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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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CAMPBELLFORD MAP-AREA, ONTARIO

(Map and Descriptive Notes)

By

C. G. Winder

OTTAWA

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Price, 50 cents

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LOCATION

Campbellford map-area lies between longitudes 77°30' and 78°00' and latitudes 44°15' and 44°30'. Highway No. 7 crosses the area in an easterly direction and No. 14 and No. 30 in a northerly direction. The main line of the Canadian Pacific Railway and two branch lines of the Canadian National Railways serve the area. The Trent River Canal system, which connects Lake Ontario and Georgian Bay, can only accommodate shallow-draught boats. The principal towns, Havelock, Campbellford, Stirling, and Marmora, have small populations although the last named is growing because Bethlehem Mines Corporation is developing a recently discovered magnetite deposit nearby. Profitable farming is largely restricted to the south border of the map-area. Many tourists visit the chain of lakes each season.

PREVIOUS WORK

Campbellford map-area was the scene of some of the earliest metalliferous mining in Ontario, the Blairton iron mine on the south shore of Crow Lake being opened in 1820 (Lindeman and Bolton, 1917, p. 44)[1]. The geology of the Marmora district was discussed by Logan (1863) who described a 40-foot section of limestone, the Precambrian inliers along Crow River, and the occurrences of iron ore on the north shore of Crow Lake, at Blairton, and at Allan Mills.

The Crow Lake area produced small quantities of lithographic limestone between 1885 and 1887 but apparently the industry could not compete with Solenhofen stone. Coste (1888, p. 43) quoted production figures and Volney (1892, pp. 181-184; 1893, p. 137) gave descriptions of the rock and the location of quarries, and some chemical analyses.

The geological map of the Belmont Lake and Marmora district, made by Vennor (1870), shows the disposition of 'Silurian' limestones. On page 160 he described the north-facing precipitous front of massive limestone and recognized the gentle dip southward under the 'deeper soil' cover. He mentioned numerous grooves trending north 3 to 6 degrees east, but offered no explanation for them. Johnston (1906) briefly mentioned the Precambrian inliers along Crow River. Miller and Knight (1914) made a detailed geological map of the Belmont Lake area, gave an analysis of limestone from the Havelock quarry, and reviewed Volney's work on the lithographic limestones.

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[1] Names and dates, etc., in parentheses refer to References, page 11.

The more recent map of Satterly (1943) gives a generalized distribution of the Ordovician limestone over a small part of Campbellford map-area, his limestone analyses being derived mainly from Goudge (1938). The excellent map made by Wilson (1940) gives an accurate picture of the Ordovician limestone in the Campbellford area north of latitude 44°25', but his grouping of the 'Leray and Lowville' formations resulted in the positions of contacts being considerably different from those of the writer. Field examination suggests that Wilson's 'Lowville' included only the upper massive limestone zone of the Lowville as defined in this report, and 'Pamelia' apparently embraced the lower thin-bedded zone of the Lowville and the Pamelia.

The aeromagnetic survey of the Campbellford area (1950) was instrumental in the discovery of the magnetite deposit now being developed by Bethlehem Mines at Marmora. Surface examination of some of the anomalies found by this aerial reconnaissance was carried out by Harding (1951) and the theoretical aspects were considered by Garland (1951).

ACKNOWLEDGMENTS

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Mr. H. O. Olsen, General Manager of Bethlehem Mines Corporation, permitted the author to examine the Marmora pit, and Mr. K, Bickford of Trent River Iron Company made available certain limestone cores from drilling done in the district. Many local citizens were helpful by supplying information and giving access to their properties.

DESCRIPTION OF BEDROCK GEOLOGY

The Palaeozoic limestones of the Campbellford area are Middle Ordovician (Mohawkian) in age. Bedrock can best be seen in the northern half of the map-area where most of the exposures are either Precambrian or units of the Black River group. The Trenton group, which forms the bedrock in the southern half of the map-area, is generally concealed by a mantle of glacial drift that apparently thickens to the south. It is, however, exposed along Trent River. Many of the relationships between topography, land-use, vegetation, and the underlying bedrock that were noted for Peterborough and Burleigh Falls areas (Winder, 1953) apply also for Campbellford area. The rock units of the Black River include, in ascending order, the Rideau, Pamelia, Lowville, and Leray, and of the Trenton the Kirkfield and Sherman Fall.

ORDOVICIAN

Black River

Rideau Beds

The Rideau beds - sometimes called 'Basal' beds - are correlated with sandstones in the Kingston district, which were given that name by Ami (1902, p. 82). Although these beds are apparently discontinuous along strike, they are considered a separate unit because of their distinctive red and green colours. Most of them are either maroon, arenaceous and arkosic sandstone, shale, and fine-grained limestone, or light green, calcareous shale and fine-grained limestone with occasional zones of limestone breccia. The rock is friable and, consequently, rarely exposed, the Precambrian-Palaeozoic contact in particular being almost always concealed. The presence of these beds is commonly indicated by red soil such as can be seen on the west side of Round Lake. One exposure, however, occurs in a small outlier 5 miles due east of Marmora where friable, mottled red and green, arkosic sandstone and conglomerate, in beds up to 4 inches thick, rests on the side of a granite-gneiss ridge.

The maximum known thickness of Rideau beds is 25 feet, measured in a core from the central part of the area, but greater thicknesses probably occur. In the south pit at the Blairton mine and on the north side of Highway 7, just off the northeast corner of the area, Pamelia-type limestone can be seen resting directly on the Precambrian. It is considered that the Rideau forms wedge-shaped bodies with a maximum thickness in the valleys in the Precambrian surface and thinning to zero on the sides of adjacent ridges. No fossils have yet been found in the unit.

Pamelia Beds

The Pamelia is best exhibited in the Marmora pit of Bethlehem Mines. Rideau red beds underlie the unit and the top is below a massive, 4-foot bed of light greyish green calcareous sandstone. At this locality the Pamelia is 47 feet thick. Bedding is regular and strata range in thickness from less than an inch to a foot. The Pamelia consists of limestone, grey, blue-grey, brownish grey, and buff in colour, fine grained to lithographic, with occasional horizons of fine quartz grains and some dolomitic beds. Layers showing fine reddish grey laminations occur in places. Mud-cracks and small nodules of crystalline calcite are common near the top of the unit. The rock is characteristically dense and brittle, breaking with a smooth conchoidal fracture. The colour of the weathered surface seen below the dam on Crow River at Marmora is a drab yellow or light buff. Many beds weather out as yellowish, resistant slabs with a gritty surface of more resistant sand grains. Stylolites and highly irregular surfaces on which black shaly material has accumulated are relatively common. Fossils are rare except for a few ostracods.

Lowville Beds

The Lowville can be divided into a lower, thin-bedded zone and an upper, massive, thick-bedded zone; in each the lithology, except for minor differences, is the same. An almost complete section of the Lowville, measuring 81 feet, can be seen in the Marmora pit. Other sections occur in the Havelock quarry of the Building Products Company and in the road cut on Highway 7 just west of Marmora.

A detailed description of the last named exposure is given here because it illustrates several interesting points, noted below.

(1) The lithology of the lower part of the section is typical of the Lowville.

(2) The upper part, although composed of typical Lowville white weathering sublithographic limestone, is considered to be Leray beds for it contains the guide fossil Lyopora. The difficulty of establishing the boundary between the Lowville and Leray is thus illustrated.

(3) Two horizons of metabentonite occur - one in the Leray and one in the Lowville.

(4) Black chert nodules occur in both the sublithographic and fine-grained limestone.

Section in Road Cut on North Side of Highway 7 just West of Marmora

Top of section (all measurements in inches)

Leray Beds

20 Limestone: buff, sublithographic, weathers whitish grey; abundant calcite tubes, gastropod debris, ostracods, fine crinoid debris.

40 Limestone: dark grey-brown, sublithographic; weathers bluish grey and whitish grey near top; abundant calcite tubes, black chert nodules, Lyopora, and some fragmental fossil zones.

44 Limestone: dark brownish grey, fine grained, with Stromatocerium and Lyopora at base, changing toward top to sublithographic with Tetradium and abundant calcite tubes; top part weathers light grey, sharp break with beds above; occasional black chert nodules.

46 Limestone: massive, brownish grey, fine grained, in places coarse, granular; some black shaly horizons; weathers bluish grey; a few calcite spots and some fossil debris.

2 Yellow weathering metabentonite and fine clastic limestone.

27 Limestone: grey-brown, very fine grained; weathers light grey and blue-grey in thin regular beds separated by shale; fossil debris includes crinoid stems, bryozoa, and trilobites.

36 Limestone: massive, grey-brown, very fine grained; in places fine conglomerate showing current bedding; weathers blue-grey; irregular black shaly horizons; contains fine fossil debris, Stromatocerium on top surface and Lyopora near base.

Lowville Beds

20 Limestone: dark brownish grey, very fine grained; weathers blue-grey in thin irregular beds containing much fine fossil debris, Tetradium, Coelochilina, and trilobite and crinoid fragments.

11 Limestone: dark brown, very fine grained, with fine conglomerate in upper zone; top surface very flat showing pits.

14 Limestone: brownish grey, fine grained; weathers mottled grey and brown; large ostracods in shale at top.

36 Limestone: brownish grey, fine grained; weathers blue-grey; brachiopod and bryozoa debris.

32 Limestone: dark brown, sublithographic; thin shale horizon at top and in middle; in places appears coarsely crystalline with fine rounded conglomerate; weathers brown and grey; fine fossil debris; top of bed flat with pits.

32 Limestone: buff and mottled grey, sublithographic; some calcite tubes and fine stylolites; some black shaly horizons; top of bed sharp.

1 Shale: prominent, green.

24 Limestone: buff, sublithographic, with smooth conchoidal fracture; abundant calcite tubes and one pyrite horizon; weathers dark buff; bottom of bed appears irregular, top of bed very flat.

45 Limestone: dark brownish grey, sublithographic; weathers blue-grey; calcite tubes, Tetradium cellulosum, Hormotoma, and other gastropods, crinoid debris; black shaly horizons.

6 Limestone: dark brown, sublithographic, spots of finely disseminated pyrite; weathers grey and brown; breaks irregularly; black shaly horizons; conformable with beds above and below.

32 Limestone: similar to 45-inch bed above.

Base of massive, thick-bedded zone

33 Limestone: regular, thin bedded, brownish grey, sublithographic; in places crossbedded with fine conglomerate separated by thin argillaceous horizons, conglomerate pebbles of sublithographic limestone; weathers light grey.

13 Limestone and shale: very dark grey, fine grained; zones of fine conglomerate; some pyrite, (?)mud-cracks; weathers grey; ostracods.

42 Limestone: regularly thin bedded, brownish grey. sublithographic, in places laminated; contains zones of fine fossil debris, particularly near base; weathers light grey, some calcite spots; fragments of Tetradium fibratum.

12 Limestone conglomerate: brownish grey; some flat and rounded limestone pebbles; thin argillaceous horizons; ostracods, brachiopod and trilobite debris, oolites.

2 Clay: prominent; upper half grey lower half yellow and brown; metabentonite.

8 Limestone: dark grey, fine and medium grained, in places appears as conglomerate.

2 Shale: prominent, green.

14 Limestone: light brownish grey, sublithographic; weathers light brown; fine stylolites near base, prominent glauberite horizon near top.

22 Limestone: greenish, argillaceous, in thin zones alternating with thicker zones of dark grey, sublithographic limestone with a smooth fracture; weathers greenish grey.

10 Limestone: dark brownish grey, sublithographic, containing fine angular calcite crystals that weather out leaving sand and shaly material with a rotten appearance.

36 Limestone: grey-brown, sublithographic, in regular beds up to 3 inches thick; weathers blue-grey; stylolites; separated by green shale horizons; large and small ostracods.

52 Limestone: laminated, grey-brown, sublithographic, with some massive beds, separated by yellow weathering shale, ostracods, (?)mud-cracks.

14 Shale: yellowish brown, calcareous, friable; irregularly bedded.

18 Limestone: brownish grey, fine grained; weathers greenish yellow; quartz grains.

12 Sandstone: greenish, calcareous, somewhat friable; shaly near top.

Base of exposed section

Fossils are not abundant in the Lowville and are most commonly found in the upper part of the unit. The most typical form is the coral Tetradium cellulosum; other fossils include T. fibratum, Actinoceras, Lambeophyllum, Leperditia, Coelochilina, various gastropods, and pelmatozoan debris.

Leray Beds

Typical Leray limestone is dark grey to brownish grey, fine to medium grained. It weathers dark or bluish grey. It occurs in massive beds up to 3 feet in thickness that weather irregularly into thinner beds or a rubble of angular blocks averaging 1 1/2 inches across. On freshly broken surfaces, some beds show thin, rusty encrustations. Nodules of black chert are irregularly distributed through the lower members of the unit. The Leray has a different aspect in flat exposures directly south of Banker Lake in the north-east corner of the area where the limestones are considerably coarser in texture and contain angular fragments of vein quartz and pink feldspar up to an inch across.

In the lower Leray and, in places, in the upper Lowville, beds have flat plane surfaces covered with irregular, shallow pits. In the small park at Crow Bridge, on one of these surfaces an Actinoceras can be seen inside the conch of an Endoceras. On another type of exposed surface irregular tubes of coarser grained material can be seen that weathers a drab yellow.

Typical fossils of the lower Leray, in addition to the above mentioned, are: the corals Lyopora, Tetradium fibratum, Streptelasma, and Calapoecia; the stromatoporoids Labechia and

Stromatocerium; the brachiopod Strophomena; and the gastropod Maclurites. On Crow River between Crow Bridge and Allan Mills is a small biostrome composed almost entirely of Stromatocerium and Lyopora, with the former predominating. One corallum of Lyopora measures 44 inches across. The exposed area of this 'reef', along the bank and in the river bed, is approximately 100 by 50 feet, the total thickness being composed of one layer of individual corals. Several Gonioceras (cephalopod) were found on flat exposures south of Beloporine Creek west of Round Lake.

The top of the Black River group is exposed in the abandoned channel below the dam at Healey Falls where a distinct break occurs between massive Leray and overlying, thin-bedded Trenton limestones. This break is not obvious in the present falls to the north of the abandoned channel, which suggests that, except for the nature of the bedding, the general lithology of the upper Black River and the lower Trenton is similar. The brachiopod Resserella occurs in countless thousands, but all are broken, worn, and without noticeable alinement. Other fossils found there are broken fragments of Lyopora (coral), Receptaculites (sponge), Endoceras (cephalopod), Stromatocerium (stromatoporoid), and Hesperorthis (brachiopod).

The thickness of the Leray within the area cannot be measured directly but it is thought to be about 40 feet.

Trenton

Kirkfield Beds

The term Kirkfield is used for the lower unit of the Trenton in southern Ontario for reasons set out by Sinclair (1954). In the Campbellford area, the Kirkfield is not well exposed, except at Healey Falls and at the two dams on Trent River north of Campbellford. Most of the rock is a resistant, fine-grained, brownish grey limestone in regular beds up to 6 inches in thickness, which break out in huge slabs. Minor amounts of grey shale separate the limestone strata. On the north side of the exposure at Healey Falls are some giant ripple-marks with a wave length of about 2 feet and a height of about 4 inches. In the abandoned channel at Healey Falls, this unit shows a change in facies, the beds being only 1 inch or 2 inches thick and separated by beds of friable, yellow weathering, extremely fine-grained, clastic limestone. Similar material can be seen on the west bank of Trent River below the dam at Lock 14, and in the Lowville on Indian River a mile north of Warsaw, similar material weathers from certain massive, less resistant limestone beds.

Fossils are not abundant in the Kirkfield. The most characteristic forms seem to be the brachiopod Strophomena filitexta, although it is not confined to this unit. Crinoid calyces were found

only in disrupted slabs below the dam at Lock 13 on Trent River. Other fossils that seem characteristic are the trilobites Ceraurus and Encrinurus, the brachiopod Glyptorthis, and the gastropod Phragmolites.

Beds at the top of the west-facing cliff below Healey Falls resemble the Sherman Fall unit but no contact with the underlying Kirkfield was seen. With an allowance for a small thickness of Sherman Fall and approximately 15 feet of Leray, the thickness of the Kirkfield in the Healey Falls area is about 75 feet.

Sherman Fall Beds

The contact between the Kirkfield and the Sherman Fall is exposed at a small falls on Trent River just south of Campbellford. Limited exposures in the vicinity of Glenn Ross suggest the occurrence of this contact there also but confirmation was not possible.

The Sherman Fall consists of thin beds of grey, greenish weathering, calcareous shale containing numerous large Prasopora (bryozoa), separating thin beds of brownish grey and grey, medium- to coarse-grained limestone, some of which are coquina. Most of the bedding is irregular. This unit is the most fossiliferous of those examined and, in addition to Prasopora, which seems to have rested on limestone beds and later been smothered by mud, there are large numbers of the brachiopods Resserella, Sowerbyella, Rafinesquina, Zygospira, and Rhynchotrema, the trilobite Calymene, bryozoa, and pelmatozoan debris. A typical exposure is in the small abandoned quarry on the east side of Highway 30, 2 miles south of Campbellford. Within the area, probably a thickness of less than 100 feet of this unit is present.

The Cobourg unit has not been definitely identified, but attention should be drawn to outcrops in the vicinity of Hastings whose areal position and lithology indicate either upper Kirkfield or lower Sherman Fall. Fossils collected on the south shore of Trent River opposite Preston Island suggest that they may be Cobourg, but because certain other diagnostic fossils were not found, they have been mapped as Sherman Fall.

Glacial Geology

The entire area has been glaciated with the thickest glacial deposits in the southern part. Lineations made by glacial action indicate that ice movement was about north 30 degrees east. Drumlins are fairly prominent but not as well developed as in the Peterborough area to the west. A large esker extends parallel with Highway 7 between Havelock and Norwood. Huge gravel terraces occur along the railway about 2 miles east of Campbellford, and just

south of Glenn Ross. In the southeast corner of the sheet is a high northeast trending ridge that may be the eastern extension of the Oak Ridge moraine.

Structural Geology

The irregular topography of the Precambrian surface is indicated by inliers projecting above Black River strata, well south of the main Precambrian-Palaeozoic contact. The maximum relief of this surface, judging from the thickness of the Black River, is probably at least 200 feet. In the vicinity of Allan Mills, the limestone on the sides of the inlier have a circumferential dip up to 12 degrees.

The attitude of the Ordovician limestones is essentially flat, but local dip determinations indicate a general undulation of all beds, which is probably a reflection of the irregular Precambrian surface. There is a regional dip at south 10 degrees west of about 20 feet a mile.

Along Squire Creek, 1/2 mile south of Wellman, is an anticline with a height of 12 feet trending parallel with the stream. Similar structures have been observed a mile north of Youngs Point and just east of Fenelon Falls. Their nature suggests a secondary relief of pressure by removal of overburden along a line of weakness, such as a joint. This origin is supported by the sudden appearance during excavation of two sets of similar structures, approximately at right angles to one another, in the floor of the Marmora pit.

Economic Geology

The magnetite deposit at Marmora, being developed by Bethlehem Mines Corporation, a subsidiary of Bethlehem Steel Corporation, was indicated on an aeromagnetic map issued by the Geological Survey of Canada in 1949. Clearing operations and exploration drilling to test the anomaly and outline the deposit were carried out from 1950 to 1952. Excavation of an open pit to expose the orebody is expected to be completed in 1954. Approximately 20,000,000 tons of overburden, principally Ordovician limestone, will have been removed. No commercial use was found for this material except for a small amount that was crushed and used locally as road metal. A new road built from Highway 7 leads directly to a specially built observation platform from which visitors have a panoramic view of the entire operation.

Exploration for other iron deposits in the district is being carried out by several companies. Trent River Iron Company of Ottawa has done some drilling at several places.

The 'metabasalt' quarried by Building Products Company of Havelock is reduced to granule size for the manufacture of roofing material. The crushing plant has a capacity of 2,000 tons a day. The limestone quarry has not been operated for several years.

From 1940 to 1946, fluorite veins southwest of Banker Lake were being mined in two underground mines and an open-cut. The deposits are cavity fillings in Black River limestones. The only exploration for fluorite in the area during 1953 was trenching, carried out by G. Williams and A. Swerdfeger of Springhill, Ontario, on a property a mile west of Bend Bay on Moira River. The surface exposure is a barite vein up to 6 inches wide. Within the last 10 years, some shallow diamond drilling for sulphides was carried out a couple of miles west of Havelock but no economic deposits were found.

Limestone quarries in the area have supplied road metal but all have been abandoned.

The large esker near Havelock and Norwood has supplied gravel for local use, and the water supply for the village of Norwood also comes from it. The gravel terrace a mile east of Campbellford, during the summer of 1953, supplied twenty-two carloads of gravel a day for railway ballast. For this purpose a railroad siding was built to a portable crushing plant owned by Trent Valley Sand and Gravel.

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