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NEW CARLISLE MAP-AREA, ELECTORAL DISTRICT OF BONAVENTURE

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PROVINCE OF QUEBEC, CANADA

Department of Mines

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A.-O. DUFRESNE, Deputy Minister

GEOLOGICAL SURVEYS BRANCH

I. W. JONES, Chief

GEOLOGICAL REPORT 70

NEW CARLISLE MAP-AREA

**ELECTORAL DISTRICT
OF BONAVENTURE**

by

PETER C. BADGLEY



QUEBEC

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MAP AND ILLUSTRATIONS

Map

No. 1096 - New Carlisle Map-area (in pocket)

Figure

Figure 1 - New Carlisle Map-area: Columnar Sections (in pocket)

Plates

- I - Looking north from Saint-Jogues-de-Hope across the upland surface, toward ridges underlain by Clemville clastics in Honorat township.
 - II - Looking north from near Paspébiac, Cox township.
 - III - Kame and kettle topography west of Saint-Jogues-de-Hope.
 - IV - Typical relief on Little Port-Daniel river, Port-Daniel township.
 - V - Post-Acadian, pre-Bonaventure unconformity east of New Carlisle, Cox township.
 - VI - View eastward along the coast from New Carlisle showing a small promontory supported by resistant intrusive rock.
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NEW CARLISLE MAP-AREA

ELECTORAL DISTRICT OF BONAVENTURE

by Peter C. Badgley

INTRODUCTION

The area herein described was mapped by the writer for the Geological Surveys Branch of the Quebec Department of Mines during the summer of 1949. One of the main purposes of the investigation was to determine the oil and gas and other economic possibilities of the region.

Location and Access

The New Carlisle map-area lies in Gaspé peninsula, on the north shore of Chaleurs bay, between the towns of Bonaventure and Port-Daniel. It is bounded by latitudes $48^{\circ}00'N.$ and $48^{\circ}15'N.$, and longitudes $65^{\circ}00'W.$ and $65^{\circ}30'W.$ The area is situated in the electoral district of Bonaventure and includes the whole of Cox and Hope townships, and parts of Hamilton and Robidoux townships on the west, of Garin, Honorat, and Weir on the north, and of Port-Daniel on the east. It occupies about 400 square miles, of which approximately 75 square miles are sea.

The region may be reached by either the Matapedia-Gaspé branch of the Canadian National railway or by highway No. 6, both of which closely follow the coast. At numerous places graveled roads lead inland from the paved highway to serve the farming region to the north. Land is under cultivation almost to the northern limits of Cox and Hope townships. There are few roads north of the farming region. A lumber road, passable by truck or wagon, extends from near the Cox-Garin township boundary, north of Saint-Elzéar-de-Bonaventure, to Duval lakes, on the north boundary of the area. A motor road, beginning near the Hope-Honorat township boundary, north of Saint-Jogues-de-Hope, reaches a point well beyond the northern boundary of the area. Kirby's Camp on Bonaventure river, about four miles northwest of the northwestern corner of the area, may be reached by automobile from New Richmond, a town 20 miles west of Bonaventure. A wagon road follows North Port-Daniel river north-northwestward from Port-Daniel.

Aside from these arteries of travel, the area must be traversed on foot. Much of it, except for the heavily timbered eastern and western portions, was burned over within the past twenty-five years and, as a result, travel is not too difficult along the higher ground.

In the lower ground generally and along most of the streams, the underbrush is dense and travel difficult. The Bonaventure is the only river within the area navigable by canoe for any appreciable distance. Travel along all other rivers must be made on foot owing to the numerous rapids and waterfalls.

All the coastal settlements are fishing and farming communities. The largest villages are New Carlisle, Bonaventure, and Paspébiac. All three are the centres of relatively prosperous farming communities and, in addition, they are growing in importance as summer resorts. Paspébiac serves also as the headquarters in the Gaspé region of the trading firm of Robin, Jones and Whitman. The only inland farming communities are Saint-Jogues-de-Hope and Saint-Elzéar-de-Bonaventure, both of which have developed in the past fifteen years.

Field Methods

Streams are fairly numerous in the area and, as they usually provide the best rock exposures, they were all carefully examined. Most of the other exposures seen were in road cuts and along ridges. Cross-country traversing was done at the places where the streams or the roads were not sufficiently close together to give adequate coverage of the ground. Aerial photographs furnished by the Surveys and Mapping Branch of the Department of Mines and Technical Surveys, Ottawa, were of great assistance in locating exposures and planning traverses.

Able assistance in the field was rendered by Robert Bergeron, graduate of Laval University and post-graduate student at Columbia university.

Agricultural Possibilities

The region contains large areas of flat, or gently undulating, upland surface, as well as a somewhat flat coastal belt. The cover of coarse drift is insufficient to be over-troublesome, and, in view of the presence of numerous marl lake deposits, the agricultural possibilities of both the upland and the coast sections of the area are relatively good, even if the soil is not maturely developed.

Previous Work

Sir William E. Logan, founder and first Director of the Geological Survey of Canada, devoted his first two field seasons, in

1843 and 1844, to an examination of the Gaspé and Chaleurs Bay regions^A. He collected fossils at Port-Daniel in 1844, and his assistant, A. Murray, ascended Bonaventure river in the same year. E. Billings described fossil faunas from the region in 1858, 1859, 1862, 1863, and at later dates. R.W. Ells continued the survey of Bonaventure river in 1883. J.M. Lambe contributed to the palaeontology of the region in 1899 and 1901.

J.M. Clarke published a brief description of the Black Cape section in 1912. In 1923 and 1924, C. Schuchert and J.D. Dart mapped a small area at Port-Daniel, and published a description of the Chaleurs Bay series^{AA} in 1926. S.A. Northrop, C. Schuchert, and C.O. Dunbar returned to Port-Daniel and Black Cape in 1927. Northrop studied the collections made in that year and re-studied those made in 1923 and 1924. He reported the results of these studies in a thesis entitled "The Geology of the Port-Daniel-Gascons Area, Quebec" which he presented at Yale University in 1928. In 1928, Northrop, with the assistance of H. Johnson and under the direction of F.J. Alcock, mapped the coastal belt from the Gaspé-South county line to Little Cascadepia river, a distance of sixty miles, including the coastal portions of the present map-area. At that time, also, he made traverses inland along some of the major streams. The results of this field work were reported in 1935 by Alcock. Northrop continued his palaeontological studies at Yale in 1929, in 1931, and in 1937, and the results of his work were published in 1939 as a special paper of the Geological Society of America on the "Paleontology and Stratigraphy of the Silurian Rocks of the Port-Daniel-Black Cape Region, Gaspé".

GENERAL GEOLOGY

The consolidated rocks of the New Carlisle map-area are all of Palaeozoic age, and are assigned to the Ordovician, Silurian, and Carboniferous systems.

The Ordovician rocks of the Mictaw group outcrop in the northeastern part of the map-area. They consist of thinly bedded, black, green, and grey shales, fairly thickly bedded greywackes, occasional limestones, and conglomerates. The Silurian succession consists of sandstones at the base followed upward by a limestone formation, then a siltstone formation, and finally by siltstones, shales, and limestones. To the west of the map-area, the upper portion of the Silurian section contains volcanic rocks. Red sandstones, shales, and conglomerates of Pennsylvanian age underlie a narrow fringe of the coast.

^ASee Bibliography at end of report.

^{AA}This series has been referred to in earlier reports as Chaleur series and Chaleur Bay series. In view of this variation, of the erroneous spelling, and of the requirements of history, the Quebec Department of Mines has adopted the term "Chaleurs Bay Series".

The accompanying Table lists the formations of the area with their rock types and the maximum thickness of each.

Table of Formations

<u>Period</u>	<u>Formation</u>	<u>Rock Types</u>	<u>Maximum Thickness</u>
Quaternary		drift, gravels, and sands	
Pennsylvanian	Bonaventure	red sandstone and conglomerate	100 ft.
	Pre-Bonaventure age unknown	Sedimentaries and intrusives	
Middle Silurian (Niagaran)	Chaleurs Bay Series: Indian Point West Point Bouleaux Gascons La Vieille Clemville	siltstone, limestone limestone, shale shale, limestone siltstone limestone sandstone, shale, conglomerate	456 ft.+ 1,714 ft. 888 ft. 2,300 ft.+ 900 ft. <u>1,430 ft.</u> 7,688 ft.+
Middle Ordovician	Mictaw group	shale, greywacke, conglomerate	

THE MICTAW GROUP

The Mictaw group consists of thinly bedded, black, green, and grey shales, thick-bedded greywackes, occasional limestones, and several varieties of conglomerate.

The group is exposed only in the northeastern corner of the map-area. Including the region to the north and east of the map limits, the total area of outcrop has been estimated at thirty-five square miles by Northrop (1939, p. 11).

The structural complexity, and the lack of conspicuous horizon markers, do not allow a division of the group into formations. The main rock type is greywacke and its fine- and coarse-grained equivalents: some greenish-grey, greyish-black, and dark-grey shales, and

some poorly sorted (polymictic) conglomerates. The particles seen in thin sections included ordinary quartz, vein quartz, chert, quartz-mica schist, volcanic rock, quartzose sandstone, and feldspar. The matrix which binds these fragments together is made up of finely ground rock fragments and chloritic and micaceous material. Sorting and rounding are extremely poor. The large content of feldspars makes this rock a high rank greywacke.

The beds at places grade into true conglomerates. Beds of such rock, poorly sorted and about fifteen feet thick, are exposed at a point about a quarter of a mile downstream from the junction of the Mictaw and Middle Port-Daniel rivers. The angular fragments in this rock are pale-brown limestone and greyish-black thinly laminated shale, some of the fragments of the latter being as much as fifteen inches long. The less angular fragments are volcanics, quartz, and quartzose schist. The matrix is greywacke.

The next outcrop upstream from this exposure is a thinly laminated greyish-black shale of the same nature as the large shale fragments in the conglomerate. Similar conglomerates, however, were seen again a mile or more farther upstream. On Middle Port-Daniel river, in range VII of Port-Daniel township, a one-foot bed occurs in a sequence of thinly bedded dark-grey shales. This conglomerate contains fragments of quartz (including vein quartz), quartz-mica schist, and chert, but none of shale or of similar non-resistant rocks. The fragments are bound together not by a greywacke-like matrix but by a calcitic cement. The ratio of fragments to cement is very high, and sorting is poor. Fragments ranging from 0.2 mm. to 8.0 mm. were seen in a thin section of the rock and fragments up to 20 mm. were seen in the rock exposure. The larger fragments are more rounded but rounding as low as 0.1 was observed in the coarse-grained variety. The fragments in this conglomerate clearly are much more abraded than those in the conglomerate first described.

On Grum brook, in range VIII of Port-Daniel township, greywackes similar to those described above grade into a fine-pebble conglomerate in which nearly all the fragments are angular, pale-bluish green to greenish-grey shale up to 25 mm. in diameter. Similar shales have been found interbedded with the greywackes elsewhere.

The writer has noticed that the proportion of greywacke increases relatively to the amount of shale, from west to east in the area examined.

The absence of evidences of re-working in the shales and greywackes suggests deposition below wave-base. Neither graded bedding nor evidence of soft-rock deformation was observed. The general features of the Mictaw rocks suggest a rather continuous subsidence, but the presence in the conglomerates of fragments of adjacent shale beds suggests periods of still-stand as well. The pyrite of the greyish-black shales indicates conditions of restricted circulation.

Much of the material that went to form the Mictaw group of sedimentary rocks has probably not travelled very far. The vein quartz, and the quartzose schist of the greywackes, might well be derived from the Macquereau rocks to the east. The various types of conglomerates suggest both local (older Mictaw beds) and less local (Macquereau-type lithology) source-areas. The basal conglomerate of the Mictaw group was not observed by the writer, but according to Alcock (1935, pp.13-14) it is made up in part of Macquereau material. The source of the chert fragments is not known.

All the fossils so far collected from the Mictaw group have come from a few localities immediately south of the mouth of Mictaw river. According to Alcock (1935, p. 14) and to Northrop (1939, p. 12), fossils were collected from grey to black shales at three localities on the west bank of Middle Port-Daniel river, in ranges VII and VIII of Port-Daniel township. Graptolites from the Northrop and Alcock collections were submitted to Ruedemann who reported 13 species indicating a late-Trenton early-Eden age from the Northrop collection. He reported to Alcock (1935, p. 14) that the combination of fossils from Middle Port-Daniel river was not conclusive evidence of any particular horizon, but that it suggested an age not far above the Normanskill shale, probably of Black River to Trenton age. Other fossils reported by Alcock (1935, p. 14) included the brachiopods, Schizambon sp. and Lingula cf. progne, and a species of conularid. Northrop (1939, p. 12) also reports several genera of brachiopods and one cephalopod, Geisonocerina? danielensis. In his latest publication on the subject, Northrop (1940, p. 1974) reports twenty-seven species from the Mictaw group, including seventeen graptolites, eight brachiopods, one conularid, and one cephalopod. On the basis of this fauna, Northrop correlates the Mictaw group with the Dolgeville and Snake Hill formations (Trenton-Utica age) of New York State.

The writer searched the Mictaw group carefully for fossils but unfortunately was able only to make small collections and these were from the same localities as visited by the earlier workers. Very poorly preserved graptolites (?) were observed in grey shales interbedded with greywackes on Grum brook, in range X of Port-Daniel township.

Strata of the Mictaw group were first described by Logan (1846, p. 55). The term Mictaw was proposed by Northrop in 1928 in an unpublished manuscript (see Northrop 1939, p. 12), and the name Mictaw first appeared in print in 1930 (Schuchert 1930, p. 712). The group received its name from the Mictaw river, an east branch of Middle Port-Daniel river. The present writer, following the system of nomenclature proposed by Ashley et al. (1933), is inclined to consider the Mictaw a group rather than a series.

The Mictaw group has been subject to the same recent erosional history as the overlying and the underlying rocks. However, as a result of the large percentage of shales and greywackes, both of which are weakly cemented, the Mictaw outcrop-area is relatively subdued topographically.

CHALEURS BAY SERIES

The Silurian sequence in this map-area and in the adjacent remaining part of Port-Daniel township was first studied by Logan and described by him in the Reports of Progress of the Geological Survey of Canada for 1846 and 1863. Logan did not include either the lowest formation, the Clemville, or the highest formation, the Indian Point, within the Chaleurs Bay series, so that he found a thickness of only 3,340 feet.

Schuchert and Dart (1926, p. 37), largely on the basis of lithology, subdivided the Chaleurs Bay series into seven divisions (presumably of formational rank) as follows, in descending order:

Indian Point Formation	194 ft.
West Point or <u>Crotalocrinus</u> (<u>Syndetocrinus</u>) limestones	1,445 ft.
Bouleaux formation of thin-bedded limestones, coral reefs and breccias, and shales	800 ft.
Gascons or <u>Taonurus</u> muddy and shaly sandstones	1,800 ft.
La Vieille limestone or <u>Stricklandinia</u> beds	285 ft.
La Vieille sandstones and conglomerates	170 ft.
Clemville formation	385 ft.

Total thickness 5,079 ft.

More detailed work elsewhere in the area led Northrop (1939, p. 25) to conclude that the Chaleurs Bay series was thicker than had been indicated by Schuchert and Dart (1926). He listed the formations and their respective thicknesses as follows:

Indian Point formation	456 ft.
West Point " 	1,714 ft.
Bouleaux " 	888 ft.
Gascons " 	1,890 ft.
La Vieille " 	405 ft.
Anse Cascon " 	332 ft.
Clemville " 	<u>824 ft.</u>

Total thickness..6,509 ft.

As will be noted, Northrop introduced a new formation name (the Anse Cascon) for the lower part of the La Vieille formation of Schuchert and Dart: "La Vieille sandstones and conglomerates". Schuchert and Dart (1926, pp. 45-46) had themselves defined the lower part of the formation as "La Vieille sandstones and shales" instead of "La Vieille sandstones and conglomerates". Furthermore, on their map (1926), they designate one of their map units as "La Vieille and Clemville formations (sandstone, shale)". Apparently Schuchert and Dart had difficulty in mapping as distinct units the sandstones and shales beneath the La Vieille limestones. Thus, a variety of terms have been used to designate these lower formations of the Chaleurs Bay series. This apparent confusion can be partly explained by the facts that good exposures are lacking along the shore for the Clemville, and that the successive Silurian formations were nearly all measured at different localities in the Port-Daniel area.

The type Clemville section of Schuchert and Dart (1926) (Section 3, Figure 1, of the present report), contains a considerable percentage of quartzose sandstones. These consist of quartz and chert fragments (some pink), set in a calcitic cement; they are quite distinctive. The sandstones were also seen in the type-section defined by Northrop for his Anse Cascon formation and in one of his sections of the Clemville formation (see Sections 1 and 4, Figure 1, of this report). It appears that these particular sandstones, thicker in some parts of the area than in others, occur at approximately the same stratigraphic level: the middle of the Clemville formation as defined herein. Therefore, it seems to the writer that the Anse Cascon of Northrop, the type Clemville of Schuchert and Dart, and the "La Vieille sandstones and shales" also of Schuchert and Dart, are one and the same zone. This conclusion is based on the distinctive lithological character of the sandstones (quartz and pink chert grits), and on the fact that only one such set of sandstones has been seen in those sections which are completely exposed from the lower Clemville up to the La Vieille limestone (Section 5, Figure 1, of this report).

The sandstones are underlain and overlain by, and at places interbedded with, shales. In some parts of the area, as on Duval river, range XIV West of Paspébiac, the upper shales are missing. At Anse-à-la-Vieille (identical with Anse aux Gascons), where Schuchert and Dart described their "La Vieille sandstones and shales, below, and the La Vieille limestones above", the lower shale portion of the Clemville with its distinctive fauna also is missing. These lower shales appear only farther west. This may explain why Schuchert and Dart did not recognize the Clemville at this locality.

No distinctive fossil assemblage was found in the sandstones; Paleocyclus rotuloides Hall appears to characterize the shales overlying the sandstones.

The above discussion shows that the term "Anse Cascon" is no longer needed. The term was introduced by Northrop to separate the La Vieille sandstones and shales from the La Vieille limestones, but the La Vieille sandstones and shales have been shown to be identical with the Clemville. The quartzose sandstones are part of the Clemville formation, and it does not seem that any clarity would be gained by introducing a new formation or even a new member at this level.

In the descriptions of the formations which follow, the earlier descriptions of Schuchert and Dart (1926), of Alcock (1935), and of Northrop (1939), will be referred to and used in part, especially for the formations which are little exposed within the present map-area.

Correlation with the Silurian of other regions is based on the correlation chart of C.K. Swartz et al. (1942).

Clemville Formation

The Clemville formation consists in this map-area mainly of shales, quartzose sandstones (ortho-quartzites), well-sorted quartz and chert conglomerates, and to a lesser extent of thin-bedded limestone, coarse-grained poorly sorted conglomerate, and sub-greywacke.

The following is a detailed stratigraphic section measured by the writer on the Second West branch of Middle Port-Daniel river, in ranges X and XI of Port-Daniel township (Section 5, Figure 1). The contact with the underlying Mictaw group was not seen on this river. In descending order:

	<u>Thickness</u>	<u>Cumulative Thickness</u>
Thinly bedded, dark greenish-grey to greenish-black, limy shale, with occasional thin limestone beds grading upward into shaly and muddy limestones of the lower part of the La Vieille limestone. The following fossils were collected:	170 ft.	170 ft.

Dolerorthis flabellites (Foerste)
Dalmanella wisbyensis nana McLearn
Parmorthis elegantula (Dalman)
Paleocyclus rotuloides (Hall)
Rhipidomella hybrida (Sowerby)
Favosites sp.
Trilobite sp.

Fine-grained, medium-grey to blackish-red quartzose sandstone, becoming locally conglomeratic; finer-grained toward the base, grading into a siltstone; beds six inches to two feet thick. The following fossils were collected from the finer-grained beds near the base:	975 ft.	1,145 ft.
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Coelospira hemispherica (Sowerby)
Mendacella uberis (Billings)
Halysites catenularia var. simplex
Lambe
Pterina emacerata (Conrad)
Protomegastrophia profunda (Hall)
Favosites sp.
Mytilus sp.
Gastropod sp.

Thinly bedded, dark greenish-grey shales with occasional thin limestone beds or limestone-concretion beds. The following fossils were found at this stratigraphic level:	155 ft.	1,300 ft.
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Camarotoechia peneborealis Twenhofel
Coelospira hemispherica (Sowerby)
Dalmanella wisbyensis nana McLearn
Dolerorthis flabellites (Foerste)
Hallopora gracilens Twenhofel
Leptaena rhomboidalis (Wilckens)
Parmorthis elegantula (Dalman)
Sowerbyella transversalis brevis Northrop

	<u>Thickness</u>	<u>Cumulative Thickness</u>
<u>Tentaculites niagarensis</u> Hall		
<u>Buthotrephis</u> sp.		
Trilobite sp.		
Thinly bedded, pale brown-weathering limestone, with interbedded shales in minor amount.	130 ft.	1,430 ft.

The basal conglomerate of the Chaleurs Bay series was seen at three localities: on Little Port-Daniel river at the Clemville Bridge (range V of Port-Daniel township), on the First West branch of Middle Port-Daniel river (range VIII of Port-Daniel township) and at Anse aux Gascons, east of the map-area. At the first two localities the conglomerate rests upon the Mictaw shales, but at Anse aux Gascons it rests unconformably upon the Macquereau quartzose schists.

The section exposed at the Clemville Bridge is 112 feet thick (Section 3, Figure 1). Here conglomeratic beds up to four feet thick appear to alternate with thinner sandstone beds. The conglomeratic beds probably are cut-and-fill deposits. This is suggested by the nature of the beds, coupled with abrupt changes of thickness. Both the conglomerates and sandstones are very poorly sorted. Many of the pebbles less than two inches in diameter consist of somewhat rounded quartz, quartzose schist, and occasional jasper. With these pebbles are many angular fragments of light greenish-grey shale, greyish-black pyritiferous shale, and blocks of limy concretionary material up to two feet across. The matrix consists of finely comminuted rock fragments. The larger and angular blocks of shale and concretionary material as well as the cementing matrix are probably of Mictaw origin. The origin of the better rounded and smaller quartz, schist, and jasper pebbles is less certain. All these could have been derived from the Macquereau.

The conglomerate on the First West branch of Middle Port-Daniel river is similar to the above. That at Anse aux Gascons, resting unconformably on the Macquereau quartzose schist (here cut by numerous quartz veins), has quite a different composition. It consists almost completely of very angular vein-quartz fragments about 20 mm. in diameter, set in a secondary quartz cement. Recognition of the causes of the contrast between the conglomerate resting on the Mictaw shales and that resting on the Macquereau schist helps explain the presence of shales and fine-grained sub-greywackes in the otherwise dominantly quartzose Clemville formation.

The main quartzose portion of the Clemville formation consists of quartz and chert fragments set in a calcitic matrix. The following attributes for quartz were seen in typical thin sections; each range given was observed within the same slide.

Size of grains: slide(a) 0.15 to 1.0 mm.
slide(b) 0.30 to 1.5 mm.

Roundness of
average grain: slide(a) 0.2 to 0.5 mm.
slide(b) 0.2 to 0.5 mm.

Sphericity of
average grain: slide(a) 0.6 to 0.9 mm.
slide(b) 0.8 to 0.9 mm.

Many of the quartz grains were stained brown along minute cracks. At one stratigraphic level they were coated with a film of ferruginous cement. At this same level a considerable amount of ferruginous as well as calcitic cement was observed.

Near the base of the sandy portion of the section, the grade size of the grains decreases and the rock appears in thin-section to be a sub-greywacke rather than an ortho-quartzite (quartzose sandstone) as a few feldspar grains were seen among the fragments and the matrix consists of chloritic and micaceous material.

Within this map-area the Clemville is best exposed along the lower Little Port-Daniel, upper Middle Port-Daniel, Bonaventure, upper Duval, and upper Hall rivers. Listed below are the localities where the formation has been measured and described, and correlated with reasonable certainty with Schuchert and Dart's type-section (Section 3, Figure 1). Alcock has recognized the Clemville lithology on the south shore of Chaleurs bay and uses the same formational names there for the Chaleurs Bay series. Crickmay's figures from the Matapedia Lake area are included here for comparison, although correlation between the individual Silurian formations of the Chaleurs Bay and Matapedia areas has not been confidently established as yet.

<u>Locality</u>	<u>Geologist</u>	<u>Thickness</u>
Anse aux Gascons (Section 1, Figure 1)	Northrop (1939)	168 ft.
Southeast limb of Clemville anticline (Section 3, Figure 1)	Schuchert and Dart (1926)	829 ft.
Northwest limb of Clemville anticline (Section 4, Figure 1)	Northrop (1939)	1,097 ft.
Second West branch, Middle Port-Daniel river (Section 5, Figure 1)	Badgley (1949)	1,430 ft.
Along the shore of Culligan, west to Armstrong brook, New Brunswick	Alcock (1935)	3,000 ft.
Limestone Point south to Petit Rocher, New Brunswick	Alcock (1935)	2,400 ft.
Along the shore of lake Matapedia east of Val Brillant, Quebec. (The Val Brillant formation is correlated tentatively by the writer largely on the basis of lithology and similarity of sequence, and only partially on a faunal basis)	Crickmay (1932)	200 ft.

At each locality, the principal part of the formation is a medium-grained sandstone, usually of the ortho-quartzite variety, although arkoses have been reported in the New Brunswick sections (Alcock 1935). Northrop has also reported arkoses from the Port-Daniel area. However, the present writer's collection of "arkoses" from this formation were seen in thin section to be either sub-greywacke or a variety of ortho-quartzite containing small, angular iron-stained chert grains.

The Matapedia Lake section (Crickmay, 1932) consists of a cross-bedded quartz sandstone with a limonite and silica cement, but contains no shales. All the other sections contain at least minor amounts of shale. In the Port-Daniel area, the main ortho-quartzite is sometimes overlain and underlain by shale. In other places, as on Little Port-Daniel river (Badgley, 1949) and at Petit Rocher (Alcock, 1935), the transition is abrupt from ortho-quartzite to the La Vieille limestone above.

The thick ortho-quartzite beds are very resistant to erosion and they stand out as distinctive ridges at several localities, as in the upper Duval River area. Elsewhere, however, as in the vicinity of Port-Daniel, Clemville and La Vieille ridges are about equally prominent.

La Vieille Formation

The La Vieille formation consists of thin-bedded, muddy, greenish-grey, fossiliferous limestone grading upward into thick-bedded, medium dark-grey, purer limestone.

The following is a stratigraphic section measured on Little Port-Daniel river, in range VIII of Port-Daniel township (Section 6, Figure 1).

In descending order (Gascons formation above):

	<u>Thickness</u>	<u>Cumulative Thickness</u>
Pure, medium dark-grey limestone in beds ranging from five inches to three feet, becoming slightly muddy and quite nodular near the top.	610 ft.	610 ft.
Muddy, greenish-grey limestone (two- to three-inch beds) becoming shaly limestone (one-inch beds) at the base. The following fossils were collected:	290 ft.	900 ft.

Chonetes tenuistriatus (Hall)
Leptaena rhomboidalis (Wilckens)
Mendacella uberis (Billings)
Stricklandia gaspéensis (Billings)
Paleocycclus rotuloides (Hall)
Favosites sp.
Pterina sp.

Occasional biostromal coral beds (bedded rocks made of fossils) were seen in the upper part of the section. The purer limestones above the muddy portion represent a time when detrital material was not accumulating. Some of this calcareous mud has crystallized, but no dolomitization nor evidence of re-working by wave action was observed.

The La Vieille formation is well distributed throughout the present map-area and good sections are exposed on the Little Port-Daniel, Duval, Hall, and Bonaventure rivers. In the southeastern part of the map-area, the formation is thick-bedded. Proceeding north and west it becomes thinner-bedded and somewhat argillaceous. The formation has been reported from a number of localities beyond the map-area. Correlation has been made largely on the basis of lithological and sequence similarities rather than on palaeontological grounds. However, Stricklandia gaspéensis Billings seems to be restricted to the La Vieille formation, at least in the Chaleurs Bay region. The formation varies greatly in thickness, as shown below:

<u>Locality</u>	<u>Geologist</u>	<u>Thickness</u>
Port-Daniel East (Section 2, Figure 1)	Schuchert and Dart (1926)	285 ft.
Southeast limb of Clemville anticline (Section 3, Figure 1)	Schuchert and Dart (1926)	405 ft.
Little Port-Daniel river, range VIII, Port-Daniel township (Section 6, Figure 1)	Badgley (1949)	900 ft.
Black Cape, Quebec	Schuchert and Dart (1926) and Northrop (1939)	1,185 ft.
Culligan to Armstrong brook, New Brunswick	Alcock (1935)	1,730 ft.
Limestone Point to Petit Rocher, New Brunswick	Alcock (1935)	800 ft.
Three miles east of Sayabec, Quebec, on the shore of lake Matapédia (the Sayabec formation)	Crickmay (1932)	200+ ft., possibly 500 ft.

The Port-Daniel East section, the thinnest of all, shows the best coral and stromatoporoid "reef" beds. It appears that these "reefs" are biostromal (bedded structures, not swelling into mound-like form) in character rather than biohermal (dome-like, mound-like, or lens-like). The term "reefy" has been used rather loosely by previous workers in the area, but unless modified it may give a false idea as to the structure and economic possibilities of the formation.

The Port-Daniel East section and the section described by the writer on Little Port-Daniel river are relatively free from mud. The latter, however, contains a low percentage of reef organisms. The Black Cape section, not far west of the map-area, is quite muddy, nodular, and nowhere very thickly bedded. The New Brunswick sections are thick-bedded and relatively uncontaminated with non-calcareous material. The thin Sayabec formation is somewhat argillaceous, and somewhat dolomitized. No palaeogeographic interpretation is attempted at this time beyond pointing out that the dolomitization of the Matapedia rocks, and the cross-bedding in the underlying Val Brillant formation, suggest shallow-water conditions. The inclusion of the Sayabec formation in this discussion is based on the stratigraphic position and lithologic characters of the formation rather than on its fossil content.

The La Vieille formation, except in the southeast part of the map-area where it is made up of pure, thick-bedded limestone, is gradational into both the overlying Gascons and the underlying Clemville formations.

Gascons Formation

The Gascons formation consists for the most part of a quartz siltstone containing a small percentage of mica shreds set in a calcitic cement. Its upper portion was not observed with the map-area, but beyond the map limits, both at Port-Daniel and Black Cape, the formation was measured by Schuchert and Dart (1926), and by Northrop (1939). It contains a Monograptus zone in its lower part, but the relation of this zone to the base of the formation was not established at either of the above localities. The writer was able to establish this relationship on Little Port-Daniel river (Section 6, Figure 1). The section there is relatively complete, and the lower part is believed to be fairly typical of the lower part of the formation throughout much of the map-area. This section is as follows (in descending order):

	<u>Thickness</u>	<u>Cumulative Thickness</u>
Upper beds cut off by faulting	?	
Dark greenish-grey siltstones, in six- to twelve-inch beds	2,300 ft.	
Alternating beds of very fine-grained, dark-grey limestone, one to three inches thick, and beds of muddy, medium dark-grey limestone, one inch thick	180 ft.	2,480 ft.
Thin-bedded, dark-green shaly siltstones (two to three inches thick), locally red in colour, dominate this portion of the section. Thin beds of muddy limestone appear toward the base.	400 ft.	2,880 ft.

Monograptus priodon (Bronn) was found in a zone 100 ft. thick starting 200 feet, above the base.



Looking north from Saint-Jogues-de-Hope across the upland surface, toward ridges underlain by Clemville clastics in Honorat township.

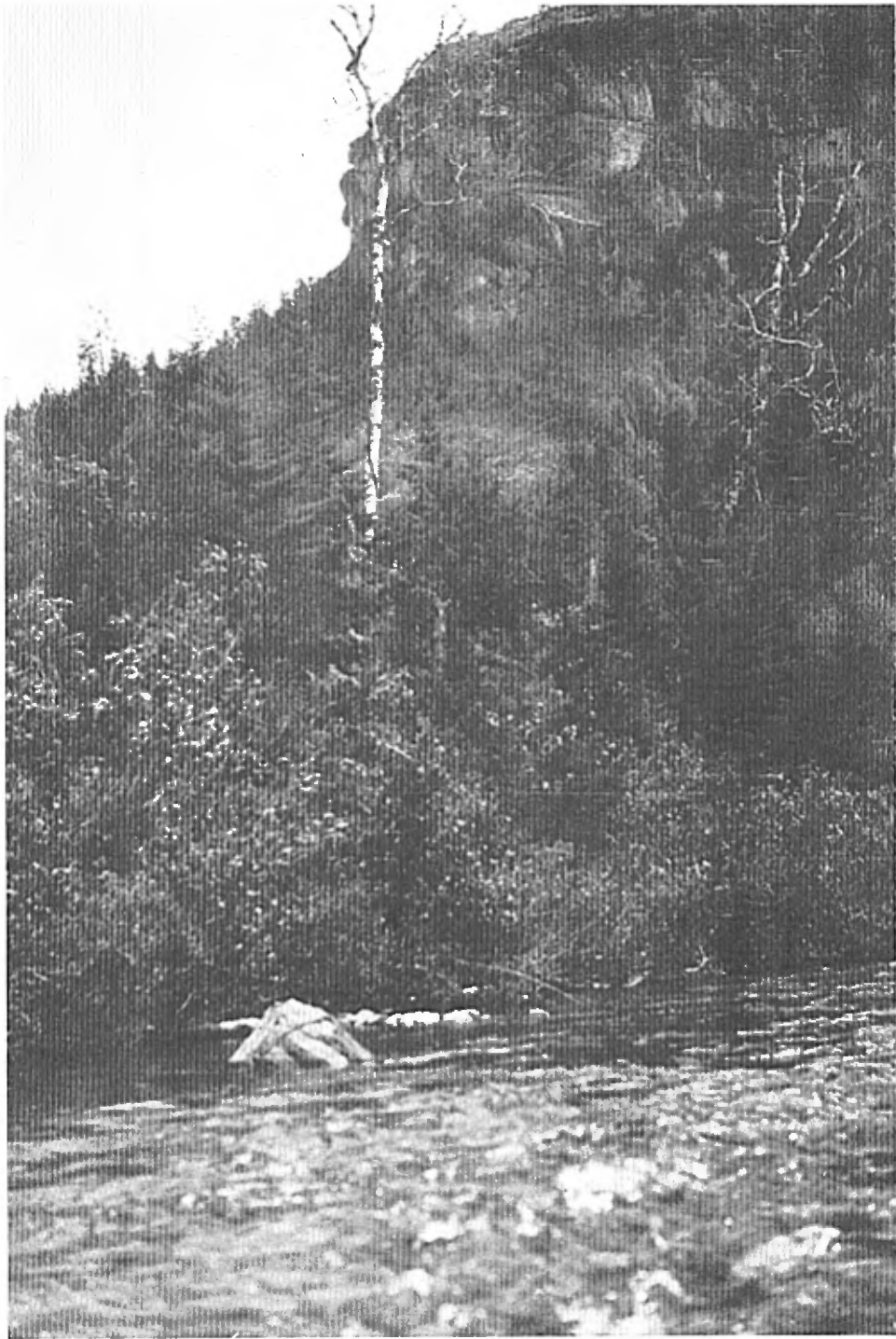


Looking north from near Paspébica, Cox township.

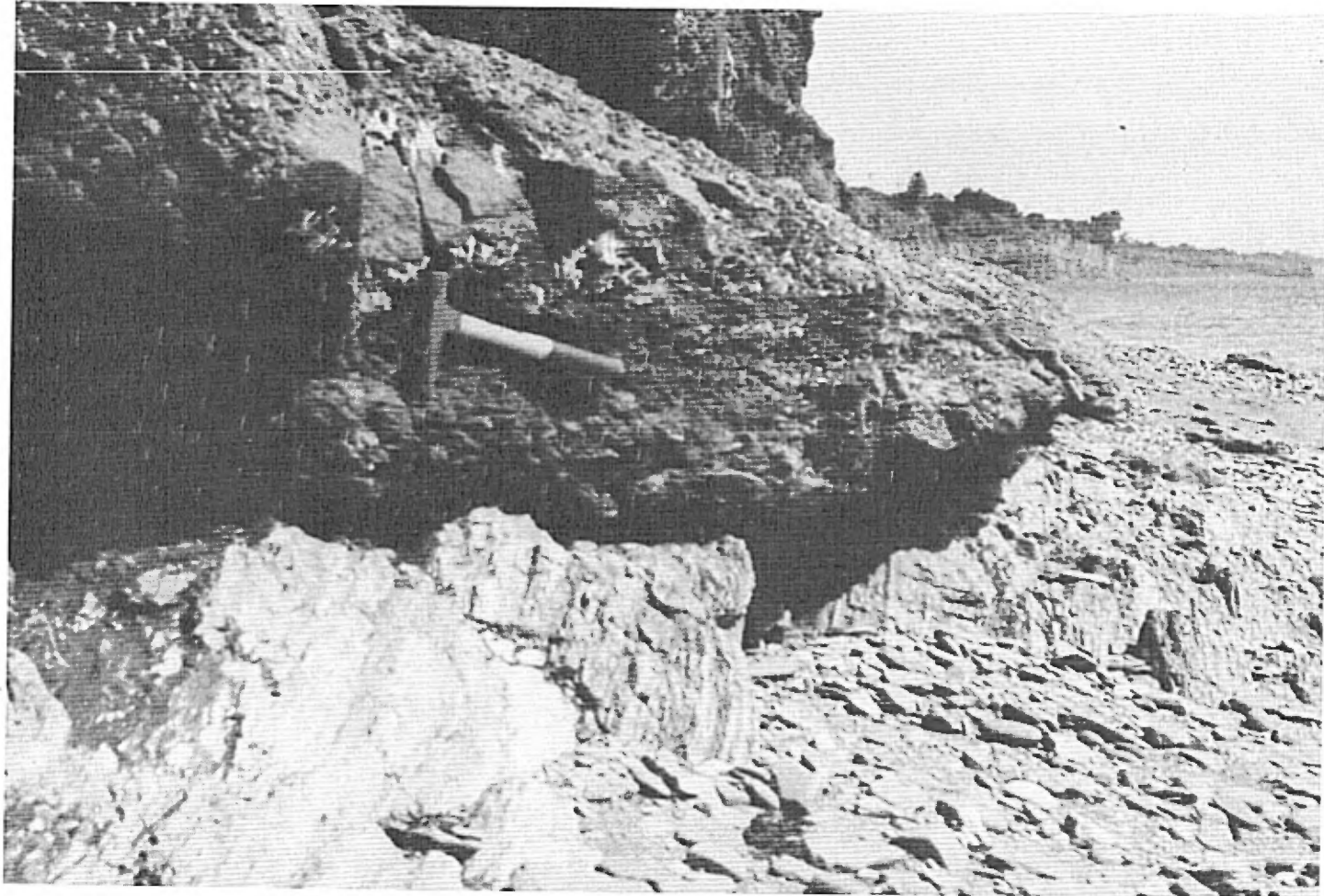


Kame and kettle topography west of Saint-Jogues-de-Hope

Plate IV



Typical relief on Little Port-Daniel river, Port-Daniel township.



Post-Acadian, pre-Bonaventure unconformity east of New Carlisle, Cox township.



View eastward along the coast from New Carlisle showing a small promontory supported by resistant intrusive rock .

A Monograptus zone has been recognized in several areas in Gaspé, New Brunswick, and Maine where Middle Silurian formations are exposed, but the correlation of these zones has not yet been ascertained. Other Monograptus species identified in the map-area (and also found near the base of the Gascons siltstone) are: Monograptus varians (Wood) var. pumilus Wood, and Monograptus chimaera Barrande var. alaskensis? Ruedemann. These identifications were made by the writer. Northrop reported also Monograptus clintonensis (Hall) from this formation.

The formation shows a persistent lithology throughout the area. The quartz of a thin section of a typical hand specimen exhibits the following attributes:

Size of grains:	slide(a) 0.01 to 0.05 mm.
Roundness:	slide(a) 0.3 to 0.5 for grade 0.05 mm.
Sphericity:	slide(a) 0.65 to 0.85 for grade 0.05 mm.

The constituents of the rock are distributed as 55 per cent quartz grains, 15 per cent mica and chlorite shreds, and 30 per cent calcite cement. The percentage porosity appears to be very low.

The Gascons formation underlies a large part of the map-area. The regions drained by the Hall, Cullen, and upper branches of Little Port-Daniel river in particular are underlain by this formation. Its thickness at Port Daniel West has been estimated at 1,860 feet by Schuchert and Dart (1926), and at 1,880 feet by Northrop (1939). This section, however, is not complete on account of faulting. The thickness of the Gascons siltstone at Black Cape, forty miles west of Port-Daniel, is 3,835 feet according to Schuchert and Dart (1926). There does not seem to be any conspicuous facies change between the two localities, notwithstanding the apparently much greater thickness at Black Cape than at Port Daniel.

Bouleaux Formation

The Bouleaux formation, named by Schuchert and Dart (1926), has its type exposure at Pointe Bouleaux, five miles east of the map-area. So far as known, it is represented by only one outcrop in the present map-area.

The formation consists of thin, interbedded, dark greenish-grey and pale reddish-brown siltstones, and thin-bedded limestones. The limestones are made up of accumulated débris of corals, stromato-

poroids and crinoids. They are evidently indicative of shallow-water conditions. In addition, mud cracks, rain pits, and intraformational conglomerates occur at Black Cape. The Bouleaux formation is transitional into the Gascons formation below and the West Point limestone above. Its thickness increases from 888 feet at Port-Daniel to 2,594 feet at Black Cape, forty miles to the west.

West Point Formation

The type-section of the West Point formation is one and one half miles east of the map-area (Schuchert and Dart, 1926). The formation is not exposed within the map-area. The description which follows is a summary of the published description of earlier workers together with the writer's observations of the type-sections at West Point and Black Cape. The formation consists of thick- and thin-bedded limestones which at places are almost completely made up of corals and stromatoproids. Other beds consist largely of crinoid columnals. The crinoidal beds show good evidence of wave action, being considerably broken and re-worked. At one locality, coarse intraformational conglomerates were seen, with boulders over one foot in length. Interbedded with these limestones are pale reddish-brown to dark greenish-grey siltstones. The limestones range in colour from very light grey to medium red. The information at hand seems to point toward continuing shallow-water deposition from Bouleaux time on.

The West Point formation has been reported from only two areas: in the vicinity of Port-Daniel (Pointe Bouleaux to West Point) and at Black Cape. At Black Cape, however, the upper portion of the West Point and perhaps most of the overlying Indian Point formation are absent, for, just after the West Point sedimentation began, several flows of basalt were extruded, some apparently below sea level. The West Point sedimentaries are 1,714 feet thick at Port-Daniel, and only 434 feet thick at Black Cape, where 4,626 feet of volcanic rocks occur.

The West Point formation is overlain at Port-Daniel by the Indian Point formation. The contact is fairly abrupt, but conformable.

Indian Point Formation

The Indian Point formation was named by Schuchert and Dart (1926). Its type locality is at Indian Point, half a mile east of the map-area. It is the youngest sedimentary formation of the Chaleurs Bay series and is exposed only along a narrow stretch of the coast from Point Trachy northeast to Indian Point.

The formation consists largely of pale-brown to dark greenish-grey siltstones in beds one inch to one foot thick, and of thin beds of crinoidal limestone in zones up to three feet thick. The crinoidal material is somewhat re-worked. In addition, occasional coral breccia beds were seen, and Taonurus and gastropod trails have been reported by previous workers. Indian Point time appears to represent a return to Bouleaux-like conditions of deposition.

The Indian Point formation is at least 456 feet thick (Northrop 1939, p. 50). The top of the formation is covered by the sea in the type-area and is not exposed elsewhere.

A typical lithological specimen of the formation was seen under the microscope to consist of quartz and very minor amounts of shred-like mica and chlorite set in a calcitic cement. The attributes for quartz are:

Size of grains: 0.045 to 0.15 mm. (average 0.7 mm. as compared with about 0.3 mm. in the Gascons)

Roundness: 0.02 to 0.3

Sphericity: 0.08 (average)

Clastic to cement ratio: 70 to 30

It is inadvisable to draw any conclusions from the meagre petrographic examination made. The sorting as to size appears to be a little better than in the Gascons siltstone.

Age and Correlation of the Chaleurs Bay Series

On the basis of the correlation chart published by the Geological Society of America for the Silurian formations in North America (Swartz, 1942), the following correlations may be made:

<u>Chaleurs Bay Section</u>	<u>North America</u>
Indian Point formation	Guelph dolomite (New York State)
West Point formation	Lockport dolomite (New York State)
Bouleaux formation	Lower McKenzie formation (central Pennsylvania to northeastern Tennessee)
Gascons formation	Lower part of Gascons is equivalent to the upper part of the Rochester shale
La Vieille formation	(Correlate with the Clinton group of central New York minus the upper part of the
Clemville formation	(Rochester shale

Pre-Bonaventure Sedimentary and Igneous Rocks near New Carlisle

In the vicinity of New Carlisle, erosion of the Carboniferous cover has revealed deformed siltstones, shales, and, locally, breccia. The siltstones consist of quartz grains with fairly abundant associated mica and chlorite shreds in a calcitic cement. A thin-section of a typical specimen consists of quartz from 0.02 mm. to 0.07 mm. in diameter. The ratio of clastic to cement is high. The colour ranges from dark grey to blackish red.

The breccia is found about 1,250 feet east of the first promontory east of the New Carlisle pier. It consists of angular fragments of medium brownish-red rhyolite embedded in the otherwise normal siltstones of this group. The source of these fragments was not seen but, as they range in size from 0.15 mm. to over 100 mm. and are highly angular, it is to be concluded that their source is not far distant. Thin section of the rhyolite show feldspar phenocrysts (oligoclase) set in a glassy groundmass. Together with the rhyolite fragments are found several large boulders (up to two feet) of siltstone, quite similar to the Indian Point, Bouleaux, and Gascons siltstones. These volcanic and sedimentary fragments suggest proximity to a volcanic neck. Unfortunately, the inland continuation of these beds is hidden by the capping Bonaventure formation.

The New Carlisle sedimentary rocks are cut by numerous dykes ranging in composition from andesite to basalt, and in texture from finely crystalline to megaporphyritic. At about 1,600 feet east of the second promontory east of the New Carlisle pier, inclusions of porphyritic andesite several feet in diameter occur in an intrusion of finely crystalline igneous rock of the same composition. In the contact zone with the intrusion, the sedimentary rocks are quite tightly folded. All the dykes seen had sharp cross-cutting relations in reference to the intruded rocks. The dykes trend approximately north-south on the average, and are nearly vertical. Primary orientation of the feldspar phenocrysts parallel to the dyke walls was observed at numerous localities.

The sedimentary rocks lack fossils and so may be classed only as pre-Bonaventure in age. Their proximity to Silurian strata just north of the Bonaventure coastal belt suggests that they may be of Silurian age. The attributes of the siltstones are not unlike those of the Gascons, Bouleaux, and Indian Point siltstones. The miniature cross-bedding in the New Carlisle siltstones suggests shallow-water conditions and in this respect these rocks resemble those of the Bouleaux and Indian Point formations.

BONAVENTURE FORMATION

The Bonaventure formation rests with pronounced angular unconformity upon the deformed Silurian strata along the southern border of the map-area. Beyond the limits of the map-area and west of Cascaedia bay along the north coast of Chaleurs bay, it rests with angular unconformity upon deformed Devonian strata. Alcock (1935, p. 90) has summarized the general features of the formation as follows:

"The Bonaventure formation is marked by three features which are widely characteristic - a coarse, clastic lithology, a deep red colour, and an undisturbed structure - though exceptions to all three are to be noted".

The Bonaventure formation consists of conglomerates, sandstones, siltstones, and shales. Occasional limestones have been reported from regions beyond the map-area. The colour varies from pale reddish-brown to medium red. Horizon markers that might be used to correlate different sections are absent. In general, the grades are coarsest at the base, becoming finer upward. The formation is well exposed in cliff sections in the map-area and extends inland for two miles at the most. These cliff sections range up to 100 feet in thickness and there is no reason to believe that the formation is much thicker than this anywhere inland. Elsewhere, however, much greater thicknesses have been reported: up to 800 feet near Percé, 600 feet near Maguasha (near the head of Chaleurs bay, on the Quebec side), and 600 feet near Dalhousie in New Brunswick. The dips observed were always low and usually southward. The base of the formation is well exposed at New Carlisle, Point Trachy, and Point Loup Marin. The large fragments of the basal conglomerate consist dominantly of the local underlying-rock material. However, a considerable number of chert fragments were also seen in the coarser grades. The conglomerate fragments are bound together by material of sand and silt grade similar to that forming the sandstones and siltstones seen higher in the section. A thin section of a typical lithological specimen of the Bonaventure sandstones shows the following attributes for quartz:

Size of grains:	0.1 to 0.5 mm. (average 0.3 mm.)
Roundness of grains:	0.5 average
Sphericity of grains:	0.8 average
Clastic to cement ratio:	70 to 30. The cement is calcitic.

The sandstones and siltstones consist largely of about equally rounded quartz and chert fragments. The percentage of chert grains

is somewhat higher in relation to quartz grains than in the Silurian or Ordovician sandstones. The rock owes its colour to ferruginous films coating the grains as well as to the fact that a number of the grains consist of medium reddish-brown chert or jasper.

Coarse conglomerates with angular boulders up to four feet in diameter mark the base of the formation two miles east of the map-area. According to Schuchert and Dart (1926, p. 54), "the material lies in a Palaeozoic hollow". Near Jacquet river, in New Brunswick (Alcock 1935, p. 93), there is evidence of old Silurian cliffs re-exposed in the sea caves; flat-lying strata abut against these cliffs and also form the capping of the cliffs. Coarse conglomerates have been reported from the basal portion of the formation on both sides of Chaleurs bay. In the present area, the basal conglomerates lie on a flat surface and do not contain fragments larger than one foot.

No fossils were found in the Bonaventure formation. The formation has been assigned ages ranging from Devonian to Pennsylvanian. Casts of calamites and fragments of other plants were collected by C.H. Kindle from the Cannes-de-Roches formation at Malbaie, northwest of Percé, Quebec. These plants were studied by W.A. Bell, who, according to Alcock (1935, p. 94); concluded that "a late Mississippian or a Pennsylvanian age is indicated more probably Pennsylvanian". Alcock suggests that the Bonaventure and Cannes-de-Roches are approximately the same, and that they are probably Early Pennsylvanian.

STRUCTURAL GEOLOGY

Structurally, the rocks of the map-area can be divided into three main assemblages on the basis of the number of revolutions which have affected them. These divisions include: (a) the Ordovician rocks deformed by the Taconic and Acadian orogenies, (b) the Silurian rocks deformed by the Acadian orogeny, and (c) the relatively little disturbed Carboniferous rocks. Difference in degree of metamorphism cannot be used to separate Ordovician from Silurian rocks. Nevertheless, there is a difference in the degree of folding between the Ordovician and the Silurian; folding in the former is in places tighter than any folding seen in the Silurian.

The Ordovician Rocks

Insufficient key beds were recognized for the determination of major structures in the area underlain by Ordovician rocks. The Ordovician outcrop-area is relatively subdued topographically, and good exposures were found only along the rivers. The Mictaw beds are intricately folded and dragged, and the attitudes measured suggest a

very irregular structural pattern - particularly along Middle Port-Daniel river. Farther east and northeast, the proportion of greywackes to shales increases and the pattern is somewhat less irregular. In the western part of the Ordovician outcrop-area, isoclinal folding was observed at several places. The bedding planes are well preserved and fracture and flow cleavage are not extensively developed.

Besides the difference in the degree of folding, there is, in this region, some indirect evidence for the Taconic orogeny. Along North Port-Daniel river, a considerable thickness of Ordovician rocks separates the Macquereau schist from the Silurian. In contrast along Anse-à-la-Barbe brook, two or three miles eastward, the Silurian rests directly on the Macquereau with pronounced angular unconformity. This suggests a period of erosion between Mictaw and Chaleurs time.

The Silurian Rocks

The faults, fold axes, and secondary foliation in the Silurian trend northeast on the average. Although vertical dips and occasional overturning were observed, the folds as a rule have not reached the isoclinal stage except in the southeastern portion of the map-area. (Ex.: lower part of Little Port-Daniel river). The amplitude of the folds decreases proceeding from southeast to northwest within the map-area. The plunge of the major structures as inferred from gross structural relations - plunge of drag folds and plunge of "b" lineation (intersection of cleavage and bedding) - appears to be low except in the southeastern portion of the map-area, where the folds plunge steeply to the southwest.

A well-developed cleavage is conspicuous throughout most of the area except in the region immediately west and southwest of Port-Daniel. Fracture cleavage is closely spaced in the Gascons formation and widely spaced or absent in the La Vieille.

The valleys of Hall, Cullen, and upper Little Port-Daniel rivers lie in a broad synclorium which includes several smaller anticlines and synclines. Northwest of the synclorium, the La Vieille and Clemville formations are brought to the surface by folding and faulting. Further field work in the area to the north may reveal the nature of the several faults in the northwestern corner of the map-area. Two of these faults bound the domal structure which is crossed by the lower portion of Duval river. It is possible that these two faults merge to the northeast, as suggested vaguely by aerial photographs.

None of the major faults shown on the accompanying map was observed in the field. The drag folds, and some small subsidiary thrust and tear faults, together with the attitude changes observed in the fracture cleavage, suggest that the three major faults between Saint-Jogues-de-Hope and Port-Daniel are steeply north-dipping thrusts. The displacement along these faults decreases in a southwest direction because the Clemville and Gascons formations have been brought into contact near the Mictaw-Silurian contact, but farther southwest the faults are completely within the Gascons siltstone.

The Carboniferous Rocks

The Carboniferous rocks are characterized structurally by low dips and lack of secondary foliation. Cross-bedding is a common feature in the Bonaventure formation.

PHYSIOGRAPHY

The Uplands

Beginning two or three miles north of the coastline, and continuing beyond the northern limits of the map-area, an upland surface of low relief is well developed. Where the Gascons alone is exposed, as in the broad synclorium in which the valleys of Cullen, Hall, and upper Little Port-Daniel rivers lie, the relief of the upland is less than fifty feet, except adjacent to river valleys. Dissection of this surface is greater near the coast. Here it is sharply cut into V-shaped gorges by rivers. This surface may correspond to the lower plateau of Gaspé which, according to Alcock (1935, p. 115), has an average elevation of 1,100 feet in the Chaleurs Bay region. In the southeastern portion of the map-area where the thick-bedded La Vieille formation outcrops, the surface of the ground rises about 100 feet above the upland. In the Duval Lake district in Garin township, the resistant Clemville quartzose sandstones rise sharply to about 500 feet above the upland surface.

Below the level of the upland a few river terraces were seen. A pronounced terrace is present on the west bank of Bonaventure river in range V of Hamilton township. The lower part of Bonaventure river as a whole shows evidence of two stages of development. There is a fairly gentle slope down to the river from a distance of a quarter of a mile or so on either bank. The last few feet are steep, however. This suggests that, during the time when terraces were being cut, the upper banks were rounded off considerably by weathering. Further uplift caused the present incision below the former level.

The country rises gently from the coast at several places. Alcock (1935, p. 119) has suggested that this is due to the relative lack of resistance to erosion offered by the flat-lying Bonaventure beds. Where this low condition continues inland for some distance, he has suggested that the Pre-Pennsylvanian peneplain surface has been exhumed from its former cover.

Near Port-Daniel and Marcil, parts of the Gascons siltstones, normally greyish-green, have a reddish colour. This may be due to the fact that this older formation was once covered by the Bonaventure red beds.

The Valleys

All the streams of the region are degrading their courses with the exception of the lower reaches of Bonaventure, Port-Daniel, and Nouvelle rivers.

The lower Bonaventure River valley shows evidence of former meanders. Just east of this river, in range VII West of Paspébiac, Cox township, the remains of a cut-off meander can be seen on a high terrace. Small meanders are beginning to develop also on the lower portions of the three Port-Daniel rivers.

The major streams of the area, such as Bonaventure, Nouvelle, Shigawake, and Port-Daniel rivers, cut transversely across the structure of the Silurian and Ordovician rocks. The flat-lying Bonaventure formation may have contributed to this transverse trend through superposition. The tributaries of the major streams are well adjusted to the structure.

The lower part of Duval river appears to have captured the upper portion of the northwest branch of Hall river. The divide between the latter and the elbow of capture, in range II of Garin township, is marked by a chain of lakes.

Glaciation

Pleistocene glaciation within the present area produced both erosional and depositional effects. The erosional effects are relatively inconspicuous. However, the upper, or north-south, portion of Duval river appears to have been considerably worn by glaciation. The noses of valley spurs have been markedly truncated. This river is the only one in which these effects were noted.

Over most of the region the mantle of glacial drift apparently is thin. Bedrock is commonly close to the surface and controls the topography over a large part of the area. The drift is made up of erratics of mainly local origin, but foreign erratics are present. The local erratics are for the most part the durable Silurian rocks. Many of the larger ones in the Saint-Jogues region are Clemville quartzose sandstone. In this district also were found several small boulders of volcanic rocks. The most extensive exposure of the Clemville quartzose sandstones is to the north. Volcanic rocks occur at Black Cape to the west and in the Mount Alexander region to the north, and there are small exposures also at New Carlisle to the south. A number of foreign erratics were seen, conspicuous among them being fairly large boulders of granite gneiss. One boulder of specular hematite was observed at an elevation of 1,100 feet in the southeastern corner of Honorat township.

Deposits of unconsolidated sedimentary material occur in places along the streams and also in the region south and southwest of Saint-Jogues. At this locality they control the topography and have somewhat disorganized the drainage. They are rarely over 50 feet thick and probably are fluvio-glacial deposits, as shown by their washed appearance, stratified nature, and general lack of interstitial clay. The best exposures were seen in the river cuts.

The rivers are rapidly clearing their courses of glacial débris. Along the lower Middle Port-Daniel river, stratified gravels overlies coarse stratified sands and fine gravels which dip seaward at about 25 degrees. As this deposit is less than fifty feet above sea level, one interpretation of its origin is that the upper, flat-lying, coarser gravels represent the topset beds, and the lower gravels the foreset beds, of a delta which was forming in a submerged Port-Daniel bay at a time when the land was considerably lower than at present. Somewhat similar relations of flat-lying coarse material to underlying fine-grained material have been noted also on the west branch of Nouvelle river, north of Paspébiac, at an elevation of slightly over 100 feet, and north of New Carlisle, also at an elevation of just over 100 feet. The general features of these deposits could be explained also by assuming a re-advance of glaciation. Alcock (1935, p. 98) has found evidence which suggests that there may have been at least one re-advance of the glaciers in the Chaleurs Bay region, for he has observed flat-lying gravels overlying folded sands and clays.

Coastal Features

The coast is one of submergence in the stage of youth. The portion of the coast underlain by the Bonaventure formation shows a

greater maturity. Where the Bonaventure is absent, the solid rock headlands have been attacked considerably less.

Bay-mouth bars partially close the mouths of the Bonaventure, Nouvelle, and Port-Daniel rivers. A cusped foreland was formed at New Carlisle, and a stream-breached cusp at Paspébiac. The presence of these cusps and bars attests the considerable amount of material being supplied by wave attack.

ECONOMIC GEOLOGY

Petroleum

Oil has been reported in range X, lot 25, Hope township, and also just south of the bridge crossing Bonaventure river on the road to Saint-Elzéar. Both localities are indicated on the accompanying map. The writer failed to see any oil seepages at these places.

Source Rock Possibilities:

Greyish-black shales with coaly films and partings were observed at several localities on Middle Port-Daniel river, in ranges VIII and IX of Port-Daniel township. These are of Mictaw age. Swinerton (1933, p. 145) analysed these shales and found the oil content to be too low for economic extraction; the best yields were less than one gallon per ton. Certain beds within the Chaleurs Bay series might serve as source rocks, but none appear to have nearly as high a hydrocarbon content as the Mictaw shales. Among these would be included some of the richer coral zones. Link (1950, p. 286) has recently suggested that coral beds might act both as source and reservoir rock.

Reservoir Possibilities:

Petrographic study shows that most of the rocks of the area are so well cemented that porosity must be low. The Mictaw sandstones have a well-developed cement of micaceous, chloritic, and finely comminuted rock material. The rocks of the Chaleurs Bay series contain a nearly ever-present calcitic cement. Probably the most favourable conditions for porosity and permeability are to be found in the re-worked and brecciated crinoidal and coral beds of the upper Gascons, Bouleaux, West Point, and Indian Point formations. Unfortunately, these are not exposed on suitable structures either within the map-area or in the surrounding region.

Structural Possibilities:

The folds in the eastern part of the area plunge to the southwest and offer no chance of closure to the northeast. The synclinal belt to the northwest contains a number of anticlines. Some of these are indicated on the map. Owing to the poor exposures in that area and the lack of horizon-markers in the Gascons formation, it was impossible to determine the closure on these structures. In ranges I and II of Garin township, the domal structure, crossed by Duval river, has a closure of at least 1,000 feet, but is bounded by faults whose nature is not known. The Marcil anticline is not well exposed, and it disappears under the Bonaventure formation. This anticline appears to plunge in both directions, and its possible closures (on plunge or on flanks) would probably be nearly as great as on the dome referred to above. As mentioned in the section on Structural Geology, the Chaleurs Bay series is considerably fractured; the thick-bedded La Vieille Limestone is the least affected. The La Vieille, unfortunately, is unroofed on the two structures mentioned.

Marl

Deposits of white-shell marl occur in many small freshwater lakes of the region. These are indicated on the geological map. The marl is used locally as fertilizer.

Building Stone

The La Vieille limestones are quarried for building purposes at Port-Daniel. The thick-bedded limestones of the West Point formation, and the thicker quartzose sandstones of the Clemville, would also serve as excellent building stone. Both are fairly accessible in the Port-Daniel district.

Lime

The West Point limestones at Port-Daniel have been quarried and used in the pulp mills. The La Vieille limestone near Port-Daniel has been burned for lime making. Only a few kilns were seen and none was operating at the time of the writer's survey.

Road Material

Many gravel pits have been opened in the area. Other as yet unused gravel deposits of large size occur along the lower Hall river. The lower portions of Bonaventure, Nouvelle, and Port-Daniel rivers are being aggraded and all contain considerable gravel deposits, many of which are easily accessible.

LIST OF FOSSIL LOCALITIES

Location No. 1.- Clemville formation, range X, lot 11, Port-Daniel township, 2,045 feet upstream on the Second West branch from its junction with Middle Port-Daniel river.

Buthotrephis sp.

Coelospira hemispherica (Sowerby)

Camarotoechia peneborealis Twenhofel

Dalmanella wisbyensis nana McLearn

Dolerorthis flabellites (Foerste)

Leptaena rhomboidalis (Wilckens)

Hallopora gracilens Twenhofel

Parmorthis elegantula (Dalman)

Sowerbyella transversalis brevis Northrop

Tentaculites niagarensis Hall

Trilobite

Location No. 2.- Clemville formation, range X, lot 11, Port-Daniel township, 2,450 feet upstream on the Second West branch from its junction with Middle Port-Daniel river.

Mendacella uberis (Billings)

Mytilus sp.

Gastropod

Location No. 3.- Clemville formation, range X, lot 11, Port-Daniel township, 2,788 feet upstream on the Second West branch from its junction with Middle Port-Daniel river.

Coelospira hemispherica (Sowerby)

Mendacella uberis (Billings)

Protomegastrophia profunda (Hall)

Halysites catenularia var. simplex Lambe

Pterina emacerata (Conrad)

Favosites sp.

Mytilus sp.

Cephalopod

Gastropod

Location No. 4.- Clemville formation, range II, lot 8, Port-Daniel township, 4,715 feet upstream on the Second West branch from its junction with Middle Port-Daniel river.

Dolerorthis flabellites (Foerste)

Zaphrentis stokesis Lambe

Paleocyclus rotuloides (Hall)

Location No. 5.- Clemville formation, range II, lot 8, Port-Daniel township, 4,935 feet upstream on the Second West branch from its junction with Middle Port-Daniel river.

Parmorthis elegantula (Dalman)

Rhipidomella hybrida (Sowerby)

Dalmanella wisbyensis nana McLearn

Favosites sp.

Trilobite

Location No. 6.- Gascons siltstone, range VIII, lot 2, Port-Daniel township, 2,958 feet down Little Port-Daniel river from the McPherson Road bridge.

Monoqraptus priodon (Bronn)

Location No. 7.- Gascons siltstone, range VIII, lot 2, Port-Daniel township, 3,035 feet down Little Port-Daniel river from the McPherson Road bridge.

Monoqraptus priodon (Bronn)

Location No. 8.- La Vieille limestone, range VIII, lot 3, Port-Daniel township, 4,460 feet down Little Port-Daniel river from the McPherson Road bridge.

Stricklandia gaspéensis Billings

Leptaena rhomboidalis (Wilckens)

Favosites sp.

Gasconsia sp. ?

Location No. 9.- La Vieille limestone, range VIII, lot 3, Port-Daniel township, 4,486 feet down Little Port-Daniel river from the McPherson Road bridge.

Stricklandia gaspéensis Billings

The Stricklandia zone actually extends 26 feet upstream and 40 feet downstream from this point.

Location No. 10.- La Vieille limestone, range VIII, lot 3, Port-Daniel township, 4,566 feet down Little Port-Daniel river from the McPherson Road bridge.

Leptaena rhomboidalis (Wilckens)

Location No. 11.- La Vieille limestone, range VIII, lot 3, Port-Daniel township, 4,616 feet down Little Port-Daniel river from the McPherson Road bridge.

Chonetes tenuistriatus Hall

Mendacella uberis (Billings)

Leptaena rhomboidalis (Wilckens)

Pterina sp.

Crinoid stems

Location No. 12.- La Vieille limestone, range VIII, lot 3, Port-Daniel township, 4,663 feet down Little Port-Daniel river from the McPherson Road bridge.

Mendacella uberis (Billings)

Leptaena rhomboidalis (Wilckens)

Location No. 13.- La Vieille limestone, range VIII, lot 3, Port-Daniel township, at the base of the formation, 4,730 feet down Little Port-Daniel river from the McPherson Road bridge.

Palaeocyclus rotuloides (Hall)

Halysites sp.

Location No. 14.- Clemville formation, range VIII, lot 3, Port-Daniel township, at the top of the formation, 4,740 feet down Little Port-Daniel river from the McPherson Road bridge.

Favosites gothlandicus (Lamarck)

Location No. 15.- Clemville formation, range VIII, lot 3, Port-Daniel township, 5,100 feet down Little Port-Daniel river from the McPherson Road bridge.

Camarotoechia cf jonesi Northrop

Favosites sp.

Location No. 16.- Gascons siltstone, in the block of Chas. Robin and Company, Cox township, approximately 1,300 feet south of the

northern boundary of the block, on the west bank of the stream traversing the block.

Monograptus varians (Wood) var. pumilus Wood

Location No. 17.- Gascons siltstone, on the road leading north from Paspébiac, on the boundary between ranges III and IV east of Paspébiac, Cox township.

Monograptus chimaera ? Barrande var. alaskensis? Ruedemann

Location No. 18.- Gascons siltstone, on the west side of the road separating Cox and Hope townships, approximately 1,300 feet north of the boundary between ranges III and IV, Hope township.

Monograptus varians (Wood) var. pumilus Wood

Location No. 19.- Clemville formation, on the west bank of Duval river, 300 feet south of the mouth of the First West branch, Garin township.

Parmorthis elegantula (Dalman)

Encrinus caplanensis Northrop

Dolerorthis flabellites (Foerste)

Coelospira hemispherica (Sowerby)

Pterina sp.

Favosites sp.

Bryozoa

Crinoid stems

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