

STRUCTURE AND SEDIMENTATION IN THE

PORT HOOD AREA, NOVA SCOTIA

By

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*Photo 12 missing
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Plate 1. Frontispiece.

Vertical "B" limestone, Point Vertical, Hood Island

Nova Scotia.

TABLE OF CONTENTS

	<u>Page</u>
<u>Introduction</u>	
Location and area	1
Previous Work	2
Purpose	3
Acknowledgements	4
Method of Work	4
<u>Physiography</u>	5
<u>Stratigraphy</u>	6
Mississippian	12
Mabou Formation (Pennsylvanian?)	23
Pennsylvanian	26
Port Hood Formation	26
Interpretation and Tectonic significance	34
Inverness Formation	34
<u>Structure</u>	38
Tectonic History and Processes	42
Summary	45
Silica Sand	46
<u>Bibliography</u>	47

LIST OF ILLUSTRATIONS

- Map I Port Hood Area
- Map II Summary of Mabou Mines
- Figure I Correlation Chart
- Plate 1. Frontispiece - Vertical Windsor beds on Hood Island
- " 2A Overtured Pennsylvanian strata. Ragged Point
 - 2B Cross-bedding in Pennsylvanian sandstone
 - " 3A Ripple-marks in Red siltstone
 - 3B Mudcracks in fine sandstone near Colindale
 - " 4A Fracture in Pennsylvanian sandstone north of Mill Cove
 - 4B Contortions in Gypsum north of Colindale
 - " 5A Prostrate Carbonized Cordaites, near Harbour View
 - " 5B Ferruginous nodules in sandstone
 - " 6A Windsor Conglomerate near Cape Susan
 - 6B Deformation of Red beds, Cape Susan
 - " 7A Penecontemporaneous deformation in sandstone
 - 7B Shoreline southend of fault, Cape Susan
 - " 8A Small drag fold near fault, Hood Island
 - 8B Conglomerate at base of Inverness formation, Hood Island
 - " 9A Unconformity, Hood Island
 - 9B Columnar algal structure, Hood Island

List of Illustrations - Continued

- Plate 10A Major Fault, north of Coal Mine Point
10B " " south of Finlay Point
" 11A Korst Topography
11B Fault in Inverness Formation
" 12A Quartzite
12B Horton-Windsor unconformity, Mabou Mines
" 13 Correlation Chart
" 14 Contorted Ostracod limestones, Mabou Mines

Introduction

Location and Area

The area under consideration lies in Inverness County on the west coast of Cape Breton Island between $61^{\circ}25'$ and $61^{\circ}35'$ west longitude, the 46° parallel of north latitude passing roughly through the center of the map area. It is triangular in shape, and embraces an area of roughly thirty-five square miles. The Inverness branch of the Canadian National Railways passes through Port Hood and forms the eastern boundary as it follows the course of the S.W. Mabou River from the S.W. Mabou Post Office to Mabou Village. The northern and western boundaries are determined respectively by Mabou Inlet, a large tidal estuary, and the Gulf of St. Lawrence.

The Northwest coast of Cape Breton offers few protected harbors and frequent and costly dredging operations would be necessary to permit other than small craft to dock and load at any part of the area due to the movement of sands along the coast. At the time the aerial photographs of the area were taken, the sand appeared to be moving northward, north of the southern tip of Hood Island, and southward to the south as indicated by the offshore bars in shallow water. However, this may be only a seasonal phenomenon.

The principal industries are fishing and farming with the tourist trade gaining some impetus. Some coal is now being mined, primarily for local use, but commercial operation ceased in 1940. Interest has apparently been renewed, and plans were being made for further mining in the vicinity of Harbor View at the time of this writing. Due to the seasonal restrictions on farming and fishing, the opening of new workings would provide a much needed steady winter occupation.

A study was also made of the Mabou Mines area, a coastal strip on the Gulf of St. Lawrence, two and one-half miles north of the Mabou Inlet, where small scale mining operations are being carried out. A separate map (Map 2) accompanies this report.

Previous Work

The area was studied by Hugh Fletcher in the years 1880-1882, the results incorporated in the Report of Progress, 1882-84 of the C.G.S., the work being primarily of a reconnaissance nature. Several of his stratigraphic sections were valuable to the author in studying the stratigraphic sequence.

Drs. Trask and Mather studied this, and adjacent areas during the summer of 1925 under the auspices of the Gulf Oil Corporation, and their preliminary report appears in the Annual Report on the Mines, 1928, of the Department of Public Works and Mines.

In 1927-1929, G. D. H. Norman studied the Lake Ainslee Area, including Port Hood and Mabou Mines. His stratigraphic classification agrees with that of W. A. Bell and is adopted in this report.

The latest published reports are those on the Port Hood and Mabou Mines Coal Areas by G. Vibert Douglas, Professor of Geology, Dalhousie University, Halifax; his concise reports and correlation of the drill holes in the area effectively summarizing the economic prospects of it.

Dr. D. J. MacNeill of St. Francis Xavier University in Antigonish, as well as Drs. R. R. Shrock, W. L. Whitehead, and J. A. Shimer, all of M.I.T. have also studied the area, but the detailed results are apparently unpublished.

All references will be included in the Bibliography at the end of this paper.

Purpose

The purpose of this study was to make observations which would afford a basis for the interpretation of the nature of sedimentation and of deformation in this area, as well as the inter-relation between these two processes. It is also desired to illustrate the assistance lent by photogrammetry to the interpretation of the surface geology.

Acknowledgements

The author owes a debt of gratitude to the members of the Nova Scotia Research Foundation for the privilege of carrying out the field work under their auspices as well as for their cheerful assistance in every phase of the work. This is extended to all others of our Canadian friends who have contributed to the successful operation of the Nova Scotia Center for Geological Sciences at Antigonish. The project was outlined by Dr. D. J. MacNeil and Dr. W. L. Whitehead, to whose direction any ultimate value of this work may be attributed.

The work was greatly facilitated by the suggestions and criticisms of various members of the M.I.T. Geology Department, and the field work was rendered pleasant by the company of M. Stacy with whom the author occupied the field camp at Southwest Mabou.

Finally, the writer is indebted to the citizens of Port Hood and the surrounding area for their kindness and cooperation during the summer field season of 1950.

Method of Work

The field work was carried out in the summer of 1950 from a two-man field camp near the Southwest Mabou Post-office which served as a base of operations. Field mapping was accomplished by direct overlay from vertical aerial photographs, base points established at prominent topographic or man-made features. Traverses using Brunton compass and tape

or pace were run in streams and along shorelines, then tied in to the base points.

Topographic features such as scarps, ridges, and karst topography were plotted on the maps, following which surface investigations of the critical areas were made. Final mapping was accomplished by plotting from the photographs by the radial line method, the base point taken near the geometric center of the area. Although some inaccuracy results from such a method, the result is more than sufficiently accurate for geological mapping.

Laboratory work on the specimens taken consisted primarily of the preparation and microscopic examination of thin sections during the school year 1950-51.

All photographs which appear in this report were taken and processed by the author.

Physiography

The topography is an extremely important factor in the interpretation of the geology of this area as most of it is covered by a veneer of glacial till from ten to fifty feet in thickness. Outcrops are relatively scarce, exposures located in streambeds and along shorelines where erosion has denuded the underlying rock. Even where the beds are exposed, the exposure is often insufficient to permit accurate correlation, and topographic features present the sole evidence for solution of the problem.

Differential erosion is the key to topographical analysis in the area for the nature of the underlying rock is indicated by the extent of erosion which appears to be second cycle at present. The first cycle is represented by that which caused the upper surface of the crystalline Mabou Highlands which rise to over 1000' immediately north of the map-area to appear as a peneplain from a distance, whereas it is actually deeply incised by the second cycle.

Lower Mississippian (Horton) rocks have been nearly as resistant to erosion as have the pre-Carboniferous crystalline complex and on the north side of the Mabou Inlet there is little distinct lineation between these. The upper Mississippian (Windsor), composed primarily of red shales and siltstones, limestones, and gypsum as well as salt, is much less resistant to erosion and the contact with the Horton is quite distinct both along the north side of Mabou Inlet and in the vicinity of Mabou Mines. It may be traced quite precisely from the lineation exhibited on the aerial photographs. The unconformable contact traced from the photos was found to coincide precisely with exposures located on the ground.

Where gypsum forms the underlier, its presence is usually indicated by karst topography (Plate 11-A) which locates the trace of the bed upon the surface. Drainage too is strongly affected by underlying gypsum, and streams are often diverted or flow underground where they transect the bed. This well shown north of Finlay Point near Mabou Mines where Mill Brook

turns abruptly southward to follow the trend of the gypsum and in the brooks north of Colindale where the westward flowing brooks lose their identity near the shoreline where they encounter gypsum.

The areas underlain by Mabou and Pennsylvanian beds strongly reflect the effect of differential erosion. Distinct ridges of resistant sand and siltstone separate valleys underlain by less resistant rock. Seven distinct ridges may be observed along a roughly northeast line from the shoreline at Port Hood to the southern shore of Mabou Inlet (see Map 1 where these ridges have been plotted on the map from the aerial photographs). The most northeasterly pair are resistant shales and siltstones of the Mabou formation. The highest points in the map area are two knobs which rise to an elevation of 450 feet, both of which form the termination of sandstone ridges, near an area of deformation. One of these is located west of the Hunter Road, one and one-half miles north of the Southwest Mabou Postoffice and appears to be the termination of the lowest Pennsylvanian sandstone; the other is located near Rocky Ridge. The northern portion of the sandstone ridges terminates southward at Little River, which has cut a channel across them perpendicular to the strike, but those nearest the shoreline, the highest members, are again visible between Harbor View and Cape Susan. Where these ridges intersect the shoreline, the sandstone members project into the gulf as small hooks, forming in some places leeward sand-bars.

From Cape Susan northward, the shoreline nearly parallels the strike of the strata until the measures are concealed at the sandspit which projects more than one-quarter of a mile west of the original slope at Port Hood. The sea has eroded two indentations into the coastline from the sandspit to Isthmus Point, the highest sandstones at the base of the Government wharf and at Isthmus point apparently having shielded the underlying shales from erosion by the sea. Isthmus Point was at one time connected to Portsmouth Point on Hood Island by a sandbar, but three quarters of a mile of shallow water now lies between the two. The shoreline from Isthmus Point to the fault north of Colindale contains only two major indentations, Mill Cove, eroded from soft shales by the action of the sea and the small stream which flows into it, and Southerland's cove, where fine sand forms a barrier beach before a shallow lagoon. Neither of these provide good harborage, unprotected as they are from northwesterly storms.

The Southwest Mabou River follows a northeasterly course on the eastern margin of the area, and in general, follows the strike of the rock through which it has cut. Rocky Ridge forms the divide for the northern part of the area, streams on the western side flowing northwest parallel to the strike, and those to the east, flowing easterly across the strike. These, and little rivers to the south are believed to be consequent streams which have cut across the beds by

headward erosion, there being little evidence in the area for post-glacial uplift and concomitant superimposed drainage.

Hood Island is two and one-quarter miles long and roughly one mile wide at its widest point in an east-west direction. The north and west shores are rugged, with narrow beaches which appear to be undergoing more rapid erosion than the eastern and southeastern shores whose beaches are wider and apparently more sheltered from storm-action. Here too the topographical effects of differential erosion are prominent. A minor erosional scarp crosses the center of the island in a northwest-southeast direction where a resistant bed of conglomeratic arkose is truncated exposing the underlying red mud and siltstones to weathering. Resistant limestone beds standing vertically project into the water on either side of Point Vertical (see frontispiece) on the northwest corner of the island, and the presence of thick beds of gypsum are indicated by a lineation of karst topography which crosses the point.

Stratigraphy

General statement

The strata of the Port Hood area belongs to the Carboniferous system and the nomenclature of Norman (1935) corroborated by Bell (1944) is used in the table below.

Period or Epoch	Approximate Formation and Thickness	Location	Lithology
Pleistocene	Glacial Till 10-50'	Widespread	
Unconformity			
Upper Pennsylvania	Inverness (Pictou) 2000+	Hood Island	Dark red shale Ls. conglomerate
	2500+	Henry Island	Red ss, arkose and pebble conglomerate, coal.
Unconformity			
Lower Pennsylvanian	Port Hood (Rivesdale) 4000+	Port Hood	Grey and red arkosic ss, red and grey shale limey conglomerate coal, clay.

<u>Period or Epoch</u>	<u>Approximate Formation and Thickness</u>	<u>Location</u>	<u>Lithology</u>
<u>Disconformity</u>			
P. Miss-L. Penn.	Mabou (Canso) 700±	Mainland	Grey and red ss grey and red shale thin ss.
U. Miss.	Upper Windsor 1100±	Hood Island and mainland	Red and grey shale gypsum and anhydrite Thin red ss. Ls. Dolomite
<u>Unconformity</u>			
Lower Miss.	Horton Lower Windsor 1100±	" and Mabou Mines Mabou Mines, N. side Mabou Inlet	Ss. and conglomerate

Upper Mississippian (Windsor Group).

The Windsor Group receives its name from the type locality at Windsor, Nova Scotia, where over 1550 feet of strata have been measured. It contains workable deposits of gypsum, an example in this area being the quarry on the north side of Mabou Inlet which has discontinued operations. The base of the Windsor is identified by the "laminated limestone" which is widespread in occurrence throughout Nova Scotia. Although it appears on the north side of Mabou Inlet, it was not located elsewhere within the map area. At Mabou Mines, however, several excellent exposures may be observed where it rests with marked angular unconformity upon the Horton Strata. (Plate 12B.) The specimen studied microscopically came from the unconformity at Mabou Mines near the McDonald Glen schoolhouse, but in this area it lacks the characteristic dove-grey color.

Megascopeic: Unfossiliferous, light tan, fine grained crystalline limestone.

Microscopic: Brecciated appearance with light tan "fragments" in a calcareous, iron-stained matrix which contains much fine angular detrital quartz. Matrix comprises 25% of the rock.

Interpretation: Shallow marine precipitated limestone which has undergone penecontemporaneous deformation.

Approximately 1800 feet of Windsor Strata outcrop on Hood Island in an essentially unbroken succession and the strata here are considered the type section for the area although neither

the top nor the bottom is present, the lower strata faulted out and the upper concealed under the Gulf of St. Lawrence. The various strata on Hood Island were studied for distinctive features which would aid in correlation of the Windsor on the mainland. The following chart represents the generalized section with letters assigned to the various members in descending order. Measurements are approximate.

B1. Dolomitic, Buff Limestone approximately 40 feet thick. Upper portion massive about 20 feet thick, lower portion oolitic, brown, sometimes cross-bedded with dolomitized shells which Norman (Norman, 1935 p. 40) refers to the genus *Schizodus*.

Red shale and sand 315'

B2. Yellow, crystalline limestone. Two feet.

Gypsum 6'.

B3. Yellow crystalline limestone 2'.

Red shale 25'.

Gypsum 8'.

Measures concealed 30'.

B4. Partly dolomitized grey limestone approximately 15' thick. Contains large bed of brachiopods identified as *Martinia Galatea* and *Composita (obligata)*. The top of this bed is characterized by coarse ripple-marking.

Red shale veined with gypsum 215'.

C. Columnar Algal. Limestone biostrome characterized by large gray conical algal structures expanding toward the top. These columns are surrounded by a yellowish argillaceous limestone. On Hood Island, these columns make an angle of 65 degrees with the bedding indicating that there has been differential movement between the upper and lower beds during folding. The beds are vertical, with a north-south strike, the attitude of the columns indicating that the western, upper bed has moved northward (Plate 9b).

- D. A badly brecciated red and black limestone, which is 4' thick at the outcrop although possibly thicker, included in 180' of red shale.

Gypsum 12'.

- E. Small algal. Black oolitic limestone containing *Martinia Galatea* with an algal band near the top of the bed consisting of cone in cone structure. Weathers yellow and black near the top. 13'.

Base of upper Windsor.

Red and greenish shales with gypsum veining.

- F. First oolitic limestone. Black oolitic showing crossbedding. 16'

Red shales and mudstone 158'.

Gypsum 6'

- G. Second oolitic. Tan grey, 13' shows crossbedding and small algal structures near the top.

Disturbed red and grey siltstone and gypsum 600 ft. to the fault on Hood Island.

- H. The canary limestone. Does not appear in the map area.

Gypsum 200'.

- I. The Ribbon limestone. Described above.

Megascopeic and microscopeic study of the limestones in the Port Hood area, including the north side of Mabou Inlet indicates that correlation by the use of megascopeic sedimentational features such as algal tops etc. is quite valid for correlation purposes, but that microscopeic features vary so greatly within each member that thin-section study is not a great aid to correlation. A more thorough determination of the microfossil content, especially to the abundant foraminifera, may prove extremely valuable to correlation however. In the

following description of Windsor exposures, the microscopic as well as the megascopic description is given.

Ragged Point.

At Ragged Point, south of Port Hood, the upper Windsor is in faulted contact with overturned Pennsylvania Strata of the Port Hood formation. The section in descending order:

Mabou boundary determined at bottom of thin limestone bed, but no fossils were observed.

Lithology	Thickness in feet
Red Shale	5'
Black gypsum and anhydrite	15
Red shales veined with satinspar. Highly deformed	210
Black gypsum and anhydrite	15
Red Shale	10
Measures concealed	30
Gypsum with selenite	25
Measures concealed	30
B limestone (Schizodus dolomite)	41
Red shale with limey layers	100
Gypsum and anhydrite, highly contorted (black)	10
Red and greenish grey mudstone and shale veined with satinspar	30
Gypsum (Black)	10
Shale and mudstone	23
Fault	
Pennsylvanian	
	Total 574'

The Pennsylvanian is a buff colored calcareous sandstone which has suffered brecciation. Thin sections were made of several fragments to determine if fragments of limestone were present.

Spec. R1. Megascopic: Described above.
Microscopic: Angular fragments of quartz (30%) orthoclase and plagioclase feldspar (15%) in a calcitic matrix. Euhedral rhombs of dolomite comprise about 20% of the specimen studied and exhibit authigenic zoning. They are found in

Spec. R1. particularly ferruginous areas. Some biotite is present. Laths of secondary carbonate are present in one area of a section. The feldspars are fresh and angular. Fracture fillings of calcite. Interpretation: The rock was weakened and fractured by the adjacent faulting. Carbonates from the Windsor limestones was introduced by circulating ground waters and redeposited in the porous sandstone.

A specimen of the B dolomite was also studied.

Spec. R3A. Bottom, oolitic portion of the Schizodus dolomite. Megascopic: Buff colored, equigranular finely crystalline dolomite. Microscopic: Shadows of oolites remain outlined in iron stain. Scattered fine angular fragments of quartz. Interpretation: The limestone was deposited in shallow water which moved sufficiently to permit the oolites to form. Secondary dolomitization partially destroyed the oolitic structure, the ghosts of which remain.

Section at Cape Susan.

A mile and one-quarter south of Ragged Point, where the southern extension of the fault apparently goes out to sea, a small section of the upper Windsor is exposed with the B limestone apparently forming the uppermost member. Neither of the black gypsum beds are present above this bed and the highly contorted overlying beds are not gypsiferous (Plate 6B). What is interpreted to be an intraformational conglomerate consisting of rounded fragments of oolite in a calcareous matrix appears to lie below the B limestone (Plate 6A). The section is given below, the top of the section placed arbitrarily at the base of a grey, micaceous shale apparently of fluvio-lacustrine origin. Thin sections of the various limestones were studied. The specimen numbers are presented in the section.

Spec. No.	Lithology	Thickness in feet
	Hard fine-grained reddish limestone with poorly preserved shells indicating tops to the east	16'
	Measures concealed	20
5Q	Conglomerate composed of sub-angular fragments of limestone up to two inches in length. The matrix is calcareous and of a purplish color, the fragments vary from red to blue.	4.5
r	Red shales	75
L7	Gypsum Limestone. Yellow, highly fractured Gypsum	18 3 18
L4	Limestone. Strike N20E, 80W Overturned. Contains the Brachiopod Composita. Upper portion oolitic. Bottom ripplemarked. Pinkish color. Red shale and Mudstone	10 60
L9.	Yellow Limestone. Highly fractured Red shale and mudstone	6
L11- L12	Yellow limestone. Oolitic and highly weathered. Poorly preserved shell- fragments.	4
	Measures Concealed	15
L13.	Yellow limestone. High on bank. Poor exposure	10
	Measures concealed to fault	100
Total		259.5

This section is correlated with the highest B zone
exposed on Hood Island.

Microscopic examination of specimens:

- Spec. L15. Ferruginous oolitic limestone with elongated oolites. Some are flattened and have "vuggy" centers lined with fine calcite crystals. The oolites have a shadowy radiate crystal pattern. Calcite veining.
- Spec. L9 Coarse oolitic limestone, the oolites brown in a white calcitic matrix. Shell fragments form nuclei for some of the oolites. Many are fragmented and others have yielded plastically to follow the contour of adjacent shell fragments. The flat oolites lie statistically parallel to the bedding. The carbonaceous material is concentrated in concentric rings within the oolites and along planes roughly parallel to the bedding. Calcite veining.
Interpretation: Deformation has caused some recrystallization and fracture. Calcite veins derived from the filling fractures. Carbonaceous material formed films on the concentric laminae of the oolites and on the surface of deposition. Not secondarily introduced.
- L7 Partially dolomitized, equigrained, finely crystalline limestone with ghosts of the oolitic structure remaining. Scattered rhombs of dolomite, many solution cavities lined with calcite crystals.
Interpretation: Slight secondary dolomitization and much weathering.
- L4 Highly foraminiferal, coarsely oolitic with many large echinoderm fragments forming the nuclei of the oolites. Some of the forams resemble the genus *Endothyra* although the tests were not determined as arenaceous. The rock has a fragmentary appearance, the fragments foraminiferal and what appears to be a matrix fossil-free.
Interpretation. Foraminiferal muds disturbed, then reconsolidated on the sea bottom.
- L13 Fine-grained limestone, containing ostracods (*Paraparchites*) and some foraminifera. Small fragments of detrital quartz and some of feldspar. Some secondary fillings of quartz.
Interpretation: Shallow water, possibly brackish environment. Secondary introduction of quartz.
- 5Q Fragments of fine-grained crystalline and others of coarsely oolitic dolomitized ferruginous limestone. Many of the fragments are highly foraminiferal, and many perforated echinoderm

fragments are present. The coarsely crystalline calcitic matrix contains much fine-grained quartz.

This is interpreted as an intraformational conglomerate (Shrock, *Seq.* p. 69) formed in shallow water. Very possibly by storm action. However, if due to the extreme deformation in this area, the now apparently overlying limestone is in reversed stratigraphic position with respect to the conglomerate, the conglomerate may actually be representative of the base of the Mabou at this location.

The shoreline southwest of Mabou Inlet.

Along the shoreline on the mainland southwest of Mabou Inlet, the Windsor is highly contorted where it is in faulted contact with arkosic sandstone of the Port Hood formation. The strata on both sides of the fault are highly fractured with a brecciated yellow limestone approximately 6 feet thick and striking parallel to the sandstone appearing at the contact. Limestones identified as the C and E appear in an overturned position immediately north of the fault, but assume more normal dips further up the coast. Both are overlain by gypsum. Approximately 150 feet of red shale and gypsum lie between them, the extreme distortion (Plate 4B) making more accurate measurement impossible. The algal structure of the C limestone is quite apparent making identification certain although these limestones have a much higher carbonaceous content than do those on Hood Island. Streaks of asphaltic matter were observed in vugs in the gypsum and the presence of petroleum in the limestones is evidenced by the strong smell when certain of them are crushed with a hammer.

What was tentatively identified as the B limestone appears in the second brook past Colindale, but the identification is uncertain. However, this horizon was observed on the south shore of Mabou Inlet where it is apparently continuous with the strike along the shore section. The extreme contortion of the limestones due both to faulting and to slumping in the vicinity of the gypsum make the thickness of this section uncertain, and there is evidence of some duplication of the beds along the shoreline by step faulting.

Mabou Inlet

The C and E limestones again appear on the north shore of Mabou inlet where they form the southeast limb of the synclinal structure in which the gypsum quarry is located. The exposures in this area are highly disturbed, but this is common in the immediate vicinity of gypsum. The F and G oolitic limestones outcrop to the east of these near the second inlet east of the mouth of Mabou Inlet where they are structurally conformable to the large syncline which is the major structural feature of the area. Although the more important Windsor Horizons appear along the shores of Mabou Inlet, lack of exposures and extreme deformation prevent an accurate measurement of the section. Norman (Norman, 1935, p. 35) has estimated a thickness of 1400 feet of the lower Windsor from the I or Ribbon Limestone which appears in a brook to the east of the quarry. A thick bed of gypsum (probably

the same as that which forms the base of the Windsor on Hood Island) apparently overlies the Ribbon limestone both here and at Mabou Mines. The gypsum is estimated to have a thickness of approximately 300 ft. in both locations, but this thickness may be high due to plastic deformation, and there is a high probability that the gypsum beds which occur with the C and E limestones are contributing to this thickness. These beds occur in the immediate vicinity, but the determination of their attitude is hindered by the high degree of deformation. Gypsum beds can hardly be used for precise correlation in the area, first, because they appear to be of localized deposition, and secondly because of their plasticity under stress which can cause either a thickening or a pinch-out of the beds due to deformation.

The upper Windsor appears on the south side of the Inlet, the B limestone providing an important marker horizon from which the structure can be inferred. Behind the church at Mabou Village, the B limestone is overturned with tops toward the north and although the exact attitude of the limestone beds which outcrop along a curved strike line to the northeast could not be determined, it is believed that they form the northeast limb of minor anticline, breached by the Mabou inlet.

Allan Brook

The upper Windsor appears in Allan Brook, southwest of Mabou Village, where the B limestone forms an asymmetrical syncline with an underlying black oolitic limestone identified as the B2 apparently conforming to this structure.

Thin sections of the various limestones encountered were made, both for the determination of sedimentary features as well as to confirm megascopic correlation. Representative specimens are described below.

Spec. 4C B limestone south of Mabou Inlet.

Megascopic: Dark brown oolite.

Microscopic: Fractured oolites, petroleum forming concentric rings among the laminae in the oolites and in streaks parallel to bedding planes. Rhombs of dolomite transect the oolites, the surfaces of which are often ragged. Petroleum and iron oxide stain forms rims around the dolomite rhombs. Some of the oolites have nuclei of long (0.01") five chambered foraminifera.

Spec. 4E Continuation of B limestone south of Mabou Inlet.

Microscopic: Oolitic, with same features as above, but with many echinoderm spines, some of which form the nuclei of oolites.

Spec. 4L Last outcrop upstream in Allen's Brook. Correlated with B4 and overlain by gypsum.

Megascopic: Vuggy, coarsely oolitic black limestone containing many brachiopod shell fragments.

Microscopic: Echinoderm spines form the matrixes for many of the oolites, many of which exhibit concentric rims of petroleum. Clear calcite matrix.

Spec 2A Coastline southwest of Mabou Inlet. Bottom of C.

Megascopic: Black, competent coarse oolitic limestone with a strong petroliferous odor.

Spec 2A Microscopic: Oolites are brown, in a light
cont. calcitic matrix. Some are flattened, others
elongate due to the presence of echinoderm
spines as nuclei. Partial dolomitization
shown by occasional rhombs of dolomite in the
matrix. Petroliferous bands presenting a
stylolitic appearance parallel the bedding
(especially where the oolites have eroded edges)
and are concentrated in zones of fracture.

The descriptions above indicate the general character of the microscopic features of the Windsor limestones in this area, and these were repeated with little variation in the many sections studied. The limestones are all of marine origin, probably deposited in a shallow water environment as is indicated by the prevalence of cross-bedded oolitic structure. That the water became more shallow after deposition of the limestones is indicated by the presence of gypsum directly overlying some of the members, apparently a result of precipitation of sulfate due to an increase in its concentration due to evaporation. The extensive dolomitization observed also is construed as strengthening the hypothesis of deposition in shallow warm marine waters. The Windsor in this area is interpreted as the product of widespread shallow seas in which gentle warping initiated the limestone, gypsum, shale sequence. It is considered the final stage of a geosynclinal cycle.

The Mabou Formation (Canso).

The Mabou strata overlie the Windsor in this area with minor unconformity and form a band between the Windsor

and the overlying Riversdale (Port Hood) beds. The Mabou strata have been placed in the Lower Carboniferous, the Canso group by Bell (Bell, 1944, p. 5) and correlated with the type section along the straits of Canso. Norman (Norman 1935 p. 43,44) measured a total thickness of 2900 feet along the Southwest Mabou River, the basal contact concealed but with not more than an additional 100 feet believed to be present. This section is south of the map-area, and the thickness represented in the map area is believed to be less. The lower contact is placed in a calcareous shale with interbeds of grey, botryoidal limestone which weathers yellow and is believed to be of algal origin. This contact is exposed in the railroad cut north of the trestle over Campbell's Brook and is also exposed in Allan Brook 900 feet upstream from the overturned B limestone. At this point, limestones are intercalated in red shales, seven of them over one foot thick with many thinner beds of the same material between.

At Cape Susan, the top of the Windsor is placed at the bottom of a micaceous grey shale which directly overlies the B limestone. This is followed by over 100 feet of reddish shales which are highly contorted and faulted. The measures are then concealed to Cape Susan where a bed of grey arkosic sandstone containing coalified plant fragments is overlain by a bed of reddish limey pebble and shale conglomerate...a lithologic feature conspicuously missing from the descriptions of the Mabou presented by previous authors.

Although no unconformable contacts of the Mabou on the Windsor were observed in the map area, the fact that Mabou sediments are found overlying different horizons of the Windsor in various areas and that structural contours indicate a thinning of these beds at some contacts indicates a period of non deposition or of erosion at the end of Windsor time.

Although paleontological differences both in Flora and fauna between the Mabou and the Riversdale groups (and the Mabou and Port Hood Formations) (Bell, 1944, p. 9) have been noted, such as the first appearance of *Niadites* of the *Modiolaris* group in the Riversdale, usable fossil evidence near the contacts in the map-area is insufficient to define the precise upper boundary. The top in this area has been defined upon a lithological basis as that point where the argillaceous grey and red shales with intercalated thin sandstones and limestones give way to the massive coal-bearing arkoses of the Riversdale. However, due to the lensing observed in such sandstones, this boundary is liable to be quite inexact.

Drs. W. L. Whitehead and J. A. Shimer computed from accurate surveying a thickness of 600 feet of Mabou strata in Campbell's Brook, the base at the previously mentioned thin algal limestone at the top of the Windsor in the railroad cut, to a coaly layer in massive arkose containing calamite fillings. This is located several hundred feet east of the Hunter Road,

and is defined as the base of the Pennsylvanian in this report. However, as Bell mentions that poorly preserved calamitean stems are fairly abundant in the Mabou group, this boundary must be observed with caution. This bed may be equivalent to the sandstone on Kate Point.

The prevalence of such features as current ripple-marking, thin argillaceous laminae, mudcracking, a lack of marine fossils and the presence of terrestrial drift fragments support the hypothesis that the Mabou is a product of fluviolacustrine deposition in a slowly downwarping area of low relief. It is regarded as the transition stage between the dominantly marine sedimentary environment conditions of the Windsor to the conditions of terrestrial basin deposition of the Pennsylvanian coal measures.

Pennsylvanian

The Port Hood Coal-Bearing formation has been placed by Paleontological evidence in the Riversdale Group of Lower Pennsylvanian age, the lowest mineable Pennsylvanian coals in Nova Scotia. In the map area these are the highest strata on the mainland, lying in a broad synclinal basin which plunges to the southwest. An estimated 3000+ feet of Riversdale sediments are exposed along the shore from Isthmus point to the surface. The highest strata are concealed under the channel between Hood Island and the mainland. The upper 1000'

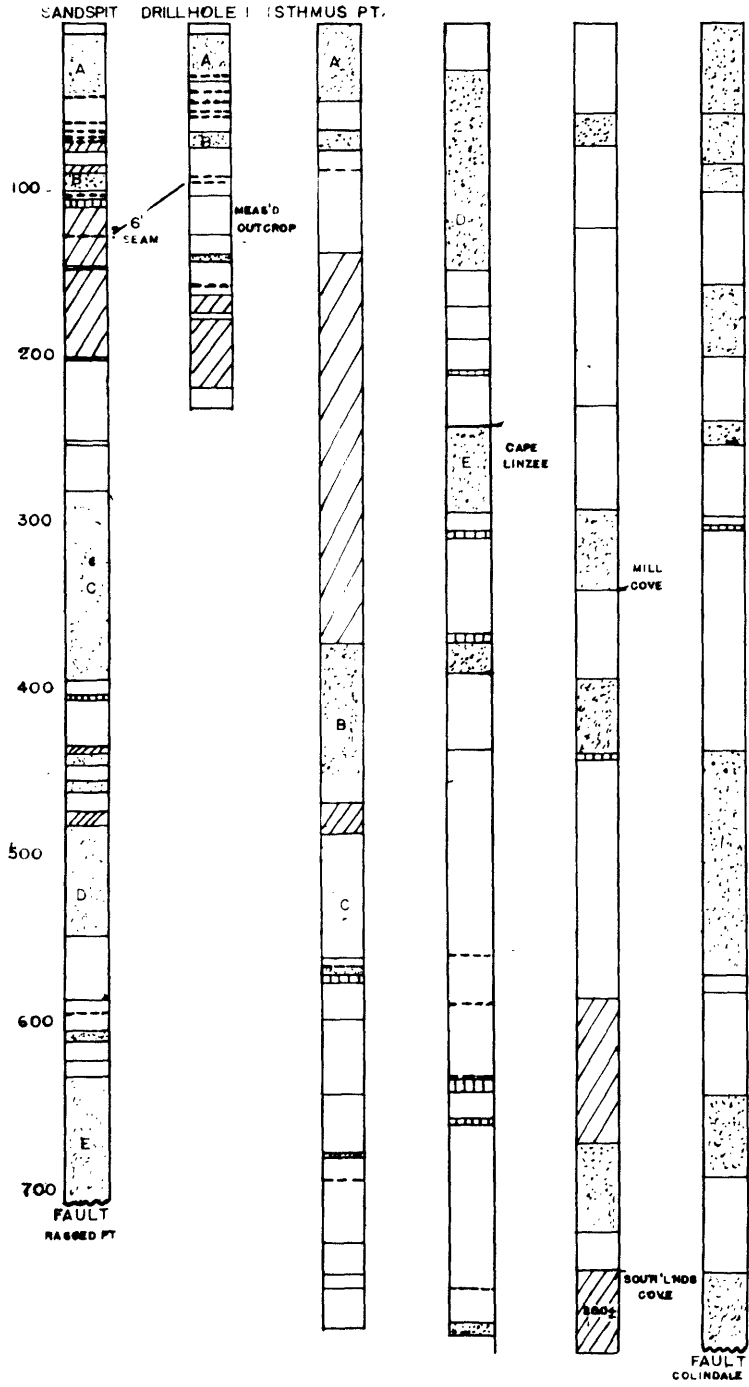
of this section is repeated in descending order from the first exposures at the sandspit north of Harbor View to Ragged Point where the Pennsylvanian is in overturned fault contact with the Windsor. The aggregate thickness of this section is approximately 700'. With minor variations, the skeleton of the graphical correlation chart (Fig. 1) is based upon Fletcher's (Fletcher, 1882-84, section H) measured sections. It graphically illustrates the author's interpretation of the correlation of the members from the use of both lithological and topographical evidence.

The sandstone adjacent to the fault at Ragged Point is essentially contemporaneous with that which outcrops at Cape Linzee. There is no expression of the strata below that exposed at Cape Linzee south of Ragged Point.

Stereoscopic examination of the aerial photographs was especially useful in the latter study, for the ridges formed by the larger and more persistent sandstone members can be followed across the countryside to their shoreline outcrops. Local lateral facies change is present; sandstones, and especially shaley conglomerate beds, were observed to lens-out within a few hundred feet of the point of maximum thickness. Correlation based upon lithology of the sandstones is questionable under these conditions, which are to be expected in a sedimentary environment in which cross-bedding and coarse to medium grain sizes in the arkoses indicate comparatively rapid movements of the water from which the

CORRELATION DIAGRAM

FIG. 1.



SS SH CALC. SH.
 COAL MEAS CONC

sediments were deposited. Raistrick and Marshall (1948, p. 26) state in this connection, "...the sandstones are most liable to vary markedly and to prove impersistent and irregular over large areas". In some cases in this area, the lithology remained essentially constant for over three miles.

The group comprises massive, medium and coarse-grained arkoses in which much cross-bedding is evident, finer grained red sandstones, dark grey and red shales, as well as many dark bituminous and calcareous bands and coal. Although several seams are present, only the six-foot seam near the top of the section has been mined commercially in the past. It is the basis for the projected operation at Harvor View. Department of Mines Drill Hole no 1. at Harbour View was completed in the summer of 1950 where it encountered the top of the 6 foot seam at 182 feet. The log of that hole is correlated with the generalized section in Fig. 1, the section immediately below added from measurement at the outcrop of the seam south of Harbour View.

The seam itself dips 35 degrees west at Harbour View and consists of two partings, the upper 1.3 and the lower 3.4 feet thick separated by 5 inches of shale. The socalled "five-foot seam" which is visible at low tide from the Fisherman's Wharf at Harbour View lies approximately 350 feet stratigraphically above the six foot seam. The

width of the surface outcrop is 4.7 feet making the true thickness approximately 3.8'. Douglas (1944) suggests on the basis of drill-hole data that the seam splits north of the Fisherman's Wharf.

Smaller seams appear below the six foot seam, some of which are being mined near the outcrop for local use. The most persistent of these are shown on the map. The extensions of those exposed in Little River outcrop between Mill Cove and Cape Linzee.

An unknown thickness of the Port Hood formation is concealed by the fault at Colindale, but at least another 1000' of strata must be added to the base on the basis of structural contours if the previously described lower boundary of the formation is accepted and no unconformity with the Mabou is present. That the Windsor was uplifted at the time of deposition of the lowest Pennsylvanian exposed southwest of the fault, is attested to by the presence of lenses of limestone conglomerate in the lower sandstones adjacent to the fault. A specimen of this is described below. In all probability, movement along or near the present fault plane proceeded during Lower Pennsylvanian time which supports the hypothesis of at least a minor unconformity of the Port Hood Formation with the Mabou.

The thickness of Port Hood sediments concealed between Hood Island and the mainland approximates another 3000' at the top of the measured section if the concealed structure is continuous. However, neither the top nor the bottom boundaries are well enough established to permit an accurate estimate of the total thickness of Riversdale sediments in the area. It is interesting, however, to note that Bell (1944) places the maximum thickness in Nova Scotia of the Riversdale group at 7000± feet.

No abrupt change in sedimentation is observed in the exposed portion of the Port Hood Formation, but rather a gradual change from barren measures with little coal to the productive measures at the top. In ascending the section from Colindale to Port Hood, the characteristics of this gradual change may be noted.

From Colindale to the south side of Mill cove, reddish, relatively barren measures predominate. Ripple-marking and mudcracking (Plate 3) are conspicuous in the lower beds, and much crossbedding and the evidence of penecontemporaneous deformation may be observed. Intercalated in the red shales are several black calcareous beds, but these are less rich in floral organic matter than are those above. Specimens of Calamites and Neuropteris were taken, but preservation was relatively poor. South of Mill Cove, a rusty arkose containing much carbonized wood may be observed and the grey to black shales become more numerous,

often occurring with thin beds of coal. Three of the seams are over 9 inches in thickness, the largest 18 inches thick. The black shales become thicker, some of the beds up to 6 feet in thickness and contain abundant fossils. From Cape Linzee to the top of the section, medium grained arkose with prominent cross-bedding (Plate 2B) predominates. There is often a shale and pebble conglomerate at the bottom of the larger members indicating that the base was a plane of rapid erosion prior to deposition of the sandstone.

In the coal-bearing strata near the top of the section a buff colored arkose is exposed from the sandspit south of Port Hood to Harbour View which contains large prostrate coalified logs, thin sections of which were identified by Dr. Boghorn of Harvard as *Cordaites*, probably *Dadoxylon*. (Plate 5A). These upper strata contain abundant fillings and impressions of *Lepidodendron*, *Stigmaria*, and *Sigillaria*. In the vicinity of the coal seams, a generalized cycle of deposition seems to prevail. The cycle is represented by the following sequence: Sandstone, underclay, coal, black shale, shale, siltstone, sandstone. In the Port Hood area the shales tend to form the roof and floor of the seams indicating that the organic material is autochthonous rather than of a drift variety. A fine-grained, bluish mudstone containing choppy cross-lamination often overlies the smaller seams and is characteristic of the upper members of the Port Hood series. The color appears to be due to the presence of finely disseminated iron sulfide.

Numerous specimens were taken of the black calcareous shales and freshwater limestones for the purpose of determining their value as marker horizons, but the flora and fauna are in general quite similar as is the lithology. Thin sections were made of representative specimens of the sandstones and black shales, several descriptions of which appear below.

Spec. 6a North of Isthmus Point.

Megascopeic: Buff colored arkose containing ferruginous nodules which stand out in relief on a weathered surface (See plate 5b for similar rock). Some of these are up to 6 inches in diameter and are highly pyritized.

Microscopic: Matrix composed of 60% sub-angular fragments of quartz, 30% weathered feldspar, many fine fragments of organic matter and perhaps 5% chlorite. The concretion contains the same minerals which are cemented with pyrite.

Others have been observed which have much the same megascopeic appearance but which have a ferruginous calcareous cement. Apparently, the decomposition of organic matter created a reducing environment with hydrogen sulfide which resulted in the formation of pyrite from the iron included in the rock.

Black shales.

Spec. 1P. In long series of black and red shales between Mill Cove and Cape Linzee.

Megascopeic: Grey calcareous shale, flexible in thin layers. Composed primarily (75%) of shell matter. Shells with radial striation. Fossils - *Estheria*, also *anthracomya* and ostracods.

Microscopic: Shells lie parallel to the bedding with brown carbonaceous matter forming a matrix. Small fragments of vitrain represent original organic detritus. Highly calcareous.

Spec. 1S. Slightly higher in the section than 1P. Bed 6' thick.

Megascopeic: Much like 1P, but of a lighter color and with abundant ostracods (up to 40% of the rock).

Microscopic: Ostracod shells are, in general filled with coarse calcite, but in some areas of the rock pyritization is more important. The replacement does not seem selective, for some of the shells are replaced by pyrite leaving the calcite core intact, in others, only the core is replaced, and all gradations between the two may be observed. Fine pyrite is disseminated throughout the rock.

Spec. 4V. Little River, near the first bridge east of the main road.

Megascopeic. Grey limey shale with much laminated shell matter and many ostracods.

Microscopic. The laminated shell matter is highly contorted, but individual layers are parallel. This is taken to indicate plastic deformation after consolidation. A scaphopod shell showing twisted external longitudinal ridges closely resembles *Coleoides* (I.F.N.A.)

Specimens of many ostracods were removed from many of the shales both in the Port Hood Area and in the vicinity of Mabou mines and studied under the petrographic microscope. They most closely resemble the genus *Paraparchites*, their dominant features including:

Average size, approximately .8mm in length and .6 mm in thickness. Subovate outline, straight dorsal line, curved ventral. Prominent dorsal sulcus, pseudo perforate valves. Right valve is larger and overlaps the left except dorsally. Valves exhibit a channeled juncture.

Interpretation: These shales contain the typical Pennsylvanian fauna consisting of *Anthracomya*, *Estheria*, *Leaia* and *Naidites*.

Interpretation and Tectonic significance

The coarser sediments of the Port Hood Series were deposited in a subsiding basin, the rate of sedimentation exceeding subsidence during the periods of sandstone deposition followed by periods of comparative quiescence during which the finer grained shales and mudstones were deposited and coal swamps could form. This rapid increase in the rate of deposition following the slower and more fine-grained deposition in the Mabou also requires more rapid uplift of the crystalline areas which supplied the arkosic sediments. This fact, coupled with the presence of the previously mentioned limestone conglomerate indicates an increase in tectonic activity in the lower Pennsylvanian.

The greater abundance of ripple-marked and mud-cracked red beds near the bottom of the section and of coal in the upper portion suggests that the climate was becoming more humid during Port Hood time.

The Inverness Formation

The Inverness Formation (Norman, 1935) appears on Hood Island in the map area and at Mabou Mines. Its occur-

rence on Henry Island has been discussed previously. On Hood Island, where the age of the strata have been defined only on lithological and structural evidence, the Inverness Formation consists of approximately 1500 feet of red and greenish mudstones, siltstones and shales and an overlying 500' of buff-colored arkosic sandstone containing many lenses of quartz pebble conglomerate and coalified organic fragments. The previously mentioned small coal seam occurs near the top of the section. The attitude of the lower beds suggests structural conformity with the Port Hood Formation, but the actual contact is not exposed. Near the faulted contact with the Windsor on the northeast shore, seven major beds of limestone conglomerate (Plate 8B) appear at the apparent base of the red beds. This conglomerate consists of sub-angular pebbles and boulders of oolitic limestone, sandstone and shale in a calcareous, silty red matrix. The pebbles grade upward from coarse to fine unmistakably indicating the tops of the bed. Thin sections of several of the pebbles revealed that some fragments of the limestone were highly foraminiferal. Other pebbles are siliceous, and thin sections revealed that they are composed of silicified cordaiten wood, probably Dadoxylon. The surface structure of the wood is well preserved, and the angularity of the fragments suggests little terrestrial transportation. That the wood may have floated to its present position must be considered however. The extremely large size of the boulders and their angularity

as well as their proximity to the major fault suggest a genetic relationship to that fault. Strong deformation of the beds after consolidation is illustrated by the tight folds which may be observed at the wharf. (See Plate 8A) east of the fault.

The top of these redbeds is exposed on both the east and west shore of the island where the unconformable contact with the overlying arkosic pebble conglomerate may be observed. That on the east side is relatively obscure, but on the west, limey interbeds are seen to be truncated and overlain by another thin series of redbeds which in turn underlie the arkosic pebble conglomerate (Plate 9A). The deformation of the redbeds prior to the deposition of the arkose is quite apparent. The conglomerate described above was not observed elsewhere on the island, but the greenish beds were observed in the lower part of the redbeds on both sides of the island.

Trask and Mather (1928, Figs. XIX and XX) place the unconformity at the base of the Port Hood Coal Measures, but unless a fault, or some extremely intense folding occurred in the measures concealed by the channel, the period of erosion is believed to have occurred after Port Hood time. There is a possibility too that the redbeds and the limey conglomerate are of Windsor age and that the unconformity shown in Plate 9A represents a Windsor-Pennsylvania unconformity, but the lack of evidence favors the previous

hypothesis, and on the basis of structural conformity it seems more plausible to consider the redbeds Pennsylvanian in age until fossil evidence proves otherwise. At Mabou Mines, the Pictou formation is in faulted contact with gypsum of the lower Windsor and there contains several thick seams of coal. Bell has established the age of these coal-bearing beds as Pictou, the paleontological evidence indicating that these are of the same group as the coals of Sydney. Detailed descriptions of the lithology, structure and paleontology of the strata in this area by Fletcher, Norman, Bell, and Douglas (Publications mentioned previously) have been published, with work in progress by Dr. Keating of St. Francis Xavier University in Antigonish.

In general, slight lithologic difference was noted by the author between the coal-bearing strata at Mabou Mines and that at Port Hood. However, on the downthrow side of the major fault at Finlay Point (Plate 10A and B), a reddish, silty sandstone with lenses of pebble conglomerate underlies a coal-bearing sequence of Pictou strata. This is lithologically unlike any rock encountered in the Port Hood sequence and there is question as to its relation to the surrounding rock. The contact is believed to be a Pennsylvanian unconformity along which slight movement has taken place during the major deformation due to its being a zone of weakness. The lower contact is with lower Windsor gypsum.

At several locations in the area, beds of bituminous calcareous ostracod-bearing shale outcrops and thin-sections were made of various specimens. North of Fihlay Point, grey shales (not marker horizons) outcrop, one of them at least twenty feet thick and highly deformed. It has been subjected to shearing stress, the axial plane of the tight folds and minor faults dipping to the northwest. The rock exhibits a high degree of plastic deformation as well as of yielding by fracture (Fig. 14A). These beds are similar lithologically to the ostracod-bearing shales in the Port Hood Formation which have been described in detail above. These however, are more solidly consolidated and, in many cases, veined with calcite, but the differences can reasonably be attributed to a higher degree of deformation. The ostracods likewise appear to be of the same genus, and the rock is interpreted to be Pennsylvanian in age.

Structure

Graphical structural interpretation is presented on the accompanying maps and sections.

Much of the strata of the Port Hood and Mabou Mines areas have been exposed to considerable stress, the competency of the various lithological units determining their mode of deformation. The harder strata, sandstones, limestones, and conglomerates rapidly reach their elastic limit and tend to yield by fracture and adjustment along planes of shear (Plate 4A),

and on a large scale, by faulting. The shales may form tight folds, or, along with gypsum deform plastically with actual flowage into bones of least pressure. Plastic flow must be considered in the interpretation of the structure in the map area, and the fact that several of the drill holes located on the anticlinal structure which trends northeast through Southwest Mabou encountered several thousand feet of salt makes this consideration more imperative. In effect then, the problem resolves into the behavior of three layers, an incompetent one, the Windsor, overlain and underlain respectively by the more competent Pennsylvanian and Horton.

There are three major structural features in the Port Hood area, the fault on Hood Island where vertical Windsor strata are apparently thrust into the Pennsylvanian, the Port Hood synclinal basin to the east of this fault, and the "faulted anticline" whose axis extends from Kate Point south of Port Hood through Southwest Mabou, then roughly approximates the course of the river to the north.

The Port Hood syncline is a relatively simple structural feature of the Riversdale sediments although several minor folds and faults are present. The edges, however, which fringe upon the fault zones have been fractured and in the immediate vicinity of the faults are nearly vertical, or as at Ragged Point, overturned (Plate 2B). The major synclinal axis is poorly defined on the mainland, but its trace on Hood Island is shown on the map.

The Windsor sediments which form the boundaries are much disturbed, forming closed folds with overturning, brecciation of the more competent members, and flowage wherever gypsum is present. The fault on Hood Island strikes slightly east of north, the straight line northern extension of which would intersect the mainland near Cape Linzee. However, there is little evidence of major disturbance south of Colindale, two and one-half miles northeast of Cape Linzee where a cross fault brings Windsor beds into contact with the Pennsylvanian. These are interpreted as representing the concealed Windsor sediments on the down-throw side of the Hood Island Fault, or on the eastern limb of a faulted anticline of which the fault parallels the axis, the axis lying parallel to and slightly off the shoreline southwest of the mouth of Mabou Inlet.

The Ragged Point Fault, which from its attitude may be termed a reverse fault, brings upper Windsor sediments in contact with the overturned Pennsylvanian beds at Ragged Point and between Cape Susan and Kate Point where it runs out to sea. At the latter location, the minimum displacement is 3000'; part of the Windsor is overturned near the fault which dips about 70 degrees to the southeast. Windsor limestone and gypsum again appears near the Southwest Mabou Postoffice, but here it is highly contorted making accurate surface structural mapping impossible. The projected continuation of the fault, which lies east of the plotted

anticlinal axis, is encountered in Allan Brook where a tight assymetrical synclinal fold suggests that the overlying Mabou beds have moved relatively upward or have been thrust into the Windsor. The fault plane, though unexposed would appear to dip parallel to the axial plane of the fold away from the major anticlinal axis. It may be observed that essentially the same relations are observed at each exposure of this fault.

At Mabou Mines, where lower Windsor Gypsum is in faulted contact with the Pictou formation, the fault contacts appear to dip in the direction of the overlying beds, the gypsum being highly contorted, but exhibiting normal drag folding at the contact (Plate 10A and B). This appears to be a normal fault with several thousand feet displacement. Many intra-formational faults may be observed in the Pennsylvanian sandstones, these in all probability either related to the movement of the main fault or to adjustment of the adjacent or underlying gypsum.

Along the shore north of Finlay Point, the Windsor strata are highly faulted although forming a generally anticlinal structure both limbs of which are terminated by faults. Nearly all of the faults dip in a westerly or a northwesterly direction and may be classified as thrusts. The prominent quartzite outcrop (Plate 12A) forms the core of a minor anticline in gypsum and is believed to be Horton sandstone silicified after faulting. The description of the rock follows:

MABOU MINES SHEET

LEGEND

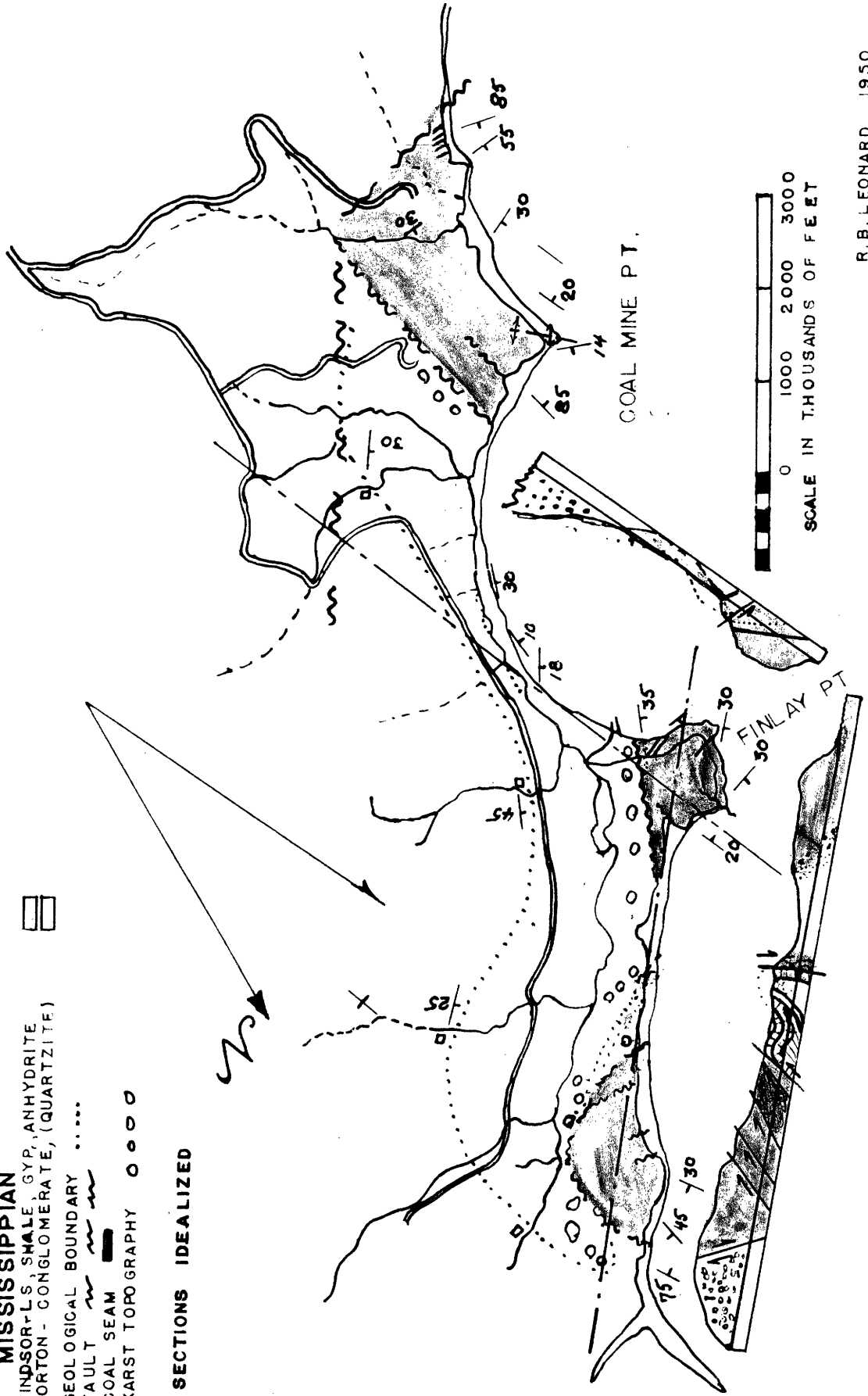
PENNSYLVANIAN
 SHALE, SAND, COAL, PEBBLE CONGLOMERATE



MISSISSIPPIAN
 WINDSOR - LS, SHALE, GYP, ANHYDRITE,
 HORTON - CONGLOMERATE, (QUARTZITE)

GEOLOGICAL BOUNDARY
 FAULT ~~~~~
 COAL SEAM ———
 KARST TOPOGRAPHY ○○○○

SECTIONS IDEALIZED



Megascopic: Red-brown in color, medium grained.
Fractures along grain margins.

Microscopic: Subrounded quartz grains with siliceous cement. Several areas in which the grains have been crushed, or mylonitized.
Undulatory extinction in most grains.

Interpretation: A siliceous sandstone which has been crushed and weakened during faulting.
Secondary introduction of quartz.

Tectonic history and processes

Although the geological history has been treated in part in the preceding sections, it is so intimately involved in the discussion of the tectonics affecting the area that this section is essentially a summary.

The area is located in a deformational belt which extends from the Bay of Fundy, through northern Nova Scotia, western Cape Breton, and apparently continues parallel to the west coast of Newfoundland. The Cobequid, Hollow, and Aspy faults in Nova Scotia are considered a part of this belt. Primary movement during the Acadian disturbance is postulated by various authors (Summary by Cameron, 1949) followed by renewed post-Pennsylvanian activity along zones of weakness. There is also evidence of post-Triassic disturbance.

Although the extremely contorted nature of the Windsor sediments and the relative scarcity of outcrops in the area render interpretation from surface outcrops highly conjectural, the observations presented point to two genetic processes:

first, crustal warping and folding of the sediments due, in all probability to the rotational shifting of basement blocks; and secondly to accentuation of the deformation by plastic flow of incompetent material. The possibility that the anticlinal structure passing through Southwest Mabou is a result primarily of plastic flowage, that is, that it is a diapiric or piercement fold is considered.

L. Mrazec (in Goudkin, 1934, p. 648) defines a diapiric fold as one in which the core, consisting of salt or some other plastic substances has pierced the more recent strata above it. The genetic process is essentially one of vertical uplift and morphologic criteria are as follows: a) The presence of a faulted core composed of older formations than of the limbs. b) A considerably deformed kernel in which the strata are picked up vertically, overturned, or crushed to such an extent as to render it difficult to determine the elements of their position. c) The dip of the enclosing strata changes from a steep dip at the center to a very gentle dip at the periphery -- the usual arching bend of the strata subjected to folding is missing.

Bogdanovich (Goudkin, p. 600) states "the definition should be limited to folds in which a core of older formations pierced through a core of younger beds (piercement folds)" and lists the external features as a steep dip of the strata in the central part of the fold, a weakly manifested

assymmetric nature of the fold, and the absence in many cases of a governing direction of overturning. He concludes, "the diapiric structure is.... independent of the dip of the enclosing formations, but dependent upon movements principally in an upward direction".

With modifications, a diapiric hypothesis fits the evidence at hand; evidence for gravity faulting and what has been termed "compressional" folding as well as thrust faulting has been observed throughout the area. In this connection, it is of interest to note that it has previously been postulated that observations of one formation having apparently plunged or been thrust into another indicate a specific horizontal force, acting in a given direction, has caused the deformation. If part of the system is less competent than the other, that part will yield first, the more competent apparently having been thrust into it. The postulation of a system under horizontal compressive stress requires that the force from one direction is equal to that from the other, the behavior of the material depending entirely upon its competency. It is also of interest to note that in the process of folding, the upper beds tend to move relatively upward and outward from the axis of a syncline, a feature which if preceded by gravity faulting or by piercement folding could conceivably lead to such features as are observed at Ragged Point and in Allan Brook.

The Southwest Mabou anticline, and the features along the shores of Mabou Inlet are believed to have been developed by a sequence of 1. "Compressional" warping due largely to the movement of pre-carboniferous basement blocks; 2. Flowage of plastic material; and 3. Block faulting.

Summary of tectonic and sedimentational history

The Acadian disturbance caused faulting and zones of weakness in the basement rocks, blocks of which have continued to be intermittently active throughout the Paleozoic and perhaps later. A period of uplift and erosion followed deposition of the dominantly terrestrial Horton Group after which warm, shallow Windsor seas transgressed and deposited marine and lagoonal sediments represented by the biostromes and gypsum of the Windsor.

Gentle warping toward the end of Windsor time initiated basins of fresh and brackish water in which the fluviolacustrine sediments of the Mabou formation were deposited. Progressive downwarping of the Port Hood basin was intensified during the Pennsylvanian by the effect of the increasing load of Pennsylvanian sediments on the underlying incompetent Windsor beds, the Windsor thinning in the center of the basin and thickening toward the edges where it formed the core of fringing anticlines, occasionally being exposed to erosion at the surface. During Port Hood time,

sedimentation periodically exceeded subsidence, and the resulting cyclical deposition in a paralic environment initiated the formation of the coal seams.

Following deposition of the Port Hood formation, a period of erosion in which the Windsor was exposed on the western margin of the basin, on Hood Island, preceded deposition of the coal-bearing basin deposits of the Inverness Formation.

The post-Inverness disturbance, probably the most severe in the area, is expressed by folding and by gravity and thrust faulting of the Carboniferous strata, in all probability as a result of block faulting in the underlying rock which tilted the exposed portion of the Port Hood Basin to the southwest. During this period of deformation, plastic flow of Windsor sediments continued, further accentuating and in some cases breaking through the previously developed folds in the overlying strata.

The last events for which there is evidence in the area is the deposition of a mantle of glacial till during the Pleistocene followed by Recent erosion.

Silica Sand

During the investigation of the area, the Pennsylvanian sandstones were also studied to determine the possibility of their use in the manufacture of glass. No significant exposure of sufficient purity was observed.

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Plate 2A. Overturned Port Hood strata at Ragged Point.
Facing north.



Plate 2B. Cross-bedding in Fort Hood sandstone. Near
Ragged Point.



Plate 3A. Ripple-marks in red siltstone near the base of the Port Hood Formation.

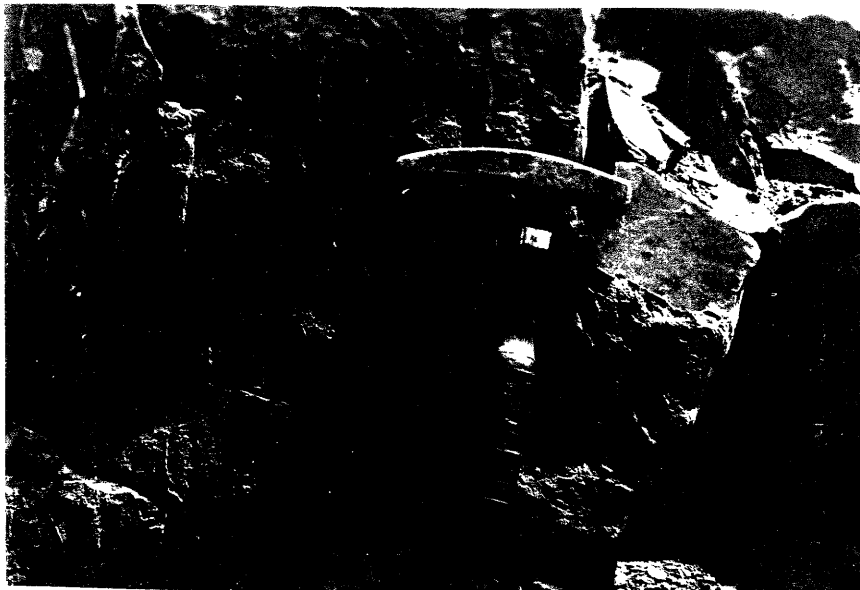


Plate 3B. Mudcracking and later fractures in fine sandstone near Colindale.

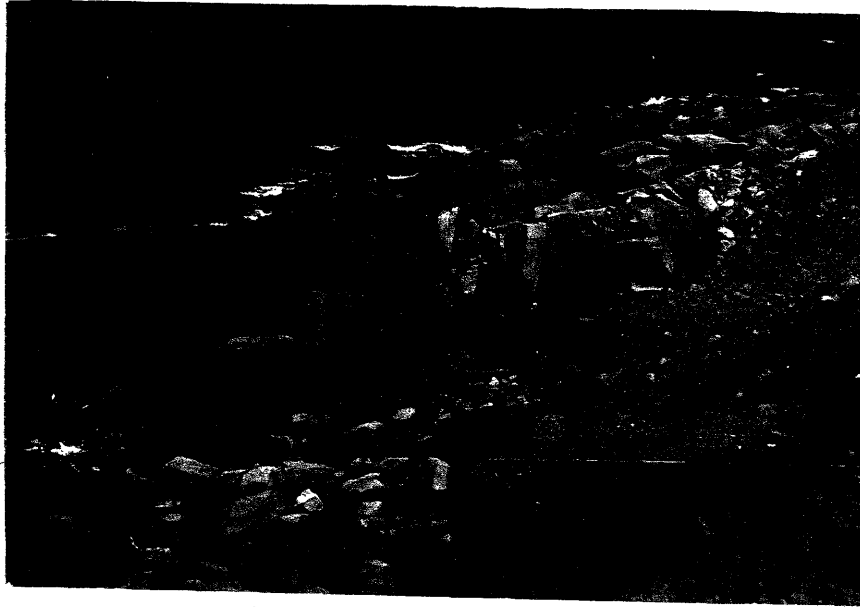


Plate 1A. Fracturing in Port Hood sandstone north of Southerland's Cove. An illustration of the behavior of the sandstone under stress.

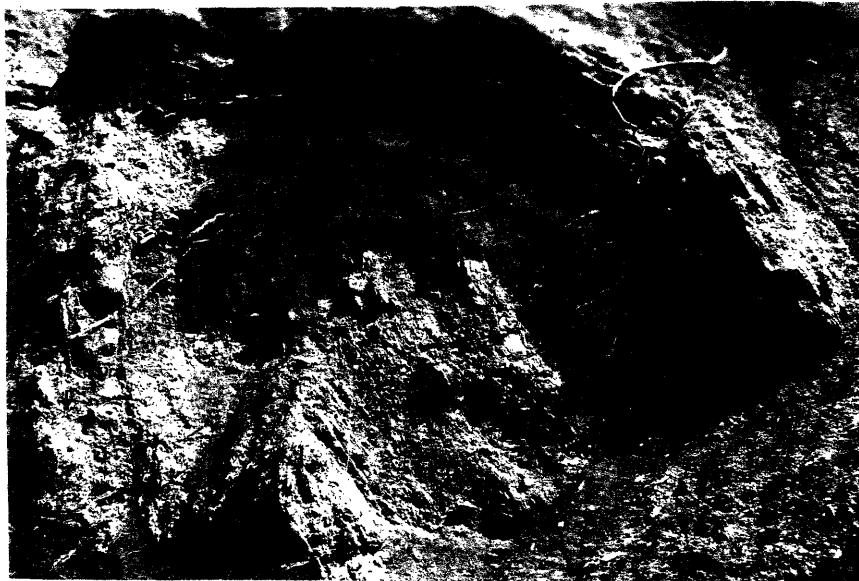


Plate 1B. Deformation of gypsum and shale north of Colindale. An example of the behavior of plastic material under stress.



Plate 5A. Prostrate carbonized Cordaites in arkosic sandstone near Harbour View.

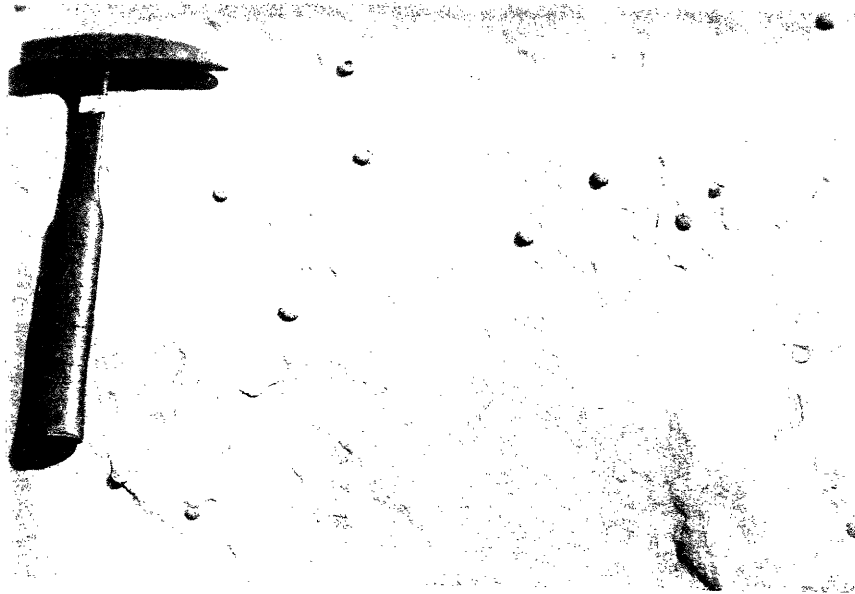


Plate 5B. Ferruginous nodules in Pennsylvanian sandstone.

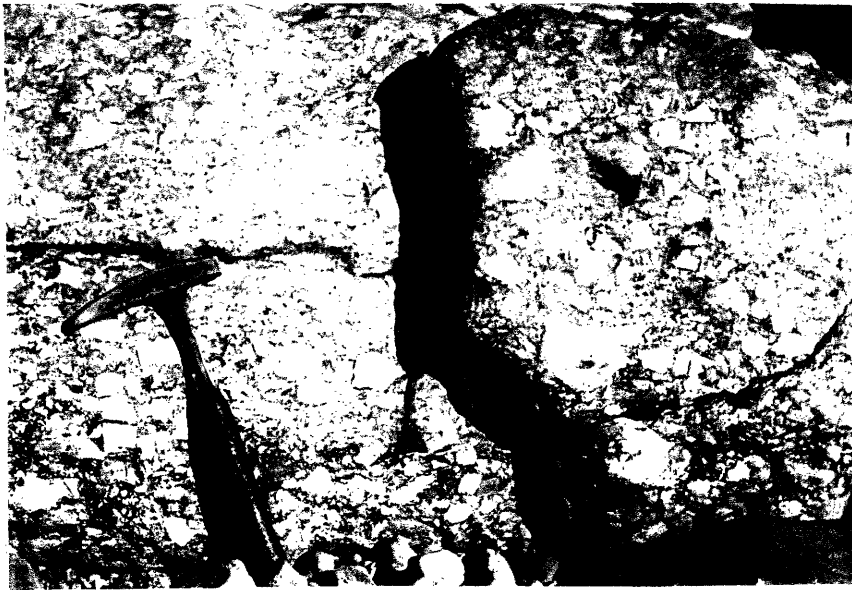


Plate 6A. Limestone conglomerate near Cape Susan.



Plate 6B. Intense deformation of Mabou?red beds near Cape Susan. Facing northwest.

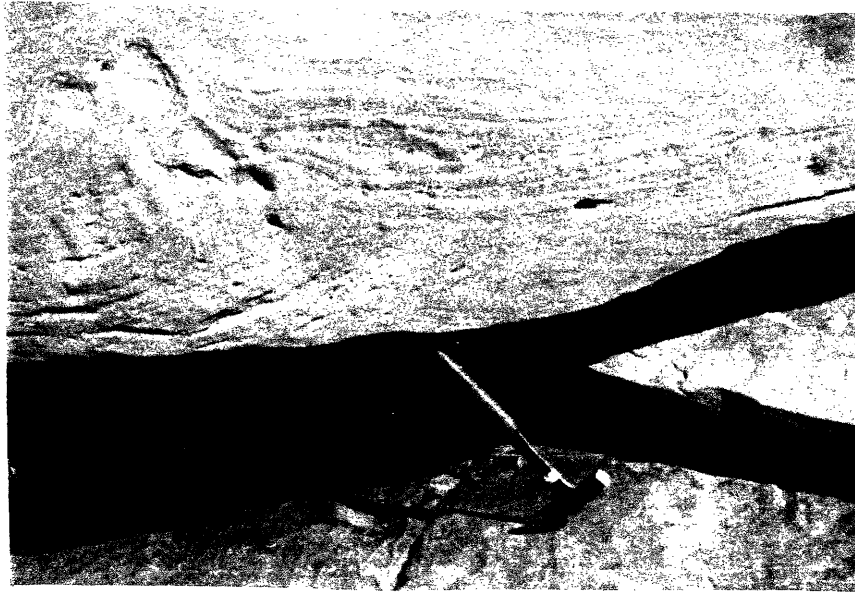


Plate 7A. Penecontemporaneous deformation in sandstone.
Lower part of Port Hood Formation.



Plate 7B. Shoreline, Cape Susan. From left to right:
Fault, gypsum, and highly distorted red beds.



Plate 8A. Small drag-fold in Pennsylvanian strata near the major fault. North shore of Hood Island.



Plate 8B. Limestone conglomerate at the base of the Inverness Formation. Hood Island.

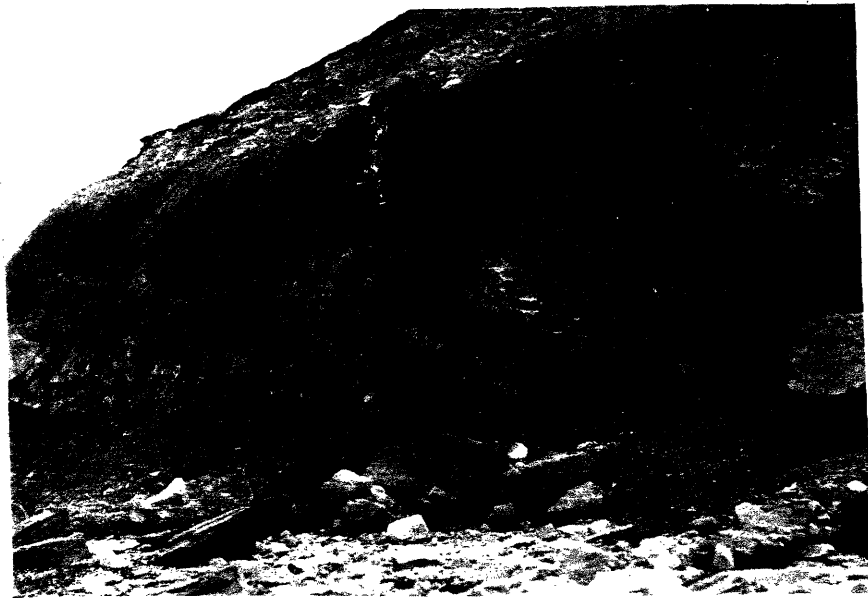


Plate 9A. Unconformity under the Inverness Formation,
Hood Island, western shore.



Plate 9B. Columnar Algal structure in Bicstrone, Hood
Island, north shore.

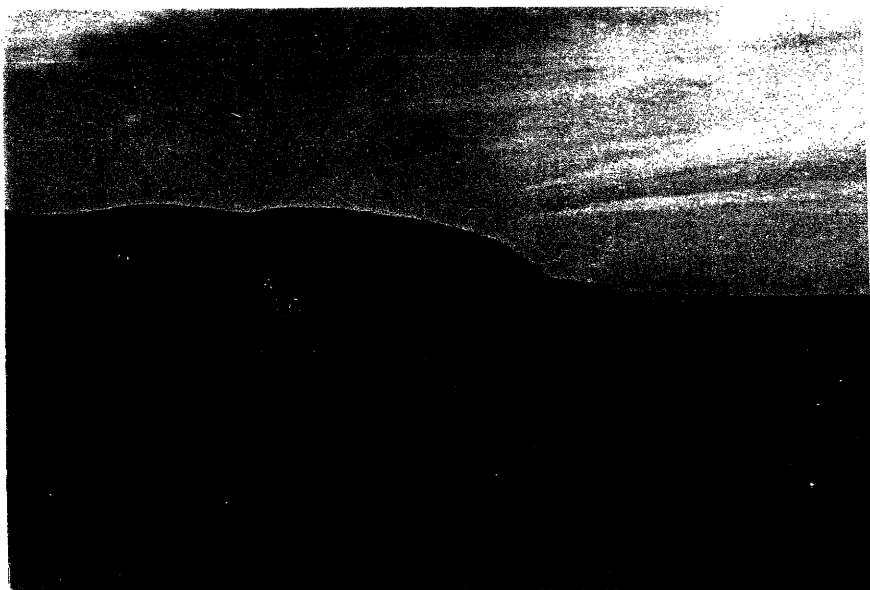


Plate 10A. Major fault north of Coal Mine Point.
Windsor gypsum is in contact with Inverness sandstone.

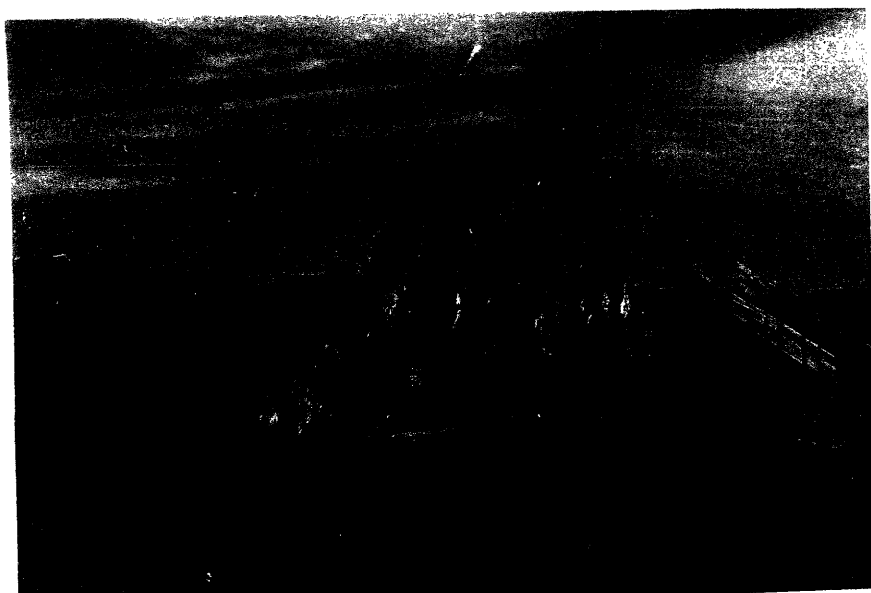


Plate 10B. Exposure of the same fault on the south shore
off Finlay Point.



Plate 11A. Karst topography. North side of Coal Mine Point.



Plate 11B. Intraformational fault in the Inverness Formation. Coal Mine Point.

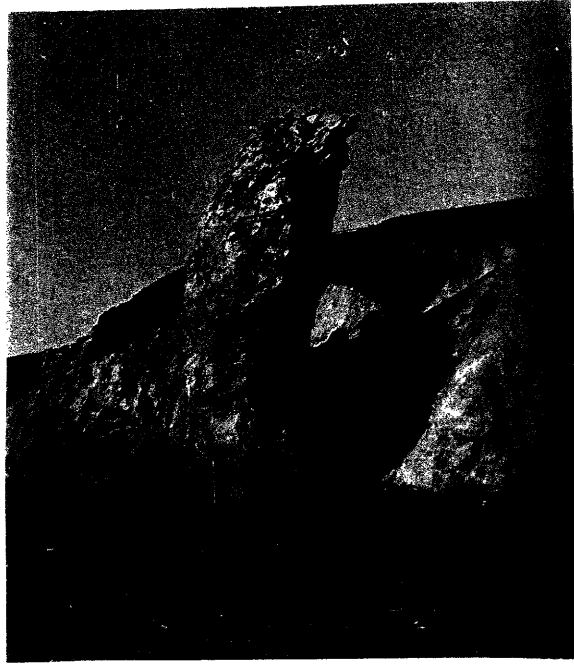


Plate 12A. Quartzite outcrop north of Finlay Point.



Plate 12B. Angular unconformity between the Horton and the Windsor (Ribbon Limestone). Mabou Mines.



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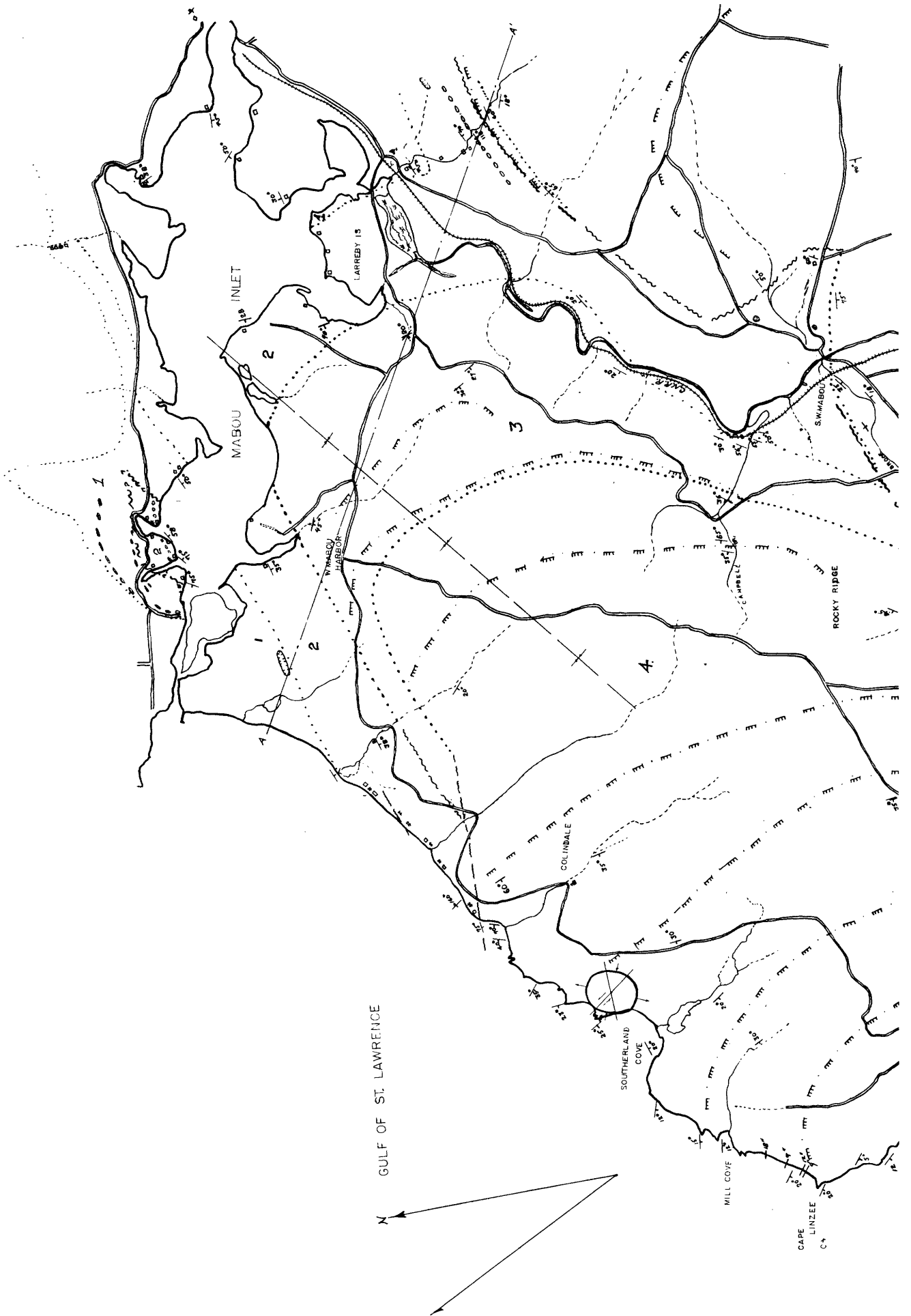
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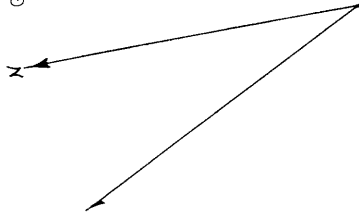
Thank you.

Some pages in the original document contain oversize maps, graphics, or tables:

Port Hood Map Area was photocopied into 3 sections due to original's large oversize.



GULF OF ST. LAWRENCE



MABOU INLET

LARREBY IS

MABOU HARBOR

SOUTHERLAND COVE

MILL COVE

CAPE LINZEE

ROCKY RIDGE

COLINDALE

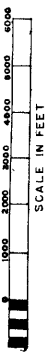
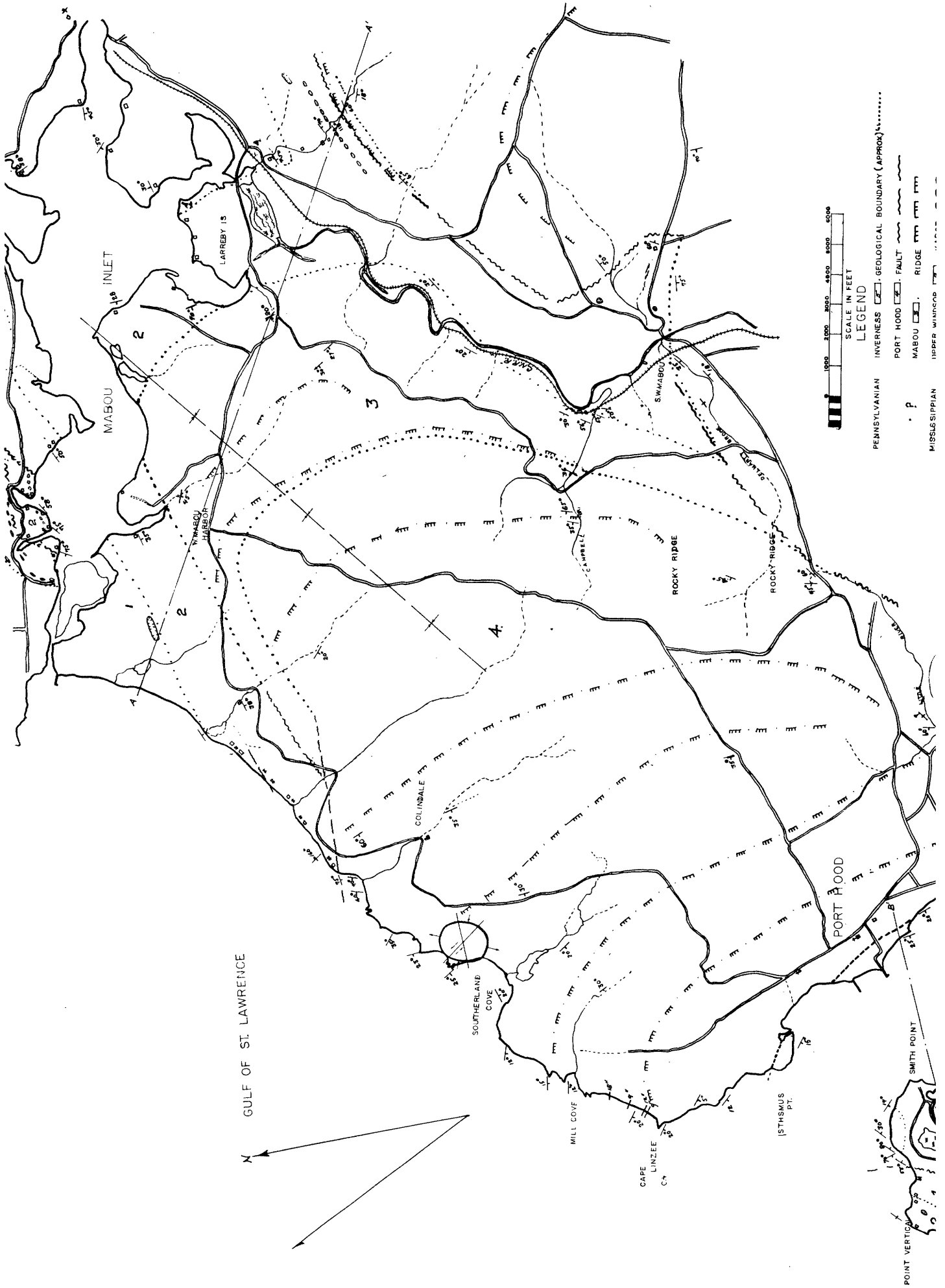
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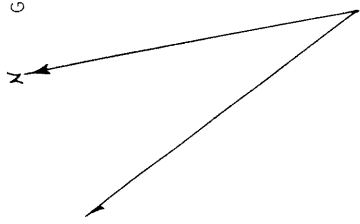
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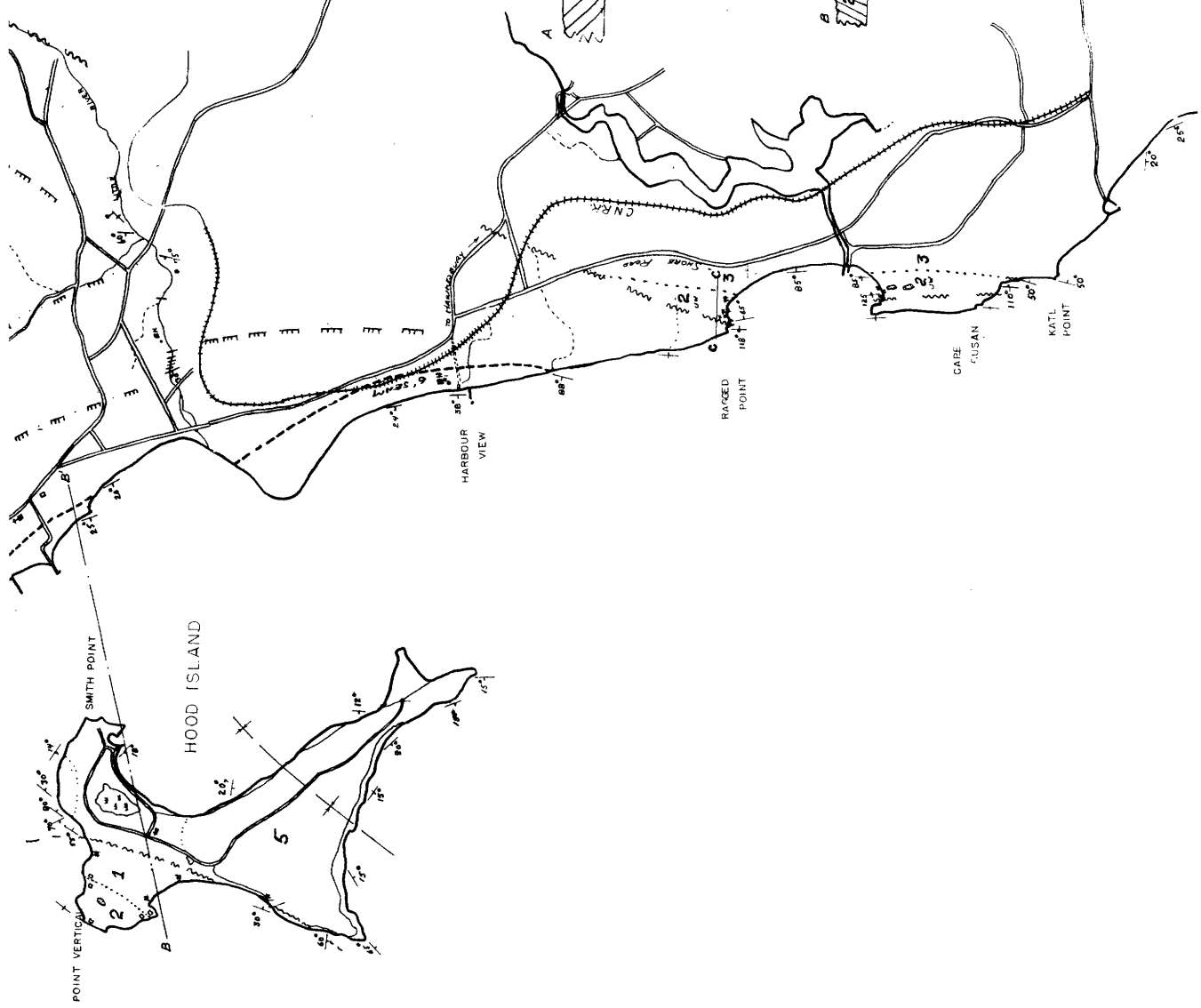
LEGEND

- PENNSYLVANIAN
- INVERNESS
- PORT HOOD
- MABOU
- MISSISSIPPIAN
- GEOLOGICAL BOUNDARY (APPROX)
- FAULT
- ROCKY RIDGE
- UPPER MISSISSIPPIAN

GULF OF ST. LAWRENCE



POINT VERTICAL



SCALE IN FEET

LEGEND

..... GEOLGICAL BOUNDARY (APPROX)

PENNSYLVANIAN

MISSISSIPPIAN

PORT HOOD

MABOU

UPPER WINDSOR

LOWER WINDSOR

FAULT

RIIDGE

KARST

GYPSSUM #

THE PORT HOOD MAP AREA,
NOVA SCOTIA

MAPPING AND GEOLOGY BY R. B. LEONARD, 1950

STRUCTURAL SECTIONS
VERTICAL SCALE ELABORATED

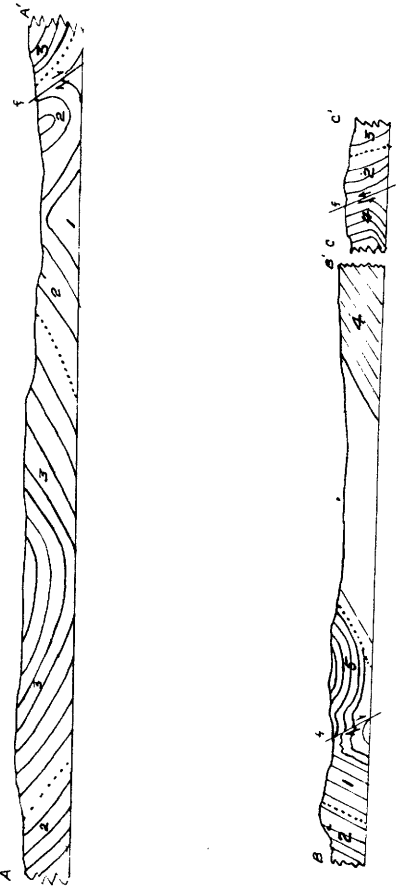




Plate 14. Faulted and drag-folded ostracod bearing grey limestone. Looking eastward. Mabou Mines.