to these gentlemen. To complete my good fortune, Prof. M. L. Fernald, of the Gray Herbarium, kindly examined with me all my collections for 1927 and 1928 except those of *Botrychium virginianum*, var. *europaeum*, which were not available at the time. I gratefully acknowledge valuable aid received from him. I am also glad to express my appreciation of assistance given by Dr. F. K. Butters, who identified my collection of *Botrychium virginianum*, var. *europaeum*, and by Messrs. Stewart Burnham and C. A. Weatherby.

During the periods in which these collections were made I was engaged in work for the Department of the Interior which required me to spend the summer in travelling along the north shore of the Gulf of St. Lawrence, between Seven Islands and Blanc Sablon, in a small motor-cruiser, and to make a great many landings on that intricate coast and on the islands fringing it, especially from Natashquan eastward. This enabled me to make incidental collections of plants in many and varied localities. My summers, from 1921 on, have been spent in travel of this kind in this region, which gave me a fairly detailed knowledge of its general features before I began to collect plants there.

I was further favoured in my work by having with me a copy of Dr. Harold St. John's valuable memoir, "A Botanical Exploration of the North Shore of the Gulf of St. Lawrence, including an Annotated List of the Species of Vascular Plants" (St. John, 1922). This excellent and detailed list furnished a most important foundation for the collecting that I was doing, and a useful standard of comparison. Comparisons with its records of various plants are repeatedly made in the list presented below. Species, varieties, or forms not contained in St. John's list, which is the most recent general list of plants for the region in question, are starred thus (*) where they occur in the list of my collections. This mark (*) appears 116 times in my list. Special remark is made concerning any species, variety, or form in my list that was not listed by St. John but that has been subsequently attributed to this region by any other author.

Concerning many of the species, varieties and forms listed by St. John and also included in the following list, remark is made as to an extension of the known range on this coast as shown by my records in comparison with St. John's. For the sake of brevity, the expression "range extension" is used to mean "extension of known range on this coast", and the capital letters "E" and "W" are used to represent "eastward" and "westward" respectively. In using the expressions "eastward" and "westward" the coast is considered as though it extended practically east and west, which, indeed, is the case with the greater part of it. As the relation of the localities named may not always be quickly comprehended by one not personally familiar with the region, a statement of the approximate distance involved in the

extension of known range is also furnished. Thus, "range extension, 50 miles E", means "extension of known range on this coast, as compared with the range shown by St. John's list, is 50 miles in a generally eastward direction, or a direction toward the Strait of Belle Isle".

The question of the geographical nomenclature that it is most desirable to use when referring to places of collection on this coast, where post offices are comparatively few and far between, has been carefully considered. St. John used consistently the names on the provincial maps by Gustave Rinfret (1913), including township names where these were available. The fact that he did so is a strong reason for my doing so too, but, on the other hand, many of these names differ from those authorized by the Geographical Board of Canada, many are quite different from the names actually in general use, and all are in French, whereas I am writing in English and English forms for many of these names are authorized and in common use. Therefore it has been decided to use for each place mentioned in the body of the list what is considered the most suitable name available, using as authorities the published decisions of the Geographical Board of Canada, the Canada Official Postal Guide, the publications of the British Admiralty, the Rinfret maps, and local usage. In order to correlate these with the names used by St. John and others, a list of all place-names used is given in Appendix A, where each such name is accompanied by the corresponding name (if any) used by St. John, and by other published synonyms, by the name of the township, seigniory, or archipelago in which it is situated, and by a statement of its latitude and longitude. The last mentioned data will enable each place-name herein referred to be located with exactness and certainty at any time.

St. John states that the north shore of the Gulf of St. Lawrence, as understood by him, "lies between Pentecote river on the west and Blanc-Sablon river on the east, and forms part of the south shore of Saguenay county, province of Quebec". The collections made by the writer all came from the area thus delimited, except that a number of collections were made east of the Blanc Sablon River, but within a mile of it. This change is due to the fact that, in 1915, when St. John made his collections, the Blanc Sablon River was believed to constitute the eastern boundary of Canada for some distance up (northward) from its mouth, which is at the head of Blanc Sablon Bay, but that, by a decision of the judicial committee of the Privy Council in 1927, the boundary of Canada was declared to extend northward from the easternmost point of Blanc Sablon Bay, or along a line roughly parallel to the course of the Blanc Sablon River, but about two miles farther east. The land between this line and the river is therefore included within the County of Saguenay, Province of Quebec, Canada. The writer made no collections west of Manowin Island, Seven Islands.

The first set of specimens will be deposited in the herbarium of the Department of Botany of Cornell University, the second set in the National Herbarium of Canada.

It is well known that most of this coast has risen from a submerged position since its last glaciation, and that consequently most of the glacial drift deposited on it has been removed by action of waves and ice at successive sea-levels as the process of emergence went on. Erratic boulders are not found where deposited by the glacier on the lower areas that have been submerged since the glacier last receded from them, but are common at higher elevations, which have experienced no submergence since their last glaciation. The line at which these poised erratics are first found, as one ascends an elevation sufficiently great, is in this region usually remarkably definite. I have visited and observed it on Little Mecatina Island, on the hills beside Mutton Bay, and on the hills north of Bradore Bay, and at all of these positions estimate its present elevation above sea-level to be roughly 450 feet, indicating a rise of that extent since the departure of the last glacier. Hind (1864) has stated the height above sea-level of the lowest erratics in the Moisie region, near Seven Islands, as about 1000 feet.

St. John (1922) has already called attention to the fact that, as a result of removal of glacial drift from the post-glacially submerged areas near the coast, the scanty soil now found on these areas has been recently formed in situ, and, generally speaking, resembles the country rock in its chemical constituents. He states, "This affords clear and neatly delimited conditions for the study of the correlations between the nature of the soil and the distribution of the plants", and goes on to show that, along this coast, calcicolous plants are generally found chiefly or exclusively on the limestone areas of the Mingan Islands and parts of the adjacent mainland and on the calcareous sandstone areas east of Bradore Bay, while typical oxylophytes are generally found elsewhere or where special conditions reduce the lime content in the soil. In his annotated list there appear, however, some exceptions, particularly in the case of the calcicoles. The number of apparent exceptions has been so

increased by my collections that it has been thought advisable to list them specially here, as well as to show them in the annotated list, and to show the special conditions on which they are dependent, so that it may clearly appear that what seem exceptional records of occurrence for calcicolous plants are actually entirely in harmony with their known need of available calcium.

Plants that appear to be calcicoles and indifferent calcicoles, at least in this region, are recorded, then, by St. John (1922) and in this present paper from the following stations that are neither in the limestone area of the Mingan region nor in the calcareous sandstone area east of Bradore Bay. The records from St. John's list are marked with a dagger (†). Following the list of apparent calcicoles from each of these stations, explanation of their occurrence there is briefly discussed.

MANOWIN ISLAND, SEVEN ISLANDS.

Thalictrum confine, Gentiana Amarella, Campanula rotundifolia.

Manowin Island is composed of Archaean rocks, but these calcicoles were found on it growing on a raised boulder beach. It is well known that sea beaches often contain much available lime, due to the presence, in the material composing them, of more or less of the broken and comminuted shells of marine molluscs. When such beaches are elevated above sea-level by the rise of the land mass on which they are situated, as they have been and are being elevated along the north shore of the Gulf St. Lawrence, they must still be able to support calcicolous plants for a longer or shorter period of time, until they become too poor in available lime through leaching or other processes. Apparently this raised boulder beach on Manowin Island was still sufficiently rich in lime for the three calcicoles named.

SEVEN ISLANDS

Thelypteris fragrans†, *Spiranthes Romanzoffiana*†, *Caltha palustris, Fragaria virginiana*, var. *terrae-novae*†, *Pyrola secunda*, var. *obtusata*†, *Arctostaphylos Uva-ursi*, var. *coactilis, Arctostaphylos Uva-ursi*, var. *adenotricha*†, *Campanula rotundifolia.*

The village of Seven Islands is situated on the western edge of what the "St. Lawrence Pilot" (1916) refers to as "an extensive tract of low sandy country, thickly wooded, between the hills and the sea, which seems to have been formed, in the course of time, by the action of the rivers [Moisie and Matamek] and the sea". Presumably this large area of littoral sand deposits, now elevated a few feet above sea level, still contains, in places, at least, a great deal of lime, originally mingled with the sand chiefly in the form of broken sea shells. It is true that *Pinus Banksiana*, a typical oxylophyte, grows on large areas of this sand plain, but this indicates only that lime is not everywhere available in the soil of the plain, but influences the flora only in certain portions of it, as might be expected from a naturally uneven concentration of the original deposits of shell, and differences in drainage subsequent to elevation above sea level. Where lime occurs, even though actually a small proportion of the soil content, it would naturally be more readily available to plants in a light, sandy soil, with its free percolation of water, than in a heavier soil. Hilgard (1911) remarks: ". . . . . some (sandy) soils containing only a little over one-tenth of one per cent of lime show all the characters and advantages of calcareous soils: while in the case of heavy clay soils, as has been shown, the lime percentage must rise to over one-half per cent to produce native lime growth". It is believed that these conditions explain the presence of numerous plants considered as calcicoles about Seven Islands.

MOUTH OF MATAMEK RIVER

Gentiana Amarella, Campanula rotundifolia.

The explanation of the occurrence of calcicoles in this case is uncertain. It may easily be due to elevation of beach material, or to sea-bird droppings, or perhaps to a fairly high percentage of calcium in the country rock.

THUNDER RIVER

Luzula parviflora, var. *melanocarpa*†, *Glyceria striata*, var. *stricta, Pyrola minor, Gentiana Amarella.*

The occurrence of these calcicoles at Thunder River is probably due to the occurrence of a sufficient percentage of calcium in the country rock, made available to the plants as the rock weathers. This is not yet proven.

BAIE JOHAN BEETZ

Spiranthes Romanzoffiana, Salix candida.

Both of these calcicoles at Baie Johan Beetz grew close to shore. They probably occurred there because of the presence in the soil of comminuted mollusc-shells.

WATSHISHU

Spiranthes Romanzoffiana.

This plant at Watshishu grew on elevated parts of small islands. Its presence there is believed to be due to the occurrence of masses of broken sea-shells, elevated bodily in depressions in the granite as the islands rose from sea-level.

MASCANIN

Spiranthes Romanzoffiana, Thalictrum confine.

Spiranthes occurs at Mascanin in the same way

as at Watshishu, and the explanation is doubtless the same. *Thalictrum confine* occurs along the border of a marshy shore, where it is probably able to obtain lime from shells of comparatively recent deposition.

NATASHQUAN

Scirpus hudsonianus, Carex diandra, Carex Oederi, var. *pumila, Habenaria dilatata*†, *Spiranthes Romanzoffiana*†, *Fragaria virginana,* var. *terrae-novae*†, *Pyrola secunda.*

These presumed calcicoles grow on the extensive sandy tracts at and near Natashquan. Their occurrence there is probably to be explained in much the same way as is the occurrence of numerous calcicoles on the similar sandy area at Seven Islands.

KEGASKA ISLAND

Habenaria dilatata, Thalictrum confine, Actaea rubra, f. *neglecta, Parnassia parviflora, Ribes lacustre, Gentiana nesophila, Gentiana Amarella.*

These plants, which I class as calcicoles, grow on the outer side of Kegaska Island, near a cove on the beach of which occur heavy deposits of mussel-shell. These deposits and the gradual elevation of the land doubtless explain why they can grow there.

GREEN ISLAND, KEGASKA

Carex diandra, Habenaria dilatata, Parnassia parviflora, Ribes hirtellum, var. *calcicola, Geum macrophyllum, Geum rivale, Viola nephrophylla, Gentiana Amarella*

The soil on Green Island, owing to its especially favourable form and situation, is composed to a very large extent of broken mussel-shell. The relation of this to the presence of a number of marked calciphiles seems fairly obvious.

ROMAINE

Carex capillaris†.

I have not visited the point, on an outer island near Romaine, where St. John collected this species, and do not know the reason for its occurrence there.

FOG ISLAND

Spiranthes Romanzoffiana, Parnassia parviflora.

This island resembles Green Island, at Kegaska, in many ways, and has similar extensive deposits of broken mussel-shell, which are doubtless responsible for the fact that these two calcicoles are able to flourish there.

WOLF BAY

Glyceria striata, var *stricta.*

I have no information as to the local conditions providing calcium for this plant at Wolf Bay.

LAKE ISLAND

Pinguicula vulgaris.

The precise reasons for the occurrence of this indifferent calcicole on Lake Island are not known.

MATCHIATIK ISLAND (WAPITAGUN)

Pinguicula vulgaris†.

This is a collection by St. John, this species not having been seen by me on Matchiatik Island. There are several possible explanations of such isolated occurrences of solitary calcicoles, but the particular one operative in this case is not known.

ETAMAMU

Potamogeton filiformis, var. *borealis*†.

The cause of occurrence is unknown in this instance.

POINTE AU MAURIER

Botrychium Lunaria†, *Pinguicula vulgaris*†.

St. John (1922) attributes the occurrence of *Botrychium Lunaria* at Pointe au Maurier to lime (probably from comminuted sea-shells) in the sea-beach, at the top of which the plant grew. The circumstance favouring the occurrence of *Pinguicula vulgaris* is not known.

ST. MARY ISLANDS

Pinguicula vulgaris.

While the cause of occurrence is not certainly known in this case, the local situation was such that it is highly probably that lime was present in the soil because of the elevation of a basin in the rock which, when at a lower elevation, was abundantly supplied with lime by sea-birds, in a manner which will presently be considered in more detail.

HARRINGTON HARBOUR (MAINLAND)

Habenaria dilatata.

This plant at this section grew on the face of a sandy bluff above the beach. Such bluffs are commonly well supplied with lime in the form of broken sea-shells that they have carried up with them from sea-level or below as the coast has been elevated.

MUTTON BAY

Streptopus oreopolus, Saxifraga Aizoon†.

St. John (1922) states that the perthitic syenite on which he found *Saxifraga Aizoon* growing at Mutton Bay contains 8 per cent of lime. Basalt from the basaltic dyke in the ravine where *Streptopus oreopolus* was found growing was submitted to the Division of Chemistry of the Mines Branch of the Canadian Department of Mines for analysis and was reported to contain 1.29 per cent of calcium. Calcium from the rock on which the plants were growing is the only

important source of the element known for the plants in these cases.

LA TABATIERE

Barbarea orthoceras, Ribes lacustre, Geum rivale, Campanula rotundifolia.

Three samples of rock from La Tabatiere were partially analyzed for me by the Division of Chemistry of the Mines Branch of the Canadian Department of Mines. One specimen of disintegrating country rock was found to contain 1.28 per cent of calcium, while another specimen contained 4.28 per cent of that element. A specimen broken from material, believed to be intrusive, that filled a narrow fissure, was found to contain 9.29 per cent of calcium. Probably calcium in the disintegrating surface rock is responsible for the continuing occurrence of these apparent calciphiles at La Tabatière.

Mutton Bay and La Tabatière are only about six miles apart, and are situated on a definitely bounded block of igneous rock formation which extends from Cape Mecatina to Lake Salé, and which, although not uniform throughout, differs conspicuously from the country rock beyond its borders in that it is higher and rougher, is composed of larger crystals, is more readily disintegrated by exposure to weather, and is marked by numerous dykes, which often, by weathering even more rapidly than the country rock, have formed narrow, shallow ravines. This block of rock is bounded by the sea on the south and east and, although it reaches a height of eight hundred feet, is cut off from the mainland north and west of it by a fresh water system consisting of a lake said to have an elevation of only twelve feet above sea level, with an outlet to the sea at either end. When the elevation of this part of the coast was only twelve feet less than it is now, which was well within historic times, the Mutton Bay—La Tabatière—Lake Salé block of land was an island in the gulf. The evidence points to a higher percentage of calcium in the rocks of this formation generally than in the country rock east, west or north of it.

KECARPOUI ISLAND

Pinguicula vulgaris†.

This is one of St. John's records, and the exact local conditions can only be surmised.

ST. AUGUSTIN

Botrychium Lunaria.

Here, as in many other places, the presence of this plant may be explained by the fact that it was growing on the upper part of a sea-beach, where lime from broken sea-shells was presumably available for it.

LITTLE COXIPI RIVER

Pyrola minor†.

This is another of St. John's records, the exact local conditions relating to which are unknown to me.

BONNE ESPERANCE

Botrychium Lunaria†, *Microstylis monophyllos*†.

St. John quotes both of these records from Stearns (1883). I am without information as to the source of lime for these plants.

BRADORE BAY (AREAS OF GNEISS AND GRANITE)

Salix candida, Taraxacum lapponicum.

In this case *Salix candida* was growing among boulders at the head of a cove, where it could probably obtain lime from broken sea-shells. *Taraxacum lapponicum* was growing on sand, where lime may be available as in the sandy tracts at Seven Islands, and elsewhere, previously discussed, and it may also have received lime through drainage from calcareous sandstone at higher levels.

It appears from the above survey that in all cases in this region where plants that behave as calcicoles are found in numbers in areas of Archaean rocks they are well supplied with lime through the nature of local soils which, in spite of glaciation and of washing by the sea, occur as a result of the action of one or more of several agencies. Probably the scattered occurrences for which the exact reasons are not at present known would be susceptible of similar explanations if the pertinent facts relating to them were available.

If it be objected that some of the plants that I have named, such as *Habenaria dilatata, Spiranthes Romanzoffiana, Caltha palustris, Barbarea orthoceras,* and *Campanula rotundifolia,* are not true calcicoles, I can only say that they clearly behave as such in this region.

Along many coasts lime salts supplied by the sea, directly or indirectly, are available only to plants in immediate proximity to the shore. Owing to several factors, of which the continuing and fairly rapid elevation of the land mass is chief, there are many exceptions to this condition along the north shore of the Gulf of St. Lawrence, where lime supplied by the sea in the form of broken and comminuted sea-shells is often available in quantity at a considerable distance from the shore and at a considerable elevation above it, especially on certain islands.

It is obvious that, if sea-shells are cast ashore by the waves and the land is subsequently elevated, these shells, rich in calcium, will occur above sea-level, and may thus be available for the support of calcicoles there. It might, however, be supposed that calcium of this origin,

occurring in strictly limited quantities, even in the largest deposits, might soon leach away, at least from the upper layers of the soil, and so become unavailable to plant life. Apparently this has actually occurred quite generally, for otherwise calcicoles should be much more widely distributed on this coast than they are. Nevertheless certain islands form exceptions. Green Island, at Kegaska, shows a strongly calciphilous flora, and that on Kegaska Island itself is only slightly less so. Fog Island and the small islands at Watshishu and Mascanin show tendencies in the same direction, although all of these islands are formed of resistant pre-Cambrian granitic rocks. Examination of these instances points to the following facts as the explanation.

1.—The soil on these islands, at least where the calcicoles grow, contains a high proportion of broken and powdered sea-shells, principally those of the common mussel (*Mytilus edulis*), which are doubtless the source of the lime that the plants in question require.

2.—The sea about these islands, especially on the seaward side, contains extensive rocky reefs and shallows, on which unusually large beds of these mussels can grow, but where they are so near the surface that agitation of the water in storms can tear great numbers of them from their places and hurl them or their empty shells on the shores of the islands.

3.—The shores of these islands are low and gently shelving, so that great quantities of shells can be securely lodged on them. Neighbouring islands that face the sea with abrupt cliffs obviously cannot receive many shells from the waves.

4.—The surface of such islands is fairly flat, but is very often characterized by shallow, smooth-sided, impervious basins in the solid granite, wherein the shells and also lime that may be removed from them by surface water are retained for centuries.

Islands of this type form suitable places for development of such calcicoles as may chance to reach them.

Another agency that helps to make lime from sea-shells available to plants on this coast, even at some elevation above sea-level, is found in the large population of sea-birds, particularly Eider Ducks (*Somateria mollissima dresseri*). These ducks feed to a very large extent upon small common mussels. These are obtained by diving, are eaten whole, and are finely ground in the powerful gizzards of the birds. Consequently the ordinary excrements of Eiders consist largely of mussel-shells broken into small pieces. A great many of these excrements are discharged either directly into the sea or on rocky shores, where they do not influence land vegetation, and many others are dropped here and there on land, where the birds go for nesting and for sunning themselves on the turf, but are so scattered as to have no observable influence. However, during the period when the young Eiders are small, that is, for about a month in the life of each brood, their mothers customarily take them ashore on some small island at evening and brood them there during the night. For such brooding they greatly prefer an area of level and rather damp turf, and on the islands which they frequent areas of this kind are commonly to be found where vegetation-supporting soil and water are caught in some shallow, impervious basin, a few yards square, in the uneven surface of the granitic country rock.

Several Eider mothers may spend night after night together, with their young, on one such small area, elevated several feet or even yards above the present reach of the waves. Toward the end of August the vegetation on such an area will be much trampled by the birds in their continued visits, and will be heavily littered with their excrements. Thus, year after year, these ducks add fresh lime to a limited patch of soil in an impervious basin, and so they may greatly aid the establishment and continuance of isolated colonies of calcicoles on the islands along the coast. Even when the general coastal elevation has carried such pockets of lime to a height where they are no longer acceptable to the female Eiders for brooding their young, the fact that they are held in impervious catch-basins of granite may enable them to support calcicoles for a long time. I suspect that some of the unexplained occurrences of *Pinguicula vulgaris* and of other calciphiles on outer islands along this coast are really due to this elevation and concentration of lime from sea-shells by Eider Ducks.

Three Eider excrements, composed almost wholly of finely broken shells of *Mytilus edulis*, which I gathered carefully from bare rock in Cape Whittle Bird Sanctuary on August 6, 1928, and which were weighed with metric balances when well dried, showed weights of 28.5 grams, 31.5 grams, and 14 grams, respectively. The average of these three weights is 24.7 grams.

If we allow 20 grams as a conservative estimate of the weight of sea-shell present in one normal Eider excrement, a female Eider brooding her young nightly for 30 nights on an area of turf containing three square meters and depositing there two excrements per night will, at the end of that time, have deposited on the area 1.2 kilograms of shell, or 400 grams per square meter.

Estimating that there are at least 10,000 such female Eiders on this coast each year, we find that they place in this way 12,000 kilograms of ground sea-shells annually, most of it concentrated on small, selected areas of a certain type. This takes no account of the fertilization of such areas by the excrements of the growing young. Male Eiders do not attend their young, and so play no direct part in this process.

Great black-backed Gulls (*Larus marinus*) and Herring Gulls (*Larus argentatus*), both of which nest commonly on islands along this coast, have the habit of opening various molluscs and echinoderms, on which they feed, by carrying them to a height in the air and allowing them to drop on a bare rock surface so that the shell is broken. The bird then alights beside its prey, eats the organism, and leaves the shell. Certain suitable rock areas in convenient situations are used repeatedly by numbers of birds for this purpose, and in consequence a litter of broken shells becomes concentrated at such places. This, too, may affect appreciably the local lime content of the thin soil, and so may permit certain calcicoles to become established.

(*To be continued*)

*FRESH-WATER PLESIOSAURS**

By LORIS S. RUSSELL

THE Mesozoic era or Age of Reptiles was characterized not only by the presence of the dinosaurs, which dominated the land, but also by the development of several independent lines of aquatic reptiles, particularly the ichthyosaurs ("fish-lizards"), mosasaurs ("lizards of the Meuse") and plesiosaurs ("near-lizards"). All of these reptiles had the limbs more or less altered into swimming paddles, but the body form in each group was peculiar. Among the plesiosaurs the trunk was low and broad, and in the typical genera there was a long neck and a somewhat shorter tail (fig. 1). This characteristic form was rather aptly described by Dean Buckland, that early synthesist of theology and geology, as a snake threaded through the shell of a turtle.

Plesiosaurs are considered to be characteristically marine reptiles, and this is certainly true for almost all of them. From time to time, however, remains of these reptiles have been found under conditions that strongly suggest a fresh-water habitat. In most cases the ecological significance of such occurrences has been disregarded. This paper describes the vertebra of a plesiosaur from beds that are definitely of fresh-water deposition, and considers some other cases of what appear to be fresh-water plesiosaurs.

The fossil to be discussed particularly came from an outcrop of the Edmonton formation on North Saskatchewan river, about six miles above the city of Edmonton. Dinosaur bones are not uncommon at this locality, and in making a collection of these, Dr. D. G. Revell, Professor of Anatomy at the University of Alberta, found a vertebral centrum of peculiar character. This centrum was first recognized as plesiosaurian by Mr. C. W. Gilmore, of the United States National Museum. Dr. Revell kindly presented the vertebra to the writer, by whom it has been deposited in the palaeontological collection of the Department of Geology, University of Alberta. The writer is indebted to Professor John A. Allan for the opportunity to complete his studies of this specimen.

The centrum (figs. 2-5) is about 47 mm. long and 65 mm. wide. It is moderately amphicoelous, somewhat constricted at mid-length, and has, in end view, the depressed-hexagonal outline that is common in plesiosaurian centra. The bases of the neuropophyses are ovoid, and there appear to be two pairs of poorly defined facets for the chevrons. On one articular face there is a rounded protuberance above the centre. There are no traces of transverse processes.

This vertebra is referred to the caudal series because of the apparent presence of facets for the chevron bones, and the absence of transverse processes. There appear to be close resemblances to vertebrae of *Leurospondylus ultimus* Brown, which is discussed below. The present specimen is referred provisionally to *Leurospondylus*, and therefore to the Elasmosauridae, but a form considerably larger than Mr. Brown's specimen is indicated.

Let us consider next the geological occurrence of the specimen. The Edmonton formation, which is the uppermost division of the Cretaceous System in central Alberta, represents a period of deposition following the last retreat of the Pierre sea. We are able to trace fairly accurately the maximum extent of this sea in its last advance in Alberta. This is the Bearpaw stage, and

* These notes were prepared prior to the writer's association with the Geological Survey of Canada, and were presented at the Washington meeting of the Paleontological Society, December, 1929.