

LOWER CARBONIFEROUS SEDIMENTARY ROCKS OF THE HORTON GROUP
IN PARTS OF CAPE BRETON ISLAND, AND THEIR RELATION TO
SIMILAR STRATA OF THE ANGUILLE GROUP IN
SOUTHWESTERN NEWFOUNDLAND

by

Philip Richard Cote

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ABSTRACT

Mississippian sedimentary rocks of the Horton group in western and northern Cape Breton Island along with sedimentary rocks of the Mississippian Anguille group in southwestern Newfoundland are investigated in detail and correlated.

Stratigraphic terminology for the Horton group is revised so that the sequence is now referred to three formations which, from the base upward, are: (1) the Fisset Brook; (2) the Craguish; and (3) the Strathlorne-Ainslie. The upper and lower contacts of the Horton are defined in such a way that the group now occupies a readily discernible stratigraphic position in the Carboniferous basin of the Maritimes. Numerous geographically separated sections are presented to show the lithological nature of the Horton group throughout the thesis area.

Spore assemblages collected from Horton strata indicate that at least three microfloral zones are present. Zone A is characterized by the spore Pustulatisporites pretiosus (Playford); Zone B, characterized by the presence of numerous species of Vallatisporites and an absence of Pustulatisporites and Zone C, characterized by Nodatitriletes. These zones aid in a more precise understanding of time equivalence within the predominantly unfossiliferous clastic rocks of the Horton group.

In southwestern Newfoundland it is now possible to recognize three formations within the Anguille group - these being: (from the base upward) (1) the Cape John; (2) the Snakes Bight; and (3) the Seacliffs. The areal distribution of these formations is shown for the first time and numerous measured sections are presented to show the lithology of these units in the thesis area.

Correlation between the Anguille and Horton groups is suggested based on (a) stratigraphic position within the Carboniferous succession; (b) gross lithological similarities in sequential order and (c) to a minor extent megafloral and microfloral assemblages.

Sedimentary characteristics of the Horton group suggest accumulation under various fresh water terrestrial environments which gradually gave way to marine conditions in the overlying Windsor group. Similar sedimentary environments are postulated for most of the Anguille succession, but the presence of bottom structures and overall bedding characteristics may indicate that portions of this group were deposited as a flysch sequence.

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CHAPTER 1

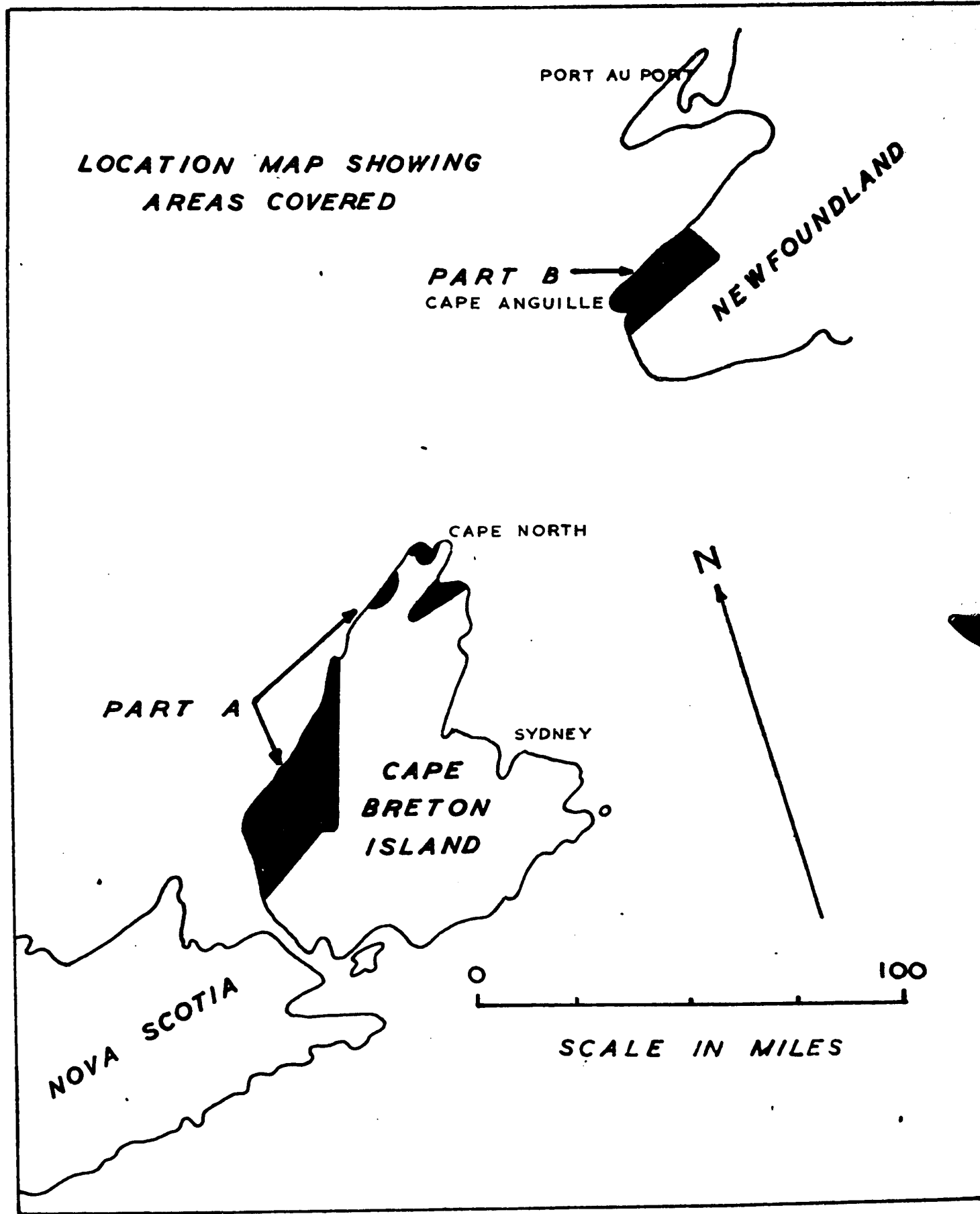
INTRODUCTION

Mississippian strata of the Horton group in western and northern Cape Breton Island as well as sedimentary rocks of the Anguille group in southwestern Newfoundland are investigated.

This thesis is divided into two portions; part "A" and part "B" (see figure 1). Part "A" is a presentation of the Horton group in Cape Breton Island, while part "B" deals with the Anguille group in southwestern Newfoundland. The two areas are separated by 75 miles across the Gulf of St. Lawrence.

The areas discussed occupy portions of a large Palaeozoic basin within the Appalachian folded belt. The regional trend is northeast - southwest, so that the Carboniferous sedimentary rocks of southwestern Newfoundland are an extension of strata in western and northern Cape Breton Island. Both the Anguille and Horton sequences record sedimentation following the Acadian revolution which resulted in the emplacement of extensive granitic intrusions into older igneous and metamorphic rocks Precambrian to lower Palaeozoic in age. Age determinations from these intrusives indicate a middle to upper Devonian age. The orogeny further resulted in the creation of extensive intermountain basins

FIGURE 1



surrounded initially by areas of considerable topographic relief. It was within these basins that sedimentary rocks of the Horton and the Anguille groups were deposited. Both sequences were formed under predominantly fresh water terrestrial environments, with initial detrital material being supplied by upfaulted igneous and metamorphic basement massifs. The first undoubted marine transgression into the Carboniferous basin marks the close of Horton accumulation. This transgression occurred during deposition of the overlying Windsor group, with beds of marine limestone, gypsum, and anhydrite being laid down.

Sedimentary rocks of the Horton group in Cape Breton Island have been studied by various workers over a period of eighty years extending from the studies of H. Fletcher (1880) to the present time. K.F. Mather, P.D. Trask, G.W.H. Norman, W.A. Bell, B.C. Murray, and D.G. Kelley all contributed to a better understanding of the Horton succession. However, extensive mapping of the Horton sequence in western Cape Breton Island by the author from 1957 to 1960 lead to the conclusion that previous attempts to subdivide the Horton were difficult to apply on a broad regional basis. Indeed, even what was considered to be the base of this group was not clearly defined. Most of the difficulty in recognizing formerly proposed lithological subdivisions was due to rapid facies changes within the sequence. Clearly, a readily recognizable scheme of

subdivision which could be applied to Horton strata throughout western and northern Cape Breton Island, reasonably uneffected by local facies changes, would be desirable. The writer proposes such a subdivision in this thesis, illustrated by the presentation of numerous geographically separated sections and regional descriptions. Further, a zonation of the Horton sequence based on included spore assemblages is presented. Although at the present time the limits of these spore zones are not known precisely, it is felt that a start on this facet of Horton stratigraphy has been made. Further refinements will undoubtedly result as more data is collected. This will lead eventually, it is hoped, to an understanding of time equivalence within the Horton sequence, thus rendering palaeogeographic reconstructions more reliable.

The Horton group is considered a rock stratigraphic unit, post Acadian orogeny and pre-Windsor group. Three formations are proposed which from the base upward are: (1) the Fisset Brook formation; (2) the Craignish formation and (3) the Strathlorne-Ainslie formation. These formations are recognized as gross changes in lithology within the succession. Fortunately these variations can be recognized throughout the area under discussion as demonstrated by the various measured sections presented in Part "A" of this thesis.

Following the Cape Breton studies, the writer spent the greater part of two field seasons in southwestern Newfoundland working on the Carboniferous sedimentary rocks. Much of this time was spent studying rocks of the lower Mississippian Anguille group. The field work was greatly aided by use of a helicopter, particularly in inaccessible regions of the Cape Anguille Mountains.

J.B. Jukes, 1843, first described Carboniferous rocks in the area between Codroy and St. Georges. Other early workers on Carboniferous stratigraphy include A. Murray, 1881, and J.P. Howley, 1918, but it was not until 1937 that the Anguille group was recognized as a distinct and mappable unit within the Carboniferous sequence by A.O. Hayes and H. Johnson. At this time, the Anguille sequence was subdivided into two units, the Snakes Bight Shale above and the Cape Anguille Sandstone at the base. The sandstones at Cape Anguille do not, in fact, underlie the Snakes Bight sequence, but rather overlie this dark grey fine clastic succession. Later work by Baird (1951) led to a third subdivision of Anguille strata, an uppermost succession of medium to coarse sandstones termed the Seacliffs sandstone.

While mapping Anguille strata in southwestern Newfoundland, the author noted that many similarities in lithological sequence existed between the Horton and Anguille successions. Regional studies led to the conclusion that

the Anguille sequence could be divided into three formations traceable throughout the Cape Anguille Mountain area. These formations are recognized as distinct lithological variations within the total Anguille group succession and are from the base upward: (1) the Cape John formation; (2) the Snakes Bight formation and (3) the Seacliffs formation. As can be seen, the terminology applied by former workers has been retained, as little would be gained by introducing new names into the literature. Measured sections are presented to substantiate this intra-group subdivision and the areal extent of the various formations is shown on plate II.

Thirty-one samples, collected from the various formations throughout the Anguille sequence, were macerated for spore analysis. It was hoped that, if the samples yielded identifiable spore assemblages, a zonal scheme similar to that established in the Horton sequence could be suggested, thus demonstrating more precise time correlation between the two groups. Unfortunately, of the thirty-one samples macerated, only one contained identifiable spores.

At the close of portion "B" of this thesis, correlation between the Horton and Anguille groups is suggested, based largely upon included mega-flora and lithological sequential criteria.

ACKNOWLEDGEMENTS

The writer expresses deep appreciation to Imperial Oil Company Limited for financial support during the entire thesis project and to both Imperial Oil Company Limited and British Newfoundland Exploration Company Limited for making available field data collected during the period from 1957 to 1961. In particular, encouragement and assistance were rendered by Dr. W.A. Roliff of Imperial Oil and Dr. A.P. Beavan of British Newfoundland Corporation.

The writer is deeply indebted to Dr. D.M. Baird, chairman of the Geology department at Ottawa University, who directed the thesis project. His knowledge of Mississippian stratigraphy in the Maritime Appalachian area, particularly in the Newfoundland region, proved to be of great assistance. Thanks is also expressed to all members of the faculty of the Geology Department who, from time to time, contributed valuable assistance and criticism.

M.S. Barss of the Geological Survey of Canada, Coal Research Division, identified the spores submitted in the macerations. Gratitude for this work is expressed. Numerous discussions with Dr. D.G. Kelley of the Geological Survey of Canada were extremely helpful in formulating many of the concepts with regard to Horton stratigraphy expressed in this thesis.

PART A

THE HORTON GROUP IN
WESTERN AND NORTHERN CAPE BRETON ISLAND

CHAPTER 2

INTRODUCTION TO PART "A"

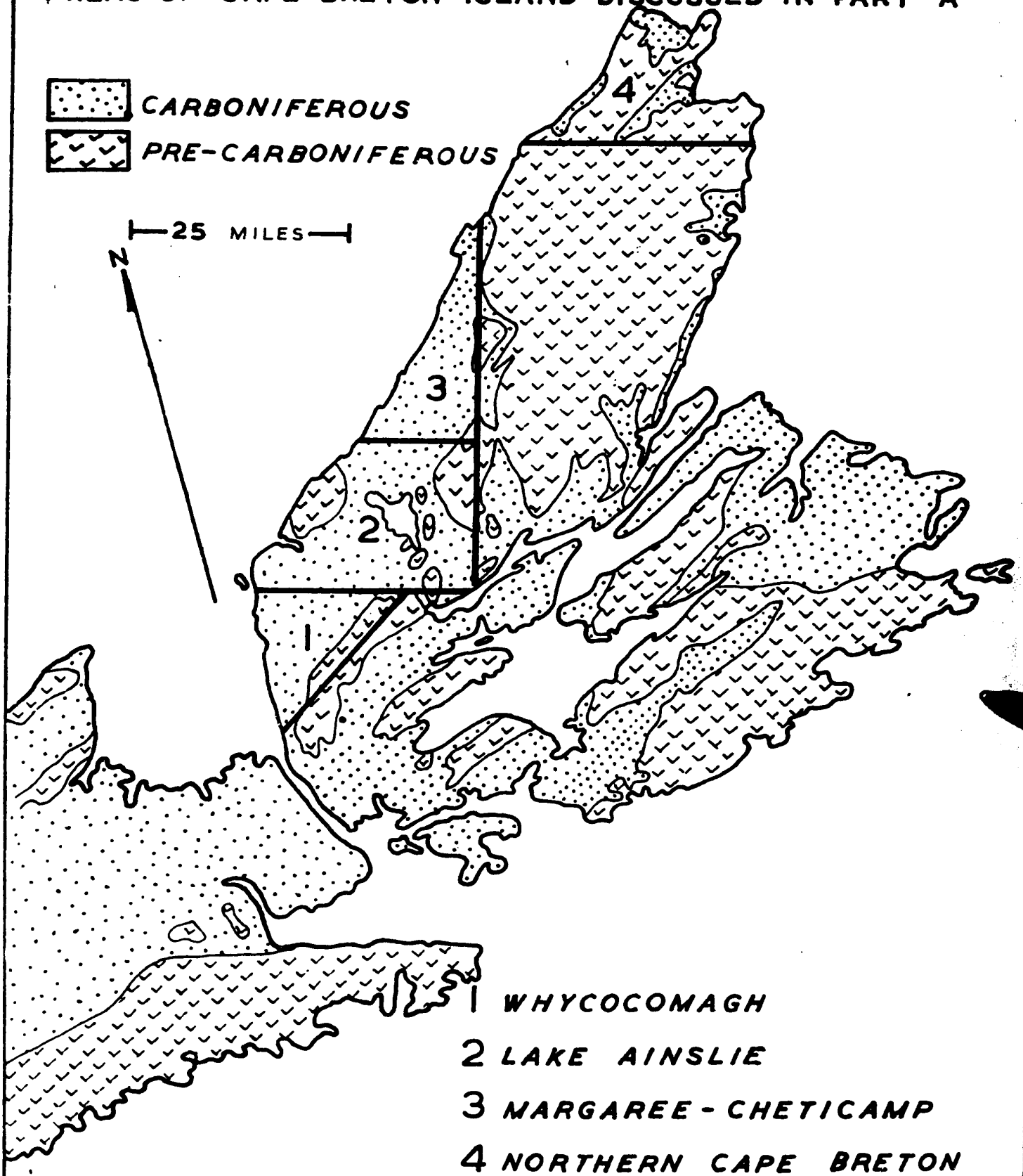
THE HORTON GROUP IN WESTERN AND NORTHERN CAPE BRETON ISLAND

Part "A" of this thesis deals with the Horton group in western and northern Cape Breton Island. The western Cape Breton Island depositional basin is subdivided into three areas which, from south to north, are: (1) Whycocomagh; (2) Lake Ainslie and (3) Margaree-Cheticamp; each of these being treated separately in Chapters 3 to 5 respectively. The northern Cape Breton Horton depositional basin is discussed in Chapter 6. For location and areal extent of these areas, the reader is referred to figure 2. Thus organized, each chapter dealing with a specific area becomes a separate entity, in which physiography, regional geology, former geological work, as well as specific and detailed data with regard to the Horton succession, are presented. This leads to a certain amount of repetition of material, but as a result, similarities in stratigraphy between the separate areas are emphasized.

The data presented in part "A" was obtained over a period of four field seasons, during three of which the writer was employed by Imperial Oil Company Limited. During this time, most available sections of Horton strata were

FIGURE 2

AREAS OF CAPE BRETON ISLAND DISCUSSED IN PART "A"



measured and many of the better exposed and complete sequences are presented. The location of these sections is shown on figure 3. The presentation of numerous geographically separated Horton sequences serves to illustrate both similarities and changes in lithology throughout the western and northern Cape Breton depositional basin. Where necessary, data collected by other workers has been incorporated in order to present as complete a picture of Horton stratigraphy as possible.

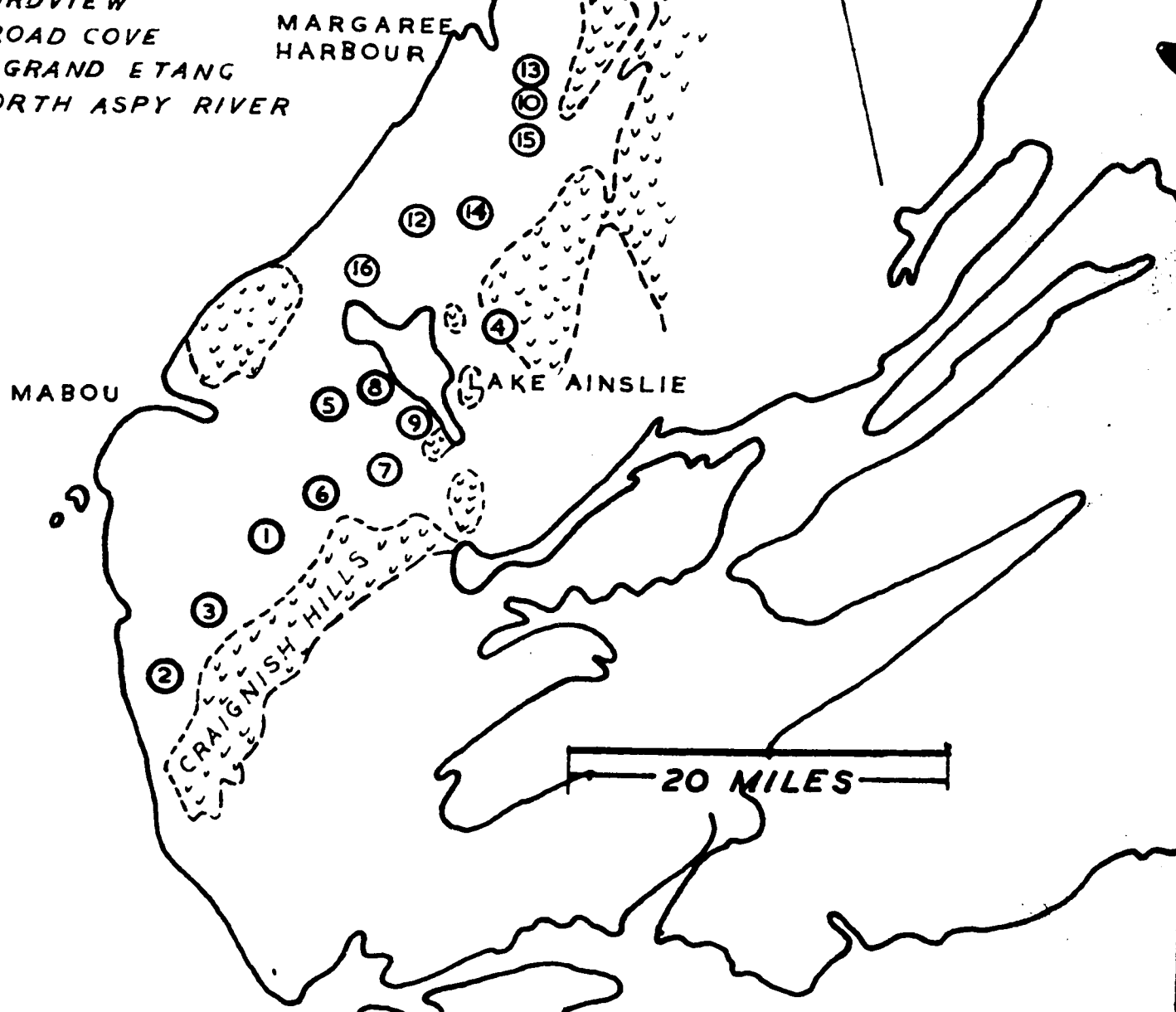
The Horton group, as here defined, is a sequence 8,000 - 10,000 feet thick of predominantly clastic sedimentary rocks accumulated as intermontane basin fillings following the Acadian orogeny. Sedimentary rocks of the Horton lie immediately below the partially marine Windsor group, and rest with disconformity to angular unconformity upon igneous and metamorphic rocks ranging in age from Precambrian to Devonian. Rocks of the Horton group occur throughout the Nova Scotia mainland and Cape Breton Island. Sedimentary rocks occupying a similar stratigraphic position in the Maritime Carboniferous depositional basin outcrop in portions of New Brunswick and Newfoundland, as well as being present subsurface in Prince Edward Island.

Plant fossils, along with spores collected from the Horton succession, indicate a lower Mississippian age. Some spore assemblages from the lowermost portion of the

FIGURE 3

MAP SHOWING THE LOCATIONS OF MEASURED SECTIONS

- 1 SOUTHWEST MABOU RIVER
- 2 GRAHAM RIVER
- 3 JUDIQUE INTERVALE BROOK
- 4 COOPER BROOK
- 5 MOUNT YOUNG
- 6 SOUTHEAST MABOU RIVER
- 7 CAMPBELL MOUNTAIN BROOK
- 8 MCISAAC POINT
- 9 CLAVERHOUSE
- 10 GALLANT RIVER
- 11 GRAND ETANG BROOK
- 12 DUNVEGAN BROOK
- 13 FIRST BROOK N. OF GALLANT R.
- 14 CAMERON BROOK
- 15 FORDVIEW
- 16 BROAD COVE
- 17 N. GRAND ETANG
- 18 NORTH ASPY RIVER



sequence contain a few Devonian types and the possibility that some of the basal Horton rocks may be uppermost Devonian in age cannot, as yet, be ruled out.

As far as is known, sedimentary rocks of the Horton group in Nova Scotia were accumulated under a fresh water terrestrial environment. The presence of mud cracks, much macerated plant debris, rapid facies changes within the succession coupled with a complete lack of marine fauna and undoubted marine lithotypes are criteria used for this postulation.

Subdivision of this unit throughout portions of the Nova Scotia mainland and Cape Breton Island into three formations is possible - these being from the base upward: the Fisset Brook formation, the Craignish formation, and the Strathlorne-Ainslie formation.

The Fisset Brook formation proposed by MacKasey (1963) consists of an interbedded succession of volcanic and clastic rocks, the former type being much more abundant than the latter. Rhyolite, andesite, basalt, conglomerate and siltstone predominate. This formation, originally considered to be pre-Horton, but now included by the author in the Horton group, rests with disconformity to angular unconformity upon igneous and metamorphic rocks of the pre-Carboniferous basement complex. The upper contact is conformable with overlying Craignish formation and is placed at the top of the

highest volcanic flow. The thickness of the Fisset Brook formation varies from 900 to 1100 feet. Spores collected from this sequence indicate a lowermost Mississippian age, although a few uppermost Devonian types were present in the assemblage. It is thought that the Fisset Brook volcanic extrusions resulted from post-orogenic structural adjustments of the basin following the Acadian orogeny.

Conformably overlying the Fisset Brook sequence in portions of Cape Breton Island is a succession of predominantly coarse, poorly bedded, immature clastics, varying in thickness from 7,600 feet to 5,100 feet. Bluish-green conglomerates, arkoses, sandstones and red siltstones and sandstones are predominant rock types found in this the Craginsh formation (Murray 1955, 1960) which, in some portions of western Cape Breton can be subdivided into two members, the Skye River and the McLeod. The former member is essentially a bluish-green, coarse clastic sequence of conglomerates and feldspathic sandstones, while the latter is a succession of predominantly red-brown sandstones and siltstones. In many areas of western Cape Breton Island the Craginsh formation rests nonconformably upon the crystalline pre-Carboniferous basement rocks, the Fisset Brook formation being absent. The Craginsh sequence possesses all the attributes of a rapidly accumulated succession marginal to positive areas possessing considerable topographic relief.

Bedding is massive and lenticular, facies changes are rapid, sorting is very poor, and fresh angular feldspar is abundant. Some of the conglomerate zones resemble alluvial fans.

The Strathlorne-Ainslie* formation is the highest formation within the Horton group. It conformably overlies the Craignish and is overlain by an extremely characteristic and geographically widespread thinly laminated grey limestone belonging to subzone A of the succeeding Windsor group. The thickness of the Strathlorne-Ainslie formation is approximately 2,900 feet, although this varies somewhat throughout the thesis area. Division of this formation into two members, the Strathlorne and Ainslie, can be made in portions of western and northern Cape Breton Island. These two members were given formational status by Murray (1955, 1960), but interfingering of the two lithologies due to facies changes in areas of the basin not studied by Murray made subdivision impossible. Thus, the two lithologies are now considered as members of an expanded formational unit. Sedimentary rocks of the Strathlorne-Ainslie formation include grey shales, fine grey sandstones and siltstones, brick red siltstones, massive buff sandstones, and locally thin grey limestones. In general, an overall decrease in grain size,

* The term Strathlorne-Ainslie formation was first introduced by D.G. Kelley (1958) who like the author encountered difficulty in distinguishing between Murrays Strathlorne and Ainslie formations in portions of Cape Breton Island. Kelley, however also retained Murrays formation names in areas in which they could be recognized. The author in 1958 independently arrived at the concept of including all the beds above the Craignish formation of Murray, into one stratigraphic unit, designated at that time as the Upper Horton, (see page 28). The term Strathlorne-Ainslie formation is used in this thesis, as little would be accomplished at this time in introducing a new formational name into the literature.

coupled with a much more evenly bedded nature of the sediments, is noticed when comparison is made to the underlying Craignish formation. Sorting is somewhat better and sedimentary structures such as mud cracks, ripple marks, flute casts, load casts, and fine scale crossbedding are much more abundant. This sequence is thought to have accumulated under deltaic, lacustrine and fluviatile environments. Reduction of topographic relief due to continued denudation of source contributing areas appears to account for the finer overall grade of the sedimentary rocks. In the Strathlorne member, dark grey fissile shales, fine grey siltstones, and fine grey sandstones predominate. The shale beds contain fish scales and spines, fecal pellets, pyrite concretions, and thin interbedded dense dark grey limestones commonly possessing cone-in-cone structures. A general increase in overall grain size is noted in the overlying Ainslie member where medium grained, massively bedded, buff to red-brown sandstones are interbedded with red siltstones. Graded sequences, not found in the Strathlorne, are present. A rejuvenation of erosional profiles following Strathlorne accumulation seems evident.

A brief view of the development of Horton stratigraphy in Cape Breton Island is presented below. A more complete review of former workers is to be found in each chapter dealing with specific areas.

Mississippian strata of the Horton group, first

recognized by W.A. Bell (1929), derive their name from the type locality near Horton Bluffs at the mouth of the Avon River northwest of the town of Windsor, Nova Scotia. The sequence was subdivided into two formations: a lower unit of dark grey shales, grey feldspathic sandstones and arkoses, the Horton Bluff formation; and an upper unit of grey arkose and red shale, the Cheverie formation. Unfortunately, difficulty is met in extending this subdivision of the Horton into Cape Breton Island due to changes in lithology.

In Cape Breton Island, rocks now recognized as belonging to the Horton group were first studied by H. Fletcher (1880), who considered them to be Devonian in age and applied the term "Devonian metamorphics". Many measured sections of this unit were presented by Fletcher, and the areal distribution of the sequence was accurately shown on his serial map sheets of Cape Breton Island.

It was not until 1925 that regional subdivisions within the now recognized Horton group were attempted. Mather and Trask, working for the Eastern Gulf Oil Company, measured a section of Carboniferous strata on the Southwest Mabou River lying disconformably upon basement igneous and metamorphic rocks. The sequence was subdivided into four "series" which were, from the base upward: the Kewstoke conglomerate series, the Dunbar sandstone series, the Hillsboro limestone series, and the MacFarlane red bed series. Overlying

the MacFarlane red beds, 900 feet of dark grey shales were assigned to the Mabou formation. The presently defined Horton group would encompass both the Kewstoke conglomerate series and the overlying Dunbar sandstone series. The Hillsboro limestone series now constitutes the post-Horton, Windsor group. This basic subdivision of the Horton group into two major units in portions of the western Cape Breton basin (three major units in other portions) is retained in this thesis, but the assigned names and stratigraphic terminology are changed, due to the introduction of new terminology by later workers.

In 1927 W.A. Bell studied Horton sequences in the Lake Ainslie area and recognized that this unit occupied a similar stratigraphic position to Horton sedimentary rocks on the Nova Scotia mainland.

G.W.H. Norman (1935) mapped the Lake Ainslie quadrangle for the Geological Survey of Canada during 1927, 1928, and 1929. Pre-Windsor and post-basement sedimentary rocks were assigned to the Horton group and correlated with the type section at Horton Bluffs. Correlation was based on stratigraphic position and a few plant fossils. Norman recognized that a broad two-fold subdivision of the Horton succession could be made using gross changes in lithology; a lower coarse clastic sequence and an upper finer clastic sequence. No attempt was made, however, to show the areal

distribution of these units on the map accompanying his memoir.

In 1946 and 1947, H.L. Cameron mapped the Carboniferous rocks in the Margaree-Cheticamp area for the Geological Survey of Canada. The areal distribution of the Horton group was shown on the accompanying maps, but no subdivisions within this group were proposed.

Major advances in the development of Horton stratigraphy did not take place until 1955. At this time, B.C. Murray measured the Horton sequence on the Southwest Mabou River and divided the strata into three formations which, from the base upward, were: (a) the Craignish formation; (b) the Strathlorne formation; and (c) the Ainslie formation. The Craignish was further subdivided into the Skye River and McLeod members, while the Ainslie formation was subdivided into the McIsaac Point and Glencoe members. Subdivisions were based on lithological variations throughout the sequence. The Gallant River section in the Margaree area, as well as a section measured in the Strait of Canso region, were presented and correlated with the Southwest Mabou section. Depositional environment during various phases of Horton accumulation as well as intergroup facies variations were considered. It was proposed that accumulation took place at approximately the same time in all areas of the Horton depositional basin.

Mapping the Whycocomagh area for the Geological Survey of Canada, D.G. Kelley in 1955, 1956 recognized four

units within the Horton group. None of these units was given formational status being recognized on the grounds of changes in lithology. The lowermost unit 4D consisted of conglomerates, and poorly bedded sandstones and siltstones, while unit 4C overlying the latter consisted predominantly of red siltstones. Unit 4B, the "grey beds", contains thicknesses of fine grey sandstone, siltstone and grey shale which grade upward into coarse sandstones and siltstones of the overlying 4A unit. Unit 4D would be approximately equivalent to Murray's Skye River member of the Craginsh, unit 4C to the McLeod member, unit 4B to the Strathlorne formation, and unit 4A to the Ainslie formation.

Following the work of Kelley, the author studied rocks of the Horton group throughout western Cape Breton Island during the 1957, 1958, 1959 field seasons, (Cote 1958, 1959), and proposed a three-fold subdivision of Horton strata which, from the base upward, included: (a) the lower Horton; (b) the middle Horton; and (c) the upper Horton. The lower Horton consists of a sequence of conglomerates, coarse to fine predominantly grey sandstones and arkoses, with minor lenticular red siltstones. This unit would be equivalent to Murray's Skye River member and to Kelley's 4D unit. The middle Horton sequence consists of red-brown, siltstones, sandstones and minor conglomerate and was equivalent to Murray's McLeod member of the Craginsh formation and to

Kelley's unit 4C. The upper Horton unit encompassed Murray's Strathlorne and Ainslie formations and Kelley's 4A and 4B units. In certain portions of the western Cape Breton basin this subdivision could be applied, but in others difficulty due to rapid facies changes was encountered.

In 1963 MacKasey presented a description of a sequence of interbedded volcanic and clastic rocks, his Fisset Brook formation, which he considered to be pre-Horton. This succession was clearly post-Devonian crystalline basement and pre-Craignish.

In the following chapters the stratigraphy of the Horton group is presented in various areas of western and northern Cape Breton Island.

CHAPTER 3

THE HORTON GROUP IN THE WHYCOCOMAGH AREA

INTRODUCTION

The Whycocomagh area, as here defined, lies north of latitude $45^{\circ} 45'$ and south of latitude $46^{\circ} 00'$. The included portion of the Carboniferous basin is roughly triangular in shape. The present upland surface of the Craignish Hills forms one side, latitude $46^{\circ} 00'$ another side, while the present seacoast forms the third side; enclosing an area of approximately 135 square miles. Thus defined, most of the area is underlain by Carboniferous sedimentary rocks ranging in age from lowermost Mississippian (possibly some uppermost Devonian) to Pennsylvanian. The village of Whycocomagh is located in the extreme northeast corner of the area.

The entire field season of 1957 and a portion of the 1958 field season were spent mapping Carboniferous sedimentary rocks in the Whycocomagh area. During this period, the writer was employed by Imperial Oil Company Limited to undertake a southward extension of the work done by R.O. Grieve, south of the Graham River to latitude $45^{\circ} 45'$. This project became the subject of an M.Sc. thesis at Acadia University (Cote, 1958). Numerous outcrop areas to the north of Graham River were remapped on completion of the project south of Graham River.

The latter portion of the 1958 field season was spent in the Lake Ainslie area. In 1963, the Whycocomagh area was revisited; the Graham River section and Little Judique Brook were retraversed and specimens collected.

As in all portions of the western Cape Breton Basin, the nature of underlying rocks is reflected in gross topographic features, which resulted from the erosion of an uplifted peneplain. The flat topped divides of the Craguish hills are remnants of this peneplain surface. Division of the area into two physiographic units may be made; the Craguish highland and the lowland seacoastal plain. Basal Horton rocks appear to have been as resistant to erosion as those of the underlying crystalline rocks as seen in areas where these sedimentary rocks overlap the basement complex, without distinct escarpments being developed. The lowlands, characterized by gently undulating hills, none over 250 feet in relief, are developed entirely upon the softer post-Horton sedimentary rocks. The Windsor strata, because of the presence of gypsum, anhydrite and limestone are poorly resistant to erosion and areas underlain by these rocks commonly develop a karst topography. Post-Windsor strata appear to be slightly more resistant to erosion.

All major streams in the area originate in the Craguish uplands and flow into George Bay. Drainage is youthful and many streams are deeply incised in narrow

"V"-shaped valleys. As the streams leave the upland areas, their gradient is reduced and transported material is deposited, thereby covering outcrops downstream with a varying thickness of stream gravels. As the valley walls are for the most part covered with slumped glacial debris, the major outcrop areas are restricted to the stream beds and exposures are best observed during low water level. Many previously inundated outcrops were observed in retraversed stream beds when the water level had dropped as little as six inches.

FORMER WORK

1887: Hugh Fletcher, for the Geological Survey of Canada, carried out reconnaissance mapping in the area. He divided the sedimentary rocks into two units: the "Devonian metamorphics" and the "lower Carboniferous". The Horton strata were thought to be Devonian, while the now recognized Windsor and Canso groups constituted his "lower Carboniferous".

1929: Mather and Trask, for Eastern Gulf Oil Company, mapped Carboniferous strata in the Whycocomagh area. The stratigraphy of the region was worked out, largely from exposures on the Southwest Mabou River. The now recognized Horton group was divided into two major rock stratigraphic units; the Kewstoke conglomerates at the base, and an overlying

Dunbar sandstone series. The latter unit was further subdivided into the lower Dunbar red beds, and middle Dunbar group, while the uppermost Horton strata were placed in the Ainslie sandstone unit. The Kewstoke conglomerates would correlate now with the Skye River member of the Craignish formation; the lower Dunbar red beds with the McLeod member; the middle Dunbar with the Strathlorne member of the Strathlorne-Ainslie formation, while the uppermost Ainslie sandstone unit would be equivalent to the now recognized Ainslie member. To beds of marine limestone, gypsum and red shale overlying the Dunbar sandstone series, Mather and Trask gave the name Hillsboro Limestone series. These beds are now considered to belong to the Windsor group. The MacFarlane red bed series along with the Mabou formation are now considered to belong to the Mabou formation of the Canso group. The work of Mather and Trask was the first attempt at a comprehensive subdivision of Carboniferous stratigraphy in this area. Unfortunately however, their stratigraphic terminology is rather vague and their subdivisions were difficult to apply in regional mapping.

1949: R.W. Decker, studied the upper Horton sedimentary rocks as exposed on the Southwest Mabou River. This was a thesis project undertaken at the Massachusetts Institute of Technology. Decker restricted his studies to the Horton succession lying

above the now recognized Craginsh formation. Altogether 2088 feet of strata were measured and described. No attempt at a revision in stratigraphic terminology was made. The upper Horton beds on the Southwest Mabou River were considered to be middle Mississippian and correlated with the section measured at Cape George on the Nova Scotia mainland.

1955: B.C. Murray made the most comprehensive study of Horton sedimentary rocks up to this time. Selecting the Southwest Mabou River as the type section of Horton strata in western Cape Breton, he subdivided the succession into three formations which were, from the base upward: the Craginsh, the Strathlorne, and the Ainslie. Subdivision was made on gross lithological variations within the Horton sequence. The Craginsh was further broken down into two members, a basal coarse clastic sequence termed the Skye River, and an overlying, predominantly red bed sequence termed the McLeod. The uppermost formation, the Ainslie, was subdivided into two members; the McIsaac Point, and the Glencoe. The Southwest Mabou River succession was correlated with other Horton sequences in western and northern Cape Breton Island and postulations as to structural and climatic conditions during accumulation were made. Murray considered the three formations to be approximately time correlative, arguing that contemporaneous major changes in basin configuration and climate resulted

in a marked change in sedimentary character at various times during Horton deposition.

1957: R.O. Grieve (Imperial Oil Limited) mapped the Whycocomagh area from its northern boundary (46°00') southward to the Graham River. Grieve recognized the presence of the Horton, Windsor, Canso and Riversdale groups. The Horton group was subdivided into three rock stratigraphic units, the lower, middle and upper Horton. The basal portion of the latter unit was termed the "grey bed series". Grieve's lower Horton unit would now correlate with the Skye River member of the Craginsh formation, while his middle Horton unit would be equivalent to the McLeod member of the same formation. The upper Horton beds are now correlated with the Strathlorne-Ainslie formation, while the grey bed series is equivalent to the Strathlorne member of this latter formation. Subdivisions within the Windsor group, following the zonal scheme of Bell (1929) were made. Some of the field season was spent by Grieve in mapping the Mull River and Mount Young Anticlinal features in the Lake Ainslie area to the north.

1957: D.G. Kelley of the Geological Survey of Canada mapped the Whycocomagh area on a scale of one inch to one mile. Areal distribution of the Horton, Windsor, Canso and Riversdale groups was shown. Four subdivisions based on variations in lithology were made within the Horton succession. The

relationship of these subdivisions to those made by Murray (1955) (1960) and the author are discussed in Chapter 1 and are summarized in Table 1.

1958: R. Cote, for Imperial Oil Company Limited, mapped the Carboniferous sedimentary rocks in the Whycocomagh area with particular emphasis on the portion from the Graham River southward. Rocks of the Riversdale, Canso, Windsor and Horton groups were recognized and described. The Graham River section of Horton strata was carefully measured, and the succession was subdivided into five lithologically distinctive members termed 3A, 3B, 3C, 3D, and 3E. The areal distribution of these Horton members was traced and structural interpretations were made. The resulting material constituted a M.Sc. thesis presented at Acadia University in 1958.

1962: A. Suparman, working on a Master's thesis at Ottawa University, described sedimentary structures in the Horton group in this area. Horton strata on the Southwest Mabou River, Southeast Mabou River, Graham River, Judique Intervale Brook and the shores of Lake Ainslie were studied.

RECENT FIELD WORK

During the 1963 field season, the Whycocomagh area was revisited by the author. In order to add to data collected during the 1958 field season, the Graham River and

Judique Intervale Brook sections were retraversed, remeasured and collected from with a view to processing the samples for heavy minerals and for spore content. The following table shows the development of Horton stratigraphic terminology in the Whycocomagh area.

TABLE No. 1

Development of Stratigraphic Terminology of the Horton Group
in the Whycocomagh Area

Mather & Trask 1929	Murray 1955	Kelley 1957	Cote 1958	Cote 1964
Ainslie Sandstone	Ainslie formation	unit 4A	Upper Horton	Ainslie member of Strathlorne - Ainslie formation
Middle Dunbar	Strathlorne formation	unit 4B		Strathlorne member of Strathlorne - Ainslie formation
Lower Dunbar	McLeod member of Craignish formation	unit 4C	Middle Horton	McLeod member of Craignish formation
Kewstoke Conglomerate series	Skye River member of Craignish formation	unit 4D	Lower Horton	Skye River member of Craignish formation
Pre-Horton	Pre Horton			Fisset Brook formation

GENERAL GEOLOGY

During the Acadian orogeny, extensive granitic intrusion took place into the older, Precambrian George River metasediments and orthogneisses. Structural instability probably continued into lowermost Mississippian time, and resulted in the periodic extrusion of acidic to basic lavas into the resulting intermontane structural basins. This lower volcanic sequence is called the Fisset Brook formation.

Mississippian sedimentation began under continental conditions with fanglomeratic accumulations marginal to the upfaulted basement massifs. This succession of interfingering conglomerates, arkoses, coarse sandstones and minor lenticular red siltstones belong to the Skye River member of the Craginsh formation. With continued denudation of the upland positive areas, the basins gradually filled with coarse granite and metamorphic debris and broad alluvial plains resulted. In the central basin areas, a red bed facies was deposited here referred to as the McLeod member of the Craginsh formation.

Continued denudation of source areas resulted in a reduction of topographic relief and a sequence of fine grained, grey clastics was deposited. This succession is thought to have accumulated under a lacustrine-fluviatile environment and is here referred to as the Strathlorne member of the Strathlorne-Ainslie formation.

Rejuvenation of erosional profiles once again resulted in a flood of coarser clastic rocks periodically into the basin. This could have been caused by renewed uplift of source areas, or by a marked change in climatic conditions or a combination of both. The resulting clastic rocks, predominantly composed of red and buff sandstones and red siltstones, are here referred to as the Ainslie member of the Strathlorne-Ainslie formation. They are thought to have accumulated under fluvial and deltaic environments.

Deposition of strata belonging to the Horton group ended with the encroachment of seas into the Carboniferous depositional basin. The first limestone deposited is a very widespread and lithologically distinctive one, being thinly laminated to fissile. This limestone, the Windsor A₁, marks the base of the Windsor group. During the accumulation of this partially marine group, many individual lithologically and faunally distinctive limestones were deposited along with thicknesses of gypsum and anhydrite. The presence of these evaporites in the sequence attests to the isolation of portions of the Windsor sea in which conditions were favourable for the accumulation of evaporitic sequences.

Gradual regression of the Windsor seas brought about the deposition of a series of fine grey clastic rocks; predominantly of silt size. These clastic rocks contain a

fresh to brackish water fauna and belong to the basal portion of the overlying Canso group. Mud cracks, fine ripple marks and salt casts are characteristic sedimentary features. A gradual increase in average grain size and bed thickness occurs in higher beds of the Canso.

Pennsylvanian strata of the Riversdale group outcrop in the extreme northwest portion of the Whycocomagh area. Coarse grained, very feldspathic, buff sandstones and arkoses predominate. Massive crossbedding is a very characteristic feature of these strata which were probably accumulated under deltaic environments. These strata are the youngest consolidated sedimentary rocks outcropping in the area. The following table illustrates the classification of the Carboniferous succession in the Whycocomagh area.

Table No. 2

Table of Formation in the Whycocomagh Area

Period	Group	Formation
Pennsylvanian	Riversdale	Port Hood
	CONFORMABLE	
	Canso	Mabou
Mississippian	CONFORMABLE?	
	Windsor	
	CONFORMABLE - DISCONFORMABLE	
	Horton	
		Strathlorne-Ainslie Craignish Fisset Brook ?
NONCONFORMITY		

Pre-Carboniferous Basement Complex

AREAL DISTRIBUTION OF THE HORTON GROUP IN THE WHYCOCOMAGH AREA

Sedimentary rocks of the Horton group extend in a northeasterly trending belt marginal to the Craginsh Hills (see plate 1). This outcrop belt varies in width from two to six miles and the strata in general dip monoclinally to the west, away from the pre-Horton crystalline basement rocks. Unlike the Lake Ainslie area to the north, no structural repetition of the sequence is found to the west of this outcrop belt. Many well exposed Horton successions can be observed in the numerous rivers and brooks cutting across the structural trend. Notable amongst these are: the Graham River, Judique Intervale Brook, and the Southwest Mabou River. Displacement of the outcrop belt has taken place along essentially northwest-southeast dip faults. Strike faults of major proportions are rare, except for the portion of the area lying south of the Graham River. Approximately 60 per cent of Carboniferous strata in the Whycocomagh area belong to the Horton group.

UPPER AND LOWER CONTACTS OF THE HORTON GROUP IN THE WHYCOCOMAGH AREA

Strata of the Horton group (Craginsh formation) lie with disconformity upon crystalline basement rocks, ranging in age from Precambrian to Devonian. The Horton -

pre-Horton contact is observed on the Graham River, where conglomerates and arkoses, generally bluish green in colour disconformably overlies pink to pale grey granite. The conglomerates contain well rounded pebbles and cobbles of pink granite, grey graniorite and white to grey quartz. In isolated outcrops south of the Graham River, patches of boulder conglomerates of similar composition are found resting on the basement crystalline rocks. To the north, in the valley of the Southwest Mabou River, conglomerates and pinkish grey massive sandstones lie above the granite basement. Here however, the contact is concealed, but it is believed to be of similar nature as that on the Graham River. Similar relationships exist on the Southeast Mabou River (See figure 7).

In the southern portion of the Whycocomagh area, the writer observed several isolated exposures of volcanic rocks, interbedded with coarse clastic rocks. These sequences very closely resemble the lithology noted in Fisset Brook beds by MacKasey (1963) in the Lake Ainslie area and are tentatively correlated with these. If this is correct, then a Horton sequence of interbedded volcanic and clastic rocks is present in the southern portion of the area lying stratigraphically below the basal Horton beds observed in the portion of the area from the Graham River northward. As these volcanic - clastic outcrops are isolated and surrounded by faults, it is impossible, at the present time, to determine the contact relationship of these beds (denoted by the symbol 2A? on plate

1) with the underlying (?) granites and metamorphics.

In summary, in the portions of the Whycocomagh area where Skye River strata of the Craignish formation are the lowest Horton beds present, the contact with the underlying basement rocks is an unconformity. In the southernmost portion of the area, where volcanic rocks are present, and tentatively correlated with the Fisset Brook formation, the Horton- pre-Horton contact cannot be observed and its nature remains unknown. In the Lake Ainslie area to the north, the Fisset Brook succession lies disconformably upon pre-Horton granites.

The upper contact of the Horton group is placed at the base of a distinctive thinly laminated grey limestone, the Windsor A₁. The laminations in this limestone are so regular that Mather and Trask (1928) gave it the name Ribbon Limestone formation. It is found in Cape Breton Island, Nova Scotia, New Brunswick, and Newfoundland, and thus serves as an excellent rock stratigraphic unit at which to place the upper contact of the Horton group. On the Southwest Mabou River, (see photograph 12), red-brown silstones of the Horton group are overlain conformably by the A₁ Windsor limestone. On the Graham River, a concealed interval of some 800 feet is present between the highest exposed Horton sedimentary rocks and the limestone marker and, thus, it is impossible to determine the nature of the contact here. It is thought to be conformable.

Thus defined, strata of the Horton group occupy a distinct and readily observable stratigraphic position in the Carboniferous sequence, being post-crystalline basement, and pre-marine Windsor group. It must be emphasized that no time stratigraphic concept is applied to strata within the Horton, and the succession is considered as a rock stratigraphic unit, correlations within which are based largely upon lithological sequences.

THE FISSET BROOK FORMATION

MacKasey (1963) described a sequence of inter-bedded volcanic and clastic rocks in the Lake Ainslie area to the north. These beds are well exposed on Cooper Brook and MacKasey reports a thickness of 1100 feet of andesitic lavas, rhyolites, intercalated with minor conglomerate beds at that locality. The succession disconformably overlies crystalline basement rocks of granitic composition, and is overlain conformably by coarse clastic rocks of the Craignish formation (see figure 6).

Lithologically similar rocks in the southern portion of the Whycocomagh area are tentatively correlated with the Fisset Brook formation.

Unfortunately, structural complications and lack of continuous exposure render contact relationships impossible to ascertain. Further, no reliable total thickness of this

sequence can be determined.

South of Long Point in the area denoted by the symbol 2A? metamorphosed feldspathic sandstones and argillites are exposed in the beds of small creeks west of Highway 19. Calcite stringers cut these rocks and where they do, small pyrite crystals are found. The coarse sandstones contain angular fragments of pink feldspar and quartz, the matrix being very dense and siliceous. Pink rhyolite outcrops immediately to the south of these exposures in a large road cut immediately west of Highway 19. The rhyolites possess a sugary texture and small phenocrysts of quartz, as well as minute cubes of pyrite and flakes of biotite are present. Other volcanic types also occur. Near the summit of the Craguish Hills, 1/4 mile northeast of the rhyolite outcrop, andesitic agglomerates and interbedded basalt flows were observed. The flows vary in colour from deep blue - black to maroon, and are commonly amygdaloidal, the vesicles being filled most commonly with quartz and calcite.

Possibly some of the rocks described and assigned to the Fisset Brook may belong to the Precambrian George River metasedimentary sequence.

THE CRAIGNISH FORMATION

Disconformably overlying crystalline basement rocks, and possibly also locally interbedded volcanics and

clastic rocks of the Fisset Brook, is a thick succession of predominantly coarse, poorly bedded and poorly sorted sedimentary rocks. This sequence resulted from the rapid weathering of upfaulted basement positive areas following the Acadian orogenic phase. The basal beds of the Craginsh formation are conglomeratic (see photos 1 and 2) and due to the massive and lenticular nature of these accumulations, are thought to have been alluvial fans, marginal to basement positive areas. The coarse, predominantly grey to blue-grey basal clastic rocks give way upward to red beds which appear to be partially a central basin facies of the underlying grey beds, as interfingering of the two lithologies does occur in the portion of the Whycocomagh area from the Graham River southward.

The Craginsh formation can be thus subdivided into two members as proposed by Murray (1955): the basal Craginsh Skye River member, and the upper Craginsh, McLeod red bed member. Well exposed sequences of both of these are found throughout the area and each member is discussed separately below.

THE SKYE RIVER MEMBER OF THE CRAIGNISH FORMATION

On the Southwest Mabou River type section, Murray, (1955, 1960) assigns to this member a thickness of

2900 feet of interbedded greenish grey to red-brown feldspathic sandstones, conglomerates and arkoses, all massively bedded. The unit at this locality appears to rest disconformably upon granitic basement rocks.

Section No. 1 (See figure 3)

THE SKYE RIVER MEMBER ON THE SOUTHWEST MABOU RIVER AFTER
B.C. MURRAY (1960)
(slightly modified)

Conformable contact with overlying McLeod member?	Feet
Concealed	30
Conglomerate .. grey, medium sandstone matrix, pebbles of white quartz and feldspar	10
Concealed	225
Siltstone red-brown, deep red, some green mottling, 1" beds	20
Concealed	340
Sandstone pale grey, thinly bedded, micaceous, scattered 1/2" pebbles	65
Concealed	85
Conglomerate .. reddish grey, coarse sandstone matrix, red shale chips, minor interbeds of red and grey sandstone and red siltstone	50
Concealed possible fault zone	465
Sandstone grey, medium to coarse grained, massive lenses of conglomerate	85
Fault Zone displacement unknown	

Sandstone	 grey, medium to coarse grained, crossbedded, massive, lenses of conglomerate, (generalized)	Feet 440
Concealed	.....	75
Sandstone	 grey, medium to coarse grained, local lenses of conglomerate; 1' - 2' beds, pebbles rounded to sub-angular	60
Conglomerate	.. grey, coarse sandstone matrix, poorly bedded, pebbles of white quartz and orange feldspar	30
Sandstone	 grey, medium grained, massively cross bedded, scattered pebbles.....	105
Concealed	.....	35
Conglomerate	.. grey coarse sandstone matrix, massive	10
Concealed	.....	10
Sandstone	 grey, coarse grained, micaceous, massive	10
Concealed	.....	15
Sandstone	 grey, medium grained, massive	10
Sandstone	 grey to greenish grey, coarse grained with conglomerate lenses, massive cross bedding	95
Concealed	.....	40
Conglomerate	...grey, coarse grey sandstone matrix	10
Concealed	.....	25
Sandstone	 grey, coarse grained, massive angular grains of quartz and orange feldspar	20
Sandstone	 greyish red, coarse grained, with pebbles of white quartz and pink feldspar subrounded to sub-angular	20
Concealed	.....	10
Sandstone	 greyish red, coarse grained, massive	20

Feet

Concealed	10
Conglomerate .. grey, with zones of coarse grey sandstone	10
Concealed	20
Sandstone red, coarse grained, small scattered pebbles	10
Concealed	40
Sandstone red, interbedded with grey conglomerate with coarse grey sandstone matrix	10
Concealed	20
Conglomerate .. red with coarse red sandstone matrix, pebbles of bluish grey limestone, and granite fractures filled with carbonate	25
Concealed	195
Conglomerate .. greyish pink, massive	15
<u>Concealed to pre-Horton basement crystalline rocks</u>	<u>20 ??</u>

Granite basement

Thickness of Skye River Member2900 Ft

The generally poor bedding, poor sorting, freshness of fragmental feldspars and abundance of lenticular conglomerate zones suggest that this succession resulted from the relatively rapid weathering of nearby igneous and metamorphic positive areas.

Smith, (1955, p.10) summarizes the lithology of these lower Horton beds on the Southwest Mabou River as follows:

"The lower group is in large part coarse in size, ranging from a coarse conglomerate to a fine sandstone, generally with many zones, beds and lenses of sub-rounded pebbles. A few thin lenses or beds are present of a brick red siltstone to shale. The colour of the lower group ranges from the brick red of the silt, through a greyish pink coarse grained sediment, through a neutral grey coarse grained sediment, to a greyish green medium sandstone. The lower group is mostly non-calcareous, except for a few thin, slightly calcareous beds, and an anomalously very calcareous outcrop near the base. Sorting is generally poor, and rarely fair, with the presence of a pasty, micaceous matrix containing fine comminuted particles. Much of the lower group is massive, but occasional beds of one foot to two feet are present, and massive and medium scale cross-bedding is often displayed in the better exposed outcrops. A few red shale pebbles, rounded, are present at one horizon, immediately above a brick red shale layer. No fossils of any kind were found in the lower group. "

Approximately 2900 feet of Skye River strata were measured on the Southeast Mabou River, located in the north-eastern portion of the Whycocomagh area. Description of this sequence is included in the following chapter on the Lake Ainslie area, as the river transects the boundary of the two areas.

An excellent section of lowermost Horton sedimentary rocks is exposed on the Graham River. Here, however, a much thicker and lithologically different basal unit is observed, attaining a thickness of approximately 7,600 feet. Numerous faults occur, along with large concealed intervals,

and it is possible that repetition of strata has taken place. However, all dips recorded show the section to dip monoclinally westward away from the Craignish Hills. Thus, if repetition by folding occurs, it is not obvious. Unlike the Southwest Mabou River type section, a sequence of fine grey clastic rocks, some 1600 feet thick, was observed on the Graham River section; lying within a typical Craignish lithological succession. This sequence can be traced southward from the Graham River, to within a few miles of the southern portion of the Whycocomagh area. North of the Graham River, outcrops of the Craignish formation are widely separated on stream sections and it is impossible to ascertain the northern extent of this grey sequence, but as mentioned, there is no doubt that these beds are not present in the Southwest Mabou section only seven miles north of the Graham River. The Graham River fine grey clastic sequence contains thicknesses of poorly bedded, pale grey mudstones and fine siltstones, interbedded with more evenly bedded sandstones, ranging in grain size from fine to coarse. Red Beds are completely lacking.

Stratigraphically below this sequence, and resting disconformably upon basement igneous rocks are 1500 feet of coarse, poorly bedded and lenticular red and grey-green clastic rocks, cut by numerous dark blue diabase dikes. Poorly bedded conglomerates and coarse, very feldspathic

sandstones possessing a grey to greenish grey colouration are interbedded with lenticular red-brown to brick red siltstones and fine grained sandstones. The conglomerates contain rounded pebbles of grey quartz, pink rhyolite, bluish green fine-grained dike rock and pink to grey granite. The matrix is generally coarse grained, bluish green, and contains abundant angular fragments of pink to salmon red feldspar and grey quartz. The sandstones have approximately the same composition as matrix material of the conglomerates. Sorting is quite poor and abundant chloritic matrix is present in the sandstones, which on occasion grade to arkoses and greywackes.

Lying above the anomalous grey bed sequence and below the fine grey clastic rocks of the overlying Strathlorne member of the Strathlorne-Ainslie formation are some 4600 feet of grey-green and red-brown clastic rocks. This succession is very similar lithologically to the previously described sequence below the anomalous grey bed unit. Further, it closely resembles the Craignish formation on the Southwest Mabou River type section, both in gross lithology and total thickness (4600 ft. vs. 5100 ft.). Large concealed intervals exist on the Graham River section towards the top of this unit and as a result, it is difficult to estimate the thickness of the McLeod red bed member. However, there is little doubt that towards the top of this unit, the percentage of red beds does increase at the expense of grey and greenish clastic rocks,

the upper 2400 feet being largely red-brown.

Thus observed, the portion of the Graham River Horton succession lying upon granite basement and conformably below the Strathlorne-Ainslie formation is problematical when compared with the Southwest Mabou section occupying the same stratigraphic position. The following factors must be considered:

- (A) Much greater thickness on the Graham River, i.e., 7,600 ft. vs. 5,100 ft. on the Southwest Mabou type section.
- (B) Presence on the Graham River section of 1,600 feet of fine grey clastic rocks not found on the Southwest Mabou River only seven miles to the north.
- (C) Lithological and total thickness similarity of the upper 4,600 feet of Cragish strata on the Graham River with the Southwest Mabou type section.

It is possible that a basin in the Graham River area was filled with clastic debris before sedimentation took place further north in the Southwest Mabou portion. Fine grey clastic sequences do occur in Cragish Horton successions on the Nova Scotia mainland in the Antigonish and Wolfville areas, and it is possible that initial source direction of the fine grey clastic sequence in the Graham River area was to a great extent from west to east, i.e., from the Cape

George-Antigonish area towards the Craguish Hills. In a study by A. Suparman (1964, p.57), a similar trend was suggested by a study of bottom structures within the finer clastic rocks of the Strathlorne-Ainslie formation. Following the infilling of the Graham River negative area, source material then could have shifted to an east-towards-west direction, away from the Craguish Hills, as in the Southwest Mabou River area. If these conclusions hold, the upper 4,600 feet of Craguish strata would roughly correlate in time with the lowermost Horton sedimentary rocks observed on the Southwest Mabou River, and the lower 3,000 feet on the Graham River would be pre-Southwest Mabou accumulation.

The following section of Craguish formation strata was measured on the Graham River.

Graham River (Section No. 2 See figure 3)

CRAIGUISH FORMATION ON THE GRAHAM RIVER

Conformable contact with overlying Strathlorne-Ainslie formation. Feet

Siltstone	 red-brown, numerous conglomerate lenses containing fragments of quartz and pink granite, 1/4" long	60
Concealed	.....	650
Sandstone	 grey, fine grained, very dense	15
Siltstone	 red-brown, poorly bedded arenaceous towards base, minor interbeds of greenish grey, fine grained sandstones-siltstones	170

Concealed	Feet	
	200	
Sandstone grey-green, coarse grained, dense	20	
Conglomerate . grey-green, coarse grained, arkosic matrix	20	
Conglomerate . red siltstone matrix, lenticular bedding	30	
Concealed	50	
Limestone black, dense, calcite veining, no apparent bedding, some lime nodules	3	
Concealed	25	
Sandstone buff, medium grained, friable, limonite stained	3	
Concealed	60	
Siltstone dark grey, thinly bedded, plant fragments	10	
Sandstone greenish grey, very fine grained, flaggy, pyrite concretions	4	
Concealed	60	
Siltstone red-brown, poorly bedded	5	
Sandstone buff, medium grained, friable	5	
Concealed	100	
Sandstone buff, fine to medium grained, massive feldspathic jointed, friable	50	
Sandstone buff, fine grained	40	
Sandstone buff, medium grained, very feldspathic ..	15	
Siltstone red-brown, poorly bedded, conglomeratic at base, local lens of conglomerate scattered throughout	50	
Concealed	40	
Conglomerate . red-brown, coarse grained sandstone matrix	5	

Concealed	Feet	100
Sandstone buff, coarse grained, friable; very feldspathic, deeply weathered, pyrite concretions		18
Siltstone red-brown, poorly bedded to crumbly		15
Concealed		450
Sandstone brown, fine grained, very feldspathic ...		8
Concealed		70
Bridge crossing River		
Sandstone grey, fine grained, very dense		8
Concealed		28
Sandstone grey to brown, medium grained, feldspathic, well cross bedded		10
Concealed		100
Sandstone grey to brown, medium grained, well cross bedded		6
Concealed		20
Sandstone greenish grey, medium grained, feldspathic, massive		25
Sandstone grey, fine grained		5
Conglomerate . coarse grained, greenish grey, arkosic matrix		15
Concealed		50
Conglomerate . grey, coarse grained, sandstone matrix ..		60
Sandstone greyish brown, medium grained, massive ..		7
Concealed		140
Mudstone grey and red-brown, crumbly, poorly bedded		5

	Feet
Sandstone buff, medium grained, limonite stained	30
Siltstone red and grey	14
Sandstone grey, fine grained, massive, brown weathering	7
Sandstone buff, deeply weathered, medium grained, limonite stained, massive	30
Siltstone grey to greenish grey	12
Mudstone grey, poorly bedded	5
Sandstone grey to red-brown, medium grained, massive	25
Siltstone red-brown, poorly bedded, massive	30
Sandstone greenish grey, fine grained, massive	12
Mudstone olive drab, massive	10
Sandstone grey, medium grained, local lenses of conglomerate	45
Mudstone red-brown, indurated	10
Fault Zone ... displacement unknown	
Diabase dike .....width	15
Sandstone grey, fine grained, indurated	9
Sandstone grey-brown, fine grained, indurated	6
Mudstone grey, poorly bedded, massive	42
Siltstone grey, fine grained	6
Mudstone grey	6
Siltstone reddish grey, poorly bedded silts, local beds of mottled red and greenish grey	46
Sandstone grey to greyish brown, fine grained	11

	Feet
Mudstone grey, crumbly	17
Pebble conglomerate . greenish grey arkosic matrix	62
Sandstone grey-green, medium grained, grades upward to pebble conglomerate	68
Siltstone grey, fine grained, well bedded, abundant plant fragments along bedding	51
Sandstone greenish grey, medium grained, arkose conglomerate lenses	384
Sandstone grey, coarse grained, conglomerate lenses, angular fragments of pink feldspar	23
Sandstone grey, medium grained	92
Sandstone greenish grey, fine grained, small quartz stringers	16
Fault	
Mudstone greyish black,	8
Sandstone greenish grey, medium grained, with fine conglomerate lenses	92
Siltstone greenish grey	8
Mudstone grey, silty, massive	39
Sandstone grey, coarse grained	7
Sandstone grey, medium grained, minor interbeds of grey mudstone	62
Sandstone grey, coarse grained, feldspathic to arkosic 2' bedding, small quartz stringers	23
Concealed	115
Siltstone reddish grey, dense, finely cross bedded	7

Feet

Siltstone	 grey to greenish grey, evenly bedded, cross bedded	30
Sandstone	 buff weathering, friable, medium grained	23
Limestone	 black, dense	5
Siltstone	 reddish grey	8
Conglomerate	. greenish grey, feldspathic matrix abundant, pink feldspar	8
Sandstone	 grey to greenish grey, coarse grained, lenses of conglomerate	103
Sandstone	 whitish grey, coarse grained, angular pebbles, 1/4" - 1/2", white quartz	8
Siltstone	 greenish grey, dense, well bedded	25
Sandstone	 grey, coarse grained, conglomerate lenses	65
Siltstone	 grey-green, dense	57
Pebble Conglomerate	. dark grey, sandy, shale matrix ...	8
Conglomerate	. greenish grey, fine grained, quartz matrix	16

Top of Grey Clastic Rock Sequence

Siltstone	 grey-green, dense, interbeds of coarse grained grey sandstone	164
Sandstone	 grey, coarse grained, conglomeratic in places	16
Mudstone	 medium gray, micaceous, massive	57
Mudstone	 very micaceous, contains numerous drift plant fragments	33
Concealed	.....	146

	Feet
Sandstone grey, fine grained	12
Mudstone grey, massive	115
Sandstone grey, coarse grained	15
Siltstone grey, well bedded, 1"- 3" bedding	84
Sandstone grey, fine grained	25
Sandstone grey, medium grained	15
Sandstone grey, coarse grained	15
Mudstone grey, silty	130
Sandstone grey, coarse grained	23
Siltstone greenish grey	23
Sandstone grey, medium grained	15
Mudstone grey	62
Sandstone grey, medium grained, drift plant fragments	12
Mudstone grey	15
Conglomerate . grey matrix, 96% well rounded pebbles of grey quartz	4
Mudstone medium grey, massive, poorly bedded, calcite	96
Sandstone grey, feldspathic, massive, dense, coarse grained, highly indurated	22
Mudstone grey; silty, with minor interbeds of grey, very fine grained siltstone	78
Siltstone grey, fine grained, minor grey mudstone	128
Sandstone grey, fine grained	13
Mudstone grey	7

	Feet
Sandstone grey, very fine grained, well bedded	71
Sandstone grey, fine grained, interbedded with siltstones, cross bedded	71
Mudstone grey, interbedded with siltstones with very minor interbeds of red brown silt, cross bedded, sample spores C 119B from top	85
Conglomerate	5
Mudstone medium grey, massive, poorly bedded, silty ?	16
Thickness of Grey Clastic Rock Sequence	1576
Sandstone grey, medium grained, local lenses of conglomerate	33
Conglomerate . grey	41
Pebble Conglomerate . reddish grey arkosic matrix	14
Sandstone red-brown, coarse grained, interbedded with red siltstone, minor conglomerate lenses	71
Arkose-conglomerate . coarse grained, red-brown, grading upwards from siltstone.....	21
Siltstone brick red, poorly bedded	107
Conglomerate . coarse grey, feldspathic, matrix	7
Siltstone brick red	36
Sandstone grey, fine grained, very micaceous, well bedded	12
Sandstone grey, medium to coarse grained, feldspathic, minor conglomerate lenses	6
Siltstone brick red, lenses of reddish brown arkosic grits	32

	Feet
Conglomerate . reddish grey, grit to fine	13
Siltstone brick red, somewhat contorted, obscure bedding, visibly lenticular	170
Sandstone buff, medium grained, feldspathic, with brick red siltstone lenses common throughout	78
Sandstone greenish grey, feldspathic, medium grained, small conglomerate lenses	30
Pebble Conglomerate . greenish grey, feldspathic sandstone matrix, massive, pebbles of pink granite and grey quartz predominate, 3" diameter	70
Sandstone greenish grey, massive, medium grained scattered conglomerate lenses, pink orthoclase, feldspathic	44
Diabase dike . black-green..... width..	15
Sandstone greenish grey, fine grained, feldspathic indurated	12
Siltstone brick red, possible lensic	15
Sandstone greenish grey, coarse grained, with conglomerate lenses	30
Concealed	30
Diabase dike	width.. 10?
Concealed	54
Siltstone brick red, massive, poorly bedded	15
Arkose	reddish grey, medium grained 3
Conglomerate . greenish grey, feldspathic matrix, well rounded pebbles, 2" in diameter	15
Concealed	31

	Feet
Sandstone greenish grey, coarse grained, highly indurated, feldspathic	22
Siltstone maroon, with calcite stringers and concretions, pitted appearance	5
Diabase dike . dark, greenish grey .....width..	50
Siltstone brick red	12
Sandstone greenish grey, coarse grained, feldspathic, with minor conglomerate lenses	6
Siltstone brick red	25
Arkose greenish grey, coarse grained	2
Siltstone brick red	3
Sandstone greenish grey, feldspathic, medium grained	4
Conglomerate	4
Diabase dike . dark bluish grey .....width..	75
Concealed	41
Sandstone greyish buff, medium to fine grained	6
Siltstone brick red, with small gash veins of white calcite	64
Sandstone - Arkose . greenish grey, coarse grained, feldspathic, scattered conglomerate lenses	64
Concealed	38
Conglomerate . poorly bedded, pebbles approximately 3" in diameter, rounded and of grey quartz, pink granite, and pinkish grey granodiorite	38
TOTAL THICKNESS OF CRAIGNISH FORMATION:	7644
Pre-Carboniferous granite - granodiorite	

THE MCLEOD MEMBER OF THE CRAIGNISH FORMATION IN THE
WHYCOCOMAGH AREA

Lying above and partially interfingering with the coarse clastic rocks of the Skye River member, is a succession varying in thickness from a possible 3379 feet on Judique Intervale Brook to 2230 feet on the Southwest Mabou River of predominantly red clastic rocks assigned to the McLeod member of the Craignish formation by Murray (1955, 1960). The possibility exists that the McLeod beds interfinger with and to a great extent replace the Skye River strata in central portions of the Horton depositional basin. Murray states (1960, p. 27):

"Now the question arises as to whether the Skye River and McLeod members likewise represent distinct intervals of geological time, or do they constitute a facies change within the Craignish formation. That the two members could be deposited simultaneously is indicated by the fact that they interfinger, represent no apparent change in source material or weathering conditions, and correspond to probably adjacent environments of deposition. Yet, the interfingering is present only in the lower part of the McLeod, and that member seems to be present only in the most central basin area, the Lake Ainslie district. Two possible hypotheses of time relationship between the two members, both consistent with available data are illustrated in figure 9.

"In possibility 'A', Skye River deposition began first in the central basin area and overlapped gradually onto more marginal areas. As pre-Carboniferous topography in the central basin was buried, fluvial plain deposition became

dominant, but alluvial plains still remained along the margins. Craguish deposition was cut short by physiographic and climatic changes before the McLeod member was able to expand into the marginal strait of Canso and Margaree Valley areas.

"The alternative possibility, Skye River deposition took place more or less uniformly throughout the basin until terminated by a tectonic disturbance. The marginal areas remained non-depositional surfaces, while the central basin locally accumulated red beds. Then a second, or continuing disturbance which may have been accompanied by a climatic change, initiated deposition of the Strathlorne. Neither possibility can be accepted until more thicknesses and contact data are obtained. The present author favours possibility 'A', the facies change."

The present author also favours possibility "A", that the McLeod red beds are a facies of the Skye River member developed in portions of the Horton basin. Rapid variations in thickness of the McLeod, coupled with inter-fingering of the two lithologies in various parts of the basin render this conclusion preferable.

Well exposed sections of this member outcrop on both the Southwest Mabou type section where a thickness of 2,230 feet was measured by Murray (1955) and on Judique Intervale Brook where the author measured 3,379 feet of McLeod red beds. Exposures on other brooks tend to be more fragmentary, and more or less continuous sections are lacking.

The following section of McLeod strata was measured by Smith (1954) and Murray (1955) on the Southwest

Mabou River.

Southwest Mabou River (Section No. 1 See figure 3)

McLEOD MEMBER, SOUTHWEST MABOU RIVER

Conformable contact with overlying Strathlorne-Ainslie formation.

	Feet
Sandstone red-brown, fine grained	20
Sandstone grey, medium-coarse grained	40
Sandstone red-brown, fine to very fine grained, small-medium scale crossbedding, no mud cracks, ripple marks channel and fill structures, non conglomerates observed ..	790
Sandstone red-brown, medium-coarse grained, minor interbeds of fine grained red-brown sandstone	90
Sandstone grey, medium grained, crossbedded, shale chips	20
Sandstone red-brown, medium grained, mottled green	20
Sandstone red-brown, fine grained, mottled green shale chips	30
Fault Zone ... displacement 30 '	30
Siltstone red-brown, fine grained, grades to fine red-brown sandstone at base	110
Shale green colour, banded 5MM	1
Siltstone red-brown, fine to medium grained, small scale crossbedding, oscilla- tion, ripple marks	50
Sandstone grey, fine grained, 2" - 6" bedding	10
Siltstone red-brown, fine to medium grained, crossbedded	65
Limestone Two beds 1' thick, blue-black, massive interbedded with red and green mottled siltstone	10

	Feet
Siltstone red-brown to brick red, no apparent bedding, minor greenish red beds, minor green mottling (generalized)	315
Sandstone grey, medium-coarse grained, cross-bedded, local lenses of conglomerate	30
Sandstone red-brown, fine to medium grained, well bedded	15
Sandstone grey, medium to coarse grained, with local lenses of conglomerate	60
Sandstone red-brown, fine grained, crossbedded, thinly bedded	20
Conglomerate . grey, fine grey sand matrix, few shale pebbles	20
Siltstone red-brown, thinly bedded, micaceous	15
Limestone dark grey	1/2
Siltstone red-brown, thinly bedded to massive, micaceous	15
Concealed	220
Conglomerate . grey, crossbedded	10
Siltstone red-brown	10
Sandstone grey, fine grained, massive, minor grey siltstone towards the base	40
Sandstone red-brown, fine grained, interbedded with red-brown siltstones, thinly bedded, mottled	120
Sandstone grey, fine grained, crossbedded	15
Siltstone red-brown, with greenish grey mottling becoming increasingly grey down section	50
Limestone dark grey, massive, a few pyrite crystals	1/2

	Feet
Siltstone grey, plant fragments	<u>15</u>
Thickness of McLeod Member	2230

On the Judique Intervale Brook, five miles south of the Southwest Mabour River, the author measured the following section of McLeod Strata.

Judique Intervale Brook (Section No. 3 See figure 3)

MCLEOD MEMBER OF CRAIGNISH FORMATION

Conformable contact with overlying Strathlorne-Ainslie formation.

	Feet
Conglomerate . greenish grey, coarse, very feldspathic sandstone matrix, fragments of grey quartz and pink granite	10
Sandstone greenish grey, fine grained	1
Concealed	100
Sandstone red-brown, fine grained, micaceous	10
Concealed	420
Siltstone red-brown to brick red, poorly bedded, green mottling	100
Concealed	600
Siltstone red-brown to brick red, poorly bedded, abundant yellowish grey lime concretions varying in size from 1/4 to 1/2"	100
Sandstone red-brown, fine grained, massive feldspathic	10

	Feet
Mudstone red-brown, crumbly and poorly bedded, abundant bluish green calcareous con- cretions	8
Sandstone red-brown, very fine grained, massive, feldspathic	3
Mudstone red-brown, silty, crumbly, poorly bedded, abundant limy concretions	12
Siltstone red-brown to brick red, poorly bedded ...	735
Siltstone red-brown, poorly bedded for the most part, minor well bedded siltstones, limy concretions	280
Concealed	35
Siltstone red-brown, poorly bedded to crumbly, a few interbeds of dense more evenly bedded siltstones	300
Sandstone red-brown, fine grained, massive, micaceous	10
Fault Zone	
Siltstone red-brown, interbedded with crumbly red-brown mudstones, one interbed of dark grey mudstone	50
Siltstone red-brown, poorly bedded	150
Concealed	30
Siltstone red-brown, crumbly, minor green mottling	5
Concealed	120
Siltstone red-brown, poorly bedded	90
Concealed to approximate contact with underlying Skye River member (see figure 5)	approx. 200
Thickness of McLeod Member	3379

The thickness of McLeod strata as exposed on Judique Intervale Brook exceeds the thickness on the Southwest Mabou River by 1150 feet. Some of this discrepancy may be due to unrecognized faulting, causing repetition of strata in some of the larger concealed intervals. However, rapid changes in total thickness of the McLeod red beds are suggested when comparison is made between the Southwest Mabou type section and the Southeast Mabou section, only five miles apart. McLeod strata on the former attains a thickness of 2230 feet, while in the latter section, only 723 feet of McLeod type clastic rocks are present.

Poorly outcropping red-brown, sandstones and siltstones with numerous conglomerate zones outcrop in the Graham River. Thin limestones and buff sandstones also are present. Precise correlation of these beds with McLeod sequences on the Southwest Mabou and Judique Intervale Brook is difficult due to the lack of continuous exposures. However, a possible 3000 feet of McLeod type strata is present, and the description of this succession is included in the previous section dealing with the Skye River member.

South of the Graham River, red siltstones and massive red-brown breccias were observed in the beds of many small brooks and indicate the presence of McLeod red beds. However, the sections are poorly exposed and large covered intervals exist. Thus, little would be achieved by describing these sections here.

THE STRATHLORNE-AINSLIE FORMATION IN THE WHYCOCOMAGH AREA

Lying stratigraphically above the McLeod red beds and below the basal A₁ Windsor limestone, is a succession of red and grey clastic rocks here assigned to the Strathlorne-Ainslie formation. This formation is the highest stratigraphically within the Horton group and varies in thickness from 2700 feet on the Graham River, to 2900 feet on the Southwest Mabou River.

Grey shales, fine grey siltstones, buff sandstones, and towards the top, red siltstones, are the predominant lithologies. Bedding is more even and thinner than in the underlying Craginsh formation and sedimentary structures such as ripple marks, flute casts, groove casts and load casts are much more abundant.

THE STRATHLORNE MEMBER IN THE WHYCOCOMAGH AREA

Lying conformably above the McLeod member of the Craginsh formation, and below the Ainslie member, is a succession of fine grey clastic rocks belonging to the Strathlorne member. The thickness of this member is remarkably uniform, varying from only 920 feet on the Graham River, to a maximum of 1077 feet on Judique Intervale Brook. On the Southwest Mabou type section, a thickness of 1050 feet was measured by Murray (1955, 1960). Grey shales, fine

grey siltstones, and minor grey, fine sandstones are predominant. The colour change from clastic rocks of the underlying McLeod red beds renders the lower contact of this member readily discernable, the contact being exposed on the Southwest Mabou River, Judique Intervale Brook and the Graham River. The contact between the Strathlorne member and the overlying Ainslie member is not as sharply defined and in portions of the area, is quite gradational and somewhat arbitrarily placed.

The marked change in lithology from the clastic rocks of the underlying Craignish formation (McLeod member) suggests a marked change in depositional environment. The clastic rocks of the Strathlorne are fine grained and more evenly bedded, suggesting a reduction of topographic relief of source contributing areas. Suparman's (1964) study of bottom structures showed a change in source direction from northeast to northwest. The change in colour from the red-brown of the McLeod to grey indicates that oxidizing conditions did not prevail in the Strathlorne succession which appears to have accumulated under fluviatile and lacustrine environments. The presence of fecal pellets and disseminated pyrite in many of the finer grey fissile siltstones, coupled with an almost complete lack of fauna (only a few fish scales were found), suggests reducing and foul bottom conditions existed during at least a portion of

Strathlorne accumulation.

The following measured sections illustrate the lithology of the Strathlorne member in various portions of the Whycocomagh area.

Southwest Mabou River (Section No 1, Figure 3)

(after Murray 1955, 1960)

STRATHLORNE MEMBER

Feet

Siltstone	 grey, medium grained	70
Sandstone	 grey, fine to medium grained, black shale chips	60
Siltstone	 grey, fine to medium grained, one medium grey, sandstone interbed	35
Sandstone	 grey, fine grained, grey shale chips	85
Shale	 grey	30
Siltstone	 grey, fine to medium grained	60
Shale	 grey, fissile, minor grey fine sandstones and siltstones, thin limestone bed	230
Sandstone	 grey, fine grained, ripple marked	20
Shale	 grey, fissile	60
Sandstone	 grey, fine grained, ripple marked	70
Siltstone	 grey, medium grained, minor thin grey sandstones	100
Limestone	 grey, thin	?
Shale	 grey, fissile, fish scales and spines, plant debris	15
Siltstone	 grey, medium grained, minor thin grey sandstones	145

	Feet
Sandstone grey, fine grained, plant debris and black shale chips incorporated at base of unit	60
Thickness of Strathlorne Member.....	1050

Both upper and lower contacts of this member are exposed and appear to be conformable.

The author measured the following section of Strathlorne strata on the Judique Intervale Brook.

Judique Intervale Brook (Section No 3 figure 3)

(See Figure 5)

STRATHLORNE MEMBER

	Feet
Conformable contact with overlying Ainslie member	
Siltstone grey, very fine grained, poorly bedded ...	75
Shale grey, medium grained, massive with minor thin interbeds of fissile grey shale, drift plant fragments, fine crossbedding, flute casts at N85°E, one thin conglomerate bed 6 ft. from base of this unit	190
Siltstone grey to greenish grey, fine grained, poorly bedded, choppy crossbedding	255
Sandstone grey to buff, medium grained feldspathic 5" bedding, plant debris	8
Siltstone grey to greenish grey, fine grained, poorly bedded	175
Shale dark grey, fissile, brittle, calcareous...	100

Feet

Siltstone	greenish grey, flaggy, one interbed of fine grey sandstone with pyrite concretions	50
Shale	dark grey, fissile, silty	50
Fault zone ...	massive, buff, arkose, probably belonging to the Craignish formation faulted in	?
Sandstone	greenish grey, fine grained, micaceous fine crossbedding	8
Shale	dark grey, fissile, thin limestones with cone in cone structures rowards the top	80
Sandstone	grey to greenish grey, fine grained, local lenses of fine conglomerate	6
Conglomerate .	greenish grey, arkosic matrix, pebbles of grey quartz and pink granite	6
Sandstone	greenish grey, fine grained	6
Shale	grey, fissile	8
Sandstone	greenish grey, fine grained, scattered conglomerate lenses	10
Conformable contact with underlying McLeod Member		
Thickness of Strathlorne Member		1077

This figure is in very close agreement with the 1050 feet measured by Murray (1955, 1960) on the Southwest Mabou River. The following section of Strathlorne strata was measured by the author on the Graham River, five miles south of Judique Intervale Brook.

Graham River (Section No 2 figure 3)

STRATHLORNE MEMBER OF THE STRATHLORNE-AINSLIE FORMATION

	Feet
Siltstone grey, fine grained, fissile, minor zones of grey fissile shale and interbeds of dense grey, well bedded siltstones....	170
Concealed	170
Sandstone red-brown, fine grained	8
Concealed	30
Sandstone red-brown, fine grained	5
Concealed	30
Sandstone red-brown, very fine grained	5
Concealed	70
Sandstone buff, fine grained, massive	5
Concealed	20
Sandstone brown, fine grained, well crossbedded....	20
Shale dark grey to black, fissile	20
Sandstone fine to medium grained, thinly bedded, well bedded	40
Shale grey, fissile, minor faulting	50
Sandstone grey, fine grained, well bedded, choppy crossbedding	30
Concealed	80
Sandstone greenish grey, coarse grained, feldspathic	10
Sandstone grey, fine grained, choppy crossbedding, 10" bedding	12

	Feet
Concealed	50
Sandstone grey, fine grained, thinly bedded	55
Siltstone grey, very fine grained to fissile, grey shale	<u>50</u>
Thickness of Strathlorne Member	920

THE AINSLIE MEMBER OF THE STRATHLORNE-AINSLIE FORMATION IN THE WHYCOCOMAGH AREA

Lying stratigraphically above and in conformable contact with the Strathlorne member is a succession of red and grey clastic sedimentary rocks varying in thickness from 1632 feet to 1820 feet. This sequence here referred to as the Ainslie member, is the highest rock stratigraphic unit in the Horton group, and is overlain by the basal Windsor A₁, laminated limestone.

Massively bedded and crossbedded red-brown and buff sandstones, with red and grey siltstones and very minor grey shales are predominant lithologies. Limestone beds occurring within the Ainslie sequence in the Lake Ainslie area to the north were not observed in the Whycocomagh area. An overall increase in grain size is noted in comparison to the finer, grey, clastic rocks of the underlying Strathlorne member. It appears that a rejuvenation of erosional profiles took place, possibly by renewed uplift of

source areas. A change in climatic conditions also seems evident due to the increase of red beds in this sequence.

Depositional environments are thought to have included deltas and river deposits accumulated on broad alluvial plains. Lack of marine fauna and marine lithologies, coupled with rapid facies changes and thicknesses of red beds indicate that accumulation took place entirely under fresh water conditions. The first marine influx into Carboniferous basin occurred during deposition of the overlying Windsor group.

The following sequence of Ainslie beds was measured by Murray (1955, 1960) on the Southwest Mabou River.

Southwest Mabou River (Section No 1 figure 3)

AINSLIE MEMBER

	Feet
Conformable contact with basal Windsor A ₁ limestone	
Sandstone grey, fine grained	10
Siltstone red-brown	55
Sandstone grey, very fine grained	20
Siltstone red-brown	20
Sandstone grey, very fine grained	20
Siltstone red-brown, medium crossbedding	35
Sandstone grey, very fine grained	10
Siltstone red-brown	20

Feet

Sandstone	 grey, fine grained, crossbedded	10
Siltstone	 red-brown	30
Sandstone	 grey, very fine grained	10
Siltstone	 red-brown	30
Sandstone	 grey, very fine grained	5
Siltstone	 red-brown	15
Sandstone	 grey, very fine grained	25
Siltstone	 red-brown	35
Sandstone	 grey, fine grained	10
Siltstone	 red-brown	30
Sandstone	 grey, fine grained	20
Sandstone	 red-brown, fine grained	100
Sandstone	 grey, fine grained	25
Sandstone	 red-brown, fine grained, one coarse grained red-brown sandstone interbed near base	50
Sandstone	 red-brown, fine grained	55
Siltstone	 grey, fine grained	15
Sandstone	 grey, fine grained	10
Sandstone	 red-brown, fine grained	30
Sandstone	 grey, medium to coarse grained	25
Sandstone	 red-brown, medium to coarse grained	15
Siltstone	 grey	10
Siltstone	 red and grey, rapidly alternating	20
Sandstone	 grey, fine grained	10

Feet

Siltstone red and grey, rapidly alternating	30
Siltstone grey	10
Sandstone red-brown, fine grained	30
Siltstone grey	30
Sandstone red-brown, fine grained	25
Concealed	30
Shale	20
Siltstone grey	70
Sandstone grey, fine to coarse grained	20
Siltstone grey	20
Siltstone red-brown	20
Sandstone red-brown, fine grained	20
Concealed	70
Siltstone red-brown	10
Sandstone red-brown, fine grained, becoming coarse towards the base	20
Sandstone grey, fine grained, minor grey silt interbeds and one zone of coarse grey sandstone	100
Sandstone red-brown, fine grained	70
Siltstone red-brown	30
Shale	20
Siltstone grey	40
Concealed	40
Sandstone red-brown, fine grained, becoming coarse towards the base, graded	60

	Feet
Siltstone grey	10
Sandstone red-brown, fine grained	80
Siltstone red-brown, very fine grained	20
Concealed	75
Sandstone red-brown, fine grained	60
Conformable contact with underlying Strathlorne Member	

Thickness of Ainslie Member1820

The author measured the following section of Ainslie strata on the Judique Intervale Brook.

Judique Intervale Brook (Section No 3 figure 3)

AINSLIE MEMBER

	Feet
Concealed to basal Windsor A ₁ limestone	600
Sandstone red-brown, fine grained, poorly bedded ..	15
Siltstone greenish grey, minor grey shale	15
Siltstone red and green mottled	6
Sandstone red-brown, fine grained, flaggy to massive	120
Siltstone grey	4
Sandstone red-brown, fine grained, massive	18
Siltstone grey, very fine grained, fissile	70
Sandstone red-brown, fine grained, flaggy	6

	Feet
Siltstone grey, fine grained	7
Mudstone red-brown, green mottling, poorly bedded	70
Sandstone red-brown, fine grained, crossbedded	18
Siltstone grey, very fine grained, thick bedded to fissile	12
Sandstone red-brown, fine grained, feldspathic massive	8
Concealed	50
Sandstone red-brown, fine grained, massive	140
Shale grey, fissile, with interbeds of fine grained, greenish grey sandstone	20
Sandstone red-brown, fine grained, massive	5
Shale dark grey, fissile	20
Concealed	175
Sandstone red-brown, massive	20
Concealed	80
Shale grey, fissile	3
Sandstone red-brown, fine grained, well bedded	6
Siltstone grey, very fine grained	2
Concealed	80
Siltstone grey, fine grained, poorly bedded to fissile	6
Shale red and grey, poorly bedded	30
Siltstone red-brown, crumbly to flaggy in places ..	16
Sandstone reddish grey, fine to medium grained massive	10

Feet

Thickness of Ainslie Member1632

The following section of Ainslie strata was
measured on the Graham River.

Graham River (Section No 2 figure 3)

AINSLIE MEMBER

	Feet
Basal Windsor A ₁ laminated limestone	
Concealed	530
Siltstone red and green mottled, deeply weathered	8
Concealed	320
Sandstone red-brown to buff, fine grained, massive and large scale crossbedding	80
Concealed	90
Sandstone buff, fine to medium grained, massive at base, grading upward to flaggy bedding, crossbedding common	30
Sandstone red-brown, fine grained, massive	35
Concealed	50
Sandstone red-brown to buff, very fine grained, massive	55
Sandstone buff, fine grained, massively bedded to flaggy crossbedding	50
Siltstone red-brown, very fine grained, fissile and shaly	15

Feet

Sandstone red-brown, fine grained	40
Siltstone red, fissile, shaly	10
Sandstone red-brown, fine grained, mostly massively bedded, a few thinly bedded zones, large scale crossbedding	360
Concealed	25
Sandstone red-brown to buff, fine grained, poorly bedded	10
Conformably contact with underlying Strathlorne Member	_____
Thickness of Ainslie Member	1708

RESULTS OF SPORE ANALYSIS OF SAMPLES SUBMITTED

- FROM THE WHYCOCOMAGH AREA -

Results of spore analysis from samples collected from the Horton group (and identified by M.S.Barss) in the Whycocomagh area indicate the presence of at least three and possibly more spore zones within the Horton group. These zones (in descending order) are: "A" zone characterized by Pustulatisporites pretiosus Playford and Vallatisporites spp; "B" zone, characterized by an acme of Vallatisporites with no Pustulatisporites being present; and zone "C", characterized by Nodatitriletes, sp and minor Vallatisporites spp.

On the Southwest Mabou River section, samples collected by the Geological Survey of Canada, Coal Research

Division indicate that "A" zone extends from the Horton - Windsor contact downsection 2600 feet. At this point, 265 feet stratigraphically above the base of the Strathlorne member, spores characteristic of "B" zone were present. (see figure 15). "B" zone continues stratigraphically downsection for a distance of at least 1400 feet. (Geological Survey of Canada, samples 715, 716 - see figure 15) or 1125 feet below the Strathlorne-Ainslie - Craignish formation contact. Unfortunately, no samples containing "C" zone spores were identified and thus the lower boundary of the "B" zone cannot as yet be determined on this section.

Four samples from the Judique Intervale Brook were submitted, C47, C45, C41, and C40. Of these, only sample C45, collected 1200 feet stratigraphically below the Horton-Windsor contact contained spores. The presence of Pustulatisporites pretiosus and Vallatisporites spp. indicate "A" zone. The sample contained the following species:

<u>Pustulatisporites pretiosus</u>	Playford
<u>Vallatisporites vallatus</u>	Hacquebard
<u>Vallatisporites verrucosus</u>	Hacquebard
<u>Spinozonotritetes uncatus</u>	Hacquebard
<u>Raistrickia clavata</u>	(Hacquebard) Playford
<u>Perotrillites perinatus</u>	(Hacquebard) Playford
<u>Grandispora echinata</u>	Hacquebard
<u>Convolutispora flexuosa</u>	Hacquebard
<u>Raistrickia</u> cf. <u>ponderosa</u>	Playford
<u>Convolutispora</u> cf. <u>finis</u>	Love
<u>Anapiculatisporites</u> cf. <u>ampultaceus</u>	(Hacquebard)
	Playford
<u>Punctatisporites</u> <u>irrasus</u>	Hacquebard

Punctatisporites planus Hacquebard
Leiotriletes cf. tortilis Playford

in addition to representatives of the following genera:

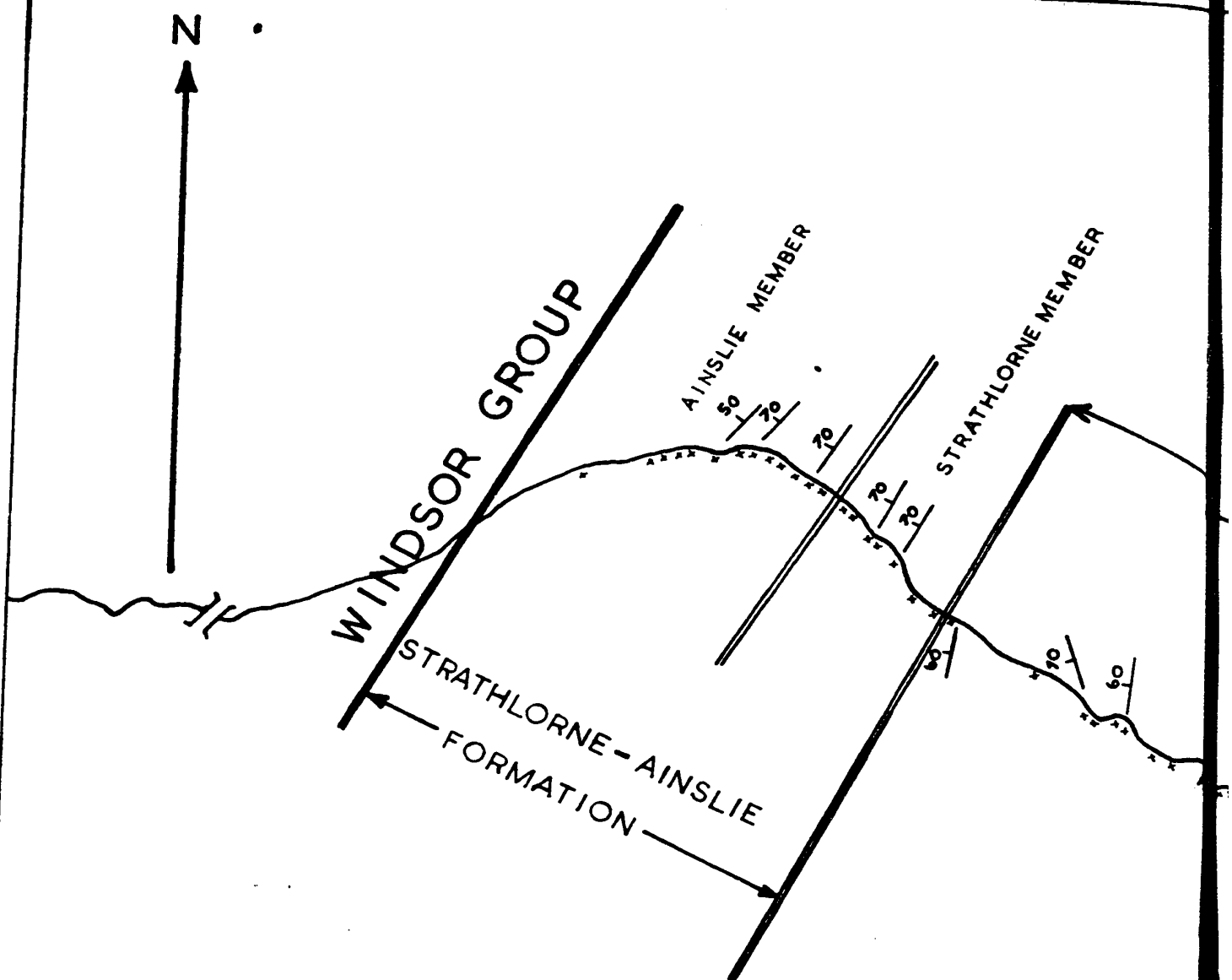
Punctatisporites
Faveosporites
Leiozonotriletes
Perotriletes
Acanthotriletes
Verrucosisporites

Samples submitted from the Graham River Horton section included assemblages characteristic of "A" and "C" zones. Sample C107 collected five feet stratigraphically above the lower contact of the Strathlorne member (see figure 13) carried a typical "A" zone assemblage, including the characteristic types Pustulatisporites pretiosus Playford and various species of Vallatisporites. This sample lies 2600 feet stratigraphically below the Horton - Windsor contact. The remaining two samples, lying 4100 feet and 5500 feet below the Horton - Windsor contact contained Nodatitriletes sp.- a spore characteristic of "C" zone. The lower limit of "C" zone is not at the present time known, but both of the latter two samples lie within the Craginsh formation.

From the foregoing information, it appears that "A" zone extends from the Horton - Windsor contact stratigraphically downsection, a distance of 2600 feet, including on the Graham River, the entire Strathlorne-Ainslie formation, and on the southwest Mabou River all of the latter formation

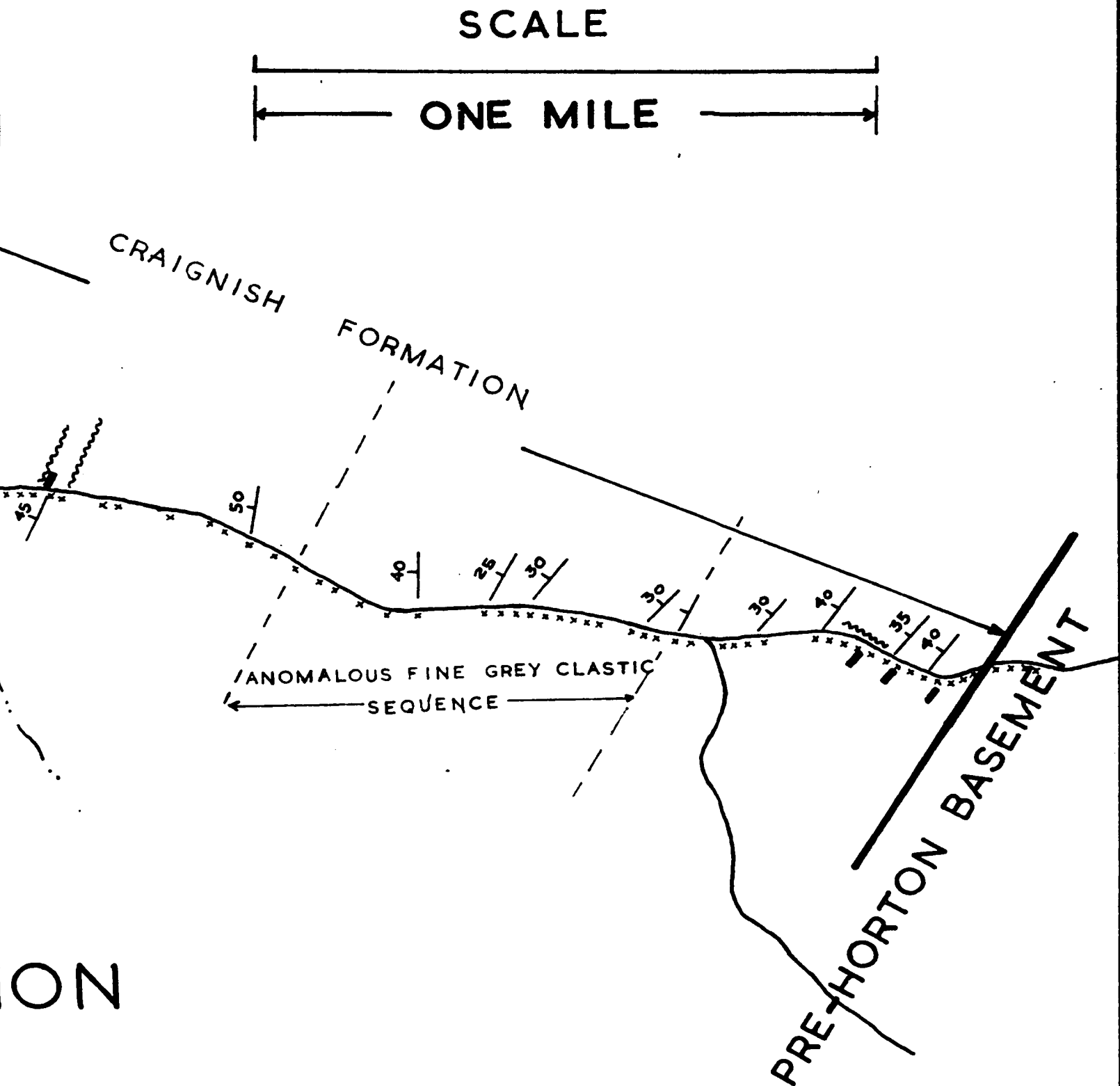
but the lowermost 265 feet. "B" zone, extends down section from the base of "A" zone into the Craginsh formation and includes a thickness of approximately 1400 feet. "C" zone, within the Craginsh formation underlies "B" zone but the base of "C" zone is not at the present time known, due to the lack of identifiable and characteristically different forms in the lower portion of the Craginsh formation.

The results of the spore analysis are shown graphically in figure 13.



THE HORTON GROUP GRAHAM RIVER SEC

FIGURE 4



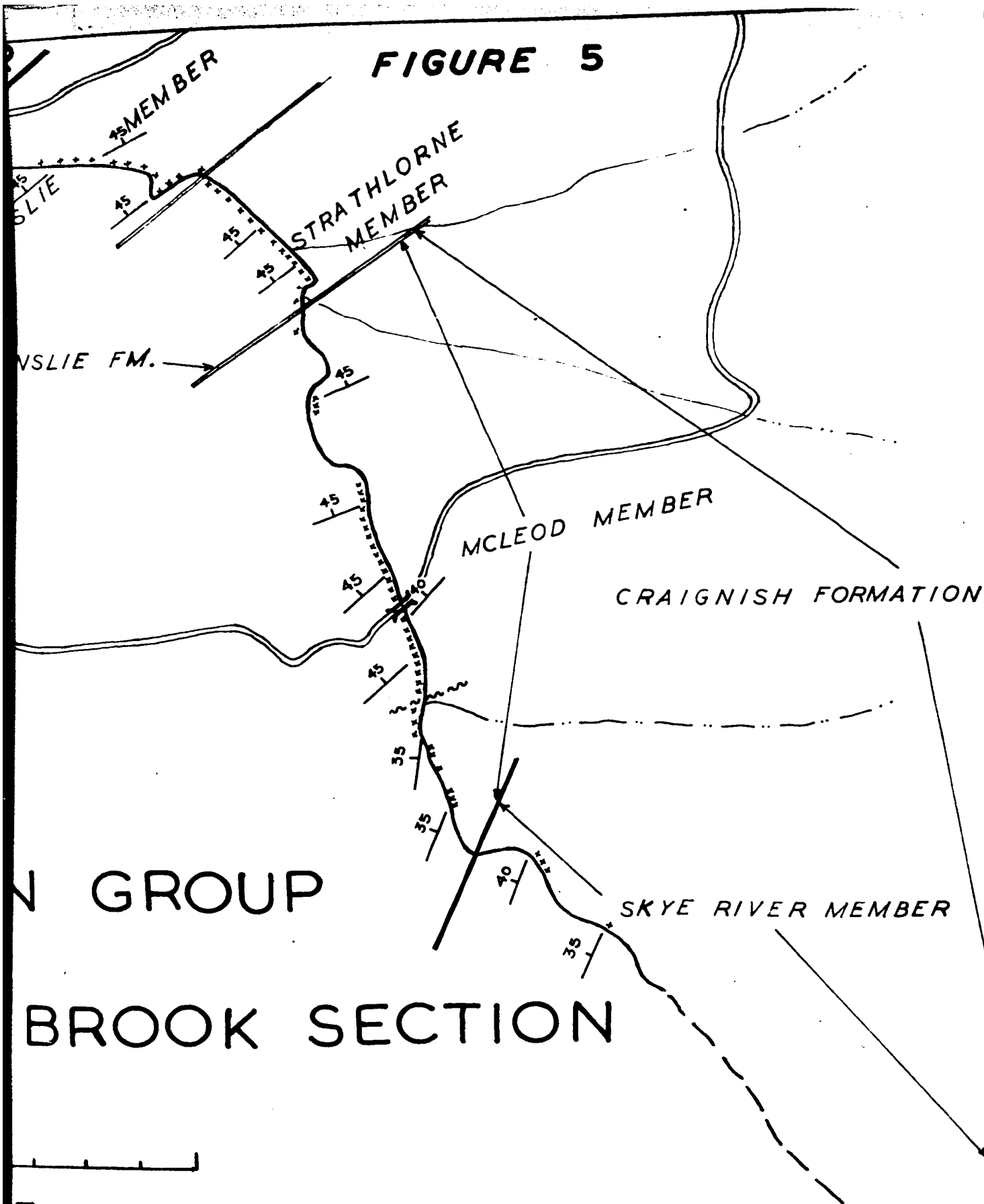
N

WINDSOR G
STRATHLORNE

THE HORTON JUDIQUE INTERVALE

ONE MI

FIGURE 5



N GROUP

BROOK SECTION

CHAPTER 4

THE HORTON GROUP IN THE AINSLIE AREA

INTRODUCTION

The Lake Ainslie area described in this chapter lies north of latitude $46^{\circ} 00'$ and south of latitude $46^{\circ} 15'$. The eastern boundary runs in an oblique line drawn from the basement massif immediately north of Whycocomagh village northeastward to Gillanders Mountain. The coastline forms the western boundary. Thus defined, the Ainslie area comprises approximately 335 square miles, 85 percent of which is underlain by Carboniferous sedimentary rocks. The remaining 15 percent of the area is underlain by Pre-Carboniferous crystalline rocks.

The area derives its name from Lake Ainslie which is about twelve miles long in a northwestward direction with a maximum width of four miles, in the central portion of the area. The lake itself has resulted from the damming of its former outlet through Loch Ban to the seacoast by glacial debris and now empties northward through the Southwest Margaree River.

The nature of the underlying rocks in this district is well reflected in topographic features. Crystalline Pre-Carboniferous rocks invariably form the highest upland surfaces in the region, as for example the Mabou

Highlands and Gillanders Mountain, while all lowland areas and major valleys are developed upon soft strata of the Windsor and Canso groups. Areas underlain by Windsor sedimentary rocks develop a karst topography in the form of numerous sink holes and swamps because of the presence of limestone and gypsum. Areas intermediate between the uplands and lowlands are developed on resistant sedimentary rocks of the Horton group, for example, Mount Young which has an elevation of 800 feet.

The entire area is covered by glacial debris of varying thickness. Outcrops are restricted to rivers, creeks, roadways and the seacoast. Cross country traverses over areas underlain by Carboniferous sedimentary rocks are unproductive due to the glacial covering.

Regional Geology

Carboniferous sedimentary rocks belonging to the Horton, Windsor, Canso, Riversdale and Pictou groups underlie the Lake Ainslie area. In the northwesternmost portion of the area, a sequence of red beds belonging to the Broad Cove formation outcrop. Norman (1935, p.49) states that these beds resemble Permian strata of Prince Edward Island but that they are placed provisionally in the Pennsylvanian as they appear to overlies conformably strata of the Inverness formation (Pictou group).

The Acadian Revolution, toward the close of the Devonian Period, resulted in block faulting and gave rise to a basin and range topography. Deposition in the lower Mississippian, (Horton group) began in various portions of the basin with a series of clastic rocks and interbedded volcanics while elsewhere, basal Horton beds were accumulated as fanglomerate deposits marginal to uplifted crystalline massifs. Probable reworking of these fans dissipated finer clastic rocks over broad alluvial plains. Continued denudation of source areas resulted in more subdued topographic conditions, and the finer clastic rocks comprising the upper portion of Horton sequence were deposited.

Probable continued subsidence of the basin resulted in a marine transgression. It was at this time that strata of the overlying Windsor group were deposited. Numerous gypsum and salt horizons attest to the isolation of portions of the Windsor sea, resulting in conditions conducive to the accumulation of evaporite sequences. There is evidence to suggest that encroachment of the Windsor sea was controlled by topographic features at the close of Horton accumulation, as the Windsor sequence thins over Horton structural highs as on the flanks of the Mull River anticline where subzone E limestone lies only some 200 feet, stratigraphically above subzone A. It thus follows, that the Windsor was non-depositional in areas of higher topographic relief (i.e., above strand line) while contemporaneously in some areas marine limestones and evaporites were accumulating.

Gradual regression of Windsor seas resulted in estuarine and eventually terrestrial environments under which were deposited the sedimentary rocks of the overlying Canso group, (Mabou formation, Norman).

Continued terrestrial conditions existed during the deposition of Riversdale, Pictou and Broad Cove strata.

The following table presents classification and relative ages of Carboniferous sedimentary rocks in the Lake Ainslie area.

TABLE OF FORMATIONS

SYSTEM	GROUP	FORMATION	THICKNESS in feet	GENERAL LITHOLOGY
<u>PERMO-PENN</u>		BROAD COVE	600	Red sandstones Conglomerate
PENNSYLVANIAN	PICTOU	INVERNESS	2500	Massive grey Sandstone Grey shale coal
	RIVERSDALE	PORT HOOD	4500	Massive grey Sandstone Grey shale Coal red siltstones
	CANSO	MABOU	2500 - 8000	Grey fissile silts and shales Thin algal lms Grey and Red Sandstone silts
	WINDSOR		1700	Limestone, Gypsum, Red Sandstone, Siltstone
MISSISSIPPIAN	HORTON	STRATHLORNE -AINSLIE	1100 - 2600	Grey and Buff Sandstone Grey shale very minor lms Red silts
		CRAIGNISH	3200	Arkose, Con- glomerate grey sands, Red Siltstone and Sandstones
		FISSET BROOK	1500	Rhyolite, Andesite arkose Sandstone
PRE- MISSISSIPPIAN		CRYSTALLINE ROCKS		Granite Diorite

FORMER WORK

Oil seepages on the shores of Lake Ainslie have attracted attention since the middle of the last century. Following is a chronological summary of exploration and regional mapping in the Lake Ainslie area since 1874.

- 1874: Two holes drilled by the pioneer Oil and Salt Company on the Isaac farm 1-1/2 miles south of Hays River.
- 1875 - 76: Hole drilled on the western side of Lake Ainslie to a depth of 1100 feet.
- 1888 - 89: I.C.White of Morgantown, West Virginia reported on the petroleum possibilities in the Lake Ainslie area.
Annual report GSC. (1888 - 89)
- 1898: Hole drilled to a depth of 2240 feet on the west side of Lake Ainslie.
- 1902: Holes drilled at Skye Glen and Lake Ainslie to depths of 1100 feet and 3260 feet respectively.
- 1912 - 1914: Five holes drilled by the Maritime Oil and Gas Company Limited on the north side of Lake Ainslie between Dunbar's Brook and Scotsville. Depths of these holes ranged from 800 feet to 1612 feet.
- 1924: De Laat made a rapid reconnaissance of Cape Breton Island for Eastern Gulf Oil Company.

- 1925: K.F.Mather and P.D.Trask, for the Eastern Gulf Company, undertook geological investigations in the Lake Ainslie area and it is at this time, that the first regional attempt at working out the stratigraphy of the Horton group in this area was attempted. Their subdivisions of Horton beds on the Southwest Mabou River are fully treated in the preceding chapter on the Whycocomagh area, but they did extend their subdivisions northward into the Lake Ainslie region.
- 1926: W.A.Bell (1926) mapped the area immediately around Lake Ainslie as part of a study of the prospects for commercial petroleum production in that area. Comments on the occurrence of barite and granite were also outlined in his report. This work, resulted in, a truly regional study of the Horton group in the Lake Ainslie district, for the first time, and the published map clearly defined the areal extent of the Horton in this area. Further, Bell attempted a two-fold subdivision of the Horton group: (a) Upper Horton series comprised of massive sandstones, ripple marked sandstones, siltstones and shales, with thick red and grey arkoses and conglomerates at the base; (b) Lower Horton series comprised of siliceous shales,

quartzites and sandstones. Lower Horton strata were reported on Sloy Brook, two miles northeast of the Lake Ainslie outlet and, according to Bell, these were the only lower Horton beds exposed in the Lake Ainslie district. Numerous sections of upper Horton strata were reported and the contact with the overlying Windsor "series" was described. Correlation of all these strata with the Horton series type area was based on their stratigraphic position below the Windsor, and on the presence of Lepidodendron corrugatum and Sporangites glabra.

1927 - 28 - 29: G.W.H. Norman mapped the Lake Ainslie quadrangle for the Geological Survey of Canada and subdivided Horton strata into upper and lower "groups".

Coarse-grained arkoses, pebble conglomerates, with interbeds of red and grey shale outcropping on the Southeast Mabou River and attaining a thickness of 2400 feet, were placed by Norman in his lower group. Lithologically similar strata were observed to extend from this section northeastward towards and beyond Skye Glen East as well as occupying the axial region of the Mount Young anticline. Further, Norman noted lower Horton beds due north of Lake Ainslie, and northeast of the lake in the vicinity of Mount Pleasant Brook. Reddish brown pebble conglomerates outcropping

along the flanks of the Mabou Highlands were considered by Norman to belong to his lower unit. It is of interest to note that pebbles from these conglomerates contain Silurian fossils. Lying above the coarse lower unit, clastic rocks on the Southeast Mabou River is a sequence of predominantly fine, grey and buff clastic rocks. It was this succession which Norman included in his upper Horton unit, which according to Norman (p. 28) attains a thickness of 3190 feet. Distribution of the upper unit was noted throughout the Lake Ainslie area, but no attempt to show the regional outcrop pattern of either this upper or lower unit was attempted on the geological map accompanying his memoir. Depositional environments of the Horton were considered to be entirely terrestrial and Norman states that accumulation took place along flood plains of streams and rivers, and as torrential outwash from upland regions. Rapid changes in lithology; abundance of ripple marks; mud cracks; the preservation of plant rootlets in situ; the presence of numerous plant fragments and the absence of marine fossils and thick limestones were the criteria for the suggested terrestrial environment.

Norman also considered that the presence of coarse clastic rocks at the base of the Horton sequence indicated considerable topographic relief at the beginning of Horton deposition and that the progressively finer clastic rocks resulted from a gradual denudation of these positive areas.

Norman noted that Horton strata overlies unconformably crystalline basement rocks throughout the Lake Ainslie area, with the exception of sections exposed along Cooper Brook, Trout Brook and Black Brook, east of Lake Ainslie. Here, a conformable contact between basal Horton clastic rocks and an underlying volcanic and clastic rock sequence was noted. The volcanic sequence was considered to be pre-Horton in age. The upper contact of the Horton "series" was placed at the base of the A₁ laminated Windsor limestone. Thus with upper and lower contacts defined, Norman stated that pre-Windsor strata in the Lake Ainslie area occupied a stratigraphically similar position to Horton strata elsewhere in Nova Scotia.

1956: R.O.Grieve, J.V.Hill and G.Jackson (Imperial Oil Company Limited) mapped the Mount Young and Mull River anticlinal structures and subdivided the

Horton group into a lower, middle and upper unit. The lower unit comprised, for the most part, coarse arkoses and conglomerates; the middle unit of fine, predominantly red, clastic rocks; the upper of fine to medium, grey, clastic rocks.

1960: D.G. Kelley of the Geological Survey of Canada remapped portions of the Horton group in the Lake Ainslie area in an attempt to extend Murray's (1955) subdivisions northward into the area from the Horton type section on the Southwest Mabou River. The results of this study are not as yet published.

RECENT FIELD WORK

During the latter portion of the 1957 and for the entire 1958 field season, a study of the Horton group was undertaken in the Lake Ainslie area while the author was in the employ of Imperial Oil Company Limited. This was carried out with a view to subdividing Horton strata into distinct lithological units, mapping the areal distribution of these units, and finally ascertaining, where possible, the characteristics of each unit within the Ainslie area. The results of this study aided in the understanding of structural and environmental conditions during sedimentation. During

the field season, all areas of Horton outcrop were visited. Pace traverses were made of all major creek and river sections while some of the more important and continuous sections were described and measured in detail using a plane table. In the summer of 1963, the Lake Ainslie area was briefly revisited. Initially, three major subdivisions of the Horton were made; these being lower, middle and upper units. The upper unit was further subdivided into A, B, C, and D members. It must be noted that while this division of the Horton group was mappable in parts of the Lake Ainslie area, it was difficult to extend these subdivisions northward into the Margaree-Cheticamp area. It is partially because of this, that a more simplified major three-fold division is now suggested. The basal volcanic and sedimentary sequence of the Fisset Brook formation (MacKasey) were not investigated by the author. The results obtained during the 1957, 1958 and 1963 field seasons constitute the material presented in this chapter, while the included table illustrates the evolution in stratigraphic terminology with regard to the Horton group in the Lake Ainslie area.

Table No. 4

90a

MATHER and TRASK - 1925	BELL 1926	NORMAN 1927 - 29	MURRAY 1955	GRIEVE 1956	COTE 1959	COTE 1963
UPPER DUNBAR	UPPER HORTON	UPPER HORTON	GLENCOE MEMBER McISAAC POINT MEMBER	UPPER HORTON	MEMBER D MEMBER C MEMBER B Upper Horton	AINSLIE MEMBER Strathlorne-Ainslie Formation
MIDDLE DUNBAR	UPPER GROUP	UPPER HORTON	Strathlorne Formation	GREY BED SERIES UPPER HORTON	MEMBER A	STRATH- LORNE MEMBER
LOWER DUNBAR RED BEDS			McLEOD MEMBER	MIDDLE HORTON	MIDDLE HORTON	McLEOD MEMBER
KEWSTOKE CONGLOMERATE	LOWER GROUP	LOWER HORTON	SKYE RIVER MEMBER	LOWER HORTON	LOWER HORTON	SKYE RIVER MEMBER
			Craignish Formation			Fisset Brook Formation

AREAL DISTRIBUTION OF THE HORTON GROUP IN THE LAKE AINSLIE AREA

Approximately 160 square miles in the Lake Ainslie area are underlain by sedimentary rocks of the Horton group. This represents a total outcrop area of 55 percent of the Carboniferous basin. Three major separate outcrop belts exist and are as follows:

- (A) Horton sedimentary rocks immediately fringing upon crystalline rocks along the Whycocomagh - Gillanders Mountain belt;
- (B) upfolded anticlinal belt of the Mull River, Mount Young and North Lake Ainslie;
- (C) Horton strata on the flanks of the Mabou Highlands. These outcrop areas are separated by essentially synclinal structures occupied by younger Windsor and Canso rocks.
(See plate 1)

UPPER AND LOWER BOUNDARY RELATIONSHIPS

Horton strata rest upon crystalline rocks ranging in age from possible Precambrian to Devonian with sharp disconformity. Basal volcanics and coarse clastic rocks of the Fisset Brook formation were described by MacKasey (1963) near the headwaters of Cooper Brook, northeast of Lake Ainslie (see plate 1 unit 2a). Here, the Fisset Brook

beds overlies the crystalline rocks with disconformity, and it is this surface that marks the base of the Horton group as here defined. Spores collected from these beds include the following types in the Margaree-Ghetticamp area:

Leiotriletes sp.
Calamospora sp.
Punctatisporites spp.
Granulatisporites sp.
Cyclogranisporites spp.
Apiculatasporites sp.
Endosporites sp.
Grandispora spp.
Perotriletes spp.
Reticulatisporites spp.
Conuolutispora spp.
Phyllothecotriletes spp.
cf. Acanthotriletes spp.
cf. Chaetosphaerites spp.
Hystricosporites spp.

and indicate a lowermost Mississippian age for these beds. Immediately south of Lake Ainslie in the vicinity of the Southeast Mabou River, coarse conglomerates and arkoses of the Craignish formation overlie crystalline rocks with unconformity, the Fisset Brook formation not being present. On the western side of the Mabou Highlands, strata similar to the Fisset Brook sequence are placed provisionally in this formation (see plate 1 2a). At this locality, however, contact relations with the older crystalline rocks are obscured by faulting.

Thus, although localities where the basal Horton contact can be directly observed are scarce in the

Lake Ainslie area, there is little doubt that Horton sedimentary rocks of either the Fisset Brook formation or the Craignish formation are separated from pre-Horton igneous and metamorphic rocks with unconformity. Norman (1935, p. 22-23) stated that the volcanic rocks and intercalated sedimentary rocks of the now recognized Fisset Brook formation may be Horton in age (Mississippian), but that it seemed more probable that they were Devonian. The spore assemblage suggests a lowermost Mississippian age but irrespective of this, a pronounced unconformity appears to be a more natural and easily recognized base than some arbitrarily chosen point within a conformable sequence. Further, as long as one uses the term "group" for the Horton, i.e. a rock stratigraphic unit rather than a time stratigraphic unit, it is of no consequence if some of the basal Fisset Brook beds are Devonian.

The upper contact of the Horton group can be observed at many locations in the Lake Ainslie area. Here as in the Whycocomagh area to the south, a very distinctive laminated limestone (basal Windsor A₁) overlies the Horton beds conformably to non-conformably. This basal Windsor limestone can be easily identified in all portions of the Lake Ainslie area, and thus serves as an excellent marker horizon at which to place the upper Horton contact.

On the Southeast Mabou River, at Miramichi Dam, 40 feet of basal Windsor laminated limestone disconformably overlies red brown crumbly siltstones of the Horton. Along the flanks of the Mount Young-Mull River anticlinal trend, the Horton - Windsor contact can be readily observed. On the western shore of Lake Ainslie immediately north of Skye Glen East, (western flank of Claverhouse anticline), basal Windsor limestones disconformably overlies grey, fine grained siltstones of the Horton group. From Matheson Glen Brook (north of Doherty Cove) northward to the northern boundary of the Lake Ainslie area, the Horton - Windsor contact can be observed on many of the streams flowing east from Gillanders Mountain into the Southwest Margaree River. South of Findlay Point, on the outer coast of the Mabou Highlands basal Windsor laminated limestones lie with angular unconformity on red brown arkoses and massive conglomerates of the Horton.

With upper and lower boundaries as described, strata belonging to the Horton group occupy a distinct stratigraphic position in the Carboniferous sequence. It may be that some of the lowermost Horton beds are upper Devonian in age, but as long as one is careful to define the Horton sequence as a rock stratigraphic unit, no error in terminology and in actual time concept will exist. It is

for this reason that the term Horton series (Bell 1926; Norman 1927-29) is replaced in this thesis by the term Horton group.

THE FISSET BROOK FORMATION

The Fisset Brook formation derives its name from the type locality of this sequence exposed on Fisset Brook in the Margaree-Cheticamp area, north of the Lake Ainslie area. The type section is described by MacKasey (1963, pp. 17-64) and will be covered in more detail in this work in Chapter 5 dealing with the Margaree-Cheticamp area. (See figure 2)

The oldest rocks of the Horton group in the Lake Ainslie area belong to the Fisset Brook formation, a sequence of interbedded volcanic and clastic rocks which overlie disconformably crystalline rocks. MacKasey (1963) described these rocks as they outcrop on Cooper Brook northeast of Lake Ainslie (see figure 6).

DISTRIBUTION OF THE FISSET BROOK FORMATION

IN THE LAKE AINSLIE AREA

Outcrops of the Fisset Brook sequence are found on Gillander's Mountain northeast of Lake Ainslie. Lithologically similar sequences are present on two separated uplands on the eastern side of Lake Ainslie between the Lake and Gillander's Mountain; on an upland south of

Lake Ainslie; and on the western portion of the Mabou Highlands. MacKasey measured only the section in the Gillander's Mountain area on Cooper Brook but placed lithologically similar sequences of the other areas as determined by Norman (1935) in his Fisset Brook formation. In this thesis, areas other than the Cooper Brook sequence are placed provisionally in the Fisset Brook formation and are shown by the symbol 2A? on plate 1.

UPPER AND LOWER CONTACTS OF THE FISSET BROOK FORMATION IN THE LAKE AINSLIE AREA

G.W.H. Norman (1935, pp. 20-23) described volcanic and clastic rocks lying below what he considered to be rocks of the Horton series on Cooper Brook, and other localities in the Lake Ainslie area. Norman further states that these rocks are definitely younger than Precambrian intrusive rocks, because of the unmetamorphosed condition of this sequence and the presence of diorite and granite boulders from the crystallines in the basal conglomerates. Although the basal contact on Cooper Brook is concealed, Norman (1935, p. 21) states that the basal conglomerate of his sequence rests unconformably upon diorite. MacKasey (1963, p. 69) reports that the contact is visible on Cooper Brook, and that a thin andesite flow lies beneath Norman's basal

conglomerate and is in nonconformable contact with the underlying diorite. Norman (1935, p.21) reports a basal sedimentary breccia unconformably overlying diorite on a small tributary of Mount Pleasant Brook, 1-1/2 miles east of the Keploch post office. As far as is known at present, these are the only two localities where the basal contact of the Fisset Brook formation is exposed in the area.

Elsewhere, the contact is not exposed, or beds of the Fisset Brook lie in fault contact with the underlying crystalline rocks, as for example, the western portion of the Mabou Highlands. However, there seems little doubt that the lowermost contact is of a disconformable nature.

The upper contact is readily observed east of Lake Ainslie in the vicinity of Gillander's Mountain. Norman (1935, p. 22-23) arbitrarily draws the upper contact of the volcanic clastic rock sequence at the highest recognized horizon of volcanic rocks. Horton clastic rocks of the overlying Craignish formation overlies these beds conformably, and Norman states that the succeeding rocks (of the Craignish) are lithologically indistinguishable from the clastic rocks intercalated with the underlying volcanics. MacKasey (1963) does not state clearly what he considers to be the upper contact of the Fisset Brook beds, but from his illustration (see figure 6) it is evident that he, like Norman, considers that the highest volcanic bed

marks the upper contact.

In summary, the Fisset Brook formation occupies a readily defined stratigraphic position in the Carboniferous (?) sequence of the Lake Ainslie area. The lower contact is an unconformity with underlying crystalline rocks. The upper contact is conformable with the overlying clastic rocks of the Craginsh formation.

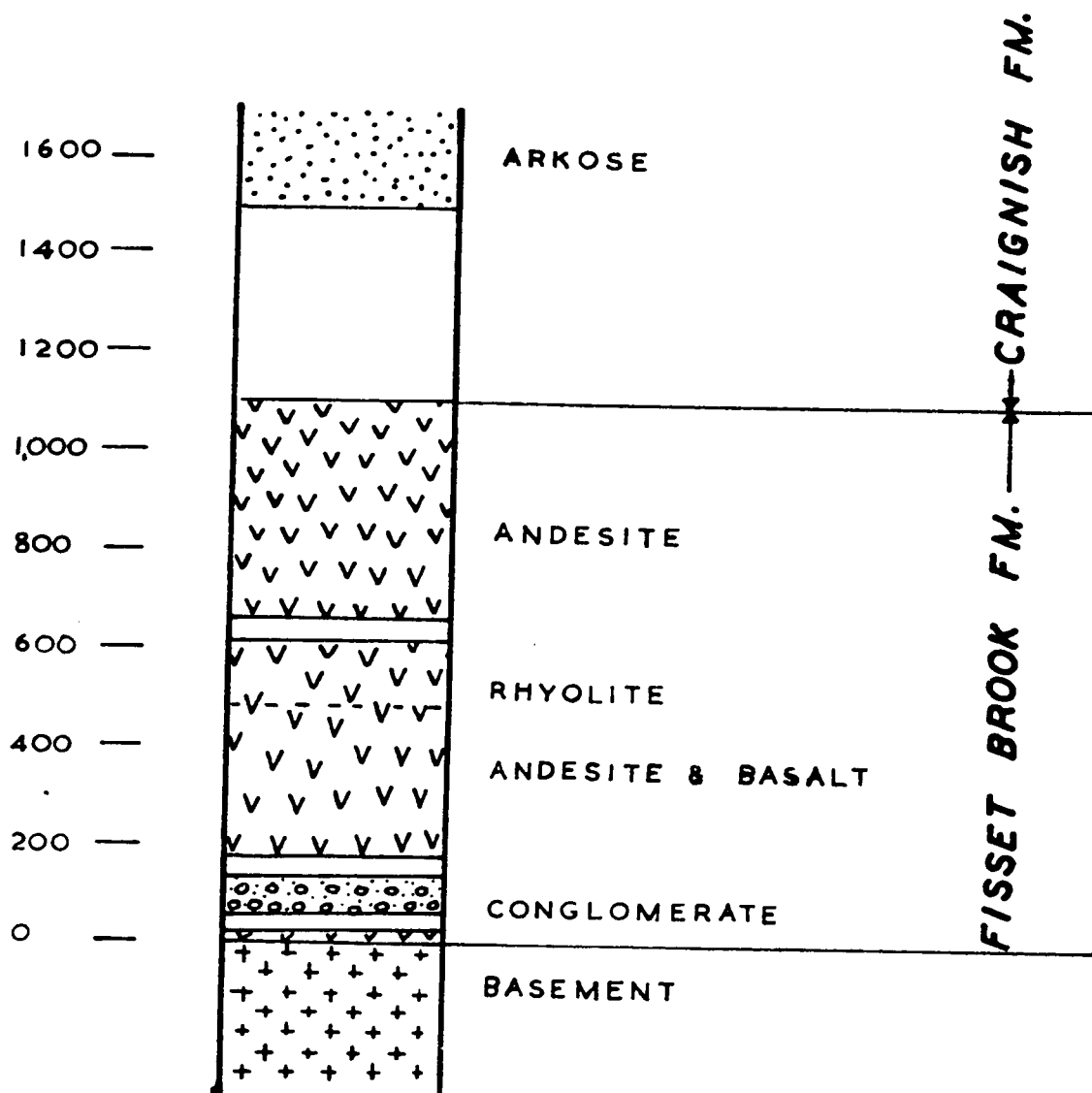
STRATIGRAPHY OF THE FISSET BROOK FORMATION IN THE LAKE AINSLIE AREA

The Fisset Brook sequence is best observed on the headwaters of Cooper Brook, because the Brook at this locality cuts across the strike of the beds almost at right angles. Here, volcanic and sedimentary rocks are nonconformably underlain by crystalline basement rocks and are overlain by structurally conformable clastic rocks of the Craginsh formation. The Fisset Brook sequence on Cooper Brook is approximately 1500 feet thick, (MacKasey, 1963). Norman (1935, p.2) reports a thickness of 3000 feet of Fisset Brook beds but admits that this thickness may be high due to repetition of beds by faulting. MacKasey's figure is in close agreement with his measured thickness on the type section of 1000 feet.

The basal bed of the Fisset Brook sequence of

Cooper Brook is a thin andesite flow. Succeeding this basal unit are 200 feet of grey and red sandstone with a basal conglomerate with well rounded boulders of diorite, some two feet in length, (Norman, 1935, p. 21). MacKasey (1963, p. 69) further describes the basal conglomerate as being "polymictic and composed of diorite, maroon and green schist and limestone pebbles, all loosely packed in a gritty coarse-grained arkosic matrix". Overlying these clastic rocks are approximately 700 feet of volcanics with minor interbeds of red siltstone. MacKasey (1963, p.71) reports that this basic lava sequence is divided into two units by a middle rhyolite member. The lower basic lava is an amygdaloidal andesite and basalt, while the basic flows above the rhyolite zone are predominantly amygdaloidal andesite. The aphanitic rhyolite zone is 100 feet thick, the lower portion being laminated; the upper portion is massive. The following figure shows the general lithology of the Fisset Brook formation on Cooper Brook.

FIGURE 6

FISSET BROOK FORMATION**COOPER BROOK SECTION**

AFTER W.O. MACKASEY

AGE OF THE FISSET BROOK FORMATION
IN THE LAKE AINSLIE AREA

With respect to age, Norman (1935, p.22) stated that "The pre-Horton volcanics and sediments in the eastern upland (Cooper Brook Area) are definitely younger than the Precambrian intrusive rocks "The volcanic rocks and closely associated sediments may be of Horton age, but it seems more probable that they, and possibly some part of the immediately overlying sediments (represented on the Lake Ainslie sheet as belonging to the Horton series), are of Devonian age as indicated by later studies by W.A. Bell in the Boisdale Hills, Cape Breton."

Mackasey (1963, p. 76) correlates the rocks on Cooper Brook with his Fisset Brook type section for the following reasons:

- "(1) Similar stratigraphic position: post-granite rocks, pre-Horton group.
- (2) Similar stratigraphy: basal sedimentary rocks overlain by volcanic flow rocks.
- (3) Similar lithology: polymictic conglomerates, fine grained clastic rocks with fossil plant fragments. Dominantly andesitic with minor basaltic flows. Rhyolitic rocks."

The author agrees with MacKasey and correlates these rocks with the Fisset Brook type section but now includes this formation within the Horton group as its basal formation.

Norman, 1935, in designating the Horton sequence as a series, implies a time connotation which in the opinion of the writer is not warranted, due to the largely unfossiliferous nature of Horton sedimentary rocks. Thus, the Fisset Brook beds now become a "downward" extension of what is considered to be Horton lithology, and the writer is using the term group implying only a rock stratigraphic unit, the base of which is placed at the unconformable-disconformable contact between Fisset Brook and underlying crystalline rocks.

No identifiable fossil plants or spores have been collected from the Fisset Brook formation in the Lake Ainslie area; however, lithologically similar rocks, occupying a similar stratigraphic position in the Margaree-Cheticamp area have yielded spores which tentatively indicate an age of lowermost Mississippian. The age relationships of the Fisset Brook in the Margaree-Cheticamp area are more thoroughly discussed in the succeeding chapter dealing with that area.

THE CRAIGNISH FORMATION

DISTRIBUTION OF THE CRAIGNISH FORMATION

IN THE LAKE AINSLIE AREA

A sequence of predominantly coarse grey and red clastic rocks which belong to the Craginsh formation of the Horton group conformably overlies the Fisset Brook formation. The formation as defined by Murray (1955,1960)

is divided into two members, the Skye River below and the McLeod above. This subdivision is retained in this thesis, and locations within the Ainslie area where these members can be observed are shown on plate 1 and denoted by the symbols "Sk" (Skye River) and "M" (McLeod)

The distribution of the Craignish formation in this area is shown by the symbol "2b" on plate 1. Strata of the Craignish occupies the axial position of the Skye Glen anticline as well as the axial positions of the Mull River and Mount Young anticlines. A broad linear belt of Craignish sedimentary rocks extends northward from the basement mass north of Whycocomagh Village, across the valleys of Trout, Matheson Glen and Mount Pleasant Brooks, east of Lake Ainslie. Well exposed sections of the Craignish can be observed in all the foregoing streams. A portion of the upland, north of Lake Ainslie, between Loch Ban and Doherty Cove, is underlain by Craignish strata. On the eastern flanks on the Mabou highlands, rocks of the Craignish outcrop.

UPPER AND LOWER CONTACTS OF THE CRAIGNISH FORMATION IN THE LAKE AINSLIE AREA

The conformable contact between the underlying Fisset Brook formation and the overlying Craignish on Cooper Brook has been discussed in the preceding section and is drawn at the last occurrence of bedded volcanic rocks. On the

Southeast Mabou River, just south of the southern boundary of the Lake Ainslie area, coarse clastic rocks (conglomerates, arkoses) of the Craignish formation overlie with unconformity crystalline basement rocks. The Fisset Brook beds are not present.

Overlying the red sedimentary rocks of the McLeod member of the Craignish formation is a sequence of predominantly grey sandstones, siltstones and shales of the Ainslie-Strathlorne formation. This upper contact of the Craignish is readily observed on the Southeast Mabou River, (see figure 7), where coarse brown sandstones of the McLeod are overlain conformably by dark grey, thinly bedded siltstones and shales of the succeeding formation. On Campbell Mountain Brook, massive red brown fine grained sandstones of the McLeod are overlain conformably by grey, fine grained sandstones of the Strathlorne-Ainslie. The foregoing two localities are the only ones in the Lake Ainslie area where the contact can be observed. North of Lake Ainslie, beds of the McLeod member are in fault contact with the overlying formation, and thus the nature of the boundary is not known.

THE SKYE RIVER MEMBER OF THE CRAIGNISH FORMATION

Epi-orogenic sedimentary rocks of the Skye River member were deposited along the flanks of uplifted basement welts following the Acadian revolution. Conglomeratic buildups

are visible everywhere along the southeastern, eastern, and northern margins of the Ainslie area. These are interbedded with coarse to fine arkosic sandstones and red shale. The sequence as a whole can be described as a somewhat cyclic series of conglomerates, sandstones and thin red shales. The "cyclic" sequence may be due to seasonal changes in transporting stream velocities, but is more probably due to rapid interfingering of dissimilar lithologies resulting from the fanglomeratic nature of these deposits.

The conglomerates vary from greenish grey, probably due to the presence of authigenic chlorite, to brownish buff and red. They vary in grain size from boulder to pebble types and are invariably poorly sorted and extremely lenticular. Bedding is very poorly developed. The most common constituent pebbles, which are well rounded to subangular, are white to greyish white quartz, pink to grey rhyolite, pink granite and grey diorite. The matrix material is arkosic, commonly friable, chloritic and very micaceous. The feldspar is microcline, generally very fresh, angular and pink to salmon red. The mica is most commonly muscovite.

Sandstones in this unit are greenish grey to buff, coarse to medium grained, very feldspathic to true arkoses. In essence, their composition is very similar to the matrix material of the conglomerate lenses. The bedding varies from good to poor, the latter being more predominant, while cementing

material is most commonly a calcareous and chloritic paste. Constituent grains are angular to subangular and sorting is generally poor.

Alternating with the conglomerates and sandstones are beds of lenticular red siltstones and shales. These beds vary from red brown to brick red; all are poorly bedded and most commonly very calcareous. Minor grey shales and siltstones do occur but in general, these form only a small portion of the total lithology.

The following section was measured on the crest of the Mount Young anticline and shows the lithology of the Skye River member in this portion of the Lake Ainslie area. Unfortunately, only 873 feet of Skye River strata are exposed here, and the contact with the underlying crystalline basement rocks is not exposed.

Mount Young Anticline (Section No 5 figure 3)

SKYE RIVER MEMBER OF THE CRAIGNISH FORMATION

	Feet
Covered interval	53
Grey, medium to coarse-grained quartz sandstone grains subangular to subrounded; very slightly calcareous; locally conglomerate with pebbles to 1/2 inch	8
Arkose, Conglomerate, etc. Conglomerate, generally thin-bedded; pebbles to 4"; becomes more arkosic as descend section; shear planes at N32E, -10 to 27 NW	23

	Feet
Grey medium to coarse-grained sandstone and conglomerate; interbedded	42
Covered interval	14
Grey to greenish-grey feldspathic; fine-grained sandstone; considerable sericite; minor thin-laminated, light green, silty shale	22
Grey, medium to coarse-grained arkosic sandstone; very poorly cemented; considerable sericite.....	9
Covered interval	4
Conglomerate, medium to coarse-grained matrix which is very minor part of rock; granules and pebbles to 4", most less than 1"	2
Shaly siltstone, buff to dark-grey with a faint purple tint; much sericite; appears schistose	1
Conglomerate	?
Grey, medium to coarse-grained feldspathic sandstone	?
Conglomerate	7
Medium to coarse grained arkose; thin-bedded	17
Light-grey silty shale; faint green tint; thin-laminated	2
Grey conglomerate; minor grey arkose and feldspathic sandstone	86
Grey shaly siltstone; and very fine to fine-grained feldspathic sandstone; thin laminated.....	2
Coarse-grained grey arkose	12
Concealed interval	27
Light-grey feldspathic sandstone; minor light brown; fine to medium-grained; some is calcareous	58
Concealed interval	28
Light-grey fine to medium-grained feldspathic sandstone; sericite and biotite; also fine and coarse-grained buff feldspathic sandstone	56
Light-grey and buff arkose and feldspathic sandstone; fine to medium-grained; subangular to subrounded grains; come well-lined by biotite, sericite, and muscovite; calcareous and cleavage or jointing in two directions - sheared; few conglomeratic beds with pebbles to 1"; minor grey, medium-grained quartz sandstone	121

Feet

As above, but mainly fine to very coarse-- grained buff arkose and feldspathic sandstone; buff arkosic conglomerate in rather indistinct beds to 3' thick; minor coarse-grained grey arkose	99
Covered interval	8
Medium to coarse-grained buff arkose and feldspathic sandstone; thin-bedded (1/2") to thick-bedded (6'); conglomeratic locally	10
Covered interval	8
Medium to coarse-grained buff arkose, few pebbles to 1/2"	37
Covered interval	22
Coarse-grained buff arkose	9
Covered interval	9
Medium to coarse-grained buff arkose, both fresh pink, and altered white feldspar	22
Covered interval	3
Medium to coarse-grained buff arkose; thin-laminated to thin-bedded; few pebbles to 1"; few greenish-grey shale to 1/10" across	2
Covered interval	2
Medium to coarse-grained buff arkose, few pebbles to 1/2"	2
Covered interval	7
Fine to medium-grained buff arkose and feldspathic sandstone; well lineated biotite and sericite appears sheared but probably just the lineation	26
Covered interval	9
Medium to coarse-grained buff arkose; biotite imparts faint lineation; few pebbles to 5/8" - some of greenish-grey, shale	4
Covered interval	

Massive buff to greenish grey feldspathic and micaceous sandstones with irregular lenses of conglomerate and red sandstone outcrop in a belt east of Lake Ainslie from Trout Brook northward to beyond Mount Pleasant Brook. Bedding in these rocks is generally very poorly developed,

and sorting is visibly poor. Structural complication in this region preclude the measuring of sections in detail even though more or less continuous outcrops of the Skye River beds can be observed in the deeply incised gorges of these stream systems.

North of Lake Ainslie, (more precisely, north of Doherty Cove), strata of the Skye River member outcrop. Here, as in the Mount Young anticline area, the contact with pre-Skye River beds is not seen. The lithology is typical, being comprised of massive feldspathic sandstones with conglomerate lenses for the most part. Continuous but structurally complex sections can be observed on streams south and southwest of Kiltarity.

The following section of Skye River strata was measured on the Southeast Mabou River. (see figure 7)

Southeast Mabou River (Section No 6 figure 3)

CRAIGNISH FORMATION SKYE RIVER MEMBER

	Feet
Arkose greenish grey minor interbeds of red and green mottled siltstone	30
Siltstone grey green and red brown mottled; poorly bedded	135
Arkose red brown to grey massive; poorly bedded..	6
Mudstone red brown; poorly bedded	5
Sandstone greenish grey; very fine grained; well bedded	90
Conglomerate coarse cobbles; well rounded of quartz; pink granite; matrix buff arkose	110

Feet

Sandstone	 greenish grey; coarse grained; feldspathic; micaceous	18
Sandstone	 grey to greenish grey; very fine grained; cross bedded	35
Sandstone	 buff; medium grained; massive conglomerate lenses; large scale cross bedding	130
Sandstone	 red brown - reddish grey; medium grained massive 4' bedding	158
Arkose	 greenish grey; medium grained	53
Sandstone	 red brown; fine grained	24
Siltstone	 brick red; poorly bedded	20
Arkose	 red brown; fine grained	6
Siltstone	 brick red; mottled green; poorly bedded	10
Sandstone	 red brown; fine grained; thinly bedded; micaceous; thinly bedded	10
Sandstone	 reddish grey; medium grained; very feldspathic; 5" bedding	15
Siltstone	 brick red; poorly bedded; crumbly	18
Siltstone	 grey; very fine grained	18
Arkose	 reddish grey; medium grained	24
Sandstone	 greenish grey; fine grained; feldspathic; flaggy; 1" bedding	114
Sandstone	 greenish grey; medium grained; lenticular; very micaceous (30 percent	21
Sandstone	 greenish grey; massively bedded 20"; feldspathic	230
Mudstone	 grey; poorly bedded	21
Sandstone	 grey green; medium grained; weathered well; crossbedded; feldspathic; limonite stained	69
Sandstone	 brownish grey; medium grained lenses of conglomerate	115
Conglomerate	. pebble conglomerate of quartz; pink granite	10
Siltstone	 greenish grey and minor grey mudstone	10
Sandstone	 grey; coarse grained; poorly bedded; feldspathic	5
Mudstone	 greenish grey; crumbly; poorly bedded	6
Sandstone	 greenish grey; coarse grained lenses of conglomerate; very feldspathic	20
Sandstone	 greenish grey; medium grained; very feldspathic	40
Sandstone	 grey very fine grained; well bedded; feldspathic	20
Sandstone	 greenish grey; medium grained; feldspathic; massive	40

Feet

Sandstone	 greenish grey; very fine grained; well bedded	40
Siltstone	 grey; well bedded; thinly bedded to fissile crossbedded	9
Gentle anticlinal fol here		
Sandstone	 greenish grey; coarse grained; very feldspathic; poorly bedded; micaceous	25
Sandstone	 grey; medium to coarse grained; slight reddish tinge; scattered pebbles	10
Sandstone	 greenish grey; very feldspathic-arkose; very poorly bedded	20
Sandstone	 red brown; fine to medium grained; very feldspathic	10
Sandstone	 grey; medium grained; minor pebble zones; limonite stained	12
Conglomerate	. grey; with minor red mottling; lenticular; poorly bedded	10
Sandstone	 mottled maroon and grey green coarse grained; very feldspathic	10
Conglomerate	. grey green arkosic matrix; coarse grained; well rounded pebbles of quartz and rhyolite; angular fragments of pink orthoclase	70
Sandstone	 mottled red and green; very feldspathic coarse grained; lenticular	35
Concealed Sandstone	 grey green; coarse grained lenses of reddish grey sandstone and lenticular conglomerate; all very poorly bedded; arkosic	30
Sandstone	 to arkose; mottled red and grey; very feldspathic; very poorly bedded; coarse grained; numerous zones of scattered pebbles of grey quartz and rhyolite	90
Concealed Breccia	 very generalized angular fragments of quartz in a coarse grained greenish grey arkosic matrix	600
Concealed Conglomerate	 approximately red brown; pebbles of quartz and pink feldspar in a red silty matrix poorly consolidated	132
Concealed to basement	- very approximate	12
Thickness of Skye River Member		2927
Basement contact not exposed.		

McLEOD MEMBER OF CRAIGNISH FORMATION

Overlying the Skye River member of the Craginsh formation, is a sequence of predominantly red clastic rocks termed the McLeod member by Murray (1960). The red beds of the McLeod can be observed in many portions of the basin, but do not appear to be as widespread as the underlying Skye River sequence, and it appears that the McLeod may represent a facies of the Craginsh developed only in part of the Horton depositional basin. Interfingering of the Skye River and McLeod lithologies in portions of the Lake Ainslie area (Matheson Glen, Mount Pleasant Brook, Southeast Mabou River, etc.) seems to substantiate this view, as does the fact that the McLeod member varies in thickness. The McLeod member is thought to have accumulated in an alluvial plain environments. Bedding is quite poor and interstratified conglomerate zones are noticeably lenticular. Crossbedding is more clearly observed than in beds of the underlying Skye River, but sorting remains poor, and the micaceous content is quite high. Cementing material is most commonly calcareous. The following section of McLeod strata was measured on Campbell's Mountain Brook south of Skye Glen East.

Campbell Mountain Brook (Section No 7 figure 3)

<u>Craignish Formation - McLeod Member</u>	Feet
Concealed	30
Red brown; fine grained sandstone; bedding planes 1 foot apart; ripple marks ...	360
Concealed	90
Grey brown; extremely calcareous; fine grained sandstone; thickly bedded and crossbedded	120
Concealed	15
Red brown siltstone	35
Concealed	15
Red brown siltstone; calcareous cement; faint green mottling	45
Concealed	165
Massive red brown siltstone; calcareous cement ..	10
Concealed	55
Massive red brown siltstone; quite calcareous ..	10
Concealed	100
Red brown fine grained sandstone to siltstone; calcareous cement	5
Concealed to underlying Skye River member	375
	1390

On the Southeast Mabou River, 723 feet of
McLeod strata were measured (see figure 7) and the sequence
is as follows.

Southeast Mabou River (Section No 6 figure 3)

<u>Craignish Formation - McLeod Member</u>	Feet
Very massive greenish grey and red brown feldspathic; fine-medium grained	30
Massive red brown fine grained sandstone; siltstone	135
Red brown poorly bedded crumbly siltstone	26
Concealed	43

Feet

Red brown crumbly siltstone; poorly bedded	15
More massively bedded red brown siltstone	13
Red brown crumbly siltstone	77
Well bedded massive red brown siltstone	35
Red brown crumbly poorly bedded siltstones; with minor interbeds of red brown more well bedded dense siltstone	169
Red brown massive; medium grained feldspathic sandstone	7
Red brown to red; poorly bedded; crumbly siltstone	77
Red siltstone with limestone nodules	1
Red brown siltstone	52
Grey silty mudstone; fairly thinly bedded	26
Interbedded red and grey; poorly bedded siltstone with limestone nodules	17

 723

North of Lake Ainslie, in the valleys of Mount Pleasant Sloy and Matheson Glen Brooks, red-brown, fine to medium grained sandstone with numerous lenses of conglomerate outcrops. The sections are structurally disturbed, but approximately 1600 feet of McLeod strata are present. The contact with the Skye River beds is concealed, but appears to be structurally concordant. The upper contact with the overlying Strathlorne-Ainslie formation is faulted. Due west of this location, across the valley of the Southwest Margaree River, approximately 1500 feet of red brown siltstones, sandstones and conglomerates belonging to the McLeod were observed on the first creek south of Kiltarty. On the eastern flank of the Mount Young Anticline, on Hays River Brook, 1200 feet of red brown feldspathic and micaceous sandstones

with lenticular conglomerates belonging to the McLeod outcrop.

STRATHLORNE-AINSLIE FORMATION

The Strathlorne-Ainslie formation, the uppermost formation of the Horton group, is, broadly speaking, a fine, predominantly grey sequence showing much better developed bedding characteristics than the underlying Craginsh strata. Partial reworking of previously deposited Horton sedimentary rocks and continued deposition in the Lake Ainslie sedimentary basin resulted in the accumulation of a distinct lithologic unit. The base of the unit is placed at the first occurrence of a persistent sequence of fine grey clastic rocks above the red beds of the McLeod member of the Craginsh formation. The upper contact is placed at the base of a characteristic laminated limestone 30 - 50 feet thick, the basal A₁ Windsor limestone.

The presence of a thick, grey, fine silt unit at the base of the Strathlorne-Ainslie suggests that widespread lacustrine conditions were prevalent at this time. Cross-bedded, massive, lenticular buff and grey sandstones interbedded with minor grey shale occur above the basal, predominantly fine siltstone sequence in portions of the Ainslie area. These thicker sandstone sequences are attributed, in part, to deltaic build-ups. In parts of the Ainslie area thin limestones separated by grey shales and fine siltstone

beds, varying in thickness from one to fifteen feet, lie above the massive sandstones. Some of these limestones contain indistinct algal-like structures. The Strathlorne-Ainslie formation closes with a sequence of thin, grey, ripple marked, crossbedded siltstones to fine grained sandstones, interbedded with red siltstones. The foregoing lithological description of the Strathlorne-Ainslie is generalized, and does not occur everywhere as described above. There follows below a more precise description of the formation in which the two members (1) Strathlorne and (2) Ainslie are discussed separately.

THE STRATHLORNE MEMBER

The basal member of the Strathlorne-Ainslie formation is comprised of fissile grey shale; dense, grey, massive, poorly bedded mudstone; olive drab shales; thinly bedded, dense, ripple marked siltstones; more thickly bedded, fine grained, grey sandstones and minor thin, dense, blue-grey limestones. This member appears to have accumulated in an extensive lacustrine-fluviatile environment in the central portion of the Horton basin. Thicknesses of grey shale and grey mudstone in which are found a few fish scales and spines, coupled with the absence of other fauna, suggest that the lake bottoms were poorly oxygenated. The thinly bedded, ripple marked siltstones carry abundant, macerated, drift plant fragments

	Feet
Sandstone ... red brown; massive	4
Concealed	22
Siltstone ... greenish grey; very fine grained; ripple marked	30
Siltstone ... red brown; fine grained; massive	30
Sandstone ... red brown; fine grained; massive	4
Siltstone ... grey; very fine grained; fissile	45
Siltstone ... red brown; poorly bedded	15
Siltstone ... greenish grey; thinly bedded to fissile; choppy crossbedded; plants	64
Fault zone and folded.	
Sandstone ... grey; fine grained; flaggy; plant fragments	7
Mudstone dark grey to bluish grey	42
Sandstone ... red brown; very fine grained	8
Mudstone grey; poorly bedded	30
Sandstone ... red brown; very fine grained; micaceous	20
Siltstone ... grey; very fine grained; poorly bedded	105
Siltstone ... red brown; fine grained; choppy crossbedding	40
Mudstone grey; massive; poorly bedded	20
Siltstone ... greenish grey; medium grained; dense	13
Mudstone bluish grey; soft; poorly bedded	130
Siltstone ... grey; very fine grained; thinly bedded to flaggy	6
Siltstone ... grey; very fine grained; fissile	6
Sandstone ... greenish grey; massively bedded	75
Mudstone grey; massive; poorly bedded	160
Siltstone ... grey; fine grained; thinly bedded	5
Shale grey fissile	65
Sandstone ... grey; fine grained; flaggy crossbedding	20
Siltstone ... grey to dark grey; very fine grained; fissile	20
Siltstone ... grey; very fine grained	55
Sandstone ... grey; fine grained; flaggy	24
Sandstone ... greenish grey; fine grained; minor interbeds of grey shale	140
Sandstone ... greenish grey; coarse grained; feldspathic massive pyrite corrugatum	6
Sandstone ... grey; fine grained; thinly bedded	24

Thickness of Strathlorne Member.....1477

Strata of the Strathlorne member outcrops north of Skye Glen East, (see plate 1). However, on the flanks of

the Mull River and Mount Young anticlines, and elsewhere in the Lake Ainslie area, it is impossible to recognize the Strathlorne as a distinct lithological unit as it inter-fingers with the Ainslie type lithology and further, the continuous sections required for subdivision are absent. The following section, measured on the eastern flank of the Mount Young anticline illustrates this.

(SECTION No. 5 figure 3)

UPPER HORTON SECTION, EAST FLANK OF MOUNT YOUNG
ANTICLINE AREA

Windsor Group:	Feet
Dolomite, dolomitic limestone	2
Concealed interval	7
Ribbon Limestone	29
Concealed interval	8
<u>Horton Group</u>	
<u>Strathlorne-Ainslie Formation:</u>	
Concealed interval	7
Few boulders to one foot of light grey, slightly calcareous, very fine grained sandstone....	1
Concealed interval	5
Light grey to greenish grey siltstone; minor buff, brown, and reddish grey; minor very fine grained sandstone and silty shale; some is calcareous; thin bedded ?...	27
Concealed interval	5
Light-grey, very fine grained calcareous sandstone, thin bedded (2 inches Maximum), local disseminated pyrite	4
Concealed interval	1

	Feet
Reddish-brown shale, thin-laminated to massive, occasional green streak	5
Concealed interval	1
Debris ?, light greenish-grey calcareous siltstone	6
Concealed interval	5
Light-green shale	$\frac{1}{2}$
Red shale	1
Light-green shale	$\frac{1}{2}$
Red shale	5
Light-green, thin-laminated to thin-bedded (3 inches maximum) shale and siltstone, some slightly calcareous	2
Thin-laminated red shale and siltstone, some green spots	1 $\frac{1}{2}$
Thin-laminated light-green shale; thin-bedded light greenish-grey shale and siltstone, slightly calcareous	1
Red shale	6
Light-green siltstone; light greenish-grey calcareous shale	$\frac{1}{2}$
Red shale and silty shale	2
Light-green shale and silty shale	1
Dark-red shale, badly sheared, thin-laminated to thin bedded ? (1 inch maximum)	3
Fault ? - rocks badly sheared for 1 foot on either side	
Light-green shale, silty shale and siltstone thin laminated to thin-bedded	4
Light-grey to light greenish-grey siltstone and very fine grained sandstone, minor light blue-green, some feldspathic, some slightly calcareous, pitted at base - brown pits to 1/10 inch	12
Reddish-brown silty shale siltstone and very fine grained silty sandstone, very slightly calcareous	11
Covered interval	9
Covered interval	10
Thin-laminated drab olive-green to grey shale, very slightly calcareous	2
Covered interval	22
Interbedded grey to greenish and brownish grey shale, silty shale, and siltstone; some very fine grained sandstone with ripple marks locally; faintly thin-laminated and crossbedded locally, very slightly calcareous locally	32

	Feet
Covered interval	69
Tan coloured shaly siltstone; thin-bedded to 1 foot thick	5
Drab olive-green thin-laminated shale	10
Covered interval	14
Light-grey silty shale, beds to 8 inches thick	6
Covered interval	75
Drab olive-green to slightly greenish brown thin-laminated shale (outcrop is 90 feet SW of stream), 2 large blocks of lime- stone conglomerate in stream bed	2
Covered interval	51
Debris of greenish grey shale and light grey siltstone	1
Covered interval	19
Blocks of very fine to fine-grained; buff to light brown sandstone, few calcareous conglomerate blocks with pebbles to 4 inches	?
Covered interval	32
Very fine-grained light grey to tan sandstone, minor siltstone, some very slightly calcareous	2
Covered interval	11
Very fine-grained light grey to tan sandstone, minor siltstone, some very slightly calcareous	2
Covered interval	81
Covered interval with blocks of very fine to fine-grained light grey sandstone, some calcareous	15
Covered interval	6
Olive-green and minor light grey shale, silty shale, minor light grey calcareous shaly siltstone, thin-laminated to thin-bedded to 1 inch	9
Covered interval	16
Drab olive-green, greenish grey and dark grey shale; some is silty, slaty cleavage, thin-laminated, rarely thin-bedded	5
Covered interval	25
Debris of light buff to light greenish brown very fine grained sandstone	1
Covered interval	36

Light grey to light greenish grey very fine-grained sandstone, very slightly calcareous, very badly sheared and broken up, clay seam (N40 inches - 77SW) is possibly along a fault?	7
Greenish grey to drab olive-green shale and shaly siltstone; thin-laminated to thin bedded, small en-echolon folds at one place (plunge low to SE and NW)	43
Light grey to light reddish grey very fine-grained sandstone	2
Covered interval	18
Greenish grey thin-bedded shaly siltstone	2
Fork in stream	
Covered interval	3
Light grey to light greenish grey silty shale and siltstone; some calcareous; siltstone is thin-laminated to thin-bedded	4
Covered interval	11
Greenish grey and dark green to dark grey shale and silty shale thin-laminated to occasionally thin-bedded	58
Covered interval	5

Thickness of section J 1112

Contact with Craguish formation

THE AINSLIE MEMBER

An overall increase in grain size, resulting in a higher proportion of sandstone-siltstone content in the sedimentary sequence, as compared to shale-mudstone content, is noticeable as one approaches the upper portion of the Strathlorne-Ainslie formation. This coarser clastic facies overlying the finer basal sequence is here referred to as the Ainslie member. Thick, massive, well crossbedded, somewhat lenticular sandstones, interbedded with red siltstones, minor grey shales

and thin limestones constitute the predominant lithology of this member. The lower contact with the underlying Strathlorne member can be observed on the Southeast Mabou River section, (see figure 7), but unfortunately, it is faulted. The lower contact is gradational and somewhat arbitrary, but as can be seen in the following table, a pronounced increase in red brown siltstones is observed.

COMPARISON TABLE SHOWING GROSS LITHOLOGICAL VARIATIONS
BETWEEN THE STRATHLORNE AND AINSLIE MEMBERS,
AS OBSERVED ON THE SOUTHEAST MABOU RIVER

	<u>STRATHLORNE</u> percent	<u>AINSLIE</u> percent
Sandstone	22	28
Siltstone	33	72
Shale - mudstone	45	0
	<u>100</u>	<u>100</u>
Siltstone - grey	28	1 (of total section)
Siltstone - red	5	71 (of total section)

Further, grey shales and mudstones appear to be absent in the Ainslie member, while in the underlying Strathlorne, they constitute 45 percent of the total lithology. It is evident that conditions conducive to grey shale - mudstone accumulation were not present, and a more oxidizing

environment existed in the upper portion of the Horton sequence. The following section presents the Ainslie member as measured on the Southeast Mabou River, where it attains a thickness of 1150 feet. Faulting in this portion of the section, (see figure 7), renders this somewhat tentative. The upper contact of the Ainslie member is a disconformity with the basal Windsor A₁ limestone.

(Section No 6 figure 3)

SECTION OF HORTON STRATA AS EXPOSED ON
THE SOUTHEAST MABOU (See figure 7)

Basal Windsor A₁ laminated limestone

Horton Group

Strathlorne-Ainslie Formation

Ainslie Member

	Feet
Siltstone red brown; poorly bedded; crumbly	81
Sandstone greenish grey; dense; very fine grained	1
Siltstone red brown; crumbly; poorly bedded	6
Sandstone greenish grey; dense; fine grained crossbedded	2
Siltstone red brown; crumbly	13
Sandstone greenish grey; fine grained; flaggy bedding to 1/8"; bedding rippled	6
Siltstone red brown; crumbly; poorly bedded; slumped	15
Sandstone greenish grey; fine grained; flaggy	20
Siltstone red brown; crumbly	20

Feet

Sandstone	 greenish grey; fine grained; choppy crossbedding	3
Siltstone	 red brown; crumbly	14
Sandstone	 greenish grey; fine grained; choppy crossbedding	3
Siltstone	 red brown; crumbly	4
Sandstone	 grey; fine grained	7
Concealed	....	30
Sandstone	 grey; fine grained	4
Concealed	....	18
Siltstone	 red brown; crumbly	20
Sandstone	 grey; fine grained; flaggy	9
Concealed	....	90
Sandstone	 grey; fine grained; massive to flaggy crossbedding	30
Siltstone	 red brown; crumbly; poorly bedded	24
Sandstone	 grey; fine grained	4
Siltstone	 red brown; crumbly; poorly bedded	24
Sandstone	 grey; fine grained; flaggy bedding	20
<u>Fault zone</u>	... Basal Windsor Limestone; down faulted	
Concealed	....	180
Sandstone	 grey; fine grained; well bedded	25
Siltstone	 red brown; crumbly; poorly bedded	5
Sandstone	 grey; fine grained; thin lenses of interformational conglomerate	12
Siltstone	 red brown; massive and poorly bedded	30
Siltstone	 greenish grey; well bedded	12
Siltstone	 red brown; crumbly	100
Sandstone	 grey; fine-grained	10
Siltstone	 red-brown; fissile	5
Sandstone	 grey; buff weathering; fine-grained well bedded	18
Siltstone	 red-brown	10
Sandstone	 grey; fine-grained; massive; feldspathic	12
Siltstone	 red-brown; poorly bedded; crumbly	45
Sandstone	 greenish grey; fine-grained	12
Siltstone	 red-brown; brick red	50
Sandstone	 red-brown and grey-green; fine-grained; crossbedded	100
Sandstone	 red-brown; massive; fine-grained	15
Siltstone	 red-brown; poorly bedded	40
Sandstone	 buff; medium-grained; massive	11

Fault Zone Thickness of Ainslie member 1150

Continuous sections of the Ainslie member outcrop on the flanks of the McIsaac Point and Claverhouse anticlines on the western side of Lake Ainslie, (see plate 1 for location.)

A plane table survey was conducted on the McIsaac Point section, and the following measurements were obtained.

McIsaac Point (Section No.8 figure 3)
WEST SIDE LAKE AINSLIE, CAPE BRETON ISLAND, N.S.

Basal Windsor limestone (not exposed on eastern flank of Ainslie McIsaac Point anticline).

AINSLIE MEMBER

	Feet
Concealed approximately	160
Sandstone red-brown, fine-grained	10
Concealed	21
Limestone dense purplish grey algal	3
Concealed	78
Siltstone red; crumbly and shaly	2
Sandstone massive buff; fine medium-grained; lime concretions and limonite staining ...	21
Concealed	15
Sandstone massive; fine-grained buff; limonite stained, and plant fragments	30
Shale red-brown; crumbly	18
Mudstone grey	83
Sandstone chocolate brown, dense, well bedded, fine-grained	17
Mudstone grey	4
Siltstone grey-green and red-brown	8
Shale grey	22
Siltstone soft grey; poorly bedded	3
Concealed	12
Sandstone grey to grey-buff; medium to fine- grained; massive; well crossbedded; porous	27

	Feet
Concealed probably grey shale	110
Sandstone buff; fine-grained	32
Concealed probably grey mudstone	12
Shale grey	93
Sandstone massive; buff	7
Siltstone grey; very calcareous	5
Shale grey	14
Sandstone massive; buff	4
Mudstone grey; silty	3
Sandstone massive; buff; fine to medium grained; porous in places; lime concretions; poorly bedded; limonite concretions - Ainslie sandstone	96
(Starting point of survey)	
Total thickness exposed	910

The following section was measured on the western flank of the Claverhouse anticline.

(Horton Section No. 9 figure 3)

West Flank of Claverhouse Anticline, Lake Ainslie District,
Cape Breton Island, Nova Scotia

(Compiled from plane table survey commencing at Basal Windsor limestone and working down section.)

	Feet
Windsor Group Basal Laminated Limestone. Limestone Breccia, gradational contact with normal basal Windsor limestone. Large angular fragments of felsite and quartz	20

Horton Group

Strathlorne-Ainslie Formation
Ainslie Member

Well bedded greenish grey; fine grained; slightly calcareous sandstone; faintly ripple marked	12
Grey black; deeply weathered; crumbly to fissile shale, patchy limonite staining	18

	Feet
Red brown shale	2
Grey limy siltstone	1
Red brown fissile shale	3
Dense grey green siltstone; well ripple marked	5
Very calcareous; dense; red brown; well bedded siltstone	5
Red brown sandstone; deeply weathered in part; silty	18
Concealed	7
Grey black fissile shale	10
Concealed	70
Grey shale	28
Concealed	39
Fine grained; grey siltstone; massive; faintly calcareous	8
Concealed	50
Limestone; dense black calcite veinlets	3
Concealed	30
Grey siltstone; massive; faintly calcareous	4
Concealed	10
Well bedded; crossbedded; red brown; fine grained sandstone	5
Red brown siltstone	15
Grey; thinly bedded sandstone	10
Concealed	20
Grey shale	3
Grey silty limestone	1
Concealed	25
Dense grey black limestone breccia, containing angular pebbles of limestone 1/4 - 2 inches in length	6
Total thickness exposed	408

The upper contact of the Horton group is observed at many separated localities in the Lake Ainslie area, and is placed at the base of a persistent, thinly-laminated grey limestone (the A₁ Windsor limestone). The contact appears in most localities to be disconformable and a variety of Horton lithologies exists at the Horton - Windsor

interface. On the Southeast Mabou River, 81 feet of red, poorly bedded siltstones underlie the basal Windsor, while on the flanks of the Claverhouse anticline, 12 feet of grey siltstones underlie the basal Windsor, which here contains a basal zone of limestone breccia containing angular pebbles of felsite and quartz. The basal Windsor limestone is so lithologically distinctive throughout the area, and indeed throughout most of the Maritime Carboniferous basin, that it is considered to represent a distinct widespread and more or less contemporaneous event in the Carboniferous depositional basin. The fact that differing Horton lithologies are present immediately below this marker should not be surprising, when one considers the terrestrial environment under which Horton deposition took place.

RESULTS OF SPORE ANALYSIS IN THE LAKE AINSLIE AREA

Three samples collected from the Strathlorne - Ainslie formation on the Southeast Mabou River were submitted for spore analysis. Only two of these, C67 and C72, contained identifiable spores.

Sample C72, collected from the Strathlorne member, the highest stratigraphically of the two (see figure 13), contain the following species;

The presence of Vallatisporites Hacquebard and lack of Pustulatisporites pretiosus Playford suggests that this sample belongs to B zone. The sample was collected 280 feet above the base of the Strathlorne member. The top of B zone on the Southwest Mabou River is 260 feet above the base of the Strathlorne member.

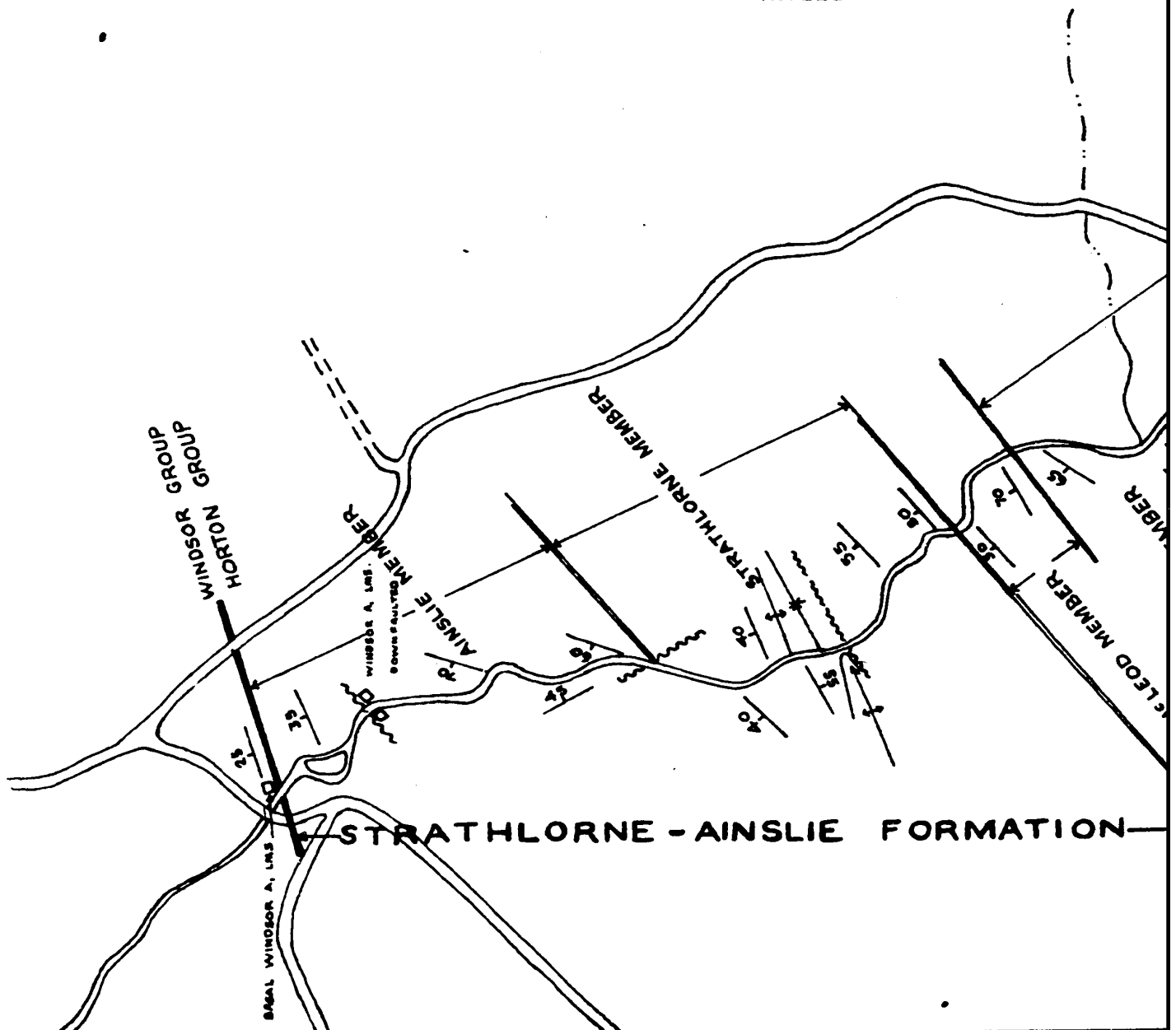
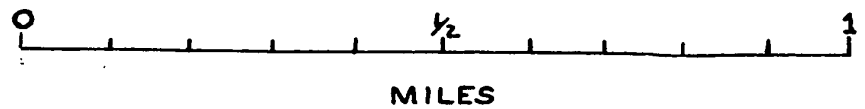
A sample was collected by the Geological Survey of Canada from the Southeast Mabou River 1860 feet stratigraphically below the basal Strathlorne member contact, within the Craignish formation. This sample contained Nodatitriletes, a form characteristic of C zone.*

The relative stratigraphic position of the samples described above is shown in figure 13.

* M.S. Barss - personal communication.

SOUTHEAST MABOU RIVER

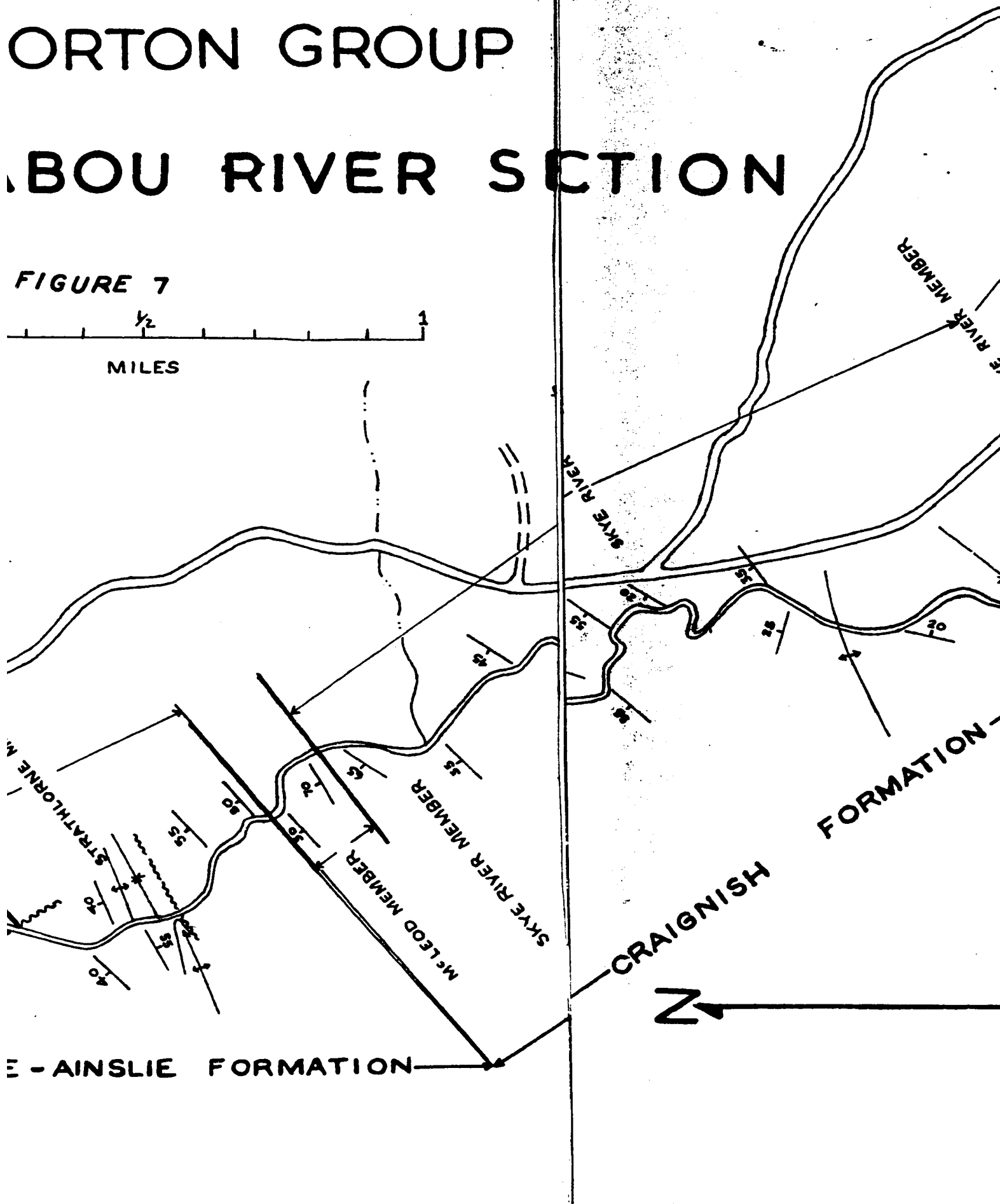
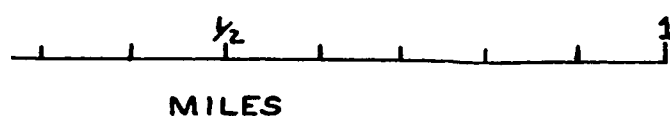
FIGURE 7

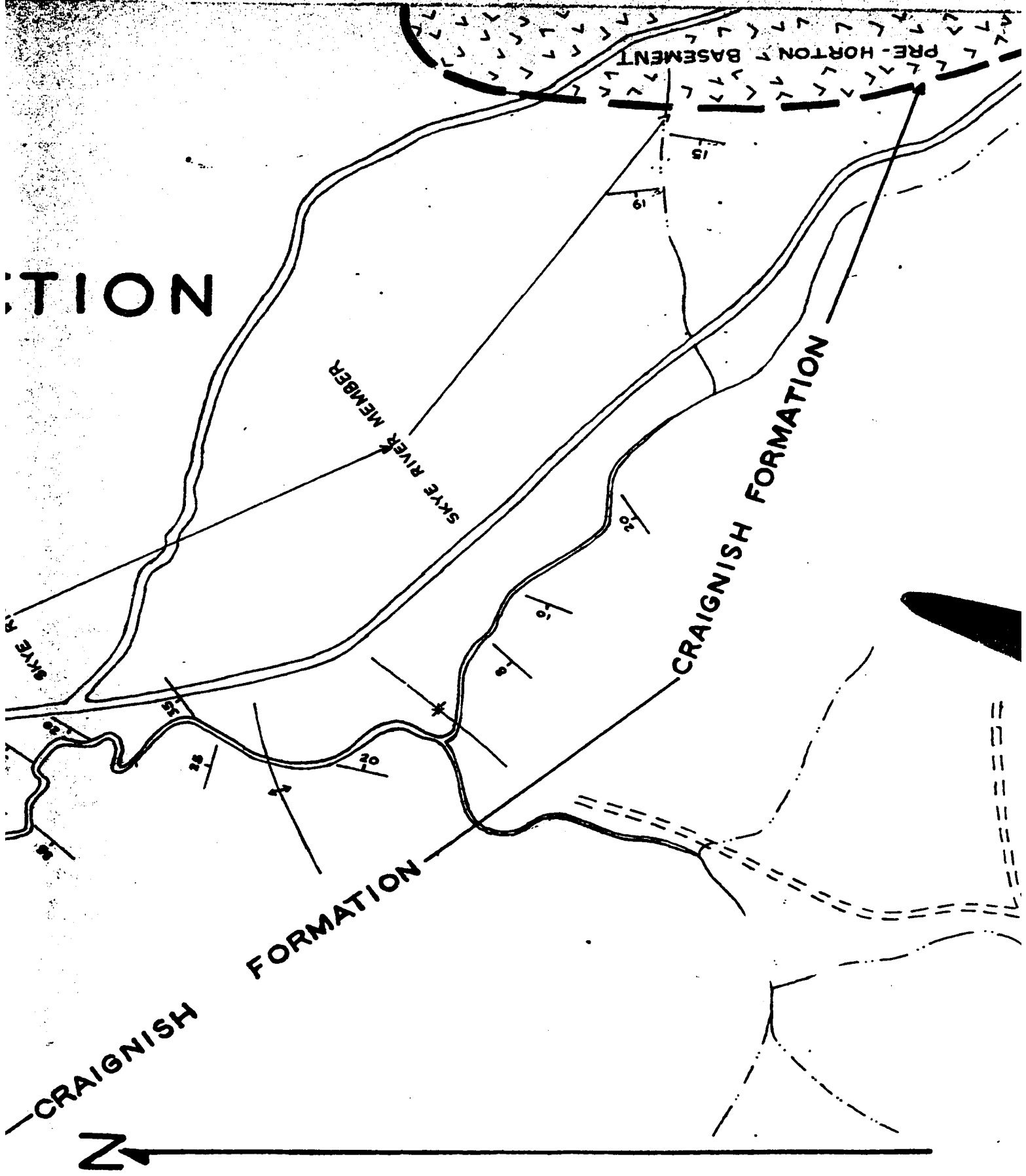


ORTON GROUP

BOU RIVER SECTION

FIGURE 7





CHAPTER 5

THE HORTON GROUP IN THE MARGAREE - CHETICAMP AREA

INTRODUCTION

The Margaree - Cheticamp area described in this chapter lies north of latitude $46^{\circ} 15'$ and south of latitude $46^{\circ} 40'$. It includes all the land west of longitude $61^{\circ} 00'$. The combined land area is triangular in shape; the present seacoast forming the hypotenuse, latitude $46^{\circ} 15'$ the base, and longitude $61^{\circ} 00'$ the third side; enclosing an area of approximately 190 square miles, 85 per cent of which is underlain by Carboniferous rocks. The remaining 15 per cent is underlain by pre-Carboniferous, crystalline and metamorphic rocks.

The area derives its name from the two largest population centres, the villages of Margaree and Cheticamp.

During the 1959 field season, a study of Carboniferous sedimentary rocks in the Margaree - Cheticamp area was undertaken by the author while in the employ of Imperial Oil Company Limited.

As in the Lake Ainslie area to the south, the nature of underlying rocks is well reflected in gross topographic features, this being essentially the result of a secondcycle of erosion on an uplifted peneplain.

Sedimentary rocks of the Horton group appear to be nearly as resistant to erosion as the underlying crystalline rocks there being no distinct topographic break between the two rock units. The gently rolling lowlands are developed on softer rocks of the Windsor and Canso groups, and areas underlain by the former commonly develop a karst topography in the form of numerous sink holes due to the presence of limestone and gypsum. An example of advanced karst topography can be observed near Cranton Creek Section, a branch of the Northeast Margaree River, where a north-south flowing creek has formed large caves in Windsor gypsum. Large steep walled sink holes have also been formed. Massive sandstones of the Pennsylvanian Riversdale group underlie a broad upland surface attaining an elevation of 1000 feet between the Margaree River and the seacoast.

The entire area is blanketed with a thick cover of glacial debris and, as a result, outcrops are restricted to river and creek systems possessing sufficient gradient to have become incised to bedrock. Exposures are also found abundantly along the seacoast, on road and railway cuts, and on the shores of some of the larger ponds. Cross country traverses in areas underlain by Carboniferous rocks are relatively unproductive; as in the Lake Ainslie area.

GENERAL GEOLOGY

In the Margaree - Cheticamp area sedimentary rocks of Mississippian and Pennsylvanian age unconformably overlies a series of pre-Carboniferous igneous and metamorphic rocks. Mississippian strata are divided into three major groups; the Horton, Windsor, and Canso, while Pennsylvanian sedimentary rocks are placed in the Riversdale group, (see table 5).

Horton accumulation commenced in portions of the area with a series of interbedded clastic and volcanic rocks which grade upward into coarse conglomerates and arkoses. As in the Lake Ainslie area to the south, the basal coarse clastic rocks appear to have been deposited as fan conglomerates along the margins of positive crystalline masses. River systems partially reworked these alluvial fans and resulted in the deposition of a heterogeneous sequence of conglomerates, arkoses, and coarse sandstones. Probably, continued reworking of these basal sediments and new material from basement massifs, coupled with a reduction of topographic relief and river profiles, led to the accumulation of finer clastic rocks in the upper portion of the Horton depositional sequence. Fine grey siltstones, grey shales, fine grey sandstones and red siltstones accumulated under a predominantly fluviatile environment.

Transgression of seas into the basin mark the beginning of Windsor deposition. The occurrence of many limestones, most containing abundant marine fossils, indicates a marine environment during portions of Windsor deposition. These thin limestones facilitate correlation throughout western Cape Breton Island. Accumulation of gypsum and anhydrite indicates the existence of enclosed evaporitic basins of the Windsor sea. These Windsor seas are perhaps better described as long embayments which were delineated by existing topographic features at the close of terrestrial Horton deposition. It is evident from field studies in this area, that erosion or non-deposition occurred at various stages within the Windsor depositional basin, resulting in many disconformities within the sequence. The concept of broad and continuous strand line fluctuations with the most complete (thickest) Windsor sequences being restricted to the central portion of local sub-basins which remained tectonically negative.

Gradual regression of Windsor seas resulted in the deposition of a sequence of grey silty calcareous shales and thin algal limestones which give way gradually upward to coarser grey and red clastic rocks. These sedimentary rocks are referred to as the Canso group.

Fresh to brackish water terrestrial accumulation existed for the most part throughout the Pennsylvanian, and

massive sandstones interbedded with red and grey shales were deposited. Coal sequences are observed in the Riversdale group.

The table on the following page shows the classification, thickness and relative age of sedimentary rocks in the Margaree - Cheticamp area.

Table No. 5

SYSTEM	GROUP	FORMATION	THICKNESS in feet	GENERAL LITHOLOGY
PERMO-PENN		BROAD COVE	600	Red sandstones, conglomerates
PENNSYL- VANIAN	RIVERSDALE	PORT HOOD	4500	Massive grey sandstones, red and grey shale, coal
CONFORMABLE?				
-----	CANSO	MABOU	2500 8000	Grey shale, thin algal lms, Grey and red sandstones, siltstones.
CONFORMABLE?				
	WINDSOR		1300	Thin marine lime- stones, gypsum, anhydrite, red gypsiferous silts, minor grey silt- stones and sand- stones
CONFORMABLE - DISCONFORMABLE				
MISSISSIP- PIAN	HORTON	STRATH- AINSLIE	3900	Grey sandstones, silts, shales, minor red silts
		CRAIGNISH	2900	Conglomerate, arkose grey sandstone, red silts, sandstones
		FISSET- BROOK	900- 1200	Rhyolite - andesite arkose - sandstone
NONCONFORMITY - ANGULAR UNCONFORMITY				
PRE- CARBONIFEROUS	CRYSTALLINE IGNEOUS- METAMORPHIC ROCKS			

FORMER WORK

- 1880 - 1882: Geological investigation of the area was first undertaken by H. Fletcher for the Geological Survey of Canada. The results of this study are shown on his serial map sheets of Nova Scotia Rocks now recognized as belonging to the Horton group were placed by Fletcher in the Devonian and termed the "Devonian metamorphics".
- 1926 - 1927: Eastern Gulf Oil carried out geological reconnaissance in the area and drilled five holes in the vicinity of Margaree Harbour and Belle Cote.
- 1942: Structural examination of the Windsor group in part of the area was made by D.J. MacNeil for the Lion Oil Company.
- 1943: W.A. Bell, Geological Survey of Canada, mapped the coastline from Broad Cove northward to Margaree Beach and made a study of the Chimney Corner and St. Rose coal fields. Bell also visited other portions of the area and remarked on strata outcropping along the seacoast in the vicinity of Friar's Point.

1946 - 1947: Geological mapping of the entire Margaree - Cheticamp area was undertaken by H.L. Cameron for the Geological Survey of Canada. Cameron mapped all rock units in the area, and presented the data on Maps Nos. 48-11A and 48-11B, G.S.C., on a scale of 2 inches to 1 mile. A short preliminary report is included with the map sheets. The distribution of pre-Carboniferous, Horton, Windsor, Canso and Riversdale strata was outlined.

1955: B.C. Murray, as part of a study of the Horton group in parts of Nova Scotia, measured in detail the Galant River section and extended his three-fold subdivision of the Horton group into this area from the Southwest Mabou River type section. Three formations were recognized; the Craignish, Strathlorne, and Ainslie. Correlation of the Galant River section with the Southwest Mabou River was made on the basis of gross lithological variations within the Horton sequence.

RECENT FIELD WORK

During the 1959 field season, studies of Carboniferous rocks in the Margaree - Cheticamp area were made by the author while in the employ of Imperial Oil Company Limited. Subdivisions within the Horton, Windsor, and Canso groups were made, corresponding in part to subdivisions made to the south in the Lake Ainslie area. During the field season, all streams, rivers, roadways and the seacoast were traversed. All Horton sections were remapped, some of them in detail. During the 1963 field season the Galant River section, along with the Broad Cove Brook section were retraversed and collected from. It was difficult attempting to extend subdivisions made previously within the Horton group in the Lake Ainslie area (1958), and as a result, a simplified three-fold subdivision is now suggested. The following table illustrates the evolution of Horton group with regard to terminology in this area.

Table No. 6

MURRAY, 1955 GALLANT RIVER SECTION	COTE, 1959	COTE, 1963	
AINSLIE FORMATION GLENCOE MEMBER McISAAC POINT MEMBER	UPPER HORTON	STRATHLORNE- AINSIE FORMATION	
STRATHLORNE FORMATION			
CRAIGNISH FORMATION	MIDDLE HORTON	CRAIGNISH FORMATION	McLEOD MEMBER
	LOWER HORTON		SKYE RIVER MEMBER
PRE-HORTON VOLCANICS AND CLASTICS	PRE-HORTON VOLCANICS AND CLASTICS	FISSET BROOK FORMATION	

AREAL DISTRIBUTION OF THE HORTON GROUP
IN THE MARGAREE - CHETICAMP AREA

Approximately 25 percent or 50 square miles of the area is underlain by strata of the Horton group. Because of greater resistance to erosion, areas underlain by the Horton form ridges above the lowland areas of outcropping Windsor and Canso sedimentary rocks. Two anticlinoria underlain by Horton sedimentary rocks trend northward from the Lake Ainslie area in the south, and extend into the southern portion of the Margaree - Cheticamp area. These anticlinal structures are flanked by the overlying Windsor and Canso sequences. The valley of the Southwest Margaree River separates the two Horton outcrop areas. The eastern anticline trends northward along a relatively narrow ridge and adjoins a Horton outcrop belt which dips monoclinally off a basement igneous mass that is the southern portion of the Cape Breton Highlands. This latter belt trends northward from Margaree Forks to the northern portion of the area and it is along this belt, in the beds of incised streams and rivers that the most continuous and structurally undisturbed sections in the area of Horton strata are observed.

UPPER AND LOWER CONTACTS OF THE HORTON GROUP

The lower contact of the Horton group is placed at the base of the Fisset Brook formation. On Fisset Brook, the type section for this formation, MacKasey (1963, p.21) reports that thickly bedded conglomerates nonconformably overlies crystalline basement rocks, Devonian in age. The basement rocks are pink, coarse grained, biotite granite, locally porphyritic. The contact between the basement rocks and the Horton group can also be observed about one mile north of Pembroke Lake, (MacKasey, 1963, p.23). Towards the base of the Horton sequence on Gallant River faulted beds, lithologically similar to the Fisset Brook sequence, were observed but due to structural complications, the nature of the contact with the granites is obscure. However, enough evidence exists to place the base of the Horton group at the nonconformable surface which separates volcanics and clastics from underlying igneous rocks with some confidence.

The upper contact of the Horton group is placed at the base of a readily observed thinly laminated limestone (the basal Windsor A₁). On the Gallant River, this limestone overlies conformably red siltstones of the Horton group (see photograph 13).

North of the Gallant River, well crossbedded, very fine grained, grey sandstones of the Horton group are overlain conformably by the Windsor A₁ limestone. Conformable contacts were also observed on Broad Cove and Dunvegan Brooks. At the latter locality, the contact is both conformable and gradational. The uppermost Horton sandstone, flaggy, fine grained and grey, becomes progressively more calcareous until the unit is a sandy limestone and eventually a pure laminated grey limestone, lithologically identical to the other A₁ Windsor types.

With upper and lower contacts thus defined, i.e., lower contact nonconformity with underlying crystalline rocks and upper contact, conformable with the lithologically distinctive A₁ Windsor limestone, Horton strata occupy a distinct stratigraphic and easily determined position in the Carboniferous sequence.

THE FISSET BROOK FORMATION

The oldest Horton strata in the area are assigned to the Fisset Brook formation which derive it's name from the type locality of this sequence as exposed on Fisset Brook. (See figure 8). The type section is described by MacKasey, (1963, pp. 17 - 64).

The Fisset Brook beds are confined to the

northernmost belt of Horton outcrops, i.e., from Margaree Village north to the northern boundary of the area, (unit 2A on Plate 1). They occupy a narrow linear belt approximately half a mile in width which is marginal to Devonian and Precambrian igneous and metamorphic rocks. North of Gallant River, for a distance of approximately six miles, no outcrops of the Fisset Brook have been observed at the Horton - pre-Horton contact and thus, are not shown on plate 1 . From here, northward to the northern boundary of the area, MacKasey (1963) has described Fisset Brook sequences on Factory Brook, Squirrel Mountain Brook, and Fisset Brook (see figure 8).

The contact between the basal Fisset Brook beds and the underlying Devonian granites is a nonconformity. Conglomerates, with included pebbles of granite, bluish-green meta-sedimentary rocks and vein quartz (MacKasey, p.29), interbedded with red and grey siltstones and blue-green andesite overlie nonconformably pink biotitic granites except on Factory Brook, where MacKasey reports that basal Fisset Brook Beds rest with angular unconformity on grey shists of the Precambrian George River group. MacKasey (1963, p. 61) states that strata of the Horton group disconformably or conformably overlie the Fisset Brook sequence. It is evident that the upper contact of the

Fisset Brook was placed at the last occurrence of lava beds. As the Fisset Brook formation is included in the Horton group, in this thesis, it would be correct to say the sedimentary rocks of the Craignish formation conformably or disconformably overlies the Fisset Brook sequence in this area.

H.L. Cameron, (1946 - 47), considered the intercalated volcanic and clastic rock sequence (now recognized as Fisset Brook) to be pre-Horton in age, possibly Cambrian or earlier (Cameron, 1948, p.5).

Spores collected from sedimentary rocks within the Fisset Brook include the following types (MacKasey, 1963, p. 63):

Leiotriletes sp.
Calamospora sp.
Punctatisporites spp.
Cyclogranisporites spp.
Apiculatasporites sp.
Endosporites sp.
Grandispora spp.
Perotrillites spp.
Reticulatisporites spp.
Convolutispora sp.
Phyllothecotriletes sp.
cf. Acanthotriletes spp.
cf. Chaetosphaerites sp.
Hystricosporites sp.

These spores were identified by M.S. Barss (Geological Survey of Canada, Coal Research Section) who stated in his report:

Fisset Brook was placed at the last occurrence of lava beds. As the Fisset Brook formation is included in the Horton group, in this thesis, it would be correct to say the sedimentary rocks of the Craignish formation conformably or disconformably overlies the Fisset Brook sequence in this area.

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Convolutispora sp.
Phyllothecotriletes sp.
cf. Acanthotriletes spp.
cf. Chaetosphaerites sp.
Hystricosporites sp.

These spores were identified by M.S. Barss (Geological Survey of Canada, Coal Research Section) who stated in his report:

"Only generic identifications were attempted, but comparison of the better preserved specimens with specimens from other samples from Nova Scotia and New Brunswick indicates a lowermost Mississippian age for the sample. The presence of the genus Hystricosporites gives some suggestion of comparison with samples from the Memramcook formation of New Brunswick which has been dated as late Devonian. (Report F1-13-1962, DCM)."

Barss however also states:

"that as the range of Hystricosporites is as yet not known in the Maritime Provinces, it would be hazardous to indicate an age other than lowermost Mississippian, since the genus does range up into the lower Mississippian in other areas." (extracted from MacKasey, 1963, p. 64).

LITHOLOGY OF THE FISSET BROOK FORMATION IN THE MARGAREE - CHETICAMP AREA

On the type section of the Fisset Brook formation, minor coarse clastic rocks are interbedded with thick acid and basic lava flows, the latter type predominating.

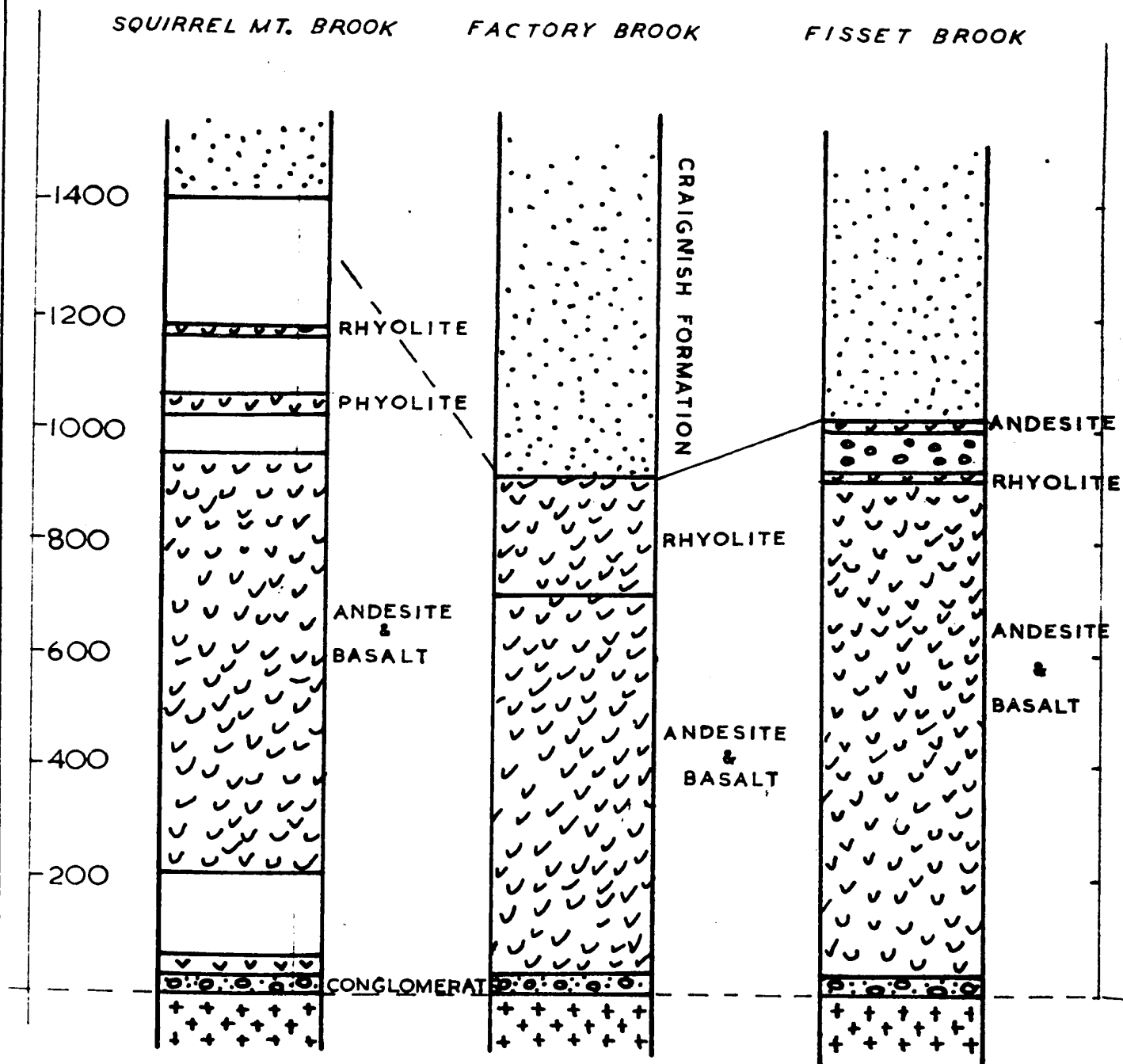
At the base of the type section, 50 feet of thickly bedded, greenish-maroon conglomerates, and red and grey siltstones are interbedded with blue-green andesite. On Factory Brook, MacKasey (1963, p. 22) reports that thinly bedded siltstones, arkoses, andesites and conglomerate overlie schists and pegmatite with angular unconformity.

The basal member here is 30 feet thick. A sequence of andesites from 800 - 1200 feet thick follows. The lavas are of massive, amygdaloidal, dark greenish-blue to purplish-blue (MacKasey, 1963, p. 24). The basic lavas are succeeded by light to dark pink rhyolites which form the upper unit of the Fisset Brook sequence. At the type section, these flows are approximately 30 feet in total thickness, while on Pembroke Brook and Factory Brook, thicknesses of 300 feet and 200 feet respectively are reported by MacKasey. The following graphic sections illustrate the lithology of the Fisset Brook formation in the Margaree - Cheticamp area.

FIGURE 8

FISSET BROOK FORMATION

MARGAREE - CHETICAMP AREA



AFTER W.O. MACKASEY

THE CRAIGNISH FORMATION

A thick sequence of generally coarse, poorly bedded clastic rocks, poorly sorted, conformably to disconformably overlying the volcanics of the Fisset Brook formation. It is to this sequence that the name Craignish formation is assigned.

The upper contact of the Craignish is placed at the first occurrence of a persistent series of grey siltstones, shales and sandstones, belonging to the overlying Strathlorne-Ainslie formation.

Outcrops of undoubted Craignish type are restricted to the Horton outcrop north of Margaree Forks and are marginal to the underlying Fisset Brook beds, or crystalline basement rocks. Lithologies typical of the Craignish were not found in the central portion of the two Horton anticlines to the south of the map area. The Craignish may be present here, but outcrops are absent in the central portion of these upland areas. Areas underlain by the Craignish are shown by symbol 2b on plate 1.

Cameron, (1948, p. 5) recognized a coarse clastic basal facies of the Horton, as opposed to an upper unit of shale and sandstone but did not map them as separate units.

Murray (1955) mapped in detail Horton strata on the Gallant River, recognized a basal unit lithologically equivalent to his Craignish formation on the Southwest Mabou River and correlated the Gallant section with his type section. A minimum thickness of 2400 feet was assigned to the Craignish formation. Whereas in the type section, two members of the Craignish, the Skye River and McLeod could be recognized, no outcrops of the latter member occur on the Gallant River section.

LITHOLOGY OF THE CRAIGNISH FORMATION IN THE MARGAREE - CHETICAMP AREA

As in other portions of the Western Cape Breton Island Basin, the Craignish formation is a sequence of coarse granite debris which conformably to disconformably overlies the interbedded clastic rocks and volcanics of the Fisset Brook formation, and is overlain conformably by the finer grey, clastic rocks of the Strathlorne-Ainslie formation. The Craignish cannot be subdivided as in the Lake Ainslie area to the south, into two members - the Skye River and McLeod. The entire Craignish lithology appears to be of the Skye River type, with the red-bed facies of the McLeod either being not deposit, or interfingering with the Skye River to such an extent as to be unrecognizable as a

distinct lithological unit.

THE SKYE RIVER MEMBER

Massive, thickly bedded, coarse to medium grained, grey sandstones and arkoses with scattered lenses of conglomerate outcrop along the upper portion of the Gallant River, south of the Margaree Village, (see figure 2). Altogether, 2900 feet of the Craignish formation can be observed, from the basal contact with the Fisset Brook, to the overlying fine grey clastic rocks of the Strathlorne-Ainslie. The McLeod red-bed facies is not present, so that the entire Craignish lithology is of the Skye River type. The sequence is a homogeneous accumulation of greenish grey to pale grey arkoses and feldspathic sandstones, all showing characteristics of near source and rapidly accumulated deposits. The feldspars are fresh in hand specimen while the constituent grains are angular to sub-angular. Cementing material is most commonly a chloritic "paste" with a high calcareous content. Conglomerate lenses are abundant, the most common pebble types being of pink granite, red to maroon volcanics, and grey to white quartz. The individual conglomerate zones seldom exceed a thickness of 50 feet and are thought to represent relic river channels. Bedding varies from poor to good, but most commonly the bedding is massive and shows large scale

crossbedded features. The mica content is very high in some portions of the section. Plant fragments are much more common in the Gallant River section than elsewhere in the western Cape Breton basin. Most sedimentary rocks with the exception of a few fine grey siltstones, are quite indurated. The lenticular red siltstones, so common in the Craginsh to the south, in the Lake Ainslie area, appear to be completely absent and the only red beds observed in the entire Gallant River section occur near the base of the Craginsh formation, 300 feet downstream from an old abandoned dam site, (see figure 9). Here, approximately 125 feet of brick red friable arkoses with numerous lenses of conglomerate outcrop. Murray (1961, p. 22) states that this represents a residual deposit and while the sequence has all the characteristics of this type of accumulation, it can hardly be considered as residual in the strict sense of the term, as the sequence is underlain by grey sandstones and arkoses. There is little doubt however, that these beds were deposited very close to source. Dark grey to black diabase dikes cut the lowermost beds of the Craginsh formation on Gallant River. East of the abandoned dam site, some 300 feet upstream along the southern tributary, a thick, whitish grey, massively bedded conglomerate appears to conformably overlies a thin andesite bed, marking what is considered to be the Fisset Brook - Craginsh contact.

The following section of the Skye River bed was measured along the upper portion of the Gallant River.

Gallant River (Section No. 10 Figure 3)

CRAIGNISH FORMATION - SKYE RIVER MEMBER

	Feet
Sandstone greenish grey, medium grained, arkosic massively bedded, numerous conglomerate lenses, with pebbles of pink rhyolite, grey quartz, and pink granite	350
Sandstone greenish grey, medium grained, very mucaceous, plant fragments, limonite stained	10
Conglomerate . massively bedded, lenticular, 1" - 3" pebbles of pink granite, grey and white quartz, and pink rhyolite	20
Sandstone arkose, grey-green, medium to coarse grained, very poorly bedded for the most part, minor conglomerate lenses and beds of green, very micaceous siltstone, generalized	1000
Concealed	80
Arkose greenish grey to grey, coarse grained, minor conglomerate lenses, micaceous	345
Conglomerate . massive, grey to buff very feldspathic, matrix	25
Siltstone dark grey to black, much plant material evenly bedded, well bedded, very micaceous	15

	Feet
Sandstone arkose, grey to greenish grey, very feldspathic, poorly sorted, numerous conglomerate lenses, bedding varies from poor and massive, to flaggy	250
Sandstone whitish grey, coarse grained, very feldspathic, crossbedded, massive, with conglomerate lenses	150
FAULT ZONE	
Sandstone grey, medium grained, massive, very poorly bedded, very feldspathic	100
Sandstone greenish grey, medium grained, very micaceous	50
Conglomerate . pink arkosic matrix "granite wash", very massive	50
Concealed	150
Arkose brick red, with conglomerate lenses, very poorly bedded, numerous lenticular conglomerate lenses, massive, cross-bedding	125
Concealed	50
Arkose pink coarse grained, conglomerate lenses, with intruded diabase dike	30
Sandstone pinkish grey, medium grained, minor interbeds of grey micaceous siltstone with plant fragments	20
Conglomerate . greyish white, massive, feldspathic, coarse, sandstone matrix	<u>100</u>

Thickness 2920

Faulted contact with Fisset Brook formation.

The following section was measured on Grand Etang Brook, immediately north of Cap Lemoyne. Here, as can be

seen, a much greater development of red beds is present than in the Gallant River section to the south. It is impossible however, to recognize a McLeod member, as lithologies typical of the Skye River member are found throughout the section, and interfingering of the two lithologies, i.e., red and non-red clastic rocks is evident.

Grand Etang Brook (Section No. 11 Figure 2)

CRAIGNISH FORMATION

(Conformable contact with overlying
Strathlorne - Ainslie Formation)

	Feet
Sandstone grey-green, medium grained, feldspathic massive, minor conglomerate lenses and interbeds of coarse grey arkose	185
Siltstone red-brown, well bedded, minor green mottling	560
Sandstone greenish grey, very feldspathic, medium grained, massive	40
Siltstone red-brown, well bedded, very micaceous ..	155
Siltstone grey, feldspathic, micaceous, concealed in part	60
Siltstone red-brown, micaceous, arenaceous, well bedded	80
Concealed	30
Siltstone red-brown, arenaceous, well bedded	30
Concealed	60
Sandstone grey-green, medium grained, feldspathic .	20
Concealed	100

THE STRATHLORNE-AINSLIE FORMATION

Lying conformably above the Craignish, and disconformably to conformably below the basal A₁ Windsor Limestone (see plate 1), is a sequence of grey argillaceous siltstones, grey sandstones, and red siltstones. These sedimentary rocks are in contrast to the underlying Craignish, much finer grained, more evenly bedded and somewhat better sorted. In short, these sedimentary rocks belonging to the Strathlorne-Ainslie formation are more mature than the underlying sequence of granite debris. It is thought that these sedimentary rocks accumulated in an alluvial and fluviatile lacustrine environment in the central portion of the Horton depositional basin. Topographic relief was undoubtedly more subdued than that present during deposition of the basal coarse clastic rocks of the Craignish.

Murray, (1955) in measuring the Gallant River section, subdivided these upper Horton beds into two formations, the Strathlorne at the base, and the Ainslie. The author feels that such a subdivision, based on a section with less than 15 percent exposure, is somewhat tenuous. Further, a concealed interval of 160 feet is present across the contact between Murray's two formation. Many better exposed sections of the upper Horton sequence can be found throughout the area, and after carefully measuring a number

of these, the author found that it was impossible to recognize two lithologically distinct formations within this sequence and suggests that the two formations of Murray, i.e., the Strathlorne and Ainslie, be grouped together into one formation, the Strathlorne-Ainslie. Little difficulty is encountered in distinguishing this rock unit from the overlying Windsor group or the underlying Craginsh formation.

Fine, grey to dark grey siltstones and fissile shales are found towards the base of this formation. The grey shales carry, in places, abundant fish scales and spines which seem to indicate a lacustrine environment for the basal portion of the sequence. Fecal pellets and pyrite concretions are fairly common and this, coupled with the lack of any other recognized faunal remains, suggests that these lake bottoms were poorly oxygenated (and non-conducive for a varied fauna). Thin sandstones within the predominantly fine silt portion of the sections commonly show load casting as bottom structures which may indicate that these slightly coarser clastic rocks were rapidly introduced into the depositional environment, (see photograph 7).

Fine grey sandstones, interbedded with red-brown siltstones predominate in the upper portion of the Strathlorne-Ainslie formation. The sandstones are commonly quite massive, well sorted and vary in colour from pale grey to buff. One sandstone bed on the Gallant River (see

photograph 8) exhibits well developed graded bedding. Sandstones form a smaller percentage of the total lithology in this formation than in the Lake Ainslie area to the south. Suparman (1964), using current direction features and bottom structures, found that transportation of the majority of the upper Horton clastic rocks was from south to north, i.e., at right angles to the basin margins, and towards the Margaree - Cheticamp area. This may explain why the Strathlorne-Ainslie formation in the Margaree - Cheticamp area is a finer facies than in the Lake Ainslie area. The following table shows the percentage of sandstone in various portions of the western Cape Breton basin and illustrates the trend towards finer clastic rocks from south to north. The remaining percentages are essentially red and grey siltstones and minor grey shale.

MARGAREE - CHETICAMP AREA

Percent

second Brook north of Grand Etang Brook	8
Gallant River	5
second Brook south of Gallant River	10
Dunvegan Brook	7
Cameron Brook	1
Broad Cove Brook	0

LAKE AINSLIE AREA

McIsaac Point Section	24
Southeast Mabou River	23

WHYCOCOMAGH AREA

	Percent
Southwest Mabou River	23
Little Judique Brook	24

Outcrops of the Strathlorne-Ainslie formation are abundant throughout the entire area and many reasonably continuous and structurally undisturbed sequences can be measured in many of the small brooks and creeks. The following sections serve to illustrate the lithology of this formation in various portions of the area. For locations, the reader is referred to the Government topographic maps on a scale of 1:50,000 and to figure 3.

SECTION OF HORTON STRATA
(as exposed on Gallant River)

(Section No. 10 figure 3)

	Feet
Basal Windsor A ₁ lms	15

STRATHLORNE-AINSLIE FORMATION

Ainslie Member

	Feet
Concealed	85
Siltstone grey-green, thinly bedded to fissile	5

	Feet
Siltstone red-brown, poorly bedded, minor interbeds of greenish grey siltstones	130
Sandstone greenish grey to buff, choppy crossbedding, massively bedded	15
Sandstone grey to buff, fine grained, choppy crossbedding, flaggy bedding	15
Concealed	190
Sandstone grey, medium grained, very feldspathic fine conglomerate lensal base, and 2' beds of interformational conglomerates of angular dense grey limestone pebbles, pink granite, maroon rhyolite, and red brown very fine grained sandstone, graded bedding, (photograph No. <u>8</u>).....	6
Concealed	130
Sandstone grey, medium to fine grained, massive to flaggy bedding	12
Concealed	600
Siltstone grey, flaggy bedding, drift plant fragments, ripple marks, strike N-S grades upward to buff weathering, fine grained sandstone	30
Concealed	<u>160</u>
Total Ainslie Member	1302

Strathlorne Member

	Feet
Siltstone grey to dark grey, thinly bedded to fissile minor interbeds of grey shale, and dense grey fine grained sandstone, load casting pyrite concretions towards base of outcrop also fecal pellets, (photograph No. <u>6</u>).....	60
Concealed	300

	Feet
Siltstone grey thinly bedded to flaggy with interbeds of dark grey shale containing fish spines and scales; minor algal- like structures and very thin limestone lenses	80
Concealed	380
Sandstone grey, fine grained, very poorly bedded ...	10
Sandstone grey to dark grey, fine to medium grained massive, feldspathic	90
Concealed	<u>120</u>
Total Strathlorne Member	1040

HORTON SECTION

Dunvegan Brook

(Section No. 12 figure 3)

	Feet
Sandstone fine grained, grey, flaggy, Windsor Horton contact	63

Strathlorne-Ainslie Formation

	Feet
Siltstone Dense, grey	5
Concealed	202
Sandstone fine grained, grey, flaggy to massive	5
Siltstone grey, dense, minor red shale	148
Siltstone red-brown, dense	5
Concealed	85
Siltstone red, dense, grey siltstone	51

	Feet
Interformational conglomerate	5
Concealed	92
Sandstone red-brown, massive	5
Concealed	135
Sandstone grey-buff, flaggy	5
Concealed	165
Mudstone grey, silty; and more massive grey siltstone	5
Concealed	120
Sandstone grey-buff, fine grained	5
Concealed	172
Sandstone buff, massive, typical of Ainslie type. Subcrop	15
Concealed	185
Siltstone grey, crumbly, soft; and silty mudstone; minor grey shale	5
	<u>1478</u>

Lithopercentage on the first 1,000 feet:

Siltstone & shale - 93 per cent
Sandstone - 7 per cent

HORTON SECTION

First Brook North of Gallant River

(Section No. 13 figure 3)

(Section No. 15 Figure 3)

	Feet
Basal Windsor	28

Strathlorne-Ainslie Formation

	Feet
Sandstone Horton grey, well crossbedded, calcareous, very fine grained	10
Concealed	28
Sandstone very calcareous, fine grained, greenish grey, flaggy	5
Siltstone red-brown, poorly exposed	10
Siltstone dense, poorly bedded, grey	4
Conglomerate . red, interformational, in red siltstone matrix	2
Shale red, silty, poorly exposed	15
Sandstone flaggy, fine grained, grey, some porosity non-calcareous	50
Concealed	15
Sandstone greenish grey, fine grained, with chips of shale	10
Concealed	20
Sandstone thinly bedded to fissile, greenish grey, very fine grained	2
Sandstone mottled red and green, very thinly bedded to fissile, very fine grained sandstone to siltstone	4
Sandstone fine grained, grey, massively bedded	30
Concealed	13
Sandstone flaggy, greenish grey, very fine grained..	15
Sandstone more massively bedded, as above	20
Concealed	45
Sandstone deeply weathered, fine grained	12

	Feet
Concealed	20
Siltstone interbedded, mottled, red-brown and grey	12
Shale minor interbeds, red	1
Shale crumbly, red	15
Siltstone dense, grey-green	1
Shale red	2
Sandstone well crossbedded, brownish grey, very fine grained	3
Shale red, silty	2
Sandstone brownish grey, very fine grained, micaceous	4
Shale poorly outcropping, red, silty	8
Siltstone mottled red and grey	2
Concealed	33
Siltstone grey-buff, massively bedded	10
Concealed	21
Sandstone very massive, fine to medium grained, reddish grey to buff	10
Concealed	50
Siltstone mottled, red, micaceous	13
Concealed	39
Siltstone mottled red and green	2
Concealed	20
Siltstone grey, indurated	15

HORTON SECTION

Traverse of North Fork Cameron Brook

(Section No. 14 figure 3)

Feet

Basal A₁ limestone, Windsor 5Strathlorne-Ainslie Formation

Feet

Concealed 252

Shale grey-green, thin bedded, silty 2

Concealed 35

Siltstone grey-green, siltstone to mudstone, thin
bedded 2

Limestone massive 1

Limestone conglomerate 4

Siltstone grey-green, siltstone to mudstone,
thin bedded 2

Concealed 26

Mudstone grey-green, silty 2

Concealed 24

Mudstone graded, black to grey-green 2

Concealed 44

Siltstone grey-green, siltstone to mudstone 2

Concealed 25

Siltstone grey-green, siltstone to mudstone 1

Sandstone very massive, grey to grey-green,
fine grained 1

	Feet
Concealed	52
Siltstone red, well bedded to massive	2
Concealed	7
Siltstone grey-green, siltstone to mudstone, thinly bedded	1
Concealed	11
Siltstone grey-green, siltstone to mudstone, thinly bedded	18
Concealed	13
Siltstone thinly to poorly bedded, red	1
Concealed	7
Mudstone grey-green, very thinly bedded, silty	1
Concealed	30
Mudstone grey-green, silty, thinly bedded	1
Concealed	39
Siltstone red-brown	2
Concealed	39
Siltstone grey, thinly bedded, shaley	21
Concealed	325
	1000

Lithopercentage on the first 1,000 feet:

Siltstone and shale - 99.5 percent
Sandstone - .5 percent

HORTON SECTION

Second Brook North of Fordview
flowing into Margaree River from the east

(Section No. 15 figure 3)

Feet

Basal Windsor A₁ limestone 12

Strathlorne-Ainslie Formation

Feet

Sandstone grey-buff, very fine grained, well
 bedded, crossbedded 9

Concealed 47

Sandstone green, massive, very fine grained 9

Concealed 38

Sandstone green-buff, well bedded, flaggy, very
 fine grained 10

Sandstone greenish buff, well bedded, flaggy,
 fine grained 56

Sandstone grit to coarse grained with a limestone
 matrix 5

Concealed 54

Siltstone green, very dense, well crossbedded 6

Concealed 24

Limestone dense, grey-black, calcite stringers;
 contorted $\frac{1}{2}$

Concealed 19

Siltstone grey-green, quite massive, dense 7

Concealed 5

Siltstone grey with minor red mottling, fissile
 shaly 7

Feet

Concealed	5
Siltstone red-brown, poorly bedded	7
Concealed	40
Siltstone thinly bedded, red-brown, shaly	8
Siltstone thinly bedded, red-brown, shaly	8
Concealed	36
Siltstone grey-green, some red mottling, massive to thinly bedded	8
Concealed	5
Siltstone red-brown and green interbedded, thinly bedded	8
Concealed	18
Siltstone grey-green, massive, well bedded, very dense	8
Concealed	38
Sandstone grey-buff, very massive, fine grained	8
Concealed	12
Siltstone grey-green	8
Concealed	141
Sandstone greenish buff, quite massive, very fine grained	4
Concealed	330
	1000

Lithopercentage on the first 1000 feet:

Siltstone and Shale - 90 percent
Sandstone - 10 percent

HORTON SECTION

Northernmost Tributary of Broad Cove Brook

(Section No. 16 figure 3)

	Feet
Basal Windsor limestone Att. N12E, D82W	10

Strathlorne-Ainslie Formation

	Feet
Siltstone red-brown, thinly bedded, Att. N24E, D80W	5
Siltstone red-brown, thinly bedded, crumbly	30
Siltstone grey-green, quite dense, massive, well bedded. A few scattered mica flakes. Att. as above	13
Concealed	15
Siltstone grey-green as above, in places has a lot of limonite flecks. Att. N8E, D59W	25
Concealed	20
Siltstone grey-green, massive, very dense. Very little if any argillaceous material	5
Siltstone red-brown, argillaceous, quite fissile. A few massive interbeds of red-brown siltstone	20
Siltstone reddish grey, thin to massively bedded, a lot of fine mica along the bedding planes. Att. N22E, D69W. By 10 feet, it has become grey-green and not as micaceous, more massive	35
Concealed	15
Siltstone grey-green, dense, well bedded. Mica along bedding planes. At 10 feet a 1 foot lense of interformational conglomerate	

Feet

	with a calcareous matrix of grey-green siltstone. The pebbles are up to $\frac{1}{2}$ " diameter. Some are of siltstone and some of granite, as well as some of pink feldspar. Also buff weathering limestone fragments. Minor interbeds of red-brown argillaceous quite fissile siltstone	15
Concealed		22
Siltstone	grey, thinly bedded to flaggy, dense. Somewhat argillaceous	10
Siltstone	grey, dense, massive, minor mica on bedding planes	2
Concealed		25
Siltstone	massive, as above	5
Concealed		15

N.B. It is probable that all of these small concealed areas consist of grey to grey-brown siltstone, since the drift material is almost entirely of this type.

Siltstone	greenish grey, dense, flaggy to massive. Some mica along bedding planes. Att. N9E, D61W. At 25 feet becomes a fine grained sandstone. A lot of limonite flecks. At 26 feet a 6" lense of conglomerate. Has a calcareous matrix. Some of the pebbles are of limestone. From 25 feet becomes interbedded greenish grey shaly siltstone, thinly bedded and massive green-grey siltstone	35
Concealed		12
Siltstone	greenish grey, thinly bedded to massive A lot of mica along bedding planes. At 10 feet is all thinly bedded and grey	20

Feet

N.B. Most of the concealed areas are underlain by soft grey argillaceous siltstones - mudstones.

Concealed	22
Siltstone greenish grey, thin bedded, argillaceous At 15 feet becomes grey and more massive, still argillaceous. From 20 to 23 feet a 3 foot red-brown siltstone bed	30
Siltstone green-brown, thinly bedded, argillaceous	10
Siltstone massive green-grey. Some mica along bedding planes. At 10 feet a lot of limonite flecks. Also more thinly bedded	15
Concealed	10
Siltstone greenish grey, thinly bedded to massive, in places argillaceous. All N-S, D50W. From 15 to 20 feet flaggy bedded	25
Concealed	10
Siltstone greenish grey, fairly thinly bedded somewhat argillaceous. Some limonite staining and a lot of poorly preserved plant stems. (<u>Lepidodendron</u>). At 15 feet a 1 foot bed of very dense blue grey calcareous siltstones. From 16 to 21 feet grey thinly bedded argillaceous siltstone. Pyrite concretions common.	21
Siltstone greenish, well bedded to massive. A few limonite flecks	40
Siltstone very hard, quite porous, very calcareous At the base a 2 foot zone of very calcareous conglomerate. Flat pebbles with weathered rust color and are of dense grey limestone. 1-3" in length, very flat	5

Feet

Siltstone	 subcrop of red-brown, fissile	45
Siltstone	 greenish-grey, fairly thinly bedded, slightly argillaceous. A lot of mica along the bedding planes. At 10 feet a 6" bed of algal-type limestone. At 20 feet another 6" algal limestone. At 25 feet minor red-brown shaly siltstone interbeds followed by green-brown thinly bedded argillaceous siltstone	30
Concealed (Possible fault)	.....	50
Siltstone	 red-brown, mottled greenish grey in places, poorly bedded, argillaceous. N45E, D50NW. Last 2 feet show signs of contortion. Possible fault zone	50
Shale	 dark grey, very fissile, calcareous, argillaceous. At 20 feet becomes grey, dense, more massive, crossbedded siltstone. From 25 to 30 feet red-brown siltstone as before	30
Concealed	.....	51
Siltstone	 massive, red-brown, poorly bedded. Att. N20E, D50NW	5
Concealed	.....	10
Siltstone	 grey, massive, well bedded. Att. N25E, D50W	10
Concealed	.....	25
Siltstone	 massive, as above. At 5 feet becomes buff color. At 10 feet grey, thinly bedded, somewhat argillaceous siltstone ..	12
Concealed	.....	8
Siltstone	 very dense, quite massive. Very calcareous. At 5 feet becomes thinly bedded and argillaceous. A few more massive interbeds. At 35 feet the Att. is N22E, D56N. Becomes dense and massive grey siltstone	40

	Feet
Concealed	15
Shale dark grey to black, thinly bedded to fissile, silty. In places, a mudstone. At 10 feet a 6" algal limestone	18
Concealed	25
Siltstone reddish grey, thinly bedded to massive argillaceous	5
Concealed	20
Siltstone brownish buff, massive, dense well bedded, very calcareous. Minor thin algal-type is above and below. A lot of mica along the bedding plane	25
Concealed	25
Siltstone dark grey, black weathering, thinly bedded, quite argillaceous siltstone- shale. Minor contorted zones. Probably no section lost	25
Concealed	15
Siltstone dark grey, as before	25
Concealed	25
Siltstone grey, massive, well bedded, dense. Att. N10E, D45W at 20 feet becomes flaggy buff fine sandstone. Minor flakes of mica. At 25 feet grades back to grey- green siltstone. At 30 feet more limonite flecks	35
Concealed	40
^w Siltstone green-brown to buff, massive, poorly bedded. Att. N15W, D60W (suspect faulting). At 10 feet becomes very fine grained light grey, very massive sandstone. At 25 feet becomes green-grey in color. At, base, quite massive very pure quartz, dense siltstone- possible some plant fragments	30

	Feet
Concealed	95
Siltstone green-brown, well bedded to massive, dense (start of short contorted zone). Att. N35E, D65SE. At 25 feet becomes buff coloured siltstones. Att. impos- sible to obtain	35
Concealed ..	60
Siltstone dark grey, very argillaceous siltstone to mudstone-shale. Quite jointed and limonite stained. Att. approx. N-S D15W	5
Concealed	21
Siltstone green-grey, quite micaceous, thinly bedded. A few lime concretions. Att. N25E, D25W	2
Concealed	27
Siltstone as above	3
Concealed	20
Siltstone grey to grey-green, thinly bedded, argillaceous, shaly and fissile. Att. N15W, D25N	6
Concealed	40
Siltstone light buff, massive, well bedded, quite jointed. Att. N12W, D25W	5
Siltstone green-buff, contorted, as before. Att. impossible	5
Concealed	13
Siltstone green-brown, very micaceous, well bedded. Att. N25W, D25W	2
Concealed	56

Feet

Siltstone	 green-grey, thinly bedded, argillaceous, At 10 feet becomes more massive. Att. N18W, D19W. Fissets are places approaching a shale	15
Concealed	.....	23
Siltstone	 green-buff, massive, well bedded	15
Concealed	.....	24
Siltstone	 green-brown, thinly bedded, argillaceous siltstone to mudstone. Att. N-S D20W. Extensive limonite staining	8
Concealed	.....	120
Siltstone	 green-buff, massive, highly jointed, dense. Att. N30W, D34W	7
Concealed	.....	10
Mudstone	 dark grey, thinly bedded, argillaceous, deeply weathered	5
Sandstone	 buff, very fine grained, poorly bedded, massive	4
Concealed	(approx.)....	150
Siltstone	 grey, quite massive to flaggy. Very little argillaceous material	4
Concealed	(approx.)....	75
Sandstone	 buff, very fine grained sandstone to siltstone. Flaggy to massive. Some mica flakes along the bedding planes. Att. N15W, D33W	5
Concealed	.....	7
Sandstone	 buff, as above	3
Concealed	.....	109

Feet

Siltstone	 green-grey, well bedded, massive, dense. Att. N12E, D20W. Some mica flakes along the bedding planes	5
Concealed	.....	10
Siltstone	 grey-green, as before; changes to green- buff siltstone at 5 feet	10
Concealed	.....	8
Siltstone	 green-grey, as before. Att. N-S, D23W	8
Concealed	 Probably contains green-brown shaly siltstone to mudstones, this type of drift predominated in the covered zone ...	81
Siltstone	 green-brown, shaly siltstone to mudstone. Extensive limonite staining. Att. N-S, D15W	2
Concealed	.....	250
Siltstone	 green-grey, quite argillaceous, thinly bedded, rubbly. Att. N25E, D60W	10
Concealed	.....	300
Sandstone	 buff, very fine grained, flaggy sandstone to siltstone. Att. approx. N15E, D50W	5
Concealed	.....	220
Sandstone	 buff, well bedded, massive, very fine grained. Att. N25E, D25W	5

Lithopercentage on the first 1,000 feet:

Siltstone and shale - 100 percent

Lithopercentage on the first 2,000 feet:

Siltstone and shale - 99 percent
Sandstone - 1 percent

	Feet
Concealed	157
Siltstone grey, well bedded. Att. N55E, D Vort	10
Siltstone grey siltstone, 80 percent; grey shale 20 percent	165
Shale grey. Att. N30E, D45W	117
Concealed	47
Siltstone grey, very dense	47
Shale grey shale to mudstone, only slightly silty. 80 percent shale; 20 percent limestone	68
Concealed	44
Sandstone grey, very fine grained,	44
Siltstone dense, grey, massive	54
Shale grey silty shale to mudstone. Att. N50E, D55W	27
Sandstone grey, fine grained, dense, massive	27
Siltstone mostly grey siltstone to very fine grained dense sandstone. 40 percent sandstone; 60 percent siltstone	135
Shale grey, silty	25
Siltstone grey, massively bedded, highly indurated	25
Shale grey, silty	125
Sandstone grey, fine grained,	10
Concealed	90
	<u>1792</u>

Contact between Strathlorne-Ainslie formation and Craginsh

Lithopercentage on the first 1,000 feet:

Siltstone and shale - 100 percent

Lithopercentage on Total Thickness - 1792 feet:

Siltstone and shale - 92 percent
Sandstone - 8 percent

RESULTS OF SPORE ANALYSIS SUBMITTED FROM
THE MARGAREE - CHETICAMP AREA

Five samples collected from the Gallant River Horton section were submitted for spore analysis. Four of these samples - C129, C137, C141, and C144 contained identifiable spores. For the stratigraphic location of these samples, see figure 13

Sample C129, stratigraphically the highest of the four, was collected from the Ainslie member, 150 feet above the base, or 1150 feet below the Horton - Windsor contact. Only two genera are present, Pustulatisporites and Vallatisporites. The species Pustulatisporites pretiosus Playford was identified and indicates that this sample belongs to A zone.

Sample C137 was collected 360 feet stratigraphically below the Strathlorne-Ainslie - Craginsh contact within the Craginsh formation. The following

species were present:

<u>Vallatisporites</u>	<u>verrucosus</u>	Hacquebard
* <u>Nodatitriletes</u>	(new species)	
<u>Perotriletes</u>	<u>perinatus</u>	Hughes and Playford
<u>Punctatisporites</u>	<u>planus</u>	Hacquebard
<u>Granulatisporites</u>	cf. <u>crenulilatus</u>	Playford
<u>Punctatisporites</u>	<u>irrasus</u>	

along with representatives of the following genera:

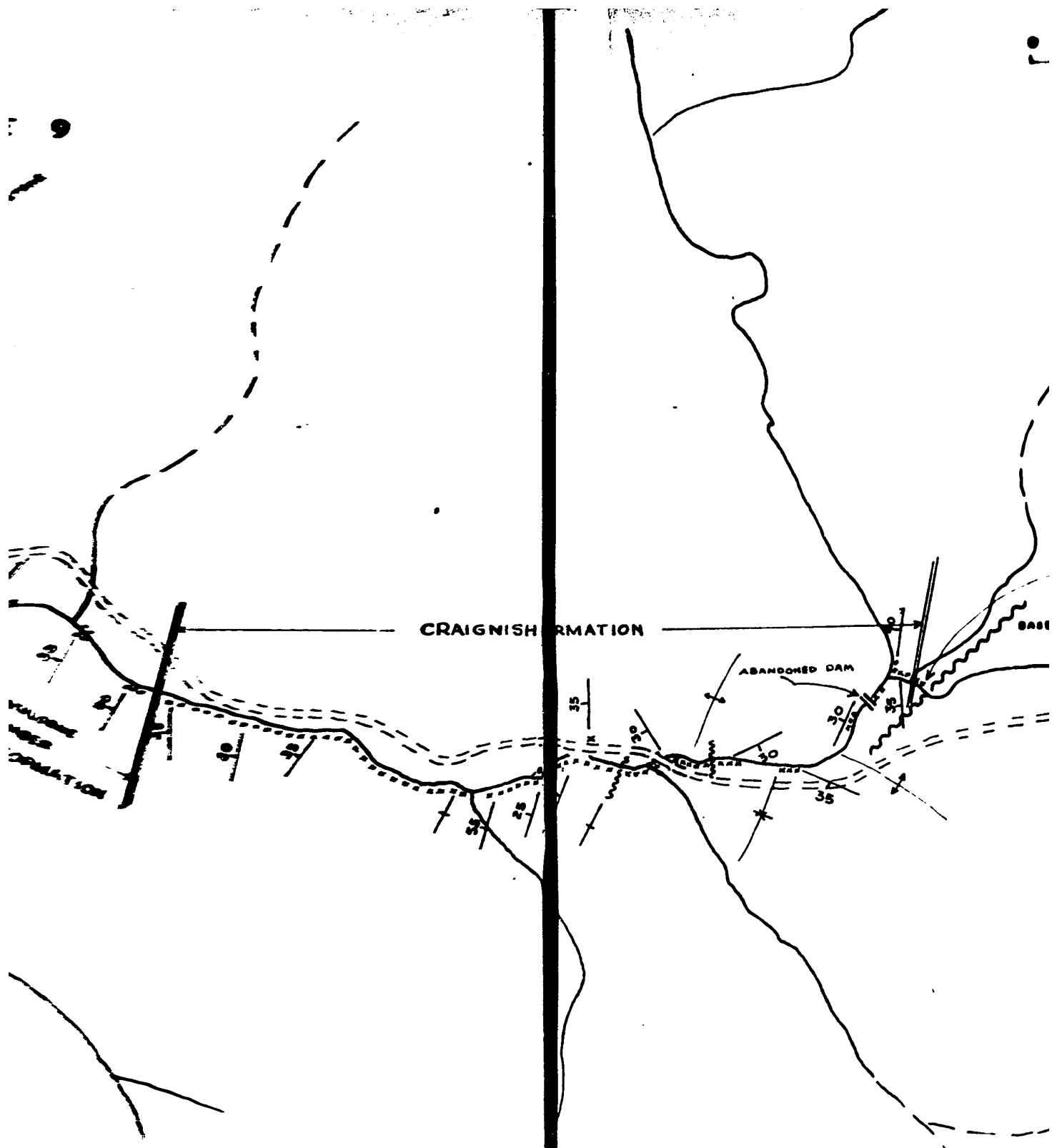
Colamospora
Cyclogranisporites
Perotriletes
Grandispora
Endosporites
Acanthotriletes
Verrucosisporites
Convolutispora
 cf. Retusotriletes
Apiculatasporites

The presence of Nodatitriletes sp. indicates that this sample belongs to C zone. The sample however, is only 2700 feet stratigraphically below the Horton - Windsor contact. In the section to the south of the Gallant River area, i.e., Graham River, Judique Intervale Brook, Southwest Mabou River and Southeast Mabou River, the B zone extends from approximately 2600 feet below the top of the Horton succession to approximately 4000 feet below the top. On the Gallant River section, the McLeod member is missing, and is believed to have been non-depositional.

More samples from the basal portion of the Strathlorne member on Gallant Brook would have to be analysed in order to indicate if B zone was present in the Gallant River Horton sequence.

Samples Nos. C141 and C144 collected from the Craignish formation, 1800 feet and 2250 feet respectively below the upper contact of this formation, contained abundant spores, but only two genera were present. In sample C141 only Punctatisporites was present, while in sample C144, Punctatisporites and Verrucosisporites were present. Neither of these genera is indicative of any particular zone, as representative species range throughout the Horton sequence.

Sample C149, collected 150 feet above the basal faulted contact of the Craignish formation, contained no identifiable spores.



THE HORTON G
GALLANT RIVER S

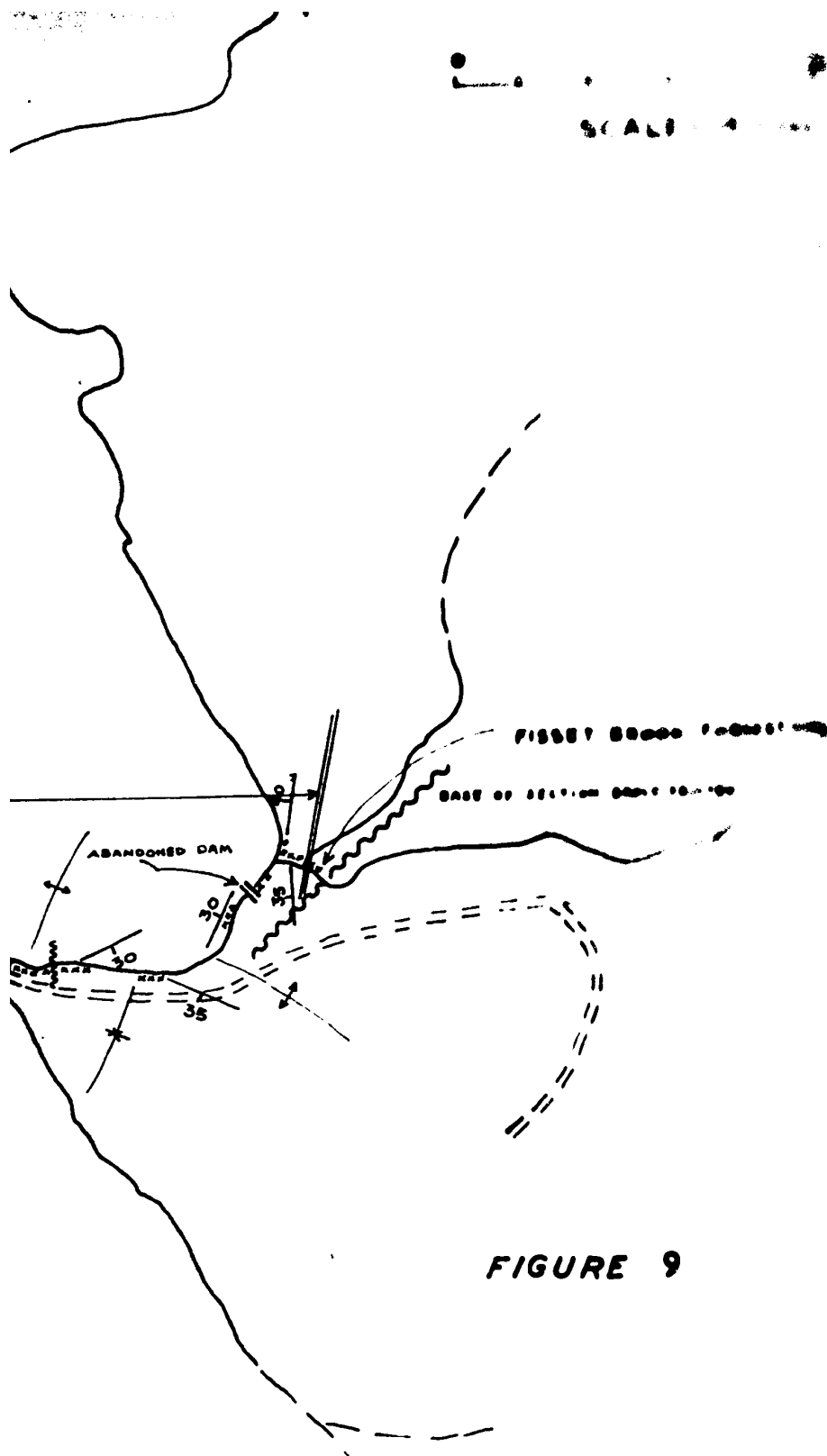


FIGURE 9

ORTON GROUP RIVER SECTION

MISSISSIPPIAN

CANSO GROUP



Maroon and grey fine clastics

WINDSOR GROUP



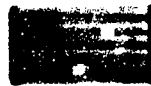
Gypsum, limestone, red clastics

HORTON AND/OR WINDSOR



Coarse red clastics

HORTON GROUP



AINSLIE FORMATION: fine to coarse red clastics, minor grey clastics

STRATHLORNE FORMATION: chiefly fine grey clastics

CRAIGNISH FORMATION: chiefly coarse red clastics

PRE-MISSISSIPPIAN

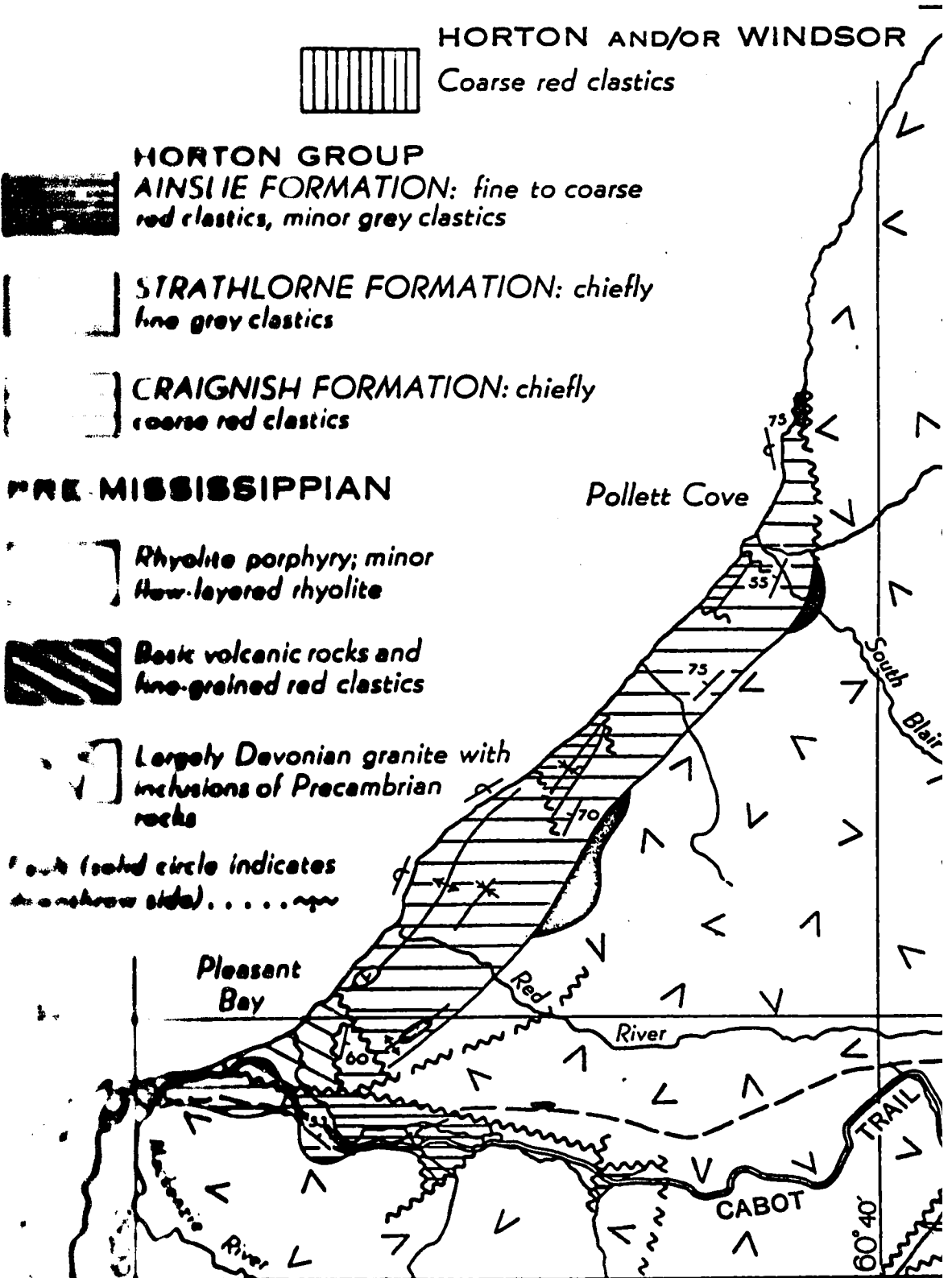
Rhyolite porphyry; minor flow-layered rhyolite



Basic volcanic rocks and fine-grained red clastics

Largely Devonian granite with inclusions of Precambrian rocks

South (solid circle indicates marsh side)



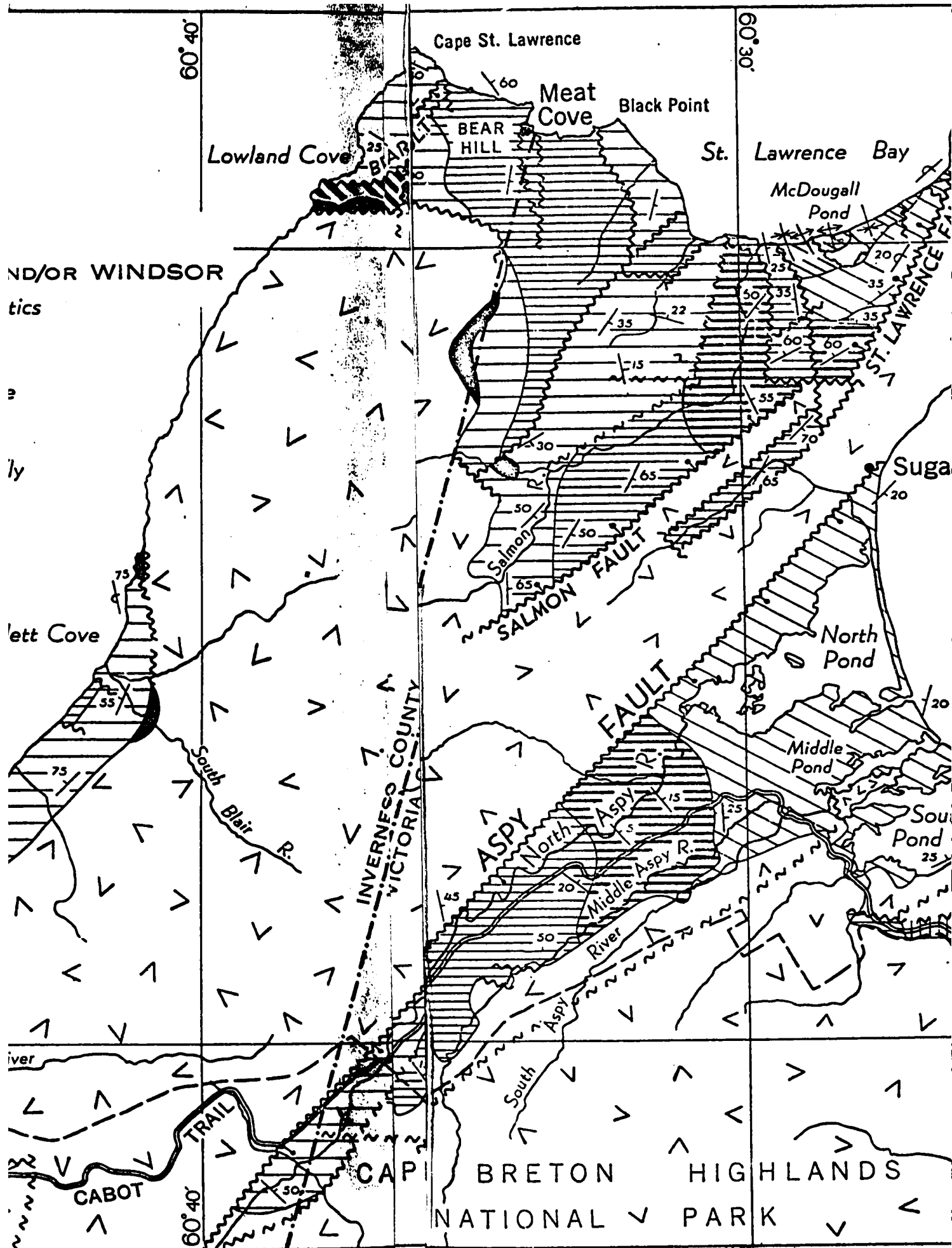
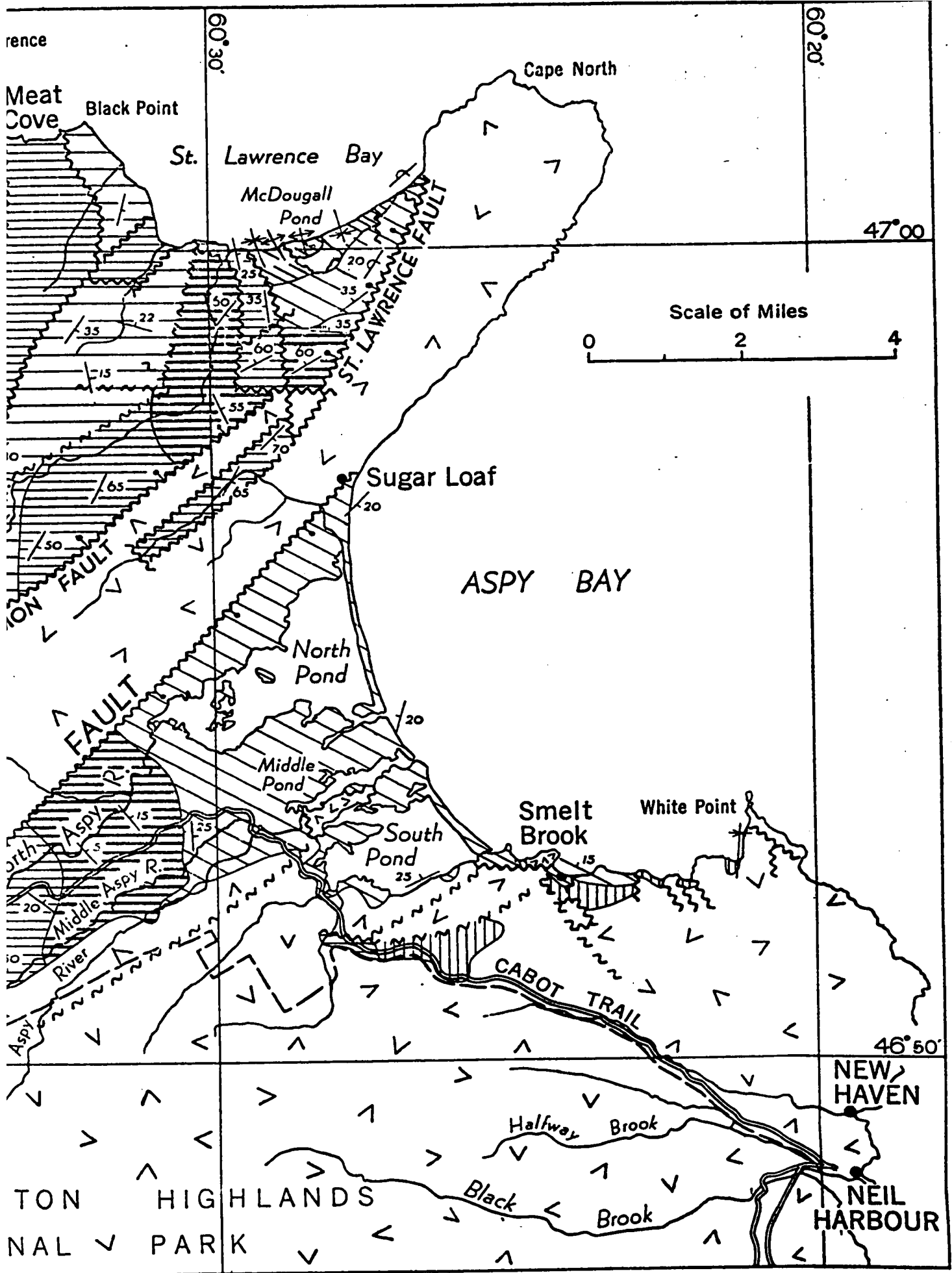


Figure 10 Mississippian rocks of Northern Cape Breton Island



CHAPTER 6

THE HORTON GROUP IN NORTHERN CAPE BRETON ISLAND

INTRODUCTION

In order to extend the study of Horton strata into the northern portion of Cape Breton Island, a detailed study of the North Aspy River section was made during a portion of the 1963 field season. The areal distribution of this study is shown on figure 11. The North Aspy River section was selected as it presented the least structurally disturbed section of Horton sedimentary rocks in this area. Numerous samples were collected, with a view to studying included spore assemblages. Unfortunately, outcrops of the Ainslie member and Craguish formation are not abundant, but are sufficient to demonstrate the distribution and general lithology of these two rock units.

The extent of the Northern Cape Breton Carboniferous basin area is shown on figure 10, a copy of the geological map accompanying the report of E.R.W. Neale and D.G. Kelley on the "Stratigraphy and Structure of Mississippian of Northern Cape Breton Island". Included is an area of approximately 275 square miles of which 80 square miles or 30 percent is underlain by Mississippian

sedimentary rocks. As can be seen, a number of downfaulted Mississippian "outcrop belts" are present, separated by upland areas of pre-Mississippian igneous and metamorphic rocks, ranging in age from Precambrian to Devonian. It appears quite probable that a number of these now separated outcrop areas were joined during Horton and possibly later accumulation.

The North Aspy River flows along the northern portion of the southeasterly downfaulted Mississippian outcrop area and it is this outcrop belt of Horton sedimentary rocks that is discussed in this chapter.

FORMER WORK

- 1855: H. Fletcher, mapping in the Northern Cape Breton area, distinguished between Carboniferous and pre-Carboniferous rocks. Igneous and metamorphic rocks were all thought to be Precambrian. The base of the Carboniferous sequence was placed at a thick coarse clastic rock, conglomeratic phase (now recognized as the Craignish formation). Numerous occurrences of gypsum and limestone were described, but no attempt to subdivide the Carboniferous was made.

- 1946: W.A. Bell visited the region, for the Geological Survey of Canada, and noted the presence of the Horton, Windsor and Canso groups. His observations were not published.
- 1953: Stacy collected fossils from the Windsor group at the mouth of South Pond as part of a study on this group in Cape Breton Island.
- 1954 - 1955: E.R.W. Neale, for the Geological Survey of Canada, mapped the area. Maps based on the 1954 field work, (Neale, 1955; 1956 a, b, c) show the distribution of Mississippian rocks and offer brief descriptions of them.
- 1955: Brooks and Maehl, working on a combined thesis project for the Massachusetts Institute of Technology described Horton strata in the valley of the Salmon River. A thickness of 11,650 feet of Horton strata was measured and described in detail. The lower contact of the Horton group is not exposed on the Salmon River section.
- 1959: Neale and Kelley spent a short time in the field checking aspects of a possible Horton subdivision and the Horton-Windsor contact relationship.

RECENT FIELD WORK

The author spent approximately two weeks in the Aspy Bay region and concentrated his study of the Horton group to outcrops on the North Aspy River. A detailed traverse of this Horton section was undertaken and numerous samples were collected for study. The areal distribution of this field work is shown on figure 11. A brief visit was made to the Cape St. Lawrence region, to check on the Windsor-Canso boundary relationship. The North Aspy River section was selected, after a study of Neale and Kelley's map on the region indicated that this portion of the area was much less structurally disturbed than other portions.

REGIONAL GEOLOGY

Mississippian rocks belonging to the Horton, Windsor and Canso groups are present in the northern Cape Breton basin area, and are described by Neale and Kelley (1961).

The various outcrop belts of Mississippian rocks belonging to the Horton, Windsor and Canso groups are generally highly folded and faulted, with the exception of the Aspy River belt.

Horton strata can be subdivided into four lithologically distinct units, a basal volcanic and clastic

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sequence, the Fisset Brook formation (MacKasey, 1963), an overlying predominantly coarse clastic accumulation, the Craignish formation of Murray (1960), a fine predominantly grey bed sequence, the Strathlorne member, and finally a coarse clastic sequence equivalent lithologically to the Ainslie member of the previously described western Cape Breton basin area. This sequence in the northern Cape Breton area occupies the same stratigraphic position in the Carboniferous basin as lithologically similar beds in western Cape Breton Island. They are pre-Windsor and lie upon igneous and metamorphic rocks of the basement complex.

Strata of the overlying Windsor group are composed of anhydrite, gypsum, limestone, red shale, siltstone, and conglomerate and clearly indicate encroachment of seas into portions of the Carboniferous depositional basin. As the Windsor group does not constitute a major portion of the thesis problem, no study of these rocks was undertaken, but Neale and Kelley (1961) report these beds, due to their generally poor resistance to erosion, do not outcrop abundantly, and no continuous sections suitable for detailed study are available. In the Aspy Bay region, the A₁ Windsor laminated limestone lies upon conglomerates of the Ainslie member in the valleys of the Middle and South Aspy Rivers.

Strata belonging to the overlying Canso group are

restricted to the St. Lawrence Bay region. A thin outcrop zone of black fissile siltstones, with minor maroon siltstones overlies uppermost Windsor sedimentary rocks. Neale and Kelley (1961, p. 88), report that the Windsor-Canso contact is conformable. The fine dark grey calcareous siltstones of the Canso commonly show mud cracking and locally thin beds contain abundant pelecypod shells (Antracomya angulata Dawson). These Canso sedimentary rocks have the general aspect of brackish water estuarine deposits.

Consolidated sedimentary rocks, younger than the Canso, are not present.

THE HORTON GROUP IN NORTHERN CAPE BRETON ISLAND

Rocks belonging to the Horton group comprise 85 percent of all the Mississippian strata present in the northern Cape Breton basin. Basal Horton sequences lie marginal to the pre-Carboniferous igneous and metamorphic basement complex, east of Pleasant Bay, south of the Middle Aspy River, and southeast of Lowland Cove. Elsewhere, the Horton lies in faulted contact with the basement along such faults as the Aspy, Salmon River and St. Lawrence (see figure 10). Although the present limits of Horton outcrop belts are confined to downfaulted areas, (generally down-faulted on one side only), Neale and Kelley, (1961, p. 91)

postulate that Horton sedimentary rocks at one time masked a greater portion of the basement rocks and state:

"The Mississippian basin of deposition in Northern Cape Breton extended over at least a part of the present upland surface and possibly over most of it."

The following criteria are used:

- (A) Continuity (very similar lithological sequences) of Horton outcrop belts in areas now separated by the basement complex, e.g., the Salmon River and Aspy Valley successions.
- (B) The transgression (on lap) of Horton sedimentary rocks onto basement rocks along the southern portion of the Aspy Valley outcrop belt.
- (C) The presence of A₁ Windsor limestones lying directly on basement rocks.
- (D) Subzone B (Windsor limestone) overlies basement rocks on the South Aspy River near Cabot Trail bridge.

Neale and Kelley (1961, p. 93) propose an alternate hypothesis for these relationships, namely a north-eastward tilting of the basin throughout Horton and Windsor accumulation with each succeeding formation transgressing eastward onto the tilted margins of the basin.

The writer agrees that evidence exists for a more extensive Horton depositional basin than is now evident, but believes the alternative hypothesis of Neale and Kelley to be more acceptable than envisioning an extensive

transgression of Windsor seas over the greater portion of the Cape Breton upland surface. However, the evidence is insufficient to prove either hypothesis conclusively, although detailed work on the petrography of the conglomerates, and directional current structures may furnish information with respect to the extent and configurations of the Horton depositional basin. Coarse boulder beds in the Ainslie member, (see photograph 11) are thought to be related to either uptilting to the west, or movement of an upfaulted horst of basement rocks bounded on the north by the Salmon Fault, and to the south by the Aspy Fault. Later erosion could have removed any remnant of Mississippian sedimentary rocks from this upfaulted block.

UPPER AND LOWER CONTACT RELATIONSHIPS

Neale and Kelley (1960, pp. 81, 82) describe a sequence of post-granite, interbedded clastic rocks and volcanics at several localities in the area. In the Lowland Cove area, amygdaloidal basalt is intercalated with indurated red sandstones and siltstones, while on Meat Cove Brook, rhyolite flows are intercalated with clastic rocks. These flows appear to be post-granite, but no mention is made of contact relationships except in the vicinity of Lowland Cove, where rhyolite is found, according to Neale and Kelley (op. cit., p. 82), to be gradational into coarse-grained granite and syenite.

MacKasey (1963) visited the area and studied these volcanic-clastic sequences and noted their lithological similarity to beds in the Western Cape Breton Basin area. As they were clearly post-granite (Devonian) and pre-Craignish, he correlated these sequences with the Fisset Brook formation in western Cape Breton. The writer now includes these volcanics in the Horton group as the basal formation, for reasons outlined previously in the chapters dealing with the western Cape Breton area.

The upper contact of the Horton is placed, as elsewhere, at the base of the Windsor A₁ laminated limestone. This limestone rests conformably upon conglomerates of the

Ainslie member, (uppermost Horton) in the valley of the Middle and South Aspy Rivers. Thus defined, the Horton group occupies a similar stratigraphic position in the Mississippian sequence to lithologically similar successions in Western Cape Breton Island, i.e., pre-basal Windsor A₁ limestone and post-igneous and metamorphic basement. Neale and Kelley (1960, p. 85) mention pale red to greenish red boulder conglomerates near Smelt Brook and White Point, and suggest that these could belong to either the uppermost Horton (Ainslie member) or could be related to the marginal basin facies of the A₁ limestone, the Grantmire conglomerate formation (Bell and Goranson, 1938).

STRATIGRAPHY OF THE HORTON GROUP IN NORTHERN CAPE BRETON ISLAND

Strata lying upon igneous and metamorphic rocks and lying below the laminated A₁ Windsor limestone belong to the Horton group as here defined and as in other areas, can be divided into three lithologically distinctive rock stratigraphic units, which are, from the base upward, the Fisset Brook formation, the Craignish formation and the Strathlorne-Ainslie formation.

Topographic relief remained high, and coarse clastic rocks were washed into the basin, marginal to uplands. In certain areas, the volcanics were already contributing clastic rocks to the depositional basin. Massive rhyolite pebble conglomerates are abundant in the Salmon River area, where Brooks and Maehl (1955) measured a homogeneous thickness of 4200 feet of these beds. Their description (p.11) of these beds is as follows:

"The lowest rocks of the Horton group represented in this area are conglomerates and have been designated the rhyolite pebble conglomerate formation. The matrix of the conglomerate is made up of poorly sorted, coarse, angular grains. An average composition of the matrix from thin section work is quartz 35 %, lithic fragments 30%, orthoclase 25%, miscellaneous 10%. The last 10% of the matrix, includes plagioclase, muscovite, biotite, iron oxide (probably hematite), pyrite, sericite, and secondary calcite. The rock is hardened through extensive recrystallization of the quartz. The iron oxide gives the rock a distinct red color. The orthoclase is orange, a feature that is noted throughout the section, and is only slightly weathered. The lithic fragments appear to be similar to the pebbles and cobbles mentioned below. Except for the lack of abundant clay matrix (which may be masked by the iron oxide) the matrix of the conglomerate would be a typical greywacke.

"The cobbles in the conglomerate are very well rounded and range up to 12 inches in greatest dimension. The largest and most distinctive are purple rhyolite porphyry, but also present are other igneous pebbles both acid and basic, metamorphic and quartz pebbles. The conglomerate is found in massive beds up to 100 feet thick interbedded with red, poorly, micaceous, fine to medium grained, non-calcareous sandstone lenses less than 15 feet thick. There are occasional plant fragments but none of them is identifiable. These characteristics do not change for the bottom 4185 feet of section."

Neale and Kelley (1960, p. 83) measured a thickness of 5400 feet of coarse clastic rocks in the Lowland Cove area. Here, as in the Salmon River area, rhyolite and rhyolite porphyry are predominant coarse clastic constituents. They also state, (p. 83):

"Evidence of a very local source area is indicated here (Lowland Cove section) and also at MacKenzie River where grey, regolithic Craignish formation is distinguished with difficulty from underlying granodiorite."

The foregoing sequences are correlated with the Craignish formation both on lithology and on their stratigraphic position above the volcanics and clastic rocks of the Fisset Brook and below the fine grey clastic rocks of the overlying Strathlorne member of the Strathlorne-Ainslie formation.

Strata belonging to the Craignish formation are also present in the Aspy Valley outcrop belt and lie in a synclinal linear zone, bounded to the north and south along faulted contacts with pre-Horton crystalline rocks. (see figure 11)

Approximately 2200 feet of coarse clastic rocks are present but, as the base of the section is faulted, it is difficult to ascertain how much Craignish strata was once deposited. Rock types are very massive and poorly bedded, coarse grained, grey feldspathic sandstones. These clastic rocks are highly micaceous and contain lenticular zones of cobble conglomerate. The cobbles are well rounded, generally

6 inches or less in diameter, although some large boulders are present, some up to three feet in largest dimension. Grey and pink granite, grey diorite and grey quartz predominate as the cobbles, and conspicuously absent are fragments of rhyolite so abundant in the Craginsh formation north of the Salmon fault. Upstream from the Cabot Trail Bridge, on the North Aspy River, friable, grey-buff and red-brown mottled arkoses with minor lenses of red siltstone constitute the predominant lithology. These clastic rocks are true granite washes and contain abundant fragments of angular fresh salmon red orthoclases. The bedding is very poorly developed and visably lenticular. Conglomerate lenses are scattered throughout these beds.

At station C 212 (see figure 11 a spectacular and beautiful waterfall some 150 feet high is developed on massive red-brown, very poorly bedded boulder conglomerates. The boulders are commonly two feet in diameter, well rounded and are composed of pink granite, pink granite gneiss and grey diorite. Some 150 feet downstream from these conglomerates, and overlying them is a thickness of 60 feet of grey thinly bedded to laminated fine grained grey micaceous siltstones. These were the only fine, well bedded, clastic rocks observed in the entire Craginsh sequence.

THE STRATHLORNE-AINSLIE FORMATION IN NORTHERN CAPE BRETON ISLAND

Overlying the coarse clastic rocks of the Cragish formation is a sequence of grey clastic rocks, fine grained toward the base, and becoming conglomeratic towards the top. This succession, lying stratigraphically below the basal Windsor A_1 limestone is referred to here as the Strathlorne-Ainslie formation and occupies a similar stratigraphic position to lithologically like sequences in Western Cape Breton Island. Neale and Kelley (1960) subdivided the upper portion of the Horton sequence into two formations after Murray (1955), the Strathlorne and Ainslie. While it is in fact much easier to distinguish these two lithologies in portions of this area compared to portions of the Western Cape Breton Basin, in considering the Horton group as a whole the author prefers to retain the terminology based on the area to the south. The Strathlorne and Ainslie members of the Strathlorne-Ainslie formation are discussed separately below.

THE STRATHLORNE MEMBER IN NORTHERN CAPE BRETON ISLAND

Fine grey clastic rocks overlying the coarse clastic rocks of the Cragish are assigned to the Strathlorne member of the Strathlorne-Ainslie formation. This succession

is distinguished from the Craignish by a marked decrease in average grain size, as well as a colour change from greenish grey and red-brown to medium and dark grey. Rock types include grey, evenly bedded siltstone, minor sandstone and dense grey limestone as well as as very minor and local coarse clastic rock interbeds. It is possible that the topographic relief of source contributing areas had become more subdued. Sedimentation was not as rapid and chaotic as in the underlying Craignish, as witnessed by the extremely evenly and thinly bedded nature of the entire Strathlorne sequence. Although the sediments are finer grained and higher in organic content, they are still composed of angular grains and remain very poorly sorted, and thus, a much greater distance from source when compared to the Craignish clastic rocks is not indicated.

The depositional environment is thought to have been fluviatile to lacustrine. Marine fossils have not been found and the entire succession is thought to be fresh water and terrestrial.

The Strathlorne member is succeeded by much coarser and more poorly bedded strata belonging to the overlying Ainslie member.

Brooks and Maehl (1955) measured 2000 feet of fine grey Horton clastic rocks between faults at Meat Cove. Murray (1960, p. 32) considers this succession equivalent to his

Strathlorne formation. Brooks and Maehl (1955, p. 12) describe the succession at Meat Cove as follows;

"Faults separate the basal beds from those above. Both field relations and lithologic changes indicate that section has been lost, presumably representing the remainder of the transitional formation, as well as an undetermined thickness of non-red fine clastic rocks. This formation is predominantly dark grey, fine sandstones, siltstones and fissile shales with minor buff sandstones and dark limestone. The most distinctive gross feature is the even, regular bedding of these rocks, contrasting with the lensing of the conglomerate sections above and below it. The coarser beds contain poorly sorted, subangular grains and are micaceous (many small flakes) and sometimes calcareous; they contain large, poorly preserved plant fragments and current ripple marks. This formation is estimated to be 2000 feet thick as a minimum."

This sequence is here considered to be equivalent to the Strathlorne member of the Strathlorne-Ainslie formation.

The following succession of the Strathlorne member was measured by the author on the North Aspy River.

North Aspy River (Section 18, figure 3)

STRATHLORNE MEMBER		Feet
Concealed		150
Sandstone	grey, very fine grained, thinly bedded to fissile, abundant plant fragments	20
Limestone	grey, dense, fracture fillings of calcite	3
Sandstone	grey, very fine grained, thinly bedded to laminated	4

	Feet
Concealed	320
Siltstone grey, thinly bedded, well bedded minor interbeds of grey arenaceous fissile shale	300
Siltstone grey, fine grained, thinly bedded, 1/2" bedding	240
Conglomerate . grey, feldspathic, coarse grained, arkosic matrix	6
Sandstone grey, fine grained, indurated well bedded, slightly feldspathic	20
Sandstone grey, medium grained, very micaceous	2
Sandstone greenish grey, medium grained, slightly feldspathic, fine grained, thin con- glomerate lenses scattered throughout ...	4
Siltstone grey, fine grained, thinly bedded, well bedded mud cracks common	160
Conglomerate . grey, coarse grained, poorly bedded	100
Siltstone grey, medium grained, well bedded, flaggy bedding, plant fragments, pyrite concretions and slump structures	400
Siltstone grey, very fine grained, fissile	5
Sandstone grey, medium grained, massive, poorly bedded	4
Sandstone grey, fine grained, partly well bedded, 1/2" bedding	30
Sandstone grey, coarse grained, massive felds- pathic	6
Sandstone grey, fine-medium grained, evenly bedded, thinly bedded	30

	Feet
Concealed	375
Sandstone grey, medium grained, very micaceous, 3" bedding, some plant material	<u>50</u>

Approximate thickness of Strathlorne member2229

Fault Zone with underlying Craignish Formation

Note: Folding in the basal portion of this section make member thickness calculations from C 190 down somewhat tenuous. The figure obtained above, however, for the thickness of the Strathlorne member is in close agreement with Neale and Kelley's estimate of 2000 feet. (Brooks and Maehl calculated a thickness of 2000 feet of Strathlorne type strata between faults at Meat Cove.)

The succession is comprised of a homogeneous sequence of grey (generally medium grey) siltstones, with fine grained grey sandstones, minor thin grey fissile shale interbeds and one bed of dense grey limestone. The most remarkable feature of the Strathlorne in this section is the extremely even bedding, generally 1/2 inch thick. Mud cracks were observed and many of the siltstones exhibit fine scale current crossbedding. Macerated drift plant fragments are abundant. The matrix contains abundant secondary calcite. The grains are angular to subangular, and sorting is quite poor. Fossils other than a few poorly preserved plant stems

and abundant plant debris were not observed. Sandstones, grey and commonly fine to medium grained become more abundant towards the base of this member and are considered transitional with the underlying Craignish formation. The coarse grained clastic rocks at the base are slightly more feldspathic than the higher siltstones, but sorting remains poor and the constituent grains are also quite angular.

THE AINSLIE MEMBER IN NORTHERN CAPE BRETON ISLAND

Overlying the grey, fine clastic rocks of the Strathlorne member, is a succession of coarse grained, poorly bedded grey and red clastic rocks, here referred to as the Ainslie member. This is the uppermost member of the Horton group, and the upper contact is placed at the base of a lithologically distinctive laminated limestone, the Windsor A₁, which marks the base of the overlying Windsor group. The Horton-Windsor contact can be observed in the valley of the South Aspy River, where Neale and Kelley (1960, p.86) state:

"At the latter locality (South Aspy River) it (Windsor A₁ limestone) rests on five feet to 60 feet of Ainslie conglomerate, but in other places, it overlaps onto the pre-Mississippian rocks."

The presence of massive conglomerates, containing boulders of pink granite, in the Ainslie member in the Aspy Valley, clearly indicate renewed uplift of basement areas following the accumulation of the fine grey clastic rocks of the Strathlorne. (see photograph 11) Massive grey arkoses with lenses of conglomerate constitute the predominant lithology of the Ainslie member in the Aspy Valley. These arkoses are very poorly bedded, and massive large scale crossbedding is common. Constituent grains are quite angular. Pebbles and boulders of pink granite and pink granite porphyry are common, and range in size from a few inches to a few feet in longest dimension. There seems little doubt that renewed uplift of basement areas resulted in a rapid accumulation of a coarse clastic sequence calculated to be some 1200 feet in the Aspy Valley area. Movement along such faults as the Aspy and Salmon faults could have resulted in the exposure of local basement masses from which the coarse clastic material was derived. The author measured the following section of Ainslie strata on the North Aspy River. Unfortunately, the upper 700 feet are concealed to the basal Windsor, but Neale and Kelley (1960, p. 86) report conglomerates directly under the A₁ Windsor limestone on the South Aspy River, and it is thought that a major portion of this covered interval on the North Aspy River is underlain by similar coarse clastic rocks.

NORTH ASPY RIVER
(Horton Section No. 18 Figure 3)

AINSLIE MEMBER

	Feet
Concealed to basal Windsor A ₁ limestone	700
Conglomerate . boulders up to 2-1/2 feet in diameter well rounded, composed of pink granite pink porphyritic granite, minor grey quartz and greenish grey siltstone. Matrix of the conglomerate is red and green mottled, coarse grained, very poorly bedded arkose	12
Arkose coarse grained red and green, friable, poorly bedded, numerous thin conglom- erate lenses, quite micaceous	85
Concealed	20
Arkose grey, coarse grained, massive cross- bedding, very micaceous with numerous channel conglomerates	70
Concealed	50
Arkose grey, coarse grained, very massive, poorly bedded, micaceous, fine conglomerate lenses and minor interbeds of thinly bedded to laminated grey fine grained sandstones	45
Concealed	15
Arkose grey to greenish grey, coarse grained very massive, friable, micaceous, very poorly bedded, minor channel conglomerates	52
Concealed	40
Arkose grey, medium grained, massively bedded, minor conglomerate lenses, very micaceous.	72

	Feet
Sandstone grey, very fine grained, well bedded plant fragments	5
Arkose grey, coarse grained, very massive, friable, micaceous	25
Concealed	50
Thickness of Ainslie Member	1221

Lying above the Strathlorne clastic rocks in the Meat Cove area, Brookes and Maehl measured close to 4300 feet of section belonging to the uppermost portion of the Horton sequence. The basal 3390 feet is comprised of conglomerate as is described by Brooks and Maehl (1955, pp. 12 - 14) as follows:

"... the Pebble Conglomerate unit is composed principally of massive quartz pebble conglomerates interstratified with sandstone. The conglomerates have a coarse grey (occasionally grading to red), poorly sorted, calcareous, matrix with angular grains of the following composition: quartz 45%, orthoclase 30%, plagioclase 10%, mica 5 - 10%, lithic fragments 5%; and minor constituents including opaques, iron oxide, and secondary carbonate up to 5%. There is less intergrowth of the quartz than in the lower conglomerate section and a sub parallel orientation of elongate grains parallel to bedding planes.

"The pebbles occur in lenses with massive, thick beds of sandstone with the above characteristics. They are well rounded, up to 2 inches in longest dimension, and are predominantly quartz, though lithics, feldspar, shale chips, and other sedimentary rocks are present. The lithics are commonly metamorphic rocks.

"The above described rocks are interbedded with at least an equal amount of poorly sorted, angular grained, usually micaceous, some arkosic, calcareous, fine grained sandstone and minor siltstones. They are predominantly grey, though locally there is a substantial percentage of red beds. Some of these are simply finer grained equivalents of the sandstones and conglomerates described above. These beds are seen to lens out over a distance of tons of feet, are much crossbedded and occasionally are ripple marked. Some of the red siltstones contain limy concretions. Plant fragments are present in many horizons and can be identified as a variety of *Lypidodendron*. Better preserved specimens were identified from the upper part of this section by Dr. W.A. Bell as *Lepidendropsis corrugata*, *Lepidendropsis sigillariodes*, and *Aneimites acadia* (Dawson). The pebble conglomerate unit is 3390 feet thick."

Overlying this pebble conglomerate sequence is the Black Shale unit described by Brooks and Maehl (p. 14) as follows:

"The pebble conglomerate section is conformably overlain by the Black shale formation, which is composed of 550 feet of grey and black fine sandstones, siltstones and shales - with one thin bed of dark, sandy limestone. The rocks are poorly sorted, limy, often micaceous, angular grained and better bedded than the rocks below them. Plant fragments and fish scales are common. The topmost 200 feet of this formation is composed of calcareous black shale."

The youngest Horton strata present are the following:

Faults separate the black shale formation from the limestone conglomerate formation above it. The bottom of the latter is composed of light green, grey, and minor buff coloured micaceous, medium grained sandstones in thin but uneven beds. These sandstones are crossbedded and in some cases contain shale chips. They are

interbedded with finer grained dark grey, thin, even beds with calcareous cement. Many contain plant fragments and paleoniod fish scales. One of the plant fossils has been identified by Dr. W.A. Bell as Leipidendropsis corrugata. Minor calcareous red, fine grained sandstones are also present. There is some decrease in grain size toward the top of this section and several oily appearing black shales with abundant fish scales are present. Near the top of the 290 feet of section are found several intraformational limestone conglomerates. The matrix of these beds is a porous, impure limestone, while the pebbles are actually limestone and sometimes show edgewise characteristics. Some of the pebbles may be organic fragments. These conglomerates are closely associated with knobby, silty limestone beds. At the very top of this formation, are a series of three beds consisting of, from bottom to top respectively, a dark grey massive limestone, a laminated limestone, and another edgewise conglomerate, wich contains pebbles of the underlying two beds as well as one pebble with oolitic structure developed about tiny detrital fragments as nuclei. The top of this section is cut off by faults."

The limestones mentioned at the top of the succession could be equivalent to the basal A₁ Windsor and there may be evidence at the Meat Cove section of a fluctuating Windsor strand line. In other words, some of the 290 feet as described above may in fact belong to the Windsor group. The 4300 feet of strata described above by Brooks and Maehl would belong to the Ainslie member of this thesis. It is much thicker, and of a completely different lithology from the Ainslie member in the Aspy valley outcrop belt, where only 1221 feet are present.

RESULTS OF SPORE ANALYSIS OF SAMPLES SUBMITTED FROM THE
NORTH ASPY RIVER HORTON
SECTION

Nine samples collected from the Horton sequence as exposed on the North Aspy River were submitted for spore analysis. Of these, only five samples C178, C182, C190, C197, and C208 contained identifiable spores.

Sample C178, the highest stratigraphically, lies 1100 feet below the Horton - Windsor contact, 120 feet up from the base of the Ainslie member. The sample contained the following species:

<u>Perotrilites</u>	<u>perinatus</u>	Hughes and Playford
<u>Verrucosisporites</u>	<u>congeatus</u>	Playford
<u>Punctatisporites</u>	<u>planus</u>	Hacquebard
<u>Punctatisporites</u>	<u>cf. solidus</u>	Hacquebard
<u>Punctatisporites</u>	<u>irrasus</u>	Hacquebard
<u>Verrucosisporites</u>	<u>papulasus</u>	Hacquebard
<u>Cyclogranisporites</u>	<u>naevulus</u>	Hacquebard
<u>Leiotriletes</u>	<u>tortilis</u>	Playford
<u>Lycospora</u>	<u>cf. magnifica</u>	McGregor
<u>Endosporites</u>	<u>micromanifestus</u>	Hacquebard

along with other representatives of the following genera:

Verrucosisporites
Perotrilites
Convolutispora
Cyclogranispora
Calamospora
Murospora
Spinizonotrilites

This sample contains neither of the species characteristic of A zone viz. Pustulatisporites pretiosus Playford; Vallatisporites vallatus Hacquebard. However, it does contain types found elsewhere within the overlying Windsor group, and is thus considered younger than any previously identified A zone Horton assemblage. (M.S. Barss*). Samples C45 and C129 collected 1200 feet and 1150 feet respectively below the Horton - Windsor contact, on Judique Intervale Brook and Gallant River did contain the characteristic A zone species Pustulatisporites pretiosis and Vallatisporites vallatus, as did G.S.C. samples collected on the Southwest Mabou River from 520 feet below the Horton - Windsor contact, downsection to 2600 feet. This seems to indicate that the uppermost 1100 feet of the Horton sequence on the North Aspy River is younger than uppermost Horton successions elsewhere in western Cape Breton Island.

Sample C182 was collected 280 feet stratigraphically lower than the previous sample and lies within the Strathlorne member, 150 feet below the Ainslie member - Strathlorne member contact. The sample contained the following species:

* <u>Pustulatisporites</u>	<u>pretiosus</u>	Playford
* <u>Vallatisporites</u>	<u>vallatus</u>	Hacquebard

* Personal Communication

<u>Vallatisporites</u>	<u>verrucosus</u>	Hacquebard
<u>Verrucosisporites</u>	cf. <u>papulosis</u>	Hacquebard
<u>Verrucosisporites</u>	<u>nitidus</u>	Playford
<u>Verrucosisporites</u>	<u>congestus</u>	Playford
<u>Punctatisporites</u>	<u>irrasus</u>	Hacquebard
<u>Punctatisporites</u>	<u>debilis</u>	Hacquebard
<u>Lycospora</u>	<u>torulosa</u>	Hacquebard
<u>Granulatisporites</u>	cf. <u>crenulatus</u>	Playford
<u>Convolutispora</u>	cf. <u>flexuosa</u>	Hacquebard
<u>Raistrickia</u>	cf. <u>clavata</u>	(Hacquebard) Playford

along with representatives of the following genera:

Convolutispora
Perotrilites
Cyclogranisporites
Apiculatasporites
Stenozonotriletes
Grandispora
Vallatisporites
Verrucosisporites
Cristatisporites
Leiozonotriletes

The presence of Pustulatisporites and Vallatisporites indicates that this sample belongs to A zone.

Sample C190 collected 1260 feet stratigraphically below the previous sample, and 725 feet above the base of the Strathlorne member, contained the following species:

* <u>Pustulatisporites</u>	<u>pretiosus</u>	Playford
<u>Vallatisporites</u>	<u>verrucosus</u>	Hacquebard
<u>Convolutispora</u>	cf. <u>finis</u>	Love
<u>Convolutispora</u>	<u>flexuosa</u>	Hacquebard
<u>Raistrickia</u>	cf. <u>clavata</u>	(Hacquebard) Playford
<u>Punctatisporites</u>	<u>debilis</u>	Hacquebard
<u>Punctatisporites</u>	<u>irrasus</u>	Hacquebard

<u>Perotrilites</u>	cf. <u>perinatus</u>	
<u>Verrucososporites</u>	<u>congestus</u>	Playford
<u>Verrucososporites</u>	cf. <u>papulosus</u>	
<u>Grandispora</u>	<u>echinata</u>	Hacquebard
<u>Apiculatisporites</u>	<u>hysticosus</u>	Playford
<u>Leiozonotriletes</u>	cf. <u>meracus</u>	
<u>Endosporites</u>	<u>micromanifestus</u>	Hacquebard

along with representatives of the following genera:

Spizonotriletes
Cyclogranisporites
Perotrilites
Punctatisporites
Vallatisporites
Calamospora
Cristatisporites
Grandispora
Leiotriletes
Convolutispora

The presence of Pustulatisporites pretiosus, along with species of Vallatisporites indicates that this sample belongs to A zone.

Sample C197 was collected 100 feet stratigraphically below the previous sample, within the Strathlorne member. The following species were present:

<u>Puatulatisporites</u>	<u>pretiosus</u>	Playford
<u>Punctatisporites</u>	<u>debilis</u>	Hacquebard
<u>Punctatisporites</u>	<u>irrasus</u>	Hacquebard
<u>Verrucososporites</u>	<u>congestus</u>	Playford
<u>Leiozonotriletes</u>	<u>insignitus</u>	Hacquebard
<u>Dictyotriletes</u>	cf. <u>submarginatus</u>	Hacquebard

along with representatives of the following genera:

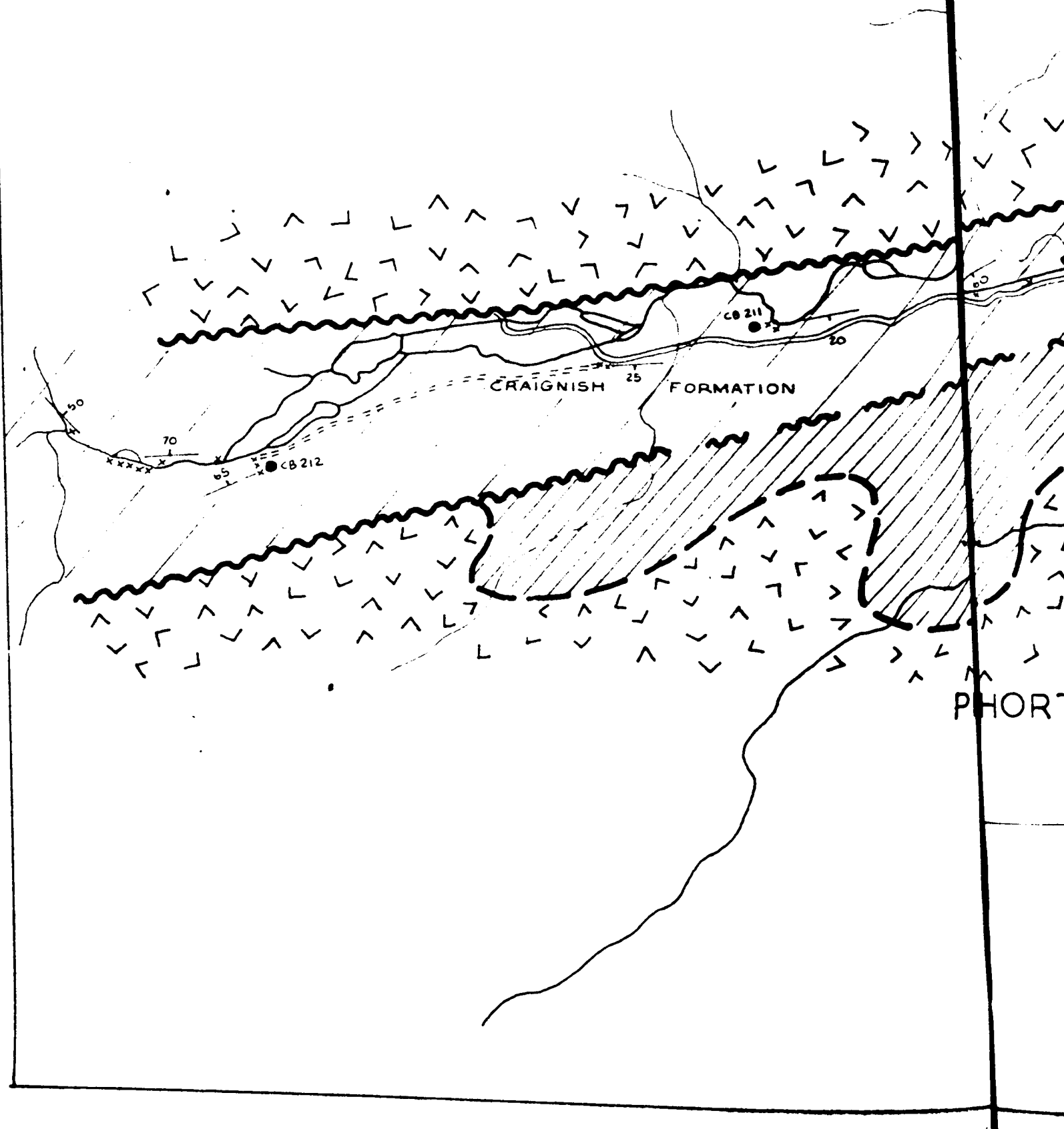
Punctatisporites
cf. Grandispora
Convolutispora
Perotrilites
Vallatisporites

The presence of Pustulatisporites pretiosus and Vallatisporites in this sample indicates that it, like the previous sample, belongs to A zone.

Sample C208 collected from a point approximately 1000 feet below the top of the Craginsh formation contained only Vallatisporites verrucosus Hacquebard and a few unidentified species of the genera Vallatisporites. As these forms range throughout the Horton succession, this sample cannot be assigned to a definite zone.

The relative stratigraphic positions of productive samples on the North Aspy River are shown graphically on figure 13.

THE HOTON NORTH ASP RIV



HOTON GROUP

ASP RIVER SECTION

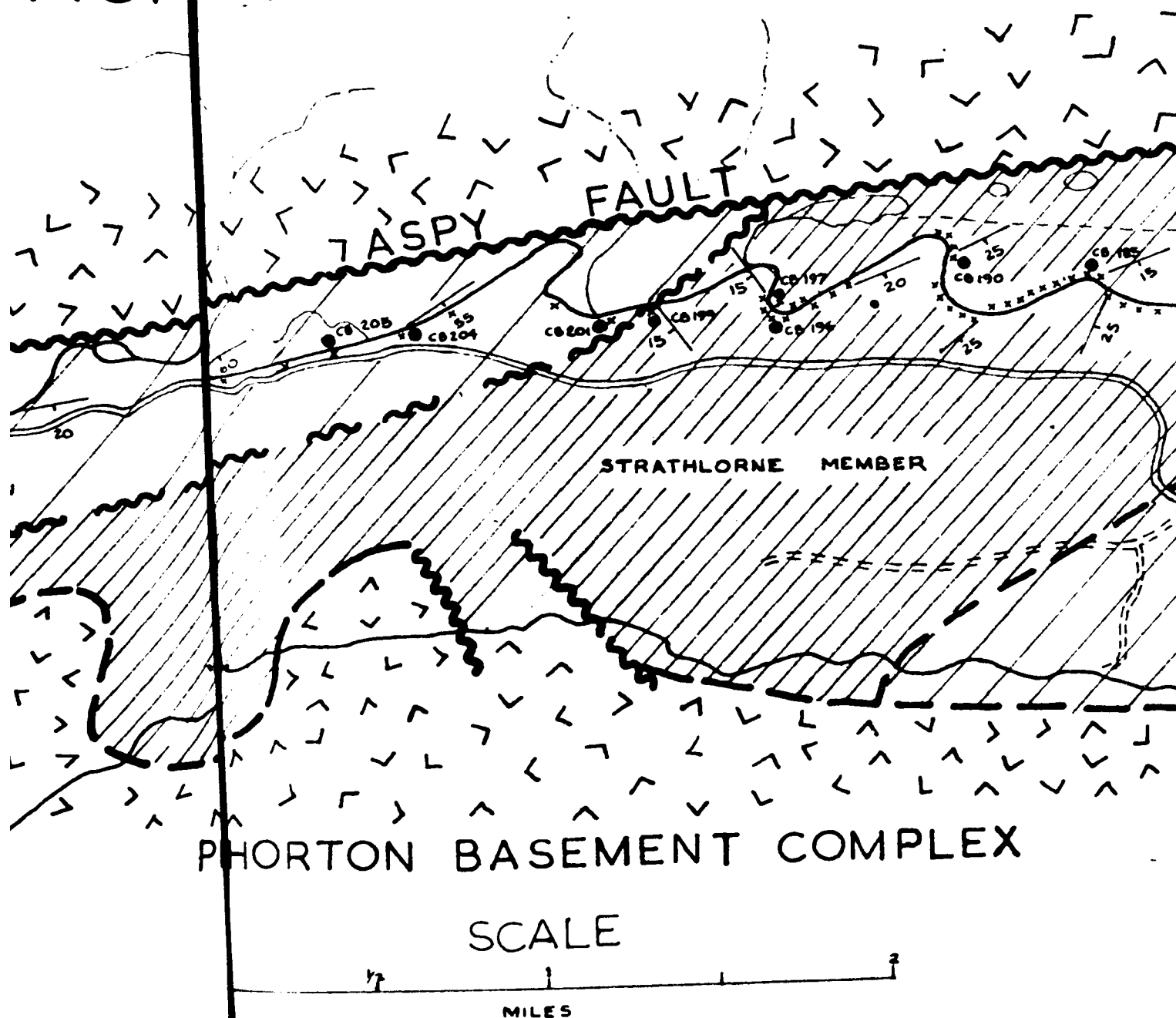
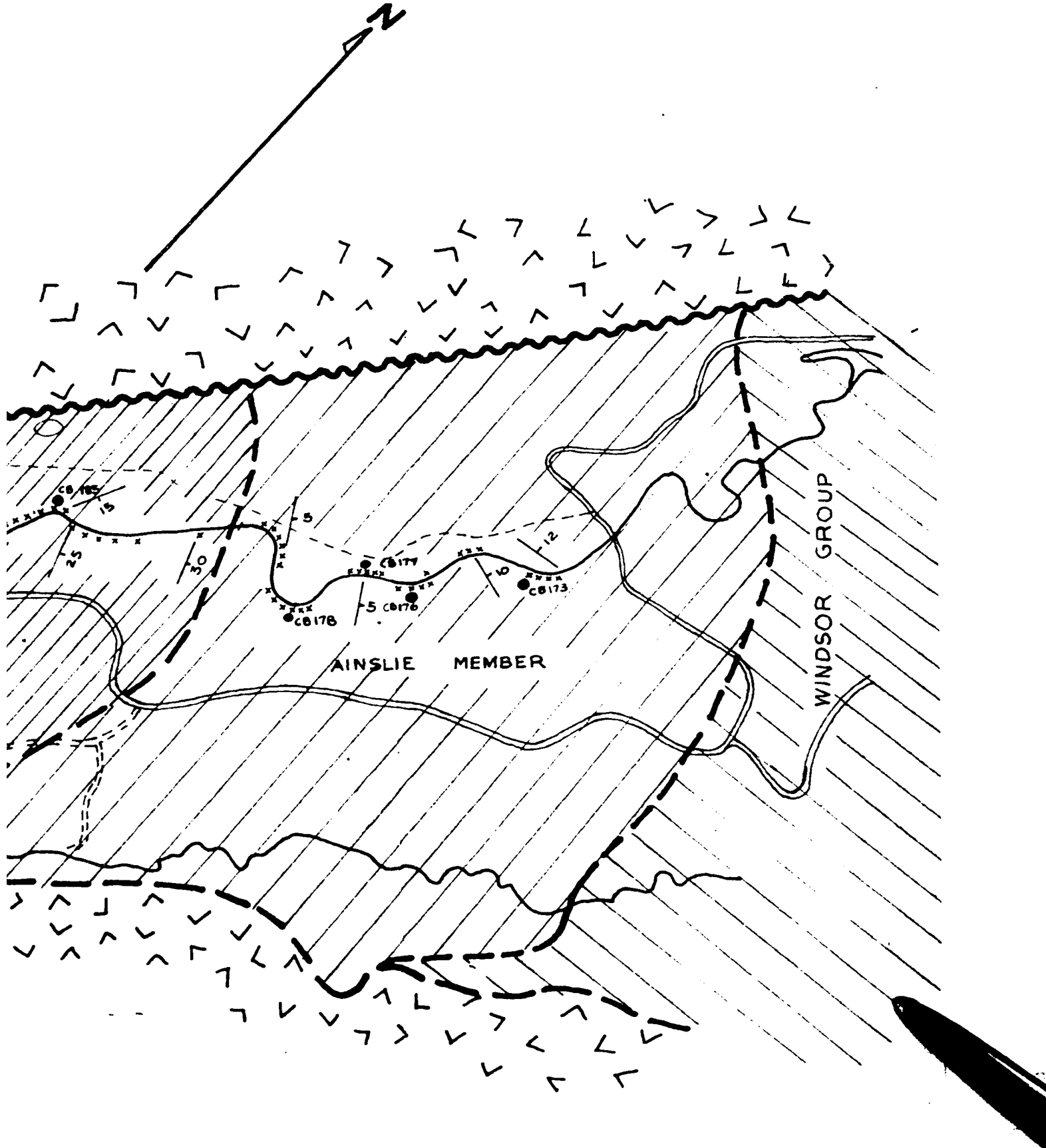


FIGURE 11



PR COTE

PART B

THE ANGUILLE GROUP
IN
SOUTHWESTERN NEWFOUNDLAND

PART B

CHAPTER 7THE ANGUILLE GROUP
IN
SOUTHWESTERN NEWFOUNDLAND

INTRODUCTION

During the 1961 field season, the author was employed by the British Newfoundland Exploration Company Limited to map and evaluate Carboniferous sedimentary rocks in the Anguille Mountain area of Southwestern Newfoundland. Although all Carboniferous rocks were studied, particular emphasis was placed on strata of the Anguille group, Mississippian in age.

In this chapter the Anguille succession in various portions of the map area is described, and a new system of Anguille group subdivision is suggested. Further, intragroup correlations between the Horton and Anguille sequences are proposed largely on lithology and sequential order criteria.

The areal extent of the Southwestern Newfoundland Carboniferous basin covered in this chapter is shown on plate 2 and on figure 1. The southeastern boundary lies along a major fault separating Pre-Carboniferous igneous

and metamorphic rocks from Carboniferous strata to the northwest. The western and northwestern boundary is the present sea coast. In longest dimension, the area extends from Stormy Point to Crabbes River, a distance of approximately forty miles; the average width from basement rocks across the sedimentary basin to the seacoast being thirteen miles; the area encompassing some 500 square miles.

The area can be divided into five physiographic units: The Cape Anguille Mountains, the Codroy Valley, an isolate highland south of Codroy Pond, the Ship Cove-Crabbes River Lowland, and the Long Range Mountains.

The Cape Anguille Mountains, which attain an elevation of 1200 feet, lie along the northwestern boundary of the area and extend from the village of Codroy to Highlands River, a distance of thirty-five miles. The average width of this upland area is seven miles. Precipitous seacliffs up to 300 feet in height form the northwestern edge of the Mountains. Continuous exposures of highly folded resistant sandstones and brittle shales of the Anguille group are found along this very rugged and desolate sea coast. Wave cut beaches are found some 200 feet above the present strand line. From the top of these seacliffs, the northern flank of the Cape Anguille Mountains rises steeply to a plateau-like top with an average elevation of 1200 feet. Streams flowing on

the northern flank from the summit to the sea coast are deeply incised and for the most part, rock exposures are abundant. However the bottoms of the gorges are filled with slabs of sandstone and large granite boulders, making traversing difficult. Numerous spectacular and beautiful waterfalls are formed on ledges of hard sandstone and brittle shale. The plateau-like gently rolling summit of the Anguilles is covered with irregular areas of a jungle-thick growth of intertwined and matted low spruce. These almost impenetrable areas give way to broad open marshes and swamps. The swamp areas are very poorly drained and many small ponds and lakes are scattered irregularly throughout. Slabs of grey sandstone are scattered on top and traces of patterned ground in the form of polygons were observed. Outcrops on top of the Cape Anguille Mountains are almost totally restricted to isolated lake areas, and are easily observed from aerial photographs. The southern flank of the Anguilles is much like the northern flank and gives way gradually to the Codroy Valley lowland. The Cape Anguille Mountains, as far as is known at the present time, are underlain totally by Mississippian dense indurated sandstones and brittle shale belonging to the Anguille Series.

The Great Codroy River flows through the Codroy Valley, a major lowland between the Anguille and

Long Range Mountains extending from the estuary of the Codroy River to Codroy Pond when it merges with the Ship Cove - Crabbes River lowland. Underlying the valley are a series of poorly resistant red and grey gypsiferous shales, limestone, gypsum, and friable micaceous sandstones. An indentation of low-lying country into the Cape Anguille Mountains, north of Coal Brook suggests this area may be underlain by the soft and easily weathered shales of the Codroy series. Sink holes are common in the lowland area, particularly near the Codroy coast, where thicknesses of gypsum outcrop.

The Ship Cove - Crabbes River lowland, merging with the Codroy Valley lowland at Codroy Pond, is like the latter, underlain by a series of soft red gypsiferous shales and friable micaceous sandstones, belonging to the Codroy and Barachois groups respectively. Sink holes, particularly noticeable near Ship Cove and in an area southwest of the Highlands River, attest to the presence of evaporitic rocks in the underlying sedimentary series.

South of Codroy Pond, a somewhat circular plateau-like upland lies between the Anguille and Long Range Mountains. Although no traverses were carried out in the area during the past field season, it is thought that the upland is underlain by resistant rocks belonging to the Anguille series. Similarities in elevation and

general form of the upland and the Anguille Mountains are quite noticeable.

The Long Range Mountains extend from the seacoast at Red Rock Point through the entire area and forms the southern extremity of the map area. This mountain system is underlain entirely by igneous and metamorphic rocks and rises rather abruptly from the Codroy Valley due to a continuous fault system, at the base of the range which overthrusts the igneous complex against sandstones and shales of the Pennsylvanian. Deeply incised streams cascade down the flanks of the mountains over numerous rapids and waterfalls. Hanging valleys and cirque-like headwaters indicate glaciation of this mountain system.

FORMER WORK

Carboniferous sedimentary rocks between Codroy and St. Georges were first described by J.B. Jukes, (1843) who included both Mississippian and Pennsylvanian strata in his "Coal Formation". He described gypsum, limestone, red shale and siltstone beds along the coast and on the Barachois and Codroy Rivers. Murray (1881, pp. 73-101) stated that the entire Codroy Valley lying between the Cape Anguille Mountains and the Long Range Mountains was underlain by beds belonging to the "Carboniferous Series".

The stratigraphy of various parts of the Codroy Valley was described and his map, the first to show the general distribution of the Carboniferous between Codroy and Port au Port, shows five principle subdivisions: A) basal conglomerate, B) gypseous group, C) Carboniferous limestone - the Lower Carboniferous, D) Millstone Grit, and E) Coal Measures - Upper Carboniferous.

The presence of coal in the Codroy Valley spurred economic interest and led J.P. Howley, (1918, pp. 360-384), to undertake an extensive and comprehensive study of coal outcrops. Measurement of coal-bearing strata, along with trenching and the driving of short adits, resulted in detailed information on local stratigraphy. In 1937, regional subdivisions within the Mississippian and Pennsylvanian were proposed by A.O. Hayes and H. Johnson, who postulated a broad three-fold division of Carboniferous strata in southwestern Newfoundland, (1938, pp. 9-22). The coastal section from Cape Anguille, south to Stormy Point, was selected as the type section. Lower Mississippian terrestrial conglomerates, sandstones, and shales in the vicinity of Cape Anguille were designated as the Anguille series. The Anguille series was further subdivided into a basal sandstone and conglomerate sequence - the Cape Anguille sandstone, and an overlying dark grey shale unit - the Snakes Bight Shale. Overlying partially marine strata

with numerous beds of gypsum, limestone, and varicoloured siltstones and shales were included in the Codroy series, with the type section just south of Codroy village. Similarities in fauna with the Windsor group in Nova Scotia were noted and correlation in part was suggested. Marked changes in lithology within the Codroy beds facilitated subdivision into four units- the Codroy shale, Black Point limestone, Woody Cove shale, and Woody Point sandstone. None of these units attained formational status, as rapid facies changes precluded the tracing of these subdivisions for any appreciable distance from the type section. Massive feldspathic sandstones, red shale, and minor coal beds overlying the Codroy series were placed in the Barachois series, believed to be for the most part Pennsylvanian in age.

W.A. Bell (1948, pp. 7-18), measured a portion of the type section in the Codroy area between Stormy Point and Cape Anguille. On the basis of floral evidence, Bell recognized a sequence of sandstones and shales outcropping along the coast, north of the village Searstone, and formerly placed by Hayes and Johnson in the Pennsylvanian Barachois, as being uppermost Mississippian age. However, the precise location of the Mississippian-Pennsylvanian boundary in the type section remained unknown and Bell stated that the Searstone Beds are both Mississippian-

Codroy in part and possibly lowermost Barachois, thus representing a transitional sequence across the upper and lower Carboniferous boundary. Bell's detailed measuring of the type section north of Stormy Point indicated that the terms Woody Point sandstone and Woody Cove shale conveyed an incorrect impression as to the lithologic nature of the units and proposed terms Woody Cove Beds and Woody Head Beds. Bell further noted that the contact between the two units was transitional.

Correlation of the lithologically distinctive Ship Cove limestone with the basal Windsor A₁ limestone of Nova Scotia established a recognizable base for the Codroy series. Revision of Anguille stratigraphy was not proposed, although Bell stated that a sequence of clastic rocks exposed on Codroy Island conformably below the Ship Cove limestone was younger than beds exposed along the Cape Anguille section north of Codroy Village.

D.M. Baird, (1951) in a report on gypsum deposits of southwestern Newfoundland, greatly extended detailed stratigraphic knowledge of the Carboniferous basin. He observed that a coarse clastic rock sequence outcrops stratigraphically below the Ship Cove limestone southwest of Ship Cove along the outer coast of the Cape Anguille Mountains. These resistant, uppermost Anguille beds form spectacular seacliffs and the term Seacliffs sandstone was

applied. Thus, for the first time, a sequence of strata lying above the Snakes Bight shales and below the basal Codroy beds was identified and named. The previously defined rock units - the Codroy shale, Black Point limestone, (Hayes and Johnson), gypsiferous beds, and Codroy breccia (Bell) were all grouped into a unit termed the Codroy Beds, while the name Woody Head Beds as used by Bell was changed to Woody Point Beds in order to make these rock stratigraphic terms conform to the correct geographical names.

RECENT FIELD WORK

The author, in 1961, noted similarities between Carboniferous sedimentary rocks in this area and those of Cape Breton Island. In particular, it was noted that sequences within the Anguille group appeared to be closely related lithologically to formations within the Horton group. A three-fold subdivision of the Anguille group was proposed; these being: (A) basal unit of feldspathic sandstones, greywackes, and siltstones, all highly indurated and very micaceous; (B) an overlying thick grey to black siltstone and shale sequence followed by; (C) grey massive sandstones and red and grey siltstones with only minor grey shale interbeds. To these units the names Lower Sandstone unit, Snakes Bight shale and Upper Sandstone unit were applied respectively.

During the latter part of the 1963 field season, the author revisited the Codroy area and additional detailed mapping at this time led to the conclusion that the Anguille group could be divided into three lithologically distinctive formations - the Cape John formation at the base; the Snakes Bight formation; and the Seacliffs formation at the top; these being essentially equivalent to the former Lower Sandstone, the Snakes Bight, and Upper Sandstone unit. (see plate III) Samples containing plant material were collected from the three formations for the purpose of more precise time correlation of these sedimentary rocks with the Horton group in Cape Breton Island, based on included spore assemblages. An effort was also made to remap the Codroy group type section in order to define the stratigraphic position of numerous gypsum and limestone beds in this structurally disturbed section. This study led the author to propose a more simplified subdivision of the Codroy group into two units, a lower Codroy unit comprised essentially of interbedded limestone, gypsum, and red silty shales, and an Upper unit of black fissile siltstones and pale grey to buff sandstones. (Baird and Cote, 1963).

REGIONAL GEOLOGY

The area described in this paper occupies a portion of the large Palaeozoic basin within the Appalachian folded

belt. The regional trend is northeast-southwest so that Carboniferous sedimentary rocks of southwestern Newfoundland are an extension of strata in western Cape Breton Island with many similarities in lithology, fauna and flora. Mississippian and Pennsylvanian strata outcrop throughout the Codroy area and are part of a sedimentary sequence with a composite thickness of approximately 23,000 feet. The rocks are grouped into the following units: Anguille group at the base, Codroy group, Searston Beds of Mississippian age, and the Barachois group, which, for the most part, is Pennsylvanian.

The lower Mississippian-Anguille group is the oldest exposed sedimentary sequence in the Codroy area. Greywacke, arkose, feldspathic sandstone and black brittle siltstone are characteristic rock types of these predominantly terrestrial beds. The base of the Anguille group is not exposed and it is therefore impossible to ascertain the total thickness of this unit. The upper contact is placed at the base of the Ship Cove limestone, a thinly laminated limestone, lithologically identical to basal Windsor A₁ limestone of Nova Scotia and New Brunswick.

Epiorogenic sedimentation in the lower Mississippian began with deposition of greywacke, coarse feldspathic sandstone and minor conglomerate derived from upfaulted igneous and metamorphic welts following the Acadian orogeny. Continued erosion of upland areas resulted in

conditions of subdued topographic relief and produced a thick sequence of dark grey to black silty shales, fine siltstones and minor argillaceous limestones deposited over the coarser basal beds. Rejuvenation of erosional profiles resulted in a thick series of sandstones being deposited towards the close of Anguille accumulation. Immediately north of the area here described, these uppermost Anguille sandstones grade into coarse conglomerates.

Encroachment of shallow seas over areas of low topographic relief at the close of Anguille sedimentation resulted in the deposition of the Ship Cove limestone. Continued fluctuation of the strand line led to the deposition of alternating marine and terrestrial sedimentary rocks within the Codroy group. Spits and bars isolated embayments of the Codroy sea and evaporitic conditions produced gypsum and anhydrite beds. It is possible that salt was also deposited in the deeper portions of these isolated evaporating basins. Limestones containing marine shelly faunas occur in the sequence and the fragmental nature of the shells, along with algal structures, suggest shallow water conditions during deposition.

As marine transgressions became less frequent, a sequence of black limy shales, very thin algal limestones, green and grey siltstones and massive friable sandstones accumulated. The presence of a meagre fauna and salt

pseudomorphs in these beds suggest brackish water, muddy, regressive marine conditions during deposition of the upper Codroy, Woody Cove beds. Sandstones, particularly well exposed at Woody Cape or Point, are massive, crossbedded and contain abundant macerated partially coalized plant remains. These beds may represent deltaic sand buildups within the predominantly estuarian environment. Lithologically lower beds of the upper Codroy closely resemble strata belonging to the lower Canso group in Nova Scotia and it would appear that environmental conditions during accumulation were similar. However, the presence of upper Windsor faunas C and D subzones within the upper Codroy, suggests a time correlation with the upper Windsor beds of Nova Scotia.

A return to terrestrial conditions in the final retreat of the Codroy sea resulted in the deposition of a very thick sequence of sandstones and shales belonging to the Searston Beds. Floral evidence (Bell, 1948, p. 20) indicates that these beds are of uppermost Mississippian age and are correlated in time to part of the Canso group in Nova Scotia. The Searston beds merge imperceptibly into the Pennsylvanian Barachois group composed predominantly of massive arkosic sandstone and reddish brown siltstone, characteristic of terrestrial alluvial plain deposits.

The following table shows the development of the Carboniferous stratigraphic column in southwestern Newfoundland.

DEVELOPMENT OF CARBONIFEROUS STRATIGRAPHIC COLUMN OF SOUTHWESTERN NEWFOUNDLAND

Table No. 7

HAYES & JOHNSON (1938) BELL (1948) BAIRD (1951) THIS THESIS 1964

PENNSYLVANIAN	BARACHOIS SERIES	BARACHOIS SERIES SEARSTON BEDS	BARACHOIS SERIES SEARSTON BEDS	BARACHOIS GROUP SEARSTON BEDS
MISSISSIPPIAN	CODROY SERIES	CODROY SERIES	CODROY SERIES	CODROY GROUP
	WOODY POINT SANDSTONE	WOODY HEAD BEDS	WOODY HEAD BEDS	UPPER CODROY
	WOODY COVE SHALE	WOODY COVE BEDS	WOODY COVE BEDS	
	BLACK POINT LIMESTONE	BLACK POINT LIMESTONE		
	CODROY SHALE	GYPSUM BEDS AND CODROY BRECCIAS	CODROY BEDS	LOWER CODROY
		SHIP COVE LIMESTONE	SHIP COVE LIMESTONE	
	ANGUILLE SERIES	ANGUILLE SERIES	ANGUILLE SERIES	ANGUILLE GROUP
	SNAKES BIGHT SHALE	UNDIFFERENTIATED	SEACLIFFS SANDSTONE	SEACLIFFS FORMATION
	CAPE ANGUILLE SANDSTONE		SNAKES BIGHT SHALE	SNAKES BIGHT FORMATION
			ANGUILLE SANDSTONE	CAPE JOHN FORMATION

THE ANGUILLE GROUP

GENERAL STATEMENT

The Lower Mississippian Anguille group underlies the Cape Anguille Mountains which extend from Codroy Village to Highlands River, a distance of 35 miles. This mountain system is developed upon the resistant strata of the Anguille group which have been folded and faulted so as to produce a structurally complex anticlinoria. An upland surface south of Codroy Pond is also largely underlain by sedimentary rocks of this group. Thus, 70 percent of the Carboniferous rocks in the area belong to the Anguille group, the remaining 30 percent being strata of the overlying Codroy and Barachois groups, Mississippian to Pennsylvanian in age.

The predominant rock types within the Anguille succession are greywackes, arkoses, feldspathic sandstones, dark grey thinly bedded to fissile siltstones and shales, and minor dense, grey, thinly bedded argillaceous limestones.

A three-fold subdivision of the Anguille group is now proposed. These subdivisions are recognizable at various locations throughout the area, (see plate II and plate III) and are, therefore, given formational status. The three formations are the Cape John formation (bottom); the Snakes Bight formation; and the Seacliffs formation. A continuous

section of the Anguille succession is not known, and thus the type localities of these formations are therefore geographically separated.

The base of the Anguille group is not exposed in this area, and therefore it is impossible to determine the total thickness of this succession, but a thickness in excess of 6500 feet is indicated. From regional considerations, it seems likely that basal Anguille sedimentary rocks lie upon either a pre-Carboniferous igneous and metamorphic basement similar to the Long Range complex, or upon shelf limestones, Ordovician in age.

The upper contact of the Anguille group is exposed at several localities in the area and is placed at the base of a lithologically distinctive and geographically widespread thinly laminated limestone - the Ship Cove limestone which is the basal bed of the overlying Codroy group. Localities at which the Anguille-Codroy contact can be observed include: the southern tip of Codroy Island, at O'Regans, at Ship Cove, on Broom's Brook, and in the vicinity of Highlands River. This marker horizon is identical lithologically to the basal A₁ Windsor limestone in Cape Breton Island, at the base of which the upper contact of the Horton group is placed. Thus, both the Anguille and Horton sequences are capped by the same limestone. An excellent exposure of the Anguille-Codroy contact can be observed on O'Regan's Brook at the roadway

bridge. Here, the thinly laminated Ship Cove limestone conformably overlies pale grey siltstones of the Anguille. On Codroy Island, brecciated fragments of Ship Cove limestone are present in a poorly sorted grey siltstone lying immediately below the thick accumulation of the main limestone bed. This, coupled with the fact that a few thin coarse clastic interbeds occur in the Ship Cove limestone at this locality, indicates that tectonically unstable conditions in the immediate area accompanied the encroachment of the Codroy sea. The contact at O'Regan's shows none of the above features. At Ship Cove, located on the outer coast of the Cape Anguille Mountains, the Ship Cove laminated limestone directly overlies uppermost Anguille coarse red and grey arkoses, while on Broom's Brook dense grey indurated sandstones of the Anguille are overlain by the laminated limestone. Faulting at this latter location complicates the section somewhat, but the contact appears to be conformable in nature.

Thus, the Anguille group as here defined represents a rock stratigraphic unit being post-granite and metamorphic basement and/or post-Ordovician shelf limestone, and pre-basal Codroy limestone. Plant spores in beds within the lower Cape John formation indicate an early Mississippian age for this sequence of clastic rocks.

In the following pages, the three formations within the Anguille group are discussed in detail.

THE CAPE JOHN FORMATION

Poorly sorted massively bedded greywackes, arkoses, lenticular conglomerates, and dense red to greenish grey siltstones outcrop towards the base of the Anguille group. It is to this sequence, which attains a thickness in excess of 2500 feet, that the name Cape John formation is applied. The base of the Cape John formation is not exposed in the area, and therefore, it is not possible to estimate the total thickness of this formation or the nature of the Anguille-pre-Anguille contact.

The upper contact of the Cape John formation is placed at the first occurrence of a thick sequence of black, brittle, thinly laminated, fine grained siltstones and shales belonging to the overlying Snake Bight formation. It is well exposed along the seacoast of the Anguille Mountains at Snakes Bight and southward to Grebes Head (see photograph 15). The contact is very sharp due to a marked colour change of the pale greenish grey strata of the Cape John formation to a dark grey to black colour of the overlying Snakes Bight sequence. Steeply dipping beds of red and grey massive arkose outcrop along the entire eastern side of Snakes Bight northwestward to Cape John. The formation derives its name from the latter locality. Rugged and precipitous seacliffs, coupled with an absence of favourable

boat landing locations, preclude the measuring of several portions of this section in detail. However, the following sequence was measured along this coastline from Snakes Bight northward to a major fault zone and is presented here as a description of the upper 300 feet of the Cape John formation.

UPPERMOST BEDS OF THE CAPE JOHN FORMATION AT SNAKES BIGHT COVE

Conformable contact with overlying dark grey siltstones of Snakes Bight formation.

	Feet
Cape John formation:-	
Sandstone very dense, fine grained, greenish grey, poorly bedded, micaceous, with calcite stringers	42
Siltstone red-brown, with minor greenish mottling and calcite stringers	28
Sandstone very fine grained, greenish grey, well bedded and containing calcite stringers	22
Siltstone red-brown, with minor greenish mottling	5
Sandstone greenish grey, medium grained, micaceous and crossbedded	6
Siltstone red-brown, mottled	3
Sandstone greenish grey, fine grained, well bedded, minor maroon siltstone parting, calcite	12
Siltstone red-brown, with good crossbedding	10

		Feet
Sandstone	 greenish grey, fine grained, well bedded, good crossbedding, calcite veins	36
Siltstone	 red-brown, minor mottled green siltstone partings, lenticular	6
Siltstone	 greenish grey, fine grained, waxy chloritic, with small calcite concretions	6
Siltstone	 red-brown and green, very fine grained, with kunkurs and lime concretions	6
Siltstone	 greenish grey, dense, very fine grained, well bedded, crossbedding, pink calcite veins	35
Siltstone	 red-brown, with minor green silty intervals and calcite veins	24
Sandstone	 greenish grey, fine grained, micaceous, well bedded	10
Sandstone	 red-brown, fine grained, with fissile red-brown siltstone partings	8
Sandstone	 greenish grey, fine grained	20
Siltstone	 red-brown	6
Siltstone	 green, fissile	10
Shale	 red-brown, fissile, argillaceous siltstones and dense, red-brown, medium grained siltstones	12
Thickness	.....	307

Scattered exposures of Cape John strata are found along the summit of the Cape Anguille Mountains in the vicinity of Friars Pond and Hynes Pond (see plate II). At the latter location, a minimum thickness of 2400 feet is

present, with neither the upper nor lower contacts of the formation being exposed. Here, beds of medium to coarse grained, greenish grey greywacke alternate with beds of fine greenish grey and red-brown siltstone. Scattered lenses of conglomerate are present in the coarse greywacke beds. The conglomerate zones carry abundant pebbles of well rounded white to pale grey quartz. Thickly bedded red-brown dense indurated siltstones outcrop towards the upper portion of the exposed sequence. The following section of Cape John sedimentary rocks was measured at this location.

SECTION OF CAPE JOHN FORMATION EXPOSED ON CREST OF
ANGUILLE MOUNTAINS AT HYNES POND

Thickness of concealed Cape John strata to Snakes Bight formation unknown.		Feet
Siltstone	grey, calcareous, micaceous, thinly bedded, minor feldspathic greenish sandstone	50
Concealed		100
Siltstone	very calcareous, red-brown, siltstone to very silty red-brown limestone	50
Concealed		200
Siltstone	fine grained, greenish grey, very micaceous, underlain by greenish grey very massive and micaceous fine grained sandstone	100

	Feet
Concealed	250
Sandstone massive, feldspathic, greenish, feldspar is mostly salmon red orthoclase, gritts are interbedded with green very calcareous, very micaceous sandstones	50
Siltstone fine grained, light grey, calcareous, dense and thinly bedded with one bed of lettuce green waxy shale at base	205
Conglomerate . massive, with green gritt matrix, feldspathic, poorly bedded, rounded quartz pebbles 1/2" to 3" in diameter	55
Sandstone fine grained, green feldspathic, to interbedded platy green gritt, minor conglomerate, minor brown and green shale	220
Sandstone fine grained, feldspathic, and thinly bedded green gritts	55
Gritt	55
Concealed	165
Gritt	55
Sandstone thinly bedded to platy, fine grained, green, slightly calcareous	55
Sandstone platy to almost fissile, fine grained, sandstone to siltstone, mascerated plant fragments, siltstones are very light green	55
Sandstone greenish grey to green, gritty, medium grained, massively bedded quartz stringers, a few scattered quartz pebbles, well rounded	110
Sandstone massive, green, feldspathic, medium grained	55

	Feet
Concealed	330
Gritt greenish, calcareous and thinly bedded, medium grained, grey feldspathic sandstone	55
Siltstone light grey, thinly bedded, micaceous and calcareous	55
Siltstone massive, greenish grey and light grey, calcareous	<u>55</u>
Fault at base of section here.	
Total thickness exposed	2380

Thickness of basal Cape John strata to basement unknown.

Other isolated exposures of Cape John strata outcropping along the crest of the Anguille Mountains are difficult to place stratigraphically, as large intervening areas are covered with broad open marshes.

Baird (1951, p. 156) reported 1,500 feet of conglomerate and grey sandstone lying stratigraphically below a thick grey shale unit southwest of Ship Cove on the northern flank of the Cape Anguille Mountains. The base of this section is not exposed, but due to the lithology and stratigraphic position, they are correlated here with the Cape John formation.

A thin fault slice of Cape John strata extends along the northern flank of the Cape Anguille Mountains from Hynes Gulch to, and possibly beyond, Lewis Gulch (see plate II).

Red-brown feldspathic sandstones and siltstones with interbeds of massive greenish grey feldspathic sandstone outcrop on Lewis Gulch, where the following section was measured.

CAPE JOHN FORMATION AS EXPOSED AT LEWIS GULCH

		Feet
Conformable contact with overlying Snakes Bight formation		
Siltstone	 greenish grey, indurated and dense, red-brown, with minor grey feldspathic sandstone	40
Sandstone	 red-brown, fine grained, feldspathic, minor green mottling	420
Concealed	.....	295
Siltstone	 red-brown, poorly bedded with minor interbeds of red-brown, fine grained sandstone	66
Thickness	.....	821
Base of section faulted out.		

All sedimentary rocks of the Cape John formation appear to have been accumulated under terrestrial environments. No undoubted marine fauna or lithologies were observed. The presence of much relatively fresh, salmon red, orthoclase feldspar in these clastic rocks suggests the rapid weathering and deposition from a nearby igneous positive area. Unfortunately, at the present time, direction of transport of the clastic material is not known.

Megafossils of any type are very rare, and only a few very, poorly preserved, plant fragments were observed in this sequence. Numerous samples were macerated for spore analysis but only one was productive. This sample was collected from the shore section immediately north of Snakes Bight Cove and yielded the following:

Punctatisporites
Calamospora
Cyclogranisporites
Apiculatasporites
Convolutispora
Raistrickia
Lycospora
Perotrillites
Leiozonotriletes
 cf. Retusotriletes
 cf. Vallatisporites

Reiotriletes tortiles Playford
Punctatisporites debilis Hacquebard
Punctatisporites planus Hacquebard
Punctatisporites irrasus Hacquebard
Dictyotriletes cf. submarginatus Playford
Perotrillites perinatus Hughes and Playford
 cf. Lycospora magnifica McGregor
Retusotriletes avonensis Playford

The above assemblage, identified by M.S. Barss, Geological Survey of Canada, Coal Research Division, indicates a lower Mississippian age. The nature of this assemblage will be discussed further on in this chapter, where correlation between the Anguille and Horton groups is considered.

THE SNAKES BIGHT FORMATION

A thick sequence of dark grey, fine grained clastic rocks here referred to as the Snakes Bight formation conformably overlies the Cape John sequence. The contact between the two formations can be observed at several localities along the outer coast of the Cape Anguille Mountains from Snakes Bight Cove, (from which the formation derives its name) southwestward to Grebes Head. (see plate II, plate III, and photographs 15 and 16). The contact, defined by a marked change in colour from pale greenish grey to dark grey; and in bedding from massive to thinly bedded and fissile, is conformable and non-gradational. The lower contact of the Snakes Bight formation can also be seen in Lewis Gulch, fifteen miles northeast of Snakes Bight Cove. Here, dark grey shales of the Snakes Bight conformably overlies pale greenish grey and red-brown siltstones of the underlying Cape John sequence.

The upper contact of the Snakes Bight formation is exposed at Cape Anguille, directly in front of the light-house. (see photograph 18) At this location, dense, dark grey siltstones and shales give way, along a conformable contact, to the overlying massive sandstones and conglomerates of the Seacliffs formation. Similar upper contact relationships were observed on Lewis Gulch where dark grey, silty shales are overlain conformably by massive fine grained grey

sandstones and conglomerates of the succeeding Seacliffs succession.

Continuous exposures of the Snakes Bight sequence are found along the outer coast of the Cape Anguille Mountains, from Cape Anguille to Snakes Bight Cove. Northeast of the latter location, Snakes Bight strata are folded into a broad syncline that extends from Snakes Bight Cove to Hynes Gulch, where the structure is terminated by a complex fault system. Scattered exposures of grey siltstones and shales in Friars Gulch clearly attest to the continuation of the structure through this area. East of Hynes Gulch, Snakes Bight strata are thought to extend in a narrow belt along the northern flank of the Anguille Mountains to a point south of Ship Cove (see plate II). On the southern flank of the Mountain, highly folded and faulted black siltstones, criss-crossed with numerous white calcite veins, outcrop in the stream bed of upper Broom's Brook. Structural complications make thicknesses difficult to estimate, but it is felt that approximately 1500 feet of Snakes Bight strata are present. Discontinuous exposures of Snakes Bight sedimentary rocks also outcrop on Granddaddy's Brook (see plate III).

The Snakes Bight formation thins eastward from the Codroy Village - Snakes Bight Cove area, where a minimum of 1000 feet and possibly as much as 2500 feet of section is present. Eastward from here, in Lewis Gulch, 775 feet of

strata are present, while further east Baird (1951, p. 156) estimated that a thickness of 650 feet of Snakes Bight strata is exposed in small brooks flowing off the northern flank of the Anguille Mountains in the vicinity of Ship Cove.

Thinly laminated, black, very fine grained, argillaceous siltstone and dense, grey, more thickly bedded, generally jointed, fine to medium grained sandstone and very brittle, black, extremely thinly laminated to fissile calcareous, silty shales are predominant rock types. Bedding is well developed and ripple drift crosslamination is common. Calcite veining is a characteristic feature and pyrite concretions are abundant in many of the dense, more thickly bedded, silty interbeds.

Bottom structures observed on some of the more massive sandstone beds include flute casts, groove casts, and load casts, all characteristic of, but not exclusive to, turbidite sequences. Graded bedding does occur in some of the thick sandstone beds. Rip-up clasts are also very abundant. Many of the coarser sandstone beds contain lenticular zones showing numerous black silty shale chips derived from the underlying shale interbeds. There is strong evidence that some of the coarser clastic rocks were deposited from density currents and it is possible that some portions of the Snakes Bight formation were deposited in a marine flysch environment.

Some of the Snakes Bight

beds may have been laid down in a marine environment, but, despite the fact that many exposures were carefully searched, no marine fossils were found in this sequence. The only fossils observed were delicate fragmented plant stems in the dark black fissile siltstones. Thirteen samples collected from the Snakes Bight sequence were submitted for spore analysis, but in every case, no identifiable spores were extracted from the macerations.

The dark colouration, the fine grain size that is prevalent in the sequence, and the extremely uniform and thin laminations, (see photograph 17), together with the presence of considerable pyrite, suggest restricted current action and overall reducing conditions during the deposition of major portions of the Snakes Bight formation. Some of the coarser clastic rocks appear to have been introduced into the basin by turbidity currents. It is thought that subdued topographic relief existed after Cape John accumulation and that an extensive lake system or inland sea was present along the margins of a broad alluvial plain. It is within this environment that beds belonging to the Snakes Bight succession are believed to have accumulated.

Structural complications, coupled with a lack of access, renders the measuring of sections of Snakes Bight strata very difficult. For example, at the type locality, along the coast of Snakes Bight Cove, precipitous seacliffs

averaging 200 feet in height rise directly from the sea with only a few isolated and very small landing beaches being present. The beaches are generally very hazardous to occupy due to the presence of overhanging cliffs of loose grey shale. These factors render the detailed measuring of the type section impossible. Continuous sections of Snakes Bight strata are present on Low Brook (see plate III) and on Broom's Brook (see plate III). However, on both of these sections, particularly the latter, complex folding and faulting disturb the sequence and the lack of recognized marker beds within the succession renders these sections impossible to reconstruct. The most continuous and least structurally complex Snakes Bight sequence outcrops along the seacoast north of Codroy Village, (see figure 12). Here, the author measured the following section.

SNAKES BIGHT FORMATION

CAPE ANGUILLE AREA

(Portion D, see figure 12)

Conformable contact with overlying Seacliffs formation.

Feet

Sandstone	....	grey, fine grained, evenly bedded, 1" - 3" interbeds of dark grey laminated siltstone, CN 319	13
Siltstone	....	grey, fine grained, 1" - 4" bedding, alternating with dark grey thinly laminated siltstones, CN 320	18
Concealed	.....		18
Sandstone	....	grey, fine grained, massive, 2 foot bedding, dense	2
Concealed	.....		5
Sandstone	....	grey, fine grained, 6" bedding well jointed to give parallelgrams 2' x 8"; joints filled with calcite	2.5
Concealed	.....		10
Sandstone	....	grey, fine grained, excellent jointing pattern, pyrite concretions common	1.5
Siltstone	....	grey, coarse grained, dense, well bedded, jointed, pyrite concretions, plant fragments, CN 321	22
Shale	.....	black, fissile	2
Siltstone	....	grey, well jointed, 2" bedding	2
Siltstone	....	dark grey, thinly laminated, brittle	3

Feet

Conglomerate	intraformational, plated of dark grey fissile silts in dark grey siltstone matrix, rip-up clasts	3
Siltstone	 dark grey, fine grained, thinly laminated to fissile	8
Siltstone	 dark grey, 4" bedding, limonite staining, jointed, CN 322	5
Shale	 black, fissile, brittle, minor contortion	75
Siltstone	 black, fine grained, thinly laminated, minor zones of rip-up clasts, CN 323	48
Siltstone	 dark grey contorted laminations, common convolutions, CN 324	6
Siltstone	 dark grey, fissile, thinly laminated, brittle, calcareous	36
Sandstone	 grey, fine grained, limonite stained, ripple marked, N80°W slopes to south	5
Siltstone	 dark grey to black, laminated, brittle ...	52
Sandstone	 buff weathering, fine grained, grey, jointed, CN 324	2
Shale	 grey, fissile	32
Sandstone	 grey, fine grained, limonite stained	3
Concealed	.....	15
Sandstone	 grey, fine grained, evenly bedded, 1 ft. beds, jointed, limonite stained, CN 325...	14
Shale	 dark grey, arenaceous, fissile, brittle ..	60

Top of Quarry Sandstone		Feet
Sandstone	 grey, fine grained, thickly bedded, CN 326	30
Sandstone	 grey, coarse grained	1
Sandstone	 grey, medium grained, crossbedded	2
Conglomerate	. lenticular, white quartz and grey shale in grey medium grained sandstone matrix, CN 328	3
Sandstone	 grey, medium grained, graded	6
Sandstone	 grey, fine grained, numerous shale rip up clasts along bedding planes, drift plant material, CN 329	32
Sandstone	 grey, very fine grained, dense	2

Bottom of Quarry Sandstone		Feet
Siltstone	 dark grey, thinly laminated	15
Sandstone	 grey, medium grained, crossbedded, platy bedding, rip up jointed clasts common 12 feet up from base, CN 331 - 332	45
Siltstone	 grey to greenish grey, fine grained fissile, rusty	6

Fault Zone

Siltstone	 black, evenly laminated, brittle, crossbedded with calcite and quartz veins, 1/4" - 1/2", delicate plant fragments	20
Sandstone	 grey, fine grained, dense, reddish brown cast in places	35
Concealed	.....	20

Feet

Siltstone black, thinly laminated, cross-cutting, calcite veins	3
Concealed approximately	100
Siltstone black, thinly laminated	<u>4</u>
End of outcrop	799

i.e., in areal portion of Cape Anguille anticline

Basal beds of Snakes Bight formation not exposed

THE SEACLIFFS FORMATION

Precipitous seacliffs of steeply dipping sandstone beds form the northern end of the Anguille Mountains south of Ship Cove. These sandstones are, for the most part, massive, arkosic and friable. It was these beds that Baird (1951, p.156) proposed to name the Seacliffs sandstone. In the present paper, these beds, and equivalent strata, are referred to as the Seacliffs formation. They represent the final phase of Anguille accumulation.

The upper contact of this formation is placed at the base of a distinctive, thinly laminated limestone, the Ship Cove limestone, which is well exposed at many localities. At Ship Cove, the characteristic basal Codroy limestone directly overlies the uppermost Seacliffs beds of coarse, red and grey, friable arkose and silty shale. In the Codroy area, the Anguille-Codroy contact is well exposed on the

southern end of Codroy Island and at the roadway bridge of Ryan's Brook. On Codroy Island, brecciated fragments of Ship Cove limestone are present in a poorly sorted siltstone lying immediately below the thick main limestone. This, coupled with the fact that a few coarse clastic interbeds occur in the Ship Cove limestone, indicates that unstable conditions in the immediate area accompanied the encroachment of the "Codroy Sea". The contact at Ryan's Brook shows none of the above features, and the uppermost Seacliffs beds are overlain sharply and conformably by typical Ship Cove limestone. The lower contact of the Seacliffs formation is exposed along the seacoast in front of the Cape Anguille lighthouse. Here, grey, coarse to medium grained sandstone, with poorly marked bedding and numerous lenticular masses of coarse conglomerate, directly overlies black siltstone belonging to the Snakes Bight formation.

Thickly bedded, medium to coarse grained, feldspathic, grey sandstone and greywacke, with more thinly bedded, grey siltstones and minor grey, thinly bedded to fissile argillaceous siltstones, are predominant rock types. However, thickly bedded, crossbedded, fissile, micaceous, red and grey arkoses and red silty shales outcrop along the outer coast of the Anguilles from south of Lewis Gulch to Ship Cove. Similar strata were not found on the southern flank of the mountains, nor in the Codroy area, and it is evident that

different facies of the uppermost Seacliffs beds exist in different portions of the basin. Current ripple marks, large scale crossbedding and mud cracks are common sedimentary features. Macerated plant fragments are found throughout the sequence, but a marine fauna was not observed anywhere. The presence of sandstones carrying abundant plant chowder, indicate terrestrial conditions nearby during sedimentation, and, in places, large-scale crossbedding is suggestive of windblown sand.

Lenticular conglomerates, particularly well developed at Cape Anguille and in Lewis Gulch, carry well rounded pebbles, from 1/4 inch to 4 inches in diameter, of white quartz, pale grey and white Ordovician limestone, chert, greenish grey anorthosite, whitish pink granite, red thuyolite and dark, fine grained volcanics, (see photograph 19). It is thought that these lenses represent the channels of old rivers that wandered across broad alluvial plains and deltas. It is clear, from the pebbles in the conglomerates, that basement igneous masses and Ordovician shelf limestones were exposed as source areas. With the information available, however, the actual areas of denudation are not apparent.

Because of their indurated nature, the rocks of the Seacliffs formation are well exposed. Many spectacular gorges have been carved into the rocks of this group by streams rushing down the flanks of the Cape Anguille mountains.

Continuous exposures of these beds are found on Granddaddy's Brook, north of Millville, where a thickness of 2,500 feet is assigned to the formation. This agrees closely with the estimate of 2,800 feet for the exposures at Broom's Brook, some eight miles to the northeast. Baird (1951, p. 156) measured 3,200 feet of Seacliffs strata in the Ship Cove area, and more than 4,900 feet of these beds have been measured at Lewis Gulch. On Codroy Island, 1,400 feet of Seacliffs beds crop out on the shore. It is estimated that not more than 350 feet of Seacliffs strata lie between the island, on which the contact with the underlying Snakes Bight strata is not exposed, and the mainland, where the contact is exposed. Assuming that there were no intervening faults, this would give a thickness, probably a minimum thickness, of 2,277 feet in the Codroy area. These figures generally indicate a marked thickening of the Seacliffs formation northeastward from the vicinity of Codroy Village, a trend opposite to that of the underlying Snakes Bight formation.

Thirteen samples of Seacliffs sedimentary rocks were submitted for spore analysis but, like those submitted from the underlying Snakes Bight formation, were unproductive. The almost complete lack of spores in the entire Anguille succession is puzzling, as there is abundant drift plant debris present. Lithologically similar strata submitted from the Horton group in north Cape Breton yielded

abundant spore assemblages. In the Newfoundland Anguille sample, it was not a case of poorly preserved material, but rather a complete lack of included spores. Two theories for this discrepancy are suggested: (A) the Anguille strata were accumulated farther from areas of vegetation than the Horton sedimentary rocks, and (B) a marked change in the Ph of the water from the Cape Breton depositional basin to the southwest Newfoundland depositional basin resulted in the destruction of spore material preferentially in the latter area.)

The following sections of the Seacliffs formation are presented to illustrate the lithologic nature of this succession.

CODROY ISLAND

CAPE ANGUILE SECTION OF SEACLIFFS FORMATION

(See figure 12)

Portion A - Exposed on Codroy Island		Feet
Sandstone	 grey, medium grained, calcareous. crossbedded	2.5
Limestone	 contorted Ship Cove type, sandstone stringers	1.0
Limestone	 brecciated shards and fragments of Ship Cove type, CN 311	2.0
Sandstone	 brown and buff, coarse-grained, feldspathic	3.5
Sandstone	 grey, medium grained, feldspathic	1.5

	Feet
Siltstone green, micaceous	1.5
Sandstone reddish grey, medium grained, feldspathic, massive, CN 312	2.0
Sandstone greenish grey, medium grained, plant fragments	4.0
Sandstone reddish brown, coarse-grained, feldspathic, CN 314	5.0
Sandstone greenish grey, medium-grained, feldspathic	2.0
Concealed	160
Sandstone grey, fine grained, evenly bedded	150
Siltstone grey, fine grained, thinly bedded	6
Concealed	100
Sandstone grey, greenish grey, medium grained, arkosic, well bedded, CN 35	75
Sandstone red, very fine grained	3
Conglomerate . fresh salmon red, granite pebbles	3
Concealed	175
Sandstone red-brown, medium-grained, arkosic, dense, indurated massive bedding	8
Concealed	290
Arkose reddish brown, medium-grained, very dense, indurated	10
Sandstone greenish grey, fine grained, dense	25
Sandstone reddish brown, fine grained, massive, dense	10
Concealed	250
Shale brownish grey, fissile, arenaceous	6

	Feet
Sandstone brown, coarse-grained, feldspathic	2
Sandstone grey, fine grained, grey silt parting	3
Sandstone grey, medium grained, ripple N80°W, 3-1/2 inches, faint worm tubes	1
Sandstone grey, coarse-grained, rip up clasts along bedding planes, quite massive	25
Sandstone grey, fine grained, ripple marked	60
Sandstone grey, medium grained, massive	25
Sandstone grey, fine grained, 1/4 inch bedding	4
Sandstone pale grey, fine grained, evenly bedded, micaceous	1
Sandstone grey, fine grained, 1/2 inch bedding	4
Siltstone grey, coarse-grained, ripple marked, strike N70°W stoss slopes to south, mud cracking	2.5
Shale dark grey, micaceous, calcareous	12
Sandstone buff, fine grained, ripple marked	1.5
Shale dark grey, silty	.5
Siltstone grey, dense, well bedded, ripples, strike N70°W	.5
Shale grey, fissile	.5
Siltstone grey, ripple marked, at N70°W choppy crossbedding, drift plant fragments	3
Shale grey, fissile, brittle	4
Sandstone buff, fine grained, feldspathic, massive	4
Siltstone dark grey, thinly laminated, fine grained, drift plant fragments	9

	Feet
Sandstone fine grained, grey, 6 inch bedding, choppy crossbedding	2
Siltstone dark grey, brittle, fissile	1
Sandstone grey, fine grained, thin shale partings, 6 inch bedding, ripple marks N70°W stoss south	6
Sandstone grey, medium grained, evenly bedded	38
Conglomerate . grey, interformational sandstone pebbles sandstone matrix, rip-up clasts	2
Sandstone grey, medium grained, massive	100
Conglomerate . sandstone pebbles in medium grained sandstone matrix, rip-up clasts	2
Sandstone grey, medium grained, massive	50
Conglomerate . grey, fine grained, angular fragments of pink feldspar and white quartz	1
Sandstone grey, fine to medium grained, massive load casting and graded, plant fragments, CN 25	12
Siltstone dark grey, fissile, fine grained	6
Sandstone grey, fine grained, very poorly bedded and jointed	40
Sandstone grey, medium grained, massive, poorly bedded, minor interbeds of grey fissile fine grained sandstone, load casting, common structures on bottom of thick sandstone units	18
Sandstone greenish grey, medium grained, channel lenses of fine conglomerate, pink feldspar and grey quartz, sandstone shows mud cracked upper surfaces	20
Concealed between Codroy Island and Mainland	<u>1757</u> <u>520</u> 2277

NOTE: It is within this interval that the Seacliffs beds northwest of the Cape Anguille lighthouse lie, so that the actual concealed interval is probably less than 160 feet, giving a thickness for the Seacliffs formation of 2277 feet.

Portion B - Synclinal fold north of Cape Anguille lighthouse		Feet
Sandstone	grey, medium grained, quartzitic, dense, poorly bedded, massive, minor calcite veining, CN 100	50
Sandstone	dark grey, fine grained, poorly bedded, rip-up clasts of black laminated siltstone of Snakes Bight type	15
Sandstone	grey, medium grained, massive, and jointed, CN 104	30
		95

Fault Zone

Amount of section lost here unknown, but believed to be small.

Portion C -		Feet
Conglomerate .	coarse cobble conglomerate, massive indistinct bedding, cobbles well rounded, range in size from 1/2" to 3". Pebbles form 90 percent of unit, 10 percent matrix of grey medium grained, sandstone. Some large rip-up clasts underlying sandstone incorporated near base of conglomerate zone, pebbles of white quartz, grey quartz, etc., pink granite, red volcanics, and dark grey, Ordovician limestone, CN 107	30
Sandstone	grey, fine grained, thinly bedded, grey shale partings	18

	Feet
Sandstone grey, medium grained, massive	20
Sandstone grey, medium grained, lenses of pebble conglomerates, CN 109 - 111	70
Conglomerate . cobble conglomerate, pebbles range in size from 1/4" to 4". 50 percent white quartz, 15 percent grey Ordovician limestone, 10 percent grey quartz etc., 5 percent Anorthosite 5 percent red rhyolite, 5 percent black volcanic, 5 percent reddish grey sandstone, 5 percent whitish pink granite	6
Sandstone grey, fine grained with conglomerate lenses forming approximately 40 percent of lithology. One conglomerate, cross- bedded, contains 3 foot angular blocks of pink granite, CN 111 - 114, cross- bedded. near base	120
	264

The following section of Seacliffs strata was measured in Lewis Gulch on the northern flank of the Cape Anguille Mountains, some twenty-two miles northeast of the previous section.

SECTION OF SEACLIFFS STRATA AS EXPOSED ON LEWIS GULCH
(Uppermost beds of Seacliffs formation not exposed.)

	Feet
Sandstone..... very massive, friable, red and reddish grey, very feldspathic and mottled green in part; minor red shaly silt- stone interbeds, micaceous	540
Sandstone extremely massive, red-brown and grey, feldspathic, medium grained, friable	540

	Feet
Sandstone massive, buff, medium grained, crossbedded	160
Shale dark grey, fissile, somewhat silty	55
Sandstone very massive, grey and buff, fine to medium grained, slightly feldspathic, somewhat friable and well crossbedded ...	1675
Sandstone massive, grey, interbedded with dark grey fissile silty shales	345
Sandstone massive, grey, slightly feldspathic, minor conglomerate lenses	215
Sandstone massive, grey, slightly feldspathic, minor conglomerate lenses	485
Concealed	270
Sandstone massive, fine grained, grey; conglomerate interbeds containing rounded pebbles of quartz, granite, and Ordovician limestone; resembles conglomerate at Cape Anguille light- house	55
Concealed	235
Sandstone very massive, grey, fine grained, dense, well cemented	340
Thickness	4915

The Lewis Gulch section is some 5000 feet thick, without the uppermost Seacliffs beds being exposed. Thus, there is a minimum thickness difference between the two sections of some 2600 feet. It is interesting to note that conglomerates carrying rounded Ordovician limestone were observed some 575 feet above the Seacliffs-Snakes Bight contact

in Lewis Gulch, while lithologically similar massive conglomerates occur at Cape Anguille (see photograph 19) 234 feet above the lower contact of the Seacliffs sequence. Massive, red, friable arkoses and feldspathic sandstones comprising the upper 1080 feet of the Lewis Gulch section are not found at Cape Anguille, nor on the southern flank on the Cape Anguille Mountains in the vicinity of Granddaddy's and Broom's Brook where fine to medium, dense, grey sandstones are overlain by the lithologically characteristic Ship Cove limestone. The massive sandstones at Lewis Gulch strike parallel to the seacoast and at Ship Cove are overlain by the basal Codroy group Ship Cove limestone. There is, therefore, no doubt that these clastic rocks belong to the uppermost portion of the Anguille group - Seacliffs formation.

The close of Anguille group accumulation is marked by the basal Codroy group Ship Cove limestone, which is lithologically identical to the basal A₁ Windsor limestone in Nova Scotia and New Brunswick. So distinctive is the lithology of this unit, that it appears that deposition of this band occurred as a signal event everywhere within the Carboniferous basin. The limestone in question is followed by a well documented faunal succession and marks the first undoubted marine encroachment into the Carboniferous basin.

The succeeding Codroy group in southwestern Newfoundland, like the Windsor group, contains thick anhydrite,

gypsum, and marine limestones interbedded with predominantly red clastic rocks.

RESULTS OF SPORE ANALYSIS OF SAMPLES COLLECTED FROM THE ANGUILLE GROUP, SOUTHWESTERN NEWFOUNDLAND

Thirty-one samples collected from throughout the Anguille sequence were submitted for spore analysis. Of these, five were collected from the Cape John formation, thirteen from the Snakes Bight formation, and thirteen from the Seacliffs formation. All the samples submitted contained visible plant debris and further various lithologies ranging from dark grey, fine grained siltstones to coarse grained sandstones were macerated. Only one sample CN335 collected from the Cape John formation yielded identifiable spores. The included assemblage is listed in this chapter under the section dealing with the Cape John formation.

A few years prior to the author's collecting, M.S. Barss of the Geological Survey of Canada, collected samples for spore analysis along the Codroy Village - Cape Anguille coastline. Samples from both the Codroy group and

Anguille group yielded no identifiable spores. It thus appears that further attempts at zonation of the Anguille succession by included spore assemblages in the Codroy area would be futile.

The paucity of spores in the Anguille succession is puzzling as much drift plant debris is present. The lithologies tested were not significantly different from those macerated from the Horton sequence on the North Aspy River in northern Cape Breton Island. The latter suite of samples yielded abundant spores. Further, in the Anguille samples, it was not a case of poorly preserved material, but rather a complete lack of included spores. Two hypotheses for this discrepancy are suggested: (A) Anguille strata were deposited further from areas of vegetation than sedimentary rocks of the Horton group, and (B) a marked change in the Ph of the water within the sediments from the Cape Breton depositional basin to the southwestern Newfoundland basin resulted in the destruction of spores. The presence of much drift plant debris would tend to rule out theory A, as presumably spores can be carried at least as far, if not farther, (from areas of vegetation) than plant remains. Further, some of the plant remains observed in the Anguille strata were structurally delicate and breakage was not excessive, a situation rather unlikely if the plant remains had travelled great distances from source. For the foregoing reasons, the author prefers hypothesis B.

CORRELATION OF THE ANGUILLE AND HORTON GROUPS

A.O. Hayes and H. Johnson, (1938, p. 11) recognizing that Anguille strata were Lower Mississippian, suggested a correlation of these sedimentary rocks with the Horton group in Nova Scotia. Their criteria for this correlation are not clearly stated in their report.

W.A. Bell (1948, p. 5) identified the following megafloral assemblage, collected from upper Anguille beds: Rhacopteris subcuneata Kidstone, Diploptera patentissimum Ettingshausen, Aneimites sp., Schuetzia sp., and Sublepidodendron nordenskioldii Narthost. He concluded that this assemblage indicated a probable correlation with upper Horton strata in Nova Scotia.

Murray (1955) divided the Horton group in western Cape Breton Island into three formations: the Craignish, the Strathlorne, and the Ainslie. This subdivision was based on reasonably recognized lithological variations within the Horton succession, which, in the simplest form, can be stated as follows: Craignish formation - coarse, red and grey clastic rocks; Strathlorne - fine grey clastic rocks; Ainslie - medium to coarse red and grey clastic rocks.

Cote (1961) noted the same gross lithological sequence in the Anguille group of southwestern Newfoundland

and, at that time, subdivided the Anguille into (1) a lower sandstone unit, (2) the Snakes Bight shale and (3) an upper sandstone unit. In this thesis, the formational units, (1) Cape John, (2) Snakes Bight, and (3) Seacliffs, replace the previous terms.

There is little doubt now that the Anguille and Horton groups occupy the same stratigraphic position in the Maritime Carboniferous basin, i.e., post-Acadian orogeny and pre-subzone A of the Windsor and Codroy groups.

The following intergroup correlations are now suggested: Craguish formation with Cape John formation; Strathlorne member with Snakes Bight formation; and Ainslie member with the Seacliffs formation. This correlation is based predominantly on comparative lithological sequences and it cannot be shown that the formational boundaries are time planes. In order to define time equivalence more closely, spore analyses were made on samples of Anguille strata in order to compare the included assemblages with those of the Horton group. Unfortunately, spores are not abundant in Anguille strata, only one sample of thirty-five being productive. However, the one productive sample collected from the Cape John formation in Snakes Bight Cove suggests a Craguish - Cape John correlation. The nature of included spores is listed previously in this chapter where the Cape John formation is considered. The species identified indicate

a Mississippian age and, further, an age older than the Horton type section of Bell (1929). Bell's type section is equivalent to the Ainslie - Strathlorne formation, and the upper portion of the Craignish in western Cape Breton Island. The spore assemblage from the Cape John sample is older than any assemblages so far recorded from the Craignish, but is still Mississippian in age. It is, therefore, concluded that the Cape John sample is equivalent in age to some portion of the lower Craignish sequence.

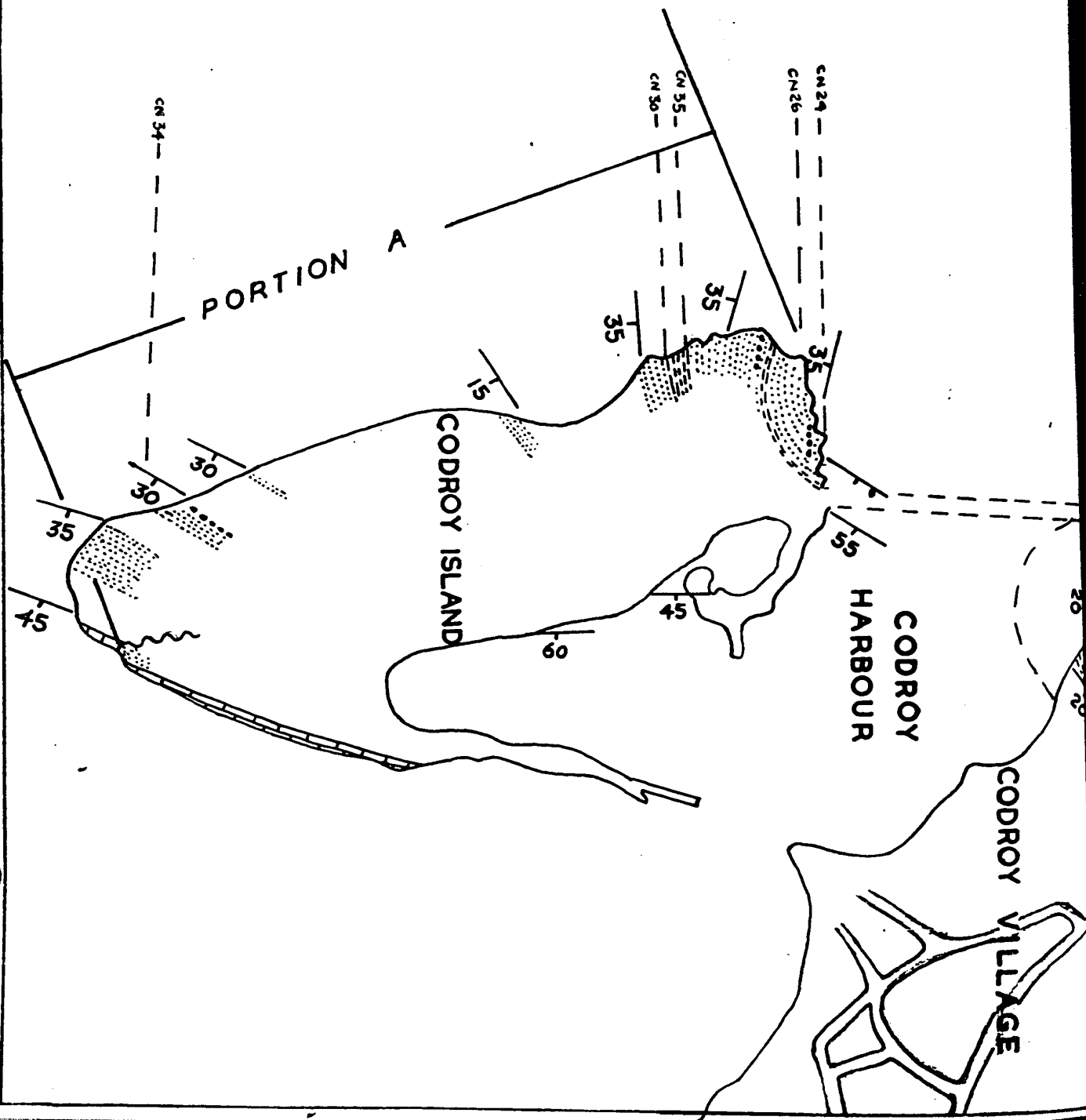
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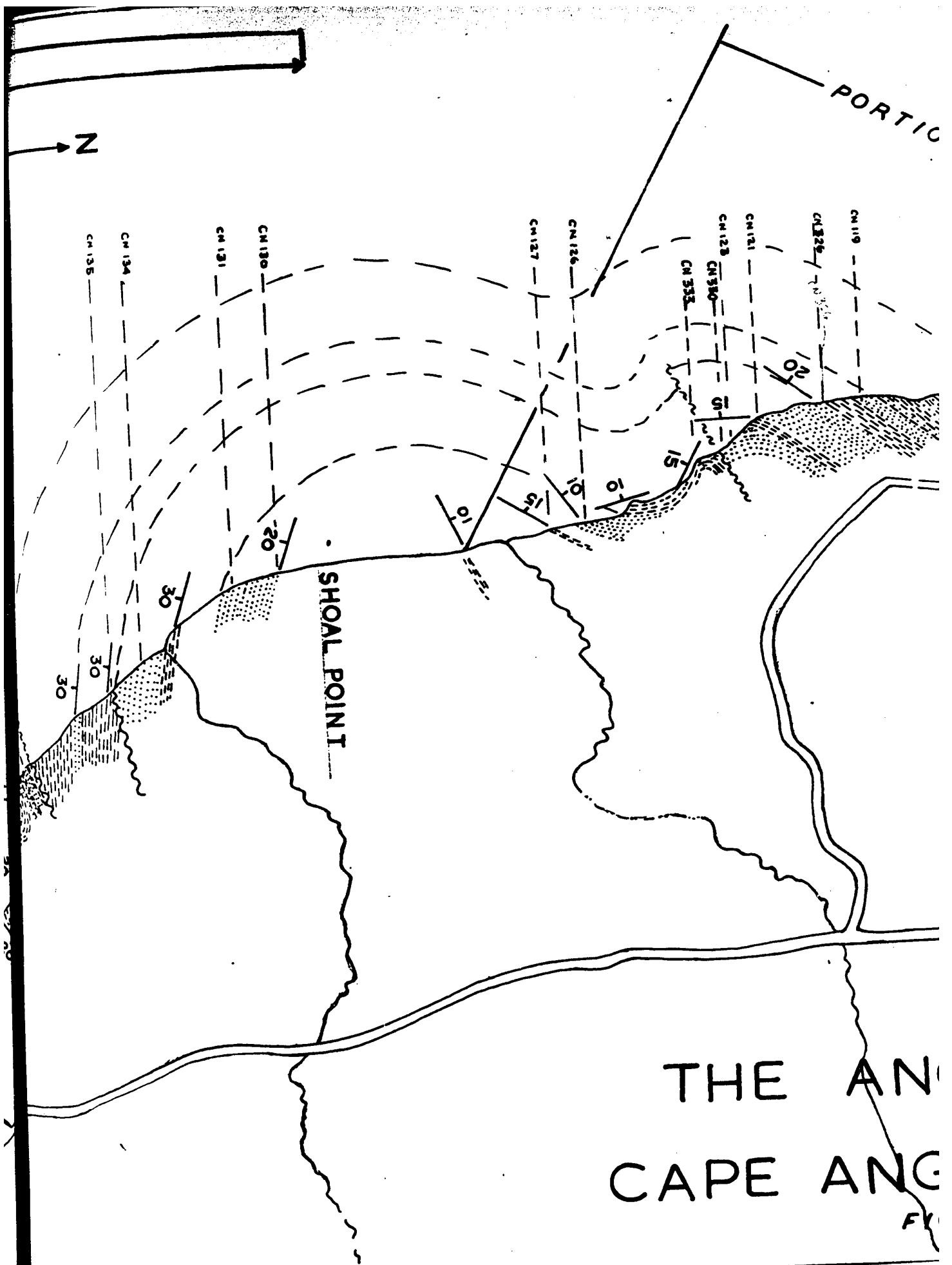
PORTION A

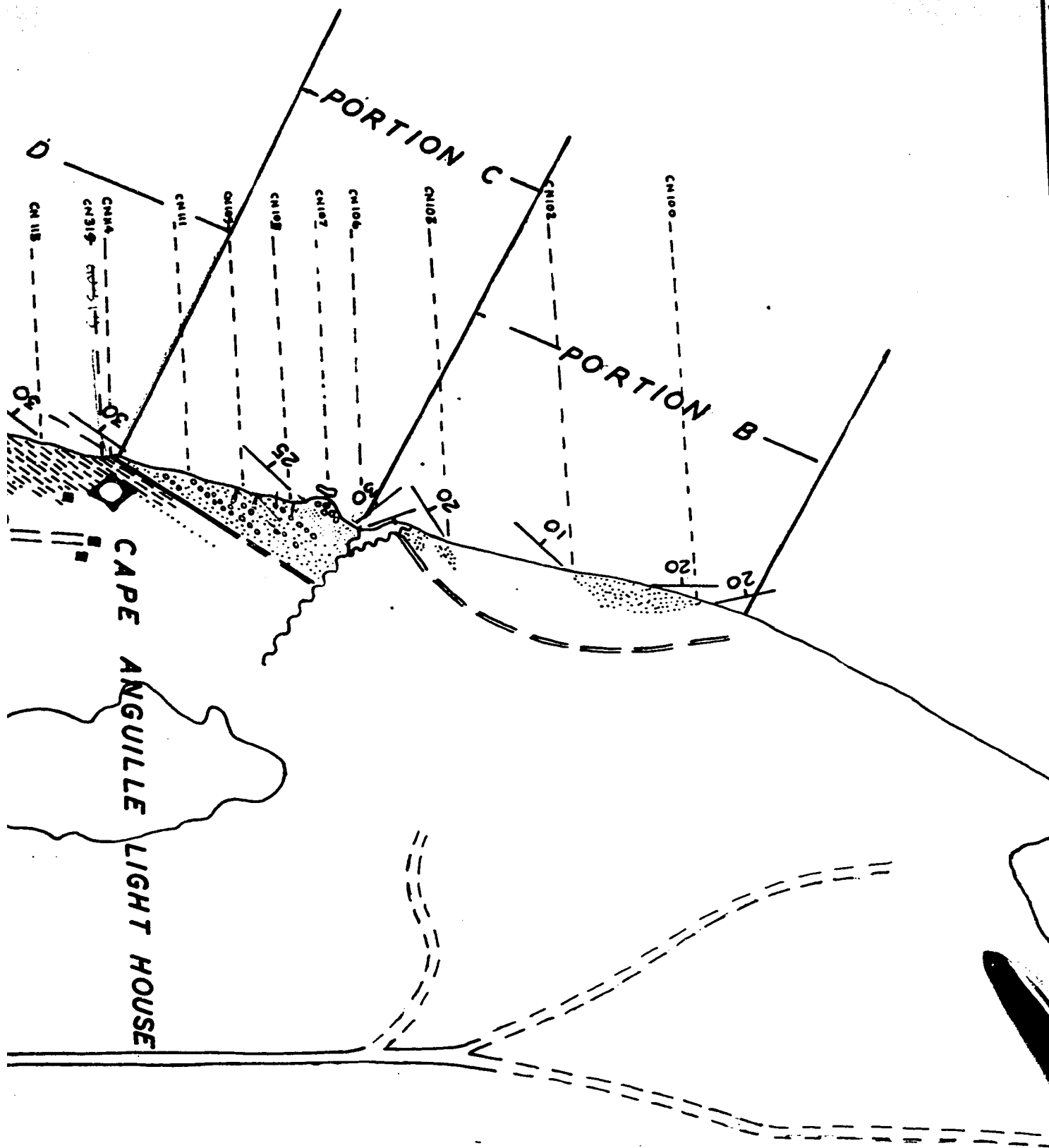
CODROY ISLAND

CODROY HARBOUR

CODROY VILLAGE







ANGUILLA GROUP ANGUILLA SECTION

SUMMARY
AND
CONCLUSIONS

CHAPTER 8

SUMMARY AND CONCLUSIONS

Many different subdivisions within the Anguille and Horton groups have been suggested by various former workers in the portion of the Maritime Carboniferous basin covered in this thesis. A combination of factors, primarily poor stratigraphic terminology and inadequate regional mapping, rendered the subdivisions difficult and in some cases impractical to apply. A full review of the contribution of former workers is included in the main body of the thesis.

As a result of extensive mapping of Horton sequences over a period of four years and the greater portion of two years spent on a study of the Anguille succession of southwestern Newfoundland, the author proposes several changes in stratigraphic terminology, in order to present a subdivision that is not severely affected by local facies changes and which can be applied in areas where continuous sections are not available.

The Horton group has been redefined so that the succession is now subdivided into three lithologically distinctive formations, which from the base upward are; (1) The Fisset Brook, (2) The Craignish and (3) The Strathlorne-Ainslie.

The Fisset Brook sequence comprised of intercalated sedimentary and volcanic rocks, is thought to have resulted from post orogenic adjustments following the Acadian orogeny. The formation is now included within the Horton group, here considered a rock stratigraphic unit, in order to remove any ambiguity as to where the base of the Horton succession is placed. Thus, with the inclusion of this formation, the lower contact of the Horton group can be clearly defined as the nonconformable surface separating basement igneous and metamorphic rocks from the overlying clastics and volcanics.

Many geographically separated measured sections of the Craginsh formation have been included in order to demonstrate the lithological nature of this rock unit throughout the entire thesis area. The generally poorly bedded and poorly sorted nature of the Craginsh coupled with extensive lenticular zones of coarse conglomerate indicates that accumulation took place marginal to source contributing areas initially possessing considerable topographic relief. The entire succession appears to be terrestrial due to (a) complete absence of marine fossils, (b) the high percentage of red beds within the sequence, (c) the poorly bedded and lenticular nature of Craginsh strata, and (d) rapid local facies changes as well as a complete absence of recognizable marine lithotypes.

As a result of extensive regional mapping, the former Strathlorne and Ainslie formations of Murray (1955) are now incorporated into one rock unit, the Strathlorne-Ainslie formation. It was for the following reasons that this change was made: (a) facies changes and interfingering of lithology in portions of the thesis area makes it impossible to distinguish between Murray's units in areas not investigated by him, (b) the more or less continuous exposures required for distinguishing these units are lacking in most parts of the area, and thus, the retention of Murray's units as formations is impractical in regional mapping. However, there is little difficulty in distinguishing the finer clastic rocks of the now proposed Strathlorne-Ainslie formation when comparison is made to the underlying predominantly coarse, poorly bedded and poorly sorted sedimentary rocks of the Craignish formation. The overall finer grade of the Strathlorne-Ainslie sedimentary rocks is most probably due to a reduction of the topographic relief of source contributing areas by continued denudation. Prevalent environments during accumulation include fluvial, lacustrine and deltaic.

The first undoubted marine transgression into the Carboniferous basin occurred during deposition of the overlying Windsor group. The top of the Horton sequence is placed at the base of the geographically widespread Windsor A₁ limestone.

For the first time, the results of systematic spore analysis of Horton strata from western and northern Cape Breton Island is presented. These microfossils are considered to be the only types upon which a zonal scheme within the fresh water, terrestrial Horton sequence could be based. The results of this study indicate that three spore zones are present; here designated in descending order; A, B, and C. "A" zone is characterized by the spore Pustulatisporites pretiosus Playford. In zone "B", the former species is absent, and there is an acme of species of the genera Vallatisporites. The characteristic spore found in zone "C" is a new species of the genera Nodatitriletes. The results of the spore analysis are shown graphically on the following figure No. 13). Although more data will be required to define the limits of these zones more precisely, a start on this segment of Horton stratigraphy has been made. The difficulty in obtaining additional data will be due to the following factors: (a) the presence of thick red bed sequences within the Horton group from which identifiable spores are not likely to be extracted, (b) the difficulty of recognizing samples, in the field, which are most likely to contain identifiable spores, and (c) the seeming lack of a varied assemblage from samples collected from the lower portion of the Craginsh formation.

A map showing the areal extent of the various formations and members within the Horton sequence in western

WINDSOR GROUP SUB ZONE A

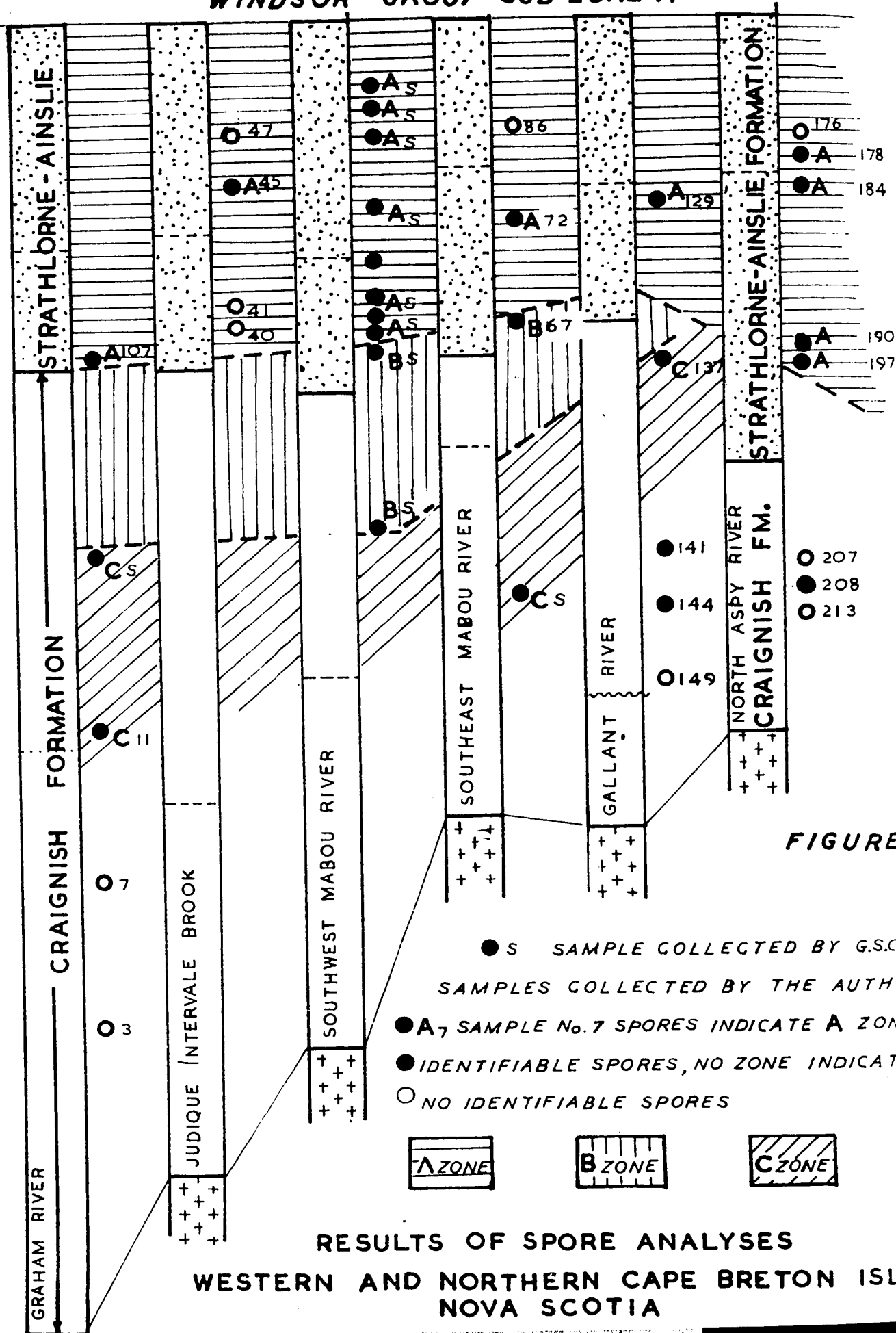


FIGURE 13

Cape Breton Island is presented.

The stratigraphy of the Anguille group in southwestern Newfoundland has been completely revised as a result of extensive regional and detailed mapping in the Cape Anguille Mountain area. For the first time, the structural configuration and lithology of Anguille strata in the interior portion of the Cape Anguille Mountains is shown. Three formations are now recognized in the Anguille sequence, these being, from the base upward: (1) The Cape John, (2) The Snakes Bight, and (3) The Seacliffs. Measured sections of these formations have been presented in order to demonstrate the lithological nature of these units throughout the area.

The Cape John formation consists of predominantly coarse to medium grained clastic rocks, ranging from pale buff to red-brown. Unfortunately, the base of this formation is not exposed and it is, therefore, impossible to ascertain the nature of the lower, Anguille group contact. The immature nature of the Cape John sedimentary rocks, the overall poorly bedded and lenticular nature of the sequence as well as rapid local facies changes, suggest that rapid accumulation took place close to upfaulted igneous and metamorphic massifs; a depositional environment very similar to that postulated for the Craignish formation of the Horton group.

A marked colour change as well as a rapid decrease in overall grain size takes place in the overlying Snakes Bight

formation. Thinly bedded and finely laminated dark grey to black siltstones and shales predominate, and thus a marked change in depositional environment is indicated when comparison is made to the lithological nature of the underlying Cape John strata. The presence of numerous bottom structures, such as load casts and groove casts, as well as graded bedding and rip-up clasts, suggest that portions of the Snakes Bight succession were deposited from density currents.

The uppermost formation of the Anguille group is the Seacliffs, a sequence of coarse to medium grained, grey sandstones and siltstones, very similar lithologically to the Ainslie member of the Horton group, and environments during accumulation are thought to have been similar.

The top of the Anguille group is placed at the base of a distinctive thinly laminated limestone, the Ship Cove, lithologically identical to the basal A₁ Windsor limestone of Nova Scotia.

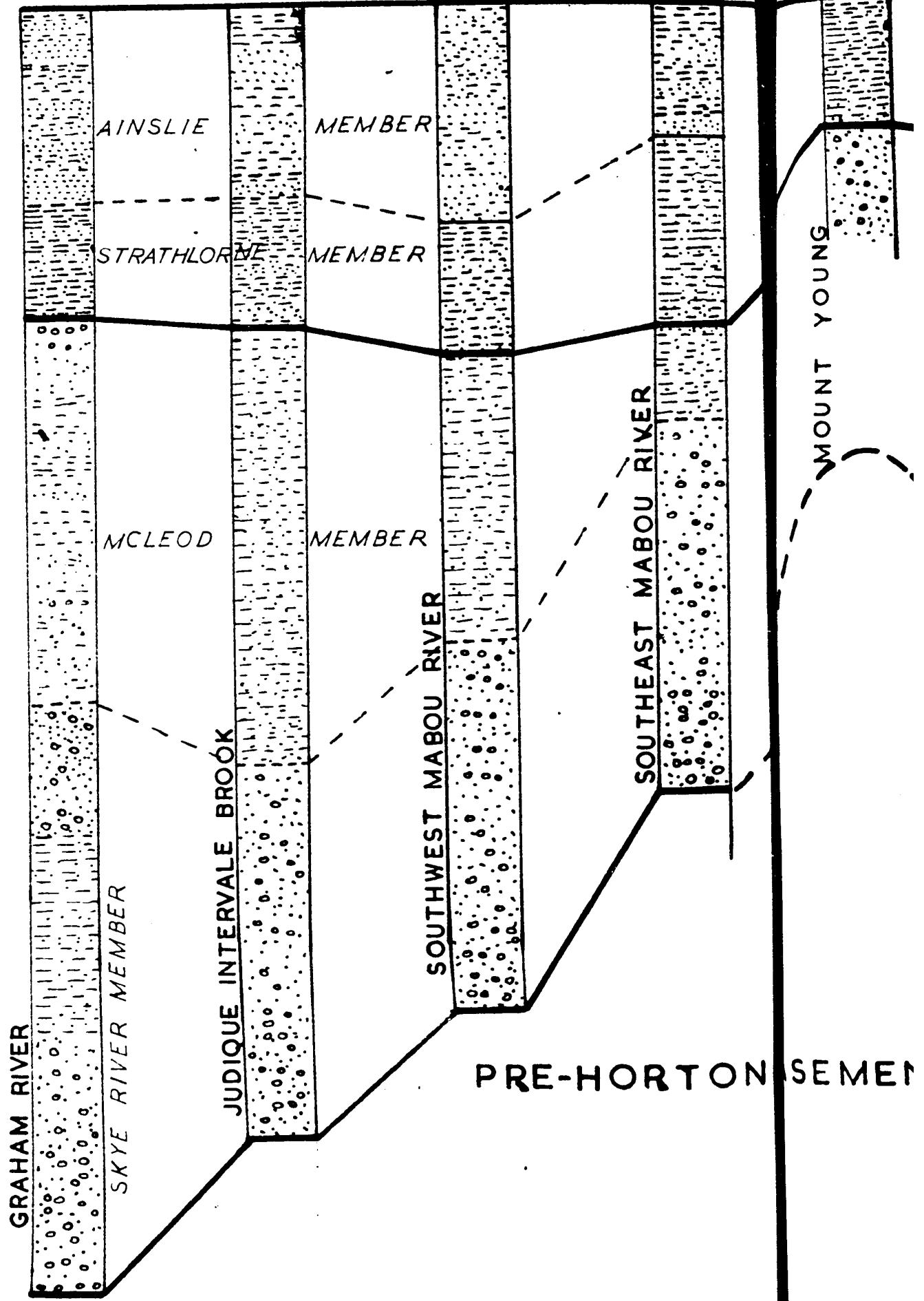
Although correlation of the Anguille and Horton groups has been proposed by various workers such as Hayes and Johnson (1938) and Bell (1948), no attempt at intra-group correlations based on extensive regional mapping of these groups had been suggested. Such a correlation has been presented in this thesis and is as follows: Cape John formation with the Craignish formation; Snakes Bight formation with the

Strathlorne member, and the Seacliffs formation with the Ainslie member. Although this correlation is based primarily upon sequential order criteria, limited spore material collected from the Anguille group substantiates these conclusions. The following table demonstrates the suggested correlation.

Table No. 8

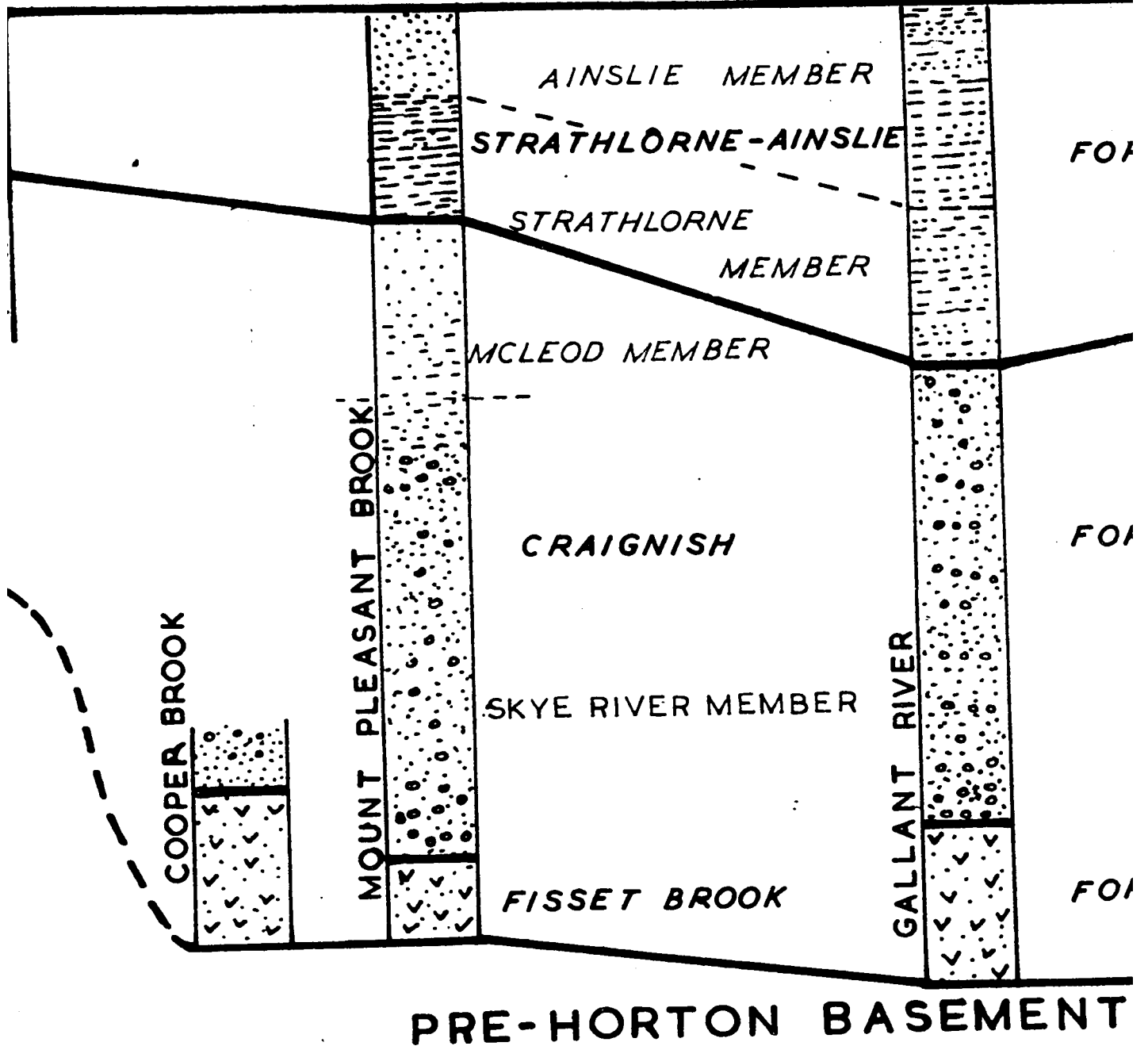
Cape Breton Island	Southwestern Newfoundland	Lithology
Basal Windsor A ₁ Limestone	Ship Cove Limestone	Grey, thinly laminated to fissile limestone.
Ainslie member	Seacliffs formation	Grey fine-medium grained sandstones, minor red siltstones.
Strathlorne member	Snakes Bight formation	Grey to black fine siltstones and shales.
Craignish formation	Cape John formation (base not exposed)	Coarse poorly sorted and immature red and grey sandstones, siltstones and conglomerate.
Fisset Brook formation	no equivalent observed	intercalated volcanic and clastic rocks.

POST-HORTON, WINDS GROUP



SUB ZONE A

WINDSOR A' LAMINA



CORRELATION

ANGUILLE AND

VERTICAL

HORIZONTAL

MINATED LIMESTONE

FORMATION

FORMATION

FORMATION

GRAND ETANG BROOK

CAPE BRETON HIGH

PRE-HORTON BAS

NT

ON DIAGRAM OF THE ND HORTON GROUPS

FIGURE 14

AL SCALE 1 INCH = 1000 FEET

NTAL SCALE 1 INCH = 5 MILES

PE BRETON HIGHLANDS

HORTON BASEMENT

NORTH ASPY RIVER

AINSLIE
MEMBER

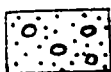
STRATHLORNE
MEMBER

CRAIGNISH FORMATION

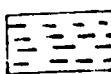
THE
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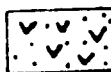
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SANDSTONE + CONGLOMERATE

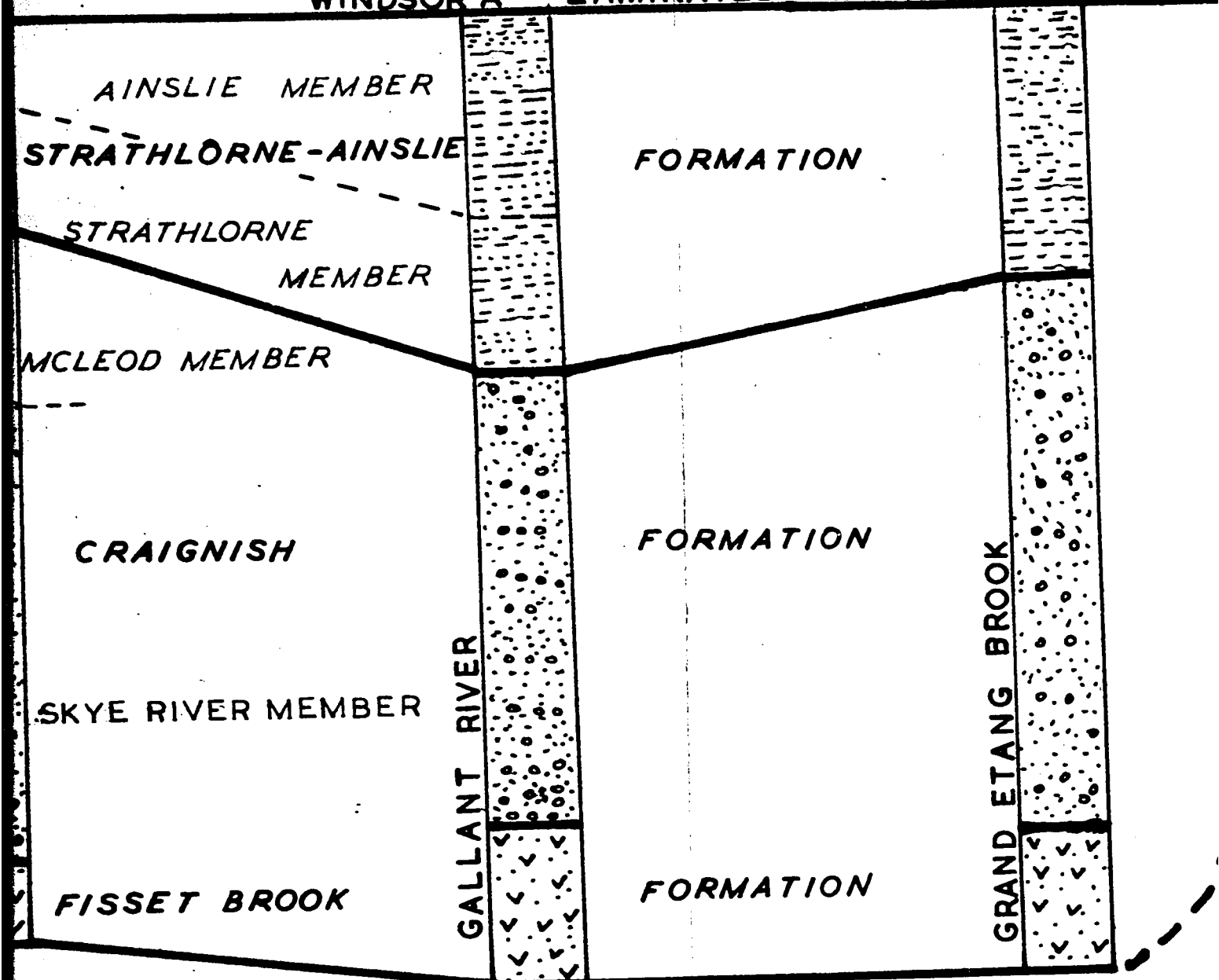


SILTSTONE, SHALE



VOLCANICS, MINOR CLASTICS

WINDSOR A' LAMINATED LIMESTONE

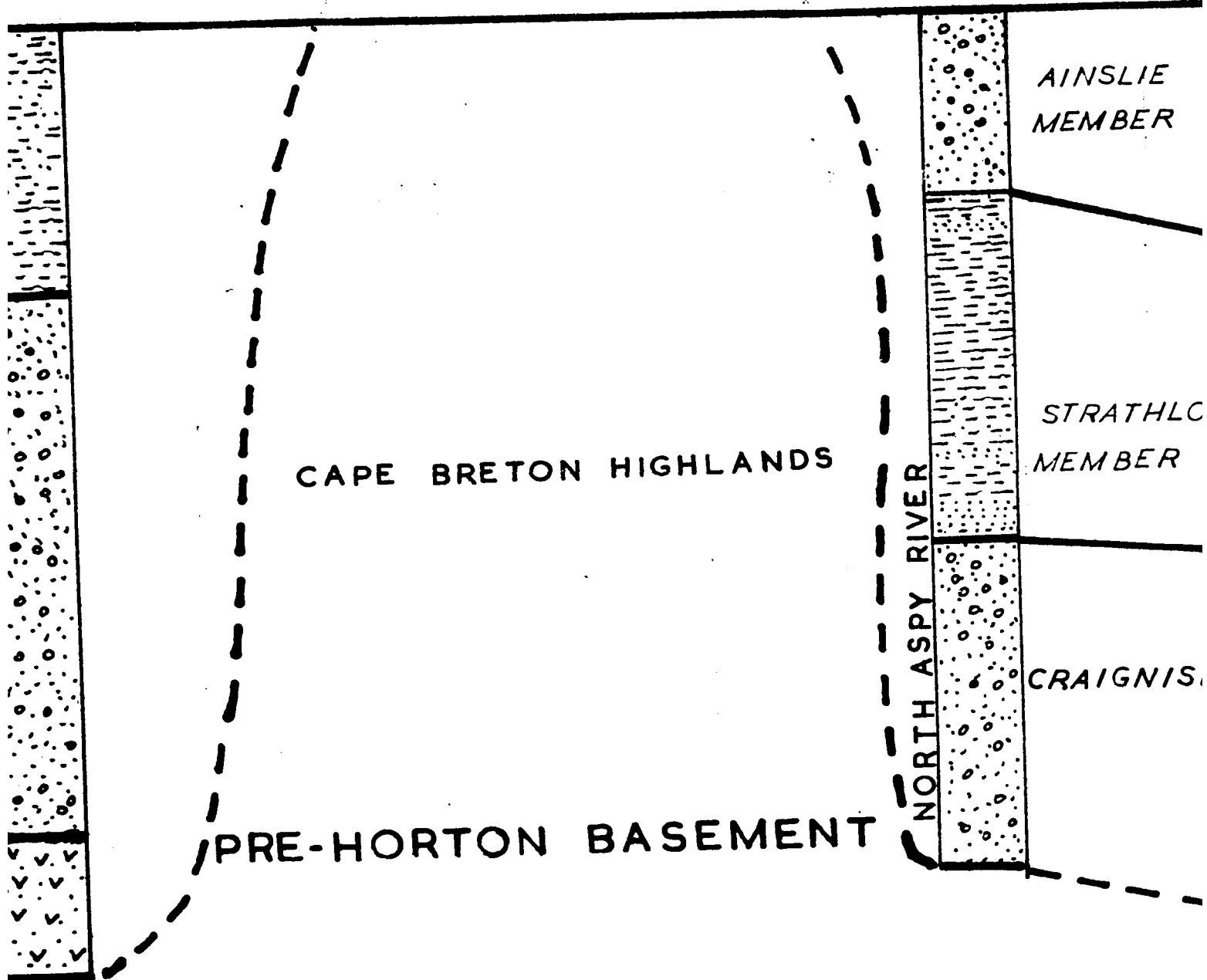


PRE-HORTON BASEMENT

CORRELATION DIAGRAM ANGUILLE AND HORTON

FIGURE 14

VERTICAL SCALE 1 INCH = 1
HORIZONTAL SCALE 1 INCH



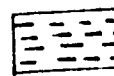
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INCH = 1000 FEET
1 INCH = 5 MILES

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SANDSTO



SILTSTON



VOLCANI

SHIP COVE LAMINATED LIMESTONE

WISLIE
MEMBER

CAPE ANGUILE

RATHLORNE
MEMBER

SNAKES
BIGHT
FORMATION

WIGNISH FORMATION

BROOM'S BROOK

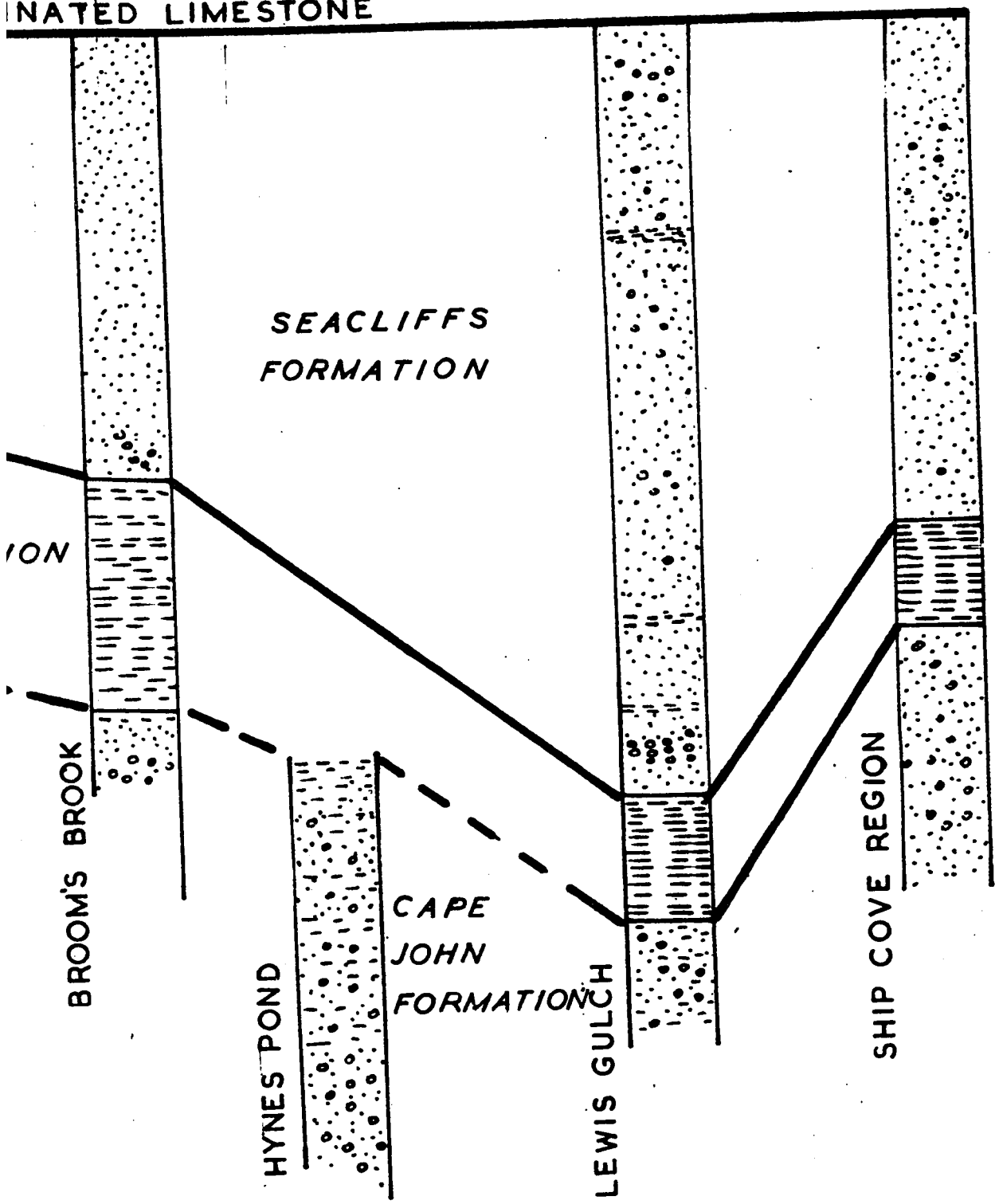
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DETAILED. DETAILED DESCRIPTIONS
AND OTHER SECTIONS
INCLUDED IN THE TEXT

SANDSTONE + CONGLOMERATE
SLTSTONE, SHALE
VOLCANICS, MINOR CLASTICS

PRE - ANGUILE BASEMENT

INATED LIMESTONE



BASEMENT CONTACT NOT EXPOSED

Although the stratigraphy of the lower Mississippian Anguille and Horton groups has been revised and much data as to the areal extent and lithological nature of the various included formations has been presented, much work remains to be done, particularly in the study of sedimentary structures and detailed petrography in order to reconstruct more accurately sedimentary environments and source directions during accumulation. More data on included spore assemblages will be necessary before a clear picture of time equivalence within these predominantly unfossiliferous sedimentary rocks emerges. However, it is felt that a firm basis of stratigraphic concepts and nomenclature has been presented which should greatly aid and accelerate more detailed considerations.

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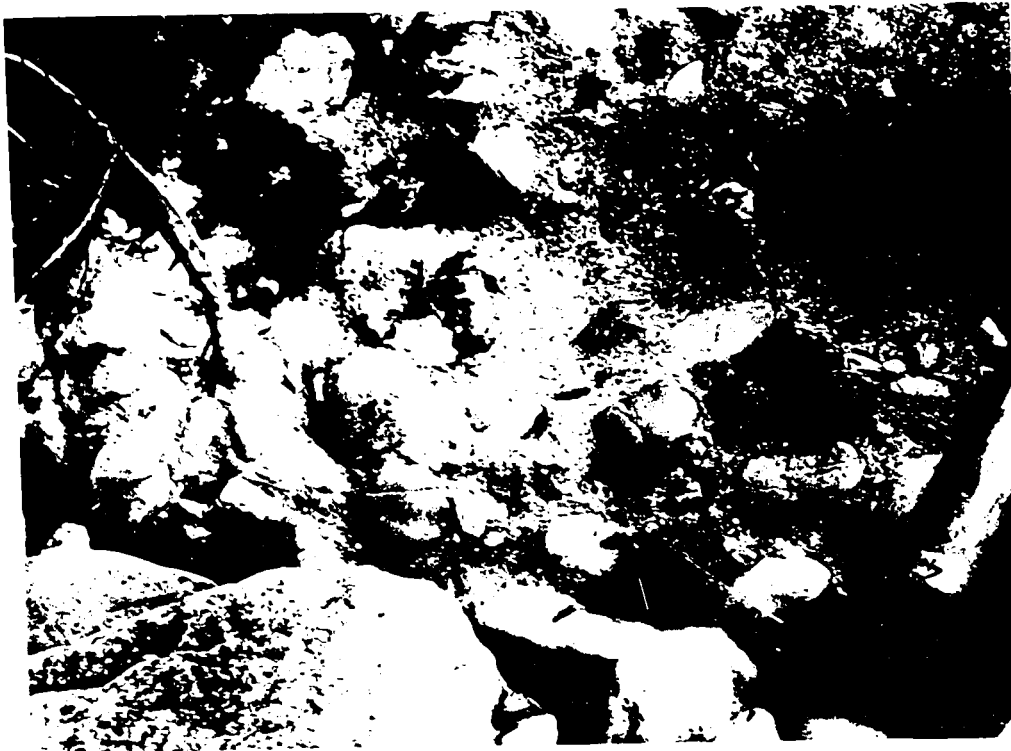
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PHOTOGRAPH No. 1

Conglomerate bed in the Craignish formation as exposed on the Graham River. Rounded to sub-rounded pebbles of pink granite, grey granite, white quartz, and dark bluish grey dike rock. Matrix is very coarse grained greenish grey arkose.

PHOTOGRAPH No. 2

Craignish conglomerate as exposed on Rory Brook, one mile north of the Graham River. Note lenticular nature of the bedding which is typical of Craignish conglomerate zones. Sub-rounded to angular pebbles of grey quartz and pink granite in a red-brown and greenish grey mottled medium grained feldspathic sandstone matrix.



PHOTOGRAPH No. 3

Massively bedded conglomerates of the Craignish formation from the Lake Ainslie area. Sub-rounded pebbles of pink granite, white granite, bluish grey dike rock and greyish white quartz in a very coarse grained greenish grey arkose matrix.

PHOTOGRAPH No. 4

Massive and poorly bedded feldspathic grey sandstones of the Craignish formation as exposed on Gallant River. Note the lenticular nature of the bedding and lenticular thin conglomerate stringers in the sandstone.



PHOTOGRAPH No. 5

Massive boulder conglomerate belonging to the Craignish formation as exposed on the North Aspy River. Boulders are of grey and pink porphyritic granite. Largest boulder in centre of photograph is 1.5 feet in diameter. The overlying bed is of greenish grey coarse arkose. Note crossbedding and irregular nature of the conglomerate-arkose interface.

PHOTOGRAPH No. 6

Typical cliff exposure of grey silty shales and thin grey fine grained siltstones of the Strathlorne member of the Strathlorne-Ainslie formation on the Gallant River. The more massive bed in the central portion of the photograph is grey sandstone. The thinly bedded nature of the sequence is typical of the Strathlorne member.



PHOTOGRAPH No. 7

Close-up view of sandstone bed referred to in previous description within fine clastic rock sequence of the Strathlorne member on the Gallant River. Note large scale slump balls resulting in load casting structures on the bottom surface of the bed. The underlying material is fissile grey shale.

PHOTOGRAPH No. 8

Graded bedding in massive sandstones of the Ainslie member on the Gallant River. The photograph shows a thickness of approximately three feet.



PHOTOGRAPH No. 9

Typical exposure of fine grained grey sandstones of the Ainslie member on the Gallant River. Note the platy nature of the bedding and large scale cross-bedding. Well developed joints as shown are also typical of the more massively bedded sandstones in this member.

PHOTOGRAPH No. 10

Very poorly bedded, and massive, friable, whitish grey, medium to coarse grained arkoses of the Ainslie member, as exposed on the North Aspy River.



PHOTOGRAPH No. 11

Massive boulder conglomerate within the Ainslie member of the Strathlorne-Ainslie formation on the North Aspy River. Boulders of pink granite and grey granite predominate. Smaller pebbles are composed of grey quartz and greenish grey siltstone. The matrix is a coarse grained, greenish grey arkose. The hammer is twelve inches long.

PHOTOGRAPH No. 12

Horton-Windsor contact, Southwest Mabou River. The massive bed at the top of the photograph is the basal Windsor A₁ limestone. Underlying it in the lower 2/3 of the photograph are red-brown shaly siltstones of the Horton group. The contact marked by the arrows is conformable.



PHOTOGRAPH No. 13

Basal foot of Windsor A₁ limestone exposed near the roadway bridge, Gallant River. The thinly laminated nature of this limestone unit, as shown in the photograph, is typical. The hammer is twelve inches long.

PHOTOGRAPH No. 14

View of the southern end of the Cape Anguille Mountains north of Codroy Village. Photograph is taken looking across break water from Codroy Island. Strata of the Snakes Bight formation outcrop along the shoreline where the break water joins the mainland. Elevation of the point indicated by arrow is 1000 feet.

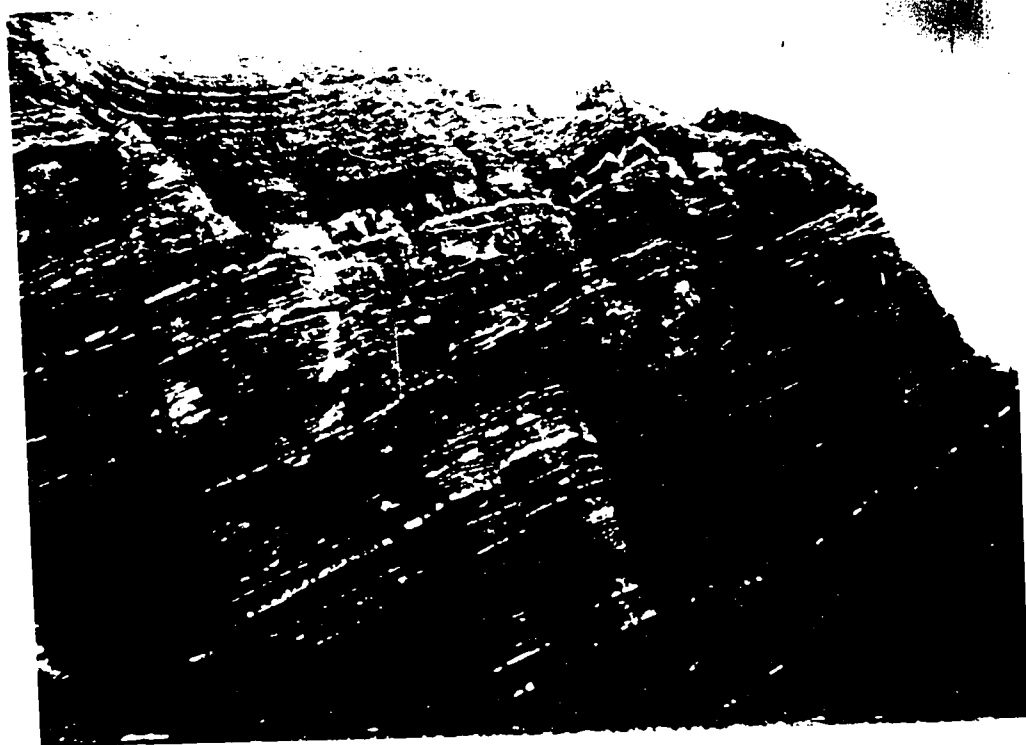


PHOTOGRAPH No. 15

Contact between Cape John formation and overlying Snakes Bight formation at Grebes Head. The contact, shown by arrows, is very sharp and conformable. The underlying Cape John formation is comprised of greenish grey and red-brown siltstones, thickly bedded, while the overlying Snakes Bight sequence is dark grey to black, thinly bedded siltstones and shales. The cliffs rise abruptly from the sea and attain a height of over 200 feet.

PHOTOGRAPH No. 16

Cliff exposure of Snakes Bight formation at Snakes Bight Cove. Note the extremely evenly bedded nature of the sequence displaced by minor vertical faults. The pale grey beds are very dense calcareous siltstone, while the darker beds are essentially thinly laminated dark grey silty shales and sandstones. The cliff is about 250 feet high.

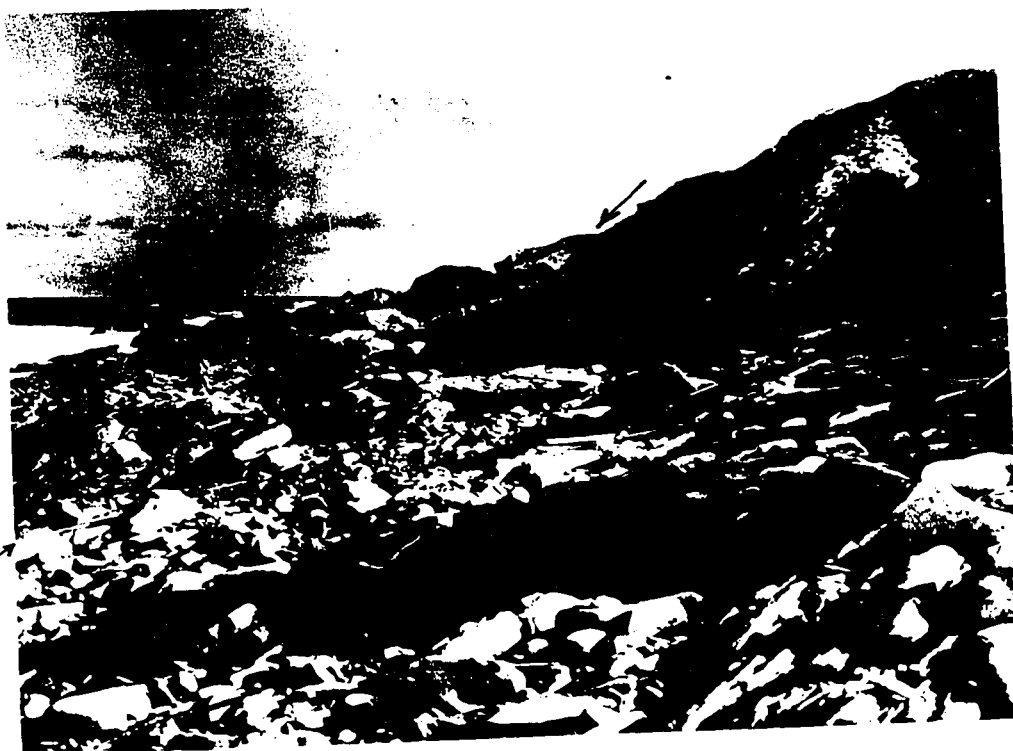


PHOTOGRAPH No. 17

Thinly laminated dark grey brittle siltstones of the Snakes Bight formation exposed on the seacoast immediately south of the Cape Anguille lighthouse. The extremely even and thin laminations are characteristic of the Snakes Bight succession. The hammer is twelve inches long.

PHOTOGRAPH No. 18

Contact between Seacliffs formation and underlying Snakes Bight formation south of Cape Anguille lighthouse. The conformable contact is shown by arrows. The Seacliffs beds are coarse grey sandstone with minor conglomerate lenses, while the underlying Snakes Bight strata is dark grey, thinly bedded, fine grained siltstones.



PHOTOGRAPH No. 19

Chaotic conglomerate in the Seacliffs formation at Cape Anguille immediately north of the Cape Anguille lighthouse. Fragments vary in size from 1/8" to 6" in largest dimension and the composition of pebbles is as follows: 50% white quartz, 15% pale grey Ordovician limestone, 10% grey quartzite, 5% grey anorthosite, 5% red rhyolite, 5% black volcanics, 5% reddish grey sandstone and 5% pink granite. Similar conglomerates outcrop in Lewis Gulch some 22 miles east of Cape Anguille. The matrix is medium grained, grey, micaceous, and very feldspathic sandstone.

PHOTOGRAPH No. 20

Evenly bedded and ripple marked grey fine grained sandstone of the Seacliffs formation as exposed on the west shore of Codroy Island. Note thin dark grey shale interbeds.

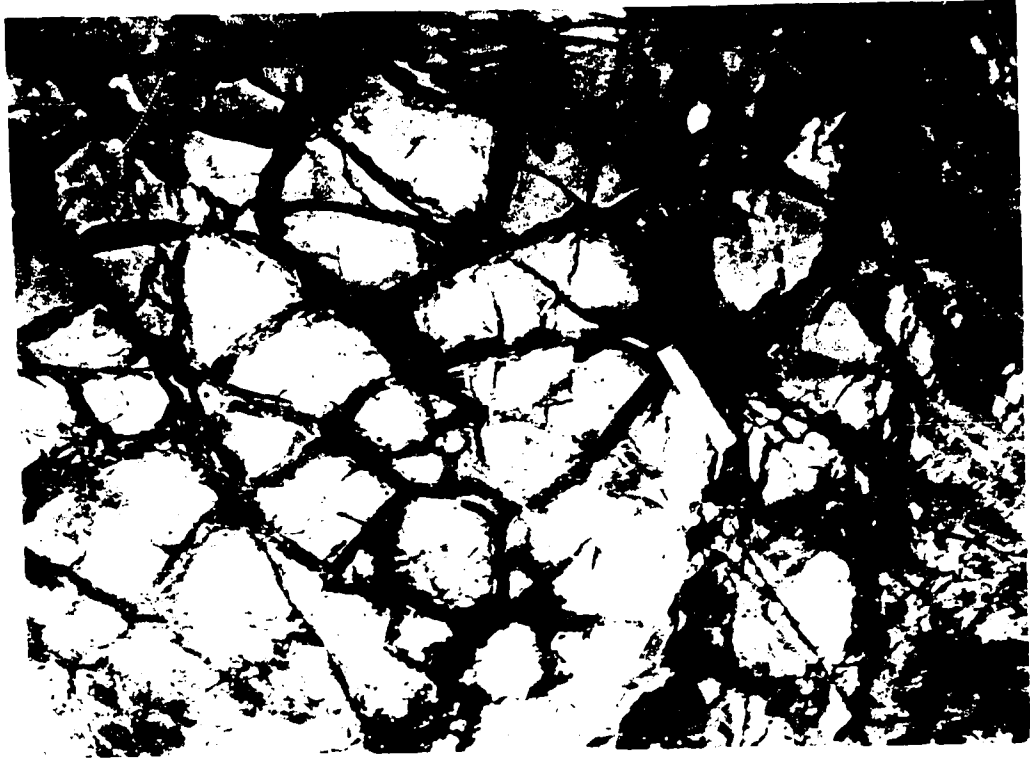


PHOTOGRAPH No. 21

Mud cracks developed on the upper surface of massive feldspathic sandstone bed within the Seacliffs sequence on the north shore of Codroy Island.

PHOTOGRAPH No. 22

Worm tubes indicated by arrows in medium to coarse grained grey sandstone of the Seacliffs formation as exposed on the western shore of Codroy Island. Note also rippled upper surface of sandstone bed.

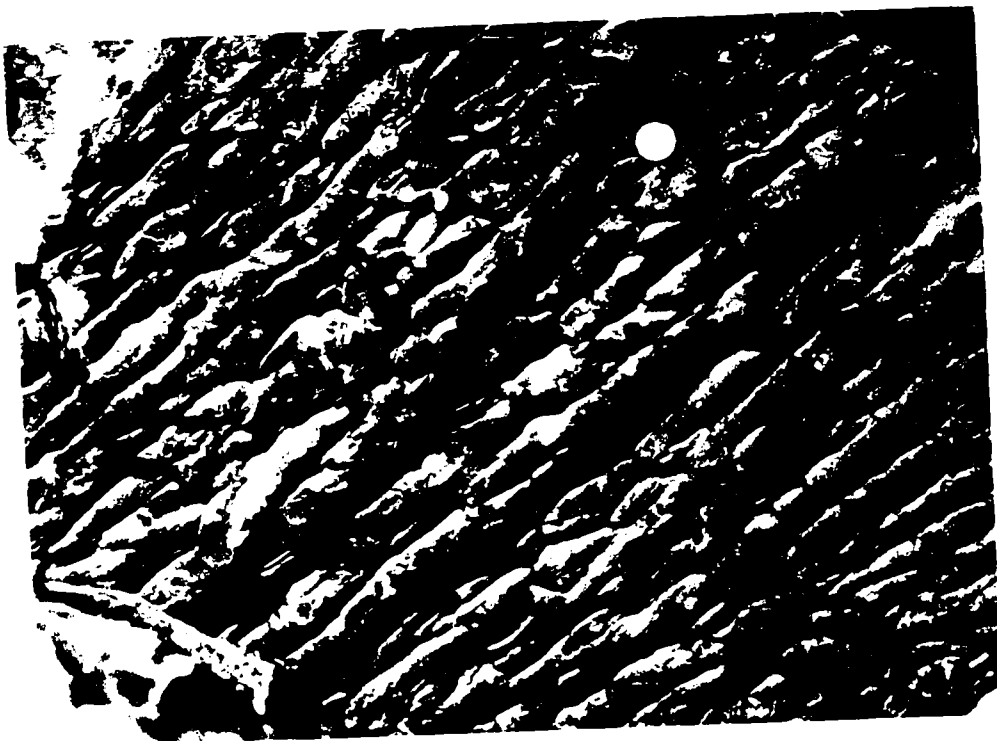


PHOTOGRAPH No. 23 .

Mud cracks in the troughs of asymmetrical ripple marks developed in sandstones of the Seacliffs formation exposed on the west shore of Codroy Island.

PHOTOGRAPH No. 24

Bottom structures from the base of a massive sandstone bed within the Snakes Bight formation. The structures are thought to be flute casts, modified by later load casting.



PHOTOGRAPH No. 25

Groove casts and minor flute casts developed on the base of a massive sandstone bed within the Snakes Bight formation. Load casts as evident in the bottom of the photograph.

PHOTOGRAPH No. 26

Bottom structures from the Snakes Bight formation. Flute casts, groove casts and possible load casts are present. Load casts appear to be superimposed upon some of the groove casts.



PHOTOGRAPH No. 27

Load casts (possibly developed on ripple marks) on the base of massive sandstone bed within the Snakes Bight formation.

PHOTOGRAPH No. 28

Ship Cove limestone as exposed on the southern tip of Codroy Island. Note extremely even and thin laminations which are characteristic of this unit. Note lithological similarity with Windsor A₁ limestone - photograph 13.

