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CHANDLER - PORT DANIEL AREA, BONAVENTURE AND GASPE-SOUTH COUNTIES

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QUEBEC DEPARTMENT OF NATURAL RESOURCES

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GEOLOGICAL EXPLORATION SERVICE

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GEOLOGICAL REPORT 120

CHANDLER - PORT-DANIEL AREA

Bonaventure and Gaspé-South Counties

by
W.G. Ayrton

QUEBEC
1967



E R R A T A

G.R. 120

PAGE

- VI - Plate X: "Mictaw" should read "Maquereau".
- 14 Par. 3, line 13: "(Plates IV-B and V-B)" should read (Plates IV-A
and IV-B)
- 44 - Title of Table 5 is "Silurian Fauna, Raudin Group".
- 49 Par. 4, line 2: "(Map 5)" should read "(Map 1568-D)"
- 59 Par. 3, line 1: "with" should read "within"
- 61 Par. 1, line 7: (a) "IV-B, V-B)" should read: "IV-A, IV-B)";
(b) "Plate IV-A)" should read: "(Plate V-B)".

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CHANDLER - PORT-DANIEL AREA

Bonaventure and Gaspé-South Counties

by

W.G. Ayrton

INTRODUCTION

The Chandler - Port-Daniel area was mapped by the writer during the summers of 1960-61-62. The main purpose of the investigation was to examine the Maquereau Group and its relationship to the surrounding Paleozoic units, and to study the economic possibilities of the area in terms of mineralization.

Location and Access

The area is in southeastern Gaspé peninsula and is bounded on the north by latitude $48^{\circ}25'$, on the south by Chaleurs bay, and on the east and west respectively by longitudes $64^{\circ}40'$ and $65^{\circ}05'$. It covers approximately 250 square miles, and includes Newport township, parts of Raudin township and Grand-Pabos seigniory in Gaspé-South county, as well as parts of Port-Daniel and Weir townships in Bonaventure county.

The coastal strip along Chaleurs bay is settled fairly well. The principal towns and villages are, from east to west, Chandler (population 3,250, approximately), Pabos Mills, Newport, Gascons and Port-Daniel. Inland the area is heavily wooded, with the timber rights being held by Gaspesia Pulp and Paper Company, Chandler. The southern part of the area is easily reached by the Matapédia-Gaspé line of the Canadian National Railways and by Highway 6, both of which follow the coast. A secondary road joins Chandler to Pellegrin, which lies to the north of the area mapped. Another road follows North Port-Daniel river to a point about 6 miles north of Highway 6. Two bush roads cross the area, leaving Highway 6 just to the west of Chandler. One road follows West Grand-Pabos river as far as McNeil brook and extends to the headwaters of North Port-Daniel river. The other

reaches Sept-Iles lake and North Grand-Pabos river. A number of shorter bush roads branch off from Highway 6 and are shown on Map 1568.

Apart from the roads mentioned above, the area must be traversed on foot. Although all of the rivers have numerous waterfalls, they can, however, be walked. The North Grand-Pabos is the only river navigable, for any appreciable distance, by canoe.

Topographic maps (1 inch = 1/2 mile) prepared by the Department of Mines and Technical Surveys, Ottawa, were used as a base, and two sets of aerial photographs were studied. The first set was taken by the Royal Canadian Air Force (1 inch = 1 mile, approximately), while the second set, taken by Photo Air Laurentides, Quebec, is to the scale of 1 inch = 1/4 mile. All exposures along the coast, the railroad, and subsidiary roads were examined and traverses were made along major and minor streams. Many cross-country traverses were made between streams to obtain information in critical areas. All traverses were made using pace and compass methods.

Development

The area is heavily forested and extensive lumbering is carried on. Balsam fir makes up approximately 70% of the forest cover, and black and white spruce make up most of the remainder. Cedar, poplar, and birch are common locally. Pine, ash, and tamarack are rare.

The lumbering industry is centered around the Gaspesia Pulp and Paper Company mill at Chandler, which has a capacity of 200,000 cords per year. Sulfite is produced and plans to manufacture newsprint in the near future are being studied. The North and West Grand-Pabos rivers are "driven" every spring, and flow directly into Grand-Pabos bay at Chandler, where the pulpwood is stored. In 1960, a forest fire burned over a large area immediately to the northeast of the area mapped, and a smaller fire burned over an area immediately west of Newport some ten years ago.

The port at Chandler remains open all year and can accommodate vessels up to 10,000 tons. Smaller ports have been built at Newport Point, Newport, Gascons, and Port-Daniel.

Commercial marine fishing is centered around a modern fish-freezing plant at Newport Point. The catch is mainly cod, but includes also herring, mackerel, salmon, and halibut. Lobster fishing is carried on in the shallow waters around the rocky coast.

Farming is done in the Port-Daniel - Gascons area where the soil overlying the limestones and siltstones of the Silurian Chaleur

Bay Group is relatively good. There is essentially no farming of the area underlain by the Maquereau Group.

Quarries are actively worked at both Chandler and Port-Daniel. No water power is obtained from the area, and there are no falls exceeding 30 feet in height. Two small reservoirs north of Chandler provide drinking water for the town.

Fish and Game

A well equipped reserve approximately 3 miles north of Port-Daniel is maintained by the Quebec Department of Tourism, Fish and Game. Moose, deer, and bear have been seen in this area, and salmon are caught in North Port-Daniel, and North and West Grand-Pabos rivers. The salmon journey upstream approximately 13 miles on North Grand-Pabos river, and 4 miles on West Grand-Pabos river, before they are stopped by wire fences. These two rivers are under private lease to the Gaspesia Pulp and Paper Company. Trout are present in many of the streams and small lakes.

Acknowledgements

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The Gaspesia Pulp and Paper Company, Chandler, provided maps of their limits and offered the writer assistance in numerous other ways. Gerald Hunt, of Chandler, and Emilien Grenier, of Newport, both prospectors, assisted the writer through their intimate knowledge of the area. The writer also wishes to thank Northwestern University, Evanston, Illinois, for financial support during the preparation of this report (doctorate thesis).

Previous Work

The rocks of the Chandler - Port-Daniel area were examined first by Sir William Logan in 1844 (1846, p. 51-52); since that time it has been examined by a number of workers. Ellis (1883) examined the rocks in the

vicinity of Maquereau point and reported briefly on the area. Schuchert and Dart (1926) examined the Silurian Chaleur Bay Group in the Port-Daniel - Gascons area. Alcock (1935) outlined the geology of the Chaleurs Bay region and reported on the rocks of the Chandler - Port-Daniel area. Kindle (1936) published a brief description of the Maquereau Group and the surrounding rocks units. Northrop (1939) studied the Silurian of the Port-Daniel - Black Cape region. Badgley (1956) mapped the west-adjacent New Carlisle area, and Sanschagrín (1963) mapped the east-adjacent Grande Rivière area,

Because of the long list of other workers who have reported on various parts of the area, further "previous work" is discussed along with the description of each lithologic unit.

Topography

Physiographically the area is characterized by two main units, namely, the Chaleurs Bay coastal plain and the Gaspé plateau. From Maquereau point, the plain rises gradually northward for approximately 12 miles, where the escarpment of the Raudin fault marks the edge of the plateau. The top of the escarpment is approximately 1,000 feet above sealevel. From the edge of the plateau, the land surface continues to rise gently to a general elevation of 1,200 feet. All the drainage is directed towards Chaleurs bay.

The plateau is a heavily wooded, dissected upland with deep valleys cut by three main rivers: North Grand-Pabos, West Grand-Pabos and North Port-Daniel (the first two are known locally as the North river and the West river, respectively).

The land surface over the Maquereau Group is rolling and commonly swampy, with many small lakes. Sept-Iles lake is the largest of these and is approximately 1 1/2 miles long.

Cliffs, headlands and stacks are found along the rugged coast. Baymouth bars with tidal lagoons occur at Chandler and Port-Daniel, and there are marine terraces up to approximately 100 feet above sealevel at Gascons and Maquereau point.

Much of the area is overlain by thin glacial drift, which comprises erratics of essentially local origin. A few erratics of Mount Alexandre volcanic rocks have been transported from the north. Glacial striae in Grand-Pabos bay indicate that the ice moved southeast.

- | | | | |
|-------------------|-----------------|---------------------------------|-----------------------|
| RECENT | | QUATERNARY ALLUVION | |
| TERTIARY | | WELDED TUFFS | |
| CARBONIFEROUS | | BONAVENTURE FORMATION | |
| SILURIAN | 7 | | |
| | 6 | | |
| | 5 | | |
| | 4 | | |
| | 3 | | |
| | 2 | | |
| | 1 | | |
| CHALEUR BAY GROUP | | INDIAN POINT FORMATION | |
| | | WEST POINT FORMATION | |
| | | BOULEAUX FORMATION | |
| | | GASCONS FORMATION | |
| | | LA VIEILLE FORMATION | |
| | | CLEMVILLE FORMATION | |
| | | WEIR FORMATION | |
| LOWER | | | |
| ORDOV. | UPPER | | MATAPEDIA GROUP |
| | | | HONORAT GROUP |
| | MIDDLE | | MICTAW GROUP |
| POST-MAQUEREAU | | NORTH PORT-DANIEL RIVER COMPLEX | |
| PRE-MIDDLE | MAQUEREAU GROUP | | NEWPORT FORMATION |
| | | | PORT-DANIEL FORMATION |
| | ORDOVICIAN | | CHANDLER FORMATION |
| | | | SERPENTINITE |
| | | | DIORITE |
| | | TECTONIC BRECCIA | |

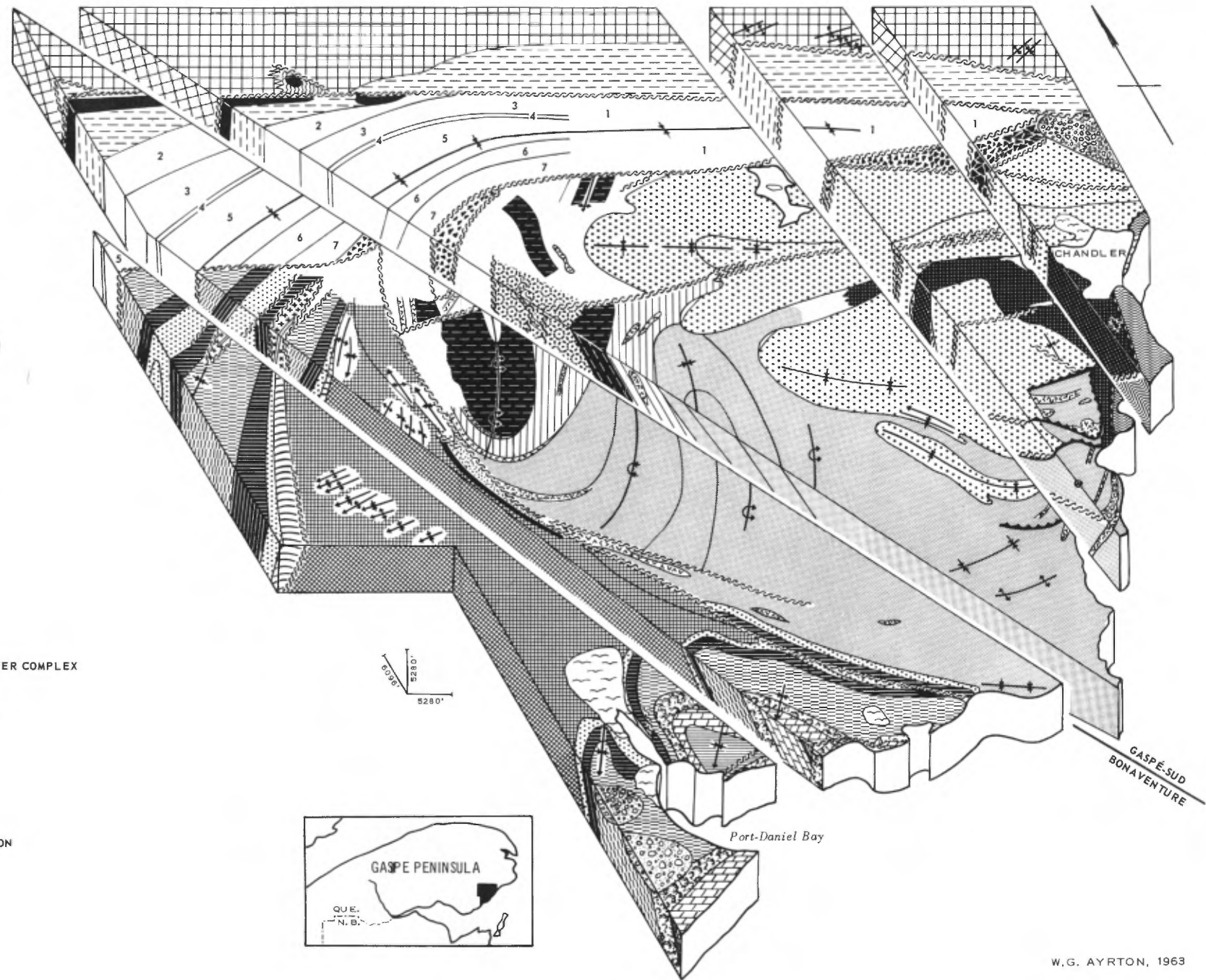


Fig. 1

BLOCK DIAGRAM OF THE CHANDLER-PORT-DANIEL AREA

W.G. AYRTON, 1963

GENERAL GEOLOGY

Regional Geology

Gaspé peninsula is part of the northeastern end of the Appalachian mountain system on the continental mainland, and may be divided geologically into four main bands parallel to its long axis (McGerrigle, 1953). The northern band, which comprises Ordovician strata, occupies the northern limb of the east-trending Gaspé synclinorium. The center of the synclinorium is occupied by Siluro-Devonian sedimentary rocks and volcanic flows, and the southern limb comprises Ordovician strata. The fourth and southernmost band comprises Precambrian(?), Cambrian, Ordovician and Siluro-Devonian sedimentary and volcanic rocks, and forms the northern limb of another synclinorium which underlies Chaleurs bay and has been traced into northern New Brunswick.

Intrusive igneous rocks are not widespread. A large granitic body intruded Ordovician strata of the northern band, and a number of ultrabasic bodies of various sizes have been mapped. Dikes and sills of rhyolite, andesite, and dolerite occur throughout the peninsula.

Local Geology

The local geology of the Chandler - Port-Daniel area is shown on Map 1568, and the stratigraphic succession in the Table of Formations (Table 1). Figure 1 is a block diagram of the area drawn approximately to scale.

The oldest rocks within the area mapped, and probably within Gaspé peninsula, are included in the non-fossiliferous pre-Middle Ordovician, Maquereau Group. This Group comprises an isolated block of metasedimentary and metavolcanic rocks, which is in fault contact on the north, west, and south sides with younger Paleozoic sedimentary rocks. On the east, it goes under the sea. This block is bounded to the north by the Raudin fault, and to the south and west by the curving Port-Daniel River fault. The Group, which probably exceeds 26,000 feet in thickness, is predominantly clastic and is divided here into the Chandler, Port-Daniel, and Newport Formations. The Chandler Formation comprises well-foliated, red-banded, green quartzose graywackes, which crop out at Chandler (Plate I A), and well-foliated, green and red quartzose graywackes which crop out at Anse-à-Carnaval (Plate I B). The Port-Daniel Formation, which comprises green quartzose graywackes, dark green intermediate volcanics, banded olive-green siltstones, orthoquartzite, chlorite schist and purple slate, is well

Table 1. - TABLE OF FORMATION

PERIOD		GROUP	FORMATION	LITHOLOGY	THICKNESS
Quaternary				Glacial till; beach and stream deposits	
Tertiary (?)		Extrusive rocks		Glassy-welded tuffs and volcanic glass	400'(1)
Carboniferous			Bonaventure	Conglomeratic redbeds, calcareous cement	50'
		Intrusive rocks		Intermediate porphyritic dike, acidic dikes	
Silurian	Middle	Chaleur Bay	Indian Point	Chocolate, maroon, and greenish-gray siltstone	456'(2)
			West Point	Well-bedded, gray, nodular limestone; maroon siltstone; pink, crinoidal limestone	1,714'(2)
			Bouleaux	Thin-bedded, maroon and green, calcareous siltstone; stromatoporoids and corals at base	888'(2)
			Gascons	Green, calcareous siltstone	1,890'(2)
			La Vieille	Dove-gray, fossiliferous, nodular limestone	405'(2)
			Clemville	Quartzose sandstone and orthoquartzite, nodular limestone with green, shaly partings	168'(3)
	Lower		Weir*	Dark gray-green siltstone; quartz pebble conglomerate; arkosic sandstone; silty limestone	2,180'
	(?)	Raudin**	"b"	Calcareous quartzose sandstone; impure sandstone; quartz pebble conglomerate; sandy siltstone and dark gray limestone	3,300'
	"c"	Nodular dark-gray limestone; calcareous siltstone, quartzose sandstone; phyllitic calcareous siltstone	4,500'		
	"d"	Purplish-red calcareous slate and siltstone	600'		
	"e"	Dark gray calcareous siltstone, black limestone; orthoquartzite	4,250'		
	"f"	Pale apple-green and gray calcareous sandy siltstone and slate	2,600'		
"g"	Dark gray limestone; green siltstone	3,100'			
		Intrusive rocks	Weir Township serpentinite, Raudin diorites,* igneous rocks of North Port-Daniel River complex*		
Ordovician	Upper	Matapédia	Dark blue limestone; silty and sandy limestone	9,500'(+)	
		Honorat	Dark gray siltstone and sandstone; predominantly non-calcareous	?	
	Middle	Mictaw	Volcanic graywacke; dark siltstone and shale; conglomerate; red siltstone	3,500'(+)	
Post-Maquereau		North Port-Daniel River Complex*	Graywacke sandstone and shale; agglomerate; red siltstone; conglomerate; serpentine breccia; chert and gray, silty limestone	?	
Pre-Middle Ordovician	Maquereau	Newport*	Upper Member: purple and green, massive quartzose graywacke; red-banded sandy siltstone; phyllitic siltstone Lower Member: purple and green, phyllitic slate	8,000' 100'	
		Port-Daniel*	Green schistose, quartzose graywacke; red, impure quartzite; orthoquartzite; banded green siltstone; chlorite schist; green intermediate volcanics; purple amygdaloidal volcanics; conglomerate	18,200'(+)	
		Chandler*	Green schistose, quartzose graywacke with thin, purple banding; reddish-brown quartzose graywacke and impure quartzite	?	

Stratigraphic succession of formations uncertain

* New term proposed in this report

1 Ross, Dennison Mines, (1963, Personal Communication)

2 Northrop (1939)

3 Schuchert and Dart (1926)

exposed along the coast at Maquereau point (Plate III-A), and along North Port-Daniel and West Grand-Pabos rivers (Plate V-B). The stratigraphic relationship between the Chandler Formation and the Port-Daniel and Newport Formations is unknown, as the units are only seen in fault contact. The Newport Formation has a thin, purple and green slate and shale basal member, but comprises mainly purple ferruginous graywackes with purple shale fragments, and massive green quartzose graywackes. The simpler structure, divergent fold trends and the characteristic massive lithology distinguish the Newport Formation from the Chandler and Port-Daniel Formations. The Newport Formation is assumed to rest with angular unconformity on the Port-Daniel Formation (Plate VI-B). This relationship is best seen west of Pabos Mills, where steeply dipping orthoquartzites of the Port-Daniel Formation strike northeast and disappear beneath the purple graywackes of the Newport Formation. The beds of the Newport Formation strike northwest and dip approximately 25°SW. (Map 1568). A complex pattern of folds and faults has been mapped within the Maquereau Group, and its overall structural complexity makes it easily distinguishable from the surrounding younger units.

To the west, the Maquereau Group is in contact with rocks of the North Port-Daniel River complex (Map 1568-A), and the Middle Ordovician Mictaw Group (Map 1568-C) along the Port-Daniel River fault. The North Port-Daniel River complex comprises a complicated assortment of rock types whose relationship to one another is uncertain. These include chert, limestone, red shale, conglomerate, manganese-rich sandstone, agglomerate, serpentinite, diorite dikes and granite. The age of the unit is unknown.

The Mictaw Group comprises a basal(?) conglomerate (Plates VII-A and VIII-A) and a monotonous succession of complexly-folded dark green volcanic graywackes, siltstones, and shales (Plate IX). The conglomerate, which appears to be at least 1,000 feet thick, is composed almost entirely of Maquereau fragments, and crops out immediately west of the Port-Daniel River fault in two main belts. The Maquereau fragments indicate that severe deformation (Gaspesian orogeny) occurred within the Maquereau Group prior to the deposition of the Mictaw Group. A Middle Ordovician age has been assigned to the Mictaw Group on the basis of its graptolite fauna (Table 2).

The northern part of the area mapped is underlain by folded strata of the Upper Ordovician Honorat and Matapédia Groups. The dark-gray to black, non-calcareous siltstones of the Honorat Group, which are in contact with the Silurian Raudin Group to the south along the North Grand-Pabos fault, are bounded to the north by the limestones of the Matapédia Group. The Honorat-Matapédia contact is a fault in the northeastern part of the area, and appears gradational in the northwest. A thin wedge of Honorat strata crops out south of the North Grand-Pabos fault in

the western part of the area, but the contact with the Silurian Raudin Group is not exposed. A tentative Upper Ordovician age has been assigned to the Honorat Group on the basis of a few fossils found by Skidmore (1962, personal communication) approximately 50 miles west of the Chandler - Port-Daniel area.

The dark blue-gray limestones of the Matapédia Group in the extreme northern part of the area have a minimum thickness of at least 9,500 feet. The unit has been traced approximately 20 miles to the northeast (Map 1568-B) and correlated with the Upper Ordovician Whitehead Formation (Kindle, 1936; Sanschagrín, 1963).

The Silurian strata have been divided into the Chaleur Bay and the Raudin Groups. The Lower to Middle Silurian Chaleur Bay Group comprises seven well-defined formations which crop out in the vicinity of Port-Daniel and Gascons (Table 3), and in Weir township (Map 1568 and Figure 2). The good exposure, simple structure, and excellent preservation of abundant fossils have made this one of the best known Silurian sections in North America.

The Chaleur Bay Group consists of a Lower Silurian basal unit of green siltstone, named here as the Weir Formation, which has been found only in Weir township. The Weir Formation is conformably overlain by quartzites and sandstones of the Middle Silurian Clemville Formation, followed by the La Vieille limestone, green and red siltstones of the Gascons and Bouleaux Formations, pink crinoidal limestones of the West Point Formation, and finally siltstones of the Indian Point Formation. Northrop (1939, p.25) estimated the group to be 6,509 feet thick. The Chaleur Bay Group overlies the Maquereau Group at Anse-à-Pierre-Loiselle with pronounced angular unconformity, but here the Mictaw Group is conspicuously absent.

Silurian and Upper Ordovician strata have been observed only in fault contact within the area mapped. The contact between Silurian and Middle Ordovician strata has been observed along Mictaw and La Grande-Fourche brooks, and North Port-Daniel river. Along Mictaw brook, the contact is a fault, along La Grande-Fourche brook the evidence for an unconformity is inconclusive, but on North Port-Daniel river, in Weir township, a 10-foot zone of quartz-pebble conglomerate marks the base of the Silurian. At this latter locality, there is also a few degrees difference in strike between the Ordovician and Silurian strata, and the underlying Mictaw is more intensely folded than the overlying Silurian. Thus, an angular unconformity is apparently present between Ordovician and Silurian.

The lithologically distinct formational units outlined within the Chaleur Bay Group have not been recognized north of the Raudin fault; therefore these strata have been assigned to a new unit, herein named

the Raudin Group (Map 1568). The Group comprises mainly calcareous siltstone, limestone, and sandstone, arranged in six units. Because of the uncertain structure and the poor paleontologic evidence, the stratigraphic succession has not been completely demonstrated. The Group forms the central block of a graben bounded to the north by the North Grand-Pabos fault and to the south by the Raudin fault.

The flat-lying, red conglomerates and sandstones of the Carboniferous Bonaventure Formation lie with pronounced angular unconformity on the Chaleur Bay, Honorat and Maquereau Groups. The thickness of the Bonaventure does not exceed 50 feet anywhere within the area mapped.

A lens of serpentinite, approximately 2 1/2 miles long and 1/2 mile wide, containing large amphibolite and quartzite inclusions, has been emplaced in Silurian strata in Weir township (Map 1568-D; Fig. 3; Plates XI-A and XI-B). Diorites and glassy welded tuffs have been mapped along the North Grand-Pabos fault in Raudin township (Fig. 4; Plates XII-A and XII-B). Numerous dikes, representing various rock types, occur within the map-area. Two large lenses of tectonic breccia have been mapped along the Raudin fault.

DESCRIPTION OF LITHOLOGIC UNITS

Maquereau Group

Previous Work

Much of the early work was concerned with establishing the age and stratigraphic relationship of the Maquereau Group to the surrounding rock units. It is only within the last ten years that detailed mapping of the lithology and structure has been attempted.

The strata which comprise the Maquereau Group were first examined by Sir William Logan in 1844 (1846, p. 51-52). The distribution, lithology, and structure are briefly described in his "Geology of Canada 1863" (p. 272). Logan observed that the sandstones of "Cape Maquereau", which he assigned to the Quebec Group, strongly resemble those of the "Sillery Series" (Lower Ordovician) and he concluded equivalency.

Ells (1883, p. 15D, and Map No. 1568-B - S.E.; 1885, p. 30-31E) re-examined the rocks in the vicinity of Cape "Macquereau" (a misspelling perpetuated in the following literature) eastward to Chandler. He believed that there were two distinct and unconformable sets of beds which strike almost at right angles to one another (1883 Note 8, Map No. 1568-B - S.E.). He assigned the strata to two groups, the Cambro-Silurian and the Precambrian. Part of the Cambro-Silurian has now been classified as the

Middle-Ordovician Mictaw Group, and the "Precambrian" strata belong to the Maquereau Group.

Schuchert and Dart (1926, p. 39-40), while mapping the Silurian of the Port-Daniel - Gascons area, named the "Maquereau Series" and briefly described the unit. They also regarded the unit as Canadian, that is Sillery-Quebec (Lower Ordovician).

Alcock (1926) studied the stratigraphic relationships between the rocks at "Maquereau Point" and the surrounding rocks of known Paleozoic age. He concluded that Logan's interpreted Early Paleozoic age for the Maquereau Group was correct, and realized that the Maquereau Group had been folded and metamorphosed in pre-Silurian time.

Parks (1930) described the "Maquereau" strata along the North Port-Daniel river; this publication also contains lithologic descriptions by Northrop of rocks along the Mictaw-Maquereau contact, with special emphasis on some bituminous shales. Parks (1931) stated that, because of their lithologic similarity, the "Maquereau series" and the strata described by Alcock (1926) at Lake Matapédia in northwest Gaspé are of the same age, i.e. Early Ordovician, probably Canadian.

Alcock (1935, pp. 9-11, and Map 330-A) accurately outlined the extent of the "Maquereau group" and described its lithology and stratigraphic relationships with the younger Paleozoic units. He tentatively suggested that a Lower or Middle Cambrian age be assigned to the Maquereau Group, and proposed an orogenic revolution of considerable magnitude during pre-Trenton time.

C.H. Kindle (1936) published a brief description of the "Maquereau formation" and the surrounding rock units. Northrop (1939, pp. 9-11) and Dresser and Denis (1944, pp. 294-295) both published short reviews of the geology of the "Maquereau" Group.

Hannah (1954), the first worker to study the "Maquereau Series" in detail, described the petrology and structure of the unit. The present study has shown that many of the structural trends suggested by Hannah are erroneous and that his stratigraphic units, based essentially on color (1954, p. 53), do not seem to be justified by more recent work.

Arbour (1962), senior assistant to the writer, studied the geology along the Maquereau-Mictaw contact and described the petrography of the Maquereau chlorite schists, graywackes and volcanic rocks in some detail.

General

The Maquereau Group crops out over an area of some 122 square miles. It is excellently exposed for 14 miles along the shore of Chaleurs bay, from Anse-à-Pierre-Loiselle, where it is unconformably overlain by Silurian strata, to a point approximately 1 mile east of Chandler, where it is overlain by the flat-lying Bonaventure Formation.

Logan (1863, p. 272) first described "the sandstone of Cape Maquereau" but the name "Maquereau series" was first used by Schuchert and Dart (1926, pp. 29-40) to describe the rocks at "Cape Maquereau". Since the group name has been spelled differently by different workers, and the correct geographic name is Maquereau Point, the name Maquereau Group should be used to avoid further confusion.

Outcrop control is generally poor on the interfluvial areas, and the undissected large upland, which occupies a poorly-defined divide in the center of the area under investigation, provided no outcrop at all. The entire area underlain by the Maquereau Group is thickly forested, except for a narrow strip along the coast.

The Maquereau Group is in fault contact with rocks of the North Port-Daniel River complex and the Middle Ordovician Mictaw Group to the west along the Port-Daniel River fault, and with the Silurian Raudin Group along the Raudin fault to the north.

A type locality was never precisely established for the Maquereau Group, although it is apparent from the literature that Maquereau point was the unofficial one. On the basis of the present study, the Maquereau Group has been divided into the Chandler, Port-Daniel, and Newport Formations, each of which comprises a somewhat varied lithology. Therefore, rather than designate a single type locality for the group, one has been established for each formation.

The Maquereau Group has been considered as Lower Ordovician, Cambrian, or Precambrian by previous workers. Since no fossils have been found, the unit can only be assigned a pre-Middle Ordovician age with certainty. This dating is based upon the presence of Maquereau fragments in the Middle Ordovician Mictaw conglomerate.

The only formation in southern Gaspé which has furnished an older fauna than the Mictaw Group is the Upper Cambrian Murphy Creek Formation, which crops out 20 miles to the northeast, near Corner-of-the-Beach. Alcock (1935, p. 11) observed that the limestones and limy shales of the Murphy Creek Formation are much fresher and less deformed than the rocks of the Maquereau Group. Kindle (1942), on the basis of poor fossil

evidence, tentatively suggested that the Murphy Creek Formation might be as old as Lower Cambrian. The writer visited the type locality and agrees with Alcock that the Murphy Creek Formation definitely has a "younger look" than the Maquereau Group. The Group is shown as "Pre-Ordovician (Precambrian?)" on McGerrigle's geological map of Gaspé peninsula (1953).

Thus, the age of the Maquereau Group, based on negative evidence, is probably Precambrian. The unit may well correlate with lithologically similar Proterozoic strata mapped in Cape Breton, Newfoundland and southwestern New Brunswick (cf. Stockwell, 1957, pp. 133-137). The Maquereau Group may also correlate with the lithologically similar Caldwell Group (Riordon, 1957) of the Eastern Townships, Quebec, which is Cambrian or Precambrian.

Chandler Formation

The Chandler Formation comprises strata from Newport Point to 1 mile east of Chandler, the type locality being along the shore immediately east of Chandler wharf. At the type locality, the well-sheared, medium-grained, greenish brown quartzose graywackes* are characteristically striped due to the presence of thin (1/10-1/2 inch) beds of purple ferruginous siltstones spaced 1/10 inch to 2 inches apart (Plate I-A). Irregular quartz veins and quartz-filled tension gashes are common. A 10-foot-wide conglomerate, containing rounded fragments of hematitic sandstone in a graywacke matrix, crops out approximately 1/4 mile east of Chandler wharf. A poorly exposed zone (60 x 20 feet) of jasper and specular hematite occurs between the two oil storage tanks at Chandler wharf.

The rocks have a characteristic sub-horizontal foliation, and have been folded about an axis which plunges gently to the southwest. These structures (Plate I-B) are also typical of the strata between La Grande-Anse and Newport Point. The lithology here is similar, but not identical, to that at Chandler; however, both areas should be considered as one unit. The rocks include predominantly reddish brown, massive, impure, rusty-weathering, quartzose graywackes, green quartzose graywackes (without ferruginous banding), and purple and green slates. All of these rocks are sheared and have phyllosilicates parallel to the prominent foliation. The

* The term graywacke is used as defined by Gilbert (Williams, et al., 1958, pp. 292-293) as a rock containing 10% or more of "dark-colored, firmly indurated matrix, which has the general composition of slate or argillite and contains an abundance of very fine grained micaceous and chloritic minerals."

original bedding is usually easily discernible, except at Carnaval point, and bedding thickness averages 1 foot to 3 feet. Faults are common and, in many instances, are within zones of purple and green slates. Small folds, with an amplitude of several hundred feet, are common (Plate I-B), and many quartz veins and mullions (Plates II-A and II-B) have been developed locally.

The Chandler Formation has an "older look" than either the Newport or Port-Daniel Formation, but no conclusive evidence as to its relative age or to its thickness is available at this time.

Port-Daniel Formation

The Port-Daniel Formation, named after Port-Daniel township, is unconformably overlain by the Newport, and is in fault contact with the Chandler. The unit is especially well exposed at Maquereau Point and along North Port-Daniel and West Grand-Pabos rivers. It is neither lithologically nor structurally uniform, but is a useful grouping for those rocks which do not clearly belong to either the Chandler or the Newport Formations.

Because of the complicated structure and the lack of exposure in the central area, it is difficult to erect a precise stratigraphic succession with chronologic significance. However, several distinct informal lithologic units exist and have been outlined (Map 1568). More than half of the area underlain by the Port-Daniel Formation comprises well-foliated, dark green, quartzose graywackes. To the west, assuming that the interpreted anticlinal structure is correct, the graywackes are underlain by three other informal units. A tentative stratigraphic succession is given below, and the units are discussed in descending order:

	<u>THICKNESS IN FEET</u>
<u>YOUNGEST</u> Well-foliated, green, quartzose graywacke and impure quartzite, phyllites, slates and siltstones. Dark green intermediate volcanic rocks.	12,000
Quartzose graywacke, conglomerates (locally calcareous), impure purple quartzite, purple and green siltstone, slate, and phyllites. Dark green intermediate volcanic rocks.	3,500
Banded olive-green siltstone, black, purple and green phyllitic siltstones and shales.	2,700
<u>OLDEST</u> Rusty weathering, impure, buff quartzite, siltstone and conglomerate, (irregular carbonate replacement). Purple amygdaloidal volcanic rocks.	<u>?</u>
TOTAL	18,200+

The relationship of a zone of orthoquartzite, which crops out in the vicinity of Pabos Mills, to the rest of the Port-Daniel Formation is unknown.

As mentioned above, the dominant lithology of the Port-Daniel Formation is well-foliated dark green quartzose graywacke which can best be seen in the vicinity of Maquereau Point - the type locality for this formation (Plate III-A). Although the graywackes are typically green, they are interbedded with reddish brown, feldspathic graywackes, black graywackes, phyllites, red and green slates, and siltstone. The graywackes are predominantly medium grained and the conglomerates are limited to the quartz-pebble variety. The steeply-dipping strata average 1 foot to 6 feet thick, although beds up to 20 feet thick have been measured, and a total thickness of approximately 12,000 feet has been estimated from reconstructed cross-sections. Quartz veins up to 1 foot thick and small, localized, pegmatite zones are common. The pegmatites comprise white milky quartz and flesh-colored potassium feldspar, and appear to be the result of metamorphic differentiation rather than magmatic intrusion. Because of the excellent exposure, both sedimentary structures (graded bedding and channels) and small-scale tectonic features (quartz-pegmatite rods, minor folds, mullions) can be examined in detail.

In thin-section, the quartz and feldspar grains of the graywackes are strained and are commonly surrounded by a rim of finely crushed quartz and sericite. The subparallel alignment of secondary chlorite and sericite defines the foliation and, in general, the long axes of the quartz and feldspar grains parallel this direction. A microscopic crenulation-foliation has been locally developed in the phyllites.

Sheared and deformed quartzose graywackes of the Port-Daniel Formation are also well-exposed along North Port-Daniel river in the vicinity of the Port-Daniel River fault. Here the steeply-dipping quartzites are interstratified with 1-foot to 2-foot-thick zones of phyllite, slate, chlorite schist and volcanic rocks, (Plate IV-A). These quartzites are pale buff or olive green dependent upon the amount of chlorite and epidote in the matrix. The extreme straining, elongation, granulation and annealing of the quartz grains can be seen in thin-section. Arbour (1962, p. 16) referred to these quartzites as "tuffaceous graywackes" based on the presence of up to 30% epidote replacing original volcanic rock fragments. The writer observed small amounts of epidote but no volcanic rock fragments. Minor folds are common and small pegmatite stringers clearly outline their form (Plates IV-B and V-B).

Much of the area behind Newport is underlain by white-weathering green and brown schistose graywackes. The prominent foliation (Plate V-A) developed in this area (planes approximately 1/10 inch apart)

combined with moss cover, effect of weathering, and small outcrop size, obscures the original bedding.

The original nature of the graywackes has been almost completely destroyed in the rocks which crop out along Anse à la Barbe river. Here the sedimentaries are strongly foliated and sheared and have been altered to rusty-weathering phyllites and sericite schists, chlorite schists and schistose graywackes. Gneiss has been locally developed along a fault, at a point 3/4 mile north of the Silurian-Maquereau contact.

Dark green intermediate volcanic rocks crop out at a number of localities within both the Port-Daniel and Newport Formations, but are most abundant in the Port-Daniel. Pillow lavas occur along West Grand-Pabos river, and on the Pellegrin road approximately 1 1/2 miles north of Chandler. Most of the flows are massive. This is an original feature in part but, in the west, it may be the result of tectonism (Plate IV-A).

Whether the flows were originally continuous and have since been stretched and separated into lentils during tectonic readjustment; or whether they were formed as separate discontinuous flows; or whether the flows only appear discontinuous because of the effect of subaerial erosion, is not known. Diamond drilling at Anse-à-Blondel has shown that the gently dipping flows are 40 to 70 feet thick at this locality, (Ayrton, 1961b). In the western part of the area, near Marguerite lake, however, they may be considerably thicker.

The aphanitic, dark-green volcanic rocks are typically criss-crossed by numerous thin, pale, yellow-green, epidote stringers, and thin irregular veins of white, milky quartz. The flows are locally porphyritic at Anse-à-Blondel and Newport. The reddish-brown phenocrysts (up to 1/2 inch in diameter) of subhedral feldspar have commonly been completely altered to a mosaic of epidote, kaolinite, calcite and limonite. The cloudy groundmass is a felt of tiny unoriented feldspar laths, epidote, chlorite, iron oxide and minor calcite. The rock is probably a meta-andesite.

As the volcanic rocks are traced toward the Port-Daniel River fault in the western part of the area, their mineral composition changes. The porphyritic meta-andesite (partly replaced by epidote) found in the east, becomes saussuritized andesite farther west, and is converted to chlorite schist in the immediate vicinity of the fault.

An elongate body of pale green, medium-grained gabbro(?) that crops out immediately west of Lake McKenzie in northeast Newport township is also thought to be a flow. The plagioclase laths are highly altered and lie within large crystals of clinopyroxene giving the rock an ophitic texture (Williams, Turner and Gilbert, 1958, p. 20).

Small dikes 3 feet wide, whose composition is similar to that of the andesitic flows, have intruded the graywackes of the Port-Daniel Formation along West Grand-Pabos river, 1/4 mile south of the tectonic breccia-Maquereau contact.

The zone of well-foliated green quartzose graywackes, etc. (youngest informal unit) is conformably underlain by approximately 3,500 feet of well-foliated purple and green calcareous graywacke quartzites, conglomerates, purple and green phyllites, siltstones, shales, and dark green volcanic flows, in the vicinity of Lamb brook. The well-foliated conglomerates, which have a calcareous graywacke matrix, contain 3-inch, rounded fragments of rose quartz, elongate pieces (12" x 1/2") of hematitic slate, and rounded quartzite fragments. Blood-red jasper concretions, up to 1 foot in diameter, and white quartz veins are locally developed in the purple quartzites.

In turn these rocks grade downwards into a zone, approximately 2,700 feet thick, of banded green siltstones, conglomerates, and black, purple and green phyllitic siltstones and shales, exposed along Bisson brook and West Grand-Pabos river. The conglomerate is similar to that in the overlying unit and contains fragments of purple amygdaloidal volcanic rocks, quartzite, and hematitic shale. This conglomerate crops out along the West Grand-Pabos, approximately 1 mile upstream from the Lamb Brook confluence. The pieces of purple amygdaloidal volcanic rocks are identical to rock found in place along Pins brook. A similar conglomerate crops out immediately north of Brisson lake.

Exposure is poor in the northwest and central part of the area underlain by the Maquereau Group, and interpretations based almost entirely on interstream correlation are undoubtedly oversimplified.

The geology of the northwest corner of the Maquereau Group, north of Hunt Lake fault, is poorly understood and structural interpretation has been held to a minimum. Rocks typical of the Port-Daniel Formation are present, but two other atypical rock types are represented, namely, rusty-weathering quartzites and interbedded, purple, amygdaloidal, volcanic rocks.

Hannah (1954, p. 91) outlined a "carbonate zone" along Pins brook comprising "cream, gray and purple rocks" replaced to varying degrees by carbonate. Kindle (1936, p. 1) also mapped rocks in this approximate area which he assigned to the "Mictaw Formation". The writer observed carbonate replacement in the same area, but has not recognized a well-defined carbonate zone. However, a zone of rusty-weathering, buff quartzites and siltstones, gray and green quartz-rich quartzites, and a conglomerate with purple volcanic fragments has been outlined, and irregular carbonate replacement is present within these rocks.

Gently-dipping beds of purple, well-foliated, amygdaloidal volcanic rocks trend northeast along Pins brook for approximately 6,000 feet. The fine-grained groundmass is composed of hematitic carbonate and chert in varying proportions. Most of the stretched amygdules (1/4 x 1/10 inch) are composed of carbonate, but locally there is a light green mineral, probably a variety of chlorite. The thickness of the volcanic flow is unknown since the base has not been observed, and it apparently has been truncated by two or more faults. A conglomerate with purple volcanic fragments immediately overlies the flow, and is also exposed along Pins brook approximately 1/2 mile from its mouth. The quartzose matrix is almost entirely replaced by carbonate.

Two other rock types do not fall readily into the oversimplified stratigraphic succession proposed for the Port-Daniel Formation. These comprise a conglomerate in the complicated northwestern area, and orthoquartzites at Pabos Mills.

The conglomerate (Plate VI-A), exposed immediately south of the tectonic breccia at a sharp bend along West Grand-Pabos river, contains large rounded cobbles of sheared quartzo-feldspathic rock (which superficially resembles pink, fine-grained granite); black, fine-grained orthoquartzite with a calcareous cement; and white quartz. The cobbles, which are elongated and flattened parallel to bedding, are contained in green quartzose graywackes. It is possible that this conglomerate may be a lateral extension of one of the conglomerates already described, but the exposure is too poor and the structure too complicated to hazard a correlation.

About 200 feet upstream from the conglomerate, there is a small exposure of what is believed to be sheared and metamorphosed conglomerate adjacent to the Raudin fault. The rock is a dark green, phyllitic quartzite, containing large, pink, egg-shaped masses of feldspar. Slickensiding is common around the hard feldspar masses, and the polysynthetic twin planes in the feldspar are bent.

Steeply-dipping beds of brown and gray weathering, white orthoquartzite crop out north of the village of Pabos Mills and west of Grand-Pabos bay. The fine-grained orthoquartzites are interbedded with green and purple phyllitic shales and siltstones, and brown impure quartzite. The orthoquartzite beds, which are typically 4 to 6 feet thick and veined with quartz, make up approximately 40% of the section. Assuming that the synclinal structure is correct, the orthoquartzites, etc., would have an approximate thickness of 11,000 feet.

The orthoquartzites may possibly be a facies equivalent of the green quartzose graywackes - the youngest informal unit. However, the units are in fault contact and their interrelationship is unknown.

Newport Formation

The Newport Formation is named after Newport township where the massive quartzose graywackes, which comprise the unit, crop out in four separate elongate bands. Two of these bands can be traced into Grand-Pabos seigniory. The type locality is here defined as the area approximately 1,000 feet west of Highway 6 between Pabos Mills village and Anse-aux-Canards river. Here, the Newport Formation, which forms a well-defined faulted syncline, overlies the Port-Daniel Formation with postulated angular unconformity. The steeply-dipping orthoquartzites of the Port-Daniel Formation strike northeast and disappear beneath the massive purple graywackes of the synclinally arranged Newport Formation. The unconformity is not exposed, but only 50 feet of covered interval separates the two formations. The massive purple graywackes form a northwest-trending ridge approximately 25 feet high and easily visible from the highway (Plate VI-B). At the type section the formation comprises a basal phyllitic-slate member (well exposed along Anse-aux-Canards river) and an upper massive quartzose graywacke member which constitutes the dominant lithology of the formation. The purple, dark green and apple-green phyllitic slate member is approximately 100 feet thick, and is locally very contorted. The member also crops out on the northeast side of the syncline 1/4 mile south of St-Hubert bay, and at several other localities within the area.

The rocks of the upper quartzose graywacke member are characterized by their lack of stratification and their lithological consistency. They are predominantly medium grained and are either purple or green, with no apparent outcrop pattern to explain the color distribution. The rocks of the upper member appear fresh, and do not possess the strong foliation seen in both outcrop and in thin-section in the Chandler and Port-Daniel Formations. Where "foliation" is present it generally appears as fracture cleavage or a series of closely-spaced, steeply-dipping joints with very little subsequent development of phyllosilicate minerals along planes of weakness.

The quartzose graywackes contain up to 30% matrix and the relative amounts of the cloudy recrystallized clay minerals, muscovite, chlorite, siliceous cement and iron oxide, as well as the degree of oxidation, determine the color of the rock. The quartz grains, which are commonly well rounded and comprise approximately 50% of the rock, are strained and have welded grain to grain contacts. The rocks also contain approximately 10-20% feldspar, slate fragments and minor chert and magnetite. The small oriented purple slate fragments, presumably derived from the basal member, have been used extensively in determining bedding directions.

The thickness of the quartzose graywacke member is estimated to be about 8,000 feet, and it is likely that the unit was originally considerably thicker and more extensive.

Small lenses of intermediate dark green volcanics, similar to those described within the Port-Daniel Formation, crop out at a number of localities. The three lenses north and northwest of Chandler and the lens at Outardes lake appear to be related to faults.

Because of the variety and complexity of the geology of the formation, each of the four bands is described separately. The northern band is bounded to the north by the Raudin fault and to the south by the Hunt Lake fault. The distribution pattern shown at the western end of the band is based on aerial photo interpretation, and no stratigraphic relations with the underlying formations were observed. Apart from the purple and green massive quartzose graywackes, a zone of purple-banded, brown, sandy siltstone has been outlined in the vicinity of Sept-Iles lake south of the Raudin fault. In thin-section, the dark purple bands, which are approximately 1/10 inch thick, contain up to 20% iron oxide. A zone of hard schistose light green and red quartzose graywacke which extends from Chandler to Rankin brook, immediately north of the Hunt Lake fault, has also been outlined. Severely crumpled purple phyllitic slates crop out between Hunt lake and Burnt lake, and are considered by the writer to be a sliver of the basal member brought up along the Hunt Lake fault.

The second band, which crops out along West Grand-Pabos river, is bounded to the north by the Hunt Lake fault. The southern contact, though not seen, can be placed with considerable accuracy in the eastern part of the band. The exact position of the contact west of Rankin brook is questionable because of the similarity here in both lithology and structure between the Newport and Port-Daniel Formations.

The rocks which comprise the third band are well displayed only at the type locality. Apart from these, exposure is restricted to outcrops along Anse-aux-Canards river and to a few widely scattered localities. The western extent of this band, and also of the fourth band, has been interpreted from aerial photos. West of Pruche Plaquée lake, purple and green slates and phyllitic siltstones appear to make up much of the section, indicating an overall decrease in grain size from east to west.

The fourth and smallest of the bands outlines a fairly well-defined syncline. The rocks are cut by a strong axial plane foliation which dips steeply to the northeast, but otherwise they are identical to those of the three other bands. The green schistose graywackes of the underlying Port-Daniel Formation have such a conspicuously "older look" that there is little doubt of the presence of an unconformity.

There is no evidence as to the age of the non-fossiliferous Newport Formation, and the indirect evidence is inconclusive. In review, therefore:

1. The Newport Formation is younger than the Port-Daniel and Chandler Formations which are pre-Middle Ordovician.
2. The Newport Formation could be Middle Ordovician, but it is lithologically and structurally dissimilar to the Mictaw Group.
3. Fragments of the folded Port-Daniel Formation comprise the basal(?) Mictaw conglomerate, but no recognizable fragments of Newport Formation have been found.
4. The Newport Formation folds are simpler than those in the underlying Chandler and Port-Daniel Formations, and resemble those mapped in the Upper Ordovician, Silurian and Devonian strata in Gaspé.
5. The unit crops out exclusively within the Maquereau block and lithologically is more closely related to the Maquereau type of sedimentation than to the Upper Ordovician and Silurian type.
6. It is possible, though unlikely, that the Newport quartzites could be equivalent to the Devonian graywacke sandstones of the Gaspé synclinorium.

Thus, the Newport Formation could be as old as Precambrian or as young as Devonian, although pre-Middle Ordovician is most likely its true age.

North Port-Daniel River Complex

(Map 1568-A)

Some of the most complicated geology within the map-area is exposed at the western contact of the Maquereau Group along North Port-Daniel river (Ranges IX - XIV, Port-Daniel township), about 6 miles north of the village of Port-Daniel. The complex is separated from the Maquereau Group by the curving Port-Daniel River fault, and is bounded on the west by a diabase dike sub-parallel to the fault. To the north the unit appears to be overlain by the northern band of the basal (?) Mictaw conglomerate and to the south the relationships have been obscured by faulting. The variety of different rock types of limited distribution and the extensive faulting make geologic interpretation in this area extremely difficult.

The complex comprises graywacke sandstones and shales, agglomerates, basic volcanic rocks, red siltstone, granite(?) pebble conglomerate, serpentinite breccia, chert, and gray silty limestone. These rocks have been intruded by serpentinites, diorites and small granite plugs.

The graywacke sandstones and shales in the southeastern part of the complex are lithologically similar to the Mictaw Group to the

west, and may well belong to this unit. However since their relationship to the Mictaw Group is uncertain, they are included here for the sake of completeness. The sandstones, which are locally porous and enriched in manganese (either in the form of thin manganese-filled fractures or as black nodules of wad 2-3 inches in diameter), are interbedded with reddish-brown manganese-rich chert.

The agglomerates, basic volcanic rocks, red siltstones, granite(?) pebble conglomerate and the serpentinite breccia are poorly exposed along the east-west section of North Port-Daniel river (Lot 29, Range XIII, Port-Daniel township) and their stratigraphic position and areal distribution are poorly understood. The red siltstones however appear to be identical to those interbedded with the basal(?) Mictaw conglomerate 1/4 mile to the northwest. The rounded fragments in the conglomerate strongly resemble pink, coarse-grained biotite granite; however, in thin-section the rock appears to be of sedimentary origin. Matrix material is present, and what resemble white milky quartz in hand-sample are really quartzite fragments. Pink plagioclase (An₄₀) is common and the fragments are rich in secondary calcite.

The rocks described in the preceding paragraph are truncated to the west by a fault, and are in contact with massive gray-green cherts at a right angle bend at the western end of an east-west stretch of river. The chert is in fault contact to the west with dark gray, fine-grained silty limestones, exposed on the south bank approximately 400 feet upstream from the right angle bend.

Arbour (1962, pp. 23-27) examined this area in considerable detail.

Ordovician

Upper Ordovician strata of the Honorat and Matapédia Groups crop out north of the North Grand-Pabos fault, and are part of a band which stretches from the Matapédia valley (Béland, 1958 and 1960) as far east as the tip of Gaspé peninsula. The Middle Ordovician Mictaw Group crops out approximately 4 miles to the south of this band, along the western margin of the Maquereau Group.

There is considerable confusion in the literature concerning the Ordovician stratigraphic nomenclature in southern Gaspé. The confusion arises mainly because detailed mapping has not been completed (Map 1568-B) and, even where mapping has been done, the rare Ordovician fossils do not permit precise interregional paleontological correlation.

Mictaw Group (Map 1568-C)

The Middle Ordovician Mictaw Group crops out over some 33 square miles in the western part of the area. The unit comprises conglomerates, graywacke sandstones and greenish-black siltstones and shales; Badgley (1956) reported limestones to be present locally.

The stratigraphic relationships between the Mictaw Group and the overlying Chaleur Bay Group have not been observed, but the difference in age and structure make it reasonable to assume that an unconformity separates the two groups. The Chaleur Bay Group rests with pronounced unconformity on the Maquereau Group at Pierre-Loiselle cove and the Mictaw Group is absent. The stratigraphic relationships between the Chaleur Bay Group and the Mictaw Group in the Weir Township area are described in the sequel. The Mictaw Group has been seen only in contact with the older Maquereau Group along the Port-Daniel River fault.

Previous Work

The Mictaw Group was first described by Logan (1846, p. 55), and since that time has been examined and reported on by many workers. Logan (1863, p. 445) described "black bituminous graptolitic shales" along the Middle Port-Daniel river and recognized their stratigraphic position between the Silurian Chaleur Bay Group and the pre-Middle Ordovician Maquereau Group. Ellis (1883, p. 14D) substantiated the work done by Logan and mapped further strata belonging to the Mictaw Group (referred to by Ellis as the "Quebec series of the Cambro-Silurian"). Ellis suggested that the Mictaw Group probably extended beneath Chaleurs bay to connect with the Tetagouche Group of New Brunswick.

Schuchert and Dart (1926, pp. 41-42) outlined the southern extent of the group (referred to as the "Ordovician(?) Upper Series"). The term Mictaw was proposed by Northrop (1928, p. 59, unpublished thesis), and first appeared in print in 1930, (Schuchert, 1930, p. 712). The group was named after Mictaw brook, which flows into Middle Port-Daniel river from the north, and which affords a good section.

Parks (1930, pp. 69-74) reviewed the work done on the bituminous shales of the Mictaw Group while reporting on the oil and gas resources of the Province of Quebec. A description of the Mictaw Group by Northrop is also included in this publication.

Alcock (1935, pp. 13-15) reported on the distribution, lithology, age and associated intrusives, of the Mictaw Group. In 1936, Kindle described an inlier of "cross-bedded sandstones which overlie a basal conglomerate" resting unconformably on the Maquereau Group in the west corner

of Newport township. Kindle assigned these rocks to the Mictaw Group, but the writer has reassigned them to the Maquereau Group.

Northrop (1939, pp. 11-12) studied the Silurian of the Port-Daniel - Noir Cape region, and discussed briefly the structure, contact relationships, lithology and age of the Mictaw. He (1940) published the first report on the Mictaw fauna (Table 2).

Badgley (1956) mapped the New Carlisle area (Map 1568-B) and described the lithology of the group. His detailed mapping of the overlying Silurian provided an explanation for the peculiar outline and distribution of the southwestern part of the Mictaw Group. Arbour (1962) examined the geology along the Maquereau-Mictaw contact (Map 1568-A).

Basal(?) Conglomerate

The term "basal conglomerate" has been used throughout the literature to describe a remarkable reddish weathering, dark gray conglomerate, approximately 1,000 feet thick, consisting mainly of material derived from the Maquereau Group. There is, however, some doubt in the writer's mind as to the validity of the terms "basal" and "conglomerate". There is little evidence, other than the fact that the unit contains mainly Maquereau fragments and that it is interbedded with typical Mictaw graywacke, to attest to it being "basal". It is here interpreted as a talus-slope deposit derived from a Maquereau fault scarp, and therefore need not necessarily be basal. Most of the fragments are angular and the term "sedimentary breccia" would be more appropriate than "conglomerate". However, for the sake of uniformity with the previous literature, the term "conglomerate" is retained.

The angular fragments include graywacke and arkosic quartzites, greenstone and milky quartz; the fragments are in general 3-6 inches in diameter with boulders ranging up to 1 1/2 feet in diameter (Plate VII-B). Smaller pebbles of pink granite gneiss are found locally but no fragments of the white muscovite granite, which intrudes the Weir Serpentinite, were observed (cf. Alcock, 1935, p. 12). Similarly, no fragments of the massive Newport Formation were found within the conglomerate.

Under the microscope, the grains within each quartzite fragment lie parallel to a foliation plane, but the foliation within each individual fragment possesses a different orientation direction. This proves that the foliation was present within the quartzite before the fragments were incorporated in the conglomerate. In outcrop, some fragments even appear to have been subjected to at least two periods of deformation prior to their incorporation (Plate VIII-B).

The matrix is composed principally of fine angular fragments of quartz and feldspar in a cloudy groundmass of chlorite, muscovite and iron oxide. The quartzite fragments are surrounded by thousands of preferentially-oriented chlorite and muscovite flakes which wrap around each individual fragment.

The conglomerate is locally interbedded with small discontinuous lenses of contorted purplish red siltstones and chert (Plate VIII-A), but for the most part reliable bedding directions are difficult to find in the massive conglomerate.

Two separate outcrop areas of conglomerate have been outlined along the Maquereau-Mictaw contact, and are referred to as the "northern" and "southern" zones of conglomerate (Map 1568-C). The zone where the conglomerate is absent was discussed above (North Port-Daniel River complex).

In the northern zone, the conglomerate is best seen in a picturesque gorge (Plate VII-A) on North Port-Daniel river (Lot 29, Range XIII, Port-Daniel township) about 3 miles upstream from the Government fishing camp. The conglomerate is also exposed 2 miles farther upstream at a sharp bend in the river, approximately 3/4 mile southeast of the Silurian-Mictaw contact. Here it comprises large angular fragments of Maquereau up to 1 1/2 feet in diameter, and is interbedded with graywacke and shale. The conglomerate is in contact with the Maquereau Group along the Port-Daniel River fault, and the fault trace is exposed along "Fault" brook. Immediately west of "Fault" brook, the conglomerate is highly sheared and in part silicified and recrystallized. It is distinctly reddish in appearance and small pods of flesh-colored feldspar give the rock a gneissose appearance.

Some explanation is required to account for the disappearance of the conglomerate between Range IX and Range XIII, Port-Daniel township. Mapping suggests that the northern zone of the conglomerate forms a syncline and anticline which plunge gently to the north, and that the North Port-Daniel River complex, which crops out beneath the conglomerate, is pre-Mictaw and post-Maquereau. Part of the western limit of the conglomerate is bounded by a fault, which is exposed on the east bank of North Port-Daniel river (Lot 29, Range XIII) just south of "Honeymoon Cabin" (Map 1568-A). The fault has not been observed north of this point, but it is possible that the northern zone of conglomerate has been truncated to the west by faulting.

A conglomerate containing well-rounded, 4-inch, pink, quartzo-feldspathic cobbles, and pebbles of milky quartz and black siltstone is exposed along West Grand-Pabos river immediately south of the

Raudin fault zone (Plate VI-A). No obvious fragments of Maquereau were observed in the conglomerate and its position in the stratigraphic succession is somewhat problematical. The writer has tentatively assigned the unit to the Maquereau Group because of its proximity to, and general structural accordance with, the Maquereau. Arbour (1962, p. 27) suggested that the West Grand-Pabos River conglomerate is pre-Mictaw and post-Maquereau, correlative with a granite-pebble conglomerate (Unit 6, Map 1568-A) exposed beneath the basal Mictaw conglomerate along North Port-Daniel river (Lot 29, central portion, Range XIII, Port-Daniel township). It is also conceivable that the West Grand-Pabos River conglomerate is the northeastward extension of the northern zone of Mictaw conglomerate.

The southern zone of Mictaw conglomerate crops out along a ridge which extends from the Government fishing camp on North Port-Daniel river as far east as Appel brook. At the Government fishing camp, the conglomerate crops out in the river and also on a small hill immediately south of the camp between the river and the camp service road. Here the conglomerate is strongly foliated and sheared, presumably owing to severe deformation along the Port-Daniel River fault, and it is not immediately apparent that this is the same conglomerate as in the northern zone. The fault strikes N.56°W. and appears vertical. Although the fault trace has not been seen, green phyllites of the Maquereau Group are exposed on the east bank of the river, 20 feet across from the closest outcrops of sheared conglomerate.

At Appel brook, large outcrops of rusty weathered conglomerate are exposed along the cliffs on either side of the stream. The conglomerate at this locality resembles the relatively "fresh"-looking conglomerate of the northern zone rather than the highly foliated and sheared conglomerate exposed at the Government fishing camp. However, there is little doubt that all three conglomerates belong to the same stratigraphic unit.

Sandstones and Shales

The main bulk of the Mictaw lithology consists of interbedded sandstones, siltstones and shales. The massive, medium- to coarse-grained sandstones and siltstones form beds 6 inches to 4 feet thick. The sandstones are dark greenish gray but weather deep buff-brown. Grains of clear quartz and reddish pink acidic volcanic fragments contrast markedly with the dark greenish gray matrix. The sandstones are poorly sorted, and the grains are typically angular.

The sandstones have been examined by Northrop (Parks, 1930, p. 72) who reported: -

"...the tuffaceous graywacke is an aggregate of quartz, plagioclase and untwinned potassium feldspar in relatively coarse grains, cemented together by a matrix constituting about one half of the rock and composed essentially of tuffaceous and andesitic material, with chlorite and iron ore as minor components."

The writer essentially agrees with the description given by Northrop. However, the abundant volcanic material - up to 30% of the total rock - constitutes discrete rock fragments rather than the main bulk of the matrix as suggested by Northrop. The matrix, which binds the quartz, plagioclase, potassium feldspar, chert, quartzite and volcanic fragments together, is composed almost entirely of finely comminuted quartz, feldspar, and chlorite, with minor amounts of muscovite, iron oxide, carbonate, shale fragments and volcanic detritus. The writer would prefer therefore to consider the sandstones as volcanic graywackes derived from the normal erosion of older tuffs and flows (epiclastic) rather than tuffaceous graywackes, a term which implies that the rock is primarily of pyroclastic origin. Diagenetic change is evident within the sandstones, chlorite is abundant in the matrix, and peripheral alteration of the volcanic fragments has resulted in indistinct boundaries between fragments and matrix.

The volcanic fragments are of three main types:

1. Welded tuff:- relict outline of shards and flow structure visible in thin-section; slight differences in iron coloration outline the original texture; under crossed nicols faint texture is still visible, fragments consist of a pepper and salt mosaic of microcrystalline particles.
2. Devitrified fragments:- pale brown in thin-section with specks of magnetite common, no original texture visible; between crossed nicols the fragments consist of a pepper and salt mosaic of microcrystalline particles, with scattered phenocrysts of quartz and feldspar. This is the most common variety.
3. Andesite fragments with a microcrystalline trachytic texture.

Arkosic sandstones are locally found interbedded with graywacke, and are best seen at a sharp right angle bend on North Port-Daniel river approximately 2,000 feet upstream from the confluence of Appel brook and the main river.

The Mictaw detrital rocks appear to decrease in overall grain size to the southwest, grading from conglomerates in the east, through sandstones, to graptolitic shales in the southwest. The greenish black shales, unlike the massive sandstones, are fissile and commonly slickensided.

Calcareous septarian nodules are locally found within the shales along Middle Port-Daniel river, approximately 1 mile above its mouth.

All of the Mictaw fossils collected to date have come from the banks of Middle Port-Daniel river, below the mouth of Mictaw brook (Table 2). The writer visited this fossil locality in 1961, and collections were made at two locations 3,000 feet apart. The first collection (Y-56-1F-graptolites; Y-56-2F-others) was made at the approximate location indicated by Badgley (1956, Map 1096), 3,000 feet downstream from the mouth of Mictaw brook. The second collection (Y-56-3F) was made just within the western limit of the area under investigation, 6,000 feet below the mouth of Mictaw brook (Maps 1568 and 1568-C).

W.B.N. Berry reported seven species of graptolites indicating a Trenton age for the Mictaw Group. A few other fossils submitted to A.J. Boucot were poorly preserved and did not permit precise dating.

Honorat and Matapédia Groups

Previous Work

The Ordovician rocks north of the North Grand-Pabos fault were first studied by Kindle (1936), who assigned them to the "Pabos formation". The unit was traced by him almost as far east as Grande river, where it is overlain by the flat-lying Bonaventure Formation. Kindle assigned this unit to the Upper Ordovician on the basis of fossils. He also mapped a slightly different assemblage of Ordovician strata north of the Pabos Formation, in the east-west Percé-Grande river belt. This unit, known as the Whitehead Formation, had been studied locally at Percé by Schuchert and Cooper (1930) and by Cooper and Kindle (1936) whose paleontological evidence showed fairly conclusively that this unit was also Upper Ordovician in age.

Alcock (1935, pp. 24-26) correlated both the Whitehead and the Pabos Formations with the "Matapédia series" of western Gaspé. McGerrigle (1950, p. 30) concluded that although both formations could be mapped separately, there was no sharp line of division between them, and that the Whitehead should be considered as an upper and more calcareous phase of the Pabos.

Skidmore (1958) suggested that only part of the Ordovician belt exposed in the Honorat West area should be correlated with the "Matapédia series", (referred to as the "Matapédia group" by Skidmore). He recognized a change between "silty and argillaceous limestones" and "a fairly pure limestone" within the Matapédia Group, which in his opinion

Table 2. - THE MICTAW FAUNA

DATE OF COLLECTION	COLLECTOR	LOCALITY	FOSSILS IDENTIFIED BY	REPORTED IN	FOSSILS IDENTIFIED	INTERPRETED AGE
1843	Logan, W.E.	Middle Port-Daniel river	Logan, W.E. Fossils lost in shipwreck	Logan (1846-p.42) Schuchert and Dart (1926,p.42) Parks (1930,p.72)		Ordovician
1927	Northrop, S.A.	Middle Port-Daniel river R. VII and VIII below mouth of Mictaw brook	Ruedemann, R.	Northrop(1939,p.12) Ruedemann (1947, p. 74) *Foerste (1936 (p.32: Pl.5, Fig.1	13 species of graptolites Cephalopod (new species) Several genera of poorly preserved brachiopods * <u>Gaionocerina ? danielensis</u>	Trenton-Early Eden
1928	Kindle, E.M. Kindle, C.H. Pratt, G.M.	Middle Port-Daniel river	Ruedemann, R.	Ruedemann (1947)	<u>Dicellograptus minimus</u> n. sp. <u>Dicranograptus</u> sp. <u>Diplograptus (Orthograptus) rugosus</u> Emmons var. <u>apiculatus</u> Elles and Wood var. <u>Climacograptus</u> cf. <u>tenuis</u> Rued.	Black River - Trenton
1931	Alcock, F.J.	Middle Port-Daniel river	Ruedemann, R.	Alcock (1935)	<u>Dicellograptus minimus</u> var. <u>Dicranograptus</u> sp. <u>Diplograptus (Orthograptus) rugosus</u> Emmons. var. <u>apiculatus</u> E. and W.var <u>Climacograptus</u> cf. <u>tenuis</u> Rued. Brachiopods - <u>Schizambon</u> sp. <u>Lingula</u> cf. <u>progne</u> Species of <u>Conulariidae</u> probably <u>Conularia</u> sp.	Black River - Trenton
				Northrop (1940, p. 1974)	Reported on the combined fauna to date "the fauna totals 27 species including 17 graptolites (examined by Ruedemann) 8 brachiopods, 1 conularid and 1 cephalopod. This is a new assemblage of two forms, <u>Diplograptus amplexicaulis</u> and <u>Climacograptus spiniferus</u> - being definitely known elsewhere".	Trenton - Utica
1961	Ayrton, W.G.	S.bank, Mid. Pt.- Daniel river, R. VII, Lt. 17. Pt.- Daniel Twp. 3,000' below mouth of Mictaw brook	Berry, W.B.N.	This report	Y-56-1F <u>Dicellograptus</u> sp. <u>Diplograptus</u> sp. (Slender form similar to one from "Ribbon Rock" in Aroostook County, Maine) <u>Glossograptus ciliatus</u> var. <u>debilis</u> <u>Glyptograptus</u> ? sp. <u>Leptograptus</u> ? sp. <u>Orthograptus truncatus</u> cf. var. <u>intermedius</u> <u>Orthograptids of the truncatus group</u> (one common form is long and slender)	Trenton - zone of <u>Orthograptus truncatus</u> var. <u>intermedius</u>
			Boucot, A.J.		Y-56-2F Orthoceroid Linguloid	Ordovician
		S.bank, Mid. Pt. Daniel river, R. VI, Lot 20, Pt.- Det. Twp. 6,000' below mouth of Mictaw brook	Berry, W.B.N.		Y-56-3F <u>Dicranograptus</u> ? sp. <u>Orthograptids of the O. truncatus type.</u>	Late Middle Ordovician Probably Trenton
			Boucot, A.J.		Pelecypod	Ordovician

probably corresponded to the Pabos and Whitehead Formations, respectively. However, the two facies were not sufficiently distinct to be mapped separately. Skidmore assigned the remaining predominantly clastic Ordovician strata to a new unit called the Honorat Group. The writer visited typical exposures of both the Matapédia and Honorat Groups with Skidmore in 1961, along the Trans-Gaspesian Highway north of New Richmond. During the same summer, Skidmore visited the Chandler - Port-Daniel area and examined the Ordovician section along Sèche river. It was agreed that the lithologic character of both the Matapédia and Honorat Groups changes little eastward from the New Richmond and Honorat West areas to the Chandler - Port-Daniel area.

Sanschagrín (1963) mapped the Grande Rivière area which is the adjacent eastern quadrangle to the Chandler - Port-Daniel area. He recognized three separate lithologic assemblages within the Matapédia Group, but did not recognize the Honorat Group as such. Skidmore mapped the Percé area during the summer of 1962, and is currently studying the complex problem of Ordovician correlation in southern Gaspé.

In conclusion, therefore, the southern part of the original area mapped by Kindle (1936) has been recently remapped by Skidmore (unpublished Percé area), Sanschagrín (1961) and the writer. On the basis of this work, it is now necessary to divide Kindle's vaguely-defined Pabos Formation in order to correlate the strata with the well-established lithologic units traced from the west. It is appropriate therefore to abandon the term Pabos Formation in favor of the terms Matapédia and Honorat Groups as proposed by Skidmore (1958).

Honorat Group

The Honorat Group, which crops out in the northern part of the area, is bounded to the north by the Matapédia Group and is in contact with the Silurian Raudin Group along the North Grand-Pabos fault. The bulk lithology of the group comprises dark gray to black siltstones and mudstones which are predominantly non-calcareous. The siltstones weather dove-gray or, locally, rusty. Massive beds 2 feet thick of gray, slightly calcareous medium- to coarse-grained sandstone crop out locally (e.g., near the mouth of Sèche river in the northeastern part of the area). Minor silty limestones are present. The unit is well bedded, the beds being characteristically 1 inch to 6 inches thick.

The Honorat Group is in fault contact with the Matapédia Group in the northeastern part of the area. The fault zone is several hundreds of feet wide and comprises highly sheared and slickensided non-calcareous black shales, and is well exposed approximately 1 mile upstream from the mouth of Sèche river. Here two contorted and altered intermediate

dikes, 3 feet wide, are present within the fault zone. The contact between the Honorat and Matapédia Groups appears to be gradational west of Little Chute (Fall) brook.

West of the North Grand-Pabos, the relationship between the Matapédia and Honorat Groups is complicated by faults and igneous intrusions. Two large blocks of Honorat siltstones, dislocated by faulting, lie along the northern side of the North Grand-Pabos fault. At the extreme western limit of the area, a subsidiary northwest trending fault parallel to McCrea brook outlines the eastern end of another large Honorat block north of the fault.

A thin wedge of poorly exposed Honorat Group crops out south of the North Grand-Pabos fault in the western part of the area mapped. It is probable that these strata belong to the same belt of Honorat strata mapped to the west by Skidmore (1958).

The contact with the Silurian Raudin Group was not observed. The similarity in stratigraphic position beneath the Silurian suggests that the Honorat Group could be correlative with the Mictaw Group, which crops out approximately 4 miles to the south. If this were so, the Honorat Group would be Middle Ordovician in age. However, none of the volcanic graywackes so characteristic of the Mictaw Group have been observed by the writer in the Honorat Group. On the other hand, Skidmore (personal communication, 1962) has found Honorat conglomerates to the west which "are usually composed entirely of well-rounded chert and volcanic pebbles". No fossils were found in the Honorat Group within the area mapped, but the few fossils found by Skidmore (personal communication, 1962) 55 miles or so to the west near Carleton and Saint-Omer indicate that a tentative Upper Ordovician (Richmondian) age may be assigned to the unit.

The Honorat Group is probably extremely thick, and Skidmore (1958) has suggested 14,000 feet in the Honorat West area. No estimate of the thickness has been attempted within the Chandler - Port-Daniel area because the unit is deformed and has been affected by major faulting.

Matapédia Group

The Matapédia Group crops out in the extreme northern part of the area mapped, and is bounded to the south by the Honorat Group. The unit comprises dark blue-gray, brownish gray weathering limestones, veined with white, sparry calcite. In the northwestern part of the area, west of Little Chute brook, the base of the Matapédia Group is marked by a 1,000-foot thick zone of sandy and silty limestones which appears to be transitional between the siltstones of the Honorat Group and the typical

purier limestones of the Matapédia Group. In the northeastern part of the area this zone is missing.

Since the structure across the Ordovician belt to the north of the area under investigation is at present unknown, it is difficult to determine exactly the thickness of the unit. Sections measured across the south limb of a syncline along North Grand-Pabos river and Rocky brook indicate a minimum thickness of 9,500 feet. Skidmore (1958) believed that this group had a thickness of at least 8,000 feet in the Honorat West area 9 miles to the west. In the northeastern part of the area, only partial sections of the Matapédia Group have been examined.

Reconnaissance mapping to the north of the area under investigation across the regional strike of the Ordovician band indicates that limestones of the Matapédia Group merge with limestones which McGerrigle (1950) mapped as the Whitehead Formation. These limestones to the north are typically ribboned (half-inch banding between pure limestone and argillaceous limestone beds), and are not as strongly foliated as those close to the Honorat Group in the Chandler - Port-Daniel area.

The limestones of the Matapédia Group have been intruded by a small plug of diorite in Raudin township. Because of the heavily wooded nature of this area, no contact relationships have been observed. Exposures of recrystallized limestone occur immediately northwest of the igneous body, suggesting the presence of a contact aureole.

No fossils have been found in this unit in the Chandler - Port-Daniel area, but, since the Matapédia Group and the Upper Ordovician Whitehead Formation appear to be one and the same, an Upper Ordovician age has been assigned to the Matapédia Group.

Silurian

The Silurian strata within the area mapped have been divided into two groups which crop out in three distinct areas:

1. Chaleur Bay Group.
 - A. Port-Daniel - Gascons area.
 - B. Weir Township area (south of Raudin fault).
2. Raudin Group (north of Raudin Fault).

The formations of the Chaleur Bay Group in the Port-Daniel - Gascons area have been traced to the west and north by Badgley (1956), and into Weir township by the present writer. The previously undifferentiated

strata north of the Raudin fault cannot be correlated with the Chaleur Bay Group and are assigned to a new unit, the Raudin Group.

Chaleur Bay Group

It is apparent from the literature (Schuchert and Dart, 1926; Northrop, 1939; Badgley, 1956; Skidmore, 1958; Burk, 1959; this paper) that the pre-Gascons stratigraphy of the Chaleur Bay Group is confused. It is the opinion of the writer that all of the exposed sections should be examined by one worker in order to clarify the ambiguous terminology and to explain the stratigraphic relationships.

Port-Daniel - Gascons Area

The Silurian strata, which crop out near Port-Daniel and Gascons, were first described by Logan (1846; 1863, pp. 442-445). Ells (1883, pp. 14D-15D) reported on them briefly.

Schuchert and Dart (1926) were the first workers to examine the area in detail. They outlined the structure and described the formations, which, with minor changes, are used today. Northrop (1939) described the stratigraphy and structure of the "Chaleur Series" in the Port-Daniel - Noir Cape area, and the greater part of his paper is devoted to the various aspects of the paleontology. Detailed quadrangle mapping by Badgley (1956) and Skidmore (1958) modified and extended the mapping done by Northrop (1939). Burk (1959) examined the Chaleur Bay Group as part of a regional study of the various isolated bands of Silurian outcrop in Gaspé.

In order to conform with the mapping of Badgley (1956) and Skidmore (1958), the writer retained the original formational terminology used by Schuchert and Dart (1926). The Anse Gascon Formation, proposed by Northrop (1939) for the lower part of Schuchert and Dart's La Vieille Formation is not used. Because only 15 days were available for study of this area, mapping was limited to a detailed structural examination of several problematical areas indicated on Schuchert and Dart's (1926) and Northrop's (1939) maps.

Structural control in this area is reasonably good, coastal exposures are excellent, although at places inaccessible, and a good section is exposed along Anse-à-la-Barbe river. Some good outcrops are found along the main highway (Highway 6), and along the railroad, but inland exposures generally are poor. Because limestones of the La Vieille and West Point Formations are "ridge-formers", they can be easily traced on aerial photographs.

Table 3. - SUMMARY OF SILURIAN STRATIGRAPHY IN THE PORT-DANIEL - GASCONS AREA

AGE		ROCK-STRATIGRAPHIC UNITS	L I T H O L O G Y	STRATIGRAPHIC RELATIONSHIPS	THICKNESS (in feet)		
SYSTEM	SERIES						
CARBONIFEROUS		BONAVENTURE FORMATION	Reddish-brown sandstone and conglomerate with calcareous cement; Boulders in conglomerate up to 4 ft. in diam., average 6" diam.; sub-angular to well-rounded; fragments closely reflect underlying lithology. No fossils found.	Rests with pronounced angular unconformity on the Silurian and older units; appears to fill shallow post-Silurian valleys; horizontal to very gently dipping.	50		
S I L U R I A N	L U D L O W	U P P E R	INDIAN POINT FORMATION	Pale brown to dark greenish-gray impure siltstones and sandstones; beds 1" - 1' thick; thin beds of crinoidal limestone up to 3' thick; reddish-brown, slightly calcareous micaceous siltstones with peculiar polygonal weathering pattern; <u>Laonurus</u> locally common.	Top of unit not seen; gradational contact with West Point Formation.	194 (1) 456 (2)	
			WEST POINT FORMATION	Pink, thick-bedded crinoidal limestone; knobby coralliferous limestone and bioherms; thin-bedded limestone (4" - 6"), <u>Stromatopora</u> common; red-weathering sandy shales, green sandy shales; mud-cracks and ripple-marks found locally.	Base marked by thick-bedded pink crinoidal limestones overlying the Bouleaux Fm. Contact is hackly and uneven as if considerable solution of the limestone had taken place.	1445 (1) 1714 (2) 1673 (3)	
			BOULEAUX FORMATION	Green, fine-grained, thin-bedded, impure sandstone and siltstone; green calcareous shales and maroon weathering shales; coralliferous limestones, corals and stromatoporoids weather out in relief; thin nodular limestone beds; greenish silty limestone. Maroon and yellowish lisogang rings very common.	Bouleaux Fm. represents transitional zone between the West Point and Gascons Fms. Gradational contact with underlying Gascons Fm. Base of Bouleaux is difficult to define, arbitrarily taken at horizon where corals and stromatoporoids become an important part of the lithology.	888 (1),(2) 733 (3)	
	L L A N D O V E R I A N	C H A L E U R	L O W E R	GASCONS FORMATION	Green and maroon sandstones and siltstones, thin-bedded to massive; dark gray limestone; coral reef zone found at mouth of Chouinard Brook (6' - 8' thick). <u>Laonurus</u> common.	Gradational contact with La Vieille Fm.; contact taken as first appearance of the gray, fossiliferous nodular limestones of the La Vieille Fm.	1860? (1) 1890 (2)
				LA VIEILLE FORMATION	<u>Upper Member</u> - pure, dark gray, fossiliferous nodular limestone, beds 4" - 3' thick, becoming slightly muddy near top. <u>Lower Member</u> - Muddy greenish-gray limestone (2" - 3" beds) locally nodular with green shaly partings.	Gradational contact with Clemville Fm.; base defined as top of first hard quartzose sandstone bed of the Clemville Fm. Contact complicated by faulting at Anse à Pierre Loiselie.	285 (1) 405 (2)
				CLEMVILLE FORMATION	Buff quartz-pebble conglomerate (2" pebbles) at base, interbedded with glauconitic quartzose sandstones. Greenish-brown impure quartz-rich sandstones with large corals; thin-bedded sandstones and green shales. A few horizons of dark gray nodular limestones with green shaly partings. (Description applies only to section at Anse-à-Pierre Loiselie.)	Rests with pronounced angular unconformity on the Maquereau Group. Not observed overlying the Mictaw Group. (N.B. Equivalent to the Anse Gascon Fm. of Northrop, 1939.)	168 (1) 104 (3)
MIDDLE ORDOVICIAN AND OLDER	MICTAW AND MAQUEREAU GROUPS	Tentative correlation after BERRY: A.J. Boucot (Personal communication, 1962).		(1) Schuchert and Dart, (1926). (2) Northrop, (1939) (3) Burk, (1959)			

The structure of the area is one of simple folds complicated by faults. At Anse-à-Pierre-Loiselle (previously known as Anse-à-la-Vieille), the Silurian Clemville Formation overlies the Maquereau Group with pronounced angular unconformity and the Mictaw Group is absent. The folded Silurian strata are unconformably overlain by the flat-lying Bonaventure Formation on the cliffs above.

Westward from this point, the Clemville, La Vieille and Gascons Formations strike inland, and two sub-parallel ridges of La Vieille limestone can be traced by scanty outcrop control and on aerial photographs. The Port-Daniel River fault has repeated the Clemville and La Vieille Formations along Anse-à-la-Barbe river. The fault explains the presence here of green, non-calcareous, sandy siltstone (very poor outcrop on west bank), which strongly resembles the siltstone of the Mictaw Group. It also explains the occurrence of green non-calcareous sheared graywacke quartzite along the range road 1 mile northwest of the village of Gascons; this rock is believed to belong to either the Mictaw or Maquereau Group.

The two poor outcrops of the La Vieille Formation found on the jeep road north of the fault are evidence that the northern band of limestone extends at least 1/2 mile west of Anse-à-la-Barbe river.

The Bouleaux and West Point Formations crop out on the east side of Anse-aux-Gascons and on the west side of the bay at Reddish point. The strata appear to occupy the southerly-dipping north limb of an east-west trending syncline, the south limb of which presumably crops out under the sea. Going from east to west around Reddish point, the dip of the strata becomes progressively steeper, until at Actesons' cove it is almost vertical. Here, the attitude of the beds changes abruptly on either side of a major fault which extends 3 miles west to McInnes cove. This fault was first recognized by Schuchert and Dart (1926, p. 37), who believed that at McInnes cove the eastern or Pillar Point block had dropped about 700 feet. They reasoned that the lower pink limestone of the West Point Formation abutted against the older Gascons Formation, cutting out the Bouleaux Formation. It is the opinion of the writer that the lower pink limestone of the West Point Formation abuts against the Indian Point Formation, that only the top of the West Point Formation has been cut out by the fault and that the Pillar Point block rose perhaps as much as 1,500 feet. The two interpretations of the fault movement are based on two different interpretations of the local stratigraphy.

The writer has reexamined this area and arrived at the following conclusions:

1. The West Point Formation at Cap de l'Enfer is definitely sheared, but no syncline was observed. All sedimentary structures from McInnes cove to Cap de l'Enfer indicate that the youngest beds are to the east; the sedimentary

structures include well-developed mudcracks, oscillation ripple marks, and many graded Crotalocrinus beds.

2. There is no structural evidence for a West Point Formation synclinal core along the east-west outcrop band north of McInnes cove. All the evidence, including the readings given by Northrop (1939, p. 42, p. 50) favor an unfolded band of West Point Formation, which strikes approximately N.75°W., and dips gently to the southwest.
3. The section on the west side of McInnes cove, which was assigned to the Bouleaux Formation by Schuchert and Dart actually belongs to the upper part of the West Point Formation.
4. The recognition of the Gascons Formation by Schuchert and Dart, and Northrop, on the basis of loose slabs containing Taonurus is of dubious value. Remembering that Taonurus is just a gastropod trail or worm burrow, environment, and not time, must be the governing factor controlling the formation of these markings. It is interesting to note that Northrop (1939, pp. 44-45) also recorded Taonurus in Member VI of the West Point Formation at West point. Member VI is near the top of the Formation, and comprises red-weathering sandy shales, and is similar to the lithology described by Schuchert and Dart (1926, p. 51) at McInnes cove. Northrop (1939, p. 52) also recorded Taonurus in some of the muddy sandstones of the Indian Point Formation.

The stratigraphic evidence is admittedly inconclusive. It is assumed by the writer that the strata on the west side of McInnes cove belong to the upper part of the West Point Formation. Consequently, some similarity should be apparent between this section and the type section at West point (Schuchert and Dart, 1926, p. 52; Northrop, 1939, pp. 44-50). Some similarity does exist, but no key beds or zones can be traced with assurance. This might be expected considering the lithologic types and the depositional environments involved. Reef limestones, reef talus, red weathering sandy shales, knobby crinoidal limestones, mud-cracked thin-bedded muddy sandstones — all suggest shallow water deposition with rapid facies changes and variations in thicknesses.

If, as suggested by Schuchert and Dart, and Northrop, the strata belong to the Bouleaux Formation, some similarity with the Bouleaux type section at West point (Schuchert and Dart, 1926, p. 49) would be anticipated. However, as with the West Point Formation, no reliable correlation can be made.

In review, therefore, it is apparent that Taonurus is not restricted to the Gascons Formation, and that the structural evidence supports the concept of a simple faulted basin, rather than the complicated

structure proposed by Schuchert and Dart, and Northrop. It follows that the Indian Point Formation, and not the Gascons Formation, underlies the lowland area north of McInnes cove.

Weir_Township Area

This area lies immediately south of the Raudin fault and immediately north of the area mapped by Badgley (1956). Previous mapping has either been directly concerned with economic occurrences of the Weir Township serpentinite (Harvie, 1921; Alcock, 1935, p. 11; McGerrigle, 1942; 1953) or with regional mapping (Alcock, 1935, Map 330A).

The Silurian strata lie along strike with those mapped by Badgley (1956), and the Clemville, La Vieille and Gascons Formations have been recognized as well as a new unit, the Weir Formation. The lithology, stratigraphy, thickness, age relationships, correlation and paleontology are represented on Fig. 2, and the structure is shown on Map 1568. The Chaleur Bay Group fauna of this area also is listed in Table 4.

Weir Formation:- The most important addition to the stratigraphic column has been the recognition of the Weir Formation, a thin wedge of Lower Silurian strata lying conformably beneath the Clemville. The unit crops out only along the headwaters of Mictaw brook and "La Grande-Fourche" brook (local name). Rocks of similar lithology, occupying an analogous stratigraphic position, have been mapped as basal Clemville by Badgley (1956) and are discussed in the sequel.

The Weir Formation is composed predominantly of dark gray-green siltstones, locally interbedded with quartz-pebble conglomerate, reddish gray arkosic sandstones, and minor silty limestone. The green siltstones are characteristically well bedded (4-inch to 1-foot beds), and locally calcareous and fossiliferous. The interbedded conglomerates are up to 1 foot thick and typically contain subangular pebbles (1/2 inch average diameter) of jasper and milky quartz, in part stained hematitic red, set in a dark green graywacke matrix; minor amounts of smaller white-weathering feldspar grains are present. The reddish gray arkosic sandstones, which also occur in beds up to 1 foot thick, comprise approximately 30% pink feldspar, 40% clear quartz, 5% rock fragments and 25% chloritic matrix.

On Mictaw brook, there is a total thickness of 2,180 feet of strata, but on La Grande-Fourche brook the thickness is only 635 feet. The Weir Formation, therefore, thickens, at least locally, to the southwest. The contact of the Weir Formation with the overlying orthoquartzites of the Clemville Formation is both gradational and conformable.

Table 4. - CHALEUR BAY GROUP FAUNA

<p>COLLECTION No. 1 - (T-29-OF; W-5-1F) West Branch Mictaw Brook, Lot 17, R. XIII Port-Daniel Twp., Bonaventure County <u>Weir Fm.</u></p> <p><u>dalmanellid</u> "Dolerorthis"? sp. tetracorals <u>Stricklandia lens</u> cf. <u>forma typica</u> "Meristina" cf. "M." <u>crassa</u> <u>Catazyqa</u> sp. <u>Mendacella</u> sp. "Dalmanella" sp. <u>Pycnactis</u> n. sp. <u>rhychonellid</u> <u>Paucicrura</u>? sp. <u>rhipidomellid</u></p> <p>Lower Llandoverly, A₃-A₄</p>	<p>COLLECTION No. 5 - (T-23-7F, B,C,D,E) Grande-Fourche Brook, Weir Twp. (unsurveyed), Bonaventure Co. <u>Weir Fm.</u> (lowermost beds) T-23-7F-B (130 ft. downstream from falls) <u>Leptaena</u> "rhomboidalis" <u>dalmanellid</u> "Dolerorthis" sp. <u>Platystrophia</u> sp. stropheodontid? chonetid? trilobites <u>Drummockina</u>? sp. plectambonitid atrypcean? T-23-7F-C and D (C is 160 ft. downstream from falls) <u>dalmanellid</u> "Dolerorthis" sp. <u>Platystrophia</u> sp. trilobite bryozoan T-23-7F-D (180 ft. downstream from falls) "Dolerorthis" sp. <u>dalmanellid</u> T-23-7F-D and E <u>dalmanellid</u> "Dolerorthis" sp. atrypcean? T-23-7F-E (190 ft. downstream from falls) "Dolerorthis" sp. <u>dalmanellid</u></p> <p>Ashgill or Lower Llandoverly</p>	<p>COLLECTION No. 7 - (T-28-OF) Grande-Fourche Brook, Weir Twp. (unsurveyed), Bonaventure Co., <u>Weir Fm.</u> (615' upstream from falls) <u>Eocoelia</u> cf. <u>E. hemisphaerica</u> Upper Llandoverly, C₃-C₅</p>
<p>COLLECTION No. 2 - (T-12-2F) West Branch Mictaw Brook, Lot 17, R.XIII, Port-Daniel Twp., Bonaventure Co. <u>Weir Fm.</u></p> <p><u>Eocoelia</u> cf. <u>E. quebecensis</u> <u>Eostropheodonta</u> sp. <u>rhychonellid</u> orthoceroid</p> <p>Lower Llandoverly</p>	<p>COLLECTION No. 6 - (T-23-7F-A) Grande-Fourche Brook, Weir Twp. (unsurveyed), Bonaventure Co., <u>Weir Fm.</u> (30 ft. downstream from falls)</p> <p><u>Mendacella</u> sp. <u>Eostropheodonta</u> sp. <u>rhychonellid</u> Lower Llandoverly</p>	<p>COLLECTION No. 8 - (B-36-2F) North Port-Daniel River, Lot 36, R.II, Weir Twp., Bonaventure Co. <u>La Vieille Fm.</u> (Lowermost beds)</p> <p><u>Eocoelia hemisphaerica</u> <u>Mesodouvillina</u>? sp. <u>Favosites</u> sp. B? <u>Syringopora</u> sp. B.</p> <p>Upper Llandoverly - pre-La Vieille (C₃ - C₅)</p>
<p>COLLECTION No. 3 - (T-29-4F) West Branch Mictaw Brook, Lot 16, R.XIV, Port-Daniel Twp., Bonaventure Co. <u>Weir Fm.</u></p> <p><u>Protomegastropia</u> sp. <u>Eocoelia</u> cf. <u>E. hemisphaerica</u> <u>rhychonellid</u></p> <p>Upper Llandoverly, C₃-C₅</p>	<p>COLLECTION No. 9 - (Y-34-3F) North Port-Daniel River, Lot 36, R. III, Weir Twp., Bonaventure Co. <u>La Vieille Fm.</u></p> <p><u>Alveolites</u>? sp. <u>Cladopora</u> sp. <u>Favosites</u> sp. A <u>F.</u> sp. B? <u>F.</u> sp. heliolitid coral ?"<u>Columnaria</u>" <u>coralliferum</u> (Hall)?</p> <p>Ludlow (?)</p>	<p>COLLECTION No. 10 - (B-41-6F) North Port-Daniel River, Weir Twp. (unsurveyed), Bonaventure Co., <u>La Vieille Fm.</u> <u>Favosites</u> sp. C. Late Ordovician, Silurian or Devonian</p>

cf. Map 1568-A for locations

WEIR TOWNSHIP AREA

Fossils identified by A.J. Boucot
and W.A. Oliver

The Weir Formation is older than any Silurian strata recorded in Gaspé to date. Fossil collections F-1 and F-2 made along Mictaw brook indicate that a Lower Llandovery (A_3 - A_4) age can be assigned to the lower part of the unit. Boucot (personal communication, 1962) reported that:-

"The two collections from the west branch of Mictaw brook are of Lower Llandovery age. Collection No. 2, (T-12-2F) contains Eostropheodonta and a primitive type of Eocoelia. The Eocoelia, however, could go as high as C_1 - C_2 , but the Eostropheodonta is of a type I would expect to find in the Lower Llandovery, rather than the Upper or Middle. Collection No. 1 (T-29-OF)... contains a critical Stricklandia, which suggests assignment to the A_3 - A_4 portion of the Lower Llandovery, that is, the upper half of the Lower Llandovery. In any event the fauna taken as a whole suggests a position very low in the Silurian, certainly in the Lower Llandovery, and rules out the possibility of an Ashgillian assignment...".

Boucot also assigned a Lower Llandovery age to Collection No. 6 from La Grande-Fourche brook and reported that Collection No. 5 could be either Lower Llandovery or possibly Ashgill (Upper Ordovician). Collection No. 5 is being reexamined in detail, but the results are not available at the time of writing.

Boucot has assigned the upper part of the Weir Formation to the Upper Llandovery:

"Collection No. 4 (T-29-5F) and No. 3 (T-29-4F) are of C_3 - C_5 age, as evidenced by the presence of Eocoelia cf. E. hemisphaerica, as well as Protomegastrophia in Collection No. 3." (Mictaw brook)

"Collection No. 7 (T-28-OF) is of C_3 - C_5 age on the basis of Eocoelia cf. E. hemisphaerica." (Grande-Fourche brook)

No marked structural, stratigraphic or lithologic break was observed between the upper and lower parts of the Weir Formation, but it may be possible to outline biostratigraphic zones when a more detailed paleontological examination of the strata is made. The complete list of fossils identified within the Weir Formation is given in Table 4.

Badgley (1956, p. 10) mapped 285 feet of green shales and thin-bedded, buff-weathering limestone with interbedded shales along Middle Port-Daniel river, and approximately 100 feet of green shales with interbedded sandstones along Little Port-Daniel river. These strata occupy a stratigraphic position at the base of his Clemville Formation. Reexamination of these strata may indicate that they should be assigned to the Weir Formation.

Much has been written about a possible major unconformity between Silurian and Ordovician strata in Gaspé. Crickmay (1932) reviewed the evidence of Taconic orogeny in the Matapédia valley, and Burk (1959) described the unconformity at a number of locations. The Weir Formation (Lower Llandovery) comprises the oldest Silurian strata mapped in Gaspé, and therefore the relationship between these rocks and the underlying Mictaw Group (Middle Ordovician) is of regional significance.

Unfortunately, the contact is nowhere well exposed. On ascending Mictaw brook, the last outcrop belonging to the Mictaw Group comprises highly sheared, drag-folded and slickensided sandstones and dark shales, suggesting the presence of a fault (Fig. 2, Section 1). On La Grande-Fourche brook, the contact with the underlying Mictaw Group is poorly exposed. There is no evidence of a fault here and approximately 490 feet of Mictaw strata immediately underlying the Weir Formation appear to be conformable (Fig. 2, Section 2). But the strata beneath this conformable section have the complicated folding characteristic of the Mictaw Group.

Three explanations of the relationships observed in Weir township are possible. The first hypothesis would favor continuous deposition during Ordovician and Silurian. If this were the case, then the complicated folding observed in the Mictaw Group and the relatively simple folding in the Chaleur Bay Group would have most likely been formed by the same period of deformation (Acadian).

The second hypothesis favors continuous deposition across the Ordovician-Silurian boundary, but there is no apparent reason why a major break should not be present between Upper and Middle Ordovician strata for example. If such a break occurs, it has not been observed in the field, nor is there any well-defined structural support. It should be noted that no Upper Ordovician strata have as yet been assigned to the Mictaw Group, but, since fossils (Middle Ordovician) have been found at one locality only, approximately 6 miles to the southeast of the Weir Township area (Map 1568-C), it is conceivable that part of the unit could be considerably younger.

The third hypothesis, the one preferred by the writer, is that an unconformity does exist between the Mictaw Group and the Chaleur Bay Group.

Clemville Formation:- It should be noted that the Clemville Formation has been used differently by different workers (Schuchert and Dart, 1926; Northrop, 1939; Badgley, 1956; Skidmore, 1958; Burk, 1959). In this paper it is defined as those quartzites, sandstones and siltstones, which underlie the limestones of the La Vieille Formation, and which overlie the green siltstones of the Weir Formation. As mentioned previously, a complete reexamination of all pre-Gascons sections is warranted, especially since Lower Llandovery strata have now been recognized.

The Clemville Formation crops out in two northeast-trending bands, one immediately overlying the Weir Formation south of the Weir Township serpentinite, and the other north of the serpentinite.

The Clemville overlying the Weir Formation comprises very hard, buff-weathering, pale gray orthoquartzites. These medium- to fine-grained strata are typically well bedded (1 foot average) with minor interbedded quartz-pebble conglomerates. They are commonly crossbedded and display ripple-marks. No fossils were found in these rocks. The top of the Clemville Formation in this band is marked by calcareous gray siltstones which grade upwards into the purer limestones of the overlying La Vieille Formation (Fig. 2, Sections 1 and 2).

The unit is approximately 1,725 feet thick along Mictaw brook, thinning to 725 feet along La Grande-Fourche brook, and is only 90 feet thick along North Port-Daniel river. At the last locality, the Clemville directly overlies the Mictaw Group since the Weir Formation is absent (Fig. 2, Section 3). A 10-foot zone of quartz-pebble conglomerate with phyllite fragments marks the base of the unit, but exposures are poor and it is questionable whether an unconformable relationship really does exist. However, there are a few degrees difference in strike between the Ordovician and the Silurian strata, and the underlying Mictaw is more intensely folded than the overlying Silurian.

The band of Clemville Formation north of the serpentinite occupies the crest of a faulted anticline and is approximately 1,400 feet thick. Here, the lower part of the unit comprises well-bedded calcareous sandstones, pale gray, fine-grained orthoquartzite and calcareous siltstone, all of which have a pronounced rusty weathering. The upper part of the unit consists of rusty weathering, gray-green slightly calcareous siltstone.

La Vieille Formation:- There are three separate outcrop bands of La Vieille Formation in the Weir Township area. The southeastern band conformably overlies the Clemville Formation and crops out along the headwaters of North Port-Daniel river, Mictaw brook and La Grande-Fourche brook, but at the last two localities only the base of the formation has been observed. Along North Port-Daniel river, southeast of the Weir Township serpentinite, the complete La Vieille section, approximately 800 feet, has been observed (Fig. 2, Section 3). This strongly-foliated unit comprises thinly bedded, brown weathering, dark gray fossiliferous limestones (locally nodular) and black calcareous shales. Fossils collected from the limestones at the base of the formation (Table 4, Collection No. 8) indicate that a pre-La Vieille (C_3-C_5) post-Upper Llandovery age should be assigned to these strata. On the basis of lithology, however, they belong to the La Vieille Formation.

Approximately 850 feet of steeply-dipping, well-foliated dark gray limestone crops out along the northwest periphery of the Weir Township serpentinite. The fossils recovered from these strata are too poorly preserved to be of any use in regional correlation. The unit is probably an extension of a band of La Vieille limestone, mapped by Badgley (1956) approximately 10 miles to the southwest, which has a northeasterly strike. Lineaments on the aerial photographs support this reasoning. Severe local deformation in the form of tight, vertically plunging, chevron folds (approximately 7 inches in amplitude) has occurred at the contact with the serpentinite along North Port-Daniel river. It appears that some of the contact limestone has been mobilized, as the serpentinite is fractured and cut by stringers of dove-gray-weathered, white calcite, giving the rock a brecciated appearance across a 30-foot zone (Map 1568-D).

The third band of presumed La Vieille Formation crops out along both North Port-Daniel river and Grand-Ravin brook, immediately south of the Raudin fault. The band is located on the northwest limb of a faulted anticline and comprises some 1,500(?) feet of well-foliated, dark gray silty limestone; some of the limestone is somewhat nodular and, locally, poorly preserved colonial corals are found (Table 4, Collection No. 10). The precise thickness of the unit is not known, but it appears to be approximately twice as thick as either of the other two bands of La Vieille limestone found in the Weir Township area.

Gascons Formation:- The Gascons Formation crops out along North Port-Daniel river and along Nadeau brook southwest of the Weir Township serpentinite. The unit conformably overlies the La Vieille Formation, and comprises some 1,450 feet of well-foliated, greenish gray, calcareous siltstones and green chloritic non-calcareous siltstones, with minor interbeds of reddish arkosic sandstone and fine-grained, black orthoquartzite.

This band is probably the northeastern extension of a wide band of the Gascons Formation, which crops out approximately 6 miles to the southwest (Badgley, 1956).

A second band of supposed Gascons Formation (and possibly some unrecognized Bouleaux Formation) crops out along the headwaters of Grand-Ravin brook and North Port-Daniel river, immediately south of the Raudin fault. When more detailed mapping has been completed to the west, it should be possible to delineate the Bouleaux-Gascons and the Gascons-La Vieille contacts more accurately.

Raudin Group

The Silurian strata north of the Raudin fault cannot definitely be correlated with the rocks of the Chaleur Bay Group for three main reasons. Firstly, they have undergone more severe structural deformation than the Chaleur Bay Group; secondly, they present poor paleontologic information; and, thirdly, the distinct formational units of the Chaleur Bay Group are not recognized. Therefore, it is proposed to name this unit the Raudin Group (named after Raudin township).

The group can be traced as separate units from North Port-Daniel river (north of the Raudin fault) as far east as Long lake. East of Long lake, the unit comprises predominantly green and gray, phyllitic, calcareous siltstone and silty limestone, as well as dark gray, non-calcareous siltstone and minor interbeds of fine-grained orthoquartzite and calcareous red siltstone. Because of the poor exposure, uncertain structure and the strongly phyllitic nature of the unit east of Long lake, no attempt at subdivision has been made.

Six distinct mappable formations can be outlined within the Raudin Group. However, because of the uncertain structure and poor paleontologic evidence the chronologic stratigraphic succession has not been completely demonstrated. Consequently, formal stratigraphic names are not assigned although further work may clarify their relationships and permit the use of formation names.

	<u>Approx. Thickness in Feet</u>
a) Undivided	
b) Calcareous, fine-grained, quartzose sandstone; impure sandstone; minor rusty-weathering quartz-pebble conglomerate; dark gray calcareous sandy siltstone; dark gray limestone. Type locality - McNeil brook, also tributaries of Harrison brook. This unit resembles the Clemville Formation.	3,300
c) <u>Western Facies</u> : nodular, fossiliferous, dark gray limestone; dove-gray-weathering, black limestone; gray calcareous siltstone and minor quartzose sandstone. Type locality - McNeil brook. <u>Eastern Facies</u> : green, phyllitic, calcareous siltstone; dark gray limestone with green phyllitic intercalations. Type locality - north-flowing tributaries of North Grand-Pabos river, approximately opposite Rocky brook. This unit resembles the La Vieille and the Rankin Formations.	4,500
d) Purplish red calcareous slate and siltstone. Type locality - Ravin-Vert brook, also North Port-Daniel river.	600

	<u>Approx. Thickness in Feet</u>
e) Calcareous gray-green siltstone. Fine-grained gray orthoquartzite, and massive gray siltstone.	1,400 850
Dark gray calcareous siltstone, black limestone, locally nodular. Type locality - West Grand-Pabos river.	2,000
f) Pale, apple-green and gray calcareous sandy siltstone and slate, well foliated with characteristic rusty- weathering. Type locality - West Grand-Pabos river.	2,600
g) Dark gray limestone; greenish siltstone; becomes increasingly phyllitic when traced to east. Light gray recrystallized limestone along Raudin fault. Type locality - West Grand-Pabos river.	3,100

If this section has not been repeated by folding or faulting, it represents a total thickness of 18,350 feet. If the structure represents an unfaulted syncline, the total section would be approximately half or 9,175 feet. Skidmore (1958) calculated a total Silurian section of 10,050 feet in the Honorat West area; Badgley (1956) calculated a section of 7,688 feet in the New Carlisle area, and Northrop (1939) calculated a section of 6,509 feet for the Port-Daniel - Gascons area. From these three totals, the 9,175-foot total for the Raudin Group appears to be of the right order of magnitude, and it is likely that the section is repeated.

The fossils collected within the Raudin Group were identified by Drs. Boucot and Oliver, and have been listed in Table 5 and the fossil localities shown on Map 1568. Oliver (personal communication, 1962) stated that "some of the collections are most certainly Silurian and all of them may be Silurian". Dr. Oliver remarked on the absence of halysitid corals:- "Silurian coral collections without halysitids are unusual. Fourteen such collections as a unit are astounding...". Halysitids occur in all the formations of the Chaleur Bay Group (Northrop, 1939, p. 82) with the exception of Northrop's Anse Gascon Formation. They are "exceedingly common" in the La Vieille, Gascons and Bouleaux Formations (Northrop, 1939, p. 153).

Concerning Collections Nos. 17 and 18, Oliver reported that: -

"Two of the collections include several species in common with coral faunas recently studied by E.C. Stumm from northern Maine (Hardwood Mountain Fm.) and myself from the Lake Témiscouata area, Quebec (Mont Wissick Fm.). The Hardwood Mountain and Mont Wissick corals indicate a Wenlock or Ludlow age but Boucot's brachiopod studies indicate that this can be narrowed to the Ludlow. Except for the lack of halysitids, the following faunules (No. 17 and No. 18) are so similar to the previously studied ones that a Ludlow age is very probable."

<p><u>COLLECTION No. 15</u> - (W-11-1F)</p> <p>North-flowing trib. of North Grand-Pabos River, 1 1/4 miles west of Camp 13 Miles. Raudin Twp. (unsurveyed), Gaspé-South Co., Formation C.</p> <p><u>Cladopora</u> sp.</p> <p>Silurian or Devonian</p>	<p><u>COLLECTION No. 18</u> - (W-10-4F)</p> <p>Small stream delta entering east side of Lac Long, R. XV, Raudin Twp., Bonaventure Co. Undivided Raudin Group.</p> <p>massive stromatoporoids</p> <p><u>Cladopora</u> sp.</p> <p><u>Favosites</u> sp. A</p> <p><u>F.</u> sp. B</p> <p><u>F.</u> sp. C</p> <p>heliolitid coral</p> <p><u>Thamnopora</u> sp.</p> <p><u>Tryplasma</u> n. sp. A (Stumm, not published)</p> <p>indeterminate horn corals and bryozoans</p> <p>Probably Ludlow.</p>	<p><u>COLLECTION No. 12</u> - (B-40-7F)</p> <p>On road which follows headwaters of North Port-Daniel River, Weir Twp. (unsurveyed), Bonaventure Co., Formation C</p> <p><u>Eccentricosta</u> sp.</p> <p>Lower Ludlow (Gascons age or younger)</p>
<p><u>COLLECTION No. 16</u> - (Z-1-5F)</p> <p>North-flowing trib. of N. Grand-Pabos River, 1 mile west of Camp 13 Miles. Raudin Twp. (unsurveyed), Gaspé-South Co. Formation D.</p> <p><u>Favosites</u> sp.</p> <p>Late Ordovician, Silurian or Devonian age.</p>	<p><u>COLLECTION No. 11</u> - (J-13-1F)</p> <p>North Port-Daniel River, Weir Township (unsurveyed), Bonaventure County; Formation B</p> <p>corals</p> <p>pelecypod</p> <p>unidentified rhychonellid</p> <p>unidentified brachiopod</p> <p>conularid</p> <p>bryozoans</p> <p>No age indicated.</p>	<p><u>COLLECTION No. 13</u> - (J-11-1F)</p> <p>McNeil Brook, Weir Twp. (unsurveyed), Bonaventure Co., Formation C</p> <p><u>Favosites</u> sp. B?</p> <p><u>F.</u> sp.</p> <p><u>Syringopora</u> sp. A.</p> <p><u>Thamnopora</u> sp. A.</p> <p>indeterminate horn coral fragments</p> <p>indeterminate bryozoans</p> <p>Silurian or Devonian</p>
<p><u>COLLECTION No. 17</u> - (R-17-F)</p> <p>South-flowing trib. of Rankin Brook, 3/4 mile west of Lac Long; R. XVI, Newport Twp. Gaspé-South Co., Formation G.</p> <p><u>Favosites</u> sp. A.</p> <p><u>F.</u> sp.</p> <p>heliolitid coral</p> <p><u>Thamnopora</u> sp.</p> <p>'<u>Columnaria</u>' <u>coralliferum</u> (Hall)</p> <p>cystiphylloid coral</p> <p><u>Spongophylloides?</u> sp.</p> <p><u>Tryplasma</u> n. sp. A (Stumm, not published)</p> <p>indeterminate horn corals</p> <p>bryozoa</p> <p>Probably Ludlow.</p>		<p><u>COLLECTION No. 14</u> - (W-7-1F, R-18-F)</p> <p>West Grand-Pabos River, Raudin Twp., (unsurveyed), Gaspé-South Co., Formation B.</p> <p><u>Favosites</u> sp. B</p> <p><u>F.</u> sp. D</p> <p><u>F.</u> sp.</p> <p><u>Thamnopora</u> sp. A?</p> <p><u>T.</u> sp. B</p> <p>Silurian or Devonian</p>

cf. Map 1568-A for locations

Number in parentheses refer to
Que. Dept. Nat. Res. collections

Fossils identified by A.J. Boucot
and W.A. Oliver

Plate I



A- Chandler Formation: Green quartzose graywacke with ferruginous bands (bedding). Note essentially flat-lying foliation. Shore approx. 1,000 feet west of Chandler wharf, Grand-Pabos seigniory, Gaspé-South county.



B- Chandler Formation: partial fold profile; thick brown quartzose graywacke beds; note essentially horizontal foliation. Location, southwestern Anse-à-Carnaval, Newport township, Gaspé-South county.

Plate II



A- Chandler Formation: large mullions which parallel fold axis of unit, formed in green quartzose graywackes. Location: Coast, approx. one-half mile northeast of Anse aux Canards, Grand-Pabos seigniory, Gaspé-South county.



B- Chandler Formation: small-scale mullions which parallel fold axis of unit. Location: Coast, 500 feet northeast of Anse aux Canards, Grand-Pabos seigniory, Gaspé-South county.

Plate III



A- Port-Daniel Formation: steeply-dipping beds of green quartzose graywacke typical of the strata exposed between Black Point, Maquereau Point and Anse à Pierre Loiselie. Foliation is paralleled to bedding. Person for scale. Location: Black Point, Newport township, Gaspé-South county.



B- Port-Daniel Formation: pillows in intermediate dark green volcanics; material between pillows is light apple-green chert. Location: West Grand Pabos River, one-fourth mile upstream from Lamb Brook confluence, Newport township.

Plate IV

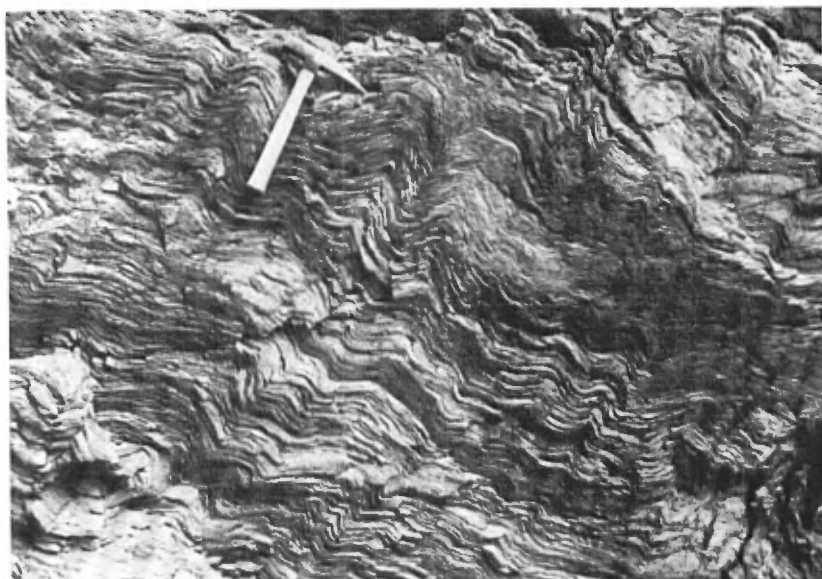


A- Port-Daniel Formation: steeply-plunging minor folds in quartzose graywackes, developed at crest of major fold. May possibly be related to movement along the Port-Daniel River fault. Light-colored pegmatitic material outlines form of the fold. Location: North Port-Daniel river, Lot 29, Range XI, Port-Daniel township, Bonaventure county.



B- As in Plate IV A.

Plate V



A- Port-Daniel Formation: incipient crenulation-foliation developed parallel to axial plane of minor folds in first foliation. Location: Coast point between Anseau Jardin and Anse à Blondel, Newport township, Gaspé-South county.



B- Port-Daniel Formation: Steeply-plunging minor folds in dark green intermediate volcanics; pale bands are predominantly epidote and quartz. Volcanics are interbedded with graywacke shown above. Location: North Port-Daniel river, Lot 29, Range XI, Port-Daniel township, Bonaventure county.

Plate VI



A- Port-Daniel Formation (?): Conglomerate with cobbles of sheared quartzo-feldspathic rock resembling pink granite. Location: Immediately south of tectonic breccia on West Grand Pabos river, Raudin twp., Gaspé-South county,



B- Newport Formation: Prominent ridge formed by massive purple graywackes of Newport Formation at type locality, approx. 1,000 feet west of Route 6 (visible in right half of photo). Lowland area underlain by ortho-quartzites of the Port-Daniel Formation. Unconformity is assumed to be present under the cover at the base of the ridge. Photo taken from above small lake at Pabos Mills looking NW., Newport twp., Gaspé-South county.

Plate VII



A- Mictaw Group: basal (?) conglomerate. Majority of fragments derived from Maquereau Group. Location: North Port-Daniel river, Lot 29, R. XIII, Port-Daniel township, Bonaventure county.



B- Mictaw Group: scenic gorge cut in northern belt of basal (?) conglomerate. Location: North Port-Daniel river, Lot 29, R. XIII, Port-Daniel twp., Bonaventure county.

Plate VIII



A- Mictaw Group: basal (?) conglomerate with thin discontinuous lenses of interbedded red siltstone and chert. Location; North Port-Daniel river, Lot 29, R. XIII, Port-Daniel township, Gaspé-South county.



B- Mictaw Group: large boulder in basal (?) conglomerate. Boulder shows evidence of deformation prior to deposition in conglomerate. Location: North Port-Daniel river, Lot 29, R. XIII, Port-Daniel township, Bonaventure county.

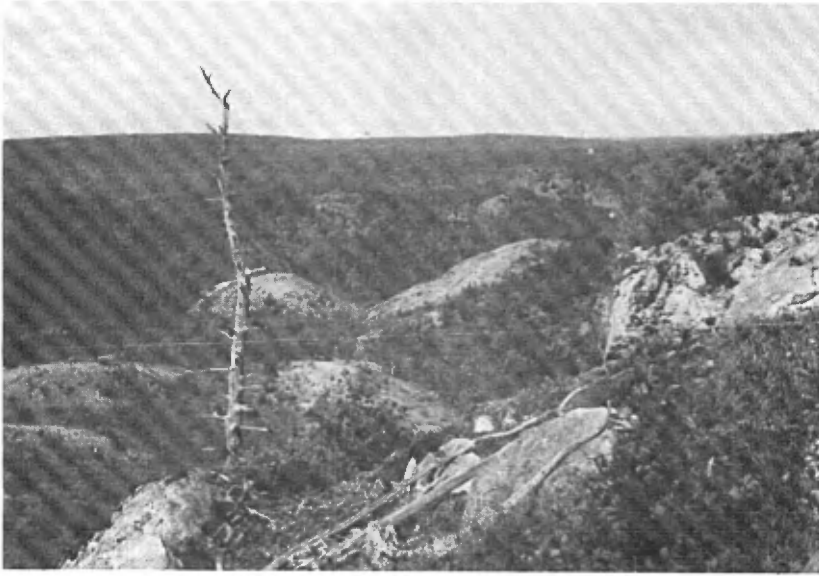


Mictaw Group: typical structure and lithology (interbedded volcanic sandstones and dark shales). Location: La Grande Fourche brook, Port-Daniel township, Bonaventure county.

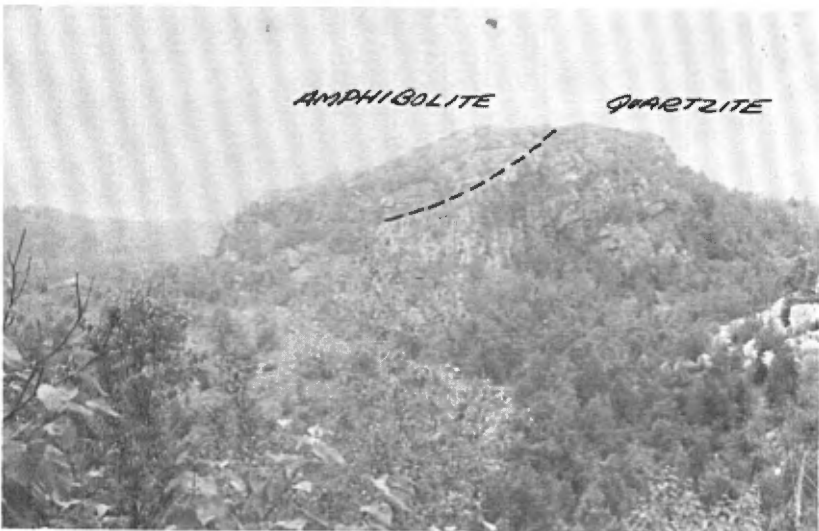


Flat-lying Bonaventure Formation overlying Maquereau Group with angular unconformity. Location: immediately east of Chandler wharf, Grand-Pabos seigniory.

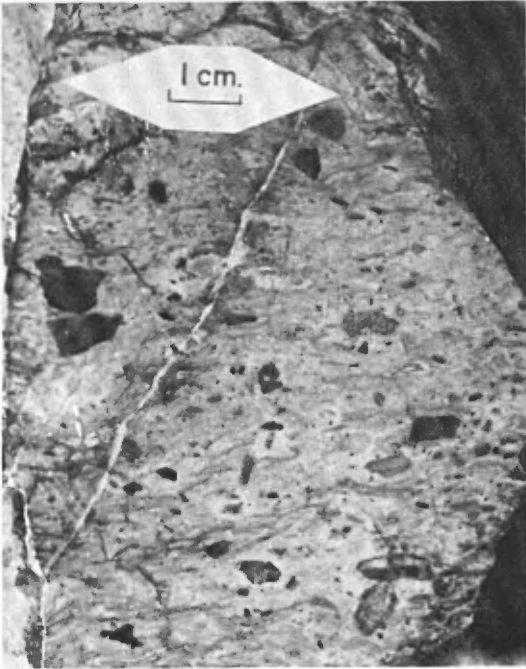
Plate XI



A- Weir Township serpentinite: Barren topography typical of serpentinite. Typical forest cover of Silurian on horizon. Location: Photo taken from "Castle Mountain", Lot 30, R. II, looking north. Valley of Nadeau brook runs from left to right.



B- Weir Township serpentinite: "Castle Mountain", large inclusion of inter-layered amphibolite and quartzite, Lots 29 and 30, R. II.



A- Buff, glassy, welded tuff (mostly devitrified); flow banding can be seen. Dark fragments are shale. Thin-section sketched in Fig. 4B. Location: Harrison brook, Raudin twp., Gaspé-South county.



B- Black glass with buff, devitrified areas, this is also a welded tuff and relict flow banding can be seen (top to bottom left in photo). Location: Harrison brook, Raudin twp., Gaspé-South county.

The contact with the Honorat Group in the western part of the area is not exposed, although strata assigned to this group have been mapped south of the Raudin fault in Weir and Raudin townships.

Carboniferous-Bonaventure Formation

The flat-lying Bonaventure Formation, which overlies the Maquereau, Honorat and Chaleur Bay groups with pronounced angular unconformity, extends over large areas to the east and west of the area under investigation. However, only small erosional remnants, nowhere thicker than 50 feet, suggestive of small valley-fillings on the post-Silurian surface are present in the Chandler - Port-Daniel area. The formation is well exposed along the coast immediately behind the church at Newport and also east of Chandler wharf.

The strata comprise coarse-grained, red conglomerates with a few interbeds of red, arkosic sandstone. The well-rounded boulders in the conglomerate measure up to 3 feet in diameter, although the average diameter is approximately 6 inches, and generally reflect the lithology of the underlying unit. The calcareous cement is stained with hematite, giving the rock its distinctive red coloring, and, locally, yellow-brown calcite has been deposited in fractures of a poorly-developed joint pattern. The distribution and lithology both suggest an environment of deposition similar to that of a coalescing alluvial fan, indicating a northern source area nearby.

The beds are flat except at a locality 2 miles north of Chandler where they strike east and dip 80° south; here the beds have been involved in late movement along the North Grand-Pabos fault. No associated igneous rocks have been found in the Chandler - Port-Daniel area, but flat-lying basaltic flows have been mapped in the Grande Rivière area to the east (Alcock, 1935, p. 93; Sanschagrin, 1963, p. 6).

Bell (Alcock, 1935, p. 94) concluded that a Late Mississippian or a Pennsylvanian age is indicated for the Bonaventure Formation from fragmentary fossil evidence in eastern Gaspé, with Pennsylvanian being the most likely. No fossils were found in the Chandler - Port-Daniel area.

Tectonic Breccia

Two large zones of tectonic breccia are exposed along the Raudin fault, one along West Grand-Pabos river in Raudin township and the other in the hills approximately 2 miles northwest of Chandler. The dark

brown breccias have a distinctive hackly weathered surface, and the outline of the fragments is best seen on wet samples. The fragments comprise schistose graywacke, quartz, and hard, angular, quartzo-feldspathic fragments that have a characteristic cataclastic texture. Segregations of blue-gray quartz and pink feldspar are common. The fragments average 1/2 inch in diameter but are commonly found up to 1 foot across. Foliation must have been developed in the fragments prior to their incorporation in the breccia, since foliation in each fragment possesses a different orientation direction. No well-developed foliation was observed in the matrix.

Some large pieces of purple hematitic limestone (up to 1 foot in diameter) are incorporated in the breccia along West Grand-Pabos river and, where present, the matrix of the breccia is decidedly calcareous. Two large dislocated blocks, several hundred feet across, of sparingly fossiliferous Silurian(?) limestone and quartzite are included in the breccia zone northwest of Chandler.

Intrusive Rocks

Weir Township Serpentinite (Map 1568-D; Fig. 3)

A lens-shaped body of serpentinite approximately 2 miles long and 1,800 feet wide has been emplaced in Silurian strata of the Chaleur Bay Group in Weir township. The serpentinite is approximately 10 miles north of the village of Port-Daniel, and crops out 1,500 feet north of the junction of Nadeau brook and North Port-Daniel river. The body is typical of the so-called "Alpine Peridotites", in that it has the form of a steeply-inclined sheet or lens concordant with the folded structure of the envelope rocks.

The rugged area underlain by the serpentinite is characterized by barren, buff hills (Plate XI-A), and it has been suggested by several authors that the absence of vegetation is due to the lack of potassium in the thin top-soil. The body contains numerous large inclusions, some up to 2,000 feet long (Plate XI-B), and has been intruded by granite. No contact aureole has been observed, but well-defined fault zones occur along both the northwest and southeast boundaries of the mass. Because of poor exposure, the extent, outline, and structural relationships of the northeast and southwest limits of the mass are poorly understood.

Harvie (1921) reported on the asbestos prospects of the serpentinite, and concluded that the occurrences had no commercial possibility. Alcock (1935), reported briefly on the petrology and regional relationship of the serpentinite and granite. McGerrigle (1942) examined the serpentinite; he reported on economic occurrences of chromite, asbestos

and talc, and made a brief outline map of the body, the granite and the envelope rocks. During the summer and fall of 1942, Chromium Mining and Smelting Company conducted a fairly extensive exploration program of prospecting, trenching and drilling, and concluded that the Weir Township serpentinite did not warrant further investigation for chromite.

Two varieties of serpentinite occur in outcrop, and their differences are mainly due to the effect of shearing within the mass. Where there has been little or no shearing, the serpentinite is dark green, pale green or reddish brown weathering, massive, and even and medium grained. It commonly contains bastite pseudomorphs. This type occurs as rounded masses up to 100 feet in diameter. The surface of each mass is characteristically slickensided and forms waxy shear planes commonly coated with picrolite (a coarsely fibrous, brittle variety of serpentine).

The second type of serpentinite occurs in zones where intense shearing along innumerable closely-spaced surfaces has converted the rock to a series of thin imbricate discs, known locally as "fishmeat". This type of serpentinite is commonly white, pale green or iridescent blue.

In almost all thin-sections examined serpentinitization is so complete that it is impossible to determine the nature of the original rock. However, in a few samples orthopyroxene (enstatite) is dominant and small patches of pseudomorphic serpentine have replaced what may once have been euhedral crystals of olivine.

A steeply-dipping dike of white muscovite granite, and a number of smaller discontinuous "pod-like" masses of similar granite occur within the serpentinite. The dike is approximately 2,700 feet long, has an average width of about 200 feet, and is best exposed where it forms a spectacular 30-foot falls on Nadeau brook (Range II, lot 32). The granite is medium to coarse grained and massive (though locally sheared), and is composed of approximately 25% quartz, 50% potassium feldspar, 15% albite and 10% muscovite.

The small granite "pods" are coarse grained and show little evidence of shearing. They may represent small pipe intrusions, as suggested by McGerrigle (1942), or may simply be dislocated blocks from an older granite body. Dresser (1920, pp. 8-9) reported on similar "granite segregations" in the serpentines of southern Quebec, and noted that "they are distributed without any apparent order but are, as far as is known, confined to the peridotite-serpentinite areas". The cuts opened by underground mining afforded him a three-dimensional view, which confirmed that these pods are not connected with one another or with any parent mass.

Large inclusions within the serpentinite comprise both amphibolite and impure quartzite (Plate XI-B); all inclusions are 20 feet or more in diameter. Banding occurs locally within the amphibolite, giving the appearance of hornblende-plagioclase gneiss. The amphibolites are dark green to black, and are composed predominantly of shiny lath-shaped crystals of hornblende which are up to 1/2 inch long. In thin-section, hornblende is poikiloblastic, has ragged outlines, and is set in a cloudy, feldspathic (?) groundmass. Tiny zircon and bright red garnet are minor accessory minerals.

The dark gray, fine-grained, massive, impure quartzite inclusions are composed predominantly of quartz and cherty material; minor feldspar, accessory penninite, muscovite, and magnetite also occur. The original sedimentary texture has been almost entirely replaced by a cataclastic texture.

The amphibolite and impure quartzite inclusions probably belong to the Maquereau Group, and represent original intermediate volcanics and graywacke quartzites respectively, metamorphosed in the ultrabasic magma. Several of the inclusions appear to be composed of interlayered amphibolite and quartzite, as at "Castle mountain" (Plate XI-B).

The foliation present within each inclusion has been plotted as a pole on a stereonet (Map 5). It is apparent from the wide dispersal of these poles that the inclusions have been rotated from their original position. The foliation may have been developed in the basement rock prior to intrusion of the ultramafic body. During intrusion, blocks were torn from the basement and subsequently rotated. It is also conceivable that the foliation was developed while the inclusions were incorporated in the ultrabasic magma, and their rotation occurred during a post-solidification "cold-intrusion" episode of the serpentinite. The latter hypothesis is preferred as no amphibolites have been found in any of the exposed stratigraphic units in southeastern Gaspé.

In the northern part of Range II, lots 32 and 33, Weir township, three small, aligned, isolated outcrops of a very hard, aphanitic, apple-green rock have been mapped within the serpentinite. The exposures appear to represent a dike, approximately 12 feet wide, enclosed by serpentinite. In thin-section, the rock is composed of approximately 50% anhedral colorless garnet; 30% fibrous hedenbergite; 10% antigorite and chlorite, and minor accessory chromite. Graham (1917, pp. 174-182) has observed calc-silicate rocks enclosed in serpentinite in the Black Lake - Thetford area of southern Quebec, and suggested that they are closely associated with granites and aplite dikes. He thought these calc-silicate rocks may have been derived from a calc-rich fraction of the cooling magma. However, in Weir township,

limestones in the Silurian envelope rocks and in the Ordovician Matapédia Group could have undergone contact metamorphism within the ultrabasic magma to produce a calc-silicate rock of this type.

A 200- to 300-foot zone of calcareous serpentinite occurs along the northwest boundary of the mass. Here the serpentinite is traversed by innumerable thin irregular veins of white calcite, and locally has been completely converted to carbonate. A thin zone of calcareous serpentinite is exposed at the southern margin of the mass along North Port-Daniel river (Range II, lot 36). In the northern part of Range II, lot 32, a 40-foot zone of rusty-weathering ankeritic rock is exposed along the north bank of Nadeau brook near the breccia-serpentinite contact.

A rather unusual breccia, comprising amphibolite and granodiorite crops out in Range II, lots 35 and 36. The sub-angular boulders of dark green amphibolite are veined with epidote, and are up to 4 feet in diameter. The pink, fine-grained granodiorite occurs as large irregular masses up to 10 feet long. It is difficult to determine whether the granodiorite intruded the amphibolite and that both were brecciated together, or if the irregular pattern exhibited by the granodiorite represents the original primary effect of intrusion.

Two major faults bound the serpentinite. The fault on the northwest side of the mass is evidenced by a spectacular fault-breccia which crops out along Nadeau brook (Range III, lots 31 and 32). The breccia comprises fragments up to 3 feet in diameter of epidote-veined amphibolite, serpentinite, quartzite, and red siltstone fragments set in a red, hematite-stained, calcareous matrix. Part of this breccia is predominantly dark green and comprises sheared fragments of white quartz and quartzite set in a phyllitic chlorite-sericite matrix. This same fault occurs on North Port-Daniel river, where a zone of finely-foliated black pyritic shales separates strongly-deformed limestones of the Chaleur Bay Group from a zone of red and green slate and quartzite of unknown age (possibly a sliver of Mictaw strata).

The fault on the south side of the mass is well exposed on North Port-Daniel river where a pyritic, brecciated zone, 30 feet wide, marks the contact between calcareous serpentinite and a unit of unknown age comprising slates and calcareous siltstone (Range II, lot 36). A large cliff exposure of fault breccia, containing fragments of quartzite up to 2 feet in diameter, is about 1,000 feet northeast of the contact just described (Range II, lots 37 and 38). A zone of thin, black pyritic slates and breccia marks the contact between the serpentinite and strata of the Chaleur Bay Group on Nadeau brook.

The following sequence of events is proposed as a tentative geologic history of the Weir Township serpentinite:

1. Intrusion of pyroxenite into Maquereau and Mictaw strata during the Late Ordovician Taconic Orogeny. Inclusions metamorphosed and foliation developed within them. Contact aureole produced.
2. Erosion on the post-Taconic Maquereau-Mictaw surface.
3. Deposition of Silurian and Devonian(?) strata.
4. Folding of Silurian, Devonian(?) and older rocks during the Acadian Orogeny.
5. Emplacement of the ultramafic body along major faults, concordant with the folded structure as a cold-intrusion lubricated by serpentine. No metamorphic aureole produced, and metamorphosed inclusions buoyed upwards and rotated. Associated hydrothermal carbonate enrichment, and shearing within the mass. Slivers of pre-Silurian strata dragged up along faults.
6. Intrusion of granite.
7. Erosion.

Port-Daniel Township (Map 1568-A)

The rocks of the North Port-Daniel River complex have been intruded by two small serpentinites, a diabase dike 3 miles long, a diorite dike, and two very small pod-like masses of granite.

Both serpentinites crop out along North Port-Daniel river in the lower part of lot 28, Range XII, and the central part of lot 30, Range XIII, respectively. Arbour (1962, p. 34) reported that in thin-section the rock has a reticulated texture, and is composed almost entirely of antigorite, pseudomorphic after olivine.

Small pod-like intrusions of pale-gray albite-rich muscovite granite are exposed adjacent to both serpentinites. The rock is fine to medium grained and hypidiomorphic granular, and has 35% quartz, 55% albite, and 6% potassium feldspar, with minor muscovite, apatite and unidentified opaque minerals (Arbour 1962, pp. 53-54).

A northwest-trending diabase dike, which is subparallel to the Port-Daniel River fault, marks the western boundary of the North Port-Daniel River complex. The dike is exposed for approximately 3 miles, and is 75 to 750 feet wide. Because of its resistant nature, the dike forms a series of small aligned hills in Ranges X, XI, and XII, and is well exposed at two places along North Port-Daniel river. In lot 28, Range X, it forms a 20-foot cliff along the west bank of the river. The contact with contorted bituminous shales is well exposed. The best exposures can be seen in lot 29.

Range XIV, where the main river and La Grande-Fourche brook flow across the dike forming small falls on both streams. Here, the dike has clearly intruded Mictaw strata. The rock is greenish black, massive, and small pale-green crystals of lath-shaped feldspar (up to 8 mm. long) are visible to the naked eye. The rock has an ophitic texture, and has 45-50% chloritized and sericitized plagioclase ($An_{8.7}-An_{4.5}$), 20-25% clinopyroxene (pigeonite), 5% magnetite, and traces of pyrite (Arbour 1962, p. 43). Two smaller diabase dikes, possibly apophyses of the main dike, were mapped (lot 28, Range XIII, and lot 28, Range XIV, respectively), and they also have intruded Mictaw strata.

Arbour (1962, pp. 50-52) reported exposures of diorite, one in lot 28, Range XI, and the other in lot 28, Range XII. The first exposure is fine grained, light greenish brown and considerably altered. The second, and more northerly, exposure is similar, but appears slightly darker and is medium grained. These rocks comprise approximately 10% quartz, 45% plagioclase (An_8-An_7), 25-30% chlorite (alteration product) and minor amounts of calcite, apatite, sericite and leucoxene. Arbour mentioned a small pyrite-rich zone a few feet east of the southern diorite.

Since the age of the sedimentary strata of the North Port-Daniel River complex is known only as pre-Middle Ordovician and post-Maque-reau, it is difficult to assign ages to the associated intrusives. The diabase dikes have intruded Middle Ordovician Mictaw strata and have not been found in the Silurian, indicating Late Ordovician intrusion (Taconic). The serpentinite, granite and diorite have not intruded Mictaw strata in the immediate area around the "complex", but serpentinite and granite (also of questionable age) have been emplaced in Silurian strata in Weir township. This suggests pre-Middle Ordovician intrusion and later mobilization. The location of the North Port-Daniel River complex intrusives suggests a close relationship to movement along the Port-Daniel River fault, but their emplacement may have taken place at any time between the Precambrian and the Carboniferous, or even later.

Raudin Township Diorites-Tertiary(?) Welded Tuffs, etc.

Three plutons have been outlined in Raudin township, in the northwest corner of the area mapped. The largest mass has a lenticular form parallel to, and south of, the east-trending North Grand-Pabos fault. This diorite is at least 3 miles long, 300 to 600 feet wide, and appears to be vertical. It has considerable topographic expression and, based on air photo trends, may extend approximately 6 miles west of the area mapped. The black, massive diorite intrudes black siltstones of the Honorat Group, and is surrounded by a thin zone of very hard, dark green, massive chert and associated pyrite mineralization. The intruded siltstones are highly sheared and brecciated in the intervening area between the diorite and the main trace of the North Grand-Pabos fault.

The second diorite, which is poorly exposed along the headwaters of Harrison brook, also lies immediately south of the North Grand-Pabos fault. The contact with country rock has not been observed but this diorite apparently also intrudes Honorat Group strata. In thin-section, both of these diorites have a medium-grained intergranular texture and comprise approximately 45% plagioclase (An_{45}), 45% hornblende (partly altered to chlorite), and 5% magnetite and ilmenite.

Poor exposures of a third diorite are found north of the North Grand-Pabos fault on a steep hill immediately north of the "dry section" (local name) on West Grand-Pabos river. Here the diorite, although similar in hand-sample to the other two diorites, has a slightly different mineralogic composition, comprising 75% plagioclase (An_{45-50}), 10% quartzo(?)feldspathic groundmass; 10% chloritized biotite, and 5% accessory magnetite (Fig. 4a).

Some of the most interesting rocks in the entire region under investigation crop out over approximately 2 square miles immediately east of the third diorite (above). They are exposed along two small tributaries of West Grand-Pabos river and along the headwaters of Harrison brook, a tributary of North Grand-Pabos river. These rocks comprise rusty-weathering, glassy-welded tuffs, agglomerates, volcanic breccias, and acidic to intermediate dikes. The presence of glass in the welded tuffs is of particular interest since it is currently thought that nearly all known natural glasses are Miocene or younger (Marshall, R.R., 1961, p. 1494). However, Precambrian glass associated with a fault near Trois-Rivières, Quebec, has been recorded by Philpotts and Miller (1963). If the rocks of Raudin township are products of Tertiary volcanism, they refute the concept that no igneous activity has occurred in the Gaspesian part of the Northern Appalachians since the end of the Paleozoic. The gray to buff welded tuffs superficially resemble massive chert, but, where oriented black shale and siltstone fragments (up to 1/2 inch long) are present, flow-banding can be distinguished on both the weathered and the fresh surfaces (Plate XII-A). Where the black fragments are absent, it is difficult to make out the flow-banding except in thin-section. Under the microscope, the matrix comprises both glass and devitrified quartzofeldspathic material in varying amounts. In three thin-sections examined, approximately 50% of the matrix in each had devitrified (Fig. 4b). The devitrified material forms irregular patches in which the shard structure of the glass has been replaced by microscopic radial aggregates (spherulites) of quartz and feldspar. Irregular carbonate replacement and sulfide mineralization are present in minor amounts in most of the samples examined.

Angular 2-inch pieces of black volcanic glass, which resemble typical obsidian, occur in a fault zone along the headwaters of Harrison brook immediately north of the most eastern diorite (Plate XII-B).

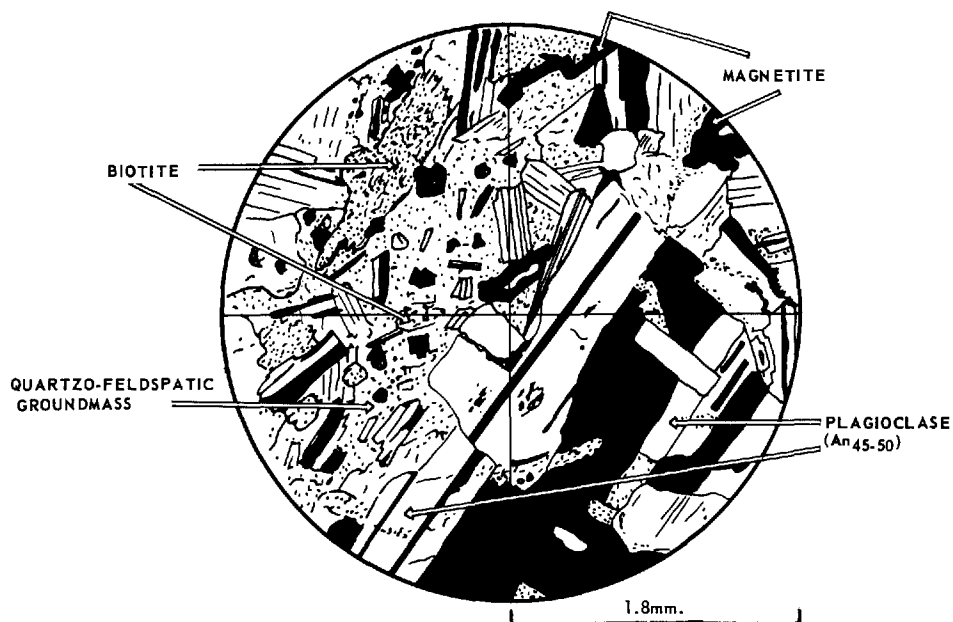


Fig. 4a

Diorite north of North Grand Pabos fault in Raudin township, Gaspé-South county. This diorite crops out immediately west of the glassy welded tuffs, agglomerates and acidic dykes.

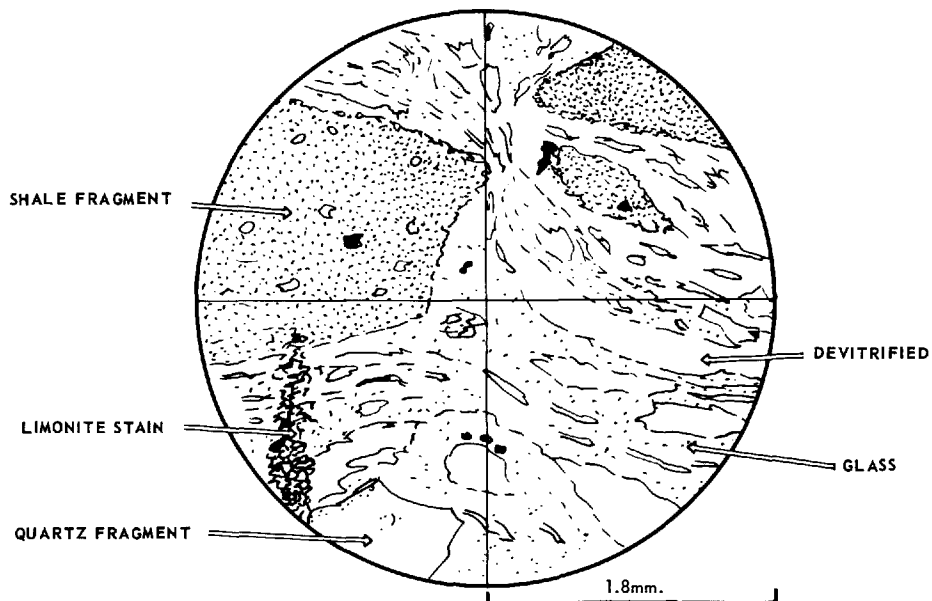


Fig. 4b

Glassy welded tuff, Raudin township, Gaspé-South county. Note flow-banding around shale fragments. In dark areas (glass) shard structure still recognizable. In lighter areas (devitrified) radial aggregates of feldspar and quartz have destroyed shard structure.

This badly-weathered zone, approximately 40 feet long, also contains red weathering, 4-inch pieces of the buff welded tuff with oriented black shale fragments. The glass and the tuff are contained in a soft, pale yellow paste which is interpreted as fault gouge material. It is apparent in thin-section that the black glass is also welded tuff, as shard structure and small enclosed fragments of shale can be distinguished. Devitrified material accounts for less than 15% of the glass and occurs in cloudy patches which commonly have shale fragment nuclei. In hand sample, the devitrified patches resemble small, rounded, pink spheres which weather out in relief. Small perlitic cracks are also associated with the devitrified material. Several fragments of angular quartz, and subhedral crystals of plagioclase and orthopyroxene were observed in the glass. The refractive index of the glass is 1.496 - 1.498, corresponding to a silica content of approximately 72% (W.O. George, reported in Williams, *et. al.*, 1958, p. 28) which is the average silica content of a rhyolite or granite (*ibid*, p. 27).

In thin-section, the shale and siltstone fragments appear to have undergone a certain amount of recrystallization, although they have not been converted to hornfels. The outlines of the grains within the fragments are vague, muscovite is abundant, and carbonate replacement is widespread.

The agglomerates and volcanic breccias occur mainly along the small stream immediately east of the northern diorite. The subrounded and angular fragments, which range in size up to approximately 1 inch in diameter, are pale brown and contrastingly set in a dark aphanitic matrix. Because of severe carbonate and sericite alteration, it is virtually impossible to determine the original nature of the fragments; however, some pieces of quartz and shale have been recognized. The matrix comprises devitrified cherty material which has also been replaced in part by carbonate and sericite.

The welded tuffs, agglomerates, etc., are separated from the limestones of the Matapédia Group by a northwest-trending fault which is exposed on both of the small streams east of the northern diorite. Five diamond-drill holes, drilled by Denison Mines Ltd., show the welded tuffs to be at least 400 feet thick (Ross, 1963, personal communication).

The rocks surrounding the northern diorite deserve further detailed investigation in order to determine the outline and structure of the unit; their relationship to the surrounding rock units and to the North Grand-Pabos fault is at present poorly understood.

Mesozoic igneous activity in the Northern Appalachians is now fairly well documented. Faul, *et. al.* (1963), have reported Early Jurassic and possible Early Cretaceous intrusives in New Hampshire and

Vermont. Two age determinations (126 and 115 million years) from an anorthositic gabbro and a granodiorite of the Mount Megantic complex in Quebec (Lowdon, J.A., 1961, p. 69) suggest emplacement during the Cretaceous. With the exception of one unreliable sample, all of the granitic rocks from 27 localities in Nova Scotia (Fairbairn, et. al., 1960) fall within the age range of 300-400 million years. Tholeiitic basalts intertongue with Triassic sedimentary rocks in the Bay of Fundy region (Klein, 1962).

Welded tuffs are not common in the Northern Appalachians. The writer is only aware of 8,500 feet of Lower Devonian "felsitic flows, tuffs and welded tuffs" which crop out over about 100 square miles in north-central Maine (Rankin, 1958), and the Lower Paleozoic "pyroclastic rocks" in New Hampshire described by Billings (1956, p. 10, 13, 18).

In conclusion, therefore, the writer is unaware of any other possible Cenozoic volcanic activity within the Northern Appalachians, and believes the glass found in Raudin township to be the first recorded within the entire Appalachian belt.

Dikes

A number of acidic, fine-grained, porphyritic dikes have intruded Ordovician and Silurian strata in the northern part of the area. The dikes are from 5 to 30 feet wide, dip vertically, and do not appear to have been folded. The small, white, plagioclase phenocrysts have an average length of about 1/8 inch and, for the most part, are altered to carbonate.

An anorthositic dike has intruded Silurian strata of the Chaleur Bay Group along the shore at Anse-aux-Gascons. The dark green dike is approximately 15 feet thick, dips steeply, and has a trachytic texture. The rock comprises approximately 30% oriented, tabular phenocrysts (up to one inch long) of plagioclase (An₄₅) set in a fine-grained matrix of 70% plagioclase, 15% chlorite and biotite, and 15% magnetite. Much of the plagioclase is altered to carbonate.

A small, poorly exposed plug of diorite has been mapped along the tectonic breccia - Raudin Group contact in Weir township. The relationship of the diorite to the surrounding units is unknown.

STRUCTURAL GEOLOGY

General

Three major orogenic episodes have affected this part of the Northern Appalachians, and the rocks representing each major sedimentary

sequence between these orogenies are present within the area mapped. The Chandler - Port-Daniel area, therefore, is ideally suited to an investigation of the styles and trends of folding produced during each orogeny, and to a study of the response of this part of the earth's crust to repeated deformation. The three major periods of folding recognized are: the Acadian, the Taconic, and the pre-Taconic or Gaspesian (new term) orogenies.

Owing to the structural complexity of this area, the methods of structural analysis developed by Sander (1930, 1948-50) in Austria and successfully used by workers in the Highlands of Scotland (Weiss and McIntyre, 1957; Ramsey, 1958) have been applied to this study. The historical background, technique, theory, and interpretation of structural analysis have been excellently described by Turner and Weiss (1963). No attempt is made here to outline in detail the somewhat complicated structural analysis of the Chandler - Port-Daniel area, and the reader is referred to Ayrton (1964) for a description of this work. However, the significant results of the study are given below.

The main value of structural analysis has been to stress differences in fold patterns between major sedimentary sequences of different ages. As a direct result, deductions have been made concerning the dates of the major orogenic episodes which have affected the area mapped. These deductions supplement deductions drawn from more orthodox study.

The complex structure of the Maquereau Group has been unravelled in part, but the poor inland exposure imposes limitations upon the amount of reasonable interpretation which may be made. By using structural analysis, the structural geometry of the complicated Chandler Formation and the eastern part of the Port-Daniel Formation have been determined. The large folds of the western part of the area underlain by the Port-Daniel Formation have been outlined primarily by routine structural investigation and by strong reliance on the striking lineaments traced from air photos (Ayrton, 1964, Map 1568-C).

Structural analysis has supported the impression gained in the field that the pattern of folding within the Newport Formation is relatively simple compared with that of the underlying Chandler and Port-Daniel Formations.

Structural analysis has not aided in unravelling the complicated and patchy folding of the Mictaw Group. It is clear, however, that no well-defined structural trends are present (at the scale of investigation), and that the folding within the Mictaw Group is dissimilar to any other folding within the area.

The proposed Gaspesian orogeny is supported by:

1) severely deformed Maquereau fragments within the basal(?) Mictaw conglomerate, 2) the characteristically "older" look of the rocks of the non-fossiliferous Maquereau Group as compared to the surrounding Paleozoic sedimentary rocks, and 3) the structure within the Maquereau Group is more complex than that mapped within any of the surrounding Paleozoic units. Therefore, it is believed that a period of severe deformation (the Gaspesian Orogeny) involving folding and metamorphism (low-grade regional metamorphism) of the Maquereau Group sedimentary rocks occurred prior to Middle Ordovician time.

The Taconic orogeny in Gaspé has been dated in the past on the basis of observable unconformities, and the writer has recognized a poorly exposed unconformity between Silurian rocks and the Middle Ordovician Mictaw Group in Weir township. However, stratigraphic relations between Silurian and Upper Ordovician, and Upper Ordovician and Middle Ordovician strata are not displayed, so some other means of establishing the date of the Taconic orogeny in the study area must be found. This has been accomplished by structural analysis, which dramatically illustrates the striking similarity in structural geometry between Silurian strata and the Upper Ordovician Honorat and Matapédia Groups (Ayrton, 1964, Table 5). Their structure contrasts markedly with the structure of the complex Middle Ordovician Mictaw Group. It is apparent that both the Upper Ordovician and Silurian strata were folded during one single period of deformation, i.e., the Acadian (based on their simple fold pattern, vertical unfolded axial plane foliation, etc.). On this basis, the main pulse of the Taconic orogeny must have occurred, at least in this area, during the early part of the Late Ordovician or at the end of Middle Ordovician time.

The Acadian orogeny, which folded the Upper Ordovician and Silurian strata, probably occurred during the Late Devonian, and the folded strata are overlain unconformably by the flat-lying Bonaventure Formation.

There is little structural evidence to suggest that the Maquereau Group has been affected by either the Taconic or the Acadian orogenies.

Folds

Maquereau Group

The three separate formations with fairly well-defined lithologies, which have been mapped within the Maquereau Group, are also distinct on the basis of their structure.

Chandler Formation

The strata of the Chandler Formation are folded about an axis which plunges approximately 15° to the west, and the folds have wave lengths of 20 feet to 3,000 feet. Profiles, which are displayed at a number of locations along the shore between La Grande Anse and Newport Point (Plate I-B) indicate that the folds are overturned to the south. For the most part, the folds are too small to be shown on the maps. The unit is cut by a well-developed subhorizontal axial plane foliation (Plates I-A and I-B) which contains the fold axis. A second steeply-dipping foliation may either have the form of a crenulated foliation displacing the first foliation, or may have no apparent effect on the first foliation. This late foliation is only locally developed and may have been formed when the younger Newport Formation was folded.

Linear structures (e.g. mullions, minor fold axes, bedding-foliation intersections, etc.) parallel the observed fold axes (Plates I-B, II-A and II-B).

Port-Daniel Formation

Fold trends with the rocks of the Port-Daniel Formation are difficult to outline, but appear to be divided into two distinct sets. One set, in the eastern half of the outcrop area, trends east and has a gentle western plunge; the western set has a northeast surface trend, but appears to plunge steeply to the southeast. The two areas are separated by a heavily forested, drift-covered region in which no outcrops have been found.

Eastern area:- A large fold, with a wave length of approximately 2 1/2 miles, has been outlined immediately west of Grand-Pabos bay between Pabos Mills and West Grand-Pabos river. Here the orthoquartzites are folded about an axis which plunges gently to the west, and the fold disappears westwards beneath the purple graywackes of the Newport Formation (Plate VI-B). No crestral zone has been observed, but the steep inwardly-dipping limbs, and the associated sedimentary structures, support the synclinal interpretation. The steeply-dipping axial plane foliation is essentially parallel to bedding.

A fold with isoclinal limbs and an east-trending axis has been mapped at Maquereau point. The strata are predominantly steeply dipping (Plate III-A), and the vertical axial plane foliation is sub-parallel to bedding on the limbs of the fold. No crestral zone has been observed here either, but sedimentary structures and minor drag-folds indicate a synclinal structure. Linear structures are especially well displayed in this area. Mullions and pegmatitic quartz rods indicate that

the fold plunges gently to the west at Pierre-Loiselle cove and gently to the east at Maquereau point. Quartz rods have not been found elsewhere within the Maquereau Group. Locally, drag-folds, which suggest that the southern beds have moved east, are developed on the limbs of this major fold, and plunge at various angles to the north and south. This movement may be a result of activity along the adjacent Port-Daniel River fault.

The only other recognized folds in the eastern half of the Port-Daniel Formation occur north of Maquereau point and immediately west of Mahy islets. In this area, the bedding is almost completely overprinted by foliation, and locally a cross-cutting crenulation foliation has been developed in addition to the first foliation (Plate V-A). The first foliation dips gently, and is broadly flexed about an east-northeast axis, and an anticline and syncline have been mapped. The foliation swings around in the northern part of the sub-area, and is essentially parallel to the curving outline of the southernmost belt of the Newport Formation.

The foliation mapped in the eastern half of the Port-Daniel Formation is broadly flexed about an east-northeast axis of folding. This means that the tight folding outlined by bedding and the broad flexing outlined by foliation, as in the Chandler Formation, are homoaxial.

Western area:- In the western part of the area, the trend of the folds is northeast on the topographic surface. However, these isoclinal folds plunge steeply to the southeast, and are overturned to the northwest. An anticline has been mapped in the region between Bisson brook, Lamb brook, and North Port-Daniel river. Structural readings, lineaments on the air photos, and the curving bands of volcanics which wrap around the nose of the fold clearly outline the structure. A few sedimentary structures on both limbs of the fold strongly indicate that this is an anticline. However, since the overall structure is complicated by minor folds, the value of the sedimentary structures is questionable. The strong lineaments on the air photos, and the nature of the few outcrops that have been found to the southeast of this fold suggest that a corresponding syncline and anticline are also present.

The axial plane foliation is essentially parallel to the isoclinal limbs in the northeastern part of this anticline. However, in the vicinity of Marguerite lake and North Port-Daniel river, the foliation is steeply dipping and wraps around the nose of the fold parallel to bedding. It is developed approximately at right angles to the foliation mapped in the northeastern part of the fold. The geographic and geologic positions of the two contrasting foliations are illustrated on Map 1568, where their attitudes have been plotted. The foliation at the nose of the fold is present within both the competent and incompetent beds, but no foliation parallel to the axial plane of the major fold was noted. The foliation

which is parallel to bedding at the nose of the fold may be an earlier foliation, or it may have been developed as a result of movement along the Port-Daniel River fault. Another possibility is that the mechanical properties of the graywackes and volcanic rocks at the nose of the fold were different from those of the siltstones and phyllites in the northeast part of the anticline, allowing different foliations to develop in different lithologies, in different parts of the fold.

Linear structures are fairly abundant, but are difficult to interpret. At the nose of the anticline, crenulations on foliation and other minor fold axes are common. The axes of the minor crenulation folds in the chlorite schist, and phyllites, are also thought to be intimately related to movement along the Port-Daniel River fault. Minor folds, which plunge almost vertically, are developed in the quartzose graywackes (Plates IV-B - V-B) and in the meta-andesites (Plate IV-A), and may be either the result of drag movement at the nose of the fold or dextral movement along the Port-Daniel River fault.

Along the outlet stream from Brisson lake, the black calcareous siltstones within the crest of the anticline are intensely folded, and the minor fold axes plunge fairly steeply to the northeast. Assuming that the fold is an anticline, as proposed, and the oldest units are found in the core, then these minor fold axes are irregular unless:

1. the nose is completely overturned;
2. the major fold axis is folded, and at this location the fold plunges to the northeast;
3. the axes of these minor folds are related to subsequent superposed folding.

It is also possible that the structure is a northeasterly plunging syncline, but the previously mentioned sedimentary structures do not support this interpretation. If it is a syncline, then the stratigraphic succession of the Port-Daniel Formation would be reversed.

Newport Formation

The relatively simple structure within the Newport Formation is completely different from that of either the underlying Chandler or Port-Daniel Formations, and it resembles more closely that present in the Upper Ordovician and Silurian units. It should be remembered that the age of the Newport Formation is unknown; that it unconformably overlies the Port-Daniel Formation; that, geographically, it crops out exclusively within the Maquereau block; and that lithologically it is more closely related to the Maquereau type of sedimentation than to that associated with the Upper Ordovician and Silurian units.

A northwest-trending syncline has been mapped at the type locality near Pabos Mills, and folds with sub-parallel axes have been delineated to the southeast. These folds are doubly plunging normal folds (Turner and Weiss, 1963, p. 119) with gently-dipping limbs, and well-developed fracture cleavage parallels the vertical axial plane.

At the western end of this same bank of Newport Formation (west of Pruche Plaquée lake), the nose of a southeasterly-plunging syncline has been outlined. The strata are cut by the typical vertical fracture cleavage and also by an anomalous north-south foliation which dips at 45° to the east. This is the only location within the Newport Formation where this north-south foliation has been mapped, and it is possible that it may have been caused by slip of the younger beds westward over older beds during the folding of the Newport Formation. Another possibility is that these strata are really part of the older Port-Daniel Formation, and that the north-south foliation should be equated with the axial plane foliation mapped in the isoclinal folds some 5 miles to the west. However, the strata are assigned to the Newport Formation on the basis of the synclinal structure, the lithology, the presence of the characteristic fracture cleavage and the strong lineaments on the air photos.

The linear structures measured within the Newport Formation comprise (1), axes of minor folds (measured at the western end of the band) which plunge to the east, and (2), axes of small-scale crenulation folds on fracture cleavage which have a variable plunge.

The southernmost outcrop band of Newport Formation is a doubly-plunging syncline, and the strata are cut by strong axial plane foliation, which dips steeply to the northeast. It is not known why foliation is more strongly developed in the southwestern exposures of the Newport Formation.

The northern band of the Newport Formation forms an east-trending syncline which plunges gently to the east, but the southern limb of the structure has been truncated by the Hunt Lake fault.

Mictaw Group (Middle Ordovician)

The Mictaw Group is folded in a complex manner, without any apparent consistency to the trend or wave length of the folds. The unit appears to have been compressed from several different directions, and, consequently, resembles rumpled blankets on an unmade bed. The few fold axes (Plate IX), which are available for measurement in the western part of the exposed Mictaw band, indicate that the strata have been folded about east-west axes, and that the folds are doubly plunging. It is clear, from the great variety of divergent bedding directions observed in the

field, that the unit is severely crumpled. Axial-plane foliation is poorly developed, although fissility in the shales is very well developed parallel to bedding.

An attempt has been made (Map 1568-C) to outline individual fold axes within the Mictaw Group. A north-trending anticline and syncline have been mapped in the northern band of basal(?) conglomerate, but these structures are based on rather tenuous evidence. Further work is required to substantiate their presence, and to map their extent in detail. The folds within the graywackes and shales west of the basal(?) conglomerate have been mapped primarily on the basis of dip reversals, as closures are rarely seen. The folds generally seem to trend northeast but, because of the extremely poor interstream correlation of structures (Map 1568-C), must be regarded as highly interpretative.

The fold axes in the Mictaw Group, west and south of the dotted line on Map 1568-C, have been interpreted by the writer from a geologic map compiled by Badgley (1956; Badgley's map gives only strike and dip of Mictaw strata and no fold axes).

Matapédia Group (Upper Ordovician)

The doubly-plunging folds of the Matapédia Group are tightly folded about a northeast-southwest axis. Several small folds, which plunge to the east-northeast, have been mapped in the eastern part of the unit, and they appear to vary in amplitude from several hundreds of feet to several miles. In the northwestern part of the area mapped, the strata dip steeply and consistently to the northwest representing the southern limb of a northeast-trending syncline. Skidmore (1958) mapped a major northeast-trending anticline within the Matapédia Group 9 miles to the west. The south limb of Skidmore's structure probably corresponds to the unmapped north limb of the syncline in the Chandler - Port-Daniel area.

Linear structures, which are bedding-foliation intersections for the most part, have a consistent northeast trend, and suggest that folds are doubly plunging. Steep fold axes of minor folds, which are thought to be related to movement along the North Grand-Pabos fault and the sub-parallel fault to the north, have also been recorded. The rocks are cut by vertical, closely-spaced axial plane foliation, which tends to overprint bedding in the western part of the area mapped.

The predominance of steeply-dipping strata is notable. Much flatter dips have been recorded within the Matapédia Group to the north of the Chandler - Port-Daniel area (Ayrton, 1964), and within the central part of the Grande Rivière area to the east (Sanschagrín, 1963).

In the area immediately to the north of the Chandler - Port-Daniel area (Ayrton, 1964), the Matapédia Group strata are folded about the same axis as the Matapédia Group strata in the present area. The folds appear to plunge primarily to the southwest. Skidmore (1958) indicated that the broad anticline in the Honorat West area had a southwesterly plunge.

Honorat Group (Upper Ordovician)

No well-defined folds have been outlined in the Honorat Group. The strata dip steeply, and there are many reversals of dip but fold closures are conspicuously absent. It is suspected that the unit is isoclinally folded about a northeast-southwest axis, and that it resembles the Matapédia Group in overall structure. The rocks are cut by a vertical axial plane foliation essentially parallel to that developed in the Matapédia Group, and the linear structures indicate that the folds are doubly plunging. The amplitude of the folds is not known, and it has not been possible to extend the mapping of individual folds from one stream to another.

Statistical analysis emphasizes the striking similarity in structural geometry between the Honorat and the Matapédia Groups, and it is evident that both groups were folded during the same period of deformation (Ayrton, 1964, Table 5).

Raudin Group (Silurian)

The Silurian strata of the Raudin Group comprise the central downfaulted block of an east-trending graben, which is in fault contact to the north with the Ordovician Honorat Group along the North Grand-Pabos fault, and to the south with the Maquereau Group and the Chaleur Bay Group along the Raudin fault.

Both bedding directions and sedimentary structures suggest the presence of an easterly-plunging syncline within the graben. However, stratigraphic units mapped on the north limb are not repeated on the south limb. (Formation 7g - Map 1568 may be an exception and could conceivably be equivalent to Formation 7c.) Unrecognized faults within the graben, parallel to the regional strike, might possibly explain the existing relationships. The structure can be interpreted in several possible ways:

1. A synclinal structure.
 - a) Not faulted. (Wave length of 2 to 3 miles)
 - b) Faulted.
2. A steeply-dipping unrepeated section.
 - a) Southern part overturned (Formations 7g, 7f, and part of 7e).
 - b) Northern part overturned (Formations 7b, 7c, 7d, and part of 7e).

A very small anticline and syncline have been mapped within Formations 7b and 7c of Map 1568 along the headwaters of North Port-Daniel river at the western limit of the map-area. These folds parallel the structural trend within the graben.

A vertical axial-plane foliation is present throughout the rocks which form the graben. It is especially well developed in the siltstones and limestones, but is only poorly developed in the massive, coarser-grained quartzites and sandstones. The foliation, which is essentially parallel to the foliation developed in the Honorat and Matapédia Groups to the north, appears to have been truncated by both the Raudin and the North Grand-Pabos faults.

At the eastern end of the graben the foliation is folded. However, it is assumed that this is only local rotation caused during the formation of the graben.

Chaleur Bay Group (Silurian)

Port-Daniel — Gascons Area

The lower degree of structural deformation of the Silurian strata in this area contrasts markedly with that found in the rest of the Silurian strata in southeast Gaspé. The main differences are: (1) that the strata in this area are thrown into rather gentle northeast-trending folds which plunge at approximately 22° to the southwest compared with the tighter folding in the rest of the Silurian, and (2) there is a complete absence of foliation in this area, whereas axial-plane foliation is strongly developed in the rest of the Silurian strata.

A large, triangular-shaped, fault-bounded syncline lies between Port-Daniel and Gascons East. The western limb of the structure is overturned. Flexuring is not uniform around the fold, but rather the strata have been bent only at specific locations, and the outcrop bands between these "corners" are essentially straight. This new interpretation of the structure contrasts with that proposed by Schuchert and Dart (1926) and Northrop (1939).

The Port-Daniel tidal flat overlies the crest of an anticline, the precise structure of which is not known. A northeast-trending anticline has been mapped west of the Port-Daniel tidal flat and immediately north of Little Port-Daniel river. The northwest limb strikes $N.41^{\circ}E.$ and dips at $70^{\circ}SE.$, whereas the southeast limb strikes $N.48^{\circ}E.$ and dips $37^{\circ}NW.$ This structure is clearly visible on the aerial photographs and has "corners" similar to those of the Port-Daniel - Gascons East syncline (see above).

Badgley (1956) mapped a series of northeast faulted folds in the adjacent New Carlisle map-area. He also observed (1956, p. 23) a well-developed cleavage throughout most of that area, except in the region west and southwest of Port-Daniel.

Weir Township Area

Structural deformation in this area is more severe than in the Port-Daniel - Gascons area. The strata are folded about a northeast axis which plunges gently S.70⁰W., and are cut by closely spaced axial plane foliation which trends N.60⁰-75⁰E. and dips steeply to the northwest. Local structural complications resulted from emplacement of the Weir Township serpentinite and movement along the Raudin fault. A faulted syncline and anticline have been outlined; the former is the northeastward extension of a syncline mapped by Badgley (1956).

Faults

Faults are prominently developed throughout Gaspé peninsula and are the most pronounced structural elements of the Chandler - Port-Daniel area. The Maquereau Group is bounded to the north by the Raudin fault, and to the west and south by the curving Port-Daniel River fault. These two faults have played a major role in the deformational history of southeast Gaspé. It is thought that the Port-Daniel River fault and possibly the Raudin fault were active during the Taconic and Acadian orogenies. It was these faults which acted as zones of slip during the folding of younger Paleozoic sediments around the structurally resistant Maquereau Group.

The east-west graben, which contains the Silurian Raudin Group, is bounded to the north by the North Grand-Pabos fault and to the south by the Raudin fault. Both of these faults can be traced a considerable distance to the west of the area mapped.

A number of other faults occur within the Maquereau Group, and a relatively simple pattern of folding is developed within the Silurian strata west of the Maquereau Group. A detailed description of the individual faults is given in the sequel.

Port-Daniel River Fault

This long, curving fault bounds the southwestern and western limit of the Maquereau Group in Port-Daniel township, and marks the contact with the Mictaw Group and the North Port-Daniel River complex.

In Lots 30 and 31, Range XIII, Port-Daniel township, the fault trace is well displayed in Fault brook (Map 1568-A). Here, as at several other localities immediately to the south, the rocks are highly sheared and silicified. These rocks of the fault zone, which have a rusty weathered surface and are typically fine grained and very hard, are composed essentially of chalcedony with minor amounts of talc and carbonate minerals.

At the mouth of Fault brook, the fault is in contact with a small, highly-sheared serpentinite body, which is cut by a myriad of siliceous, calcareous, and talcose stringers. The fault is also well exposed in North Port-Daniel river at the Government fishing camp (Lot 30, Range IX, Port-Daniel township). The actual fault-trace has not been observed, but highly-contorted green chlorite schist of the Maquereau Group crops out on the east bank, and 20 feet to the west exposures of sheared basal(?) Mictaw conglomerate crop out in the river.

The fault dips vertically where observed, but a strong northeasterly-dipping foliation in the southern basal(?) Mictaw conglomerate suggests that possibly the Maquereau Group may have been thrust southwestward over the conglomerate.

The juxtaposition of lithologic units in this region suggests downfaulting to the southwest, and it is probable that talus debris from a high Maquereau fault scarp shed the material which formed the basal(?) Mictaw conglomerate (i.e., pre-Mictaw faulting).

The same fault repeats the Silurian Clemville and La Vieille Formations along Anse à la Barbe river, and is exposed along the shore at Anse-à-Pierre-Loiselle. This location was described by Logan (1846, p. 53; 1863, p. 443) and Northrop (1939, p. 32) who thought that the downthrow was to the south. Although the limestones on the south side of the fault are gnarled and twisted, sandstones of the Clemville Formation are dragged up along the north side of the fault indicating that the downthrow is to the north. This movement is probably the result of post-Silurian readjustment along the previously existing zone of weakness.

The northern extent of the fault is not known, but the writer believes that it is either truncated by, or merges with, the Raudin fault.

Raudin Fault

The Raudin fault bounds the northern limit of the Maquereau Group and forms the southern boundary of the Silurian graben. The fault is named after Raudin township. Two spectacular zones of tectonic breccia are exposed along the fault: one along West Grand-Pabos river in Raudin township,

and the other in the hills approximately 2 miles northwest of Chandler. The western lens was apparently formed in a "protected pocket" along the fault, opened as a result of sinistral movement.

The eastern lens may have been formed by a similar mechanism. Two large dislocated blocks of fossiliferous Silurian(?) limestone and quartzite several hundreds of feet in diameter occur within this zone. The fault divides into three subsidiary faults in this area, two of which bound the tectonic breccia zone. The third fault strikes eastward and is exposed in a contorted zone along the shore one mile east of Chandler.

The main fault is exposed along the small tributaries of Rankin brook immediately west of Long lake. Westwards from West Grand-Pabos river, the fault separates the Silurian Raudin and Chaleur Bay Groups, and can be traced on aerial photographs to connect with a fault mapped by Skidmore (1958), in the Honorat West area, a total known length of approximately 37 miles.

The Silurian - pre-Silurian contact has been observed at a number of locations in the Chandler - Port-Daniel area, but no Upper Ordovician strata have been mapped south of the Raudin fault. The lithology (limestone and siltstone) is such that it probably was deposited over a very large area, and its disappearance south of the Raudin fault is problematical.

North Grand-Pabos Fault

This west-trending fault is so named by the writer because it is well displayed along North Grand-Pabos river. The fault can be traced easily westwards on aerial photographs to the Honorat West area where it was first recognized by Skidmore (1958). It extends as far west as Nouvelle river in southwest Gaspé (Beland *et. al.*, 1961), and has a total known length of approximately 85 miles. To the east, it strikes out to sea at Petit-Pabos bay, approximately 4 miles east of Chandler. Within the area mapped, the fault is exposed along many rivers, streams and roadcuts, and has a vertical dip with the downthrow to the south. It bounds the northern side of the Silurian graben and outlines the southern limit of the Matapédia Group and the eastern part of the Honorat Group.

The southern compartment may have moved west (dextral movement) in post-Silurian time, since there is considerable displacement of Honorat strata on either side of the fault. The Silurian at the eastern end of the graben is contorted, presumably as a result of squeezing between the Raudin and North Grand-Pabos faults. Minor readjustments along the fault in post-Carboniferous time have displaced the Bonaventure Formation north of Chandler.

The fault is best displayed along North Grand-Pabos river between 13-Mile Camp and the confluence with Rocky brook. A well-defined, buff-weathering fault breccia is found either in the bed of the main stream or a few tens of feet up the small tributary streams which flow into the main river from the south. The breccia pinches and swells along the fault trace and is up to 30 feet thick at a bend in the river 1 mile west of 13-Mile Camp, and thins to a few inches near the mouth of Rocky brook. The breccia comprises angular, buff, silicified fragments up to 4 inches in diameter set in a darker matrix of sheared shale and finely comminuted silicified fragments. There is a marked change in lithology on either side of the fault with rusty-weathering, well-bedded siltstones of the Ordovician Honorat Group on the north, and green phyllitic siltstones and silty limestones of the Silurian Raudin Group on the south.

Several related subsidiary faults have been mapped on the north side of the main fault. One of these bounds a thin wedge of Honorat strata in the extreme western part of the area mapped, and another separates the zone of glassy welded tuffs from the limestones of the Matapédia Group. The "Raudin diorites" appear to be closely related to the fault, and the fact that glass has been found suggests recent volcanism and possible movement along the fault.

Hunt Lake Fault

This west-trending, vertical fault stretches from Chandler to the western margin of the Maquereau Group, and appears to be contained within the Maquereau block. It is evidenced by a zone of highly-contorted purple slates west of Hunt lake, strong lineaments on the air photos, and a dolomitized fault zone along Pins brook where it truncates a zone of purple amygdaloidal volcanics. The fault is approximately 15 miles long.

Other Faults

A vertical fault, parallel to the North Grand-Pabos fault, separates the Matapédia limestones from the Honorat siltstones in the north-eastern part of the area.

A small fault extends west from Saint-Hubert bay to west of Outardes lake. The fault is believed to be dextral and to have formed the peculiar "cuspat" folds in the Newport Formation immediately south of the fault and clearly visible on air photos.

Thrusts towards the southeast have been mapped at Newport Point, and four separate slices have been outlined. The massive purple graywackes of the Newport Formation have been thrust over the well-foliated green graywackes and volcanics of the Port-Daniel Formation; the purple

phyllitic slates (basal member of the Newport Formation) outline the zone of movement along Anse-aux-Canards river. The graywackes and volcanics are thrust over the orthoquartzite unit of the same formation which is in turn thrust over the brown and green well-foliated quartzose graywackes of the Chandler Formation. These relationships can be seen along the railroad and the shore between Anse-à-Blondel and Newport Point.

The thrust zone, which separates the Port-Daniel Formation from the Chandler Formation, is best seen where Highway 6 crosses Anse-aux-Canards river. This is probably the same thrust fault which separates the Chandler Formation at Chandler from the overlying Newport Formation, and is also seen along Highway 6 immediately north of the C.N.R. station. At both localities green and purple slates and phyllitic siltstones outline the zone of thrusting.

Thrusting to the southeast has also been mapped along the shore at Newport, but is believed to be only minor readjustment in response to folding, and is not considered regionally significant.

A southeast-trending fault, subparallel to the Port-Daniel River fault has been postulated within the Maquereau Group between North Port-Daniel river and Anse-à-la-Barbe river. This fault would explain both the discordance of lineaments as seen on air photos and the zone of shearing along Anse à la Barbe river, where gneiss has been developed locally.

A number of small faults has been mapped in the northwest corner of the Maquereau Group. This complicated area apparently bore the brunt of brittle deformation after the unit became an indurated block. However, exposure is not sufficiently good to unravel the geology of this complex region.

At Port-Daniel, a fault, striking $N.05^{\circ}E.$ within the La Vielle Formation, separates gently-dipping strata on the west from steeply-dipping overturned strata on the east. The fault is well displayed in the Highway 6 roadcut immediately east of Port-Daniel, and also in the railroad cut just south of the church of Saint-Georges-de-Port-Daniel. The relative movement along the fault appears to be dextral. A second fault has been mapped east of McInnes cove.

A fault along the Mictaw-Weir contact, exposed along Mictaw brook, is the continuation of a 13-mile fault mapped by Badgley (1956) in the adjacent New Carlisle area. The eastern side is downthrown.

Major faults with spectacular breccias bound the Weir Township serpentinite (Map 1568-D, Fig. 3) and are discussed above.

SUMMARY OF GEOLOGIC HISTORY

The Maquereau Group, which may be a remnant of the Precambrian basement, acted as a resistant block or massif throughout the post-Gaspesian Paleozoic. The block, which is completely surrounded by faults, was so strongly folded and indurated during the Gaspesian orogeny that subsequent Taconic and Acadian folding had little or no effect upon it. It is assumed that the hardened quartzose graywackes of the Maquereau Group possessed considerably different mechanical properties from the limestone, sandstone, siltstone and shale of the younger units, which deformed easily during Taconic and Acadian folding. The tectonic significance of the Maquereau block, as well as a consideration of the tectonics of southeast Gaspé are discussed at length by Ayrton (1964, pp. 81-104).

The following chronologic sequence is proposed by the writer: -

Pre-Middle Ordovician
(Precambrian ?)

1. Deposition of sediments and volcanic flows of the Chandler and Port-Daniel Formations.
2. Folding and low-grade regional metamorphism of these rocks during the Gaspesian orogeny.
3. Deposition of the Newport Formation.
4. Folding of the Newport and older sediments during a later phase of the Gaspesian orogeny. (The age of the Newport Formation is uncertain, and these strata may have been folded during the Taconic orogeny.)

Cambrian

No evidence.

Middle Ordovician

1. The Maquereau block probably was a topographic feature, and there is no evidence that Mictaw strata covered the block.
2. A Maquereau fault scarp was formed along the Port-Daniel River fault; and fragments of deformed Maquereau Group make up the basal (?) Mictaw conglomerate as a talus slope deposit. The Mictaw sediments decrease in overall grain size to the southwest.
3. The Taconic orogeny occurred in this area at the end of Middle Ordovician or at the beginning of Late Ordovician time, folding the Mictaw Group. The "crazy-quilt" pattern may have been developed as a result of slippage along the basement or caused by later superposed folding.

4. Amphibolite and quartzite inclusions derived from the basement were incorporated in the Weir Township serpentinite.

5. Deep-seated activity occurred along the Port-Daniel River fault, which caused serpentinites and rocks of the North Port-Daniel River complex to be brought up along the fault.

Late Ordovician

1. The Maquereau block may have been a topographic feature. There is no evidence that Upper Ordovician strata were deposited south of the Raudin fault, or on top of the Maquereau block.

Silurian (Early Llandovery)

1. Lower Silurian strata of the Weir Formation were deposited west of the Maquereau block in an isolated marine basin. The Maquereau block may still have been a topographic feature as it is not overlain by the Weir Formation.

Silurian (Late Llandovery)

1. The Maquereau block was stable and may have stood higher than surrounding terrain.

2. The Clemville Formation was deposited unconformably on the rocks of the Maquereau Group at Anse-à-Pierre-Loiselle and shore line conditions are indicated. Basal Clemville comprises quartz-pebble conglomerate and quartzose sandstone presumably winnowed from the Maquereau Group, and the formation thickens to the southwest away from the Maquereau Group and probably did not cover the entire block.

Devonian

1. There is no evidence of Devonian deposition in the Chandler - Port-Daniel area. This part of southeastern Gaspé may have been a topographic feature.

2. The Acadian orogeny folded Silurian and Upper Ordovician strata at the close of the Devonian. Fold axes wrapped around the structurally resistant Maquereau block.

No foliation was developed in the Chaleur Bay Group in the Port-Daniel - Gascons area; this may be a shadow zone, or the strata may be underlain by the Maquereau block.

Superposed folding may account for the "crazy-quilt" pattern developed within the Middle Ordovician Mictaw Group.

The Maquereau block was unaffected by Acadian folding. The Silurian-Maquereau unconformity at Anse-à-Pierre-Loiselle is tilted, suggesting that the whole Maquereau block may have been tilted. It is more likely, however, that the block may have been faulted close to the Silurian overlap.

3. The Weir Township serpentinite was remobilized and emplaced in folded Silurian strata.

The graben occupied by the Raudin Group was formed, and is bounded, by the Raudin and North Grand-Pabos faults.

Tectonic breccias were formed along the Raudin fault as a result of lateral movement.

Carboniferous

1. Thin patches of Bonaventure Formation were deposited on the Devonian erosional surface. There is no apparent difference between the elevation of the Bonaventure Formation resting on the Maquereau Group and that resting on the Ordovician and Silurian on either side of the Maquereau block. This indicates that the block has been relatively stable since Carboniferous time.

Post-Carboniferous

1. Recent activity has occurred along the North Grand-Pabos fault. The Carboniferous was faulted north of Chandler, and igneous activity may have occurred in Raudin township (glassy welded tuffs and possible associated diorites).

ECONOMIC GEOLOGY

The location of each prospect is indicated on Map 1568 by the same number used in the following text (i.e. 1, 2, 3, etc.).

Copper, Nickel, Manganese and Chromite

Raudin Township

Mineralized zones have been found at various locations in Raudin township along the North Grand-Pabos fault as outlined below. A separate unpublished report (Ayrton, 1962a) listing locations where the fault can be observed; the lithology on either side; the mineralization; and a description of the fault-trace is on file at the Quebec Department of Natural Resources.

1. C.L. Gauthier Claims (Unsurveyed)

Where the eastwardly-flowing headwaters of West Grand-Pabos river change course and flow southeast. The area is locally known as the "dry section" because the wide river bed is essentially dry in the summer. Traces of copper, nickel (millerite needles) and pyrite are found in the rusty-weathering fault-breccia on the west bank of West Grand-Pabos river approximately in the middle of the "dry section". An 8 1/2-pound selected sample taken from this zone analysed (Quebec Department of Mines Laboratories):

Copper	0.03%
Nickel	0.08%

A block of claims, staked by the C.L. Gauthier 1960 Prospecting Grubstake and optioned to Denison Mines Ltd., covers this area and the adjacent area of welded tuffs, flow breccias, diorites, etc., immediately north of the "dry section".

2. Gerald Hunt Claims (Harrison brook unsurveyed)

Approximately 1 1/2 miles upstream from the junction with North Grand-Pabos river. A small prospect pit and three packsack diamond-drill holes have been completed in a rusty weathering, light gray, chert-carbonate zone, which is believed by the writer to lie directly along the fault. This somewhat mylonitic rock is very hard and locally banded, and has a patchy pale green stain presumably related to chrome or nickel mineralization. One grab sample (across about 12 feet) and about 20 feet of core from each of the drill holes analysed as follows:

	(a)	(b)	(b)
	<u>Grab Sample</u>	<u>Hole No. 1</u>	<u>Hole No. 2</u>
Chromium	0.23%	0.12%	0.13%
Nickel	0.15%	0.15%	0.15%
Copper	0.01%	0.01%	0.02%

(Quebec Department of Mines Labs.)

Tiny needles of millerite are present throughout the rock and the lateral and vertical extent of the zone is unknown.

3. Gerald Hunt Claims

South bank of North Grand-Pabos river, 3/4 mile west of the mouth of Rocky brook. A pit has been dug about 30 feet up the river bank, and small amounts of disseminated bornite, chalcopyrite and malachite are present. The host rock is green phyllitic calcareous siltstone of the Raudin Group (7c, Map 1568). A grab sample taken across 2 1/2 feet analysed

1.27% copper (Quebec Department of Mines Labs.). The fault breccia associated with the North Grand-Pabos fault is located in the river bed at this point.

4. Rocky Brook

At the junction of Rocky brook (east bank), and North Grand-Pabos river. Tiny needles of millerite (nickel sulphide) are found in rusty weathering black siltstones of the Honorat Group on the north side of the fault. The fault-breccia in this area is either exposed in the main river, or a few tens of feet up the small northerly-flowing tributary streams which join North Grand-Pabos river along the south bank.

Newport Township

5. Emilien Grenier Claims (Lots 11-20, Newport Village Range)

The rocks which crop out in this block of claims belong to the Maquereau Group, and comprise interbedded graywacke quartzites and intermediate to basic volcanic flows. The graywacke quartzites are composed of quartz, feldspar, and chlorite, and are predominantly green, well foliated and locally phyllitic. The volcanics are dark green, fine grained, and cut by thin stringers of light green epidote and irregular quartz veins.

Within the mineralized area of interbedded graywackes and volcanics, the strata have a general east-west strike with dips of 20°-30° to the north. The beds occupy the southern limb of an east-trending syncline. Several fault zones, with thrusting to the south, are exposed along the shore west of Newport Point.

Chalcocite and malachite have been observed within the volcanics along the lower contacts, and within the underlying graywackes. The chalcocite is found as grains up to 1/2 inch in diameter; the malachite appears as a stain along fractures and around the peripheries of chalcocite grains. The best mineralization is along the contacts, in lens-like concentrations between volcanics and the underlying graywackes; the concentrations are irregular (8"-12" thick, up to 20 feet long) and have no apparent trend. The lenses are formed of green graywacke quartzite replaced by chalcocite, malachite and pinkish brown calcite.

The mineralization was discovered by E. Grenier in 1958, and since that time he has continued to prospect within this area. Many small pits and a few trenches have been dug. During the summer of 1960, Steerola Explorations, Ltd., a subsidiary of Steep Rock Iron Mines, Ltd., did geologic mapping and geophysical work (magnetometer survey) on a block of ground including lots 11-20, Newport Village Range, and lots 19-25, Ranges IV and V, Newport township (Allen, 1960).

The property has been examined by geologists of the Quebec Department of Natural Resources. (Béland, 1959; Ayrton, 1961, 1962b).

Five vertical diamond drill holes were drilled by Grenier during the 1961 summer on lots 18 and 19, Newport Village Range. The deepest hole was bottomed at 248 feet. In one hole, up to 65 feet of dark green intermediate volcanics were recorded; a 5-foot run of core from the volcanics analysed 0.01% copper. The interesting mineralization found at the surface was not found in the core from any of the five drill holes. A more detailed report of the five drill holes is available (Ayrton, 1961).

a. Lot 19, Newport Village Range: The best showing is along the shore west of Newport Point on lot 19. A large pit has been dug here about 15 feet up a 25-foot cliff. At this locality a volcanic flow overlies a bed of graywacke quartzite. There is no visible chalcocite within the over-lying volcanics, but an 8- to 12-foot mineralized zone is present along the contact. The area is involved in minor thrusting to the south and is underlain by purple slates. The mineralized zone analysed 3.19% copper (1), whereas a 10-foot grab sample taken across the contact analysed only 0.05% copper (2). Several other smaller pits have been dug along this same contact in the immediate vicinity and all show scattered mineralization.

The underlying, well-foliated sandstones are also mineralized to a small degree. Chalcocite is found as small grains, and malachite is common along fractures. Mineralization within the sandstones appears to be a supergene phenomenon. Unfortunately, much of the best showing has been removed.

b. Lot 17, Newport Village Range: North of the railroad cuts, the more resistant gently-dipping volcanics (10^0 to the north) cap the hills. At several places within the flows and in the underlying well-foliated greenish sandstones small showings of chalcocite can be observed. A sample along the volcanic-graywacke contact, just west of Diogène Grenier's house analysed 0.79% copper (3).

The mineralization in this area is interesting and deserves more detailed exploration. Scattered mineralization and traces of copper are found at many localities, although to date the best showing is along the coast on lot 19, Newport Village Range. It is thought that the copper mineralization is intimately related to the volcanics and that it is found along contacts and in the underlying graywackes mainly because of supergene enrichment.

Analyses: Quebec Department of Mines Laboratories

1. Copper 3.19%
18 Sept., 1959
Selected 1 lb. sample taken by E. Grenier.

2. Copper 0.05%
7 July, 1960
16 lb. grab sample taken by W.G. Ayrton.

3. Copper 0.79%
20 March, 1962
Selected 1/2 lb. sample taken by E. Grenier.

Port-Daniel Township

6. C.L. Gauthier Claims

The area referred to here has been described above and the geology and mineral occurrences are shown on Map 1568-A.

Yvan Dea, a Port-Daniel prospector, discovered manganese in this region in 1956. In 1959, Noranda Mines Ltd. optioned the property held by Dea and W.F. Major (also of Port-Daniel), and conducted a magnetometer survey and a program of mapping, trenching and drilling. C.L. Gauthier and Dea staked and reexamined the region in 1961, with emphasis on the area north of Range XII. The property was optioned to Premium Iron Ores Ltd., who remapped the area and also did some trenching during a four-week period in 1962.

Finely disseminated chalcopyrite and thin films of millerite (nickel sulphide), which coat slip planes, have been observed within the serpentinites (lot 30, Range XIII, and lot 28, Range XII). An assay of a 7 1/4-pound grab sample taken across approximately 10 feet of serpentinite analysed 0.14% nickel and 0.01% copper (Quebec Department of Natural Resources Labs.).

The sedimentary strata in lot 28, Range XI, are enriched in manganese and are in part silicified. The manganese is concentrated along certain stratigraphic horizons as fist-sized nodules of wad replacing porous sandstone. An assay of a 6-pound grab sample analysed 6.50% manganese (Quebec Department of Mines Labs.). Arbour (1962) has examined this area and has made chemical and spectrographic analyses of these rocks with special emphasis on their manganese content.

Subangular serpentinite boulders (up to 8 inches in diameter) which are rich in chromite (52.21% Cr₂O₃, Gauthier, personal

communication) have been found on lot 30, Range XIII. It is possible that these chromite-bearing boulders have been transported southward from the Weir Township serpentinite (approximately 3 1/2 miles) but the concentration of float in this particular area suggests that they are of local origin.

7. Pins Brook (McGerrigle, 1950b)

Minor occurrences of chalcocite, malachite and pyrite occur in a fault zone, nearly 20 feet wide, exposed in the river and in adjacent prospect pits, approximately 5,000 feet upstream from the junction with West Grand-Pabos river. The fault-zone material comprises pale, buff-brown dolomite and calcite, and irregular associated quartz veins.

An analysis of 0.80% copper was obtained from a 4 1/2 - pound selected sample of rusty weathering, amygdaloidal, purple volcanics which crop out at a right-angle bend approximately 2,800 feet upstream from the junction with West Grand-Pabos river (Quebec Department of Mines Labs.). Patches of malachite stain coat the weathered surface, and it is not clear whether the mineralization is present throughout the rock or whether it represents a thin surface crust deposited by meteoric water. The amygdules are composed of calcite. Some, however, have a peculiar green weathering which superficially resembles malachite, but which is probably chlorite.

Chromite, Asbestos and Talc

8. Weir Township Serpentinite (Harvie, 1921; Alcock, 1935; McGerrigle, 1942)

Chromite, asbestos and talc occur within the serpentinite on lots 28-38, Ranges II and III, Weir township. This body has been prospected more or less seriously at various times for some 60 years. The most serious work was done in 1942 in search of chromite by Chromium Mining and Smelting Corporation, which took an option on the claims covering the serpentinite body. Trenching and diamond drilling disclosed some small lenses of massive chromite. Three of these are at the surface, the largest is about 12 feet by 5 feet by 5 1/2 feet. Chromite grains are scattered throughout the serpentinite and, locally, are abundant.

Asbestos showings in the serpentinite were investigated by MacLaurin Brothers between 1906 and 1920, and, more recently, by Chromium Mining and Smelting in 1942-43. The MacLaurin work consisted of two or three shallow pits and one pit, about 12 feet across, said to be about 30 feet deep, in lot 34, Range III. Some short-fibre asbestos of fair quality was noted at the pits and at a few other places in the serpentinite. McGerrigle (1942) reported that in some loose pieces of serpentinite, asbestos made up about 10% of the rock, but that the average percentage was much lower.

Talc occurs in lot 37, Range II, Weir township, on the east side of North Port-Daniel river. This occurrence also was prospected by the MacLaurins, and a pit 40 feet by 40 feet by 15 feet (deep) was dug. The quantity of talc now to be seen is small and the quality rather poor.

Iron

9. Pabos Seigniory (Denis, T.C., 1916; McGerrigle, H.W., 1942b)

Lenses and bands of iron-bearing rock varying from siliceous hematite to jasper and hematitic quartzite occur intermittently in the Maquereau Group from the Chandler wharf eastward for 1/2 mile (Lots 60-72, Range I, Grand-Pabos Seigniory). The largest mass seen (approximately 60 feet by 20 feet) is 320 feet northeast of the shore-end of the wharf, between two large oil storage tanks. The iron-bearing rock here is jasper or siliceous hematite. There is a sharp break in the bedding attitudes approximately 400 feet east of the wharf indicating that this iron occurrence may be related to a fault. This occurrence, and a smaller one at the wharf (now covered), constituted the principal showings on the Caldwell and Harrison Claim, reported on by T.C. Denis (1916). A 14-pound grab sample from this showing analysed (Quebec Department of Mines Labs.):

Iron	13.48%
Silica	79.33%

Along the shore, 1,200 feet east of the wharf, elongated nodules of hematite occur in a 4-foot-wide band in bedded graywacke quartzite. None of these iron occurrences present economic possibilities in view of their limited distribution and their siliceous nature.

10. Quartzite

A hard, massive graywacke quartzite of the Maquereau Group, quarried about 2 miles northwest of Chandler, is used for construction fill.

11. Limestone

A quarry in the West Point limestone at Gascons West supplies the Gaspesia Pulp and Paper Company mill at Chandler with limestone. A number of other small quarries operate on demand. Two of 17 analyses listed in Faessler (1962, pp. 227-231) are given below:

	No. 1262 Port-Daniel Quarry Port-Daniel East	No. 1266 Gascons Quarry
SiO ₂	- - -	1.00
Insol.	1.10	- - -
Al ₂ O ₃	2.00	0.23
Fe ₂ O ₃		0.29
MgCO ₃	0.84	0.53
Ca ₃ (PO ₄) ₂		0.02
CaCO ₃	<u>94.54</u>	<u>97.98</u>
Total	98.48	100.05

12. Gravel

Pits supplying gravel for road material are in use at Chandler, Gascons and Port-Daniel.

13. Oil Shales

In view of the current interest in oil shales, the following report on the oil shales of the general area has been added by the editors.

The occurrence of oil-bearing shales on Port-Daniel river was first reported by Logan (1846; 1863, p. 445; p. 785). Ellis (1880-82) referred to them as did Alcock (1935). The first comprehensive study of these shales, as oil-bearing rocks, was made by Parks (1929, pp. 67-74) who quotes the results of investigations up to 1929. — "As far back as 1834, the bituminous shales attracted attention and the land between the branches of the (Port-Daniel) river was acquired as a possible coal area by a man named Fashe. Since that time a number of pits, on the Middle and North (Port-Daniel) rivers, have been sunk in the hope of locating a seam of coal.

"About ten years ago the Imperial Oil Co. became interested in the shales and had a report prepared by Mr. J.V. Culbert...

"Quite recently pits were sunk near an exposure on the North river by Mr. Alfred LePage, Val Brilliant, Quebec," apparently "in the hope of locating coal...

"The black shale is much fractured and shows on polished surfaces a structure suggesting a zone of brecciation. Irregularly streaked through the shale are narrow bands of glistening black material resembling coal. This substance is apparently secondary and seems to represent the residue of an infiltration of petroleum along the fractured zone...

"Regarding this occurrence Mr. Culbert writes as follows: 'Five hundred and fifty yards north of the base line between concessions IX and X there is an old coal-prospecting pit in a very shallow layer of a good grade of shale, some of it resembling coal, the remainder being gray-green. This rests on a diabase sill and dips 60°N. At 150 paces north of this pit there is a flat-lying outcrop of shales about two feet above the water level, of good grade'."

The rocks described above "occur on the west side of the North (Port-Daniel) river on lot 29, concession X, Port-Daniel" and were considered by Northrop (quoted from unpublished report in Parks, p. 70) and Parks to be Maquereau. These rocks are in the confused zone along the Maquereau-Mictaw contact and may belong to either Group. An analysis of a selected sample of this shale gave (Parks, p. 71):

Weight of sample	700 grams
Crude oil by distillation	3 gals. per ton
Specific gravity of oil	0.9620
Ash	94.47%
Volatile matter	5.65%
Ammonium sulfate	5 lbs. per ton

The true "oil shale" of the Port-Daniel area is on Middle Port-Daniel river and is Mictaw in age. The actual locality does not appear on the map accompanying the present report, but can be seen on Badgley's map (1956) where Middle Port-Daniel river intersects ranges VIII and IX of Port-Daniel township.

According to Northrop (see Parks, 1929, p. 72), "The black shale contains enough bituminous matter to give a strong odor when heated". Logan (1846, p. 55) stated that "some part of the black shales holds a sufficient quantity of bitumen to yield a bright flame when subjected to a strong heat".

Parks (1929, p. 73) reports that according to Mr. Culbert there are wide exposures of this shale and that it is up to 220 feet thick. A list of occurrences of the shale is given by Parks (p. 73). Parks concludes by stating that Culbert's report gives no analyses, and that, while he (Parks) saw few of the exposures, nevertheless there seemed to be "little or no possibility for the economic extraction of oil or gas".

Swinerton (1930-31, pp. 146-148) examined seven beds (six on the Middle Port-Daniel and one on the North Port-Daniel), sampled and analysed them, and concluded that "there is little or no possibility for the economic extraction of oil from the Port-Daniel shale — the best yields being less than one gallon per ton".

CONCLUSIONS

The conclusions drawn are of three main categories:

- A. Structural and tectonic
- B. Stratigraphic
- C. Related to igneous bodies

Some of the remaining problems and possible solutions have also been listed.

Structural and Tectonic Conclusions

1. The rocks of the Maquereau Group acted as a structurally resistant autochthonous block throughout the Taconic and Acadian orogenies.

2. The Maquereau block is completely surrounded by faults.

3. The complex pattern of folding in the Maquereau Group resulted from deformation in pre-Taconic time, i.e., during the Gaspesian orogeny.

4. The main pulse of Taconic orogeny occurred at the end of Middle Ordovician or during the early part of Late Ordovician time in the Chandler - Port-Daniel area.

5. The fold pattern developed in the Middle Ordovician Mictaw Group resulted from deformation in the Taconic and Acadian orogenies, complicated further by the proximity of the Maquereau block.

6. The Acadian orogeny occurred between Middle Silurian and Carboniferous time in the Chandler - Port-Daniel area.

7. The fold pattern in the Upper Ordovician and Silurian strata resulted exclusively from Acadian deformation.

8. The structure of the Chaleur Bay Group in the Port-Daniel - Gascons area is a simple, faulted, triangular-shaped basin.

9. The Raudin Group occupies a graben bounded by the North Grand-Pabos and Raudin faults.

10. No folding resulted from the Appalachian orogeny in this part of the Northern Appalachians, although reactivation along previously-formed faults probably occurred.

Stratigraphic Conclusions

1. The undated Newport Formation rests with angular unconformity on the Port-Daniel Formation.

2. The exposed contact of the Mictaw Group indicates that the group does not unconformably overlie the Maquereau Group but is in fault contact with it along the Port-Daniel River fault.

3. The age of the Mictaw Group is Late Middle Ordovician (Trenton).
4. The age of the newly-named Weir Formation at the base of the Chaleur Bay Group is Lower Silurian.
5. The Chaleur Bay Group rests with angular unconformity upon rocks of the Mictaw Group.
6. The well-defined formational units of the Chaleur Bay Group cannot be applied to the strata of the Raudin Group.
7. The flat-lying Carboniferous rests with pronounced angular unconformity on rocks of the Maquereau, Honorat and Chaleur Bay Groups.

Conclusions Related to Igneous Bodies

1. The Weir Township serpentinite was intruded during the Taconic orogeny. It was remobilized during the Acadian orogeny and emplaced concordant to the folded Silurian structure along major bordering faults.
2. The North Port-Daniel River complex is a complicated zone of assorted rock types intimately associated with deep-seated activity along the Port-Daniel River fault.
3. Glassy welded tuffs, which may be as young as Tertiary, suggest recent volcanic activity along the North Grand-Pabos fault.
4. The glass in Raudin township is believed to be the first recorded in the entire Appalachian chain.

Remaining Problems and Possible Solutions

1. The absolute age of the Maquereau Group. — Potassium-argon dating of sedimentary rocks should at least establish the date of the last major orogenic episode.
2. The structure within the center of the Maquereau Group is unlikely to be solved by conventional methods, since outcrop is extremely scarce.
3. The stratigraphic relationship between the Chaleur Bay Group and the Raudin Group may be solved when quadrangle mapping is completed to the west.
4. The confused pre-Gascons stratigraphy of the Chaleur Bay Group in southeast Gaspé would be best solved if all of the known sections were examined by one worker.
5. The age, extent, and structure of the glassy-welded tuffs deserve more attention, and absolute dating of the various associated rock type, in addition to detailed mapping, are indicated before a solution can be attained.

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