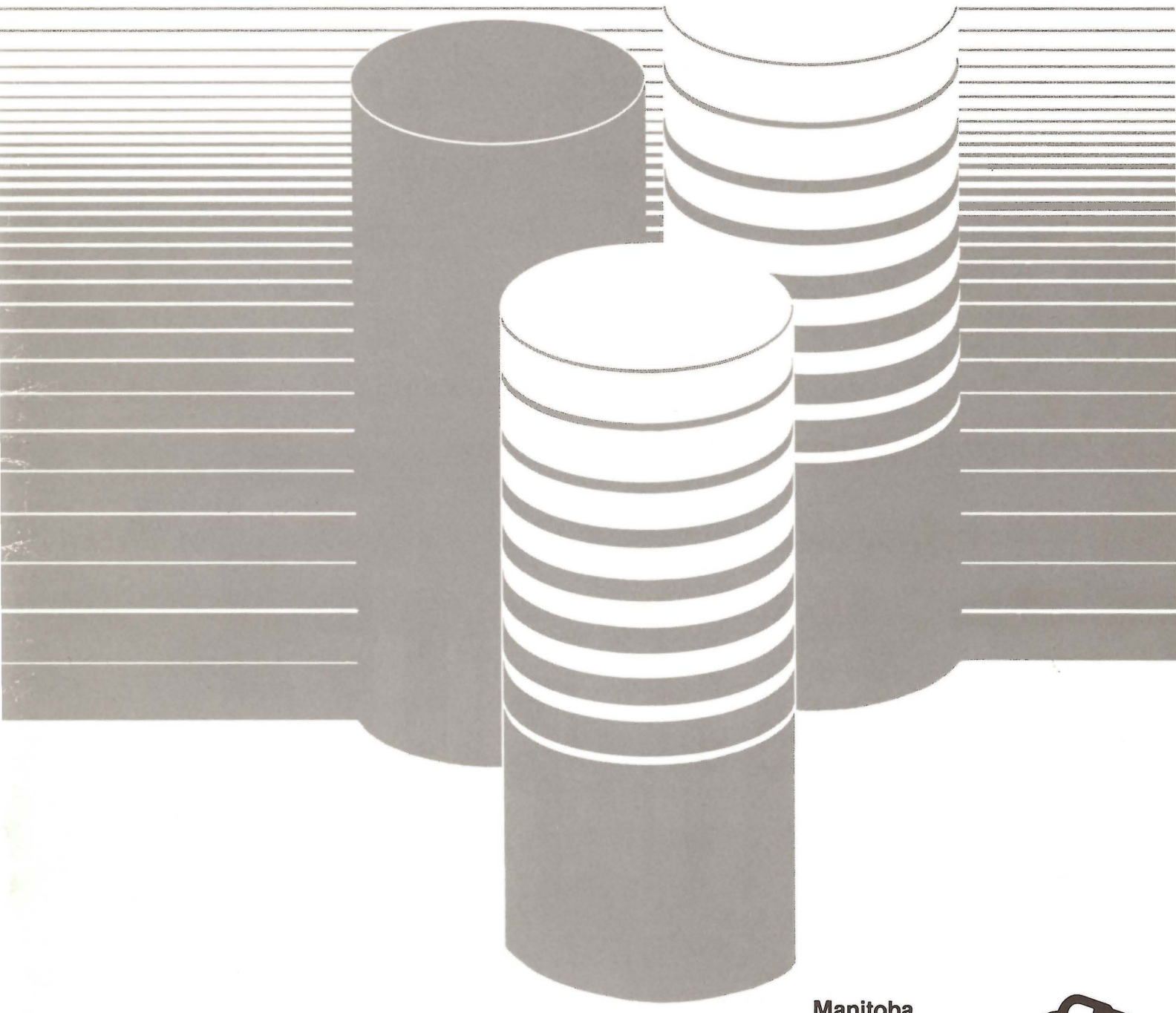
EDUCATIONAL SERIES ES79-1

LIGNITE IN MANITOBA

by B.B. Bannatyne



Manitoba
Energy and Mines

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A few thin beds of lignite occur in the Turtle Mountain area of southwestern Manitoba. Small-scale mining occurred at intervals between 1883 and 1908, and from 1931 to 1943, but annual production never exceeded 4 000 tonnes. Although the area was explored by coal companies four times between 1952 and 1972, sufficient reserves to warrant strip mining, under current economic conditions, have not been outlined. At various other localities, scattered non-economic occurrences of coal in the Swan River Group have been reported.

PEAT, LIGNITE, AND COAL

When vegetation dies within a swamp or bog, it settles and begins to decompose to humus, a dark brown ooze. In these environments, where the water table is at or close to the surface, woody materials such as trees, roots, and twigs are replaced by the humus. Humification enriches the carbon content of the organic remains, and methane (marsh gas, CH_4) and carbon dioxide are liberated. The accumulated material forms peat, which in present day environments ranges from undecomposed light brown peat derived from moss, to completely humified black peat.

If, in the course of geological time, the peat deposit subsides and is covered by clay, silt or sand, the peat is further compacted and further enriched in carbon. Eventually coal is formed. The degree of carbon enrichment determines the quality or rank of the coal. Completely humified peat can be considered a low-grade fuel, as it will burn when dried. Lignite is the lowest rank coal, and bituminous coal and anthracite are increasingly higher grades. The interested reader is referred to Holmes (1965) for additional details on the formation of coal.

In Manitoba, coal, mainly of the lignite grade, occurs in thin beds in the Turtle Mountain Formation and as scattered occurrences in the Swan River Group. The Turtle Mountain Formation was deposited about 65 million years ago during the Paleocene Epoch (or Early Tertiary Period), and the Swan River Group about 105 million years ago in the Lower Cretaceous Period. The history of lignite mining and a summary of the geology of the Turtle Mountain area are described in the next section.

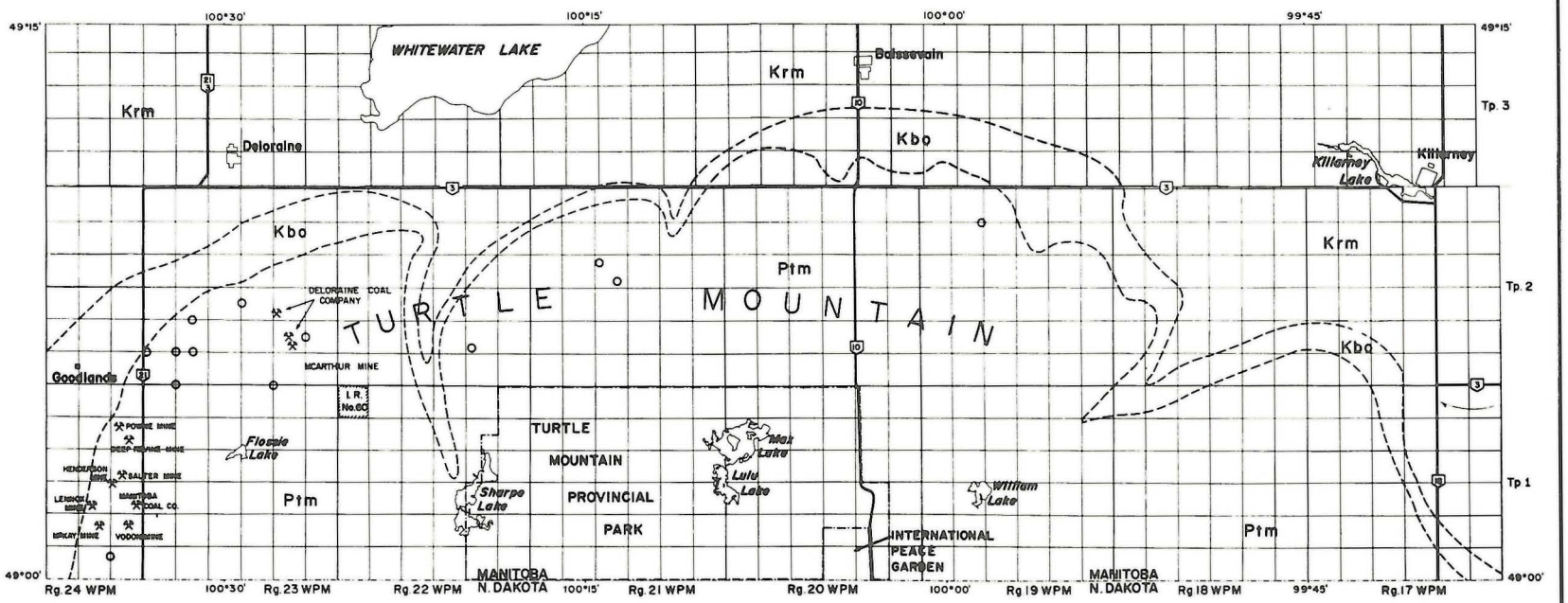
Scattered occurrences of lignite in the Swan River Group have been reported from Arborg, Meadow Portage, Dauphin, and Pine River. To date, however, deposits of commercial quantity have not been outlined. The group consists of kaolinitic shale, quartzose sands, and lignified material which would suggest that it was deposited in river channels, and that accumulations of lignitic material are therefore of limited extent. Pieces of lignified wood, usually with abundant pyrite, have been found in quarries south of Ste. Rose du Lac and in outcrops northeast of the town of Swan River. Some of these deposits occur in solution cavities.

TURTLE MOUNTAIN

Turtle Mountain is an upland area covering 1000 km^2 in the southwestern part of the province (Fig.1). The surrounding plain, underlain by shale of the Upper Cretaceous Riding Mountain Formation, has an elevation of 490 to 520 m above sea level. The highest elevation on Turtle Mountain is about 760 m.

The geology of Turtle Mountain is described by Bamburak (1973, 1978). The lower flank of the mountain is underlain by the Boissevain Formation of uppermost Cretaceous age. It is formed of impure sandstone and silt that were deposited at the mouths of rivers in a transitional environment as the shoreline of the Cretaceous sea retreated westward. In Paleocene time, the sea again covered the area for a brief interval and silt and clay that form the lowest part of the Turtle Mountain Formation were deposited. In periods when the sea partially withdrew, plant remains accumulated and were preserved in swampy basins. After burial by later sediments these were converted to thin beds of lignite. The sea again covered the area in which were deposited the sandstone and shale of the upper part of Turtle Mountain Formation. Uplift of the entire Great Plains area followed, associated with the formation of the Rocky Mountains, causing the early Tertiary sea to withdraw. Eventually Tertiary erosion and Pleistocene glaciation reduced Turtle Mountain to an isolated upland remnant.

The Turtle Mountain Formation is the eastward equivalent of the Ravenscrag Formation, from which lignite is recovered in the Estevan-Bienfait area of southeastern Saskatchewan. In Manitoba, the lignite is present in one or two beds with a combined thickness of several centimetres to 1.5 or 1.8 m. The lignite occurs generally between elevations of 525 and 555 m, along the lower slopes of Turtle Mountain. Small amounts of lignite have been mined or quarried along the walls or floors of ravines along the western and northwestern slopes. The only known outcrops of lignite at present are along creek beds west of Highway 21, 14.4 km southwest of Deloraine, near the sites of the former Powne Mine and Deep Ravine mine, shown in Figure 1.



LEGEND

TERTIARY (PALEOCENE)

Ptm — Turtle Mountain Formation: silty and sandy shale, lignite seam(s) near base (Peace Garden and Goodlands Members)

UPPER CRETACEOUS

Kbo — Boissevain Formation: impure sandstone, minor kaolinitic shale

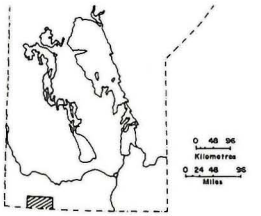
Krm — Riding Mountain Formation: marine shale, bentonitic and siliceous (Coulter and Odanah Members)

SYMBOLS

⚒ Location of previous mining operation

o Lignite exploration holes; 108 additional holes in former mining area not shown

INDEX MAP



SCALE

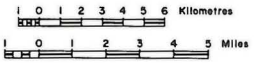


Figure 1. Turtle Mountain, Manitoba: geology and location of lignite mines and drill holes.

LIGNITE OPERATIONS

The history of the lignite operations is described in "The Saga of Turtle Mountain Coal" by A.D. Doerksen (1971), in geological reports by Selwyn (1893), Dowling (1906), Cameron (1949), and Bannatyne (1978), and in the annual reports of the Manitoba Mines Branch for the years 1931 to 1943.

Lignite was discovered in 1879, when a 0.9 m seam was intersected at a depth of 9.1 m in a well about 17.5 km southeast of Boissevain. According to Wright (1951), the first production in 1883 consisted of 9 tonnes from the Lennox mine. Intermittent mining continued to 1908, mostly from pits in the floors of ravines or from shallow shafts. The Lennox, Vodon, Manitoba Coal Company, McArthur and McKay mines were operated (Fig.1), but the amount of lignite recovered was not recorded. Presence of groundwater, caving of tunnels, and increasing thickness of overlying material caused problems in recovering the lignite.

With the onset of the Great Depression of the 1930s, interest in mining the lignite was revived, and production of lignite was recorded from 1931 to 1943, when a shortage of labour forced an end to the operations. Although much work was put into the erection of buildings, the excavation of open cuts, and in recovery by the room and stall method of mining, the annual production ranged only between 906 and 3731 tonnes. The lignite was valued at $2.50 to $3.00 per tonne.

The major operation was the Henderson mine, from which about 19 050 tonnes were recovered, amounting to two-thirds of total production of the area. An open cut in the floor of a creek bed was worked from 1932 to 1939, with lignite being recovered from a bed about 1 metre thick. Two separate adits into the sides of the ravine were worked until 1943. In 1942, horses were used to haul the coal from underground (see cover photo); the coal had previously been recovered by hand tramming.

Most of the other lignite production was from the Salter mine, located about 213 m east of the Henderson Mine. Some 7711 tonnes of lignite were recovered between 1932 and 1938, partly from an open cut, and partly from adits and shafts in the area around the open cut. Poor roof conditions hindered operations in all the underground mines, and water was a problem in some workings.

Small amounts of lignite were recovered also from the Deep Ravine and Powne farm mines in the early 1930s, and also from operations of the Deloraine Coal Co. Ltd. Today little evidence remains of these mining operations except for some odd pieces of equipment and a few mounds of waste material.

RECENT EXPLORATION AND EVALUATION

The lignite seams at Turtle Mountain are too thin, and the roof and water conditions too dangerous to allow economic extraction of the lignite by underground mining. If the lignite is to be extracted at all, it would have to be recovered by strip mining methods. The possibility of producing gas in place from lignite beds at a depth of 50m or more is currently being investigated. However, the minimum thickness of lignite required for this process is reported to be about 3 m, at least twice as thick as the main seam at Turtle Mountain. In order to determine if sufficient thickness of lignite is present at depths shallow enough to permit strip mining, coal companies explored the Turtle Mountain area four times between 1952 and 1972, and a total of 139 test holes were completed.

The results of all the exploration have been compiled and evaluated in a Mineral Resources Division report (Bannatyne, 1978). A cross-section through the western slope of Turtle Mountain is shown in Figure 2, and the geological position of the lignite is indicated. The main problem with strip mining in this area, aside from the variable and erratic thickness of the lignite, is that the amount of overburden increases greatly over a short distance, as the slope of Turtle Mountain is between 19 and 38 m/km, whereas the lignite is nearly horizontal.

The results of the drilling indicate the best combination of lignite thickness and least overburden occurs west of Highway 21, between the Vodon and the Powne mines. Although an estimated 4 800 000 tonnes of lignite are present there, a total of 154 000 000 tonnes of overburden would have to be removed to recover it. The reaction of the coal companies to date is that these conditions do not warrant exploitation of the lignite. The results of the exploration drilling have indicated that the lignite to overburden ratio in other parts of Turtle Mountain is even less promising. Thus it is not expected that the Turtle Mountain lignite, which provided a brief means of livelihood for certain hardy individuals in pioneering and depression times, will be the source of renewed industry under present economic conditions.

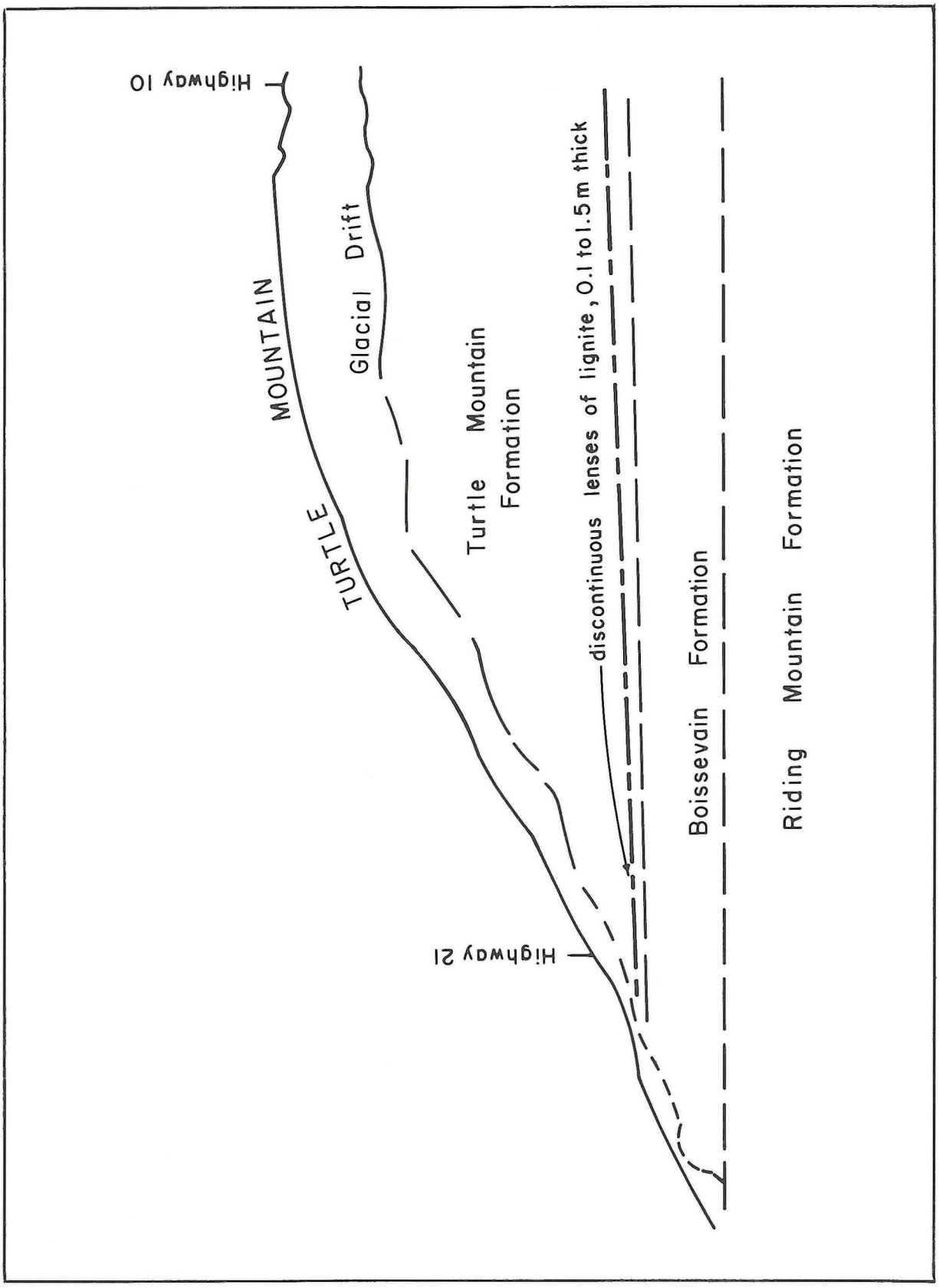


Figure 2. Diagrammatic cross-section across western slope of Turtle Mountain (not to scale).

Plate 1. Outcrop of lignite beds on Powne farm, SE¼ of section 25, township 1, range 24 WPM; the second bed is below the hammer head.

Plate 2. An adit for lignite on the western slope of Turtle Mountain.

REFERENCES

Bamburak, J.D.,
1973: The Upper Cretaceous and Paleocene stratigraphy of Turtle Mountain, Manitoba; M.Sc. **Thesis**, University of Manitoba, 110 p.

1978: Stratigraphy of the Riding Mountain, Boissevain, and Turtle Mountain Formations in the Turtle Mountain area, Manitoba; Manitoba Mineral Resources Division, Geological Report 78-2.

Bannatyne, B.B.,
1978: Summary of available data on lignite deposits, Turtle Mountain, Manitoba (with a note on other occurrences in the Province); Manitoba Mineral Resources Division, Economic Geology Report 77/1, 55 p.

Cameron, E.L.,
1949: Coal (Lignite) in Manitoba; Unpublished report, Manitoba Mineral Resources Division.

Doerksen, A.D.,
1971: The saga of Turtle Mountain coal; D.W. Friesen & Sons Ltd., Altona, 129 p.

Dowling, D.B.,
1906: Notes to accompany a contoured plan of the lower slope of Turtle Mountain, Geological Survey of Canada Annual Report 1902, part A, p. 193-203.

Holmes, A.,
1965: Principles of physical geology; Thomas Nelson & Sons Ltd., London, England, p. 435-450

Manitoba Mines Branch,
1931
to 1943: Annual Reports; Winnipeg.

Selwyn, A.R.C.,
1893: Notes on Turtle Mountain coal fields, Manitoba; Geological Survey of Canada Annual Report 1890, pt. A, p. 11, 12.

Wright, N.,
1951: In view of Turtle Hill; Deloraine Times Publishing Co., Deloraine.

Additional information on coal is contained in a booklet entitled "Coal in Canada", which is available upon request from The Coal Association of Canada, Suite 590, Three Calgary Place, 355 - 4th Avenue SW, Calgary, Alberta, T2P 0J1, and from the Information Branch, Department of Energy, Mines and Resources, 580 Booth St., Ottawa, K1A 0E4.