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GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

PAPER 70-65

GEOLOGY OF BELLEORAM MAP-AREA, NEWFOUNDLAND (1 M/11)

(Report and Map 1323A)

H. Williams

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OF CANADA

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GEOLOGY OF BELLEORAM MAP-AREA, NEWFOUNDLAND

H. Williams

DEPARTMENT OF ENERGY, MINES AND RESOURCES

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ABSTRACT

Belleoram map-area, on the south coast of Newfoundland, comprises an assemblage of Late Precambrian and lower to middle Paleozoic sedimentary and volcanic rocks cut by several granitic intrusions and by basic and silicic dykes which are the youngest consolidated rocks in the area. Molybdenite deposits are present near Recontre Lake and fluorite occurs in a few widely separated localities.

RÉSUMÉ

La région cartographique de Belleoram, sur la côte sud de Terre-Neuve, comprend un assemblage de roches sédimentaires et volcaniques de la fin du Précambrien et du Paléozoique inférieur à moyen, entrecoupées de plusieurs intrusions granitiques et de dykes basiques et siliciques qui constituent les roches consolidées les plus récentes de la région. On trouve des gisements de molybdénite près du lac Recontre et de la fluorite en divers endroits très dispersés.

GEOLOGY OF BELLEORAM MAP-AREA, NEWFOUNDLAND

INTRODUCTION

Belleoram map-area, situated in Fortune Bay on the south coast of Newfoundland, is of economic interest for its molybdenite deposits and it is of special academic interest because of the variety of rocks displayed and their relationships to nearby groups. The map-area is bounded by 47°30' and 47°45' north and 55°00' and 55°30' west. Fortune Bay covers about one-half of the area.

The three communities within the area are Belleoram, Pools Cove, and Rencontre East. Former communities (whose locations are shown on the map), are from west to east; Corbin, Turnip Cove, Bay du Nord, Lally Cove, Doctors Harbour, Hare Harbour, Stones Cove, Andersons Cove, and Little Conne. The area is accessible only by the sea via Canadian National coastal boats that make regular stops at Belleoram, Pools Cove, and Rencontre East. Gravel roads connect Belleoram and Pools Cove with nearby communities southwest of the map-area. This gravel road network will eventually be joined to the Bay d'Espoir road that crosses central Newfoundland to the Trans-Canada Highway.

First mention of the geology of the area was made in early reports of the Geological Survey of Newfoundland by Alexander Murray and J.P. Howley. There was very little subsequent work until White (1939, 1940) commenced geological investigations. This work initially concerned the molybdenite deposits north of Rencontre East and was later extended to include mapping of the Belleoram (Rencontre East) area. Detailed information concerning the mineral deposits was published in 1940 and the results of the regional study are contained in an unpublished doctorate dissertation (White, 1939). Widmer (1950)* mapped the Hermitage Bay area and this study includes the western part of the Belleoram map-area. Subsequently, Smith (1953) studied the fluorite occurrences at Long Harbour, and with White, compiled a report on the regional geology of the Belleoram area (Smith and White, 1954). At this time the Terrenceville area, which adjoins Belleoram map-area to the east, was mapped by Bradley (1962). Prior to the present study the whole of the Fortune Bay area was investigated as part of a geological reconnaissance study by Anderson (1965).

Special aspects of the geology of the map-area were studied by the following: Twenhofel (1947) who described the sedimentology and stratigraphy of the Rencontre Formation in connection with a regional study of the Silurian rocks of Newfoundland; Hutchinson (1962) who studied the Cambrian

* In preparing this report, a condensed version of Widmer's thesis edited by S. E. Jenness of the Geological Survey of Canada, was used.

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faunas and stratigraphy as part of a general investigation of the Cambrian rocks and trilobite faunas of southeastern Newfoundland; Ermanovics, et al. (1967) who investigated the petrogenesis of the Belleoram Stock; and Williams (1967a) who summarized the stratigraphy and relationships of the Long Harbour Group as possibly representing Silurian deposits in southeastern Newfoundland.

The molybdenite deposits north of Rencontre East are presently being re-evaluated by a diamond drilling program conducted by Norlex Mines Limited. A new molybdenite showing was recently uncovered in a rock-cut excavation on the Pools Cove Road. The showing is immediately west of the map-area, approximately opposite Corbin Bay. The molybdenite occurrence is similar to those north of Rencontre East where the mineralization is within and near the margin of a medium-grained massive pink biotite granite (Ackley Batholith).

The present study was made during the summer of 1969 under a contract arrangement between Memorial University of Newfoundland and the Department of Energy, Mines and Resources in Ottawa. The author was assisted in the field mapping by M. J. Calcutt, B. A. Greene, and H. F. Keates, all graduate students of Memorial University. Carl Wheaton of Gander Bay, Eugene Mullins of Rencontre East, and Roland Caines of Pools Cove acted as boatmen and field assistants. The author wishes to thank Dr. F.D. Anderson of the Geological Survey of Canada and Dr. D. A. Bradley of Brinex for their assistance and helpful advice and discussion concerning the geology of the map-area.

PHYSIOGRAPHY

The area is of varied topography with local rugged coastal areas contrasting with gently rolling inland terrain. Highest hills are found within the differentially eroded resistant volcanic rocks between East Bay and Long Harbour. Elevations reach 1,100 feet with the most prominent ridges underlain by silicic volcanic rocks. More gently rolling terrain is developed either upon sedimentary rocks, e.g. Pools Cove Formation, or upon granitic rocks in the north-central part of the area.

Bays and re-entrants are aligned in a north to northeast direction and are controlled either by structural features or the direction of glacial ice movement. East Bay and Cinq Islands Bay clearly coincide with a zone of relatively nonresistant shales and sandstones that have been folded about northeast axes and cut by northeast-trending faults. Long Harbour is also regarded as a structurally controlled feature because of the mismatch or discontinuity of rock units evident on its opposite shores. In contrast, Belle Harbour, Mal Bay, and Rencontre Lake trend northerly and intersect the east-west structural trends of surrounding volcanic rocks. These are clearly fiords carved by glacial ice. Other evidence of glaciation include striae, stoss and lee forms, and the distribution of erratic boulders. All indicate ice movement from the north and northeast toward the south and southwest.

The upland surface in some places is devoid of vegetation but elsewhere it is covered by stunted conifers and shrubs. This distribution of vegetation commonly reflects bedrock lithology. Where silicic and mafic volcanic rocks occur in alternating units between East Bay and Long Harbour, the silicic rocks are bare whereas the mafic rocks are tree-covered. Areas underlain by sedimentary rocks are also generally covered with vegetation.

Barren rolling topography characterizes the potash-rich granite batholith (Ackley Batholith) in the north-central part of the area and is unlike the rough, hummocky, generally tree-covered surface developed upon the more sodic and mixed granitic and dioritic rocks north of North Bay (Simmons Brook Batholith). Also distinctive is the generally wooded, irregular terrain characterizing the intrusion west of Belleoram (Belleoram Stock).

Local marine terraces are evident at Bay du Nord, East Bay, Rencontre Lake, and Tickle Head of Long Harbour. These are approximately 50 feet above sea level and developed upon stratified glacial outwash.

GENERAL GEOLOGY

GENERAL STATEMENT

Two northeast-trending faults, the East Bay Fault and the Hermitage Fault, separate the Belleoram map-area into three contrasting geological terranes; an eastern terrane, east and southeast of the East Bay Fault, that constitutes most of the map-area; a central terrane, about 5 miles wide, bounded toward the southeast by the East Bay Fault and toward the northwest by the Hermitage Fault; and a northwestern terrane, northwest of the Hermitage Fault, that constitutes only the extreme northwestern part of the map-area.

The eastern terrane is underlain for the most part by a thick succession of silicic and mafic volcanic rocks (Belle Bay Formation), overlain by grey sedimentary rocks (Andersons Cove Formation), mixed volcanic and sedimentary rocks (Mooring Cove Formation), and thick purple to red sedimentary assemblage (Rencontre Formation). These four formations comprise the Long Harbour Group. Local areas are underlain by Cambrian or late Precambrian rocks of the Youngs Cove Group. All of these rocks are folded about northeast-trending axes and cut by batholithic intrusions of Devonian age. Between Cinq Islands Bay and Corbin Bay, Upper Devonian conglomerates of the Great Bay de l'Eau Formation unconformably overlie Cambrian and late Precambrian rocks.

The age of the Long Harbour Group is in dispute. It was assigned a Paleozoic age by all previous workers, based mainly on reports by White (1939), Widmer (1950), Smith and White (1954), and Bradley (1962) who interpreted the Belle Bay Formation to overlie Cambrian strata unconformably. The present structural-stratigraphic study indicates that the boundaries are faults, thus removing a major obstacle to correlating the Long Harbour Group with lithologically similar late Precambrian rocks in eastern Newfoundland, e.g. Musgravetown Group. A whole-rock Rb/Sr isochron age determination, recently completed by R.K. Wanless of the Geological Survey of Canada, yielded a value of 515 $\pm$ 7 million years for the age of the volcanic rocks of the Long Harbour Group. Although the value is low, similar Rb/Sr whole-rock ages in the order of 500 million years characterize correlative late Precambrian rocks of eastern Newfoundland, Cape Breton Island, and New Brunswick (Fairbairn, et al., 1966). The isotopic age date is interpreted to support the assignment of the Long Harbour Group to the late Precambrian.

The central terrane, between the East Bay Fault and the Hermitage Fault, is mainly underlain by the undated Simmons Brook Batholith. It is unconformably overlain by red sandstone and limy shale of the Cinq Isles Formation, in turn overlain by red conglomerate, arkosic sandstone and

TABLE OF FORMATIONS

Era	Period	Formation	Lithology
Cenozoic	Quaternary	Glacial outwash	sand and gravel
		Unconformity	
Paleozoic	Devonian	Silicic dykes	pink feldspar porphyry, quartz-feldspar porphyry, green amygdaloidal dacite
		Basic dykes	diorite, diabase
		Intrusive contact	
		Belleoram Stock	medium-granied, grey to pink adamellite
		Intrusive Contact	
		Great Bay de l'Eau Formation	red to grey and pink conglomerate with pebbles of quartzite, red and purple sandstone, limestone, and granitic rocks
		Unconformity	
		Ackley Batholith	medium-grained, massive, pink biotite granite and alaskitic granite
		Intrusive contact	
	Devonian or Earlier (?)	Pyroxenite, gabbro, diorite, quartz diorite	medium-grained, massive dark green to grey and pink intrusions
		Intrusive contact	
		Pools Cove Formation	red granite-cobble conglomerate, pink to buff arkose and arkosic conglomerate, buff, coarse, boulder conglomerate
		Regional disconformity	
		Cinq Isles Formation	red micaceous sandstone, quartz-pebble-conglomerate, red shale and micritic limestone
		Unconformity with Bay du Nord Batholith	
	Ordovician or Earlier (?)	Garrison Hills Gneiss	granitic gneiss, amphibolite, and mylonite
		Fault contact	
		Simmons Brook Batholith	medium-grained, massive grey to pink altered granite, granodiorite, diorite, locally contaminated with mafic inclusions
Paleozoic and Precambrian (?)		Not in contact	
	Cambrian and Late Precambrian (?)	Youngs Cove Formation	grey siltstone, micaceous sandstone, shale; minor red to purple shale
		Conformable contact	
Precambrian	Late Precambrian	Rencontre Formation	purple crossbedded sandstone, red micaceous sandstone, purple and red pebble and cobble conglomerate, grey sandstone and argillite
		Conformable contact	
		Mooring Cove Formation	rhyolite and silicic agglomerates, mafic flows, mixed red and grey sedimentary rocks
		Conformable contact	
		Andersons Cove Formation	grey argillite, siltstone, sandstone, minor purple tuffaceous sandstone and tuffaceous sedimentary rocks
		Conformable contact	
		Belle Bay Formation	silicic to mafic volcanic rocks, minor purple to grey sandstone

conglomerate, and buff coarse boulder conglomerate of the Pools Cove Formation. The sedimentary rocks above Simmons Brook Batholith are undated but tentatively assigned to the Devonian.

The northwestern terrane, northwest of the Hermitage Fault, consists of granitic gneiss, amphibolite and mylonite. Northwest of the map-area these rocks grade upward into sedimentary rocks of the Ordovician Baie d'Espoir Group (Anderson, 1965; Williams, in press).

LATE PRECAMBRIAN

Long Harbour Group

The term Long Harbour was first used by White (1939) to designate a thick sequence of silicic to mafic volcanic rocks and minor sedimentary rocks that extend from East Bay to Long Harbour on the north shore of Fortune Bay and outcrop locally near Corbin Bay. The Long Harbour 'Series' (White, 1939) was assigned to the Ordovician and subdivided into three units of formational status: the Belle Bay volcanics, Andersons Cove slates, and Mooring Cove volcanics in order of decreasing age. Widmer (1950) retained the term Long Harbour 'Series' where he mapped the volcanic rocks at Corbin Bay but the name was subsequently dropped. Volcanic rocks of the Belle Bay volcanics have more recently been included in either the Belle Bay Group (Smith and White, 1954) or the Belle Bay Formation (Bradley, 1962; Anderson, 1965). The sedimentary rocks of the Andersons Cove slates were either assigned to the Andersons Cove Formation (Bradley, 1962; Anderson, 1965), or grouped with the Mooring Cove volcanics and all considered part of the Rencontre 'Group' (Smith and White, 1954). All of these rocks, including the Rencontre Formation, are now considered to form a continuous succession of late Precambrian age. They are therefore assigned to a single group, the Long Harbour Group. Throughout most of the map-area the group can be subdivided into four formations: - viz. the Belle Bay Formation, the Andersons Cove Formation, the Mooring Cove Formation, and the Rencontre Formation, in order of decreasing age.

Belle Bay Formation

Definition. The Belle Bay Formation as presently outlined closely coincides with the Belle Bay volcanics as originally mapped by White (1939). The base of the formation is unexposed as it is truncated by the Ackley Batholith in the north and the Belleoram Stock south of Corbin. Elsewhere, lower parts of the formation are faulted against younger groups or bounded by the sea. The top of the formation is drawn where the Belle Bay volcanic rocks are overlain by grey sedimentary rocks of the Andersons Cove Formation, or where the dominantly volcanic assemblage gives way upward to alternating sedimentary and volcanic units of the Mooring Cove Formation. East of Long Harbour the formation is directly overlain by red sedimentary rocks of the Rencontre Formation.

The top of the Belle Bay Formation is marked by a thick, pink silicic volcanic unit, except east of Long Harbour where mafic volcanic rocks underlie the Andersons Cove Formation in the Long Harbour Syncline. At Corbin Bay, structures are more complex, and the position of the top of the formation is less certain.

Volcanic rocks at Big Head in the extreme southeast of the map-area are tentatively correlated with the Belle Bay Formation. To the east in the Terrenceville map-area similar rocks have been referred to the Deer Pond Park Formation (Bradley, 1962). The Big Head exposures are included with the Belle Bay Formation (unit 1) because they are overlain by rocks correlated with the Andersons Cove Formation 6 miles northeast of Big Head (Bradley, 1962). Possibly none of these rocks are correlatives of the Long Harbour Group.

Distribution and Thickness. The Belle Bay Formation constitutes the major part of the Long Harbour Group between East Bay and Long Harbour. The outcrop belt is approximately 2 1/2 miles wide in the west and more than 10 miles wide at Long Harbour. The rocks form a southward-facing succession between East Bay and Mal Bay and the thickness is estimated at least 5,000 feet (probably 10,000 feet or more in the vicinity of Isle à Glu Pond). Where folded about northeast-trending axes east of Mal Bay, the assemblage is approximately 3,000 feet thick in the northeast limb of the Hoop Cove Syncline. Northwest of Long Harbour, the succession could reach a maximum of 20,000 feet unless repeated by faults or folds. Thicknesses of 12,000 to 15,000 feet, have been reported by Smith and White (1954) and a maximum exposed thickness of 6,000 feet was reported by Bradley (1962) in Terrenceville map-area.

At Corbin Bay, in the southwest part of the map-area, the Belle Bay Formation is exposed in fault blocks or slices that extend southwestward from North West Arm, Red Head, and Landing Cove to the northern intrusive contact of the Belleoram Stock. The exposed thickness of the rocks in this area rarely exceeds 1,000 feet.

Lithology. The Belle Bay Formation consists of a variety of silicic volcanic rocks, mafic volcanic rocks and minor tuffaceous sedimentary rocks and purple sandstone. The silicic and mafic volcanic rocks occur in alternating units from 1,000 feet or less to 5,000 feet or more thick. Several thick rhyolite units separated by basalt units can commonly be distinguished between East Bay and Long Harbour. The units are discontinuous and intertonguing in places but between Belle Harbour and Rencontre Lake and between Mal Bay and Long Harbour individual mafic volcanic units approximately 1,000 to 2,000 feet thick can be traced for 4 to 5 miles. Silicic volcanic rocks probably constitute 80 per cent of the formation in the map-area, mafic volcanic rocks about 15 per cent, and tuffaceous sedimentary rocks and purple sandstones about 5 per cent.

1. Silicic volcanic rocks of the Belle Bay Formation are mainly pink to purple and reddish rhyolite. Flow-banded to massive flows are predominant followed in abundance by pink rhyolite lithic tuff and agglomerate, crystal lithic tuff, and spherulitic rhyolite. The individual flows or fragmental horizons cannot be easily separated but locally form distinctive units that vary from 100 to 300 feet or more in thickness. One such unit, composed of tuffaceous rhyolite, from less than 200 to 1,000 feet thick, can be traced for 5 miles from the west shore of Rencontre Lake to near Doctors Harbour. Here and there columnar jointing is well developed in places, especially on the east side of Big Conne and on the west side of Long Harbour south of Andersons Cove.

Flow-banded rhyolites and local massive porphyritic flows are well-represented between East Bay and Long Harbour in the lower parts of the succession. The rocks are pink to purplish with flow lines. In most places, the flow lines are irregular even over a few feet but some are regular and can be used to determine the attitude of the flows.

Lithic tuffs, crystal lithic tuffs, and agglomerates occur in the main outcrop belt north of Belle Bay, and well-exposed examples occur at Red Head and southwest of North West Arm of Corbin Bay. The lithic tuffs and agglomerates are pink to purplish and greyish and are composed almost entirely of angular silicic volcanic rock fragments. A few varieties contain green to greyish volcanic rock fragments set in a pink to reddish matrix.

Pink to purplish grey spherulitic rhyolites occur near Red Head on Corbin Bay. Spherules are well developed in rounded clusters with individual spherules generally 1/4 - 1/2 inch in diameter. Pink rhyolite with spherules less than 1/4 inch occur between East Bay and Belle Harbour. In a few places the pink flow-banded rhyolites, so abundant throughout the formation, have a poorly developed spherulitic texture.

2. Mafic volcanic rocks of the Belle Bay Formation are mainly green to purple amygdaloidal basalt, massive green, purple, and dark grey lava, and minor fragmental volcanic rocks. The flows vary from a few tens of feet to 100 feet or more with individual flows distinguishable by either colour or textural differences. Poorly developed columnar jointing is evident locally. The amygdules are mainly calcite and less commonly quartz. In a few places, e.g. Femme Harbour, the vesicules are filled with soft zeolite (?) minerals and hard white chalcedony (?).

Where intruded by the Ackley Batholith at Isle à Glu Pond, the mafic volcanic rocks have been baked into a tough, fine-grained, dark hornfels. Contact metamorphism of silicic volcanic rocks in the aureole of the same batholith is much less obvious. Southeast of Corbin Bay on the Pools Cove road, fragmental white-weathering, dark grey hornfels of volcanic derivation is also well developed in the aureole of the Belleoram stock.

3. Sedimentary rocks of the formation are mainly tuffaceous and most are grouped with the silicic volcanic rocks. Well-bedded purple to grey tuffaceous sandstone and conglomerate composed entirely of volcanic rock fragments occur in beds a few inches to a few feet thick among the rhyolite flows near Northwest Cove of Mal Bay. Similar rocks occur bounded by two mafic flows north of Long Harbour, and other examples occur north of Belle Bay.

Two distinct horizons of purple sandstone, each approximately 200 feet thick, occur within a mafic volcanic unit at Magrath Cove. The sedimentary rocks are crossbedded and resemble sandstones of the Rencontre Formation. North of Magrath Cove on the east side of East Bay, about 300 feet of bright red rhyolite-pebble conglomerate and red argillite can be traced 2 miles eastward to Belle Harbour. Other sedimentary rocks and tuffaceous sedimentary rocks are exposed on the east side of East Bay and include red tuffaceous argillite and yellow and green fine-grained bedded tuff.

In the southeast corner of the map-area, volcanic rocks that are tentatively assigned to the Belle Bay Formation are green to pink agglomerate, lithic tuff, and crystal lithic tuff. Fragments in the pyroclastic rocks are mainly schistose quartz-feldspar porphyry. The schistose fragments locally

assume random orientations indicating deformation and development of schistosity before incorporation into the fragmental volcanic rock. Nearby, tuffs and agglomerates have similar schistose porphyry fragments and the fabric of both fragments and matrix is parallel. The local exposures at Big Head are atypical of the Belle Bay Formation throughout the rest of the map-area.

Relations to nearby groups. The Belle Bay Formation is overlain with apparent structural conformity by the Andersons Cove, Mooring Cove, and Recontre Formations. The base of the formation is nowhere clearly defined within the map-area. White (1939) and Widmer (1950) have interpreted the formation to overlie dated Cambrian strata unconformably between Red Head and Sandy Point of Corbin Bay. Smith (Smith and White, 1954) has similarly interpreted altered volcanic rocks about one mile west of Belle Harbour unconformably to overlie sandstones that conform beneath dated Cambrian beds nearby. These reports have been strengthened by work in the eastward-adjoining Terrenceville map-area, where the Belle Bay Formation was interpreted to overlie both the Cambrian (?) Nine Mile Hill Formation and the Ordovician (?) Grand le Pierre Formation (Bradley, 1962).

The present study does not support these interpretations, at least within the map-area, and assignment of the rocks to the late Precambrian inadvertently challenges the stratigraphic and structural interpretations in the adjoining Terrenceville map-area.

Between Sandy Point and Red Head of Corbin Bay, dated Cambrian shales and siltstones are separated from overlying volcanic rocks of the Belle Bay Formation by a moderately southeast-dipping fault. The Cambrian rocks are fractured and altered but the overlying more competent volcanic rocks are relatively undeformed. The rocks are slickensided in the fault zone but the relative movement along the fault is unknown. A similar southeast-dipping fault on the west side of Cinq Islands Bay has definite reverse movement and has brought the older Cinq Isles Formation structurally above younger Pools Cove conglomerates. By analogy, the fault separating the Cambrian and Belle Bay Formation at Corbin Bay is interpreted as a moderately dipping reverse fault or thrust.

The contact between northerly trending Cambrian rocks and the easterly trending Belle Bay Formation at East Bay is also marked by a fault. The fault is steeply dipping and northeast trending. Near Belle Harbour the fault contact is displaced to the southeast and on a steep east-facing slope west of a small lake at the displaced boundary, a stratigraphic contact is exposed between purplish sandstones and volcanic rocks. This is thought to be the locality described by Smith (Smith and White, 1954) and interpreted to represent an unconformity between the Doten Cove Formation (presently included in the Rencontre Formation) and the Belle Bay Formation. Purple sandstones at the bottom of the slope are slump-folded and although generally southwest-dipping the direction of tops is uncertain. Farther up the slope the sandstones have interlayered volcanic breccia or tuff beds a few inches to a few feet thick over an interval of about 20 feet. These are followed upward by siliceous tuff and epidotized mafic lava. The slump-folded sedimentary rocks could not be traced into nearby late Precambrian Rencontre Beds, which toward the east are southeast-dipping and overturned, but if the sedimentary rocks are of Precambrian age, then the continuous and conformable contact implies the same age for the Belle Bay volcanic rocks.

Andersons Cove Formation

Definition, Distribution, Thickness. The name Andersons Cove was first used by White (1939) to designate a sedimentary assemblage (Andersons Cove slates) that overlies the Belle Bay Formation. The type area is at Andersons Cove, Long Harbour, where the rocks occur in the Hoop Cove Syncline and are best exposed along the coast between Andersons Cove and Shellbird Cove. The rocks also occur in the axial zone of the Long Harbour Syncline on the east side of Long Harbour. From there they extend northeastward into Terrenceville map-area where they have been referred to the Andersons Cove Formation (Bradley, 1962). Lithologically similar rocks at Burin Peninsula, 10 miles east of the type area, have also been included in this formation (Bradley, 1962).

In the extreme southeast corner of the map-area at Big Head, green tuffaceous sedimentary rocks, tentatively assigned to the Andersons Cove Formation, lie along the strike of similar rocks assigned to the formation by Bradley (1962). It is not yet certain whether or not these rocks are equivalent to those of the type area.

The Andersons Cove Formation was estimated at 1,500 feet thick in the type area but the rocks are tightly folded and estimates of thickness are subject to error. Probably 1,000 to 1,500 feet of strata are represented in the northwest limb of the Hoop Cove Syncline. In Terrenceville map-area. Bradley (1962) assigned 4,000 feet of strata to the formation near Bay l' Argent.

Lithology. The Andersons Cove Formation consists of finely laminated grey argillite or slate with wavy irregular bedding, grey siltstone, and grey sandstone. The coarser clastic rocks occur in beds a few inches to a foot or more thick. The argillites commonly display 10 to 15 laminae in a one-inch stratigraphic thickness. The grey clastic sedimentary rocks are monotonous except at the base of the formation where purple argillite and sandstone interlayers are present. Tight minor folds from less than 6 inches to 3 feet in amplitude and somewhat shorter wavelength are common in the finely-laminated rocks at Andersons Cove. Some are slump folds but others are regularly oriented with axial planes parallel to slaty cleavage wherever the latter is developed.

The base of the formation is marked in most places by a purple to red volcanic boulder conglomerate, purple sandstone and pebble-conglomerate, or red crystal tuff and agglomerate. In the Hoop Cove Syncline the basal member is represented by about 30 feet of red argillite, crystal tuff, and purple sandstone and conglomerate. Similarly, 50 feet or more of coarse conglomerate and agglomerate occurs on the eastern limb of the Long Point Syncline between Andersons Cove and Stones Cove. Approximately 50 feet of purple tuff, argillite and sandstone are found at the base of the formation in the northwest limb of the Long Harbour Syncline, but this horizon is apparently missing in the southeast limb of the same fold.

Near Woody Point an exposure of rhyolite is included in the formation. The rhyolite appears to intertongue with the grey sedimentary rocks and is similar to that in the overlying Mooring Cove Formation.

Beds assigned to the Andersons Cove Formation in the southeast corner of the map-area are green tuffaceous siltstone and sandstone that locally contain poorly sorted silicic volcanic rock fragments from 1 inch to 6

inches in diameter. Bedding is rare or absent but locally the rocks have irregular, lensy bedding and less commonly crossbedding. At one locality a sandstone bed contains a fresh-appearing, medium-grained massive pink granite pebble 4 inches in diameter.

Basal relationships. Purple to red sedimentary and volcanic rocks at the base of the Andersons Cove Formation conformably overlie silicic volcanic rocks of the Belle Bay Formation in the Hoop Cove Syncline and in the eastern limb of the Long Point Syncline. Along the northwest limb of the Long Harbour Syncline similar purple beds overlie mafic volcanic rocks of the Belle Bay Formation. Purple to red basal beds are absent in the southeast limb of the Long Harbour Syncline where grey sedimentary rocks directly overlie mafic volcanic rocks of the Belle Bay Formation. The contact is everywhere conformable.

Mooring Cove Formation

Definition, Distribution, Thickness. The term Mooring Cove was introduced by White (1939) to designate a dominantly mixed volcanic assemblage that overlies the Andersons Cove Formation and is succeeded by sandstone of the Rencontre Formation in the Hoop Cove and Long Point Synclines. Similar rocks are clearly displayed along the coast between Mal Bay and East Bay but there they were assigned to the Rencontre Formation or Rencontre Group (Anderson 1965; Smith and White, 1954). The rocks form a mappable unit of formational status in the type area and similar rocks between Mal Bay and East Bay are clearly separable from the underlying Belle Bay and overlying Rencontre Formations. The boundaries of the formation are not sharply defined in the Corbin Bay area, but the mixed volcanic rocks at North West Arm and north of Landing Cove, are considered part of the formation.

White (1939) estimated the thickness of the formation at 1,500 feet in the type area. Toward the west, the formation has a similar thickness (1,000 to 1,500 feet) reaching a maximum of 2,500 feet at Rencontre East.

Lithology. The Mooring Cove Formation in the type area consists mainly of deep red to pink rhyolite with interbedded purple and green lava and associated purple to grey sedimentary rocks. Nearby at Stones Cove, the formation consists of purple to pink sandstone and conglomerate in 50- to 150-foot-thick units that alternate with mafic flows of similar thickness. A mafic flow marks the base of the formation in both the Hoop Cove and Long Point Synclines.

Between Lally Head and Mal Bay easily distinguishable mafic flows from 50 to 100 feet thick are predominant. These are mainly purple and green amygdaloidal lava, massive green lava, and green porphyritic lava with plagioclase phenocrysts up to one inch in diameter. Locally the flows have a poorly developed columnar jointing and a reddish green flow at Isle à Glu Cove exhibits flow lines in irregular patterns. Purple to red sandstone, conglomerate, and argillite occur interlayered with the mafic flows. At least three sedimentary units are evident at Burdock Cove and two 50- to 100-foot-thick sedimentary units occur at Isle à Glu Cove. At Lally Cove Island pink flow-banded rhyolite and tuff occurs as a distinct horizon above purple sedimentary rocks and a mafic flow.

In the Corbin Bay area, the formation consists of a wide variety of volcanic rocks best displayed at Dog Island and Long Island, with local

sedimentary interlayers north of Landing Cove. Red to pink agglomerate with angular pink volcanic rock fragments up to 6 inches in diameter occurs at Dog Island. Pink to deep red lithic tuff, and crystal lithic tuff are associated with the coarser fragmental volcanic rocks. Crystal fragments in the crystal lithic tuffs are pink feldspars, about 1/8 to 1/4 inch in diameter, set in a dark red matrix side by side with small welded rock fragments or irregular shape.

At Long Island the volcanic rocks are reddish agglomerate, lithic tuff, crystal lithic tuff, flow-banded rhyolite, and amygdaloidal mafic lava. The fragmental volcanic rocks are in beds a few inches to ten feet or more thick and locally the finer tuffaceous beds display grading.

Basal relationships. The Mooring Cove Formation rests conformably upon the Andersons Cove Formation in the Hoop Cove and Long Point Synclines. Toward the west the Andersons Cove Formation is missing and the Mooring Cove lies directly upon silicic volcanic rocks of the Belle Bay Formation. The contact is conformable in local outcrops but the absence of the Andersons Cove Formation suggests regional disconformity.

Rencontre Formation

Definition. The name Rencontre was proposed by White (1939) for the purple and red sandstones and volcanic rocks that overlie the Mooring Cove and Belle Bay Formations. It was not initially regarded as part of the Long Harbour 'Series' (White, 1939). The formation was mapped by Widmer (1950) in the Corbin Bay area and it has been recognized in Terrenceville map-area (Bradley, 1962). Smith and White (1954) proposed that the formation be elevated to group status to include the Andersons Cove slates and Mooring Cove volcanics as originally outlined by White (1939). Where mapped by Anderson (1965) the Rencontre Formation included all of the present Mooring Cove Formation between Long Harbour and Lally Head. As presently outlined, the Rencontre Formation has no volcanic rocks at its base. Where it overlies the Mooring Cove Formation its base is drawn at the top of the highest volcanic unit in the Mooring Cove Formation. East of Long Harbour, the Rencontre Formation lies directly upon silicic volcanic rocks of the Belle Bay Formation. There it is likewise composed entirely of sedimentary rocks, except for a single 25-foot-thick amydgaloidal flow about 500 feet above the base (Smith and White, 1954). Another minor flow (felsitic) occurs still higher in the succession east of the map-area (Bradley, 1962).

Red sandstones on the west side of Corbin Bay, east of East Bay, and at the north end of Chapel Island, were referred to the Doten Cove Formation where mapped by White (1939), Widmer (1950), and Smith and White (1954). These beds are now assigned to the Rencontre Formation and the name Doten Cove dropped. Where continuous sections are exposed, at the north end of Chapel Island and east of East Bay, the red sandstones grade upward into grey micaceous sandstones of the Youngs Cove Group.

Distribution and Thickness. The Rencontre Formation is present in the axial zones of the Femme, Hoop Cove, and Long Point Synclines and approximately 100 feet of sandstone is exposed in the core of the Mal Bay Syncline. The thickest section is exposed across Rencontre Island where 5,000 feet of mainly coarse purple sandstone with local grey sedimentary horizons dip and

face southwestward. East of the map-area in the Rocky Hills (Femme) Syncline, Bradley (1962) estimated the thickness of the formation at 4,000 feet.

In the Corbin Bay area the rocks are interpreted to form a northeast-plunging anticline on Long Island with a corresponding syncline to the west between Long Island and Bob Head. Southeast of Long Island the beds are interpreted to form a southeast-dipping, southeast-facing succession without major dislocation between Tickle Island and Farmers Cove Head. The thickness of this section is estimated at 2,000 to 3,000 feet. Smaller areas of the Rencontre Formation are present at Isle à Glu, Doctors Harbour, Potato Point, Belle Island, and Stearin Island. East of East Bay at least 1.000 feet of red micaceous sandstone and crossbedded purple sandstone conformably underlie the Youngs Cove Group.

Lithology. The Rencontre Formation consists of pale purple to deep purple, grey and red, crossbedded sandstone, red micaceous sandstone, and pebble-conglomerate, with thin interlayers of bright red siltstone, sandstone, and argillite. The formation is believed to thicken across the map-area from west to east and is accompanied by a distinct overall coarsening, from mainly sandstones west of Rencontre Island, to coarse sandstones and pebble-conglomerates in the Hoop Cove and Long Point Syncline, to mainly pebble- and cobble-conglomerates in the Femme Syncline. These features suggest derivation from the east, an inference also proposed by Twenhofel (1947), based upon the direction of crossbedding and cut and fill structures.

Pale purple to purple and red crossbedded sandstones in beds about 1 to 3 feet thick predominate in the lower parts of the formation west of the type area at Rencontre East. These are composed of quartz and feldspar grains and volcanic rock fragments. Locally they contain red siltstone or argillite horizons a few feet to a few tens of feet thick. Commonly the purple crossbedded sandstones have argillite breccia layers a few inches thick and traceable for a few tens of feet. These result from the disruption of semi-consolidated finer beds by the deposition of coarser overlying beds. Also common are wavy-bedded purple sandstones that locally display small-scale slump folds. Northeast-trending, steeply west-dipping cleavage is well-developed in the beds at Rencontre Island and nearby.

Coarse sandstones and pebble-conglomerates in the Hoop Cove and Long Point Synclines are composed of silicic pink to purplish volcanic rock fragments and quartz pebbles. Farther east in the Femme Syncline the coarser deep purple conglomerates are composed almost entirely of sub-rounded volcanic rock fragments. Most common are pebbles and cobbles of flow-banded rhyolite, purple felsite, crystal tuff, and purple amygdaloidal lava. The conglomerate beds generally exceed 5 feet in thickness and locally contain lenses of purple sandstone.

The upper parts of the Rencontre Formation, exposed only in Corbin Bay area and east of East Bay, consist mainly of red micaceous sandstone and siltstone. These rocks are well exposed on the northwest side of Corbin Bay and at the north end of Chapel Island. The rocks are more thinly bedded (1/2 inch to 6 inches), finer grained and contain much more detrital muscovite than beds lower in the succession. Small-scale sedimentary features include crossbedding, wavy irregular bedding, rolled slump folds, argillite breccia interlayers, and current ripples. Interference ripples and sandstone dykes were noted locally near Doting Cove Head.

Grey sedimentary rocks are locally represented in the formation on the north shore of Rencontre Island and in thin units in the Hoop Cove and Long Point Synclines. One such thin unit, from 30 to 100 feet thick, can be traced around the Hoop Cove Syncline from Long Cove to near Woody Head. Grey and red micaceous sandstones and siltstones are interlayered where the Rencontre Formation grades upward into the Youngs Cove Group.

Relations to nearby formations. The Rencontre Formation conformably overlies the Mooring Cove Formation between Long Harbour and Lally Head and most places southeast of Corbin Bay. West of Long Harbour in the Femme Syncline, the Rencontre Formation directly overlies silicic volcanic rocks of the Belle Bay Formation. Contacts are conformable and the absence of the nearby Andersons Cove and Mooring Cove Formations indicates either transgressive overlap or unconformable stratigraphic overstep. A similar situation is apparent at Maggoty Cove of Corbin Bay where grey and red sedimentary rocks assigned to the formation directly overlie silicic Belle Bay volcanic rocks. Here it is less certain that the succession is due to structural complications. The rocks assigned to the Belle Bay Formation could be Mooring Cove equivalents, or alternately, the rocks assigned to the Rencontre Formation could be Mooring Cove and/or Andersons Cove equivalents.

The Rencontre Formation is overlain conformably and gradationally by the Youngs Cove Group. This relationship is clearest at Farmers Cove Head on Chapel Island, and can be inferred with some confidence northeast of East Bay.

Age and Correlation

Formations of the Long Harbour Group have been variously assigned to the Ordovician, Silurian, or Devonian by all previous workers, based mainly upon stratigraphic and structural interpretations in the map-area or upon tenuous indirect lines of evidence (White, 1939; Widmer, 1950; Twenhofel, 1947; Smith and White, 1954; Anderson, 1965; Williams, 1967a). From the structural and stratigraphic information presently at hand it seems most likely that the rocks are late Precambrian and were thrust northwestward where interpreted to overlie Cambrian strata unconformably (White, 1939; Widmer, 1950; Smith and White, 1954). This interpretation is supported by the stratigraphic succession in the Corbin Bay area and also by an Rb/Sr age determination of 515 $\pm$ 7 million years for the volcanic rocks of the Long Harbour Group.

Other lines of evidence suggesting a late Precambrian age for the Long Harbour Group are:

1. The Long Harbour Group is lithologically similar to Precambrian rocks of the Avalon Platform in eastern Newfoundland (Williams, 1969). Its volcanic rocks and red sedimentary rocks are identical to rocks of the late Precambrian Musgravetown Group (Jenness, 1963) that occurs northeast of the map-area on the opposite side of Ackley Batholith.

2. Red and purple sandstones of Long Island appear to underlie similar beds of nearby northern Chapel Island conformably. All of the Chapel Island rocks were mapped as Precambrian by most previous workers because 10 miles southwestward at Blue Pinion Cove, correlative beds are overlain by dated fossiliferous Cambrian (Widmer, 1950; Smith and White, 1954; Hutchinson, 1962; Anderson, 1965). A succession similar to that at Chapel

Island is exposed east of East Bay where purple and red sandstones were also mapped as Precambrian as they conformably underlie strata of the Youngs Cove Group to the west. In both areas the purple and red sandstones were referred to the Doten Cove Formation (White, 1939; Widmer, 1950; Smith and White, 1954; Hutchinson, 1962). All previous workers assigned the Long Island exposures to the Rencontre Formation (at the time considered to be Ordovician or younger) without regard for their apparent stratigraphic position below similar beds assigned to the late Precambrian Doten Cove Formation at Chapel Island. If the Long Island and Chapel Island exposures are part of the same succession (the Precambrian Rencontre Formation as presently defined) then this enigmatic structural-stratigraphic problem automatically disappears.

3. In the Terrenceville map-area, the Andersons Cove Formation is depicted as being infolded with Precambrian rocks in regionally conformable map patterns on Burin Penninsula (Bradley, 1962) suggesting that the Andersons Cove and underlying Precambrian rocks are of the same general age. For this reason the Andersons Cove Formation, on Burin Peninsula, was assigned to the Precambrian on the geological map of Newfoundland (Williams, 1967b). At the same time the Andersons Cove Formation at Belle Bay was assigned to the Paleozoic (Silurian) based upon the reports of White (1939), Widmer (1950), and Smith and White (1954). A similar Precambrian age throughout again removes these difficulties.

Thus a late Precambrian age for the Long Harbour Group seems most reasonable. Evidence for a Paleozoic age for equivalent rocks in the adjoining Terrenceville map-area is considered inconclusive, although the previous discussion is in no way intended to discredit this evidence.

CAMBRIAN AND LATE PRECAMBRIAN (?)

Youngs Cove Group

Definition, Distribution, Thickness

The name Youngs Cove Group was proposed by White (1939) for the shales, siltstones, and sandstones that form a thin northeast-trending belt in the type area along the east shore of East Bay. Dated Middle Cambrian strata on the south shore of Corbin Bay were also included in the group, as well as highly deformed undated shales on the southwest shore of Cinq Islands Bay. Widmer (1950) mapped similar rocks in the adjoining Hermitage map-area but choose to redefine the group to include "only those shales .... that contain Middle Cambrian fossils and the related rocks of Middle Cambrian age". Hutchinson (1962) preferred the term formation to that of group but similarly defined the Youngs Cove to include the known Middle Cambrian rocks north of Fortune Bay.

In the type area, dated Middle Cambrian rocks of the Youngs Cove Group appear to overlie conformably red beds of the Rencontre Formation (formerly referred to the Doten Cove Formation at this locality, White, 1939). Similarly at Chapel Island, grey shales and siltstones conformably overlie the Rencontre Formation (here also formerly referred to the Doten Cove), and although undated, the shales and siltstones are lithologically similar to the Youngs Cove Group of the type area. The grey-green beds of Chapel Island were previously referred to the Chapel Island Formation (White, 1939;

Widmer, 1950; Hutchinson, 1962) and correlated with undated beds that underlie dated Middle Cambrian rocks and quartzites at Blue Pinion Cove, 8 miles southwest of Chapel Island. The author feels that the grey-green shales and sandstones at Chapel Island should also be included in the Youngs Cove Group, regardless of their uncertain age. The Chapel Island occurrences are lithologically similar to other rocks of the Youngs Cove Group in the map-area and as noted by Hutchinson (1962), these rocks at Belle Bay, north of Fortune Bay, do not closely resemble the Middle Cambrian strata elsewhere in eastern Newfoundland.

The Youngs Cove Group as presently mapped includes those dated and undated grey shales, siltstones, and sandstones within the map-area that overlie the Rencontre Formation. The rocks are dated as Middle Cambrian at Corbin Bay and at East Bay but those included in the group at Chapel Island could be late Precambrian and other rocks included in the group at Cinq Islands Bay could be Ordovician (Smith and White, 1954).

The Youngs Cove Group has an estimated thickness of 2,000 feet in the type area (White, 1939) and the thickness of the succession at Chapel Island has been estimated at 1,700 to 2,000 feet (Widmer, 1950).

Lithology

The Youngs Cove Group consists of grey to green micaceous siltstone, light to dark grey shale and argillite, and grey to green micaceous sandstone. At the type area in East Bay the rocks are faulted and folded dark grey shales and argillites with 1- to 2-inch beds of pyritic grey siltstone. They are finely bedded and in places the shales contain limy lenses about 6 inches thick and 2 feet long. Locally there are red and purple micaceous siltstone units up to 30 feet wide among the dominantly grey sedimentary rocks. In places grey micaceous sandstones in beds two feet thick occur with well-preserved, load-cast sole markings.

At Chapel Island the rocks are grey to green siltstone and argillites with green micaceous sandstone interbeds from 1/4 inch to 2 inches thick. Locally the siltstones and argillites have wavy, irregular bedding and in places the sandstones display fine-scale crossbedding. As in the type area, the dominantly grey sedimentary rocks contain thin (5-foot- to 20-foot-thick) red to purple argillite units.

Grey micaceous sandstone beds from 3 inches to 1 foot thick are prominent among the siltstones and shales at Cinq Islands Bay. Load casts in irregular, lumpy patterns are common at the base of the sandstone beds. Southwestward and near the edge of the map-area these rocks are closely fractured and brownish weathering.

At Corbin Bay the rocks are mainly grey micaceous siltstone and shale. Local sandy beds have small-scale crossbedding and in places the grey shales are brownish weathered. In the aureole of the Belleoram granite the rocks have been converted to fine-grained, hard, cherty hornfels.

Age

Numerous trilobite fragments (mainly cephalons) occur in micaceous siltstone of the Youngs Cove Group between Sandy Point and Red Head of Corbin Bay. Trilobite forms identified by B. F. Howell (after Smith and White, 1954) are as follows:

Paradoxides eteminicus (Matthew)
Paradoxides bennetti (Salter)
Bailiella ornata (Resser)
Liostracus ouangondianus (Hartt)
Acrothele matthewi (Hartt)

In addition, Hutchinson (1962) recognized Liostracus tener (Hartt) and revised Howell's identification of Bailiella ornata (Resser) to Bailiella manuelensis, a newly defined species common in east Newfoundland. Collections made in 1969 failed to reveal any additional forms. All of the above fossils are typical of the Paradoxides bennetti zone of early Middle Cambrian age.

White (1939) also collected fragments of Paradoxides eteminicus from the north shore of Youngs Cove, East Bay. Unfortunately no subsequent workers have succeeded in confirming the occurrence of fossils in this type area.

Rocks included in the Youngs Cove Group 2,000 feet south of Shine Cove of Cinq Islands Bay contain small linguloid brachiopods. These were studied by B.F. Howell and were described as resembling Lingulella laevis (Matthew), probably of late Cambrian or younger age (Smith and White, 1954). Collections made in 1969 at the same locality and identified by W.H. Fritz of the Geological Survey of Canada contained a single form of Lingulella sp. considered to range in age from Early Cambrian through the Middle Ordovician, and possibly into the Late Ordovician.

Rocks included in the Youngs Cove Group at Chapel Island have not yielded organic remains. However, they are lithologically similar to rocks in the type area and similarly overlie red sedimentary rocks of the Rencontre Formation. At Farmers Cove Head, there is interlayering of red and green units over several hundred feet, indicating a conformable and gradational boundary between the Rencontre Formation and the Youngs Cove Group.

Detrital muscovite collected 1/2 mile south of Farmers Cove Head has been dated isotopically at 517 million years. A similar age of 565 million years was obtained on detrital muscovite from the Rencontre Formation nearby at Long Island.

Correlation

Cambrian stratigraphy and correlation in the Fortune Bay area is enigmatic, mainly because of the absence of continuous stratigraphic sections, structural complexity of the rocks, and the dissimilarity of dated Middle Cambrian rocks in Belle Bay compared with rocks of the same age nearby at Blue Pinion Cove and elsewhere in eastern Newfoundland.

At Blue Pinion Cove dated Middle Cambrian rocks are dark grey and red shales that occur in distinct units and the rocks lack the arenaceous aspect of the Youngs Cove Group to the north. These shales, typical of the Cambrian of eastern Newfoundland, are underlain by white quartzites, the Blue Pinion Formation, in turn underlain by grey and green shales, siltstones, and sandstones. The latter more closely resemble the Youngs Cove Group to the north and have been correlated with similar beds at Chapel Island. Hutchinson (1962) interpreted the Blue Pinion quartzites and underlying rocks as possibly Precambrian and analagous to the late Precambrian Random quartzites and underlying rocks of eastern Newfoundland.

Facies variation and diachronous lithologic boundaries must be invoked to explain the local contrasts between the Middle Cambrian Youngs

Cove Group at Blue Pinion Cove with beds of the same age in the type area at East Bay. Conceivably, all of the rocks at Blue Pinion Cove are of Middle Cambrian age with only the lower beds (Chapel Island Formation) resembling the Youngs Cove Rocks in the map-area to the north.

Quartz sandstones at Bufford Cove, a few miles west of the map-area, were also assigned to the Blue Pinion Formation and overlying undated purplish sandstones and hornfelsic shales were correlated with the Youngs Cove Group (Hutchinson, 1962). The contact between the quartz sandstones and overlying purplish sandstones is conformable with intercalating of the two in the contact zone. This relationship suggested to Hutchinson (1962) a conformable and gradational stratigraphic boundary between the possibly late Precambrian Blue Pinion Formation and overlying possibly Middle Cambrian Youngs Cove Group. Reconnaissance in this area in 1969 indicated that the quartz sandstones are underlain by silicic volcanic rocks and that both the quartz sandstones and conformably overlying purplish sandstones are similar to sedimentary rocks of the Rencontre Formation within the Belleoram map-area. The Bufford Cove succession may therefore be partly equivalent to the Rencontre Formation with the grey undated hornfelsic rocks higher in the Bufford Cove succession being possibly equivalent to the Youngs Cove Group at Chapel Island.

ORDOVICIAN OR EARLIER (?)

No dated Ordovician rocks occur within the map-area. The Simmons Brook Batholith is tentatively considered Ordovician or earlier for it is unconformably overlain by the Cinq Isles Formation of Devonian or earlier age. The Garrison Hills Gneiss grades upward into Ordovician rocks west of the map-area at Baie d'Espoir (Anderson, 1965; Williams, in press). The gneisses are therefore derived from rocks of Ordovician or earlier age.

Simmons Brook Batholith

Definition and Extent

White (1939; 1940) proposed the name Bay du Nord for the intrusive rocks northwest of North Bay. The name was used by Eardley (1951) and retained by Widmer (1950) and Smith and White (1954). This name however has been pre-empted by Cooper (1954) who used the term for a group of sedimentary rocks in the La Poile Bay area of southwest Newfoundland. The intrusion is therefore renamed the Simmons Brook Batholith.

The intrusion is elongate with only its central part exposed in the map-area. It extends 18 miles southwestward to Harbour Breton and an additional 4 miles northeast of the map-area. It is faulted on the northwest side in contact with the Garrison Hills Gneiss. On the southeast it is both faulted against and overlain unconformably by younger rocks of the Cinq Isles and Pools Cove Formations.

Lithology

The Simmons Brook Batholith is composed of a variety of pink to grey, medium- to coarse-grained granite and granodiorite with locally

predominant dark green mafic intrusive rocks. The mixed lithology of the batholith, and especially its mafic rocks and mixed-granitic and mafic phases, clearly distinguish it from the more homogeneous Ackley Batholith and the Belleoram Stock. Most of the rocks are altered, as indicated by the transformation of mafic minerals to chlorite, epidote, and zoisite.

Medium- to coarse-grained grey to greyish pink granite and granodiorite are most typical of the Simmons Brook Batholith within the map-area. These granitic rocks have white plagioclase in excess of pink potash feldspar and contain 10 to 15 per cent biotite and green amphibole that are largely altered to chlorite and epidote. Most of the rocks are massive, but locally there is a vague foliation portrayed by the alignment of mafic minerals or aligned clusters of mafic minerals. Well-exposed examples occur north of the Pools Cove-Belleoram road and locally along the Coast of East Bay.

Also common within the intrusion, especially along the shoreline at North Bay, is massive, coarse-grained, pink to reddish pink granite. It is composed of potash feldspar and quartz with about 5 per cent chloritized biotite. Potash feldspar occurs in twinned crystals up to one centimetre in diameter. This variety of the Simmons Brook Batholith is similar in appearance to granite of the Ackley Batholith although more altered and much less extensive areally.

Mafic phases of the batholith are exposed along Bay du Nord River. The rocks are mainly biotite-hornblende diorite cut by dark mafic dykes. The latter seem to be associated with the mafic phases of the batholith. Most of the rocks are medium grained, massive and relatively unaltered; a few exhibit a weak foliation portrayed by the alignment of chloritized biotite flakes.

The mafic phases of the Simmons Brook Batholith occur as screens, schlieren, and inclusions within the more granitic rocks, suggesting that they are the older. Mafic dykes clearly cut the pink granitic rocks in some places. Similar dykes were not observed cutting either the Ackley Batholith or Belleoram Stock and possibly the dykes are related to the Simmons Brook Batholith and are of the same general age.

Age and Relationships

The Simmons Brook Batholith is unconformably overlain by both the Cinq Isles Formation and the Pools Cove Formation. Northeast of Parsons Cove, East Bay, the contact with the former is exposed in a small brook just a few hundred feet from its mouth. Here the basal beds of the Cinq Isles Formation comprise several feet of coarse crumbly arkosic sandstone that strikes northeast, dips gently southeast, and rests directly upon the granite. West of Pools Cove the contact is exposed along Simmons Brook and approximately 1/2 mile west of the brook on the north side of the Pools Cove road. At both localities the contacts are vertical to steeply southeast-dipping and the granite is unconformably overlain by arkosic sandstone and conglomerate of the Pools Cove Formation.

The contact between the Simmons Brook Batholith and the Cinq Isles Formation is also thought to be an unconformity between North Bay and Salmon River, although it is not exposed. South of this contact and near Salmon River the rocks have been complexly faulted and the relationships are obscure.

All previous authors interpreted the Simmons Brook Batholith to intrude both the Cinq Isles and Pools Cove Formations (White, 1939; Widmer,

1950; Smith and White, 1954; and Anderson, 1965). These interpretations were based mainly on the fact that the Pools Cove Formation is hornfelsed west of the map-area where it is adjacent to Simmons Brook granite. Clearly the metamorphism must result from the action of a younger intrusion. Furthermore, misinterpretations could arise through a failure to distinguish between pink phases of the Simmons Brook and the younger Ackley granite.

The Cinq Isles Formation is undated but it is most probably Devonian. This sets an upper limit to the age of the Simmons Brook Batholith. Widmer (1950) has interpreted the Simmons Brook to cut volcanic rocks of the Connaigre Bay Formation, in turn probably equivalent to the Long Harbour Group. This suggests a lower age limit of late Precambrian. Conceivably, the Simmons Brook Batholith is late Precambrian and the same age as the Holyrood granite of eastern Newfoundland. On the other hand, it may be as young as early Devonian. Its degree of alteration and weak foliation suggest a pre-Devonian age, possibly Ordovician.

Granitic and dioritic rocks at Big Head in the extreme southeast corner of the map-area have been correlated with Simmons Brook Batholith. These rocks were mapped toward the east by Bradley (1962) and referred to the Jacques Fountain granite sill. The latter, in turn, is considered equivalent to the Cape Roger Mountain Batholith in the same area. The age of these granitic rocks is unknown, other than that they cut late Precambrian rocks and are considered to be the oldest intrusions in the Terrenceville map-area (Bradley, 1962).

Garrison Hills Gneiss

The term Garrison Hills 'granite' was introduced by Jewell (1939) for the foliated quartz-feldspar gneisses of the Bay d'Espoir area. Similar rocks were mapped in Hermitage map-area (Widmer, 1950) and in Rencontre East map-area (White, 1939) and interpreted as metamorphosed granitic intrusions. The term 'gneiss' is used in preference to the term 'granite' as many of the rocks are heterogeneous and banded, and most are foliated.

Rocks similar to the Garrison Hills gneiss have been traced northeastward across Newfoundland to the Wesleyville map-area on the north coast of the island (Jenness, 1963; Williams, 1968), and westward to Grey River on the south coast (Williams, in press). The rocks are coarse-grained, foliated and porphyroblastic biotite gneiss, muscovite-biotite gneiss, and fine-grained, pink foliated gneiss that is interpreted as mylonite. More complete descriptions of these rocks are given by White (1939), Widmer, (1950), Smith and White (1954), Jenness (1963) and Williams (in press).

Everywhere along their southeastern margin the gneisses are bounded by faults. This is a fundamental break which in Newfoundland separates the Avalon Platform from the Central Mobile Belt (Williams, 1969). The northwest margin of the gneisses has been interpreted as a gradational contact where the metamorphic rocks seemingly grade upward into Ordovician rocks of the Baie d'Espoir and Gander Lake Groups (Jenness, 1963; Anderson, 1965; Williams, in press).

The Garrison Hills gneiss is exposed only in the extreme northwest corner of the map-area where the rocks are separated from the Simmons Brook Batholith by a distinct topographic depression that is interpreted to mark the trace of a major fault (Anderson, 1965). A similar northeast-

trending fault, marked by a similar topographic depression, is exposed at the village of Bay du Nord. The extent of the Garrison Hills gneiss and the open 'S'-shaped regional configuration of these rocks in central Newfoundland has been recently reviewed by Williams et al. (1970)

DEVONIAN OR EARLIER (?)

Cinq Isles Formation

Definition

The term Cinq Isles 'Series' was introduced by White (1939, 1940) to designate the succession of red sandstone, limy shale, and pebble-conglomerate exposed on the shores of North Bay, East Bay, and the northwest shore of Cinq Islands Bay. The series was subdivided into 5 units; the Spoon Cove, Yankee Cove, Pools Cove, Tilt Point, and Spyglass Cove, in order of decreasing age. Widmer (1950) recognized that the successions at North Bay and at Cinq Islands Bay represented the same strata, repeated by faulting, and that the intervening Pools Cove Formation did not form a central part of the Cinq Isles succession but rather a younger overlying formation. Three formations were retained within the restricted Cinq Isles 'Series', viz. Spoon Cove, Yankee Cove, and Spyglass Cove (Widmer, 1950). Although each contains diagnostic lithologies, their boundaries are neither clearly defined nor delineated. Abrupt lithologic changes are common both vertically and laterally so that it is doubtful if in fact Widmer's subdivisions are regionally mappable units of formational status. Exposures of the Cinq Isles rocks are furthermore isolated and restricted making correlation difficult. For these reasons the name Cinq Isles Formation is preferred to that of 'Series' (White, 1939, 1940; Widmer, 1950) or 'group' (Smith and White, 1954; Anderson, 1965). Further subdivisions of the succession, if practical, can be referred to members.

The Cinq Isles Formation within the map-area unconformably overlies the Simmons Brook granite. The upper boundary is placed where red siltstone, limy shale, and red sandstone are overlain by the basal coarse red conglomerate of the Pools Cove Formation.

Distribution and Thickness

The Cinq Isles Formation forms a northeast-trending, steeply southeast-dipping succession approximately one-half mile wide that extends from Parsons Cove in East Bay southwesterly to Salmon River. It is missing, or else preserved only in local patches, farther southwest where the Pools Cove conglomerate lies directly upon Simmons Brook granite. Northeast of Parsons Cove the formation is truncated by the East Bay Fault.

The northwest boundary of the Cinq Isles Formation is marked by a significant basal unconformity at Parsons Cove and probably also to the west of North Bay. The Cinq Isles Formation is faulted against the Simmons Brook granite between North Bay and East Bay and the relationships are modified by faulting at Salmon River. The southeast boundary, at the top of the formation, is mainly modified by local faults, except on the east shore of East Bay where the Cinq Isles Formation is overlain conformably by basal red conglomerate of the Pools Cove Formation.

The Cinq Isles Formation at Tilt Point and Spyglass Cove in Cinq Islands Bay also forms a northeast-trending, southeast-dipping succession. It is faulted against the Pools Cove Formation to the southeast. Southwest of the map-area the Cinq Isles Formation occurs at Wreck Cove and at Eastern Head of Great Bay de l'Eau.

The only section of the formation with base and top exposed extends along the east shore of East Bay southward from Parsons Cove. There it is about 1,000 feet thick. The formation is also approximately 1,000 feet thick on the peninsula between North Bay and East Bay and it is at least 1,000 feet thick on the west side of North Bay. Estimates of thickness by Widmer (1950) suggest a maximum of 1,500 feet.

Lithology

The Cinq Isles Formation is composed of red micaceous siltstone and shale, grey and reddish crossbedded sandstone, grey micritic limestone, and quartz-pebble conglomerate. Most characteristic of the formation is the micritic limestone, and mixed beds consisting of shale or sandstone and conglomerate with grey or pink micritic limestone. Limestone beds may reach 20 feet in thickness but are usually less than 4 feet thick. Most are featureless, but in a few places, the limestone has a concretionary appearance similar to algal growths. Limestone also occurs as nodules and lenses in red siltstone beds, as a matrix to sand grains and pebbles in mixed beds, and as relatively pure interlayers in sandstone and siltstone beds.

Conglomerate also constitutes a wide variety of characteristic rock types, although relatively minor in abundance. Some are merely red or grey sandstone with widely separated well-rounded white quartz pebbles. Others have pebbles of quartz, granite, volcanic rock, and red sandstone in an arkosic red sandstone matrix. A few others consist mainly of white quartz pebbles in a matrix of finer white quartz and limestone.

The Cinq Isles Formation displays vertical and lateral variations. The succession at Spoon Cove on the west side of North Bay has several hundred feet of medium grey to dark grey sandstone at its base followed by siltstone and mixed shale, micritic limestone, and pebble beds. In contrast the base of the succession at Parsons Cove has only a few feet of arkosic sandstone that grades abruptly upward into mixed siltstone and micritic limestone beds. Other variations are found outside of the map-area. At Wreck Cove the base is marked by a pebble-conglomerate that is not represented to the northeast.

Lateral variations are also common locally in intertonguing sandstone, shale, and micritic limestone beds. Sandstone beds from two to three feet thick in places lense out either into beds one foot thick, or disappear within 20 to 30 feet.

The Tilt Point section is probably correlative with central parts of the section exposed in North Bay and East Bay. The section at Spyglass Cove is less typical of the rocks to the north. It is made up mainly of grey and purple sandstone, arkosic sandstone, micaceous siltstone and shale, and a few micritic shale beds. Where cut by granitic dykes, the beds are hornfelsic and darker in colour. Metamorphosed Cinq Isles micritic siltstone near the base of the succession at Wreck Cove, was misinterpreted as volcanic rocks by Hutchinson (1962) (Calcutt, pers. comm. 1969).

Relationships and Age

The Cinq Isles Formation-Simmons Brook granite unconformity is exposed in a small brook at Parsons Cove. In other places where the contact is concealed, a complete lack of thermal metamorphism of the Cinq Isles Formation within a few feet from the granite, indicates an unconformity rather than an intrusive contact. In addition Cinq Isles conglomerates contain pebbles of the Simmons Brook granite.

The surface of unconformity at Parsons Cove dips gently southeastward and the Simmons Brook granite is overlain by about 2 feet of unsorted poorly indurated arkose or granite wash that grades upward over 1 foot into harder arkosic sandstone, siltstone, and silty micrite. A similar contact is evident in dislodged blocks 1/2 mile west of Salmon River where basal arkosic sandstones are up to 6 feet thick. West of North Bay the contact is not exposed but arkosic sandstones occur locally at the base of the succession within a few tens of feet of exposures of Simmons Brook granite.

At Simmons Brook and westward, steeply southeast-dipping Pools Cove conglomerates overlie the Simmons Brook granite. The conglomerates are locally separated from the granite by about 3 feet of red shale and siltstone that has unsorted angular pink feldspar fragments and a few Simmons Brook granite pebbles. The red shale, atypical of the Pools Cove Formation, is interpreted to represent local pockets of Cinq Isles Formation preserved at the base of the sedimentary succession. Red sandstone fragments in the overlying Pools Cove conglomerates suggest that the Cinq Isles Formation was once more extensive in this area and removed by erosion along the unconformable contact. The red shale with feldspar fragments is separated from the underlying granite by 1/4 to 1/2 inch of arkose that is almost indistinguishable from the underlying granite.

The upper contact of the Cinq Isles Formation is exposed on the eastern shore of East Bay. The uppermost 50 feet of the formation consists of grey limestone with commingled quartz-pebble conglomerate and sandstone. The contact is drawn where a quartz-pebble conglomerate bed grades within one foot into arkosic sandstone and shale that is overlain by coarse, red, poorly sorted conglomerate of the Pools Cove Formation. The contact displays no angular discordance between the lithologically-distinct overlying and underlying formations. At most it is a minor disconformity.

The Cinq Isles Formation unconformably overlies dated Upper Cambrian shales of the Salmonier Cove Formation at Wreck Cove of Great Bay de l'Eau (Hutchinson, 1962). The Pools Cove Formation, which overlies the Cinq Isles Formation, is unfossiliferous but indirect geological evidence suggests a Devonian age. The Cinq Isles Formation is unique to the Fortune Bay area. It is atypical of the Newfoundland Ordovician and Lower Silurian, and it is therefore most likely Late Silurian or Devonian. Tests for microfossils in limestones of the formation gave negative results.

Pools Cove Formation

Definition, Distribution, Thickness

The term Pools Cove Formation was used to designate a thick conglomerate succession that was interpreted to form the central part of the

Cinq Isles 'Series' (White, 1939; 1940). Widmer (1950) retained the name Pools Cove and recognized that the conglomerates were a distinct stratigraphic unit that overlay the Cinq Isles succession. Subsequent work has supported Widmer's conclusion (Smith and White, 1954; Anderson, 1965). The Cinq Isles beds exposed at Cinq Islands Bay are therefore older than the southeast-facing Pools Cove conglomerates to the north and the two formations are brought into juxtaposition by a northwest-directed thrust or moderately southeast-dipping reverse fault.

The Pools Cove Formation forms a northeast trending, southeast-dipping succession that extends from the east side of East Bay southwestward to form the headland of the penninsula that separates East Bay and North Bay. From there it extends southwestward to North Bay and eventually beyond the map-area. The northwest margin of this belt is bounded by the Cinq Isles Formation, except west of Salmon River where the steeply southeast-dipping Pools Cove conglomerate lies directly upon the Simmons Brook granite. The southeast margin of the succession is faulted where in contact with Cinq Isles Formation in Cing Islands Bay. The belt is terminated northeastward by the East Bay Fault. Rocks of the formation are generally southeast-dipping, except at East Bay where variable attitudes result from local faulting. Along the southwest shore of North Bay the dips are gentle at the southeast margin of the belt (approximately 20 degrees) steepening northwestward to more than 60 degrees at the Bay du Nord granite contact.

The type section of the formation is along the southwest shore of North Bay at the settlement of Pools Cove. Its base is drawn where coarse red conglomerate overlies red sandstone and micritic siltstone of the Cinq Isles Formation. The top of the formation is not exposed.

The thickness of the formation in the type area is estimated at between 4,000 and 5,000 feet. White (1939) estimated the thickness of the formation at a minimum of 3,000 feet.

Southwest of the map-area, the Pools Cove Formation extends to the north shore of Old Bay. Brief excursions farther southwestward along the west side of Great Bay de l'Eau suggest that the conglomerates there are also part of the Pools Cove Formation, rather than the Great Bay de l'Eau Formation as mapped by Widmer (1950) and Anderson (1965). The Great Bay de l'Eau occurrences lie along strike with the formation in the type area and display a red conglomerate unit and an overlying arkosic sandstone unit at Little Bay West that are lithologically similar to the same stratigraphic subdivisions of the formation in the type area.

Lithology

The Pools Cove Formation is separated into three mappable units; a basal unit approximately 500 feet thick consisting of coarse red conglomerate, a central unit about 400 feet thick consisting mainly of coarse arkosic sandstone and arkosic conglomerate, and an upper unit of boulder conglomerate and coarse arkosic sandstone interbeds. These subdivisions are easily distinguishable in the type area and on the peninsula between North Bay and East Bay. East of East Bay the units are also represented but the succession is complicated by faulting so that delineation of the units is less precise.

The basal red conglomerate consists for the most part of well-rounded granite and diorite boulders, locally exceeding one foot in diameter, set in a matrix of coarse red sandstone. The commonest granitic boulders

are similar to the Simmons Brook granitic rocks but in addition coarse-grained porphyritic biotite granite, and medium-grained pink alaskitic granite are also present. Other common clasts include a variety of foliated granite and granitic gneiss typical of the Garrison Hills metamorphic terrane, muscovite-quartz-feldspar schist, quartzite, red sandstone, and a variety of volcanic rocks.

The red conglomerate unit thins southwestward from the type area to Salmon River and is missing farther southwest where arkosic sandstone and conglomerate of the middle unit lie directly upon the Simmons Brook granite. Southwest of the map-area, on the west side of Great Bay de l'Eau, the red conglomerate unit is thought to be present also.

The middle unit of the Pools Cove Formation consists of buff to bright orange, coarse arkosic sandstone that occurs as units up to 30 feet thick. These alternate with boulder conglomerates that have an arkosic matrix. The arkose is poorly sorted and in places contains up to 90 per cent potash feldspar fragments. Locally these rocks are crossbedded and in places have well-rounded boulders up to one foot in diameter that look out of place where isolated within an arkosic sandstone bed. Grading is evident locally in beds from 3 inches to 4 feet thick. In the type area a few beds of reddish to pink mixed conglomerate and nodular limestone resemble conglomerate of the Cinq Isles Formation.

The upper unit comprises most of the Pools Cove Formation and consists of boulder conglomerate with coarse arkosic sandstone beds, and in a few places, thin beds 1/2 inch to 4 inches thick of red micaceous sandstone. Everywhere within the conglomerate boulders are well-rounded and generally poorly sorted. Clasts include foliated coarse-grained porphyritic biotite granite and an assortment of granitic gneiss and mica schist – typical of the Garrison Hills gneissic terrane; massive grey to pink altered granite, granodiorite, and diorite – typical of the Simmons Brook Batholith; massive coarse-grained porphyritic biotite granite with perthitic feldspar phenocrysts up to two inches in diameter – typical of Devonian intrusions north of the map-area; a variety of mafic to silicic volcanic rocks and red and purple sandstones - typical of the Long Harbour Group; micaceous (muscovite) siltstone and quartzite – typical of the Youngs Cove Group; and red argillite, red sandstone, and locally grey to pink limestone – typical of the Cinq Isles Formation.

The conglomerates of the upper unit appear to be coarsest at the peninsula between East Bay and North Bay. One bed there has granite boulders up to 6 feet in diameter and boulders from 2 to 4 feet in diameter are commonplace. In the type area, boulders rarely exceed 3 feet in diameter and at the southwest edge of the map-area they are generally a foot or less in diameter.

Northeast of Salmon River the formation is mildly indurated. Fractures follow grain boundaries and boulders are easily removed from the matrix of the rock and fall to the shore where coastal exposures are subjected to wave erosion. Near the western margin of the map-area the conglomerates are more highly indurated and they fracture across boulders and matrix alike. Southwest of the map-area to Old Bay the rocks are thermally metamorphosed and original dark shale fragments within the conglomerate have been altered in situ to dark grey hard cherty hornfels.

At East Bay Head, the mildly indurated conglomerate contains clasts of cleaved micaceous siltstone and hard white to pink quartzite. These clasts are probably derived from the Cambrian and earlier (?) Youngs Cove Group.

Their presence within the conglomerate indicates a deformational event within the map-area before conglomerate deposition.

Age and Relationships

The Pools Cove Formation overlies the Cinq Isles Formation and the Simmons Brook granite. It contains boulders of the Garrison Hills metamorphic rocks so that it is younger than the metamorphism that affected these rocks. It also contains boulders of distinctive coarse-grained massive porphyritic biotite granite (Ackley Batholith) of a type that is common in central and northeastern Newfoundland (Jenness, 1963; Williams, 1968). Similar granites north of the map-area have been dated isotopically and yield ages in the order of 360 million years (Jenness, 1963; Wanless, et al. 1965). Southwest of the map-area the Pools Cove Formation has been intruded and thermally metamorphosed by lithologically similar granite that is also considered Devonian (Widmer, 1950). Boulders of this granite occur in the Upper Devonian Great Bay de l'Eau conglomerate. This evidence indicates that the Pools Cove Formation is Devonian.

Widmer (1950) reported a fragmentary plant fossil recovered from the Pools Cove Formation in the first cove west of East Bay Head. The fossil was referred to Wahpia terranovica by B. F. Howell but no conclusion was reached on its probable age. Careful searching for additional material at this locality failed to uncover organic remains. The occurrence of the fossil is indicative of a Devonian age, rather than earlier Paleozoic ages.

Widmer (1950) interpreted the Pools Cove Formation to overlie the Cinq Isles Formation unconformably at 'the funnel' of Salmon River (called Simmons Brook in Widmer's report). The unconformity has not been verified by more recent work and the relationships in this area are complicated by faulting. Nearby, map pattern and stratigraphic relationships indicate a regional unconformity overstep where the middle unit of the Pools Cove Formation directly overlies the Simmons Brook granite. Little structural significance is placed on this relationship and as stated by Widmer (1950) both formations are equally folded and faulted.

Most previous workers considered the Pools Cove conglomerate to be of early Paleozoic (Ordovician) age (White, 1939, 1940; Widmer, 1950; Smith and White, 1954; Anderson, 1965). This consideration was based mainly upon the erroneous interpretation that the Pools Cove Formation was intruded by the Simmons Brook granite. The information presently available suggests that the formation is Devonian and that it was deposited between intrusive episodes of the Acadian Orogeny. It is therefore interpreted as a synorogenic alluvial fan.

Mafic Intrusions

A wide variety of small mafic intrusions occur throughout the map-area; only a few of these are shown on the geological map and no serious attempt was made to subdivide or properly classify these rocks. Some are northwest-trending dykes of Devonian age and are discussed in a later part of this report. Another group of mafic intrusions have been mapped separately, where practicable, and designated unit 10. They occur as northeast-trending dykes and sills, and as small plugs, and cut only Cambrian and

older rocks. Although also probably Devonian in age, it is equally possibly that they are older. Most occurrences are confined to the relatively incompetent and deformed Youngs Cove Group at Cinq Islands Bay and the northeastward continuation of this belt at Southeast Bight of East Bay. A diorite plug, or discontinuous sill, occurs at Maggoty Cove of Corbin Bay. There are a few small mafic intrusions at Long Harbour.

The occurrences at Cinq Islands Bay and northeastward are dark green gabbroic and ultramafic rocks. The five islands of Cinq Islands Bay are composed of medium-grained massive gabbro and similar rocks constitute two small plugs toward the southwest. Some of these rocks are buff to brownish weathering and are deficient in plagioclase. They appear to be olivine-bearing pyroxenite or peridotite. At Southeast Bight of East Bay dark green, altered gabbroic silts are sheared parallel to the regional clevage.

The Maggoty Cove occurrence consists of fine-grained diorite that has plagioclase phenocrysts up to 1/4 inch in length in its central part. The rock bears little resemblance to the Cinq Islands intrusions although included in unit 10a.

Two small mafic sills and another much larger one occur within the Andersons Cove slates of the Long Harbour Syncline. On the opposite side of Long Harbour a tear-drop-shaped intrusion near Tickle Beach is more silicic than the sills and is a medium-grained massive dark pink diorite.

The Cinq Isles Formation is thermally metamorphosed where adjacent to the mafic intrusions at Cinq Islands Bay. Granitic dykes (unit 15) are common and cut both the mafic intrusions and the Cinq Isles Formation. The dykes do not have noticeable contact metamorphism associated with them elsewhere suggesting that the metamorphism in the Cinq Isles Formation may have resulted through the emplacement of the nearby mafic intrusion (unit 10). If so, then the intrusions are post-Cinq Isles Formation and most likely of Devonian age.

DEVONIAN

Ackley Batholith

Definition and Extent

The term 'Ackley' was proposed by White (1939, 1940) for the large batholith that constitutes the northern part of the Belleoram (Rencontre East) map-area. The name was first applied to the granite exposures at the Ackley City molybdenite prospect in the north-central part of the map-area at Rencontre Lake. Subsequently, the term was used by Bradley (1962) for the eastward extension of the batholith into the Terrenceville and Gisborne Lake map-areas, and by Jenness (1963) and Williams (1968) who mapped and described similar granites that form an almost continuous belt that extends to the northeast coast of Newfoundland at Bonavista Bay. Southwest of the map-area several smaller granite bodies have been referred to as Ackley granite (Widmer, 1950). The Ackley Batholith intrudes the Belle Bay Formation along its southern contact and the Rencontre Formation along its western boundary.

Lithology

The Ackley Batholith is composed of homogeneous pink granite that is medium- to coarse-grained massive. Its main constituents are pink potash feldspar (commonly perthitic), quartz, plagioclase, and biotite. Mafic minerals are sparse in places and the rock has been termed alaskite (White, 1939, 1940; Smith and White, 1954). Modal analysis of typical Ackley granite within the map-area is as follows (Smith and White, 1954); perthitic orthoclase- 40 per cent, quartz- 27 per cent, albite-oligoclase- 25 per cent, biotite (and minor chlorite)- 7 per cent, and accessory minerals- 1 per cent. The alaskitic varieties consist of quartz- 40 per cent, perthite- 34 per cent, albite- 26 per cent, and minor biotite, chlorite, muscovite, magnetite, allanite, sphene, apatite, and zircon. The perthite and albite are both pink and are difficult to distinguish in hand specimen. Thin section study indicates local alteration but commonly in hand specimen the rocks are fresh-appearing and biotite, where present, is relatively unaltered.

Alaskitic varieties are abundant along the southern contact of the batholith and this rock type is apparently gradational with more biotite rich phases toward the north. Aplite also occurs along the southern margin of the batholith in an irregular zone adjacent to the contact on both sides of Rencontre Lake. Molybdenite prospects at the periphery of the batholith are thought to be related to this aplitic phase of the intrusion (White, 1940). The aplite is most abundant within embayments in the contact zone where the batholith has intruded volcanic rocks of the Belle Bay Formation (Smith and White, 1954). The rock grades into compositionally similar alaskitic phases of the batholith.

A small plug of miarolitic medium- to fine-grained pink granite occurs on the east side of Belle Island where it cuts sandstones of the Rencontre Formation. It is thought to be a fine-grained phase of the Ackley granite and contains calcite, chalcopyrite, and molybdenite in the miarolitic cavities.

The Ackley Batholith is surrounded by a thin thermal metamorphic aureole which rarely exceeds 1/4 mile in width which is surprisingly narrow compared to the size of the intrusion. Thermal metamorphic effects are most apparent in the sedimentary rocks of the Rencontre Formation and Youngs Cove Group where original purplish red and grey sandstone, siltstone, and shale have been converted to dark grey to pale purplish, hard, cherty hornfels. Within the aureole of the granite northeast of East Bay it is impossible to separate rocks of the Rencontre Formation from those of the overlying Youngs Cove Group.

At Isle à Glu Pond, mafic volcanic rocks of the Belle Bay Formation have also been converted to black hard hornfels near the granite contact. Corresponding thermal metamorphic effects are not noticeable in the nearby silicic volcanic rocks.

The Ackley granite within the map-area is mainly equigranular. North of the map-area the most characteristic and abundant rock type within the batholith is coarse-grained porphyritic biotite granite locally with twinned tabular perthitic feldspar phenocrysts up to several inches in length. Boulders identical to this type of granite are common in the Pools Cove Formation.

Age

The Ackley Batholith is considered to be of Devonian age for it has yielded several isotopic dates in the order of 360 million years north of the map-area (Jenness, 1963; Wanless, et al., 1965). In addition boulders of granite similar in all respects to the Ackley granite of the map-area occur within the Upper Devonian Great Bay de l'Eau Formation.

Widmer (1950) delineated several smaller granitic intrusions in the Hermitage map-area to the west, which he correlated with the Ackley Batholith. One of these clearly cuts the Simmons Brook Batholith and another cuts the Pools Cove conglomerate. None of the intrusions cut the Great Bay de l'Eau Formation (Widmer, 1950). They are considered to be Devonian but those that cut the Pools Cove Formation are younger than the coarse-grained porphyritic granites of the main Ackley Batholith that occur as boulders within the Pools Cove Formation.

Great Bay de l' Eau Formation

Definition, Distribution, Thickness

The Great Bay de l'Eau Formation was named by Widmer (1950) in Hermitage map-area. The single occurrence at Corbin Head Promontory in Belleoram map-area was earlier named the Smiths Hole Conglomerate (White, 1939) but this name has been dropped (Smith and White, 1954). The formation was earlier described by Murray (1870), Dale (1927), and Taylor (1940), (in Widmer, 1950). It is the least deformed of all layered rocks within the map-area and consists entirely of conglomerate. Beds generally strike parallel to the shoreline of Corbin Head Promontory and dip gently to moderately inland, forming an open synclinal structure. At least 500 to 1,000 feet of strata are exposed in the cliffs of Corbin Head Promontory.

Lithology

The Great Bay de l'Eau Formation consists of poorly bedded purple to red, grey, and buff cobble and boulder conglomerate. Clasts within the rock are in most cases similar to immediately underlying rocks so that the appearance of the formation changes markedly where it overlies contrasting rock types. The conglomerate is not highly indurated and in this respect resembles conglomerates of the Pools Cove Formation.

Along the west side of Corbin Bay to Cinq Islands Head the conglomerate is red and made up almost entirely of angular clasts of purple and red micaceous sandstone typical of the underlying Rencontre Formation. Also present are resistant fragments of pink to grey quartzose sandstone and quartzite. The matrix of the rock is a coarse sandstone composed of mineral grains and sedimentary rock fragments that are much more rounded than the larger clasts. Bedding is obscure but is apparent locally as one-foot-thick finer-grained horizons. Most of the fragments within the conglomerate are from 1 inch to 5 inches long and 1/2 inch to 2 inches wide. A few reach 1 foot in length. All are tabular-shaped and aligned parallel to bedding.

White quartzite pebbles are conspicuous in the rocks at Corbin Head, and between Cinq Islands Head and Shine Cove grey to pink, well-rounded

limestone boulders form prominent clasts. The limestone boulders reach two feet in diameter and are typical of the Cinq Isles Formation.

At Shine Cove the conglomerate is grey where it contains numerous fragments of the underlying shales and siltstones of the Youngs Cove Group. South of Shine Cove it is more indurated and includes a wider variety of fragments including volcanic rocks, Ackley granite, quartz, and foliated muscovite granite. Granite fragments increase in abundance toward West Brook and the matrix of the rock becomes typically arkosic. This type of conglomerate is very similar to parts of the Pools Cove Formation.

Age and Relationships

The Great Bay de l'Eau Formation overlies the Rencontre Formation and the Youngs Cove Group with marked angular unconformity. The contact with the Rencontre Formation is clearly displayed 1/2 mile southwest of Corbin Head, 2 miles southwest of Corbin Head, and on the west side of Corbin Head Promontory 1 mile southwest of Cinq Islands Head. At all localities the Rencontre Formation is moderately to steeply dipping and it is overlain by subhorizontal to gently-dipping conglomerate beds of the Great Bay de l'Eau Formation. At Shine Cove and 1/4 mile southwestward grey conglomerates of the Great Bay de l'Eau Formation overlie moderately to steeply dipping beds of the Youngs Cove Group.

The Great Bay de l'Eau Formation has black bituminous shale and dark grey siltstone interbeds on the southeast side of the entrance to Coombs Cove, Great Bay de l'Eau, southwest of the map-area. These beds contain numerous plant remains that have been identified by Erling Dorf as Protolepidodendron sp. and Eospermatopteris sp., forms typical of the Upper Devonian (Widmer, 1950). Samples collected for spore analyses are being investigated by M.S. Barss of the Geological Survey of Canada (1970).

The Great Bay de l'Eau Formation is intruded by the Belleoram granite (Widmer, 1950; Anderson, 1965; Ermanovics, et al., 1967) and cut by northwest-trending mafic and silicic dykes.

Statistical petrographic studies on the composition of detrital plagioclase in the conglomerate along the east and west sides of Great Bay de l'Eau indicate two distinct plagioclase types (Ermanovics, et al. 1967). One type closely matches in composition the average plagioclase of the Simmons Brook Batholith, - the other, the average plagioclase of a granite body to the west of Great Bay de l'Eau correlated with the Ackley granite (Widmer, 1950). As mentioned previously, the conglomerate on the west side of the bay more closely resembles the Pools Cove Formation to the northeast than the Great Bay de l'Eau Formation on the east side of the bay. If the conglomerates on the west side of the bay are in fact Pools Cove equivalents, then the statistical petrographic results may be interpreted to suggest correlation between the Pools Cove and Great Bay de l'Eau Formations.

The Great Bay de l'Eau conglomerate probably represents an alluvial fan deposit and like the Pools Cove Formation, it accumulated between periods of granite intrusion during the Acadian Orogeny.

Belleoram Stock

The Belleoram Stock occupies the southwest corner of the map-area near Belleoram and outcrops along the western side of Chapel Island. The

stock intrudes the Long Harbour and Youngs Cove Groups toward the north, and southwest of the map-area it intrudes the Upper Devonian Great Bay de l'Eau Formation (Widmer, 1950; Anderson, 1965; Ermanovics, et al., 1967). The areal extent of the intrusion outside the map-area is comparable to its extent within the map-area.

The Belleoram stock is composed of uniform grey to pink massive granite, formally named adamellite (Ermanovics, et al., 1967). The rock is medium grained and equigranular, with potash feldspar and plagioclase in roughly equal amounts. It has between 10 and 20 per cent mafic constituents and usually not more than 10 per cent quartz. Amphibole is the chief mafic mineral with lesser amounts of biotite, locally altered to chlorite. The Belleoram granite is broken by numerous steeply dipping, closely spaced joints and in most places displays a subhorizontal sheeting.

The most characteristic feature of the Belleoram granite is small dark inclusions from less than one-quarter inch to two inches or more in diameter and consisting mainly of plagioclase and amphibole. The inclusions are ubiquitous. In the contact zones some are sharp and angular but in the central part of the stock they are more recrystallized with less distinct boundaries. They have been interpreted as partly digested shale fragments derived by stoping of the surrounding country rock (Ermanovics, et al., 1967). Their ubiquitous nature and small size however, combined with the absence of significant intrusion breccia at the granite contacts, suggests explosive brecciation, rather than stopping, preceded granite emplacement.

The Belleoram granite has been dated isotopically at 400 and 342 million years (Wanless, et al., 1965, 1967), and because it intrudes the Upper Devonian Great Bay de l'Eau Formation, then the age is most probably Late Devonian. An Early Carboniferous age is also possible, but the absence of granitic intrusive activity within the Carboniferous elsewhere in Newfoundland, favours a Late Devonian assignment. The Belleoram stock also cuts Ackley granite (Ermanovics, et al., 1967) so that it is the youngest of all granitic intrusions within the general area. Because the Upper Devonian intrusion cuts gently dipping Upper Devonian rocks toward the south, then the intrusion must have been emplaced at a very high level within the crust.

The Belleoram stock, although a high-level intrusion, has a fairly wide and well-developed thermal metamorphic aureole bordering its steeply dipping northern contact. The aureole varies in width from 1,000 to 3,000 feet and is comparable to that developed around the much larger Ackley Batholith. Where the aureole is much wider at the western edge of the map-area, the thermal metamorphism may represent the combined effects of both the Belleoram Stock and nearby Ackley granite. Within the aureole the country rocks have been baked into dark grey hard cherty hornfels. Southwest of the map-area, the contact between the stock and the Great Bay de l'Eau Formation is planar and dips a mere 4 degrees toward the south. This contact is gradational but the conglomerate has not been affected chemically beyond a few hundred feet from the intrusion (Ermanovics, et al., 1967).

Dyke Rocks (Units 14 and 15)

A variety of dykes of unknown affinity and relative age occur throughout the map-area. They are more common toward the west, especially along the coastline between Belleoram and North Bay. Almost all trend north-

northwest and are steeply dipping or vertical. They vary in width from a few feet to a few tens of feet, rarely exceeding 50 feet. One dyke south of Cinq Islands Bay can be traced intermittently for more than 1/2 mile and another at Barrow Rock appears to extend 3,000 feet to the shorelines on the opposite sides of the strait between Bob Head and Long Island. The dykes range in composition from basic to intermediate to acid with the more acid varieties being most abundant. Several types, ranging from basaltic to granitic, cut the Upper Devonian Great Bay de l'Eau Formation and porphyritic composite granitic dykes cut the Belleoram granite at Chapel Island. Smith and White (1954) reported rhyolite dykes cutting the East Bay Fault (Spyglass Cove Fault) at Spyglass Cove of Cinq Islands Bay.

Composite dykes are most common, composed of reddish rhyolite porphyry in their central parts bordered by dark green dacitic marginal zones. Examples are well exposed along the west shore of Corbin Bay where one such dyke crosses the Rencontre-Great Bay de l'Eau unconformity. Others occur at Chapel Island, on Barrow Rock and nearby headlands and islands, and in Cinq Islands Bay. The dykes are from 10 to 30 feet wide with the symmetrical green outer zones rarely exceeding 2 to 3 feet in width. Porphyry of the central part of the dykes has euhedral phenocrysts of bright orange feldspar from 1/8 to 3/16 inch in diameter, set in a finer grained matrix. The marginal dacites show fine-grained chilled margins against the country rocks and are commonly amygdaloidal, with quartz and/or chlorite and epidote being the commonest vesicule filling. The porphyry has inclusions of dacitic marginal phase from less than 1 inch to a maximum of 1 foot in diameter. In a few places the porphyry is miarolitic at its borders, with quartz and calcite lining the cavities. On the west shore of Corbin Bay several small dykes, from 1 foot to 3 feet wide, are composed entirely of dacite and lack a rhyolite interior zone.

Other granitic and rhyolitic dykes within the area lack darker marginal zones. Examples occur to the southeast of Landing Cove and southwest of Cinq Islands Bay. Chemical analyses of granitic dykes are given by Smith and White (1954) and Ermanovics, et al., (1967).

A small plug-like intrusion surrounded by fragmental rocks is well-exposed in a vertical cliff face on the west side of Farmers Cove, Chapel Island. The plug is several hundred feet wide and is composed of buff to greyish pink rhyolite. The rhyolite has phenocrysts of quartz and feldspar that are 1/8 inch in diameter or less, set in a fine-grained matrix. Flow banding is visible locally and prismatic mafic minerals are aligned parallel to the banding. Several hundred feet of fragmental rocks border the intrusion on its south side and similar rocks occur locally at its northern boundary. The fragmental rocks are unbedded and chaotic with angular fragments. Most are red micaceous sandstone from the surrounding Rencontre Formation, others are grey and green sandstone, dark purple crystal tuff, and quartz-feldspar porphyry. Some of the rocks at the intrusive contact have an obvious volcanic matrix, but farther from the contact the matrix is fragmental and some of the rocks resemble sedimentary breccias. Their local occurrence around the Farmers Cove plug indicates that they are related to igneous processes of brecciation and explosive activity during rhyolite emplacement.

Dykes of intermediate composition are also widespread. Examples occur at the southwest and northeast ends of Long Island, south of Belleoram, and near Turnip Cove. These are medium grained, grey to pink porphyritic trachytes and andesites. Feldspars form the largest phenocrysts, rarely

exceeding 1/4 inch in diameter, and somewhat smaller prismatic amphibole crystals are commonly present. Green epidote alteration is apparent in some varieties.

A green quartz diorite dyke cuts the Pools Cove Formation at East Bay Head. It has quartz amygdules in its central zone and the dark green dyke is in turn cut by small purple dykes from 2 to 3 inches wide. The latter have aphanitic chilled margins about 1/4 inch wide and porphyritic interiors containing numerous small elongate plagioclase phenocrysts.

Two brownish weathering lamprophyres, each 2 to 3 feet wide occur at the shoreline of Long Harbour about one-half mile north of Andersons Cove. The rocks are medium- to fine-grained, noticeably heavy, and contain visible biotite flakes. Similar rocks in northeast Newfoundland have yielded Mesozoic radiometric ages (Williams, 1969).

STRUCTURAL GEOLOGY

The map-area is comprised of three contrasting structural belts separated by the northeast-trending East Bay and Hermitage Faults. The eastern belt includes most of the map-area and is underlain by the Long Harbour and Youngs Cove Groups. These rocks have been folded, faulted, cut by granite intrusions, and locally unconformably overlain by the Upper Devonian Great Bay de l'Eau Formation. The central belt, between the Hermitage and East Bay Faults, is underlain by the Simmons Brook Batholith and an unconformably overlying monoclinal succession comprising the Cinq Isles and Pools Cove Formations. The western belt, northwest of Hermitage Fault, is underlain by structurally complex crystalline rocks that are sharply contrasted with the relatively unmetamorphosed rocks to the east.

Eastern Belt

North of Belle Bay rocks of the eastern belt are involved in upright folds with northeast-trending, gently plunging axes. Most of the folds are relatively open and plunge southwestward, e.g. Mal Bay, Hoop Cove, and Long Point Synclines. The Long Harbour Syncline is a much tighter fold with moderately to steeply dipping limbs but gentle plunge. The Femme Syncline is a broad depression with gently dipping limbs and a gentle northeasterly plunge. These folds are cut by high angle faults which roughly parallel the fold axes. The Mal Bay Syncline is truncated to the east by the Mooring Cove Fault, the Hoop Cove and Long Point Synclines are separated by a northeast-trending fault near Long Cove, and the axes of both the Long Harbour and Femme Synclines have been displaced by faults. Structural discontinuity indicates that Long Harbour must mark the course of a major fault, probably a continuation of the fault separating the Hoop Cove and Long Point Synclines. Most of the faults have a left-handed strike separation, e.g. faults near Northwest Cove, Keeping Cove, and Lakes Cove; a few others have right-handed strike separation, e.g. faults near Doctors Harbour and Big Conne.

The nature of movement along the fault that separates the Youngs Cove Group from the Belle Bay Formation at East Bay is unknown. The fault is exposed in two northward-draining brooks. The fault plane dips 70 degrees southeastward at one locality and is nearly vertical at the other. Because

the fault separates probable older rocks to the south from those interpreted to be younger to the north, then the south side moved upward, indicating a high angle reverse component of movement.

Between Chapel Island and Cinq Islands Bay the rocks or the eastern belt are more tightly folded and are repeated by high angle reverse of thrust faults. Rocks of the Long Harbour Group at Long Island form a moderately northeast-plunging anticline with the western limb of the corresponding syncline underlying Bob Head and Lord-and-Lady Island. Farther westward the rocks are repeated in fault bounded belts.

At Corbin Bay the Belle Bay volcanics are separated from underlying dated Cambrian strata of the Youngs Cove Group by a moderately southeast-dipping fault. The Cambrian shales near the fault are sheared and altered. The more competent overlying volcanic rocks are little affected. The stratigraphic relationships indicate that the fault is a thrust or moderately-dipping reverse fault that has brought the older Belle Bay volcanic rocks structurally above dated Cambrain strata.

Within the eastern belt axial plane cleavage is well-developed in the relatively incompetent Andersons Cove Formation but is rare in the volcanic rocks and represented by parallel open fractures in the coarse sandstones and pebble-conglomerates of the Rencontre Formation. At Rencontre Island the cleavage strikes consistently northeast and dips steeply northwest.

The East Bay Fault is a fundamental break for it separates two contrasting geological terranes. The incompetent Cambrian rocks east of this fault are the most deformed rocks within the map-area and mafic intrusions are localized along this zone. Northeast of the map-area the East Bay Fault merges with the Hermitage Fault and the resultant fault extends for several miles into the Ackley Batholith (Anderson, 1965). The eastern belt was brought up relative to the central belt along the East Bay Fault, thus bringing into juxtaposition older rocks toward the east with younger rocks toward the west.

Central Belt

Within the central belt the Cinq Isles and Pools Cove Formations comprise a monoclinal succession that dips moderately to gently southeast. The dips steepen toward the Simmons Brook granite contact in the northwest. The rocks are essentially unfolded, except near Parsons Cove where the Pools Cove red basal conglomerate overlies the Cinq Isles Formation in a small westerly plunging syncline.

Faulting is prevalent in this central belt. The Cinq Isles beds at Tilt Point have been brought upward and northwestward to overlie younger Pools Cove conglomerates along a moderately southeast-dipping fault. This fault parallels the East Bay Fault and has the same sense of relative vertical movement. A prominent fault, marked by a topographic depression, separates the Simmons Brook granite from the Cinq Isles Formation at Bay du Nord and extends northeastward into the Simmons Brook Batholith. Several smaller faults are apparent on the peninsula between East Bay and North Bay.

The unconformity between the Simmons Brook granite and overlying strata is gently southeasterly dipping at Parsons Cove. West of North Bay it is steeply dipping and an irregular map-pattern at Salmon River results from imperfectly understood fault movements.

Western Belt

Only a few outcrops were seen in the western belt within the map-area. Much clearer coastal exposures to the west at Bay d'Espoir consist of banded porphyroblastic (feldspar) biotite granitic gneiss, garnet-sillimanite-biotite schist, garnetiferous muscovite leucogranite and pegmatite, and mylonite. These metamorphic rocks characterize the whole length of the eastern margin of the Newfoundland Central Mobile Belt (Williams, 1969) and west of the map-area they appear to grade upward into much less metamorphosed rocks of the Ordovician Baie d'Espoir Group (Anderson, 1965; Williams, in press). Along its entire length, the belt of metamorphic rocks is interpreted to be faulted against relatively unmetamorphosed rocks of the Avalon Platform toward the east (Williams, 1969). The Hermitage Fault marks this boundary in the map-area and separates the metamorphic rocks from the Simmons Brook granite to the south. Exposures or the fault plane west of the map-area indicate that the fault dips steeply northwest (Widmer, 1950). It is therefore interpreted as a high angle reverse fault of thrust that has brought strongly metamorphosed rocks upward and eastward over less metamorphosed rocks. A similar type of fault occurs at Little Bay West, Great Bay de l'Eau. It is northeast-trending, northwest-dipping, and has brought the Simmons Brook granite upward and eastward above younger conglomerates.

Orogenic History

Simple fold patterns in the eastern belt indicate that it was affected by only one period of folding which pre-dated the deposition of the relatively unfolded Great Bay de l'Eau Formation and probably accompanied emplacement of the Ackley Batholith during the Acadian (Devonian) Orogeny. Rocks of the central belt are chiefly unfolded, lack cleavage, and are deformed mainly by faulting. In contrast, the structural history of the western belt is complex and equivalent regionally metamorphosed rocks in northeast Newfoundland exhibit evidence of three phases of deformation that pre-dated the intrusion of Devonian batholiths (Kennedy, pers. comm.).

Three periods of granite intrusion are recognized within the map-area, separated by two periods of synorogenic clastic deposition. The age and effects of the oldest intrusion, the Simmons Brook granite, are unknown but subsequent to its emplacement it was uplifted, eroded, and unconformably overlain by the Cinq Isles and Pools Cove Formations. The Pools Cove conglomerates contain boulders of granite similar to granites correlated with the Ackley granite north of the map-area (Jenness, 1963; Williams, 1968). The Pools Cove Formation is also cut by granite correlated with the Ackley granite southwest of the map-area (Widmer, 1950). These relationships suggest that the Ackley granite was not emplaced in a single episode and that the Pools Cove Formation accumulated during separate episodes of intrusion. The Great Bay de l'Eau Formation was deposited still later, or possibly at the same time as the Pools Cove. It is the least deformed of all formations within the map-area. The final intrusive event was the emplacment of the Belleoram Stock, that cuts the Upper Devonian Great Bay de l'Eau Formation toward the south of the map-area (Widmer, 1950; Ermanovics, et al., 1967). Its emplacement was most likely during Lake Devonian, and apart from later dykes, this intrusion represents the final stage of Acadian igneous activity.

The age of the metamorphism in the Garrison Hills gneiss west of Hermitage Fault is unknown. The metamorphic rocks occur as boulders within the Cinq Isles conglomerates and outside of the map-area they are intruded by the Ackley granite (Anderson, 1965; Williams, in press). This indicates an Early Devonian or earlier age. The relative age of the metamorphism with respect to the age of the Simmons Brook granite intrusion is unknown.

ECONOMIC GEOLOGY

The most important mineral occurrences within the map-area are molybdenite deposits in the vicinity of Rencontre Lake. These deposits were investigated intermittently over a period of about 40 years. One of the prospects, that at Wylie Hill, is presently being drilled by Norlex Mines Limited.

Fluorite occurs in a few widely separated localities. Several small occurrences were trenched at Lobster Cove of Long Harbour. Fluorite is a common associate of the molybdenite mineralization. A small occurrence of miarolitic granite at Belle Island has chalcopyrite and molybdenite in its cavities, and disseminated galena and chalcopyrite occur locally in mafic volcanic rocks west of Mal Bay.

Molybdenite

Four molybdenite deposits are known at or near the southerly dipping margin of the Ackley Batholith, two on each side of Rencontre Lake. These are from west to east, the Motu, Ackley City, Crow Cliff, and Wylie Hill deposits. The only occurrence that is unrelated to the Ackley Batholith contact is near Spout Brook about two miles north of Rencontre Lake. All were studied in detail by White (1939, 1940) with emphasis on mineralogy, paragenesis, and origin. The following account is based mainly upon this earlier work.

The distribution of molybdenite shows a close relationship to the distribution of the aplitic and alaskitic border phases of the Ackley Batholith. The richest mineralization is in aplite, but alaskite also contains mineralization near mineralized aplite. Most of the aplite is concentrated in three broad embayments along the margin of the batholith in the vicinity of the Motu, Rencontre Lake, and Wylie Hill deposits. Each embayment contains smaller zones of mineralization adjacent to the contact with the Belle Bay volcanic rocks. However, many aplites contain no molybdenite, particularly where they are far removed from the contact. The deposit north of Rencontre Lake differs from the others for the molybdenite occurs in association with quartz veins within the granite. The Ackley City deposit was reported as the most promising and has received much of the development work. The Wylie Hill deposit is larger, but is of considerably lower grade.

The Ackley City deposit has disseminated molybdenite in altered aplite. The deposit is at the contact with the Belle Bay Formation on the west shore of Rencontre Lake. The mineralized zone is lens-shaped and about 140 feet long. It contains numerous patches of greisen-like alteration with quartz, muscovite, molybdenite, fluorite and chlorite distributed

throughout the rock. Stripping and blasting have been carried out for some 800 feet along the granite contact on the steep western shore of Rencontre Lake. An adit leads to about 250 feet of drifts and cross-cuts and there is a shaft near the lakeshore from which 650 feet of underground work was conducted more than 35 years ago.

The Wylie Hill deposit consists of two mineralized areas, each about 1,200 feet long by 400 feet wide. Both are at the Ackley Batholith-Belle Bay contact. The mineralization occurs in aplite that has a distinguishable boundary with nonmineralized alaskite. The aplite is characterized by closely spaced joints compared to the more openly jointed alaskite nearby. About 1,000 feet of trenching through shallow overburden was carried out on the Wylie Hill deposit up to 1954. The deposit is presently being investigated by Norlex Mines Limited and over 8,000 feet of diamond drilling was carried out during the summer of 1969.

At the Motu prospect five surface trenches, each about 100 feet long, were cleared across the granite-aplite contact. Molybdenite occurs sparingly as disseminations within the aplite and fine-grained granitic rocks (Smith and White, 1954).

The Crow Cliff showing is in coarse pegmatite that contains coarse-grained molybdenite and euhedral quartz crystals up to one foot in diameter. The pegmatite trends northerly and has an average width of 3 to 5 feet (Smith and White, 1954).

White (1940) has emphasized the spatial distribution of molybdenite mineralization and aplite as an unusually clear case of a genetic relationship between mineralization and associated igneous rocks.

Fluorite

Some prospecting has been carried out on fluorite showings near Lobster Cove and between Andersons Cove and Stones Cove at Long Harbour. Most occurrences are small and few of the test pits and trenches presently contain visible mineralization. All of the showings are in silicic volcanic rocks of the Belle Bay Formation. Most occurrences are between Long Harbour and Conne where fluorite occurs along joint surfaces or within narrow breccia zones.

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