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30 N/14 and part of 30 N/15 W½

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By

B.A. Liberty

DEPARTMENT OF

MINES AND TECHNICAL SURVEYS

CANADA

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BELLEVILLE AND WELLINGTON MAP-AREAS, ONTARIO

INTRODUCTION

The map-area lies between 77° and 77°30' W long. It embraces the Belleville and Wellington sheets (National Topographic Series 31 C/3 and 30 N/14 respectively) and two small addenda from adjacent sheets to the east (30 N/15 and 31 C/2). The nature of the bedrock surface is known in considerable detail because of the thinness of glacial drift, the great amount of outcrop and extent of bedrock-controlled areas, and because of the numerous quarries and pits.

The land surface is largely bedrock controlled throughout the area and presents a typical 'escarpment-and-plain' topography. Most of the escarpments reflect the underlying stratigraphy, but in one or two places, as for example near Picton, faults are also involved.

STRATIGRAPHY

The bedrock formations are of Middle Ordovician age, except for three small Precambrian inliers. The Ordovician stratigraphic units—here designated as map-units 2 to 7—lie within the Blackriveran (Kay, 1960)[1] and Trentonian stages. In ascending order, they correspond to certain units to the west (Liberty, 1953), as follows: map-unit 2, Pamelia-Lowville; map-unit 3, Leray; map-unit 4, Rockland-Hull; map-unit 5, Sherman Fall; and map-units 6 and 7, Cobourg. Correlation inferred by use of these names is tentative only.

Map-units 2 to 7 are rock units and have clear-cut, easily defined lithologic contacts. By detailed mapping these units have been traced from the Lake Simcoe district where they were defined (Caley and Liberty, 1952), westward into Manitoulin Island (Liberty, 1957), and eastward to the Trenton area (Liberty, 1960) and the present map-area. An estimate of the thickness of the Black River - Trenton grey-carbonate sequence within the Belleville-Wellington area is 900 feet. The black shale of the Collingwood probably occurs about 100 feet above the stratigraphic limit of the Wicked Point section of map-unit 7.

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[1] Names and dates in parentheses refer to publications listed in the References.

PRECAMBRIAN

Precambrian strata occur only in three inliers, or monadnocks, within the map-area. One of these, 2 1/2 miles northeast of Ameliasburg, consists of red and maroon granite. The other two are within 2 miles northwest of Shannonville; the northernmost consists of fine crystalline dolomite, and the southernmost is composed of both red and maroon granite and conglomerate. The inliers indicate a varied lithology of the Precambrian rocks underlying the Ordovician rock cover.

MIDDLE ORDOVICIAN

Map-unit 2

Map-unit 2 in this map-area comprises Pamelia-Lowville strata of map-areas to the west. It contains lower, middle, and upper members, but the lower member does not outcrop in the map-area. The upper member includes the Moore Hill (Okulitch, 1938) and Chaumont (Kay, 1937, 1942; Young, 1943) units. The formation has been mapped near Foxboro, along the valley of the Salmon River, and at Point Anne.

The middle member is composed of brown and grey limestones of various textures and bed thicknesses. Included are fine-grained argillaceous limestone; fine, medium, and coarse granular limestones; fragmental and bioclastic limestones; and fine to medium crystalline, sublithographic and lithographic limestones. Beds are generally between 0.1 and 0.7 foot thick but some are 2 to 3 feet thick.

The upper member is composed of brown lithographic, sublithographic, and admixed fine granular limestone (calcarenite) and sublithographic limestone. Fine and medium granular (calcarenitic) limestone may also be present. This member weathers into both thin (0.1 foot) and thick beds. Nodules of black chert occur throughout the upper member. Map-unit 2 is about 175 feet thick; its middle and upper members are 65 and 40 feet thick respectively.

Important fossils of this unit are: *Tetradium cellulosum*, *Columnaria halli*, and *Stromatopora* sp., all in profusion in the upper member, and *Tetradium fibratum*, *Stromatocerium* sp., and orthocone cephalopods.

Map-unit 3

This unit comprises the strata designated as Leray (Caley and Liberty, 1952) to the west. It is traceable into the Coboconk

formation (Okulitch, 1938; Johnston, 1912). The unit outcrops in the same three localities as map-unit 2, and underlies the entire map-area.

The strata consist of the following rock types: grey, fine and medium granular (calcarenitic) limestones; brownish, soft, argillaceous, fine-grained limestone; brown, very fine crystalline limestone (calcisiltite); and minor, brown or grey, lithographic limestone. The beds weather steel-grey, smooth, and about 0.4 to 0.6 foot thick. Near Shannonville, however, a twofold subdivision can be made: thin (0.1 foot), crossbedded, bluish, fine granular and fine crystalline limestone (10 1/2 feet) underlies a light grey and pinkish grey, fine and medium granular calcarenite (11 1/2 feet) containing a large proportion of pink feldspar. These units can be traced over a considerable area. Map-unit 3 is about 20 to 25 feet thick.

Important fossils in this unit include: Tetradium cellulosum (which occurs in abundance), Tetradium fibratum, Columnaria halli, Streptelasma sp., Hesperorthis tricenaria, Triplecia cuspidata, Dalmanella rogata, Prasopora sp., Calapoecia canadensis, Receptaculites sp., Doleroides ottawanus, Solenopora compacta, Stromatopora sp., Stromatocerium sp., Phragmolites compressus, and Maclurites logani.

Map-unit 4

Map-unit 4 comprises strata designated as Rockland-Hull (Caley and Liberty, 1952) to the west. It can be traced westward into the Kirkfield Quarry where the unit occurs between 2 and 36 feet above the quarry floor in the northwestern corner. It outcrops at Point Anne and in the valley of the Salmon River, and underlies the entire map-area.

The calcarenitic content of these strata is not as great or as coarse as it is to the west, near Kirkfield. For this reason the formation appears as a denser unit in the Belleville area where it is predominantly brown, evenly textured, fine crystalline limestone, and brown, admixed fine granular and sublithographic limestone. These rock types occur in beds varying from 0.3 to 0.5 foot thick in fresh sections. They weather into thin and medium-thick, smooth, dark bluish beds. Prominent in the lowest strata are thin to thick (1/16- to 5/8-inch) partings of black 'shale' (black limestone) between beds (0.1 foot) of brown to dark grey, sublithographic limestone. These strata always appear soft and fossiliferous in weathered sections. Fine granular calcarenites may occur at irregular intervals, but sections are known in which they are absent. Map-unit 4 is about 18 to 20 feet thick.

Important fossils in this unit include: Dalmanella rogata (in profusion), Triplecia cuspidata, Receptaculites sp., Stromatopora sp., Stromatocerium sp., Columnaria halli, Solenopora compacta, and Gonioceras groenlandicum. A profusion of echinoderms is also consistently found in this unit. The 'Dalmanella beds' and 'Crinoid beds' of the early workers are embraced within this unit (Johnston, 1912).

Map-unit 5

This unit includes only those strata previously referred to as Sherman Fall by Caley and Liberty (1952) in the Lake Simcoe area. They are the 'Prasopora beds' of Johnston (1912). Only a middle part of this unit is the Sherman Fall formation of Kay (1937, 1942). Map-unit 5 outcrops extensively in Prince Edward county and underlies the entire map-area.

This unit is one of the most distinctive lithologic units of the entire Middle Ordovician carbonate sequence. It is a natural rock unit and is also the most fossiliferous in the map-area. It is typified by its alternation of limestone and 'shale'. The limestone is in the form of hard bands, 0.3 to 0.8 foot thick, of blue, fine and medium, crystalline limestone. The alternating beds of 'shale' in weathered sections are in reality beds of calcareous claystone. On fresh and protected faces, the claystone is sufficiently unweathered and resistant to be recognized as limestone. The lowest 30 feet of the map-unit contains important amounts of irregularly bedded claystone, commonly including thin beds of brown and dark grey sublithographic limestone. Thin friable shale partings result from the weathering of some of the claystone, which is interbedded in turn with bluish weathering, dark grey and blue sublithographic limestone, and brown, soft, argillaceous limestone. The lowest strata may contain important thick developments of bioclastic and fragmental limestones in which silicified fossils occur. The uppermost 10 to 15 feet in the unit, on the other hand, contains thin-bedded (0.05 foot), blue, fine crystalline limestone alternating with equally thin beds of calcareous claystone 'shale'. The map-unit is at least 350 feet thick.

The abundant and varied fauna include: Cryptolithus tesselatus, Solenopora compacta, Columnaria halli, Receptaculites sp., Pasceolus globosus, Rafinesquina deltoidea, Hormotoma trentonensis, Hemiarges paulianus, Trematis ottawaensis, and Encrinurus cybeleformis. Prasopora sp. occurs abundantly almost throughout the map-unit, and Dalmanella sp. is equally abundant but is especially characteristic of the lowest strata. Two levels of echinoderm profusion are also persistent laterally; one in the lowest strata and a second in the highest strata of this unit. These levels of Prasopora, Dalmanella and echinoderm profusion have been traced eastward from the Lake Simcoe area.

Map-units 6 and 7

Map-units 6 and 7 include only the strata previously designated as Cobourg by Caley and Liberty (1952) in the Lake Simcoe district. They comprise 70 to 100 feet less strata than the Cobourg of Kay (1937, 1942). Within the present map-area these units outcrop extensively and underlie the surficial deposits. They are distinctive lithologic units of at least member status, and, for the purpose of this paper, they have been so designated: the lower member is map-unit 6 and the upper member is map-unit 7.

Map-unit 6 (lower member) consists of blue-weathering, blue, very fine crystalline to sublithographic limestone that is resistant, hard and brittle. These strata weather to thin (about 0.1 foot) beds that are pseudo-nodular—they contain irregularly shaped fragments of limestone that are more resistant to weathering than the surrounding argillaceous material. Lowest strata are sparsely fossiliferous, but an abundant fauna occurs higher in the unit. About 60 feet above the base is a 10-foot-thick section of grey, calcareous, fossiliferous claystone. An additional 30 feet of the blue, fine to sublithographic limestone overlies this claystone interbed; thus the total thickness of unit 6 is at least 100 feet.

Important fossils from this unit include: Rafinesquina deltoidea, Cyclospira bisulcata, Hormotoma trentonensis, Fusispira subfusiformis, Trochonema umbilicatum, and Pasceolus globosus.

Map-unit 7 (upper member) consists of grey calcareous claystone, which weathers nodular and rubbly, but in fresh and protected quarry faces where it occurs as massive 3-foot-thick beds, it is resistant and appears lithographic and sublithographic in texture. At intervals of a foot to 2 1/2 feet throughout, are thin (0.1 to 0.2 foot) beds of grey, fine crystalline and bioclastic, fossiliferous limestone. Map-unit 7 is soft and non-resistant; it is sufficiently argillaceous so that its rubble has been interpreted as gravel in most of the gravel pits marked within its bedrock belt. The limestone of unit 7 (calcareous claystone) weathers into thin (0.1 foot), irregular, rubbly and nodular beds enclosing thin irregular shale partings; these shale partings may comprise as much as 15 per cent of the section. Highest strata in map-unit 7 are the grey, sublithographic and lithographic limestones with thin 'wispy' shale partings that underlie the black shale of the Collingwood at most localities, e.g. Bowmanville (Liberty, 1953). Only the lower half of map-unit 7 is exposed in the map-area. As far south as the Wicked Point outcrop, the unit has attained only about 100 feet of its true stratigraphic thickness, which the writer estimates to be about 200 feet.

Important fossils in map-unit 7 include: Pseudogygites canadensis, Rafinesquina deltoidea, Cyclospira bisulcata, Hormotoma

trentonensis, Fusispira subfusiformis, Subulites elongatus, Trochonema umbilicatum, Pasceolus globosus, and Probillingsites primus. There is also a profusion of Dalmanella sp. within this unit, and at least one level of echinoderm abundance.

GLACIAL GEOLOGY

Most of the bedrock surface is concealed beneath a thin veneer of glacial drift. Two directions of glacial striae have been observed. The anomalous direction (315-335° azimuth) of striae in the Trenton and Port Hope areas (Liberty, 1960) has been recognized also at Belleville and Point Anne. These latter striae (277-282° azimuth) thus indicate some movement of ice out of the Lake Ontario depression in a westerly direction. Other striae are oriented 210 to 250° azimuth, which is the common direction in the Lake Simcoe-Kawartha Lake area. The striae are best preserved on strata of map-units 3, 4, and 5.

Drift is as much as 30 to 40 feet thick east of Belleville, northeast of Picton on the mainland, and near Wellington. Elsewhere it is between 2 and 10 feet thick.

Sand and gravel pits are numerous throughout the area. Most of the gravel pits indicated within map-unit 7 on the topographic map, are in reality bedrock quarries consisting of nodular limestone rubble. As in the Lake Simcoe area, there is a definite correlation in the present map-area between the increase in drift thickness and the more argillaceous bedrock formations. The latter may have slowed and impeded the progress of the overriding ice more than the massive, resistant but smoothed surfaces of map-units 2, 3, and 6.

The map-area embraces most of the Quinte and part of the Peterborough drumlin fields (Chapman and Putnam, 1951). The drumlins of the Quinte field are well displayed in the Wellington and Hay Bay areas. They are typified by their exceptionally long, narrow, and high character and by their equally tapered stoss-and-lee ends. A single esker extends southwest from Picton for about 4 1/2 miles towards Yeo Lake.

STRUCTURAL GEOLOGY

The regional striae of the stratigraphic units in the map-area is about east-west. Their dip is about due south at 20 feet per mile; this dip has been determined along the east-facing escarpment north of Picton, south of Roblin Lake, and in the Moira River at Belleville. At the last locality the gradient of the river is just less than the apparent dip of the bedrock. Structurally, the map-area is a

gently sloping terrace with a few small undulations (bearing about northeast), and some slight modifications caused by faulting.

Higher dips (up to 60°) occur in the strata that rest on the flanks of the Precambrian monadnocks north of Shannonville and near Ameliasburg. These are interpreted as initial dips that have been steepened locally by compaction of sediments, and by movements related to these Precambrian topographic highs. Relief of such features may be judged from the associated stratigraphy—the Ameliasburg inlier, for example, presents an estimated minimum relief of 450 feet. In the writer's opinion Precambrian highs are responsible for the configuration in the Foxboro and Point Anne areas. As the structure at the Point Anne quarry is synclinal, this site is not considered to be on the apex of the 'high', but rather on the south limb.

At Picton, normal faulting has occurred, presenting three steps or hogbacks with an overall 100 feet of throw. Map-unit 7 is downfaulted to the west so that it is at a considerably lower topographic level than unit 6 to the east. The faults can be traced southward where they separate and trend into or towards Spence Lake, Soup Harbour, and Point Petre. Stratigraphic offset decreases southward, suggesting a 'scissors' effect or a pinching out of the fault in that direction, probably indicative of active positive movement north of the Lake Ontario depression. Submarine contours north of Picton suggest that the Picton fault extends along most of Long Reach; stratigraphic evidence substantiates this suggestion.

ECONOMIC GEOLOGY

Sites of present economic activity in the area are the Picton north quarry (Lake Ontario Portland Cement Co.), the eastern quarry at Point Anne (Canada Cement Co.), and several smaller quarries such as at Bayside, Milltown, and Mountain View, which are operated by construction companies. These, and some of the more important but now abandoned quarries (see Goudge, 1938; Hewitt, 1960) are located in the following stratigraphic units:

Map-unit 7—Picton, Consecon, Huff Corners.
Map-unit 6—Mountain View, Lake Ontario Portland Cement Co.
Map-unit 5—Bayside, Milltown, Picton, Belleville.
Map-units 4, 3, 2—Point Anne.

Purposes for operations include: crushed stone, Portland cement manufacture, lime manufacture, pulverized stone for asphalt filler, and agricultural limestone.

The only noteworthy sand and gravel pits in operation are located as follows: east of Belleville, about 1 1/2 miles north of Point Anne (gravel); about one mile south of Hallowell station (sand); and about 1 1/2 miles south of Picton, in the esker (gravel).

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