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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PAPER 53-27

BURLEIGH FALLS AND PETERBOROUGH MAP-AREAS, ONTARIO

(Report and Two Maps)

By

C. G. Winder

OTTAWA
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Price, 50 cents

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BURLEIGH FALLS AND PETERBOROUGH MAP-AREA ONTARIO

INTRODUCTION

Location

Burleigh Falls and Peterborough map-areas lie between longitudes 78°00' and 78°30' west, and latitudes 44°15' and 44°45' north. They are crossed by east-west highways 7 and 36, and by north-south highway 28. The main line of the Canadian Pacific Railway and a branch of the Canadian National Railways pass through the city of Peterborough. The Kawartha Lakes are a principal centre of the important tourist industry of the region.

Previous Work

J. J. Bigsby (1829, p. 264)[1] mentions the occurrence of "horizontal limestone" in south-central Ontario, in a paper that contains an outline map showing, in part, the Kawartha Lakes. The information gathered by Alexander Murray, on his expeditions into "Western Canada" between 1840 and 1855 are summarized by Logan (1863), describing particularly the course of the Black River limestone escarpment. Wilson (1904, p. 157) refers to the prominent limestone cliff on the south shore of Deer Bay, and Johnston (1906a, 1906b, 1908) gave brief geological descriptions of the rocks of the region. Adams and Barlow (1910) recognized "Black River limestone" on the south shore of Stony Lake, and the limestone outliers north of the lake, detached from the main limestone mass.

More recently, Goudge (1938) published chemical analyses of the limestone of the Lakefield quarry and of an abandoned quarry northeast of Warsaw, Ontario. Kay (1942, p. 596) illustrated some of the stratigraphic sections measured in the Peterborough area, and mentioned (p. 630) the Lynch Rock and Galesburg inliers. Satterly's map (1943) of the Haliburton region shows the approximate location of some of the limestone outliers north of Stony Lake, and depicts the regional structure of the Precambrian rocks.

Nicholson (1875), Raymond (1921), and Sinclair (1944, 1948) have described fossils found in the map-areas.

Acknowledgments

J. R. Donaldson and F. C. Plet were student assistants during the summers of 1941 and 1952 respectively. Their assistance in the field and the willingness of many residents of these areas to supply useful information are gratefully acknowledged.

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[1] Dates, etc., in parentheses are those of references listed at the end of this report.

PHYSIOGRAPHIC FEATURES

The area occupied by Burleigh Falls and Peterborough map-areas can be divided, roughly, into three parts, each of which is distinguished by surface exposures of a different geological era. The northern part exposes abundant outcrops of Precambrian rocks, consisting chiefly of granite and granite-gneiss, with minor hornblende and mica schists, pegmatites, and white, crystalline limestone. The central part is underlain by Middle Ordovician limestones, exposures of which decrease greatly in number from north to south. In these two parts of the area mapped the topography is influenced by bedrock features. The southern part, however, is covered by Pleistocene glacial deposits, which obscure the bedrock almost completely except along the two south-flowing rivers, the Otonabee and the Indian. These deposits have been mapped, and are described in detail for the Peterborough map-area by C. P. Gravenor (1952).

The passage from the Precambrian to the Palaeozoic terrain is interrupted by eleven large and several small Ordovician outliers, which occur as far as 7 miles north of the continuous limestone outcrop. These outliers range in size from several miles in diameter to one 100 feet long, 10 feet wide, and about 3 feet thick. Their trend follows the general strike of the main mass of limestone.

In addition to observed outcrops, certain physical features permit deduction of the type of underlying bedrock:

(1) Trees on the Precambrian rocks are dominantly coniferous; on the limestone, they are deciduous.

(2) There are few farms in the Precambrian terrain, whereas even the small outliers support some farming.

(3) Viewed from a distance, hills of Precambrian rocks appear rounded because of the spalling peculiar to them, whereas limestone hills are flat-topped, with vertical cliffs at the edges. Round-topped Mount Julian, near Viamede on the north shore of Stony Lake, stands out in contrast to the flat-topped limestone outlier north of it.

(4) The rugged north shores of Deer Bay, Lovesick Lake, and Stony Lake are bordered by granitic and metamorphic Precambrian rocks, whereas the relatively smooth south shores are controlled by Palaeozoic limestone.

(5) Roads over limestone areas are usually straight, but those over the Precambrian terrain are normally sinuous.

(6) The land most commonly rises sharply where passing from Precambrian to Palaeozoic rocks, as seen along the highways south of Buckhorn (Hall's Bridge) and Burleigh Falls.

Because of these and other features, the areas underlain by

Precambrian and Palaeozoic rocks are distinct in air photographs, and in many places where the actual contact between such rocks cannot be accurately placed by ground traverses it is clearly defined on these photographs.

PALAEOZOIC GEOLOGY

ORDOVICIAN

The limestones of Burleigh Falls and Peterborough map-areas are Middle Ordovician. Lithological and faunal units, similar to those farther west in Ontario (Caley and Liberty, 1950) and to the east in New York (Kay, 1937 and Young, 1943), including the "Birdseye" limestone, "Columnaria" beds, "Dalmanella" beds, and "Prasopora" beds, are recognizable. The subdivisions of the map-units employed are essentially similar to those used by Caley and Liberty (1950) and by Liberty (1952), but their names, adopted from the standard Ordovician section in New York, are used tentatively because, although faunas and lithologies are apparently similar, direct correlation will have to be based on more extensive studies. In ascending order these named subdivisions are: 'Basal', Pamelia, Lowville, and Leray beds, all considered Black River units, and Rockland-Hull and Sherman Fall beds, regarded as Trenton units.

Black River

'Basal' Beds

A series of thin beds of mottled, green, calcareous and arenaceous sandstone, red to maroon shale, arkosic conglomerate, and greenish grey to maroon, fine-grained limestone containing fine quartz grains and angular feldspar particles, rests unconformably on the irregular Precambrian surface. Sandstone and shale compose most of the unit, and their semi-friable character tends to obscure their contact with the underlying Precambrian rocks. The greatest exposed thickness, in a road-cut on highway 28, 4 miles northeast of Burleigh Falls, is only 25 feet, but greater thicknesses probably occur elsewhere. The 3-foot bed of greenish grey, fine-grained limestone at the top of the section is considered part of the overlying unit. In this area, fossils have not yet been found in these basal red and green beds.

Pamelia Beds

Cultivation on a rolling surface underlain by Pamelia, and in part by 'Basal', beds results in small trapezoidal fields, which have a characteristic patchwork pattern in air photographs. The limestones of the Pamelia are of two principal types: both are noticeably brittle, breaking along plane or conchoidal surfaces; both occur in relatively thin (1- to 6-inch), regular beds; and both carry quartz sand along certain horizons. One type is represented

by a buff and dark brown, very fine-grained to sublithographic limestone, which weathers buff, brown, orange-brown, and light yellow-brown. Stylolites, pyrite crystals, 'calcite spots', and glauberite crystal impressions (Young, 1943, Pl. I, fig. 2) are common. Black, 'shaly' material occurs as partings along highly irregular surfaces, and has a similar appearance to partings described by Stout (1941, p. 98) in the Upper Silurian Greenfield dolomite of Ohio, in which the mineral celadonite has been found. The other type is represented by a more resistant, dark greenish yellow, very fine-grained limestone weathering drab-yellow, with a few thin beds of lithographic limestone; such limestone is well exposed in the small quarry 2 miles northwest of Burleigh Falls, where mud-cracks occur at an horizon on the quarry floor. Nodules of crystalline calcite, and calcite vugs up to 4 inches in diameter, are prominent features of these resistant beds, and in the Burleigh quarry some of the vugs are filled with white gypsum. Fine gypsum sand has also been found in the residue of Pamelia limestone dissolved in hydrochloric acid. On the south shore of Pidgeon Lake, one section included three thin beds of yellow lime detritus. Wherever these resistant beds are exposed at the surface, they develop a bench covered with slabs of the drab-yellow limestone. Many of the cottages on the south shore of Deer Bay Reach, Lovesick Lake, and Stony Lake rest on this bench.

Fossils are comparatively rare, and are restricted to fragments of the trilobite Bathyurus and ostracod shells. The Pamelia does not appear to be more than 25 feet thick.

Lowville Beds

The base of the Lowville is placed at the lowest occurrence of green shale interbedded with calcareous sandstones and thin beds of limestone. Beside the highway 1 mile south of Burleigh Falls, these green shales contain many individuals of the ostracod Isochilina measuring up to 12 mm. in length. The lower part of the Lowville is thinly bedded (1 inch to 3 inches), but usually poorly exposed because of the overlying massive beds. Sixteen feet of these thin beds are exposed in a road-cut near the schoolhouse on the highway half-way between Burleigh Falls and Buckhorn. There, stylolites, quartz grains up to 1/4 inch, and calcite and pyrite crystals are common. Other localities expose fine conglomerate, with pelmatozoan debris, and black, 'shaly' beds. Fossils are rare. In both the thin-bedded and overlying massive sections, the Lowville is dove-toned, light to dark brown, or buff, sublithographic to very fine-grained limestone, weathering light to dark grey and white; it breaks with an irregular fracture. The massive sections contain some stylolites, pyrite crystals and associated pink zones, a few beds with quartz sand, and thin beds of grey shale; calcite grains and calcite-filled tubes (Phytopsis) are abundant; black chert nodules are rare; and in places the rock has a petroliferous odour. Fossils are restricted almost exclusively to the upper part of the massive section; the most common forms are the corals Tetradium

cellulosum and T. fibratum; the nautiloids Actinoceras, Spyroceras, and Michelinoceras; small brevicones, numerous gastropods, some brachiopods and trilobites, pelmatozoan columnals, and occasional cup corals. The greatest measured thickness was 35 feet on the south shore of Deer Bay.

Leray Beds

The Leray consists of grey and brownish grey, fine- to medium-grained limestone, weathering dark or bluish grey. In the upper part it has a more granular appearance, with zones of coquinite and pisolites, and weathered surfaces show rude bedding. On irregularly broken fresh surfaces, some faces are weathered rusty, and the rock disintegrates in time to a rubble. Irregular nodules of black chert in places form interrupted beds. There is no apparent regular distribution of the chert except that it is rare in the upper third of the Leray beds.

The character of the contact between the Leray and Lowville limestones is variable, as indicated in the following observations:

(1) In a pit on the west side of the highway 1 1/2 miles south of Burleigh Falls, a glaciated surface shows a strikingly sharp contact between the light-coloured Lowville, the upper surface of which appears to be covered with deep (3-inch) solution pits, and the dark-coloured Leray, which fills the pits.

(2) In a small highway road-cut 2 miles northwest of Buckhorn, the light-coloured Lowville passes imperceptibly into the darker coloured Leray, with a corresponding change in fossil content. Only close examination reveals this change.

(3) Near the top of a cliff on the southeast shore of Deer Bay, a 9-inch band of typical Leray rock containing the stromatoporoid Stromatocerium occurs below an 8-foot massive bed of typical Lowville rock. A similar relation was observed in the section along Indian River just north of Warsaw, Ontario. This particular section was illustrated by Kay (6, p. 596), who correlated it with the Chaumont (Leray?) because of a clay zone. In this section the Lowville-Leray contact is placed at the base of the lowest granular limestone bed with the Lyopora fauna.

The outstanding feature of the Leray beds is their massiveness, resulting in small cliffs formed mainly by the lower part of these beds. In most places they carry only a very thin soil cover, and land use is restricted almost entirely to pasture. Flat exposures of these beds are crossed by numerous joints, which have been widened by solution; the association of common sumac and poison ivy growing in these joints is occasionally of use in locating outcrops.

The map-unit to which the term Leray is applied can be divided into three zones on a palaeontological basis. The lowest part, referred to by earlier authors as the Columnaria beds, carries numerous specimens of the coral Lyopora, together with Stromatocerium, Tetradium fibratum, Actinoceras, Endoceras, brachiopods, trilobites, and bryozoa. The middle zone is marked by the small colonial coral Calapoecia, and by the gastropod Maclurites. The highest zone contains Receptaculites. Some authors (Kay, 1942, p. 598) consider this last zone to be the lowest Trenton; others have referred to it as " transition beds". Because of its lithological similarity to the lower Leray and because there is no perceptible break in the sequence, it is considered here as part of the Leray limestone. Concerning these beds, Sinclair (1945, p. 74) wrote: "This great difficulty in deciding what is on which side of the line may be largely due to trying to draw a line where there is none in nature". More recently, Flower (1952, p. 25) wrote: "Beds currently classed as lower Trenton contain many survivors of Black River types which are unknown in overlying beds of middle Trenton age. The marked change in cephalopod faunas above rather than below the lower Trenton, suggests that a more natural grouping would result if these beds were classed with the Black River instead of the Trenton". This upper zone is very fossiliferous, and contains many forms that occur in lower horizons. A notable feature is that most of the fossils are broken or worn, and in places the rock is composed almost entirely of worn valves of the brachiopod Dalmanella. The residue of pieces dissolved in hydrochloric acid is principally dolomitized pelmatozoan columnals.

The thickness of the Leray, measured south from Pidgeon Lake toward Lakehurst, is approximately 40 feet. Actual contact with the overlying Trenton strata is not seen within the mapped area, but beds on either side of the contact can be seen close together just north of Lakehurst, on a side road 2 miles due south of Youngs Point, and along Indian River at the east road bridge, Warsaw, Ontario.

Trenton

Rockland-Hull Beds

The Trenton limestone terrain is excellent for farming as compared with that of the Leray. Furthermore, farms on upper Black River strata are consistently abandoned, with fences constructed almost wholly of grey weathered, upper Leray cobbles, with an occasional boulder of Precambrian rock.

The term Kirkfield is applied by some authors to the lower section of the Trenton group in south-central Ontario because of difficulties arising from the separate use of the terms Rockland and Hull in the Ottawa Valley (Sinclair, 1942, 1952). The beds are poorly exposed throughout the area mapped. The lower part (mainly Rockland beds) as seen along Indian River at Warsaw, south of

Youngs Point and north of Lakehurst, is a dark brown and brown-grey, fine- to coarse-grained limestone in thin regular beds, marked by rusty weathering. Fossils are usually abundant, including the brachiopods Dalmanella, Strophomena, Rafinesquina, and Sowerbyella; some beds are filled with macerated fossil debris. The upper part of the section (mainly Hull beds) as seen below the road bridge at Lakefield, Ontario, is a resistant, fine-grained, brownish grey limestone in regular, 6-inch beds that break out in huge slabs. Fossils are scarce. The combined thickness is approximately 60 feet, as calculated by the regional dip from exposures in the vicinity of Lakefield. Two miles northwest of Lakehurst, a poorly exposed section, with coquinite at the base and much pelmatozoan debris at the top, measures 58 feet above the Leray Receptaculites Zone.

Sherman Fall Beds

The base of the Sherman Fall is exposed in contact with the underlying Hull beds below the road bridge at Lakefield, Ontario. There, alternating thin beds of grey calcareous shale, weathering greenish and containing large numbers of the bryozoan Prasopora, separate thin beds of grey and grey-brown, fine- and medium-grained limestone with a large brachiopod fauna. In general the Sherman Fall contains abundant fossils, mainly brachiopods and trilobites. The bedding is irregular and undulating in places. In the Lakefield quarry the rock is not as argillaceous, and the top of the 40-foot quarry face is approximately 100 feet above the base of the Sherman Fall, as exposed along the river at Lakefield. The rock in the quarry on highway 28, 4 miles north of Peterborough, contains less shale than the Lakefield quarry although the fauna appears similar. As mentioned by Sinclair (1945, p. 178), the fauna of this quarry contains many cystoids, and the limestone layers contain contemporaneous breccias, coquinites, and rounded and flattened pebbles. This quarry is estimated to be 60 feet above the top of the Lakefield quarry.

Although outcrops of the Sherman Fall are almost continuous along Otonabee and Indian Rivers, a thickness for this unit cannot be measured because of a lack of recognizable marker horizons, and because the southerly dip of the beds is about equal to the gradient of the rivers. It is estimated, however, that the Sherman Fall is between 200 and 250 feet thick in Peterborough map-area.

Outcrops of the Cobourg, highest unit of the Trenton, have not been found in these map-areas, but the formation outcrops in the adjoining Lindsay map-area to the west (Liberty, 1952) and probably underlies a considerable area in the southwest corner of Peterborough map-area.

STRUCTURE OF THE PALAEOZOIC LIMESTONES

The general strike of the Ordovician limestones is

easterly, with a gentle dip to the south. However, owing to the irregularity of the Precambrian surface, quaquaversal dips up to 12 degrees surround four groups of Precambrian inliers found within Burleigh Falls map-area. These inliers are exposed: (a) as an island in the middle of Buckhorn Lake; (b) within the large limestone outlier north of Deer Bay Reach; (c) in the vicinity of Galesburg and Lynch Rock, 1 1/2 miles northeast of Lakefield (Kay, 1937, p. 630); and (d) at the south end of Dummer (White) Lake. In places, too, Lowville and Leray beds are found lying on the sides of these inliers, indicating that the several Black River units are not continuous sheets of sediments but are wedges of limestones between or surrounding the crystalline Precambrian hills and ridges. A very small limestone outlier on the south side of highway 36, 2 miles east of Nogies Creek, carries large fragments of fresh angular feldspar, quartz, and gneiss, and rests directly on the Precambrian rocks.

The regional dip, calculated by plotting structural contours on the Leray-Lowville contact, the only recognizable horizon to provide sufficient outcrop data, is about 20 feet per mile: in the western part of the area the dip is to the southwest; in the central part it is approximately south; and in the eastern part it is slightly east of south. Local dip determinations on Sherman Fall beds showed no relation to the general regional dip, indicating the undulatory nature of all the Ordovician strata.

ECONOMIC GEOLOGY

All limestone quarries within Burleigh Falls and Peterborough map-areas have been abandoned. Those in Black River rocks are located northwest of Buckhorn; north of Deer Bay Reach and Lovesick Lake; south of Burleigh Falls; north of Stony Lake; southeast of the east end of Stony Lake; at the northeast corner of Clear Lake; and just north of Warsaw, Ontario. Stone from these quarries was used principally in the building of the Trent River canal system. Quarries in Trenton strata are located at Bridgenorth; 4 miles north of Peterborough; and at Lakefield. These have been used, respectively, for building the Chemung Lake causeway, road metal, and cement. Some of these quarries were discussed by Goudge (1938).

Eskers in this region are sources of sand and gravel for local use (Gravenor, 1952).

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