CANADA

DEPARTMENT OF MINES AND RESOURCES

MINES AND GEOLOGY BRANCH

GEOLOGICAL SURVEY BULLETIN
No. 10

EARLY CARBONIFEROUS STRATA OF ST. GEORGES BAY AREA, NEWFOUNDLAND

BY
W. A. Bell

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,
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CONTENTS

Illustrations

PREFACE

The present report deals with rock formations of considerable economic interest that underlie not only the St. Georges Bay area of Newfoundland but large areas of the Maritime Provinces of Canada. Their study in Newfoundland provides additional information on events that took place in our own country during one period of geological history. In the Maritime Provinces these events were determining not only the sites of gypsum and rock salt deposits in an early part of that period, but the later sites for important coal seams.

Although the report is concerned only with a limited part of the Carboniferous geology of the St. Georges Bay area, it will prove useful in applying data published in reports of the Geological Survey of Newfoundland towards a fuller understanding of our own Carboniferous formations.

GEORGE HANSON,
Chief Geologist, Geological Survey

OTTAWA, May 15, 1947

EARLY CARBONIFEROUS STRATA OF ST. GEORGES BAY AREA, NEWFOUNDLAND

INTRODUCTION

The following report deals only with selected sections of Mississippian strata in western Newfoundland. Their study was undertaken to add to our knowledge of Mississippian sedimentation in, and geological history of, the Acadian region of Canada. In this geological province the Mississippian system is economically important, for it provides natural gas, some crude petroleum, gypsum, salt, barite, and limestone, besides known deposits, as yet of doubtful economic value, of oil-shale, fluorite, and ores of lead, iron, and manganese.

In Nova Scotia the Mississippian system embraces Lower Mississippian non-marine deposits, known as the Horton group, and Upper Mississippian deposits comprising a marine Windsor group and an overlying non-marine Canso group. In an early study of the Windsor group in the type Horton-Windsor area the writer (1929, p. 78)[1] assumed that the Windsor sea entered the maritime region from the North Atlantic, in all probability across central Newfoundland, although an alternative transgression between Newfoundland and Cape Breton Island was suggested. The assumption was based on the obviously North Atlantic character of the faunas, and on the northeast-southwest trend of late Palæozoic basins of deposition. However, it became evident from later geological work in the Maritime Provinces that some factors of Windsor sedimentation did not support an invading sea from the northeast. On such an hypothesis it is difficult, for example, to account for the fact that the latest Windsor faunas in southwestern Nova Scotia contain corals, bryozoans, and other elements common to normal marine deposits, whereas faunas of the same age in northeastern Nova Scotia, if present at all, are restricted largely to molluscs. Moreover, in many areas of northeastern Nova Scotia the Windsor deposits, particularly those of late Windsor age, are either wholly non-marine in character or include thick members of conglomerate and sandstone that are interpreted to be alluvial fans or deltaic deposits. A more critical examination of Mississippian deposits in Newfoundland, especially of those equivalent in age to the Windsor group, was necessary to determine whether such clastic sediments were prevalent there in like manner.

Our knowledge of Mississippian rocks in Newfoundland was greatly advanced by recent work of A. O. Hayes and H. Johnson (1938) in the St. Georges Bay area. As this area contained the only reported marine deposits of Carboniferous age in Newfoundland, it was the one examined by the writer. The area is readily reached by tri-weekly steamship service from North Sydney to Port aux Basques, a distance of about 95 miles, thence by the Newfoundland Railway 20 miles to St. Andrews, and by the same railway to various stations between St. Andrews and Stephenville Crossing. There is at present no through highway communication from Port aux Basques to St. Georges, but Codroy may be reached by road from St. Andrews, and roads are available to reach shore sections from railway stations at St. Fintans, Jeffreys, Robinsons, Heatherton, and Fishels. Barachois Brook and Robinsons River are crossed by good highway bridges, so that road travel near the shore is possible between Jeffreys and Fishels, a distance of about 10 miles. There is also a good road and taxi service from Stephenville Crossing to Port au Port and Boswarlos on Port au Port Bay.

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[1] Dates in brackets are to references at end of this report.

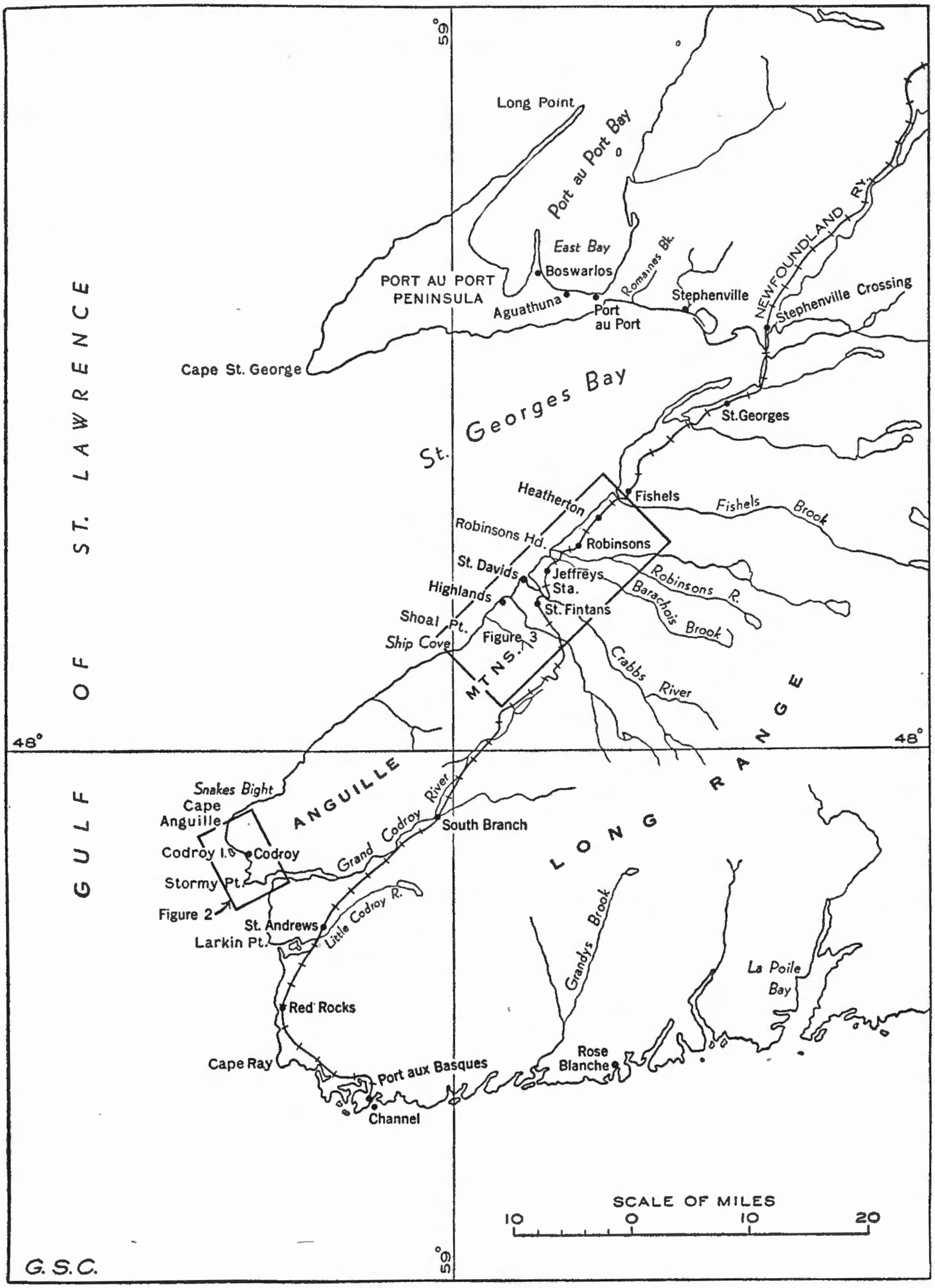

Figure 1. Index map of the St. Georges Bay area, southwestern Newfoundland, showing outlines of mapped areas (Figures 2 and 3).

TOPOGRAPHIC FEATURES

The Carboniferous rocks of the St. Georges Bay area underlie a rolling wooded lowland, generally less than 300 feet above sea-level, of which the southwest border is interrupted by a linear upland known as the Anguille Mountains (Figure 1). The southeastern boundary of this lowland is known as the Long Range (Figure 1), an upland, 1,800 to 2,000 feet high, developed on crystalline and metamorphosed pre-Carboniferous rocks. This upland rises from the lowland as a steep, fault-line escarpment, running northeast from the mouth of Little Codroy River to Robinsons River, a distance of about 50 miles, thence swinging more northerly for 15 miles to Flat Bay Brook near St. Georges, and from there running again northeasterly to St. Georges River and beyond. This escarpment is cut by the gorges of Little Codroy River, Grand Codroy River, Crabbs River, Barachois Brook, Robinsons River, Fishels Brook, Flat Bay Brook, and a few smaller streams. On leaving the upland the two Codroy rivers flow southwesterly into the Gulf of St. Lawrence over the narrow part of the Carboniferous lowland lying between the Long Range and Anguille Mountains. The other rivers flow directly northwest to west across the lowland into St. Georges Bay, in courses from 8 to 18 miles long.

Anguille Mountains, underlain by early Mississippian strata, have a flat-topped summit about 1,800 feet high. This upland, at its broadest only 7 or 8 miles wide, borders the southwestern shore of St. Georges Bay for 25 miles from Cape Anguille to near Ship Cove. The seaward slope is abrupt, and rugged cliffs make this part of the coast almost inaccessible. The upland slopes are heavily wooded and practically uncrossed by roads or trails. Many short, small streams have cut gorges into the northwestern face of the upland at right angles to the shoreline, and precarious boat landings may be made in small coves at the mouths of some of these streams.

The bedrock over the lowland area is concealed by thick glacial deposits, both morainal and glaciofluvial. Hayes and Johnson (1938, p. 4) record outwash sands, 200 feet thick, at Robinsons Head, from which *Saxicava arctica* was collected. Deposits of peat are present over the glacial deposits at St. Georges and locally elsewhere, and thin deposits of marl have a restricted local distribution. The bedrock geology can be studied, therefore, only along the rivers and in sea-cliff exposures. On Anguille Mountains bedrock is exposed in places, chiefly shaly sandstone and arenaceous shale. Such rocks could not be expected to preserve glacial striæ. Hayes and Johnson, however, present evidence for glaciation of the Long Range upland and infer that the Anguille Mountains were also covered by ice.

MISSISSIPPIAN STRATIGRAPHY

The Carboniferous sedimentary rocks of the area were divided by Hayes and Johnson (1937, p. 2; 1938, pp. 9-15) into the following three stratigraphic units:

Pennsylvanian
- Barachois series

Mississippian
- Codroy series
- Anguille series

They stated, however, that on account of structural deformation of the rocks "a continuous section cannot be found, and, consequently, an unbroken sequence cannot be established even within any one of the above-named series. Coupled with this fact, fully two-thirds of the sediments are of continental origin and contain no definite key beds."

The most complete section of Mississippian strata within the area is afforded by sea-cliff exposures from Cape Anguille to Larkin Point (Figure 1); and in this district Hayes and Johnson subdivided both the Anguille and Codroy series into lithological divisions of formational rank. In the present report the names of these divisions, with some minor modification, are used, together with some additional terms to designate individual members or larger groups of beds. But all these terms are used here solely for the purpose of description and correlation, and are not proposed as standard mappable units. One important group of beds thus differentiated is the "Searston beds". Previously these were placed by Hayes and Johnson in their Barachois series, although beds of equivalent age on Crabbs River were mapped as belonging to the Codroy series. In the following table the stratigraphic terms used in the present report are correlated with those in use by the Geological Survey of Newfoundland:

Geological Survey, Newfoundland	*Present Report*
Pennsylvanian	
Barachois series	**Barachois series**[1]
Mississippian	
Barachois series in part; Codroy series in part	Searston beds
Codroy series	Codroy series[1]
Woody Point sandstone	Woody Head beds
Woody Cove shale	Woody Cove beds (Crabbs limestone and Jeffreys limestone may lie in a zone equivalent to Woody Cove Beds)
Black Point limestone	Black Point limestone
Codroy shale	Gypsiferous zones, including the Codroy breccia
In part Anguille series; in part Codroy series	Ship Cove limestone
Anguille series	Anguille series[1] (undifferentiated)
Snakes Bight shale	
Cape Anguille sandstone	

The following pages include a detailed description of some sections through the above Mississippian series of beds.

Anguille Series

The oldest Carboniferous rocks in the St. Georges Bay area were designated by Hayes and Johnson (1937, p. 2; 1938, pp 5, 9) the 'Anguille series". The type section of this series lies along the coast from Snakes Bight on St. Georges Bay to Codroy village. Hayes and Johnson stated that the series was at least 2,600 feet thick "without either upper or lower contacts exposed" (1938, p. 11). The writer found that the upper contact of his Anguille series was exposed at Ship Cove. It may possibly be present also at Snakes

[1]The Barachois, Codroy, and Anguille stratigraphic units would ordinarily, by present usage of the Geological Survey, Canada, be designated "groups" and not "series".

Bight where "a limestone member is reported" (Hayes and Johnson, 1938, p. 11). The approximate position of the upper contact may also be fixed on Codroy Island. Most of the shore from Ship Cove to Cape Anguille is inaccessible, except that narrow beach landings are possible at a number of small coves when water conditions permit. This part of the section was not examined by the writer. From a point on Cape Anguille, 5,500 feet north 17 degrees east of the lighthouse, to Codroy village the shore is low and may be readily traversed. The strata, however, are moderately folded and broken by a few faults. The main structure is an anticline of which the axial beds are concealed, but the axis is inferred to strike about north 52 degrees east and to lie about 3,450 feet south of the lighthouse (Figure 2). The syncline lying north of this anticline has the youngest strata present in the Cape Anguille-Codroy village section, but is broken 1,400 feet north of the lighthouse by a fault along which older beds to the north have been upthrown. The anticline and syncline that occur towards the north end of the section are both minor folds.

The youngest Anguille strata form that part of the broken syncline that lies just north of the lighthouse. They are composed mainly of coarse grey conglomerate, which has cobbles of quartzite, white quartz, and Ordovician limestone, up to a foot or more in diameter, and a few pebbles and cobbles of granitic and volcanic rocks. This conglomerate, with intercalated sandstone, is about 300 feet thick. About 400 feet stratigraphically below the conglomerate a thick sandstone member with pebbly lenses carries small pebbles of white quartz. But the remaining sediments of the Anguille group in this section are grey, brownish weathering, fine-grained, hard or quartzitic sandstone, alternating with dark grey to black, argillo-arenaceous shales. Current ripples with stoss slopes facing northwest to north by east are common. Many shale beds have veinlets of calcite, both along and oblique to joint planes, the majority striking east by south to southeast. Plant debris is common, although mostly unidentifiable. The best fragments collected by the writer included cf. *Rhacopteris subcuneata* Kidston, *Diplotmema ? patentissimum* Ettingshausen, *Aneimites* sp., *Schuetzia* sp., and *Sublepidodendron nordenskioldii* Nathorst. These indicate a Mississippian age, probably equivalent to that of an upper part of the Horton group of Nova Scotia.

At Ship Cove the highest Anguille beds lie accordantly below the Ship Cove limestone member of the Codroy series. They comprise fine-grained, hard, grey and greyish brown sandstone, some surfaces of which are current-rippled.

Anguille beds outcropping on the northern shore of Codroy Island consist of thick, much jointed, grey, fine- to medium-grained sandstone. Some beds are coarser, gritty, and arkosic, and a few of these have pebbly lenses, carrying pebbles of quartz, quartzite, and Ordovician limestone, and a few of granitic and volcanic rocks. Near the base of the exposed section is a 6-foot band of argillo-arenaceous, dark grey shale. The sandstone beds exposed here are folded in a subsidiary anticline, and are about 285 feet thick. South of them bedrock is concealed in the middle, boggy part of the island, representing perhaps about 475 feet of strata. Farther south, on the west shore of the island, low reefs of grey and purplish grey, quartzitic sandstone, including rare, thin, lenticular patches of arkosic pebbly grit, are altogether about 240 feet thick. Between the uppermost of these beds and basal beds of the Ship Cove limestone a concealed interval represents about 220 feet of strata. Here again there is structural conformity between the exposed Anguille and Codroy strata.

The writer estimated that the exposed beds in the southern limb of the anticline north of Codroy village are at least 1,000 feet thick. The Anguille beds on Codroy Island are all seemingly younger, and if so would give an additional thickness of about 1,220 feet, making a total of 2,220 feet, not including possibly additional strata concealed in a part of the submarine area between Codroy Island and the mainland. Accordingly, the estimate of Hayes and Johnson of 2,600 feet for the thickness of the Anguille strata comprised in these sections is seemingly not excessive.

The Anguille-Codroy contact is well exposed at the highway bridge at Ryans Brook, about 2 miles east of the map-area of Figure 2. The top Anguille bed, a hard, fine-grained, grey sandstone, is there overlain accordantly by a band of argillo-arenaceous shale, 1·5 feet thick, above which is laminated limestone. The limestone and probably the underlying shale band belong to the Ship Cove limestone member at the base of the Codroy series.

As already noted, Hayes and Johnson (1938, p. 11) stated that a limestone member was reported in Snakes Bight (*See* Figure 1). If such a limestone is present at that locality it would probably be the Ship Cove limestone. The strata along the sea front of Anguille Mountains from Snakes Bight to Ship Cove are stated by Hayes and Johnson (1938, p. 13) to be red and greenish grey, micaceous sandstone, estimated by them to be 2,000 feet thick. Certainly the sandstone, which is marked by red bands, lying below the Ship Cove limestone at Ship Cove, belongs to the Anguille series, and unless there is a pronounced fault along the northwest side of Anguille Mountains, for which there seems to be little evidence, the above red and grey measures would seem to belong also to that series. These beds, as mapped by Hayes and Johnson, dip at high angles to the northwest or are overturned to the southeast. Anguille strata north of Cape Anguille dip at moderate angles south-southwest, whereas those at Ship Cove dip steeply to the north. The general structural feature of the rocks in the Anguille upland would, therefore, seem to be an asymmetrical anticline rather than a thrust fault, and if any such fault is present it would be under the bay.

Strata of the Anguille group are well exposed in Fishels Brook, which has cut a gorge through them in part of its course. They are in contact with, and lie accordantly below, the Ship Cove limestone member of the Codroy series, and form the northwest limb of an open anticline, which is seemingly the northeasterly extension of the Barachois anticline (Figure 3) to be noted later. The beds comprise a thick zone, of which about 650 feet are exposed, of grey or brownish grey cobble-conglomerate, which is marked by thin lenticular interbeds, generally not more than 2 feet thick, of grey sandstone. Rude shingling in places indicates currents from a northerly direction. The conglomerate has rounded cobbles and boulders up to 2 feet in diameter, many of which are of Ordovician limestone. Quartzite boulders are likewise abundant, and others are of reddish volcanic rocks. The constitution of these beds is similar to that of the conglomerates previously noted as occurring in the upper part of the Anguille series near the Anguille lighthouse.

Codroy Series

CODROY AREA

The type section of the Codroy series lies between Stormy Point and Codroy village, a distance of about 3 miles. Individual beds were measured by the writer, and are described in the following sections A to D. In the gypsum-bearing part of the series, however, it was not possible, at least in the time available, to unravel the true sequence, and the rough estimates of thicknesses given are in some instances little better than guesses. This part of the section is marked by evidences of local brecciation and faulting, and by flowage of gypsum into surrounding beds. Many of the siltstone zones in it are so commingled with gypsum as to suggest that they are commonly in the form of large "horses" embedded or partly embedded in the gypsum as a result of flow under lateral pressure. Numerous, smaller, included masses of limestone are seemingly due to the same cause. How much strata has been lost to, or repeated in, the present surface sections by faults between or within the various sections is in most places unknown, for few beds can be correlated on lithological or palæontological evidence. Two faults along which stratigraphic displacement has been particularly great lie between sections A and D (*See* Figure 2). Between them the beds of sections B and C form part of an upthrust block, which is itself broken by faults of less consequence. The beds of section C in this block have been largely overturned to the south and thrust upward against beds of section D with a probable stratigraphic displacement of more than 2,500 feet. Also, an upward displacement of beds of section B against beds of section A may have equalled or exceeded this amount. More detailed faunal studies would perhaps make possible a correlation of some beds of sections B and C with beds in section D and provide more accurate data on the stratigraphic movements that took place.

Section A

(Stormy Point northeastwards towards Capeland Cove)

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
	Searston Beds		
267	Sandstone, reddish brown, shaly..........................	22	22
266	Sandstone, grey, shaly; thin lenses of limestone-conglomerate. *Calamites* and *Diplotmema adiantoides* (Schlotheim)....	31	53
265	Siltstone, brownish red and grey; thin interbeds red and grey sandstone..	53	106
264	Sandstone, grey, shaly, micaceous........................	12	118
263	Siltstone and arenaceous shale, grey and reddish brown.....	12	130
262	Sandstone and arenaceous shale, reddish brown............	3	133
261	Sandstone, grey, coarse; pebbly grit with white quartz pebbles..	25	158
260	Sandstone, shaly, and arenaceous shale, grey and reddish brown; with lenses grey siltstone carrying small, limy concretions...	9·5	167·5
259	Shale, arenaceous, brownish red and minor greenish grey....	17	184·5
258	Siltstone, argillaceous, hackly weathering, reddish brown and grey..	4·4	188·9
257	Sandstone, fine, shaly, grey and brownish grey............	5·8	194·7
256	Siltstone, laminated, brownish red and grey..............	3·4	198·1
255	Siltstone, hackly weathering, brownish grey..............	6	204·1
254	Sandstone and arenaceous shale, micaceous, purplish grey...	9·8	213·9
253	Sandstone, arenaceous shale, and siltstone, grey...........	7·7	221·6
252	Siltstone, hackly weathering, grey, with small limy concretions...	7·3	228·9
251	Sandstone, shaly, and light and dark grey siltstone........	4·5	233·4
250	Shale, arenaceous, light and dark grey bands..............	3·5	236·9
249	Sandstone, light grey, medium to coarse grained...........	12·8	249·7
248	Sandstone, shaly, and siltstone, grey......................	2·5	252·2

Section A (Conc.)

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
247	Sandstone, shaly, fine grained, brownish grey..............	2·6	254·8
246	Siltstone, hackly weathering, grey........................	10·1	264·9
245	Sandstone and pebbly grit, grey..........................	12·5	277·4
244	Sandstone, shaly, grey, and interbedded siltstone...........	27	304·4
243	Siltstone, grey, with limy nodules........................	4	308·4
242	Siltstone, laminated, dark grey; sphenopterids	10	318·4
241	Sandstone, grey; grit, and arenaceous shale................	13·5	331·9
240	Shale, arenaceous, grey, and siltstone.....................	6·7	338·6
239	Grit, grey, coalized plant debris..........................	9	347·6
238	Shale, arenaceous, grey; grey grit, and grey, shaly sandstone; two small normal faults with some loss of section; thickness estimated....................................	50	412·6
237	Siltstone, grey, hackly weathering, interbedded with grey grit and sandstone and brownish red siltstone..........	17·4	430·0
236	Sandstone, coarse, grey....................................	2·1	432·1
235	Shale, ribbon-banded, argillo-arenaceous, and argillaceous. *Diplotmema adiantoides* (Schlotheim)................	9·5	441·6
234	Sandstone, grey...	1·6	443·2
233	Shale, micaceous, argillo-arenaceous, dark grey............	1·4	444·6
232	Sandstone, grey, weathering light buff, with lenses grit and dark argillo-arenaceous shale........................	32·7	477·3
231	Siltstone, brownish red....................................	14·6	491·9
230	Siltstone, grey, rubbly, with small limy concretions; disturbed by small fault................................	3	494·9
229	Siltstone, brownish red, small limy concretions.............	6	500·9
228	Sandstone, fine, argillaceous, and grey and greenish grey siltstone; small lime concretions.....................	12·9	513·8
227	Sandstone, ribbon-banded with light and dark grey bands...	1·5	515·3
	——— fault ——— Section B (upthrown)		

Section B

(Capeland Cove, northeast of Section A)

Section A (downthrown)

——————fault——————

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
	Codroy Series		
46b	Siltstone, greenish grey and brownish red, in crush zone....	19	19
45b	Siltstone, rubbly, greenish grey, with pink calcite stringers..	16·9	35·9
44b	Siltstone, brownish red..................................	7·4	43·3
43b	Siltstone, and areno-argillaceous shale, dark grey, with a few thin beds fine, grey sandstone..........................	73·2	116·5
42b	Shale, grey, areno-argillaceous; top 5 feet calcareous and with *marine fauna (Martinia, Dielasma, Spirifer, Productus*, and mollusca)................................	25	141·5
41b	Sandstone, fine, argillaceous, grey........................	8	149·5
40b	Siltstone and argillaceous shale, grey......................	20	169·5
39b	Siltstone, grey, calcareous, and argillaceous, dark grey *limestone; marine fossils*..............................	35	204·5
38b	Sandstone, fine, grey, and arenaceous shale with few thin lenticular beds impure *limestone*......................	39·8	244·3
37b	Shale, ribbon-banded, calcareous, dark grey...............	3	247·3
36b	Siltstone, grey..	5	252·3
35b	Sandstone, micaceous, grey, thinly bedded, and siltstone....	10·2	262·5
34b	Siltstone, light grey, with small calcite-lined vugs..........	4·2	266·7
33b	Siltstone, brownish red, with a few bands grey, fine sandstone...	7·4	274·1
32b	Sandstone, shaly..	3·3	277·4
31b	Siltstone, dark grey, calcareous, and slightly vuggy.........	0·5	277·9
30b	Shale, grey, arenaceous, with thin beds sandstone and dark grey areno-argillaceous shale.........................	22·6	300·5
29b	Siltstone, calcareous, dark grey, and argillaceous shale; poorly preserved *Productus*..........................	3	303·5
28b	Shale, grey, argillaceous, alternating with thin, dark grey, calcareous bands of siltstone........................	9	312·5
27b	Shale, arenaceous and argillo-arenaceous, light grey.........	18·3	330·8
26b	Sandstone, grey, finely crossbedded.......................	2·2	333
25b	Shale, dark grey, argillaceous, and argillo-arenaceous......	15	348
24b	Sandstone, fine, grey, minutely crossbedded...............	2·4	350·4
23b	Shale, arenaceous, dark grey, with several, thin, calcareous bands...	5·6	356
22b	Sandstone, fine, shaly, grey, alternating with darker grey siltstone...	64	420
21b	Shale, arenaceous, grey..................................	10	430
20b	Sandstone, fine, argillaceous, grey, and grey siltstone........	31·5	461·5
19b	Siltstone, brownish red..................................	7	468·5
18b	Siltstone, greenish grey..................................	20	488·5
17b	Sandstone, fine, grey....................................	1	489·5
16b	Siltstone, argillaceous, grey; calcite stringers..............	16	505·5
15b	Siltstone, brownish red; calcite stringers..................	36	541·5
14b	Siltstone, greenish grey; calcite veinlets...................	3·7	545·2
13b	Siltstone, calcareous, or argillaceous limestone, dark grey....	0·4	545·6
12b	Siltstone, grey, rubbly; cut by small fault with possibly some repetition of beds; calcite stringers in top beds.........	43	588·6
11b	Siltstone, brownish red..................................	10	598·6
10b	Siltstone, rubbly, greyish green, with harder, thin, limy bands in basal part...	22	620·6
9b	Sandstone, fine, grey, and siltstone, buff weathering........	7	627·6
	——————fault ?——————		

Section B—Conc.

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
8b	Siltstone, greenish grey................................	15	642·6
7b	Shale, argillaceous, bluish grey, with thin, harder, minutely vuggy, calcareous bands..........................	10	652·6
6b	Siltstone, rubbly, rusty weathering.......................	4·5	657·1
5b	Siltstone, dark grey................................	3·8	660·9
4b	Mudstone, carbonaceous................................	1	661·9
3b	Siltstone, dark grey; *Pseudestheria* and *Leaia*.............	3	664·9
2b	Mudstone, carbonaceous................................	0·5	665·4
1b	Siltstone, dark grey, hackly weathering..................	3	668·4
	——————— fault ———————		
	Section C (upthrown)		

Section C

(Capeland Cove, foot of Woody Head, southwestwards to basal beds Section B)

Section D (downthrown)

———fault———

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
	Codroy Series		
49c	Siltstone, mudstone, and micaceous, fine sandstone, with bands of argillaceous *limestone;* in crush zone; thickness estimated..	41	41
48c	*Limestone*, thinly bedded, argillaceous, somewhat brecciated..	4·8	45·8
47c	Sandstone, grey, calcareous, buff weathering...............	4·3	50·1
46c	Sandstone, fine, micaceous, grey, and grey siltstone.........	4	54·1
45c	*Limestone*, argillaceous, and calcareous siltstone, grey.......	4·2	58·3
44c	Siltstone, grey, and fine sandstone, crushed and drag-folded, with thin bands argillaceous *limestone*.................	48	106·3
43c	Sandstone, fine, greenish grey, minutely crossbedded, and argillo-arenaceous shale............................	39·4	145·7
42c	*Limestone*, argillaceous, dark grey, brecciated..............	4·2	149·9
41c	Sandstone, argillaceous, brecciated, dark grey..............	8·3	158·2
40c	Sandstone, calcareous, fine, grey.........................	3·5	161·7
39c	Shale, calcareous, and thinly bedded, argillaceous *limestone*..	7·6	169·3
38c	Mudstone, apparently dolomitic.........................	0·5	169·8
37c	Shale, arenaceous, greenish grey.........................	5·8	175·6
36c	Shale, calcareous, dark grey, slightly bituminous...........	2·5	178·1
35c	Shale, argillaceous and argillo-arenaceous, brecciated.......	99	277·1
34c	*Gypsum*, ribbon-banded, with alternating light and dark grey bands..	54·5	331·6
33c	*Limestone*, dark grey, rubbly, thinly bedded..............	5·7	337·3
32c	*Limestone*, dark grey, brecciated, and with gypsum veinlets .	4	341·3
	——————— fault ———————		

Section C—Conc.

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
31c	Mudstone, bluish grey, and brecciated, grey, argillaceous sandstone and siltstone; in crush zone................	32	373·3
30c	Shale and shaly sandstone, micaceous, greenish grey, finely crossbedded..................................	11·2	384·5
29c	Mudstone, greenish grey..............................	2	386·5
28c	Shale, arenaceous, grey..............................	2·2	388·7
27c	Shale, calcareous, dark grey..........................	0·7	389·4
26c	Sandstone, grey, finely bedded, and siltstone...............	12·3	401·7
25c	Sandstone, grey and brownish grey, with a few, thin, limy bands..	4·7	406·4
24c	Sandstone, fine, purplish grey, and siltstone...............	2·5	408·9
23c	Sandstone, thinly bedded..............................	2·8	411·7
22c	Siltstone, purplish grey, with small, calcareous nodules......	3·4	415·1
21c	Mudstone, grey and purplish grey.......................	0·2	415·3
20c	Sandstone, fine, thinly bedded, with bands of siltstone......	6·9	422·2
19c	Siltstone, brownish red, faulted, possibly with some loss of section..	15	437·2
18c	Shale, arenaceous, greenish grey.........................	5	442·2
17c	Siltstone, dark grey, with thin bands grey sandstone........	4	446·2
16c	Sandstone, fine, grey, weathering buff....................	2·6	448·8
15c	Sandstone, shaly....................................	0·6	449·4
14c	Siltstone, dark grey, with a band of buff weathering, calcareous sandstone near top.........................	11·9	461·3
13c	Sandstone, greenish grey, finely crossbedded...............	5	466·3
12c	Sandstone, fine, shaly................................	3	469·3
11c	Mudstone, dark grey..................................	1·3	470·6
10c	Sandstone, fine, shaly, with interbeds of dark purplish grey siltstone..	18	488·6
9c	Siltstone, dark, purplish grey, with bands of harder, calcareous, fine sandstone.............................	20	508·6
8c	Sandstone, fine, buff weathering.........................	9·5	518·1
7c	Siltstone, greenish grey, with interbeds buff weathering, fine sandstone..	14·4	532·5
6c	Sandstone, fine, buff weathering.........................	8·4	540·9
5c	Mudstone, purplish grey, with bands grey siltstone or fine sandstone..	9·3	550·2
4c	Siltstone, finely crossbedded, grey, with rare, thin, argillaceous bands..	7·4	557·6
3c	Mudstone, silty, dark purplish grey, hackly weathering.....	7	564·6
2c	Siltstone, buff weathering and probably dolomitic, with a little dark grey mudstone...............................	18·8	583·4
1c	Shale, dark grey, areno-argillaceous......................	9·5	592·9
	——— Concealed and fault ? ———		
	Section B (downthrown)		

Section D

(Capeland Cove, foot of Woody Head, northerly to Codroy)

Section C (upthrown)

———fault and loss of part of section———

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
	Codroy Series (Woody Head beds)		
226	Sandstone, fine, grey, crossbedded	11	11
225	Siltstone, grey, alternating with thin beds fine sandstone, and thin beds dark grey, argillo-arenaceous shale at top	20·9	31·9
224	Sandstone, grey, thinly bedded, and arenaceous shale	4·2	36·1
223	*Limestone*, argillaceous, with transverse, calcite veins	0·4	36·5
222	Sandstone, grey, shaly, and arenaceous shale	2·6	39·1
221	*Limestone*, argillaceous, grey	0·7	39·8
220	Siltstone, greenish grey, alternating with grey, arenaceous shale and shaly sandstone	81·3	121·1
219	Sandstone, grey, rusty weathering, with lenses limestone-conglomerate	36·3	157·4
218	Sandstone, grey, argillaceous, and siltstone with intercalated grey and purplish grey mudstone	4·7	162·1
217	Sandstone, grey, fine to medium grained; *Calamites*	10·6	172·7
216	Shale, arenaceous, grey, and darker grey, argillaceous, in faulted zone with brownish red shale; at least	35	207·7
215	Sandstone, brownish grey, micaceous, much crossbedded	7	214·7
214	Sandstone, grey, alternating with dark grey, argillaceous shale; latter carries *Leaia* and *Pseudestheria*	5	219·7
213	Shale, dark grey, argillaceous; *Leaia* and *Pseudestheria*	2·1	221·8
212	Shale, calcareo-argillaceous, and argillaceous	0·8	222·6
211	Sandstone, shaly, and arenaceous shale; oscillation rippled	3·8	226·4
210	Shale, arenaceous, micaceous, reddish grey, and argillo-arenaceous shale	14	240·4
209	Siltstone, reddish brown, with small, calcite-lined vugs	11·9	252·3
208	Shale, arenaceous, grey, alternating with shaly grey sandstone and dark grey siltstone and silty mudstone; petrified plant stems and *Calamites* in the sandstone; small, limy concretions in the siltstone	71·8	324·1
207	Sandstone, grey, medium grained, crossbedded	4·1	328·2
206	Sandstone, reddish brown, shaly, with current ripples	13	341·2
205	Siltstone, greenish grey, alternating with thin members grey, rusty weathering sandstone and dark grey, *Leaia*-bearing, argillaceous shale	41·9	383·1
204	Shale, reddish brown, arenaceous, and red siltstone	13·3	396·4
203	Sandstone, fine, shaly, grey, with thin lenses limestone-conglomerate, alternating with grey, arenaceous, and thin bands argillaceous, shales; *Pseudestheria* in some of argillaceous bands	80·8	477·2
202	Shale, grey, arenaceous, and ribbon-banded sandstone	21·1	498·3
201	Siltstone, grey, hackly weathering, alternating with grey, arenaceous shale and thinly bedded, grey, fine sandstone; some of siltstone has hard concretionary balls, and there are thin lenses of limestone-conglomerate in some of the sandstone	67·4	565·7
200	*Limestone*, argillaceous, dark grey	0·3	566
199	Shale, grey, arenaceous, and at base a band of argillaceous shale	9·7	575·7
198	*Limestone*, argillaceous, grey	0·3	576
197	Siltstone, grey, hackly weathering	3·2	579·2

Section D—Continued

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
196	*Limestone*, argillaceous, greenish grey	0·4	579·6
195	Sandstone, fine, grey, and arenaceous shale	15·3	594·9
194	Shale, grey, arenaceous, and grey siltstone	7	601·9
193	Sandstone, fine, grey, buff weathering, much crossbedded (occurs at Woody Head)	36·1	638·8
	(Woody Cove beds)		
192	Siltstone, dark grey, a lenticular bed	3·4	641·4
191	Sandstone, grey, shaly or irregularly flaggy	7	648·4
190	Shale, arenaceous, greenish grey, alternating with darker, carbonaceous shale	9	657·4
189	Sandstone, grey, rusty or buff weathering, lenticular	5·9	663·3
188	Shale, grey, arenaceous, and siltstone	6·6	669·9
187	Siltstone, grey	11·6	681·5
186	Shale, calcareo-arenaceous and argillaceous in alternating ribbon-like bands	3	684·5
185	Siltstone, dark grey, with several thin bands grey sandstone	12	696·5
184	Shale, calcareo-arenaceous, interlaminated with dark grey, argillaceous shale; pea-size granules of calcite in the calcareous bands	3·3	699·8
183	Siltstone, grey, poorly bedded	1·8	701·6
182	Sandstone, fine, grey, thinly bedded, with bands of dark grey, argillaceous shale with *Pseudestheria* and *Leaia*	6·9	708·5
181	Sandstone, fine, grey, rusty weathering	1·5	710
180	Shale, arenaceous and argillo-arenaceous	6·7	716·7
179	Siltstone, grey, unbedded	4·5	721·2
178	Shale, grey, calcareo-argillaceous and argillaceous in ribbon-like bands	2	723·2
177	Siltstone, bluish grey	4·4	727·6
176	Sandstone, grey, with thin zones argillaceous shale and grey siltstone and rare thin bands of limestone; *Leaia* and *Pseudestheria*	198·9	926·5
175	Siltstone, grey, with a few thin beds of fine, grey sandstone; small, calcite-lined vugs, and concretionary calcareous nodules occur in some of the siltstone	28·9	955·4
174	Sandstone, fine, grey, shaly, and rusty weathering, with some siltstone	20·7	976·1
173	Shale, grey, argillaceous and argillo-arenaceous	2	978·2
172	Shale, calcareous, grey, buff weathering, with laminæ of argillaceous shale	0·9	979·1
171	Shale, argillaceous, dark grey; *Leaia* and *Pseudestheria*	2·2	981·3
170	*Limestone*, brownish grey, interlaminated with argillaceous shale	1·3	982·6
169	Shale, argillaceous, dark grey	1	983·6
168	Limestone, grey, with bands argillaceous shale	1·3	984·9
167	Siltstone, grey, ribbon-banded, buff weathering, calcareous or dolomitic	6·4	991·3
166	Siltstone, grey	22·1	1,013·4
165	Sandstone, fine, grey, weathering brownish	3·9	1,017·3
164	Siltstone and argillo-arenaceous, grey shale	8	1,025·3
163	Sandstone, fine, grey, and siltstone; weathering buff	3·7	1,029
162	Sandstone, fine, grey, and siltstone with thin, calcareous bands	3·6	1,032·6
161	Shale, dark grey, argillaceous and calcareous in ribbon-like bands	1·2	1,033·8
160	Siltstone, grey, weathering buff	6·2	1,040
159	Siltstone, grey, hackly weathering	11·2	1,051·2
158	Siltstone and arenaceous shale, light grey	16·2	1,067·4

Section D—Continued

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
157	Shale, arenaceous, grey, weathering buff, and interlaminated siltstone, argillaceous shale, and fine sandstone.........	51·6	1,123
156	Siltstone, calcareous or dolomitic, grey, weathering to buff, and thinly bedded, fine sandstone; current-rippled, with northerly facing stoss slopes........................	9·6	1,132·6
155	Shale, calcareo-argillaceous, finely banded, grey weathering brownish to buff, with a small *marine fauna* as well as *Pseudestheria* and *Leaia*...........................	8·1	1,140·7
154	Siltstone or fine sandstone, greyish brown................	9·1	1,149·8
153	Shale, calcareo-arenaceous, buff weathering...............	11·9	1,161·7
152	Shale, arenaceous, and siltstone..........................	19·1	1,180·8
151	Shale, arenaceous, greenish grey, with a thin band, vuggy limestone..................................	11·4	1,192·2
150	Shale, arenaceous, grey, and siltstone, with a thin sandstone bed in middle part, and three thin calcareous shale bands..................................	4·9	1,197·1
149	Shale, calcareous, with minute, calcite-lined vugs, interbanded with argillaceous shale......................	2·1	1,199·2
148	*Limestone*, in thin bands interbedded with calcareo-arenaceous shale..................................	2·1	1,201·3
147	Shale, calcareo-argillaceous, dark grey, with a *marine, molluscan fauna*................................	6·5	1,207·8
146	*Limestone*, argillaceous, thinly bedded, with scattered calcite-lined vugs..............................	38·5	1,246·3
145	Shale, argillaceous, grey................................	4·6	1,250·9
144	*Limestone*, argillaceous, dark grey, with bands of argillaceous shale..................................	3·5	1,254·4
143	Shale, arenaceous, greenish grey.........................	3	1,257·4
142	*Limestone*, argillaceous, dark grey......................	0·4	1,257·8
141	Shale, arenaceous, greenish grey.........................	1·6	1,259·4
140	Shale, calcareous, ribbon-banded.........................	0·5	1,259·9
139	Shale, arenaceous, greenish grey.........................	2·2	1,262·1
138	Shale, calcareous, ribbon-banded.........................	0·5	1,262·6
137	Shale, arenaceous, greenish grey, with thin bands argillaceous shale..................................	5·8	1,268·4
136	Shale, calcareous, interlaminated with argillaceous shale in ribbon bands..............................	1·3	1,269·7
135	Shale, arenaceous, greenish grey.........................	2·2	1,271·9
134	Shale, calcareous, ribbon-banded.........................	0·2	1,272·1
133	Shale, argillaceous, grey, with *Leaia*.....................	2·3	1,274·4
132	*Limestone*, argillaceous, dark grey, thinly bedded...........	1	1,275·4
131	Shale, arenaceous, greenish grey, and argillaceous shale.....	3	1,278·4
130	Shale, argillaceous, dark grey...........................	4	1,282·4
129	Siltstone, greenish grey, unbedded........................	7·9	1,290·3
128	Shale, arenaceous, greenish grey.........................	7·7	1,298
127	*Limestone*, argillaceous, dark grey, ribbon-banded at top with argillo-arenaceous shale.........................	1·2	1,299·2
126	Shale, grey, argillo-arenaceous..........................	3·7	1,302·9
125	Siltstone, calcareous, with a *marine, molluscan fauna*........	3·9	1,307·8
124	Shale, areno-argillaceous, interbedded with arenaceous *limestone* bands..............................	2·3	1,310·1
123	Shale, dark grey, areno-argillaceous......................	2·5	1,312·6
122	*Limestone*, arenaceous, thinly bedded.....................	1	1,313·6
121	Shale, arenaceous, grey, and shaly sandstone..............	5	1,318·6
120	*Limestone*, argillaceous, and calcareous shale with small vugs lined with calcite..............................	1	1,319·6
119	Siltstone, greenish grey, alternating with shaly, micaceous sandstone..............................	6·5	1,326·1
118	Sandstone, greenish grey, much crossbedded, with bands of grey siltstone; *Calamites*.........................	73	1,399·1

Section D—Continued

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
117	Siltstone, grey, some with calcareous, nodular concretions...	27·6	1,426·7
116	Sandstone, greenish grey, medium grained................	7·1	1,433·8
115	Siltstone, grey....................................	3·6	1,437·4
114	Siltstone, purplish grey and grey........................	21	1,458·4
113	Siltstone, grey, and argillaceous, fine sandstone............	64·2	1,522·6
112	Siltstone, greyish brown and greenish grey................	5·1	1,526·7
111	Siltstone, grey, and thinly bedded, fine sandstone..........	5	1,532·7
110	Sandstone, grey, fine to medium grained, much crossbedded; few coalized plant remains.........................	19·7	1,552·4
109	Siltstone, grey, with minor amount of interbedded, grey, thinly bedded, fine sandstone and ribbon-banded, argillaceous and arenaceous shale. Several thin, argillaceous, limy bands *Adiantites* sp. and *Sphenopteridium pachyrrachis*. *Leaia* and *Pseudestheria* in some beds..........	235·6	1,788
108	Siltstone, grey, and areno-argillaceous shale...............	6·3	1,794·3
107	Shale, ribbon-banded, arenaceous and argillaceous..........	3·7	1,798
106	Sandstone, fine, grey..................................	2·6	1,800·6
105	Shale, argillo-arenaceous, dark grey......................	11	1,811·6
104	Sandstone, fine, greenish grey, with interbeds siltstone......	28·2	1,839·8
103	Shale, grey, argillo-arenaceous; *Sphenopteridium pachyrrachis*	2·2	1,842
102	Sandstone, grey, rusty weathering, thinly bedded..........	3·5	1,845·5
101	Siltstone, purplish grey, hackly weathering................	3·5	1,849
100	Siltstone, dark greenish grey, hackly weathering...........	6·4	1,855·4
99	Sandstone, grey, ribbon-banded, rusty weathering..........	7·8	1,863·2
98	Sandstone, grey, thinly bedded, and argillo-arenaceous, grey shale..	12·2	1,875·4
97	Shale, greenish grey and purplish brown, and siltstone......	7	1,882·4
96	Siltstone and silty mudstone, grey, hackly weathering.......	21·8	1,904·2
95	Sandstone, greenish grey, minutely crossbedded, alternating with grey siltstone................................	11·5	1,915·7
94	Siltstone, brownish red, unbedded........................	18·5	1,934·2
93	Sandstone, grey, argillaceous, grading into siltstone.........	6·5	1,940·7
92	Siltstone, argillaceous, grey, hackly weathering.............	26	1,966·7
91	Siltstone, argillaceous, greenish grey, slightly mottled purplish red or with red bands.......................	7·0	1,974·6
90	Sandstone, fine, grey, with a few thin beds siltstone........	28·9	2,003·5
89	Siltstone, bluish grey..................................	2·3	2,005·8
88	Sandstone, finely crossbedded, greenish grey, with comminuted plant debris................................	34	2,039·8
87	Siltstone, bluish grey..................................	3·2	2,043
86	Sandstone, finely crossbedded, micaceous, grey, with comminuted plant debris................................	12	2,055
85	Sandstone, fine, grey, alternating with siltstone; at top 1-foot band dark grey, argillaceous shale with *Leaia* and *Pseudestheria*................................	30	2,085
84	Siltstone, argillaceous, grey, hackly weathering.............	1·9	2,086·9
83	Shale, argillo-calcareous, grey..........................	0·3	2,087·2
82	Sandstone, grey, thinly bedded, with a few coalized plant stems..	11	2,098·2
81	Sandstone, grey, weathering buff, micaceous, medium grained, with coalized plant debris..................	7	2,105·2
80	Siltstone, grey, with hard, nodular concretions.............	2·8	2,108
79	Sandstone, fine, argillaceous, grey, with bands of siltstone..	6·3	2,114·3
78	Siltstone, grey, hackly weathering........................	4	2,118·3
77	Sandstone, fine, argillaceous, grey, weathering to buff.......	2	2,120·3
76	Siltstone, argillaceous, grey, hackly weathering.............	1·8	2,122·1
75	Sandstone, fine, grey, rusty weathering....................	3·4	2,125·5
74	Siltstone, argillaceous, dark grey.........................	2·6	2,128·1
73	Sandstone, fine, micaceous, grey, weathering rusty.........	4·7	2,132·8
72	Siltstone, grey, poorly bedded...........................	16	2,148·8

Section D—Continued

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
71	Breccia, intraformational, consisting of fragments of shale and sandstone	1·9	2,150·7
70	Shale, arenaceous, interlaminated with argillo-calcareous bands in lower part	15·5	2,166·2
69	Shale, dark grey, areno-argillaceous; a few *marine pelecypods* and rare *Productus*	13·7	2,179·9
68	*Limestone*, dark grey, argillaceous	2·1	2,182
67	Mudstone, dark grey	0·5	2,182·5
66	Sandstone, calcareous, grey	0·9	2,183·4
65	Siltstone, argillaceous, with septarian concretionary balls	3·5	2,186·9
64	Sandstone, finely crossbedded, grey, interbanded with siltstone	21·7	2,208·6
63	Shale, argillo-arenaceous, in part ribbon-banded with more argillaceous layers	3	2,211·6
62	Shale, calcareo-arenaceous, grey	0·4	2,212
61	Shale, grey, ribbon-banded with darker areno-argillaceous layers	1·7	2,213·7
60	Shale, dark grey, areno-argillaceous	4	2,217·7
59	Siltstone, greenish grey, interbedded with micaceous, arenaceous shale and thin, grey, shaly sandstone	24	2,241·7
58	Sandstone, greenish grey, finely crossbedded and micaceous	6·2	2,247·9
57	Shale, dark grey, calcareo-argillaceous, interbedded with thin, grey sandstone	65	2,312·9
56	Shale, mudstone, and siltstone, dark grey, with calcareous bands; carries a sparse *marine* fauna, including *Bucanopsis* and *Productus*	65·5	2,378·4
55	*Limestone*, argillaceous, in thin bands alternating with dark grey, argillaceous shale	11	2,389·4
54	Siltstone, dark grey, and in part calcareous, alternating with thin beds greenish grey, fine sandstone	20	2,409·4
53	Shale, dark grey, argillaceous and areno-argillaceous, with rare thin bands *limestone*	15	2,424·4
52	Sandstone, fine, argillaceous, finely crossbedded, with bands areno-argillaceous shale	5	2,429·4
51	Shale, grey, argillaceous and areno-argillaceous; *Pseudestheria*	4·5	2,433·9
50	Siltstone, grey, argillaceous, ribbon-banded, with numerous cavities, some of which are cubic and may be moulds of salt crystals	14·5	2,447·4
49	Shale, greenish grey, arenaceous	3	2,450·4
48	Shale, greenish grey, arenaceous siltstone; and dark grey, argillaceous shale; also thin gypsum bands; occurs in crush zone and thickness indeterminable, but estimated to be at least	89	2,539·4
	——— fault ———		
47	Siltstone, brownish red	2	2,541·4
46	Siltstone, argillaceous and arenaceous, grey	6·8	2,548·2
45	Siltstone, brownish red, with calcite-lined vugs	3·7	2,551·9
44	Siltstone, greenish grey and brownish red, with thin bands fine sandstone	5·7	2,557·6
43	Siltstone, brownish red, with limy nodules	1	2,558·6
42	Shale, grey, arenaceous	2	2,560·6
41	Shale, dark grey, argillaceous	0·1	2,560·7
40	Shale, grey, arenaceous, finely crossbedded	2·3	2,563·0
39	Shale, areno-argillaceous, bluish grey	2·8	2,565·8
38	Shale, arenaceous, greenish grey, and grey mudstone in crush zone	12	2,577·8
	——— fault ? ———		

Section D—Continued

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
	(Gypsiferous zones)		
37	*Gypsum*, laminated with alternating dark and light grey bands; associated with brecciated shales and siltstones in a crush zone; thickness indeterminable, but at least..	20	2,597·8
36	Shale, dark grey, areno-argillaceous, brecciated, with beds grey, fine sandstone and minor amount of brownish red siltstone..	34	2,631·7
35	Shale, grey, arenaceous, with grey and a little brownish red siltstone, gypsum veinlets..........................	9·7	2,641·5
34	Siltstone, brownish red..................................	3·5	2,645
33	Siltstone, grey, micaceous..............................	9	2,654
32	Siltstone, brownish red..................................	5	2,659
31	Shale, grey, argillo-arenaceous or silty, micaceous..........	30·6	2,689·6
30	Siltstone, dark grey, calcareous, or argillaceous limestone....	0·6	2,690·2
29	Sandstone, fine, calcareous, grey, and siltstone.............	7	2,697·2
28	*Gypsum*, ribbon-banded, with laminæ dark, calcareous, brecciated shale; large channel-like zones of greenish grey mudstone or marl, and included masses of dark grey limestone..	110	2,807·2
27	Siltstone, brownish red, criss-crossed with gypsum veins.....	60	2,867·2
26	*Gypsum*, as before, with included masses of dark limestone and of red and grey siltstone......................	205	3,072·2
25	Siltstone, greenish grey.................................	38	3,110·2
24	*Limestone*, argillaceous, dark grey, thinly bedded...........	16·5	3,126·7
23	*Gypsum*, rather pure, with veins coarse selenite............	20	3,146·7
22	Siltstone, greenish grey.................................	8	3,154·7
21	*Gypsum*, ribbon-banded with dark, calcareous, brecciated laminæ of shale..	16	3,170·7
20	Siltstone, greenish grey, and a bed of gypsiferous shales.....	25	3,195·7
19	*Gypsum*, grey, with ribbon-like laminæ of brecciated, dark, calcareous shale..	95	3,290·7
18	*Limestone (Black Point limestone)*, dark grey to greyish brown, vuggy, mostly brecciated, including a channel deposit of consolidated conglomerate, 20 feet or more wide; this conglomerate lies seemingly parallel to bedding and may be inwash into a channel formed by solution..	60	3,350·7
	———— fault ————		
17	Siltstone, weathering buff, perhaps dolomitic, somewhat vuggy..	8	3,358·7
16	Siltstone, brownish red..................................	1·5	3,360·2
15	Siltstone and silty limestone, grey, weathering buff, with thin, brownish red interbeds.........................	27·1	3,387·3
14	Siltstone, light grey.....................................	13·5	3,400·8
13	Siltstone, brownish red..................................	19	3,419·8
12	Siltstone, greenish grey, calcareous, laminated.............	6	3,425·8
11	Siltstone, light grey, and calcareous or dolomitic, buff siltstone with interbeds of brownish red siltstone and of buff limestone-breccia *(Codroy breccia)*...............	40	3,465·8
10	Siltstone, brownish red..................................	18	3,483·8
9	Siltstone, buff weathering, alternating with brownish red siltstone..	144	3,627·8
8	*Limestone*, dark grey, vuggy............................	25	3,652·8
7	Siltstone, light grey and buff weathering, with thin bands dark grey, vuggy limestone............................	47	3,699·8
6	*Gypsum*..	20	3,719·8
5	Siltstone, grey..	70	3,789·8
	———— fault ? ————		

Section D—Concluded

Bed Nos.	Descending section	Thickness	Total thickness
		Feet	Feet
4	Siltstone and argillaceous shale, brownish red, with a few greenish grey zones....................................	50	3,839·8
3	*Gypsum*, in several zones alternating with brownish red and grey siltstones that have rare bands of dark argillaceous limestone; very roughly estimated as.................	215	4,054·8
2	Concealed in submarine area............................	?	?
1	*Limestone (Ship Cove limestone)*, finely laminated, arenaceous, with grey, slightly arkosic, calcareous sandstone beds in middle part; some beds rippled; similar to basal Windsor limestone of many areas in Nova Scotia...............	60	?

Description of Codroy Series in Codroy Area

Ship Cove Limestone. The writer considers this member to be the natural base of the Codroy series. At Ship Cove the member was included in the Codroy series by Hayes and Johnson, but in the Codroy area was mapped with the Anguille series. The limestone member is well exposed on the southeastern shore of Codroy Island; except for its interbedded sandstone layers it is similar to the laminated limestone (subzone A) that lies at the base of the Windsor group in many parts of Cape Breton and in certain areas of the mainland of Nova Scotia. The upper part of the Anguille series is only partly exposed on Codroy Island, and the actual contact with the Ship Cove limestone is concealed. The uppermost exposed Anguille beds are here grey and purplish grey, arkosic sandstones, dipping about 30 degrees south 28 degrees east. About 220 feet of overlying strata are concealed to limestone beds that dip about 40 degrees in the same direction. Many layers of the limestone, which is ribbon-banded, have abundant, small, concretionary-like pellets. The middle part of the member includes grey and purplish grey, shaly, micaceous and slightly arkosic sandstone, of which some surfaces are rippled.

The Ship Cove limestone outcrops again at Ryans Brook at the highway bridge, as previously mentioned, and its disconformable contact with grey sandstone of the Anguille group is there well exposed. Both the Anguille and overlying Codroy beds dip 32 degrees in a direction about south 37 degrees east. Here again the limestone is impure and finely laminated. It weathers quite vuggy, and is cut by a few veinlets of calcite and barite.

Gypsiferous Zones. Hayes and Johnson (1938, p. 12) differentiated a lower, gypsiferous part of their Codroy series as a separate formation, the "Codroy shale", which they estimated to be at least 3,700 feet thick. That part of section D at Codroy that includes these gypsiferous zones is too badly broken by faults, and the gypsum and siltstones are too intimately commingled, as already noted, to permit even a rough approximation of the total true thickness. Moreover, an unknown part of this division is concealed in the submarine area between Codroy Island and the mainland. In section D, beds 1 to 37 belong here, and are estimated to be at least 1,450 feet thick. They include at least four distinct limestone members, but the predominant sediments besides gypsum are siltstones and silty mudstone, some of which are light grey and calcareous or dolomitic. Most of the gypsum is grey, ribbon-banded, with blackish grey laminæ made up of pellets or fragments of calcareous shale, and some of the gypsum zones have large included masses of brecciated, blackish limestone, which are seemingly "horses" torn from limestone beds by flow of the gypsum under pressure. The thickest and most prominently displayed limestone is the Black Point limestone (Hayes and Johnson, 1938, p. 13), outcropping at Black Point. It is mainly a vuggy, partly brecciated, dark grey to brown limestone. In its middle part is a band, 20 feet or more thick, of conglomerate, carrying pebbles and cobbles of quartzite, quartz, green and red siltstone, and dark limestone, together with some greenish volcanic and red granitic rocks in a light brown calcareous matrix. At first sight this conglomerate would seem to be an original interbedded constituent of the limestone member, but it was concluded that it was probably a consolidated filling of glacial material deposited in a channel after solution of some readily soluble beds, for the pebbles in the conglomerate are like those in unconsolidated drift near by.

No fossils were observed in the Black Point limestone except rare *Spirorbis*. The limestone is seemingly overlain by a very thick zone of gypsum and interbedded greenish grey siltstone, including 15 feet of dark grey, argillaceous limestone. From underlying beds the Black Point limestone is separated by a fault. These older strata comprise grey, buff weathering, dolomitic and calcareous siltstones and red siltstones, including beds of a limestone-breccia (Codroy breccia) made up of angular fragments of dark limestone in a yellowish grey, dolomitic matrix. The zone containing such breccia beds is about 40 feet thick, and outcrops from 1,000 to 1,200 feet north of the fault that cuts off the Black Point limestone. This breccia may indicate a pronounced shallowing of the sea in the Codroy area, and may possibly be correlated with basal beds of subzone C of the Windsor group of Nova Scotia.

Woody Cove Beds. The uppermost gypsum (bed 37, section D) of the gypsiferous zones is in contact with brecciated siltstones in a crush zone, which is probably the locus of a fault. Overlying beds that outcrop in Woody Cove were differentiated by Hayes and Johnson (1938, p. 14) as "Woody Cove shale." In addition to greenish grey and red siltstone, there are many intercalated beds and subzones of dark grey shales carrying *Leaia* and *Pseudestheria*, dark calcareo-argillaceous shales carrying shells of marine mollusca, and grey, commonly thin, sandstone with broken plant debris. Fine-grained sandstone makes up about 25 per cent of the total sediment of the member, and calcareous beds less than 1 per cent. The bulk of the sediment is, therefore, siltstone and shale. Beds with marine shells were noted 200 and 400 feet above the base of the subdivision. In arenaceous beds near the top of the member *Sphenopteridium pachyrrachis* and *Adiantites* sp. occur sparingly.

Woody Head Beds. Beds overlying the Woody Cove, here designated Woody Head beds, were made a separate formation called the "Woody Point sandstone" by Hayes and Johnson (1938, p. 13). It was clearly stated, however, by these authors that the underlying formation seemed " to grade upward without any break." The total amount of sandstone in that part of section D that makes up the "Woody Point sandstone" has increased slightly so as to become about 40 per cent of the sediments as compared with 25 per cent in the underlying Woody Cove beds. Although some of the sandstone is slightly coarser in grain, this is not a general character, and lithologically no satisfactory criteria suggest a separation into two formations. The base of the "Woody Point sandstone" as mapped by Hayes and Johnson was evidently the base of bed 110, section D. This bed is a grey, fine- to medium-grained sandstone, about 20 feet thick, carrying a few coalized plant stems, much like some of the sandstone members both above and below. This base does not mark the summit of marine horizons, for marine fossils were noted by the writer in beds lying 245, 345, and 410 feet above it. Moreover, *Leaia* and *Pseudestheria* similar to those found in the Woody Cove beds are present also at several horizons in the Woody Head beds. An arbitrary base for the Woody Head beds could be chosen, well above obviously marine beds, at the base of the sandstone at Woody Head (bed 193, section D), but, as the sandstone beds are seen to be variable and lenticular, it is doubtful whether any such base would be mappable elsewhere. At present, therefore, the term "Woody Head beds" is useful merely to designate an upper part of section D in which as yet no marine fossils have been found. The underlying beds throughout a thickness of 1,400 feet include, at different levels within the section, a few beds and members with a marine, mainly molluscan fauna. These marine beds are separated, however, by dark shales similar to those in the Woody Head beds, which commonly carry *Leaia* and *Pseudestheria,* and which have, therefore, a palæontologic character of non-marine deposits.

Searston Beds. An unknown thickness of strata is missing at the surface between the highest bed (226) of section D and the lowest bed (227) of the Searston beds, which make up section A. Many of the Searston arenaceous beds are strongly micaceous, differentiating them from Woody Head and Woody Cove beds, and many of the sandstones are gritty and conglomeratic. Higher Searston strata, outcropping for 4 miles from Searston to Larkin Point (*See* Figure 1), were only cursorily examined by the writer. Altogether more than 5,000 feet of strata must be represented. In the upper part of the section, about 1,000 feet north of the radio towers, specimens of *Lepidodendron volkmannianum* (Plate I, figures 1, 2) were gathered, and from a lower part *Diplotmema adiantoides* (Plate II, figures 1-4). These fossils indicate a probable early Namurian age (very late Mississippian). The strata of this section are greenish grey sandstone and arkosic grits, with lenticular beds of conglomerate, alternating with reddish brown arenaceous shale, siltstone, and sandstone, and with a few interzones of dark argillo-arenaceous shale. Some of the sandstone beds are arkosic, with angular fragments of pink feldspar and red granite. Lenticular beds of intraformational limestone-conglomerate are sparingly present. The arenaceous sediments are commonly strongly micaceous. Two faults were observed in this section east of the area of Figure 2, the more important one striking about east by north and with downthrown side on the south.

Strata of the Searston beds were noted by the writer in a downfaulted block on Crabbs River (Figure 3), outcropping in places from 5,500 to 8,500 feet upstream from the railway bridge. They include grey and brown, strongly micaceous sandstone, grit, and arenaceous shale, interbedded with dark grey shale, argillaceous siltstone, grey conglomerate, and pebbly sandstone. The conglomerate carried predominantly pebbles of white quartz, but pebbles of red granitic rock are also present. Coalized and petrified drift stems, some coated with malachite stains, are fairly common in some of the sandstone beds. One outcrop on the northern side of the brook shows an 8-foot band of dark brown, compact siltstone resembling a very lean oil-shale. This band carries ostracoda, rhizodopsoid fish scales, coprolites, *Lepidodendron* sp., and *Diplotmema adiantoides,* indicating a correlation with the beds at Searston and Stormy Point.

The strata on Crabbs River are downfaulted on the southeast against grey and brownish red siltstone, which is underlain by gypsum. These latter beds obviously belong to some part, probably an upper part, of the gypsiferous zone of the Codroy series. The northwest boundary of the Searston beds is likewise a fault (Figure 3), for although a fault contact is not actually exposed, the Searston beds stand vertically, with their top surfaces to the southeast. The nearest outcropping strata of the Codroy series dip steeply west, and comprise grey areno-argillaceous shale and siltstone with small vugs, some of which appear to be moulds of salt crystals; downstream is an outcrop of vuggy, buff-weathering, argillaceous and probably dolomitic limestone, at least 50 feet thick, overlain by brownish red siltstone and, farther downstream, by red and grey interbedded shale and siltstone, of which some beds have moulds of salt crystals. These last mentioned beds also include a few thin bands of intraformational limestone-breccia somewhat like the Codroy breccia near Black Point, and they include, in addition, a band of grey, calcareous siltstone carrying *Leptodesma dawsoni.* It is inferred that they occupy a stratigraphic position in the Codroy series equivalent to that of the strata at Codroy immediately north of Black Point.

Strata higher up Crabbs River, southeast of the above noted Searston beds and gypsum, were not examined by the writer, but from their description furnished by Hayes and Johnson (1938, p. 17) it may be concluded that Searston beds occupy a second downfaulted block of greater width than that present downstream, and representing probably the southern extension of the downfaulted block that contains the coal seams of the Barachois series on Barachois Brook and Robinsons River.

SOUTHEAST SHORE ST. GEORGES BAY

Only those outcrops of the Codroy series on the southeast shore of St. Georges Bay that lie in the area from Ship Cove to Fishels were examined by the writer. This area, however, includes the best exposures of strata of the group in the St. Georges Bay district.

Representative sections of the series are exposed as follows:

Section E: from Ship Cove to French Brook
Section F: from Highland Brook to Crabbs River
Section G: Stinking Cove and Robinsons Head
Section H: Robinsons River and Barachois Brook
Section I: Heatherton, and Fishels Brook.

Section E

(Ship Cove to French Brook)

The basal beds, the Ship Cove limestone, of the Codroy series at Ship Cove lie accordantly upon hard, fine-grained sandstone of the Anguille series. The contact is well exposed in a small gulch at Ship Cove about 400 feet above the mouth of the small brook that empties into the southeast corner of the cove, and also on the shore 1,250 feet west of this brook. The Ship Cove limestone here comprises flaggy and laminated, arenaceous limestone, some beds of which are current-rippled. The upper part of the member weathers vuggy and shaly. The estimated thickness is about 175 feet.

The limestone is overlain by about 60 feet of grey and brownish grey, laminated siltstone, capped by about 10 feet of shaly gypsum and siltstone (gypsum zone a), which in turn is overlain by brownish red siltstone with grey bands lying in a crushed zone and apparently faulted against a thick gypsum zone (gypsum zone b) to the north. This gypsum member comprises upper and lower gypsum beds, separated by 50 feet or more of brownish red and some grey siltstone including, near the top, a thin band of intraformational breccia consisting of angular fragments of dark limestone in a grey, limy matrix. This breccia recalls the Codroy breccia of the Codroy section north of Black Point. The lower gypsum of zone b, about 1,500 feet northeast of the brook at Ship Cove, rests directly upon brecciated limestone (*Cormorant limestone*) (*See* Figure 3). For 700 feet on the shore northeast of this gypsum-limestone contact the strata are too distributed to fix confidently their precise position within the section. They comprise gypsum and brownish red siltstones, which presumably belong to the same gypsum zone b as that overlying the Cormorant limestone. Farther northeast for 600 feet broken and crushed grey shales and siltstones occur in what is inferred to be an upraised fault block, the structure of the beds being anticlinal. If this interpretation is correct, these grey silts and shales are older than the Cormorant limestone.

The Cormorant limestone is well exposed at the "hole-rock", a local name given to a sea-eroded tunnel in the limestone. The limestone is blackish grey, and some of it quite fossiliferous, *Batostomella, Linoproductus lyelli, Diaphragmus tenuicostiformis, Dielasma davidsoni* or var., and *Conularia* being especially abundant. It forms part of the limb of an anticline, about 400 feet southwest of the anticlinal axis. The beds of the axial region are dark grey siltstone and shale with a bed or two of grey sandstone, overlain by calcareous grey siltstone, one or two beds of which carry *Leptodesma dawsoni,* and finally by 4 feet of blackish calcareous shale carrying abundant *Batostomella,* which directly underlies the Cormorant limestone of the eastern limb of the fold. The limestone member here is about 115 feet thick, and is again overlain directly by the lower gypsum of zone b at least 35 feet thick. Although the limestone is blackish grey it weathers an ochreous yellow. Above the gypsum is a grey sandstone bed standing about vertically, and it is inferred that the section is here cut by a fault trending about north 80 degrees east, with a downthrow on its north side. The downthrown beds are mainly ribboned, dark grey siltstones and shales with a few brownish red layers and thin beds of grey and brownish red sandstone. These beds are partly crushed and contorted, and are at least 100 feet thick; many of them have casts and moulds of small cubical salt crystals; a few are rippled. The only fossils observed were small fragments of a sphenopterid with small wedge-shaped pinnules. The beds are best exposed in the lower part of a small brook. The ribboned shales have a general dip to the south, and are underlain by a thick zone of alternating gypsum and brownish red and grey siltstones, dipping south-southeast to where they encounter a crush zone and inferred fault 1,000 feet north-northeast of the brook mouth. Overlying the gypsum beds in the sea cliff is a band of grey limestone-breccia similar to that already noted in the siltstone of gypsum zone b southwest of the brook. For this reason it is inferred that the gypsum north of the brook represents the lower gypsum of the same zone. The gypsum and associated siltstone are presumably repeated in outcrops farther north beyond the crush zone, where the beds are vertical or dip steeply southwesterly to another inferred fault, along which they are upthrown against a very thick series of brownish red siltstones, dipping north. The total thickness of siltstone and gypsum of zone b is very doubtful, but presumably is well over 500 feet. Apparently there has been much intermingling of gypsum and siltstones as a result of flow of the gypsum under pressure, for the dips of the gypsum and intervening siltstone members are commonly discordant.

The thick siltstones younger than gypsum zone b outcrop at Shoal Point and in Plaster Cove, and are mainly laminated red siltstones with thin grey bands, and, more rarely, grey interzones of which the thickest is about 130 feet. Fine crossbedding is very common, and many beds have cubical moulds of salt crystals, mostly small, but some up to 1 inch square. This series of beds is estimated to be about 2,200 feet thick, assuming there are no faults present in a concealed interval in the vicinity of Shoal Point Brook, and that changes in strikes are due to gentle folding.

At Plaster Cove the red and associated grey siltstone beds are overlain by gypsum zone c. The basal gypsum of this zone is at least 150 feet thick. It is overlain by brownish red, and interbedded grey siltstones that include an 8-foot bed of coarse, selenitic gypsum. These beds dip rather steeply northward, but are only exposed along the shore for a few hundred feet, and northeasterly to Harbour Point, a distance of more than 2 miles, the rocks are concealed on the shore by glacial boulder clay or overlying stratified sands and gravel.

Section F

(Shore of St. Georges Bay from 3,500 feet west-southwest of the mouth of Highland River to St. Davids at the mouth of Crabbs River)

In this section strata of the upper part of the Codroy series are almost continuously exposed. They are folded in an open syncline of which the axis trends northwesterly about a quarter mile east of Highland River. The highest beds are exposed on the shore about 1,800 feet northeast of this river. The lowest bed of the section is the Crabbs limestone outcropping at St. Davids at the mouth of Crabbs River. In the southwestern limb about 1,470 feet of strata are well exposed, but farther west the rocks are concealed by thick deposits of stratified sand and gravel, except for one or two poor outcrops on the beach at Harbour Point.

Strata of the northeastern limb of the fold were measured roughly, and are as follows:

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
(p)	Grits and sandstone, brownish red, some with pebbles of white quartz and grey quartzites, alternating with zones of brick-red siltstone. Some of the grits have lenses of intraformational limestone conglomerate, and some of the siltstones carry lime nodules *(kunkur)*. Green bull's-eyes mark some of the siltstone	984	984
(o)	*Limestone*, compact, light grey, seemingly non-marine	2·5	986
(n)	Grits and sandstone, as above, brownish red and occasionally grey; some beds pebbly, alternating with brick-red siltstone zones some of which carry *kunkur*-lime. The grits not uncommonly channel into the siltstone members	574	1,560
(m)	Concealed	255	1,815
(l)	Grits and sandstone as above, brownish red and some reddish grey, alternating with zones of brick-red siltstone, some of which are *kunkur*-bearing	322	2,137
(k)	Concealed	300	2,437
(j)	*Limestone*, purplish grey to grey, seemingly non-marine	2·5	2,440
(i)	Grits and sandstone, brownish red, and a little grey, some beds of which have pebbles of white quartz and of quartzites, alternating with zones of brick-red siltstone some of which are *kunkur*-bearing and some marked by green bull's-eyes	815	3,255
(h)	*Limestone member (Crabbs limestone)*		
	Limestone, purplish grey, thinly bedded, some layers with seaweed imprints	1·2	
	Siltstone, shaly, brownish to purplish red, mottled with grey	0·3	
	Limestone, purplish grey, and mottled with seaweed imprints	0·8	
	Sandstone, argillaceous, flaggy, grey or mottled grey and red; some surfaces rippled	1·4	
	Shale, areno-argillaceous, grey or mottled grey and red, with thin sandstone layers	3·3	
	Shale, brownish grey, mainly argillaceous, with thin band mottled grey and brown sandstone at base	2·1	

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
	Limestone, rubbly, purplish grey, with *Camarotoechia*..	0·6	
	Mudstone, brown................................	0·3	
	Limestone, rubbly, thinly bedded, purplish grey. *Camarotoechia* and small crinoid stems.................	11·2	
	Limestone, grey, thinly bedded, *Productus avonensis* and a nautiloid present as well as small grass-like seaweeds (?). Slight fetid odour when struck......	9·4	
		31	3,286
	A limestone *(Jeffreys limestone)*, lying about 335 feet stratigraphically below the Crabbs limestone, is exposed on the shore at Jeffreys east of Crabbs River. The above section may, therefore, be extended downwards to include this limestone and underlying beds that are exposed for an additional half mile on the shore.		
(g)	Siltstone, brick-red, and sandstone, crossbedded, purplish red and grey, some with rare pebbly lenses............	334	3,620
(f)	*Limestone (Jeffreys limestone)*		
	Limestone, purplish grey with *Schizodus* common......	1·2	
	Shale, ribboned, areno-argillaceous, mottled purplish red and grey................................	0·6	
	Limestone, purplish red with imprints of a branching seaweed....................................	1·6	
	Shale, greyish brown............................	0·2	
	Sandstone, calcareous, greyish brown, with purplish brown, rootlet-like imprints....................	0·8	
	Shale, argillo-arenaceous, grey and grey mottled with purplish brown............................	2·4	
	Sandstone, calcareous, purplish brown...............	0·5	
	Shale, argillaceous, purplish brown and grey mottled...	2·3	
	Limestone, purplish grey and grey...................	0·5	
	Mudstone, greyish brown..........................	0·4	
	Limestone, thinly bedded, grey and purplish grey......	5·9	
	Limestone, thinly bedded, grey; *Camarotoechia* and rare *Dielasma*....................................	8	
	Shale, argillaceous, grey..........................	0·7	
	Limestone, in beds up to 1·5 feet thick, grey; algal nodules in basal part, which has a slight fetid odour when struck. A small orthocerid present..........	7·7	
	Limestone, grey, with one or two mudstone layers......	0·7	
		34	3,654
(e)	Siltstone, brownish red and a little grey, alternating with reddish brown and grey or reddish grey sandstone, of which some beds are rippled........................	287 ±	3,941
(d)	Shale, arenaceous and argillaceous, grey and dark grey......	14	
	Sandstone, calcareous, grey; with *Lithophagus poolii*.......	5·6	
	Shale, calcareo-argillaceous, with limy nodules in some beds.	5·2	
	Shale, argillaceous, grey..............................	2·8	
	Mudstone, calcareous, grey and dark grey................	0·4	
	Shale, areno-argillaceous, greenish grey..................	1·4	
		29·4	3,970
(c)	Siltstone, brick-red to brownish grey, some marked by green bull's-eyes, and reddish brown and some grey sandstone; some beds irregularly flaggy..................	535 ±	4,505
(b)	Sandstone with lenses conglomerate carrying pebbles of white quartz and of grey and brown quartzites up to 3 inches diameter................................	70 ±	4,575
(a)	Siltstone, brownish red, alternating with reddish brown and a few beds grey sandstone. Near base are ribboned dark grey shale with selenite veins along bedding planes and casts of salt hoppers...........................	393+	4,968

The exposed basal beds of the above section strike north 43 degrees east and dip 61 degrees northwest. The next exposed beds on the shore lie about 10,000 feet to the northeast, east of the mouth of Barachois Brook, where reddish brown sandstone with conglomerate lenses carrying pebbles up to 3 inches in diameter strike about north 48 degrees east and dip 50 degrees northwest. These beds are similar to those of (b) of above section, and are inferred to represent the same approximate horizon. The Jeffreys limestone should, therefore, lie roughly about 1,300 feet offshore of the mouth of Barachois Brook. A half mile farther northeast and northeast of the mouth of Robinsons River, the strata strike more northerly, so that the Jeffreys horizon still should keep a short distance offshore at Robinsons Head. At Robinsons Head, the strata are tilted vertically and apparently lie in a broken, much compressed anticlinal flexure, whereby the Jeffreys limestone and Crabbs limestone have been offset to the southeast from their inferred submarine position so as to appear again in the shore section east of Stinking Cove where the following beds occur:

Section G

(Section on shore of Stinking Cove, St. Georges Bay)

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
(12)	Sandstone, brownish red and reddish grey, alternating with zones of brick-red siltstone. Some beds of sandstone have scattered pebbles. Thin bands of calcareous sandstone occur 175 feet from the top and also near the base. Some of the siltstone carries lime nodules *(kunkur)* and is marked by green bull's-eyes......................	350 ±	350
(11)	*Limestone*, grey, sun cracked............................	0·3	
(10)	Sandstone, brownish red and reddish grey; some beds with scattered pebbles of white quartz and of grey and brown quartzites, alternating with zones of brick-red siltstone, some of which is marked by green bull's-eyes..........	530 ±	880
(9)	*Limestone (Crabbs limestone)*		
	Limestone, purplish grey..........................	1·4	
	Shale, argillaceous, mottled grey and purplish red......	1·4	
	Sandstone, rippled, mottled grey and purplish red......	0·5	
	Shale and sandstone in ribbon-band, grey and mottled grey and red................................	8·3	
	Limestone, thinly bedded, grey.....................	2	
	Mudstone, laminated, grey and purplish brown........	0·5	
	Limestone, purplish grey, thinly bedded; with *Camarotoechia*..	1·8	
	Shale, argillaceous, grey..........................	0·6	
	Limestone, grey, mottled with purplish brown, thinly bedded; *Productus avonensis*, *Straparollus*, *Leptodesma dawsoni*, a small orthocerid, and a nautiloid. Basal beds have a few algal nodules and give a fetid odour when struck................................	15·7	
	Shale, argillaceous, purplish grey...................	2·9	
	Limestone, grey......................................	0·4	
	Shale, grey, ribboned with purplish brown............	1	
	Shale, calcareous, grey, with argillaceous laminæ.......	1	
		37·5	917
(8)	Siltstone, brick-red, alternating with zones of brownish red, greyish red, and grey, crossbedded sandstone. A few inches of pebble-conglomerate at base of one of sandstone..	334 ±	1,251

Section G—Continued

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
(7)	*Limestone (Jeffreys limestone)*		
	Shale, argillo-calcareous, greenish grey; *Schizodus* and *Lithophagus poolii*	1	
	Shale, mottled purplish red and grey, in alternate ribbons	0·8	
	Limestone, grey, thinly bedded; *Productus avonensis* and *Lithophagus poolii*	0·3	
	Shale, arenaceous and argillaceous, ribboned, and mottled purplish red and grey	3·4	
	Limestone, grey	0·1	
	Shale, argillaceous, ribboned, and mottled purplish red and grey	0·4	
	Limestone, grey	0·1	
	Shale, argillaceous, mottled as before; with a few flat, limy concretions	1	
	Limestone, grey or purplish grey	0·3	
	Shale, argillaceous, mottled purplish red and grey	0·4	
	Limestone, argillaceous, with purplish brown, rootlet-like imprints oblique to bedding	0·5	
	Shale, areno-argillaceous, mottled with purplish brown	2·1	
	Limestone, rubbly, grey and purplish brown	0·3	
	Shale, areno-argillaceous, mottled as before	1·4	
	Limestone, thinly bedded, grey with purplish brown mottlings; *Camarotoechia*	1·5	
	Shale, argillaceous, greenish grey and purplish brown	1	
	Limestone, purplish grey; *Camarotoechia*	1·5	
	Shale, mottled purplish red and greenish grey	0·5	
	Limestone, thinly bedded, brownish and purplish grey or mottled; *Productus avonensis, Bellerophon*	9·4	
	Limestone, rubbly and thinly bedded, grey; algal nodules and algal coatings around fossils; *Bellerophon, Lithophagus poolii*, and a small orthocerid	4	
	Limestone, brownish grey; fetid odour when struck; *Productus avonensis*	1·2	
	Shale, argillaceous, grey, ribboned	2·9	
	Limestone, brownish grey; fetid odour when struck	0·5	
	Shale, argillaceous, grey, ribboned at base, with carbonaceous laminæ	0·9	
	Limestone, grey, brownish grey; fetid odour when struck	0·2	
		35·7	1,287
(6)	Sandstone, reddish grey and brownish red, crossbedded, alternating with zones of brick-red siltstone	165 ±	1,452
(5)	*Limestone*, brownish grey	0·3	
(4)	Sandstone, purplish red to brownish red, with a few grey bands near base, underlain by brick-red siltstone with thin bands grey and brownish red sandstone. Some of siltstone marked by green bull's-eyes	178	1,630
(3)	Shale, dark grey, argillo-calcareous, and greenish grey, argillo-arenaceous, some of it ribbon-banded, with thin interbeds of grey, shaly sandstone not more than 8 inches thick. *Leaia, Lithophagus poolii*, and *Conularia* occur in a 5-foot band of dark shale, which is overlain by an argillo-arenaceous band carrying *Nodosinella priscilla* and imprints of a branching seaweed, and underlain by ribboned shale with calcareous bands carrying *Lithophagus poolii* and *Spirorbis*	30 ±	1,660
(2)	Sandstone, brownish red and grey, some beds irregularly flaggy, others current-rippled, alternating with brick-red and brownish red siltstone some of which is marked by green bull's-eyes. In lower part of member siltstone zones prevail, some marked by grey bands. Several		

Section G—Concluded

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
	bands of sandstone have scattered pebbles. One band of grey shale, 2·5 feet thick, has lenses and interbedded veinlets of gypsum and brownish grey shales; 3 feet below it has casts of large salt hoppers. Other bands of grey shales above the gypsiferous band have casts of small salt crystals..................................	594±	2,254
(1)	Sandstone, grey, gritty, and pebbly, with lenticular beds of conglomerate carrying pebbles up to 4 inches diameter, underlain by grey and red conglomerates, sandstone, and red siltstone.......................................	70+	2,324

Beds (1) of above section lie approximately at the same horizon as beds (b) of section F. Beds (3) with *Lithophagus poolii* and *Nodosinella* are equivalent to beds (d) of that section, but the stratigraphic interval between them and the Jeffreys limestone is about 60 feet greater than the corresponding interval in section F at Jeffreys. The Jeffreys limestone according to the strikes of the strata on the shore should just clear Robinsons Head. As already noted, it must be tilted there to a vertical position, and is apparently carried farther seaward by a sharp and broken anticlinal flexure. The vertical displacement brought about by faulting in this disturbed zone is seemingly several hundred feet. At Robinsons Head purplish to brownish red grits, standing vertically or slightly overturned to the south, are in contact along a fault with crushed and contorted siltstone, mainly dark grey, but with some interbedded red siltstone and thin beds of grey and brownish sandstone and arenaceous shale. No fossil confirmation was obtained for correlation of these beds, although they most resemble in lithology beds (3) of the Stinking Cove section G. South of Robinsons Head to Robinsons River there are only scattered outcrops of reddish brown and brownish grey grits, some of which are pebbly or have conglomeratic lenses with pebbles of white quartz and of grey and brown quartzites. Similar strata, including some interbedded brownish red siltstone, outcrop on the shore between Robinsons River and Barachois Brook.

On Robinsons River, however, lower beds are almost continuously exposed to the vicinity of the railway bridge, as described in the following section:

Section H

(Section of strata on Robinsons River from mouth of river to near the railway bridge. Top of section inferred to lie about 850 feet below the Jeffreys limestone)

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
(13)	Sandstone, brownish grey and grey, some with conglomeratic lenses, carrying pebbles of white quartz, of quartzites, and more rarely of volcanic rocks, up to 2 inches diameter. A few thin interzones of brownish red, and a little grey, argillo-arenaceous shale..................	300 ±	300
(12)	Mainly concealed, but scattered outcrops micaceous, greyish and reddish brown, arenaceous shale and shaly sandstone	245 ±	545
(11)	Concealed..	270 ±	815
(10)	Siltstone, brownish red, much of it hackly weathering; finely micaceous, and crossbedded, with interbeds brownish red, and more rarely grey, thin zones and beds of argillaceous sandstone and arenaceous shale. Some of siltstone is minutely vuggy........................	755 ±	1,570
(9)	Concealed..	75 ±	1,645
(8)	Siltstone, brownish red and grey, some of it hackly weathering	50 ±	1,695
(7)	Siltstone, mainly brownish red and grey, and thinly bedded sandstone..	68 ±	1,763
(6)	Siltstone, brownish red, with thin beds argillaceous, red sandstone..	110 ±	1,873
(5)	Siltstone, brownish red and grey, and reddish grey sandstone	50 ±	1,923
(4)	Siltstone, brownish red, some of it hackly weathering, with interbeds fine red sandstone........................	115 ±	2,038
(3)	Siltstone, grey and reddish grey, and grey shale. Some beds have casts and moulds of salt hoppers................	40 ±	2,078
(2)	Siltstone, brownish red, with rare grey bands; many beds micaceous; interbedded with thin bands brownish red and grey sandstone and arenaceous shale..............	305 ±	2,383
(1)	Sandstone, grey, fine to medium grained, with angular quartz grains; *Calamites*................................	80 ±	2,463

Lower beds of the Codroy series are exposed between many concealed intervals along Barachois Brook as indicated by the rough measurements below. The top beds, providing there is no intervening fault, are perhaps 1,500 feet below the beds (1) of the Robinsons River section H.

Section I

(Section on Barachois Brook from railway bridge upstream for about 1·5 miles)

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
(14)	Scattered outcrop of grey, medium-grained, crossbedded sandstone, one bed of which has pebbles of white quartz and grey quartzites up to 1 inch diameter, and brownish red sandstone, alternating with brownish red and some greenish grey siltstone. Topmost beds are grey siltstone, sandstone, and calcareo-argillaceous shale.......	320 ±	320
	——— Barachois fault ——— (upthrow on southeast side)		
(13)	Brownish red, shaly sandstone underlain by brownish red siltstone, alternating with red, finely crossbedded sandstone...	280 ±	600
(12)	Concealed (one gypsum boulder noted in drift)............	380	980
(11)	*Limestone*, grey, top beds vuggy and buff weathering; underlain by thinly bedded limestone with *Leptodesma dawsoni* and a small *Linoproductus*. Basal beds are brecciated and nodular..................................	25 ±	1,005
(10)	Siltstone, brownish red and grey.........................	40 ±	1,045
(9)	Sandstone, grey, with conglomeratic lenses carrying pebbles of white quartz and of volcanic rocks up to 1 inch diameter...	60 ±	1,105
(8)	Concealed in part; in part brownish red siltstone and mottled brownish red and grey, soft, argillaceous sandstone.....	400 ±	1,505
(7)	*Limestone*, brecciated, greyish buff weathering and seemingly dolomitic, only partly exposed......................	5 ±	1,510
(6)	Siltstone, brownish red with some ribboned, grey and red siltstone and argillaceous, micaceous sandstone. Some of the siltstones have casts of cubical salt hoppers up to 2 inches to a side..................................	90 ±	1,600
(5)	Concealed, except for one outcrop brownish red siltstone....	420 ±	2,020
(4)	Mainly brownish red, argillaceous sandstone with bands grey sandstone and some red siltstone at top..............	165 ±	2,185
(3)	A small part concealed, but mainly brownish red, finely crossbedded, argillaceous sandstone or ribboned, brownish red and grey sandstone............................	225 ±	2,410
(2)	*Limestone (Barachois limestone)*, of which top only is exposed, argillaceous and dolomitic, weathering light buff, with fetid odour when struck. A *Productus* present and large loosely coiled casts of worm burrows (?)..........	15 ±	2,425
(1)	Concealed, except for scattered small outcrops of brownish red, reddish grey, and grey, finely crossbedded, argillaceous sandstone.................................	540 ±	2,965

Beds (1) of the above section strike about north 38 degrees east and dip about 30 degrees northwest. The underlying rocks are then concealed for one-third mile, but large sinks in the drift near E. Hulan's meadow indicate probable gypsum or rock salt deposits. The inferred gypsum beds may not lie more than 250 feet below beds (1) of the preceding section.

In the next half mile upstream there are two small outcrops of grey siltstone, one of which has moulds of large and small salt hoppers. This siltstone dips southwesterly and lies within the axial region of an anticline that is the dominant structural feature of this area. Within the next half mile upstream there are a few isolated poor outcrops of grey sandstone and of grey and red siltstone; one of the siltstone beds has a band of selenitic gypsum. The outcrops lying farther upstream represent beds in the southern limb of the anticline, as indicated below.

Section J

(Section on Barachois Brook beginning about 3·5 miles in direction east 23 degrees south from the railway bridge, and ending 2·4 miles in direction east 14 degrees south from same bridge)

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
(o)	Shale, grey, micaceous, arenaceous, ribboned with red bands	30 ±	30
(n)	Shale, calcareous, weathering buff and vuggy	3 ±	33
(m)	Reddish grey and greenish grey, micaceous, arenaceous shale, and laminated, brownish red siltstone with a few grey bands of calcareous shales	190 ±	223
(1)	Siltstone, and argillaceous sandstone, brownish red, with rare, thin bands grey sandstone	125 ±	348
(k)	Concealed	155 ±	503
(j)	*Limestone*, grey, laminated or thinly bedded, vuggy at top. Fetid odour when struck. Imprints of a branching fucoid and of a grass-like stem	12 ±	515
(i)	Concealed	180 ±	695
(h)	Grey sandstone bed underlain by brownish red, argillaceous sandstone and siltstone	165 ±	860
(g)	Concealed	135 ±	995
(f)	Siltstone, reddish brown	145 ±	1,140
(e)	Concealed, except for several outcrops of brownish red siltstone and argillaceous sandstone	210 ±	1,350
(d)	*Limestone (Barachois limestone)*, argillaceous, grey, weathering light buff, probably dolomitic. Top beds vuggy, and some beds with algal nodules and fetid odour when struck. *Productus* cf. *avonensis* fairly abundant and loosely coiled casts of burrows ?	15 ±	1,365
(c)	Concealed	140	1,505
(b)	*Limestone* and calcareous siltstone, grey; upper part vuggy and probably dolomitic; poor fossils, including *Linoproductus*, *Diaphragmus ? tenuicostiformis ?*, *Dielasma*, and a branching seaweed. A few feet exposed.		
(a)	Siltstone, greenish grey and mottled grey and brown, argillaceous sandstone	60 ±	1,565

Limestone beds (d) and (j) of the above section are equivalent respectively to beds (2) and (7) of section I through the northwestern limb of the anticline. The inferred gypsum zone in the axial region is assumed to be the probable equivalent of the gypsum zone (c) at Plaster Cove. About half a mile upstream from beds (a) of the above section gypsum is reported to stand vertically in a fault zone separating the Codroy and Barachois series (Hayes and Johnson, 1938, pp. 20, 29). The stratigraphic position of this gypsum zone is doubtful. Alongside the road and a little less than halfway from Robinsons Head to Robinsons station there are several sinks, which may indicate a gypsum zone not observed in the above recorded sections of the strata on Robinsons River and Barachois Brook. If such a gypsum zone is present it may possibly lie in the concealed interval between the respective railway bridges of the two rivers. Otherwise it may be assumed that its apparent absence in the northwestern limb of the Barachois anticline on Barachois Brook was brought about by uplift along the Barachois fault.

The Barachois fault seemingly trends north-northeast and if extended in that directon would reach the present shoreline of St. Georges Bay where the bedrock is concealed some 3,000 feet northeastward of beds (12) of section G at Stinking Cove. Beds (12) of the Stinking Cove section strike towards the mouth of Rattling Brook, and unless a fault is present the strata of the Stinking Cove section would be expected to appear again in the exposed sections on the shore at Rattling Brook, Heatherton, and farther northeast on Fishels Brook. They do not do so, although there is little difference between the strikes of the beds at Heatherton and Fishels and those of Stinking Cove. Moreover, a fossiliferous limestone (*Fishels limestone*) among the upper beds of the Fishels Brooks section indicates an horizon in the Codroy series much lower than that of the Jeffreys limestone of the Stinking Cove section. Accordingly, it must be inferred that a fault with important upthrow on its southeast side separates the strata at Heatherton and Fishels Brook from those of Stinking Cove and Robinsons. Such an inferred fault might trend nearly east-west, but tentatively it is assumed to be the same fault (Barachois fault) as that present near the railway on Barachois Brook.

Section K

(Strata exposed on the shore at Heatherton and in the lower part of Rattling Brook)

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
	Sandstone, brownish red, gritty, with conglomeratic lenses carrying pebbles of white quartz, grey quartzite, and volcanic rocks, up to 2 inches diameter...............	50 ±	50
	Siltstone, brick-red, with thin bands grey and brownish red sandstone....................................	28 ±	78
	Gypsum..	10 ±	88
	Limestone, grey, unfossiliferous........................	4 ±	92
	Celestite..	1·5	93
	Gypsum..	7 ±	100
	Siltstone, brick-red, with rare grey layers..................	65 ±	165
	Limestone (Heatherton limestone)		
	Limestone, light grey with algal nodules; has fetid odour when struck................................	11	
	Limestone, rubbly and impure, sandy in lower part, red and grey or mottled..........................	9·5	
		20·5	186
	Concealed, except for irregularly flaggy, brownish red sandstone at base....................................	70 ±	256
	Limestone, grey and mottled grey and red, with imprints of a branching seaweed...............................	40 ±	296
	Concealed..	35 ±	331
	Limestone, impure, partly exposed, dark grey and reddish, with thin interbeds dark grey mudstone..................	12·5 ±	343

The Heatherton and underlying limestone beds are again exposed on Fishels Brook in the followng section:

Section L

(Section on Fishels Brook from 650 feet upstream on brook, from where road at Fishels crosses to a point 1 mile upstream from railway bridge)

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
	Sandstone, gritty, salmon to brick-red, underlain by brick-red siltstone with *kunkur*-lime nodules, and pebbly, brownish red grit weathering yellowish; quartzite pebbles up to 2 inches in diameter	110±	110
	Limestone, rubbly, mottled grey and purplish red	13	123
	Sandstone, gritty, brownish red and reddish grey, and brick-red siltstone	95±	218
	Concealed	77±	295
	Sandstone, gritty, with pebbly and conglomeratic lenses, and interbeds brick-red siltstone	218±	513
	Limestone (Heatherton limestone), light grey, algal, and with fetid odour when struck, carrying rare *Spirorbis;* underlain by mottled grey and red limestone	17	530
	Concealed	90±	620
	Limestone, grey, thinly bedded, with thin partings dark grey mudstone; underlain by rubbly, reddish grey limestone; sparse *Linoproductus*	14±	634
	Concealed, except for red, pebbly grit at base	283±	917
	Limestone, grey, some layers with algal-like structures and nodules; slight fetid odour when struck; carries imprints of a branching seaweed, rare small crinoid stems, and a rare *Naticopsis*-like gastropod	24	941
	Concealed, except for brownish red, gritty sandstone at top.	84±	1,025
	Limestone, grey, thinly bedded, buff weathering, with partings grey mudstone	8	1,033
	Shale, greenish grey, argillo-arenaceous, with fragments broken plants	22±	1,055
	Limestone, grey and reddish grey, thinly bedded, and in part sandy; *Linoproductus*	6±	1,061
	Sandstone and pebbly grit, brownish red to grey, with sub-angular pebbles of quartzite up to 2½ inches diameter, underlain by brick-red siltstone and brownish red sandstone with conglomeratic lenses, and brownish red, irregularly flaggy sandstone, interbedded with grey sandstone and brick-red siltstone	297±	1,358
	Limestone (Fishels limestone)		
	Limestone, buff weathering, seemingly dolomitic, with minute vugs	4·3	
	Limestone, grey, thinly bedded	5·6	
	Shale, grey, argillaceous	0·6	
	Limestone, grey, thinly bedded, buff weathering; partly vuggy, with a thin parting of dark grey mudstone	5·6	
	Shale, greenish grey, argillo-calcareous	1·7	
	Limestone, grey, with *Batostomella* and imprints of a branching seaweed	0·5	
	Shale, greenish grey, argillaceous	1·0	
	Limestone, buff weathering, seemingly dolomitic, abundantly fossiliferous, with *Linoproductus lyelli, Diaphragmus tenuicostiformis, Composita windsorensis, Dielasma latum, Batostomella, Aviculopecten*		

Section L—Concluded

Beds	Descending section	Thickness	Total thickness
		Feet	Feet
	lyelli, A. lyelliformis, Edmondia rudis, Parallelodon dawsoni, Schizodus sp., *Leptodesma dawsoni, Stroboceras hartti, Naticopsis howi*.....................	5·7	
	Limestone, buff weathering.........................	8·1	
		33	1,391
	Shale, greenish grey, argillo-arenaceous, with a few thin bands calcareous sandstone..............................	11	1,402
	Sandstone, greenish grey and reddish brown, with interbeds grey shale and red siltstone.........................	234±	1,636
	Siltstone, brownish red, some layers containing casts of small salt crystals..................................	265±	1,901
	Sandstone, reddish brown and some grey, shaly or ribboned, with interbeds grey siltstone or mudstone. Casts of cubical salt crystals common up to ½ inch to a side.....	115±	2,016
	Mudstone and siltstone, greenish grey, hackly weathering, with interbeds grey and brown, ribboned sandstone and shale..	155	2,171
	Concealed..	70±	2,241
	Sandstone, brownish grey to reddish brown, irregularly flaggy	31±	2,272
	Concealed..	289±	2,561
	Sandstone, grey and brown, and in part concealed..........	34±	2,595
	Siltstone, brownish red, with thin interbeds reddish brown sandstone..	39±	2,634
	Concealed mainly....................................	48±	2,682
	Siltstone, brownish red, with minor grey beds, and thin beds argillaceous, reddish brown sandstone. One thin, grey, rippled band with casts of small cubic salt crystals.....	20±	2,702
	Siltstone, mainly ribboned dark grey and reddish brown. Moulds and casts of small salt crystals common........	94±	2,796
	Siltstone, brownish red with some grey and a few bands dark mudstone. Some beds have casts of salt crystals......	99±	2,895
	Concealed. *If no fault present*..........................	566±	3,461
	Gypsum and anhydrite..................................	150±	3,611
	Concealed, except for one outcrop of brownish red and grey siltstone with thin bands dark grey mudstone. Possibly fault or faults present..............................	208±	3,819
	Gypsum chiefly, with some calcareous, grey shale and grey, ribboned mudstone. Some beds concealed............	270±	4,089
	Concealed mainly....................................	185±	4,274
	Limestone (Ship Cove limestone), arenaceous, and calcareous sandstone, some of it ribboned or laminated with calcareo-argillaceous shale. Many beds have concretionary pellets of lime. Top beds are vuggy, ribboned, calcareous shales................................	67±	4,341
	Sandstone, rippled, grey..............................	1	4,342
	Anguille series		
	Conglomerate, grey to greyish brown, with cobbles up to 2 feet diameter of volcanic rocks, quartzites, and Ordovician limestone. Many thin bands, generally not more than 2 feet thick, of grey sandstone..................	650+	

The lowest beds of the Anguille group are nearly horizontal and are inferred to lie in the axial region of the Barachois anticline.

PORT AU PORT AREA

Scattered outcrops of the Codroy series in the Port au Port area were not examined in detail by the writer. The most interesting are limestone deposits that fill erosion caves and fissures in Ordovician limestone. At one time these were considered to be downfaulted blocks (Schuchert and Dunbar, 1934, p. 111; Hayes and Johnson, 1938, p. 18). These deposits may be seen on the shore at, and east of, Aguathuna. The limestone filling these channels is abundantly fossiliferous, the fauna including many species most commonly found in subzone B of the Windsor group of Nova Scotia, e.g., *Dielasma latum, Productus (Linoproductus) lyelli, Leptodesma acadica, Leptodesma dawsoni, Edmondia rudis, Conularia planicostata,* and *Serpula annulata.* But in addition the fauna includes species, e.g., *Martinia galataea, Ambocoelia acadica, Spirifer nox,* and *Productus avonensis,* that are indicative of an Upper Windsor age. Present also is a *Meekella* closely allied to, if not conspecific with, *Meekella leei* Thomas, which occurs in the Upper Limestone group of Ayrshire, Scotland. It is inferred, therefore, that the limestone is not older than subzone C of the Windsor age and may be as young as subzone E.

On the shore at Boswarlos west of Aguathuna a thin, calcareous conglomerate of the Codroy series, carrying pebbles and boulders of Ordovician limestone, rests unconformably upon brownish red shale that seemingly belongs to the Ordovician Humber Arm formation. The conglomerate is overlain conformably by thinly bedded or laminated limestone, which is succeeded by nodular limestone with platy, locally contorted interbeds, by some considered to be intraformational landslides, and grey, calcareous and arenaceous shales. These calcareous beds resemble in some respects the Ship Cove limestone member, but, in addition to small algal-like pellets, they carry a few poorly preserved brachiopods, ostracods, and fragments of a crustacean. They are probably equivalent in age to a part of subzone B of the Windsor group. These beds are seemingly warped into a shallow syncline, which plunges inland towards outcropping gypsum. A borehole, however, put down through this gypsum in 1946 failed to strike the limestone and conglomerate before entering Ordovician limestone. Accordingly, the Codroy deposits as a whole in the Port au Port area are considered to be outlying remnants of different members of the Codroy series that overlapped upon Ordovician limestone, which throughout most of Codroy time lay above the sea and formed the northwest borders of the Codroy subsiding basin of deposition. Seemingly the Windsor sea transgressions in the Port au Port area came from the Gulf of St. Lawrence area along a different route than that followed by the arm of the sea that periodically invaded the Codroy basin.

Basal sediments comprising flaggy limestone or calcareous sandstone, with fragments of Ordovician limestone, outcrop also on the road east of Aguathuna, and again on the north shore of St. Georges Bay. The Codroy beds of the latter locality, judging from their dip, should lie below gypsum that outcrops on Romaines Brook. On the shore near Port au Port buff dolomite limestone, carrying abundant *Serpula* and ostracoda and a few *Productus,* lies in fissures in Ordovician limestone, and overlying beds include nodular limestone with some platy beds succeeded by greenish grey shales and shaly sandstone carrying plant debris. Some of these beds carry much pyrite.

STRUCTURAL FEATURES

The Carboniferous rocks of the St. Georges Bay area are folded into two major structures, which in a broad sense may be designated the St. Georges syncline and the Anguille and Barachois anticlines. The St. Georges syncline lies in the St. Georges coalfield east of the area of Figure 3. Secondary folds are present in these major structures, and both are cut by numerous faults. Both structures lie northwest of a great thrust fault that is expressed in a fault-line escarpment of the Long Range. The general trend of the major structures is northeast, but the faults mainly form two sets, one of which trends northeast to north-northeast and the other 5 to 15 degrees south of east. These faults have broken the continuity of the major folds, resulting in the presence of: (*a*) narrow, easterly trending upthrust blocks, such as that at Capeland Cove in the Codroy area; (*b*) tilted fault blocks of like trend, such as that of Ship Cove; and (*c*) downfaulted blocks, such as those present at Searston, South Branch, and in the St. Georges coalfield. Most, if not all, of the major faults are steeply dipping and are apparently reverse faults. At the most northerly fault at Capeland Cove (Capeland Cove fault) beds of one of the gypsiferous zones have been upthrust against Woody Head beds; at Ship Cove beds lying immediately above the Ship Cove limestone have been upthrust against higher beds of one of the gypsiferous zones; at Crabbs Brook, about 2·5 miles above the railway bridge, there is an upthrust block of beds of one of the gypsiferous zones into Searston beds; near the railway on Barachois Brook and at Heatherton beds lying east of an inferred north-northeast trending fault have been raised against much higher beds. Numerous other stratigraphic displacements of less amount also indicate thrust from southerly or easterly directions. Along other similar striking faults, however, the relative movements are reversed. Thus, just north of Stormy Point in the Codroy area, Searston beds are downthrown against Woody Head beds; on Crabbs River, about 3 miles above the railway bridge, Searston beds are downthrown against one of the gypsiferous zones; and in the St. Georges coalfield, strata of the Barachois series have been downthrown against one of the Codroy gypsiferous zones.

The Anguille anticline has a moderately dipping southeasterly limb in the Anguille upland, and a nearly vertical or overturned northwesterly limb along the southeast coast of St. Georges Bay. At Ship Cove and inland to the east, and also on Crabbs River, the extension of this structure is broken by oblique faults, whereby strata of the Codroy series were downthrown, and Anguille strata are only exposed again on Fishels Brook. Thus on Barachois Brook an anticline (Barachois anticline), plunging southwestward, is alined with the structural axis of the Anguille upland, and may be considered an extension of that major, complex structure. And on Fishels Brook strata of the Anguille series lie in the northwestern limb and axial part of an anticline, which is presumably continuous with the Barachois anticline. The southeasterly limb of the anticline on Fishels Brook is inferred to be cut and downthrown by the same fault that brought down strata of the Barachois series in the nearby St. Georges coalfield.

The rocks of the Barachois series were not examined by the writer. In the St. Georges coalfield the structure is seemingly a much faulted syncline with minor folds in the fault blocks, and with both limbs cut by major faults. At South Branch and near St. Andrews only a part of the northwestern limb of the Barachois synclinal structure is preserved, the other limb being cut off by the great thrust fault along which pre-Carboniferous rocks of the Long Range were uplifted. The area between South Branch and the St. Georges coalfield is heavily drift covered and wooded, and its geology is largely unknown. It is crossed, however, by the tilted fault block of Codroy strata that trends easterly from Ship Cove, and on Crabbs River flat-lying Searston beds hold an axial position in the St. Georges syncline.

It might be expected that the weak beds of the Codroy series would be protected from any strong compressive forces involved in the uplift of the crystalline rocks of Long Range, providing the latter rocks relieved the pressures by fracture and lateral movement. Such movement along a low or moderately pitching thrust plane would be favoured by the palæogeography of the area at the time, for the carboniferous strata were laid down in a subsiding basin of deposition and the crystalline floor of this basin probably rose rapidly to a bordering upland not far southeast of the Codroy area. When this upland bore the brunt of compression from the southeast, fracturing and thrusting over weak strata of the basin would relieve a large part of the pressure. In such an event the Long Range fault might be expected to have a low or moderate inclination, and consequent displacement would involve considerable foreshortening of the basin area. Carboniferous strata in the vicinity of Long Range were not examined by the writer, but the map of Hayes and Johnson shows Carboniferous strata near South Branch dipping 25 to 30 degrees towards the crystalline basement rocks as if the thrust truncated the Carboniferous at a moderate angle. Such a supposition is supported by the 20- to 30-degree general dip of the southeastern limb of the Anguille anticline, where the beds are more competent than those of the Codroy series.

The presence of steeply inclined reverse faults and of high dips in the post-Anguille Carboniferous strata may readily be explained by the presence of thick, weak siltstone and gypsum members. The more competent Anguille beds were folded in the asymmetric anticline of the Anguille upland, which has a moderately inclined southeasterly limb and a nearly vertical and overturned northwesterly one. That compressive stress was here moderate, however, is attested by a few secondary, symmetrical open folds in the southeastern limb. Under stronger compression the Anguille strata, consisting of alternating thin sandstone and arenaceous shale, would probably yield by secondary, isoclinal folding.

CONDITIONS OF DEPOSITION

Anguille Series

The sediments of the Anguille series have the character of alluvial flood-plain deposits. They are, in general, well sorted, and represent a rhythmic alternation of sandstone, arenaceous shale, and flaggy siltstones. Crossbedding and current ripples are common, and there is abundant, finely broken debris of plants. Rude shingling is apparent in some of the beds of coarse conglomerate exposed in Fishels Brook. The absence or rarity of freshwater shells indicates that deposition was too rapid to permit of long-continued presence of lakes on the fluvial plain. The direction of current ripples, the large amount of coarse conglomerate in the series at Fishels Brook as compared with that present in the Codroy area, and the composition of the boulders, all point to a probable derivation of material from the north or northeast. It is inferred that the deposits represent those of an intermontane subsiding basin that extended southwest into St. Georges Bay area from the central interior of Newfoundland during the time that similar valley deposits were laid down as the upper part of the Horton group in Nova Scotia.

The large aggregate amount of comminuted and broken plant debris in the Anguille group indicates a probable pluvial climate.

Codroy Series

A part of the sediments of the Codroy series testifies to periodical invasions of the Windsor sea into the same basin of deposition as that of the Anguille series. In an early stage of these sea invasions, represented by the gypsiferous zones, marine conditions were long continued, and deposition of thick deposits of calcium sulphate indicate a change from the preceding pluvial climate to one of semi-aridity. In conformity with this change the siltstones and mudstones interbedded with the gypsum are dominantly red. Their content of mudstone as compared with that of siltstone and silty sandstone is very slight, so that it may be inferred that the deposits were littoral and the waters shallow. Limestone and grey, dolomitic siltstone comprise substages of comparatively short duration, and their faunas are meagre, indicating unfavourable conditions for varied marine life. A prevailing character of the gypsum deposits is the presence of recurrent laminæ of dark calcareous shale, which may have been caused by seasonal changes, and the thicker limestone members between the gypsum zones may have resulted from long-termed climatic fluctuations.

The marine stage as a whole seemingly persisted throughout the area during the time represented in Nova Scotia by subzones A and B (Bell, 1929, p. 46). In subzone C time the sea occupied a more restricted area within the basin, and subsequent inundations of the northeastern part of the basin were few and oscillatory.

Details of the sequence of strata in this stage are far from known, owing to lack of complete natural sections, and to disturbances in the neighbourhood of the gypsum zones. Moreover, it has not been possible yet to correlate individual beds, and thus to establish what degree of uniformity of sedimentation prevailed within the area. The Fishels and Cormorant limestones, for example, both carry a fauna of subzone B Windsor age, but these two limestones are wholly unlike, and the latter is overlain by gypsum deposits not present over the former. The two limestones may represent members of a common subzone, widely separated stratigraphically, or on the other hand may be contemporaneous or nearly so in formation, in which event they would indicate very different local conditions of sedimentation. The latter possibility seems to be the more reasonable, for at this stage, as in the succeeding one, the sea margin was probably fluctuating.

The Woody Cove beds, which show an alternation of marine and non-marine zones, may be considered a second major stage in the development of the Codroy series. Beds of this age in the coastal area of St. Georges Bay (St. Georges area), 35 miles and more northeast of the Codroy area, are largely non-marine. They included beds of clastic material much coarser and thicker than any at Codroy at this stage, and the interbedded siltstones are dominantly brick-red or brownish red instead of dark grey, and locally contain abundant nodules of *kunkur*-lime. It is inferred that this stage of the Codroy series represents deltaic deposits, the Codroy area being periodically flooded by the Windsor sea, whereas the St. Georges area, lying in an upper dominantly subaerial part of the delta, was only rarely inundated. The *Nodosinella-Lithophagus* beds, the Crabbs limestone, and the Jeffreys limestone testify to three marine invasions of the St. Georges area during an early part of the stage, but the subsequent deposits are probably all non-marine. The outlying deposits of the Port au Port area seemingly did not lie in the deltaic area, but represent invasions of the sea along an independent route from the main body of the Windsor sea that lay northwest in the Gulf of St. Lawrence area.

The second stage of the Codroy series lasted apparently throughout the time represented by subzones C, D, and E of the Windsor group. A few species inferred to be equivalent in age to subzone C or to a lower part of subzone D occur in the *Nodosinella-Lithophagus* beds, whereas marine forms as late as substage E are present only in beds of the Codroy area. All these faunas are dominantly molluscan, and the beds containing them are either flaggy limestone interbedded with mudstone and siltstone, or impure and argillaceous limestone, indicating that the sea water was generally too muddy or silty for the existence of many kinds of sea life.

The third stage of the Codroy series, that of the Woody Head beds, differs only from the preceding one in the apparent absence of any marine fossils. Thin bands of limestone are sparingly present, but they are more probably freshwater than marine. Although this stage shows a moderate increase in the amount of sandstone, the sediments are essentially like those that are interbedded with marine members in the preceding stage. The beds of this stage contain in addition to essentially non-marine conchostracans (*Leaia* and *Pseudestheria*) specimens of *Calamites*, probably *C. cistiformis*, and because the beds lie stratigraphically higher than those containing fossils of late Windsor age they may be younger than Windsor and equivalent in age to an early part of the Canso group of Nova Scotia.

The closing stage of the Mississippian, represented by the Searston beds, differs from the preceding stages in the Codroy area by including beds of conglomerates, coarse gritty sandstones, and arenaceous shales marked generally by a high content of mica. Some beds carry *Diplotmema adiantoides*, indicating a probable early Namurian (late Mississippian) age. As the Canso group of Nova Scotia is in part at least of this age, the Searston beds can be correlated with the Canso with more confidence than can the older, Woody Head beds. Previous to this stage the Windsor sea had withdrawn from the entire Acadian region. The land uplift implied by this withdrawal probably explains the greater amount of coarse clastic debris deposited in the Codroy basin of deposition. Subsequently the Searston beds were overlain by an early Pennsylvanian coal-bearing group, named the Barachois series (Hayes and Johnson, 1937, p. 2; 1938, p. 20).

RELATIONS TO THE WINDSOR SEA

Early investigations of the Windsor group in Nova Scotia by the writer led him to postulate that the Windsor sea entered the maritime region of Canada from the North Atlantic Ocean either across central Newfoundland or between Newfoundland and Cape Breton Island (Bell, 1921, p. 168, Figure 2; 1929, p. 78). Later work, however, in other parts of the Maritime Provinces, indicated rather strongly that the Windsor sea finally withdrew southwestwards through the type Horton-Windsor area, and that the sea entrance was probably over the same route. The faunas of both early and late Windsor stages, particularly the latter, in the Horton-Windsor area are larger and richer in brachiopods and corals than the faunas found farther northeast. Moreover, coarse clastic materials are practically absent in the Windsor area, although abundant in parts of the group in many areas of northeastern Nova Scotia, suggesting lower bordering land if not deeper water.

In southern New Brunswick and Nova Scotia north of the Cobequid upland there was uplift in middle Windsor time, but the sea persisted throughout all late Windsor time in the area of Minas Basin, and throughout much of late Windsor time in areas farther to the northeast, including that of the Magdalen Islands. Yet in many of these northeastern areas the Windsor group includes coarse alluvial deposits derived from nearby uplands. Prominent examples are: (1) the McAra Brook formation bordering the northern flank of the Antigonish-Pictou highland; (2) coarse conglomerate of Upper Windsor age in the Loch Lomond and Mira River areas, bordering Cambrian and Precambrian terrain of the southern upland of Cape Breton; (3) the Grantmire conglomerate bordering the Coxheath Hills; and (4) the St. Anne formation, north of St. Anne Bay and east of the north tableland of Cape Breton Island. Over all this northeastern area it would seem that the Windsor sea invaded local intermontane basins of deposition that were already in existence in preceding stages of Horton deposition (early Mississippian). During the initial invasion of the sea the uplands that partly separated the again subsiding basins were low or submerged and most of them supplied little or no conglomerate, as evidenced by the relatively great areal extent of finely laminated, arenaceous limestone comprising subzone A of the Windsor group. Later, many of the uplands were rejuvenated and supplied abundant fine and coarse detritus to the adjoining basins. In Newfoundland the Codroy series testifies to similar physiographic conditions.

It has already been noted that the Codroy series was deposited in a northeasterly trending basin, and that the amount and coarsenesss of clastic material within this basin increases from southwest to northeast. These deposits, therefore, provide strong evidence that this local basin was invaded by the Windsor sea from the southwest, and not from the northeast. Because direct, Windsor sea connections with the North Atlantic through St. Georges Bay area is thus disproved, it is very improbable that any such connections were present in Windsor time across the crystalline axis of the Long Range Mountains.

Neither the Codroy sediments nor the Windsor sediments in the Sydney area lend support to the hypothesis that the Windsor sea entered the St. Lawrence Gulf and maritime region of Canada by way of Cabot Strait between Newfoundland and Cape Breton Island. The Windsor group in the Sydney area does contain more limestone and more varied marine faunas than the Codroy series; but the same statement applies to the Windsor group in many areas of Cape Breton and northeastern Nova Scotia. It is not until the Minas Basin area to the southwest is reached that there seems to be any important overall change in the composition of the faunas. There, cup corals and bryozoa become more abundant and varied, and brachiopods and bryozoa together equal the mollusca in number of species. It is reasonable to conclude that this area is much nearer the entry of the Windsor sea than any areas farther northeast. Two factors of Windsor sedimentation do not lend support to the hypothesis that the Bay of Fundy trough west of the Windsor area was the route of Windsor invasion: first, although this trough presumably had an origin in late Devonian or early Mississippian time, and was in part at least flooded in Windsor time, all well established marine strata of Windsor age in southern New Brunswick belong to an early stage of the Windsor group, and the limestones there, where fossiliferous, carry very few species, all of which are ubiquitous; and second, if the Bay of Fundy were the route of invasion, limestone of Upper Windsor age in the Chester area, 30 or 40 miles south of Windsor, would presumably be an outlier. Yet this limestone has a fauna that is more normally marine in composition than any of those in the Bay of Fundy and Minas Basin areas. Of special significance is the presence of a columnar coral, referred by Lambe to *Lithostrotion caespitosum* Martin, and of a *Productus* that Lambe stated to be 'unusually large forms of *Productus cora* d'Orbigny' (Lambe, 1910, p. 238). Although this fauna at Chester requires a more detailed study before its bearing on Windsor physiography may be fully evaluated, it certainly presents evidence that the Chester area, above all others in the St. Lawrence Gulf region, lay closest in Windsor time to waters of the Ancient North Atlantic. Because the Windsor group as a whole occupies a geosynclinal basin area that was already in existence in earlier Mississippian time, it is concluded that the Windsor sea entered this subsiding basin across south-central Nova Scotia, and that the final Windsor sea retreated along this same route.

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Plate I

Plants from Searston Beds

Figure 1. ***Lepidodendron volkmannianum*** Sternberg

Surface of an old stem. The leaf bolsters lie in vertical rows, those of one row alternating with those of adjacent rows. Except for the raised, transverse, rhomboidal areas of the leaf scars, the bolsters are flat and ill defined on the longitudinally corrugated back. The central leaf-trace is small and punctiform; the oval or ovate parichnos scars are well defined. Plesiotype 6320. Natural size.

Figure 2. ***Lepidodendron volkmannianum*** Sternberg

Part of surface of another old stem. Plesiotype 6321 x 2.

Figure 3. ***Adiantites tenuifolius*** (Goeppert)

Pinnules, about 0·7 mm. long, cuneate-obovate, flatly rounded at apex, cuneate at base to short, stout footstalk. Surface, microscropically striated, but veins well marked, spreading fanwise from base, dichotomizing once or twice. Plesiotype 6319. Natural size.

Figure 4. ***Adiantites tenuifolius*** (Goeppert)

Pinnules, 0·6 to 0·7 mm. long. Plesiotype 6318 x 2.

PLATE I

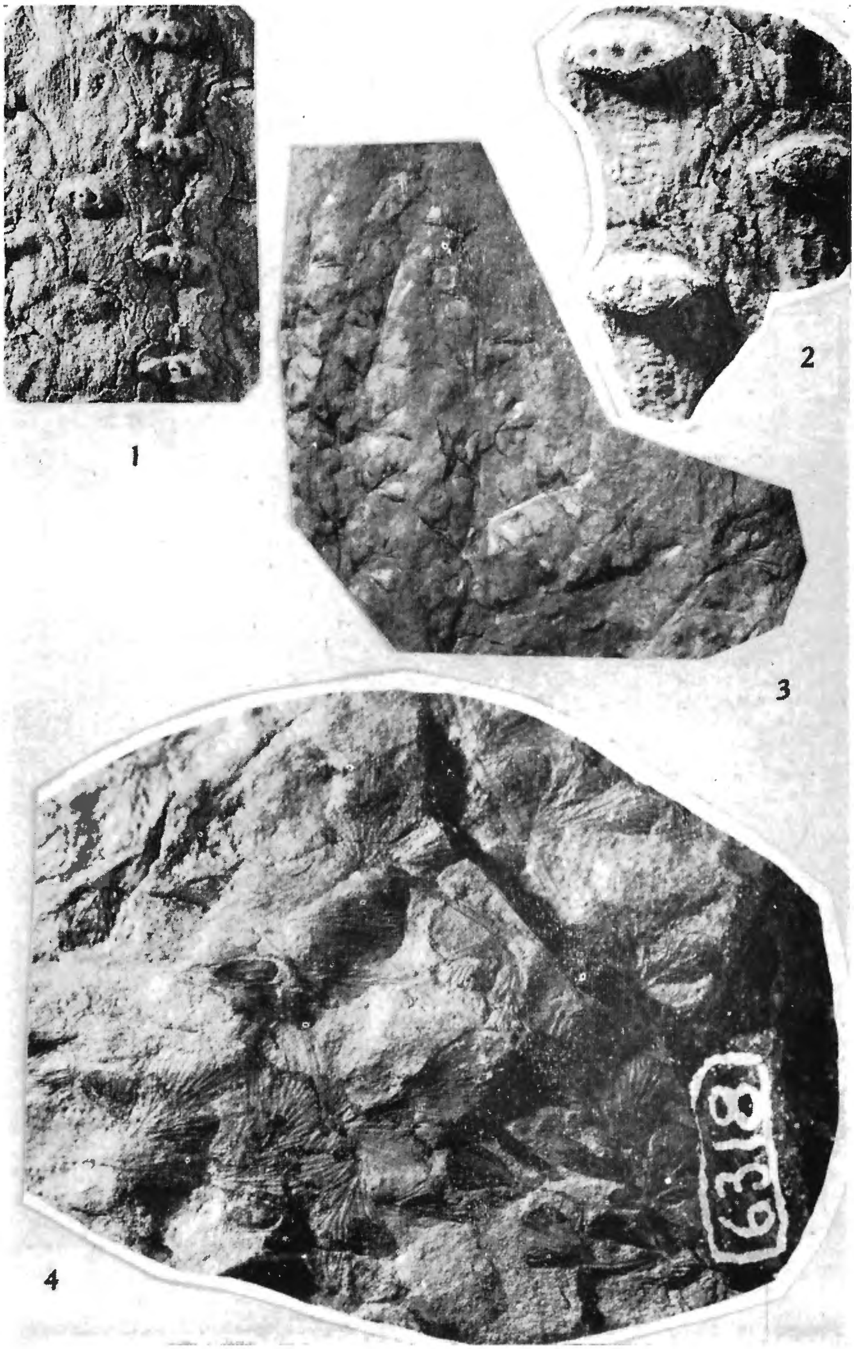

Plate II

Plants from Searston Beds

Figure 1. *Diplotmema adiantoides* (Schlotheim)
Probably the distal end of a primary pinna. Plesiotype 6315 x 3.

Figure 2. *Diplotmema adiantoides* (Schlotheim)
Part of a frond showing primary pinnæ, which are longer on outer side of axis. Plesiotype 6317. Natural size.

Figure 3. *Diplotmema adiantoides* (Schlotheim)
Part of a frond showing lanceolate, primary pinnæ with short, deltoid to lanceolate, secondary pinnæ. Secondary pinnæ bear three or four pairs of alternate pinnules that are deeply cut into linear, slightly cuneate, bluntly rounded segments. Leaf substance is thick and surface microscopically striated. Veins immersed; doubtfully a simple or once divided vein to each pinnule segment. Axis of frond is marked by short, close, transverse bars as well as by discontinuous, longitudinal striæ. Plesiotype 6314. Natural size.

Figure 4. *Diplotmema adiantoides* (Schlotheim)
Part of a frond showing minute crossbars and longitudinal striæ on axis. Plesiotype 6316 x 3.

PLATE II