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Geology of the Iron Bridge Area
District of Algoma

By
JAMES A. ROBERTSON

Geological Report No. 17

TORONTO
Printed and Published by Frank Fogg, Printer to the Queen's Most Excellent Majesty
1963

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- Map No. 2032—Blind River–Elliot Lake Area, District of Algoma. Scale, 1 inch to 2 miles.

ABSTRACT

This report describes the stratigraphy, structure, and economic geology of Bright, Gladstone, Patton, and Thompson townships of the Blind River area, District of Algoma. Iron Bridge is the principal community. Semi-detailed mapping using air photographs was carried out in 1953, 1954, and 1960.

The area is divided into two parts— that lying north of the Bright Lake–Dean Lake–Mississagi River depression, and that to the south. The depression is an erosional expression of the Murray Fault.

The oldest rocks exposed are gneissic to massive pink granites, south of the Murray Fault. Remnants of volcanic and sedimentary rocks may represent Keewatin(?) or Sudbury groups.

The granite complex was eroded to a peneplane on which remnants of old soils are locally preserved.

Huronian sedimentation began with coarse-grained sediments derived from a weathered granitic terrane. The Bruce Group is represented by Lower Mississagi Formation—arkose and quartzite; Middle Mississagi Formation—basal conglomerate and argillite at depth in the north, and interbedded quartzite and siltstone in the south; Upper Mississagi Formation—quartzite and pebbly quartzite in the north, quartzite in the south; Bruce Formation—polymictic conglomerate thinning from north to south; and the Bruce Limestone member of the Espanola Formation—thinly bedded limestone and siltstone. These rocks were all derived from the northwest and were deposited in cool water deepening towards the south.

The Bruce Group is overlain unconformably by the Gowganda Formation of the Cobalt Group—a heterogeneous assemblage of conglomerates, siltstones, and quartzites formed under subtemperate to glacial conditions.

These rocks were folded about an anticlinal axis striking slightly north of west and plunging gently west near the north limit of the map-area. Diabase sills were intruded into the tensional areas of the fold and differentiated *in situ*. Faults and joints were developed parallel to the axial plane of the fold and with northwest and northeast strikes (strike-slip faults indicative of a north-south compression). During relaxations of the compressive forces, fractures were intruded by diabase dikes. Locally, albitization, chloritization, and the introduction of sulphide mineralization and magnetite, are associated with the contacts of the diabase intrusions—particularly of the sill-like bodies. Bruce Limestone near such bodies may have had a chemical effect on mineralizing fluids.

Pleistocene glaciation resulted in the removal of soil and gravel. Sand and gravel plains represent former extensions of Lake Huron or ice-dammed lakes.

The area has been extensively prospected, mainly for copper, gold, iron, and uranium. Copper was produced in small quantities during the early part of the century. In 1962 an attempt was made to rehabilitate the Glagoma mine near Iron Bridge. In 1962 copper was discovered at an old iron prospect on the Cobden River just north of the map-area.

Geology of the Iron Bridge Area

By

James A. Robertson¹

INTRODUCTION

During the 1953 and 1954 field seasons, Ontario Department of Mines field parties under the leadership of E. M. Abraham carried out geological mapping in the townships of Bright, Gladstone, Patton, and Thompson in the District of Algoma. The village of Iron Bridge, with a population of 800, near the centre of the map-area, is the principal community.

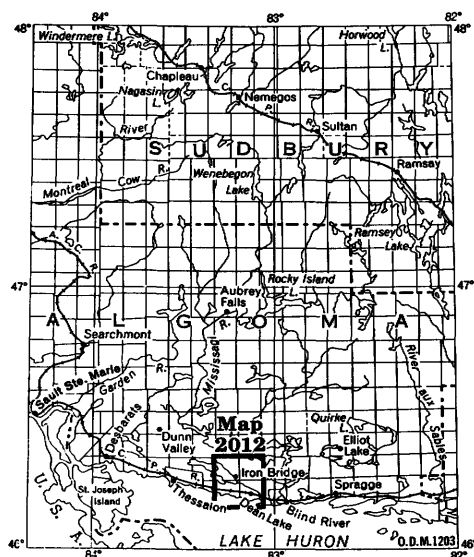


Figure 1 — Key map showing location of the Iron Bridge map-area. Scale, 1 inch to 50 miles.

Iron Bridge is 17 miles west of Blind River and lies on the Trans-Canada Highway (No. 17) where it crosses the Mississagi River. Highway No. 546 runs generally north from Iron Bridge to Parkinson, on the north edge of the map-area, and thence runs northeast to Mount Lake serving scattered farms, tourist camps, and lumber operations. From Parkinson a cross-road (No. 554) links highway No. 546 with the Chapleau road (No. 129) of the trans-Canada system. Unimproved roads serve the various farms and camps, and the greater part of the

¹Geologist, Ontario Department of Mines.

Iron Bridge Area

map-area is readily accessible. The larger lakes, rivers, and creeks provide access by canoe. Charter float-planes are available at Lauzon Lake, a few miles east of Blind River, and at Sault Ste. Marie. The Canadian Pacific railway (Sault Ste. Marie branch) runs through the southern part of the area, with stations at Dean Lake in Thompson township, and Eley in Bright township.

Semi-detailed mapping, on a scale of 1 inch to 1,320 feet, was plotted on transparent acetate sheets attached to air photographs (which were flown in 1949) and subsequently transferred to a basemap using a sketchmaster. Control was provided by readily identifiable points.

Active prospecting throughout the North Shore of Lake Huron has been carried out since the discovery of copper at Bruce Mines in 1846. There are a number of copper showings in the map-area, and occasional shipments of hand-picked concentrate have been made—particularly in the early part of the century.

Subsequent to E. M. Abraham's field work, attention was diverted to the Blind River-Elliot Lake uranium deposits. Although no diamond-drilling was carried out in the Iron Bridge area, the large amount of information that became available on the regional geology necessitated revision of the earlier work. Mr. Abraham was unable to complete this revision before leaving the Department in 1957. The author was therefore instructed to bring the Iron Bridge map up to date as part of the work carried out in the Blind River area during the 1960 field season. Visits were made to a number of localities, and the style of the map was brought into line with that of the other maps prepared by the author. However, most of the information used in preparing this report is that originally collected by Mr. Abraham and his assistants.

Acknowledgments

The following persons took part in the field work, as indicated:

1953—Bright and Gladstone townships:

E. M. Abraham, D. H. Williamson, J. M. Brander, J. R. Lill, and G. E. Bouchier. Messrs. Abraham, Williamson, and Brander were responsible for the mapping.

1954—Patton and Thompson townships:

E. M. Abraham, W. J. Pearson, G. E. Bouchier, J. A. Robertson, D. K. Brodie, and A. E. Wilson. The mapping was undertaken by Messrs. Pearson and Bouchier. Mr. Abraham worked on the Pronto area to the east.

1960—During work throughout the Blind River district the author was assisted by D. S. Sinclair, G. E. Bouchier, J. M. Johnson, R. Balgalvis, T. Nou, T. Stem, and C. J. Hodgson. Mr. Bouchier's ability to evaluate much of the original field work was greatly appreciated. Mr. Balgalvis was responsible for most of the drafting.

Throughout the years of field work, many local residents, businessmen, tourists, and representatives of mining companies freely rendered services, information, and hospitality. Rio Algom Mines Limited (Pronto Division) provided the author with accommodation and office facilities during the 1960 field season.

During the field seasons of 1959 and 1960, M. J. Frarey of the Geological Survey of Canada carried out semi-reconnaissance mapping of the Dean Lake and Wakwekobi Lake sheets of the National Topographic System (Frarey 1961a; 1961b). Close co-operation and free interchange of information were maintained between the two groups. Information on the area to the south of the C.P.R. track, which had not been mapped by Abraham, was made available by Dr. Frarey.

Means of Access

Access by highway and railway has been described on page 1. Partially improved motor roads lead from Iron Bridge to Chiblow Lake; from highway No. 546 to the Red Rock Falls Power Station on the Mississagi River; from Patton in an east-southeasterly direction along the valley of the Cobden River towards Blind River; from highway No. 17 northerly along the west edge of the map-area, and throughout the farming country between highway No. 17 and the C.P.R. track. The North Channel of Lake Huron can be reached by roads leading south from Eley and Dean Lake. Side roads in Patton township and the eastern part of Gladstone township may require clearing and brushing-out for vehicles but can be used on foot. Trails and portages lead to most of the lakes not served by roads suitable for motor traffic.

Chiblow Lake can be reached by lake and portage, following the Blind River system. The Mississagi River is normally navigable, by canoe, throughout the area, with short portages around rapids; however, the river is used for driving logs. The Cobden River is normally navigable during high water.

The following lakes are suitable for light float-planes: Dean, Everett, Bright, Wakwekobi, Denman, Chiblow, and Darrell. In addition, the following lakes may be used, depending on wind, load, and the power of the aircraft: Hagen, Warnock, Eaket, Gladstone, Alma, Oscar, Mapleleaf, and Bay. The flood area north of Red Rock Falls Power Station may be used, subject to satisfactory flood level and absence of logs and floating debris.

Previous Geological Work

After the discovery of copper at Bruce Mines in 1846 the North Shore of Lake Huron became the scene of much geological activity. Between 1847 and 1858 considerable work was done in the district by Logan and Murray, the pioneer officers of the Geological Survey of Canada. The results of the mapping, largely Murray's responsibility, are given in *The Geology of Canada* (Logan 1863), and a map "showing the distribution of the Huronian rocks between Rivers Batchewahung and Mississagui" is included in the atlas accompanying this work. The Iron Bridge map-area lies within the area covered by Murray's map, close to its east limit.

The succession given by Logan and Murray for the "Original Huronian" of Bruce Mines is given as column 1 of Table I on page 11. Of the sedimentary units, white quartzite, lower slate conglomerate, limestone, and upper slate conglomerate are shown within the Iron Bridge area. These units were observed in an anticlinal structure near Macomingue Lake (now Chiblow Lake). The upper slate conglomerate underlay the area to the north of the Marsh River (now Cobden River) valley and its northwesterly extension. The limestone unit

Iron Bridge Area

was considered to be exposed along this valley. The area between the Marsh River and Deane (now Dean) Lake was correlated with the lower slate conglomerate. An east-striking fault traced from the Echo River to the Blind River crossed the area, forming the Pakewagaming Lake (Bright Lake)–Dean Lake–Mississagi River linear. To the south of this fault pre-Huronian granites (Laurentian) were exposed. Copper showings were noted in the southeastern part of Patton township and along the Mississagui River.

With the discovery and development of the great mining camps at Sudbury and Cobalt, geological work in the North Shore District was confined to prospecting and to visits to the "Original Huronian" of Bruce Mines.¹ Mention is made of iron claims in Thompson township in the annual report of the Ontario Bureau of Mines for 1898 (O.B.M. 1898, p. 97). In 1902, copper showings were recorded in Gladstone township; these may be the showings along the Mississagi River indicated by Logan and Murray. In 1905, Northern Ontario Copper Company was formed to exploit a copper showing in the north half of section 13, Thompson township.² Underground work and production were reported on this property in 1906 (O.B.M. 1906, p. 69). Activity on the nearby Jury prospect was also reported, in 1907.

By 1913 the need for field work and correlation between the "Original Huronian" of Bruce Mines and the rocks of the Sudbury–Cobalt area was obvious. In 1914, Coleman published *The Precambrian Rocks North of Lake Huron with special reference to the Sudbury Series*. Coleman's table of formations (in so far as it applied to the Blind River area) is given as column 2 of Table I. In a preface to Coleman's paper W. G. Miller introduced the term Algoman (defined in 1913 by A. C. Lawson in the Rainy Lake area) for the bulk of the granitic rocks of the district.

In 1914, W. H. Collins of the Geological Survey of Canada carried out systematic mapping in the North Shore District. In this he was assisted by T. T. Quirke (1917) and later by P. Eskola. Certain areas were selected; each was mapped and then correlated with the others on the basis of lithology and structure. Collins' stratigraphic column is given in column 3 of Table I. Patton and Thompson townships were included in Collins' map of the Blind River area. Collins was able to confirm much of Murray's original mapping. However, although recognizing the equivalence of Murray's lower slate conglomerate to the Bruce conglomerate and Murray's limestone to the Bruce limestone, Collins maintained that the conglomerate and limestone units mapped near Chiblow Lake were in reality part of the Upper Huronian or Cobalt Series. No indication of limestone was found along the Marsh (Cobden) valley, and all rocks north of the great fault were correlated with the Cobalt Series. The presence of the great fault was confirmed, and it was named the Murray Fault after its discoverer.

Only one copper showing, the Moosehorn mine, supposedly in section 11, Thompson township, was described by Collins. However, from the location given on the Lake Huron Sheet (G.S.C. 1933) it is probable that this was the property, mentioned above, worked by the Northern Ontario Copper Company Limited, in section 13 of the township.

In the Elliot Lake–Quirke Lake area the structure was shown to be a west-striking, gently west-pitching syncline. To the south of this, in the Elliot Lake–

¹For a bibliography covering this period see Collins (1925).

²See map No. 2032 (back pocket), and Figure 2.

Blind River area, there lies an anticline, the south limb of which is cut and repeated by the Murray Fault. The surface expression of this structure is a reverse-S exposure of the sedimentary units. The present map covers the southern sector of this structure.

However, to the east of the Blind River area the geology is complicated by faulting, and the granite present was believed to be either intrusive or to be

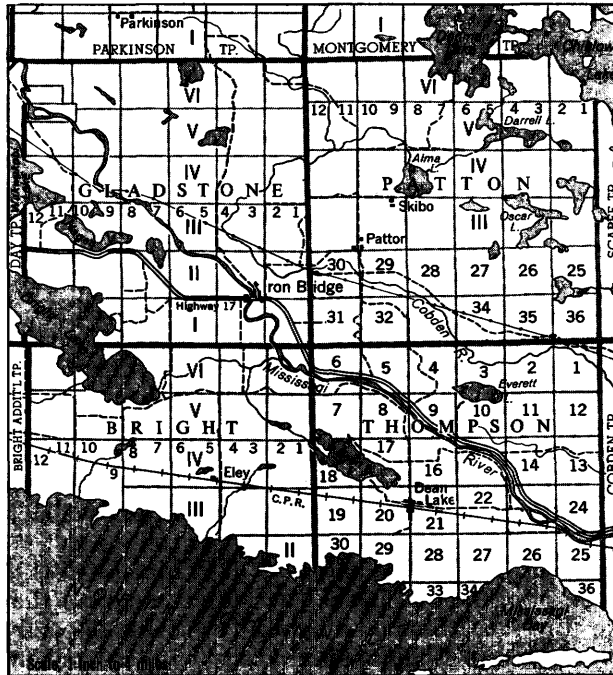


Figure 2 — Index to lots, concessions, and sections.

granitized Huronian sedimentary rocks (Collins 1925; Quirke and Collins 1930). In this area Coleman (1914) called all the rocks south of the Murray Fault the Sudbury Series, but Collins (1925), Quirke (1917), and Quirke and Collins (1930) maintained that both Huronian and pre-Huronian sedimentary rocks occurred to the south of the Murray Fault; however, they admitted difficulty in delineating any unconformity between the rocks assigned to the two units.

In 1929, on the basis of field relationships immediately east of Blind River, A. C. Lawson argued that the Sudbury Series was in fact the Cobalt Series.

However, the early mapping was not continuous, and geological terminology and the correlation of ideas of different workers had become largely incomprehensible. In 1950 and 1951, J. E. Thomson carried out detailed mapping in Baldwin township. Thomson (1953a, p. 13) pointed out that: (a) one stratigraphic unit can show great lithological variation, and (b) different units can show markedly similar lithology; and he suggested the establishment of local successions, leaving the regional correlation to await completion of detailed structural mapping.

Iron Bridge Area

In 1953, E. M. Abraham of the Ontario Department of Mines began semi-detailed mapping in the Iron Bridge area (Bright and Gladstone townships) with a view to mapping the gap between Collins' Bruce Mines and Blind River maps (G.S.C. 1925a; 1925b). However, with the discovery of economic uranium deposits at the east end of Lauzon Lake, some ten miles east of Blind River, the Blind River–Elliot Lake area became the scene of intense exploration and development. In addition to the mapping, drilling, and underground work carried out by mining companies, both the Geological Survey of Canada and the Ontario Department of Mines have undertaken extensive programs within the area, the provincial department being responsible for the regional mapping, and the federal department for a study of the ores and their origin.

In the second half of the 1953 field season, Abraham carried out detailed mapping in the vicinity of the Pronto discovery 27 miles east of Iron Bridge, and a preliminary map and report were published (Abraham 1953). During the first part of the 1954 field season Abraham's field party mapped Patton and Thompson townships and, during the second part, country between Pronto and Blind River. In 1955, mapping was carried out in Scarfe, Mack, Cobden, and Striker townships. However, apart from a brief paper (Abraham 1957, pp. 59–62) no data were published. Abraham used Collins' terminology but divided the Mississagi into three formations; Upper, Middle, and Lower. Within the confines of the Iron Bridge map, Abraham's interpretation, including the identification of all rocks younger than the Upper Mississagi Formation with the Cobalt Series, was identical with that proposed by Collins.

In 1955–56, Ontario Department of Mines published a series of aeromagnetic-aeroradioactivity maps covering individual townships of the Blind River uranium area on a scale of 1 inch to 1,320 feet. Such maps are available for the Iron Bridge area.

During the field seasons of 1956 and 1957, J. P. McDowell (1957) studied the sedimentary petrology of the Mississagi Quartzite throughout the Bruce Mines–Blind River area. In 1956, Abraham mapped Townships 149 and 150 (Abraham 1956) and again adhered to Collins' terminology with only slight modifications (*see* Table I, column 4). In the same year, S. M. Roscoe published preliminary results of work carried out in the Quirke Lake–Elliot Lake area and recommended the adoption of a new stratigraphical nomenclature (*see* Table I, column 5). This nomenclature was used in his subsequent papers but has not received wide support.

In 1957 the author took over Abraham's field work in the area, and since then the following work has been carried out:

1957—Townships 143 and 144 (Robertson 1961).

1958—Townships 137 and 138 (Robertson 1962).

1959—Townships 155, 156, 161, 162, and parts of 167 and 168 (Robertson 1963).

1960—Long and McGiverin townships (O.D.M. Maps 1960, Nos. P.70, P.73); also local revision of Iron Bridge map (*see* map No. 2012, back pocket) and compilation and revision of maps of Scarfe, Mack, Cobden, and Striker townships (O.D.M. Maps 1960, Nos. P.68, P.69, P.71, P.72).

1961—Esten and Spragge townships and the west half of the Serpent River Indian Reserve (I.R. No. 7) (O.D.M. Maps 1961, Nos. P.130, P.131).

Meanwhile in 1956, M. J. Frarey of the Geological Survey of Canada began mapping in the Echo Lake area; this work was completed in 1958 (Frarey 1959). In 1959-60, Frarey mapped the Dean Lake and Wakwekobi Lake sheets of the National Topographic Series (Frarey 1961a; 1961b).

The Iron Bridge area is entirely contained within these map-areas. In 1961, Frarey carried out mapping in the vicinity of Bruce Mines and Thessalon (Frarey 1962a; 1962b). Close contact was maintained between Frarey and the author, and there is general agreement on matters of interpretation and terminology. The author has conformed to the usual practice in the Blind River area and used a modified form of Collins' stratigraphical nomenclature (*see* Table I, column 6).

Thus since 1953 the region between Sault Ste. Marie and the mouth of the Serpent River has been subjected to either detailed or semi-detailed mapping, and the correlation of the Blind River area and the "Original Huronian" of Bruce Mines has been established. During the same period much work has been carried on in the area between Blind River and Sudbury, notably by Thomson (1953a; 1953b; 1960), Ginn (1960; 1961), and Card (report in preparation), but regional correlation, particularly for the rocks south of the Murray Fault, has not yet been accomplished.

Geologists and mineralogists working for, or in association with, the mining companies have published papers in which general accounts of the regional geology are given. Age-determination research has been undertaken on the granitic rocks of the North Shore of Lake Huron (Fairbairn *et al.* 1960. Wetherill *et al.* 1960) but, as yet, no age-determinations have been made from the Iron Bridge area.

Topography

Topographically the region may be divided into two parts: that lying to the north of the Murray Fault and that to the south.

The area north of the Murray Fault shows the topographical features typical of the North Shore area: namely, a lack of major relief contrasted with a ruggedness of detail (Collins 1925; Quirke 1917). The remarkable uniformity of the skyline is a reflection of the peneplanation of the Precambrian Shield (Photos 11 and 13). This peneplane surface rises from 700 feet near Dean Lake to 900-1,000 feet on the north edge of the map-area. In detail the region is very uneven, and locally the relief may be as much as 300 feet, though it is generally about 100-150 feet. Higher ground is found over the harder more siliceous rocks and over massive diabase bodies; in contrast, low areas tend to be found over the softer more argillaceous rocks and along dikes, joints, and faults. The lower areas are commonly swampy, but in parts of Patton and Gladstone townships mixed farming is, or has been, carried out on flat-lying areas underlain by glaciofluvial sand. Land is more suitable for farming along the valley of the Mississagi River and in Bright township between the Mississagi River and the Murray Fault.

The second area, that to the south of the Murray Fault, consists of granitic rocks overlain by glaciofluvial sands, clays, and gravels. South of the C.P.R. track this fosters a wooded, swampy wasteland with little outcrop. North of the track there is rather more relief, giving better drainage, and some cultivation is possible.

Iron Bridge Area

Photo 1



Red Rock Falls dam and generating station, Gladstone township.

Drainage

Drainage within the area is provided by the Mississagi and Blind rivers and their tributaries.

The Mississagi River flows southeasterly across the map-area. Recently an important reservoir and hydro-electric generating station have been constructed at Red Rock Falls (Photo 1). The Mississagi River and a tributary, the Little White River, are used for driving logs from the country north and northeast of the map-area.

Blind River drains Chiblow and Denman lakes, and the creeks in the eastern part of Patton township flow eastwards to join the Blind River. A major tributary, the Cobden River, drains eastern Gladstone and central Patton townships, flowing south to the outskirts of Iron Bridge, where it turns sharply and then flows slightly south of east through Patton and Thompson townships.

Bright Lake drains eastward via the Bolton River to the lower reaches of the Mississagi River. A few short, southerly-flowing creeks flow directly into the North Channel of Lake Huron.

Resources

Iron Bridge lies about 25 miles west of the Pronto uranium deposits and a similar distance to the southwest of the Elliot Lake uranium area. Much of the ground within the map-area was staked, but no diamond-drilling was undertaken within the map-area, since the probable depth to basement was considered too great. A deep hole (F.1) was collared at the east end of Demorest Lake in Township 167 (about 1 mile east of the northeast corner of the map-area), and another (P.1) on the north shore of Chiblow Lake a mile farther east. Those holes, both completed to the pre-Huronian basement, make it possible to predict the stratigraphy in the Chiblow Lake-Denman Lake area.

As indicated (*see* pages 2-4), the district has long been known for its copper showings, and small shipments of hand-picked ore have been made. These showings are normally quartz-chalcopyrite (with or without specular hematite, carbonate, pyrite, pyrrhotite, and possibly bornite) in fractures or breccia zones close to the contacts of large diabase intrusions. In 1956 active exploration was carried out on the old Northern Ontario Copper Mining Corporation's property in Thompson township; this work included the dewatering and examination of the underground workings. Following the conversion, in 1960, of the mill at the Pronto uranium mine to the production of copper concentrate, prospecting activity within the map-area increased. In 1962, active exploration was carried out on the old Glagoma mine, a mile northeast of Iron Bridge. A new adit was driven at the 80-foot level, and the shaft dewatered. Small shipments were made to the Pronto mine, but an operating profit was not achieved, and the operation closed in July 1962. In July 1962 copper mineralization was reported near the Bruce Limestone-diabase contact on the east bank of the Cobden River, west of Corbold Lake, Montgomery township. In August 1962, exploration of this deposit was continuing.

The chief industries are mixed farming, sporadic lumbering, and the tourist trade. Between 1958 and 1961 a large number of men were employed in the construction of the Red Rock Falls dam and generating station. This operation is capable of supplying about 50,000 kilowatts and is operated by remote control

Iron Bridge Area

from the George Rayner Generating Station, 15 miles upstream. The dam is 925 feet long and 93 feet high. A log-chute has been incorporated (Photo 1, right-hand side) so that the logging operations served by the river might continue.

Wild life abounds within the area, particularly in the more remote parts. Bear, deer, fox, and moose, as well as many smaller animals, are common. In recent years beaver have multiplied. Of the game birds there are several varieties of duck and partridge. Most of the lakes and rivers provide good fishing. Facilities for hunting, fishing, and aquatic sports, combined with the easy accessibility, make the area popular with tourists.

GENERAL GEOLOGY

The map-area includes part of the southwest elbow of the Blind River reverse-S structure. The surface trace of the axial plane of the Chiblow anticline lies close to the north edge of the map-area, where the following formations are exposed: Upper Mississagi Quartzite, Bruce Conglomerate, Espanola Formation (Bruce Limestone only) of the Bruce Group, and the Gowganda Formation of the Cobalt Group. Throughout the greater part of the area, bedrock consists of boulder conglomerate, greywacke conglomerate, arkose, quartzite, greywacke, and shale of the Gowganda Formation cut by Keweenawan diabase dikes and large irregular bodies of differentiated gabbro. Towards the south, dips become steep, and subsidiary folding increases as the Murray Fault zone is approached. Between the Murray Fault and the north shore of Lake Huron, Algoman granite-migmatite with admixed basic inclusions is exposed. Diabase dikelets are numerous. On the French Islands quartzites and argillaceous quartzites grade upwards into quartzites typical of the Upper Mississagi Formation as exposed to the east in the southern parts of Cobden and Striker townships (O.D.M. Maps 1960, Nos. P.71, P.72).

The unconformity between the Cobalt and Bruce groups is manifest in the northern part of the map-area. That between the Bruce Group and the Algoman is obscured by drift and has not been proven in the map-area.

After the deposition of the Cobalt Group the area was folded and faulted; the Chiblow anticline formed. Dikes and irregular, differentiated bodies of Keweenawan (Nipissing-type) quartz diabase were then intruded. Further folding and faulting took place. The Lake of the Mountains fault—the youngest fault in the Blind River area—enters the southeast corner of Thompson township.

The Precambrian Shield was flooded by shelf seas during the Lower Paleozoic, since when it has remained a stable positive area subject to periodic rejuvenation. The present immature topography developed at the expense of the modified Precambrian peneplane prior to the Pleistocene glaciation.

Glaciation removed the soil that had developed, and irregular glaciofluvial clays, sands, and gravels were substituted. The greater part of the drainage system shows marked geological control, but locally, irregular drainage may be due to the Pleistocene deposits. Glacial rounding, grooving, and polishing of outcrops, scouring of the softer beds, striae, and chatter-marking are common. These indicate that the direction of ice flow was about S.15°W.

The early mapping by Murray and the modifications suggested by Collins have proved surprisingly accurate. The recent mapping has shown that the limestone and the underlying conglomerate in the Chiblow Lake sector (*see* pages 3, 4) are continuous with the Bruce Limestone and the Bruce Conglomerate

TABLE I—COMPARISON OF STRATIGRAPHICAL NOMENCLATURES USED IN THE SOUTHERN LIMB OF THE BLIND RIVER REVERSE-S STRUCTURE

1	2	3	4	5	6
Logan and Murray (1863)	Coleman (1913)	Collins (1925)	Abraham (1956, 1957)	Roscoe (1956)	Robertson (1960)
Greenstone Intrusions	Intrusions	Keweenawan	Keweenawan	Keweenawan	Keweenawan
(Upper Members)	Cobalt	(Upper Members)	(Upper Members)	(Upper Members)	(Upper Members)
Upper slate conglomerate		Lorrain	(Lorrain)	(Lorrain)	(Lorrain)
Limestone		Gowganda	Gowganda	Gowganda	Gowganda
Lower slate conglomerate		Espanola Bruce Limestone	Espanola Bruce Limestone	Espanola Bruce Limestone	Espanola ⁽¹⁾ Bruce Limestone
White quartzite		Bruce	Bruce	Bruce	Bruce
Green chlorite slate ⁽²⁾		Bruce	Upper Mississagi	Ten Mile	Upper Mississagi
Grey quartzite		Mississagi	Middle Mississagi	Whiskey	Middle Mississagi
Laurentian Granite	Laurentian Granite	Granite	Algomian Granite	Algomian Granite	Algomian Granite
	Sudbury	Sudbury			Sudbury(?)
	Granite				Relationship unknown
	Keewatin	Keewatin	Keewatin	Keewatin	Keewatin(?)

⁽¹⁾The upper members of the Espanola Formation and the entire Serpent Formation are not found in the southern limb of the Blind River reverse-S structure.
⁽²⁾Later defined as intrusions.

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TABLE OF FORMATIONS

CENOZOIC

RECENT: Swamp, lake, and stream deposits.
PLEISTOCENE: Gravel, clay, sand, till.

Great Unconformity

PRECAMBRIAN

PROTEROZOIC

Keweenawan:

Diabase, gabbro, diorite, and granophyre, cut by later acid and basic dikes.

Intrusive Contact

Huronian:

Cobalt Group:

Gowganda Formation: conglomerate, greywacke, feldspathic quartzite, argillite.

Unconformity

Bruce Group:

Espanola Formation:¹ Bruce Limestone—limestone, siltstone.

Bruce Formation: Bruce Conglomerate—conglomerate, local quartzite lenses.

Upper Mississagi Formation: arkose, quartzite (in south).

Middle Mississagi Formation: { argillite
conglomerate } (in north)
argillaceous quartzite (in south)

Lower Mississagi Formation: arkose, quartzite. (Not exposed in map-area.)

Great Unconformity

ARCHEAN

Pre-Huronian soils.

Algonian:

Migmatite, granite gneiss, granite and allied rock types.

Intrusive Contact

Sudbury Group:

and Keewatin(?):

Relationship to each other unknown, appear as sedimentary or basic phases of migmatites or as undifferentiated inclusions in Algonian.

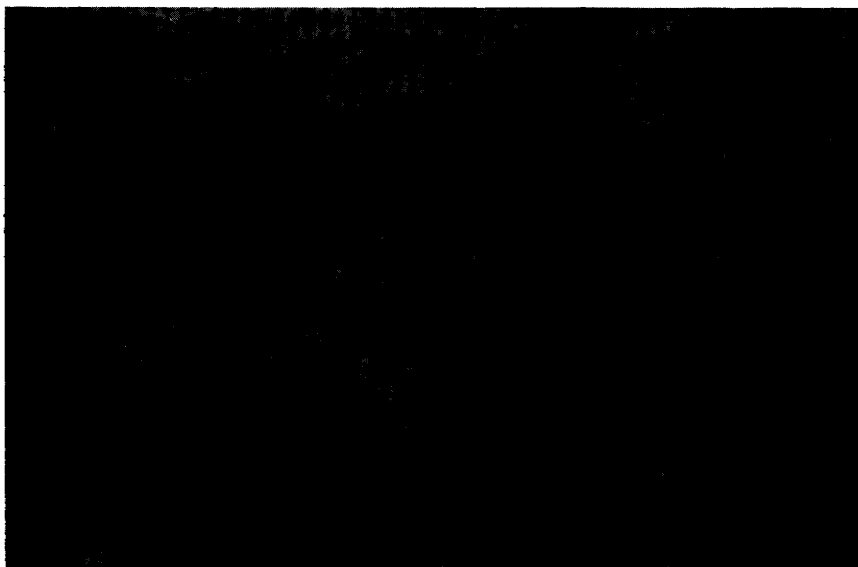
¹Upper members removed by pre-Cobalt erosion.

of the Quirke syncline, with which they are, therefore, conclusively correlated. Much detail, particularly regarding the distribution of diabase and other specific rock types, has been added. However, the outstanding accomplishments of Murray and Collins, considering the conditions under which they worked, should be recognized.

Archean

Throughout the Blind River area the Archean consists of Keewatin-type metavolcanics interbedded with metasediments, grey granodioritic gneisses with basic inclusions, and massive red quartz monzonite. Within the map-area only the granitic rocks, ascribed to the Algomian, occur as mappable units.

Photo 2



Algomian migmatite; north shore of Lake Huron, due south of Eley Station, Bright township.
Dark grey is amphibolite, light grey is gneissic granite, grey-white
is aplite and pegmatite.

Algomian Basement Complex

Rocks of the Algomian basement complex are exposed only in the area between the Murray Fault and the north shore of Lake Huron. Exposures are generally poor, being small, partially covered by drift and vegetation, and cut by numerous diabase dikes and dikelets. To the south of the C.P.R. tracks the rocks are mostly covered by Pleistocene and Recent deposits.

The complex consists of biotite and hornblende migmatite, gneissic to massive pink biotite granites, and red porphyritic biotite granite. Quartz veins, aplite, and pegmatitic phases are common, particularly in the gneissic and migmatitic sectors.

The massive porphyritic varieties tend to occur in a zone striking east-west lying close to the present shore of Lake Huron; the gneissic and migmatitic varieties are best-developed towards the north and northwest of the granitic outcrop

Iron Bridge Area

area. This relationship is that found throughout the Blind River area as a whole, and described by the author (Robertson 1960, p. 281), where east-trending bodies of massive quartz-monzonite are surrounded by variable granitic rocks grading outwards into grey, gneissic, granodiorite with inclusions of basic volcanic rocks and, locally, metasediments. However, the steeply-dipping to vertical gneissosity observed in the migmatitic gneiss of Bright township strikes slightly east of north rather than the east-west direction typical of the region. Within the basic migmatites, boudinage of the host rock and pinch-and-swell of the intrusive granite have been observed.

The age of the host component in the migmatite is not known with certainty. However, rocks normally regarded as belonging to the Sudbury Group are included in the Cutler batholith (either late Algonian or Penokean in age), which occupies a similar structural relationship to the Murray Fault, about 20 miles to the east. These Sudbury Group rocks are quartzites and mica-staurolite-garnet schist cut by metadiorite, normally massive. Keewatin(?) rocks in migmatite zones near Elliot Lake are largely basic volcanic rocks giving rise to amphibolites and chlorite schists (Abraham 1956, Robertson 1961). It may well be that in the Dean Lake sector of the Iron Bridge map-area both Sudbury Group sedimentary rocks and Keewatin(?) volcanic rocks provided the host rocks for the Algonian migmatite complex.

At Demorest Lake, Chiblow Lake (northeast of the northeast corner of the map-area), and in Scarfe township to the east, drillholes bottom in granitic rocks. The more easterly holes bottom in grey, massive to gneissic, granodiorite; the more westerly holes bottom in a medium- to coarse-grained, porphyritic granodiorite, with phenocrysts of flesh-coloured microcline up to $\frac{1}{2}$ inch across; this probably also underlies the Huronian rocks of the northeastern part of the map-area. The mineralogical composition is as follows: quartz 15–40 percent; microcline 5–27 percent; plagioclase (andesine-oligoclase) 42–68 percent; and chloritized biotite 4–10 percent. The accessory minerals are apatite, iron oxides, epidote, carbonate, sphene, zircon, and monazite. The microcline occurs largely as phenocrysts, and the distribution of these is probably responsible for the apparent wide range in the mineralogical composition of the rock. The microcline shows exsolution of sodic plagioclase; the plagioclase is normally zoned and saussauritized or sericitized—the cores more so than the margins. Sphene and titaniferous magnetite are altered to leucoxene and biotite to chlorite (penninite) and magnetite. Hornblende may be represented by aggregates of epidote, chlorite, and magnetite; apatite and sphene are frequently associated with such aggregates.

The chemical character of the porphyritic granodiorite of the Chiblow-Matinenda lakes area is summarized in Table II (*see* page 15).

In thin sections, both the gneissic and massive granites of the Dean Lake area are seen to consist of quartz, plagioclase, and microcline—each comprising about 32 percent by volume of the rock—and 4 percent chlorite replacing biotite. The quartz is generally strained; the plagioclase is strongly altered to sericite but was originally calcic oligoclase; microcline is fresh to slightly altered; and the biotite is almost completely altered to chlorite (penninite). Primary muscovite may be present but is normally absent. The accessory minerals are magnetite, ilmenite, hematite (largely as dust in the feldspars), monazite, sphene (partially altered to leucoxene), apatite, and zircon. The sulphides pyrite, chalcopyrite, and pyrrhotite may be present, but it is not clear whether these are accessory minerals or were introduced after the rock solidified.

TABLE II—COMPARISON OF AVERAGE CONTENTS OF ALKALI AND FERROMAGNESIAN CONSTITUENTS OF THE RED AND GREY PHASES OF THE ALGOMAN GRANITES
(Partially after Robertson 1960, p. 61)

Type	K ₂ O	Na ₂ O	$\frac{K_2O}{Na_2O}$	CaO	FeO	MgO	$\frac{MgO}{FeO}$	MnO
Grey.....	percent 2.66	percent 5.29	0.51	percent 1.91	percent 1.66	percent 1.22	0.62	percent 0.038
Mean deviation..	0.70	0.64	0.14	0.80	0.58	0.57	0.25	0.017
Red.....	4.70	3.68	1.29	1.06	0.88	0.52	0.60	0.016
Mean deviation..	0.78	0.44	0.26	0.62	0.42	0.37	0.22	0.008
South of Iron Bridge	3.88	3.24	1.19	1.25	1.05	0.82	0.78	0.020
Matinenda-Chiblow.	1.37	5.89	0.25	0.50	1.80	1.03	0.60	0.035

Only one granite from the map-area has been analyzed chemically. This was a slightly gneissic granite from about 2 miles south of Iron Bridge. In a hand specimen and in a thin section it was intermediate in character between the massive red granite and the grey gneissic granite. Table II compares the average contents of alkali and ferromagnesian constituents of this sample with an average of three samples taken from the Matinenda-Chiblow porphyry, and with the corresponding values for the "red" and "grey" granites throughout the Blind River area. These components have been found to be the most significant for comparison purposes. Thus, chemically the Iron Bridge sample is intermediate between the two phases; on the other hand the granitic rocks of the Matinenda-Chiblow lakes area are very close chemically to the typical grey-phase granites.

Throughout the area (*see* Table II) the red phase is characterized by high potash, a high potash-soda ratio, and low calcium and ferromagnesian constituents, and by a less marked variation in these constituents. Where the granites are contaminated by greenstone inclusions, the resulting hybrid rocks are enriched in ferrous iron, magnesium, calcium, titanium, and strontium. Of the trace constituents, Rb follows K, Sr follows Ca, and Mn follows Fe plus Mg; zirconium is twice as abundant in the red phase as in the grey, and chromium is characteristically absent in the red although present in the grey. The accessory mineral assemblages derived from both types are similar (Robertson 1960, Table 14). The dominant species from the grey phase are biotite, hornblende, sphene, titaniferous magnetite, and apatite; those dominant in the red are biotite, apatite, magnetite, monazite, sphene, zircon, and epidote. Monazite and sphene are sporadically distributed in both phases and are characteristic of the more porphyritic varieties. Zircon in the grey phase is hyacinth, whereas in the red phase it is malacon. Apatite is more abundant in hornblendic varieties.

When the areas of outcrop of the various granite types are compared with the distribution of radioactivity anomalies (O.D.M. Maps 1955) it is revealed that usually the anomalies over basement areas are restricted to outcrops of massive red-phase granite. However, such anomalies are not found in the southern parts of Bright and Thompson townships; this could be due to the lack of relief and the extensive drift deposits in the area.

It may be pointed out that the presence of potassic granites in masses of batholithic dimensions, generally red in colour, has been known for some time, and there has been a tendency to regard such granite as Killarnean, i.e. post-

Iron Bridge Area

Huronian in age and contemporaneous with the Grenville orogeny (Harding 1950: Moore and Armstrong 1945, p. 12). However, it has been shown, particularly in the Quirke Lake area, that the basal members of the Huronian rest with pronounced unconformity on both red and grey granites alike (Robertson 1961). The macroscopic and microscopic characteristics of the rocks of the Dean Lake area compared with those of the granitic rocks exposed north of the Murray Fault, and the structural and stratigraphic relations observed in Cobden and Striker townships (O.D.M. Maps 1960, Nos. P.71, P.72), leave little doubt of the pre-Huronian age of the rocks in question. A large granite body, the Cutler batholith, occupies a similar position south of the Murray Fault about 20 miles to the east. The Cutler granite was considered by Eskola and Collins (Collins 1925, p. 87) to be Killarnean in age. However, this has not been proved, and in view of the relationships of the Dean Lake granites a pre-Huronian age for the Cutler granite is a strong possibility. (Recent age-determinations, however, suggest a Penokean age for the Cutler batholith).

Post-Algoman Interval

Throughout the Blind River area the Huronian rests with marked unconformity on the Algoman complex. The boundary surface, although irregular, is approximately parallel to the bedding in the Huronian. The boundary is not exposed in the southern part of the map-area, but such evidence as is available suggests that in the southeast corner of the map-area it lies close to the shore of Lake Huron. Transition zones have been observed in granites south of the Murray Fault between Blind River and the west end of Lauzon Lake (O.D.M. Maps 1960, No. P.72). The drillholes at Demorest and Chiblow lakes (F.1 and P.1) passed through a "transition zone" of crumbly unsorted granitic material lying between the Lower Mississagi Formation and the Algoman granite. The material is yellow-green in colour and towards the base assumes a granitic texture. Such a "transition zone" has been observed in drill core and on surface throughout the entire Blind River area, and it is generally interpreted as a regolith (fossil soil) developed during the Archean-Proterozoic interval.

Both P. J. Pienaar, formerly a post-graduate student at Queen's University at Kingston, who carried out research on the origin of the Blind River uranium deposits under the sponsorship of the Geological Survey of Canada, and the author have investigated the chemical nature of the regolith. The author analyzed two samples, one from near the top of the regolith and one from near the base, from the transition zone intersected in the Demorest drillhole, and Pienaar analyzed a sample of regolith developed over red quartz monzonite in the Quirke Lake area. In Figure 3, straight-line diagrams have been drawn comparing:

- 1) Red granite and transition material, Quirke Lake.
- 2) The average composition of six grey granites in the Matinenda Lake area, with the upper transition material developed from similar granite at the east end of Demorest Lake.
- 3) The upper and lower transition material developed above grey-phase granite at the east end of Demorest Lake.

The diagram reveals the relative gains and losses of constituents during the formation of the regolith. They have the following features. In all three cases silica remains constant, and alumina shows a slight increase. This compares with observations by Leith and Mead (1915), who showed that during weathering

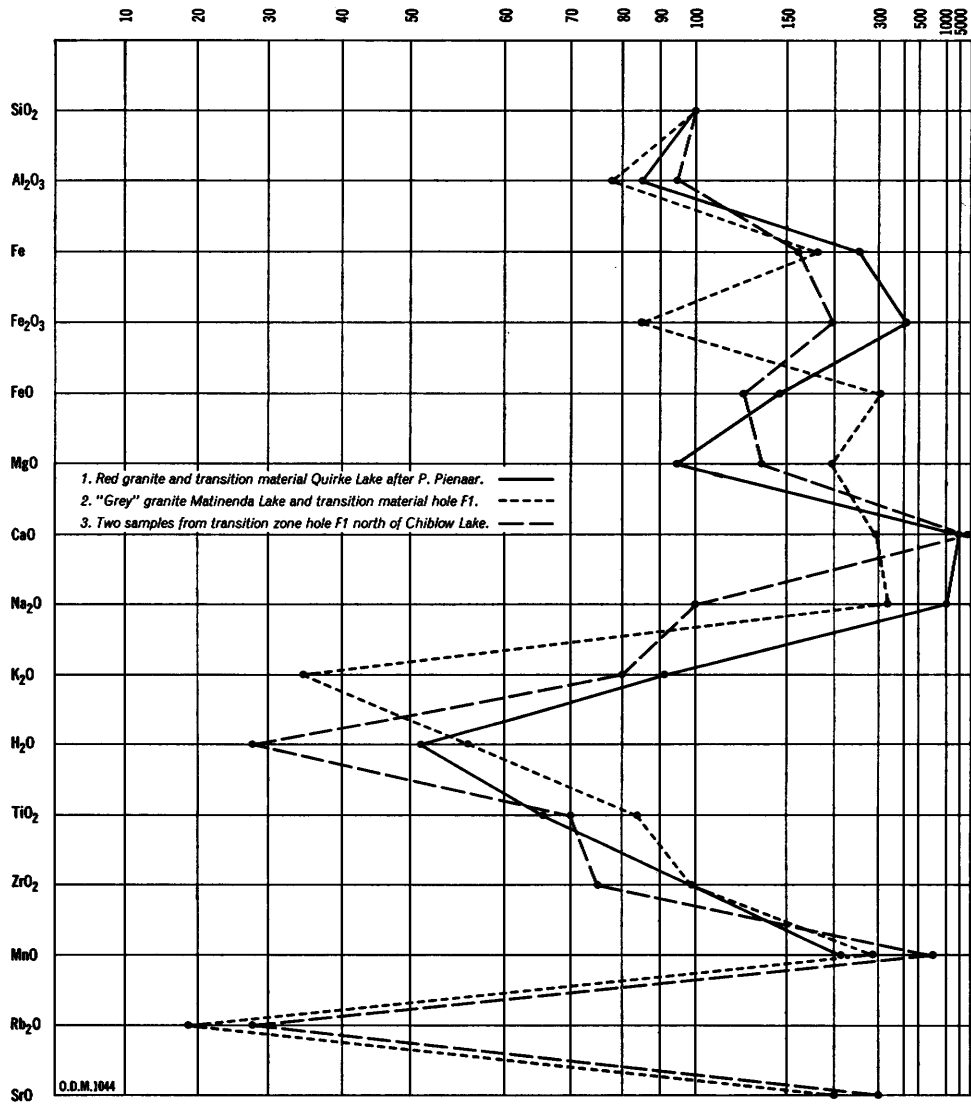


Figure 3 — Straight-line diagram illustrating formation of regolith.

Iron Bridge Area

alumina remains constant and silica is slightly reduced. In two cases zirconia is constant and in one case is enriched—an expression of the stability of zircon. Of the other components, total iron, ferric iron, ferrous iron (the former in preference to the latter), magnesia, and manganese have been partially lost; soda, lime, and strontia are practically completely removed, whereas potash, rubidia, and water are enriched in the transition material. This reflects the removal of soluble constituents, the stability of potash feldspar, and the hydration of clay minerals. The trace elements follow the major elements in the following groups: Mn-Mg, Rb-K, and Sr-Ca.

In two of the three cases (Nos. 1 and 3) ferric iron has been lost. (That ferric iron is enriched in case No. 2 is probably due to a difference in the composition of the parent rock from the average rock of the Matinenda Lake area, because case No. 3 shows that, in the formation of the material, which must be regarded as progressive, ferric iron was removed.) In all three cases total iron has been lost, suggesting that ferric iron was converted to ferrous and removed by leaching. Such a reduction may have been due to exclusion from the atmosphere by overlying material or to an atmosphere deficient in oxygen. Whatever the cause may be, it is of interest, since regolith material contributed to the formation of the uraniferous, pyritiferous, oligomictic conglomerates of the basal Lower Huronian.

Proterozoic

Rocks of Proterozoic age, the Huronian sedimentary rocks and the Keweenawan diabase, form the bedrock north of the Murray Fault and also the islands in the North Channel of Lake Huron.

The exposed Huronian is divided into the Upper Mississagi Formation, the Bruce Formation, and the Bruce Limestone member of the Espanola Formation, all comprising the Bruce Group, unconformably overlain by the Gowganda Formation of the Cobalt Group. The Gowganda Formation is a heterogeneous assemblage of conglomerate, quartzite, arkose, greywacke, argillite, and siltstone. The Huronian rocks are only slightly metamorphosed, and original structures such as bedding, crossbedding, ripple-marks, and mud-cracks are present. The complete table of formations is given on page 12, and a comparison of the different stratigraphical nomenclatures used in the Iron Bridge area is given in Table I (page 11).

Bruce Group

The lowermost group of the Huronian is the Bruce Group, which is made up of the Lower Mississagi Formation, the Middle Mississagi Formation, the Upper Mississagi Formation, the Bruce Formation, the Espanola Formation, and the Serpent Formation. Within the map-area the basal members of the Gowganda Formation lie unconformably normally on the Bruce Limestone member of the Espanola Formation but locally on the Bruce Formation. The individual formations of the Bruce Group are easily distinguished in the field and in drill core and can be readily traced, except where they are cut out by the Gowganda Formation.

Mississagi Formations

The Mississagi Formation, as originally defined by Winchell (1887) and understood by Collins (1925), comprises the oldest Huronian sedimentary rocks in the district, and because the lowermost beds contain uranium and thorium it is

the formation in which most interest has been taken. The formation as mapped by Collins, may now, within the confines of the Quirke syncline, be subdivided into three formations. These are the Lower Mississagi—arkose, conglomerate, and quartzite; the Middle Mississagi—basal polymictic conglomerate overlain by argillite; and the Upper Mississagi—quartzite and arkose. S. M. Roscoe has introduced a new local nomenclature for the Huronian (Table I, column 5). Roscoe's formational boundaries coincide with those of the author, except that an argillite-greywacke sequence at the top of the Lower Mississagi, as exposed in Townships 149 and 143 to the east of the Nordic Mine, has also been given formational status.

These formations and their members are easily discernible within the Quirke syncline (Robertson 1956; 1960; 1961; 1962; Roscoe 1957) and are intersected in the Demorest and Chiblow drillholes in Township 167. However, the Middle Mississagi basal conglomerate cannot be traced along the south limb of the Chiblow anticline southeast of Lake of the Mountains in Striker township (O.D.M. Maps 1960, No. P.72). The argillite, when traced in a similar direction, passes into a sequence of interbedded quartzite, silty quartzite, siltstone, and minor argillite with transitional boundaries to both the Upper and Lower Mississagi formations. This latter type of sequence is repeated on the upthrow (south) side of the Murray Fault between Algoma and Blind River (O.D.M. Maps 1960, Nos. P.71, P.72, P.73). The boundary zone of the Middle and Upper Mississagi formations may be traced farther west into the Iron Bridge map-area, where it is believed to follow the north shore of the French Islands.

LOWER MISSISSAGI FORMATION

The Lower Mississagi Formation is not exposed within the map-area. It is, however, intersected in the Demorest Lake drillhole and is believed to underly Mississagi Bay north of the French Islands.

The following is derived from the company drill-log¹ of hole P.1 of Matinenda Uranium Mines Limited, on the north shore of Chiblow Lake in Township 167.

FOOTAGE	DESCRIPTION
1,267.....	Base of Middle Mississagi conglomerate.
1,267-1,575.....	Grey to white quartzite—variable grain size and feldspar content, locally greenish and sericitic. Pyrite may occur, but no radioactivity.
1,575-2,175.....	Green sericitic feldspathic quartzite and arkose, occasional thin bands of quartz conglomerate—pebbles pea-sized, some pyrite and faint radioactivity. Some pebble bands, up to 4 inches thick with pebbles up to ½ inch, and dark pyritic matrix, gave geiger readings 5-8 times background. No samples were assayed.
2,175.....	Transition zone.

A similar sequence was intersected in hole F. 1 at the east end of Demorest Lake.

The Lower Mississagi Formation is not well-exposed to the west of Blind River, but exposures to the east (O.D.M. Maps 1960, Nos. P.72, P.73) consist of greenish, sericitic, arkosic quartzite with scattered pebbles grading upwards to

¹Submitted for assessment credit

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grey, well-bedded, feldspathic quartzite, and quartzite. A reliable estimate of the thickness of the Lower Mississagi Formation in the southeastern part of the map-area is not possible.

J. P. McDowell, in a regional study of the character of the Mississagi Quartzite, has suggested that the Lower Mississagi was derived from a weathered granite terrane by southeasterly-flowing streams. No crossbedding determinations were made close to the present map-area (McDowell 1957).

MIDDLE MISSISSAGI FORMATION

The normal facies of the Middle Mississagi Formation, comprising basal conglomerate followed by argillite, is found at depth in the drillholes on Demorest and Chiblow lakes. The southern facies, consisting of silty quartzites, quartzite, with argillite partings, probably lies immediately north of the French Islands.

The Middle Mississagi basal conglomerate contains boulders, cobbles, and pebbles of white granite, greenstone, and, rarely, quartzite, and fragments of quartz, feldspar, and argillite, randomly distributed in a matrix ranging from siliceous greywacke to siltstone. Interstitial sulphides, particularly pyrite but also pyrrhotite and, more rarely, chalcopyrite, are present. In the Demorest Lake drillhole (F.1) about 39 feet of conglomerate was intersected, but in the Chiblow drillhole (P.1) only 11 feet was recovered.¹

In the Quirke Lake area the Middle Mississagi Conglomerate rests on the Algonian basement; in the Elliot Lake area, on the Nordic Argillite of the Lower Mississagi Formation; and in the Lake of the Mountains area, on Lower Mississagi Quartzite. Roscoe (1957, pp. 9-10) regarded the conglomerate as "the most important horizon marker within the lower Huronian succession" and used it as the basis for his classification.

In the Demorest and Chiblow drillholes, as in the Quirke syncline, the Middle Mississagi Conglomerate is overlain by thinly-bedded, fine-grained, black to grey, argillites and greywackes with a total thickness of 311 feet in P.1 and 421 feet in F.1. Pyrite, and minor pyrrhotite, and chalcopyrite are disseminated through the argillite, and small blebs were encountered in drillholes. Upwards, the argillite passes through interbedded quartzites, greywackes, and argillite, into the Upper Mississagi Formation, which consists of quartzite and feldspathic quartzite.

When traced southeast along the outcrop of the south limb of the Chiblow anticline, the Middle Mississagi argillite member decreases to between 25 and 40 feet in thickness south of Emerald Lake (O.D.M. Maps 1960, No. P.69). Farther southeast the Middle Mississagi Formation is represented by interbedded siltstone and quartzite with little fissile argillite (O.D.M. Maps: 1960, Nos. P.72, P.73; 1961, No. P.131). Individual beds are only a few feet thick. The quartzite members are coarse-grained, feldspathic, and crossbedded, and cannot be distinguished from those of the underlying Lower Mississagi Formation or of the overlying Upper Mississagi Formation. The silty quartzite and siltstone beds range in thickness from a few feet to 30 feet; they are dark grey when fresh but weather light to rusty grey. A conchoidal to subconchoidal fracture is characteristic. Minute amounts of disseminated pyrite may be visible. These rocks are repeated south of the Murray Fault and can be traced from Algoma to Blind River. West of Blind River the rocks are obscured by drift or by Lake Huron. The French Islands and the headlands between the Blind and Mississagi rivers are

¹Company drill-logs submitted for assessment credit.

composed of Upper Mississagi Quartzite dipping steeply south. Silty quartzite and argillaceous beds are interbedded with quartzite along the northern edge of the above outcrops. As quartzite is the dominant member, the upper boundary of the Middle Mississagi Formation has been placed just north of the French Islands. The lower boundary of the Middle Mississagi Formation has been extrapolated from Cobden township (O.D.M. Maps 1960, No. P.71). The total thickness of the Middle Mississagi Formation underlying Mississagi Bay is estimated as 900 feet.

Owing to the lack of exposure, the relationship of the Middle Mississagi Formation to the southwesterly extension of the Lake of the Mountains fault is not known. Probably the displacement is at least a quarter of a mile to the northeast on the northwest side of the fault.

Along with observations on the Middle Mississagi and the other formations of the Bruce Group throughout the Blind River area, the changes in Middle Mississagi facies from north to south within the map-area are interpreted as indicative of near-shore conditions to the north of the map-area and of deeper water to the south.

UPPER MISSISSAGI FORMATION

The Upper Mississagi Formation is exposed on the shores of Chiblow and Demorest lakes and southeast of Holmes Lake in the northeastern part of the map-area and also on the French Islands in the southeast. As with the Middle Mississagi Formation there are marked facies distinctions between the two localities.

Medium- to coarse-grained, light grey- to brown-weathering, grey to pale pink, crossbedded, feldspathic quartzite is exposed in high cliffs near the shores of Chiblow Lake. On the weathered surface the feldspars, predominantly microcline, are converted to clay minerals. Small grains of pyrite, some of which are euhedral, are sparsely scattered through the matrix. These and occasional ferromagnesian grains may be partially altered to limonite.

The uppermost 80 feet of the Upper Mississagi Quartzite is well-bedded, with argillaceous flaggy partings at not more than 5-foot intervals. These partings are strongly ripple-marked (Photo 4). There is no uniformity of direction of the ripple-marks—those on adjacent layers are frequently close to 90 degrees apart in the azimuth directions. Planar crossbedding is, however, more uniform, and McDowell (1957, Figure 5; 1963) has recorded the southeast direction characteristic of the Upper Mississagi Formation. Lower in the formation the partings become more widely spaced.

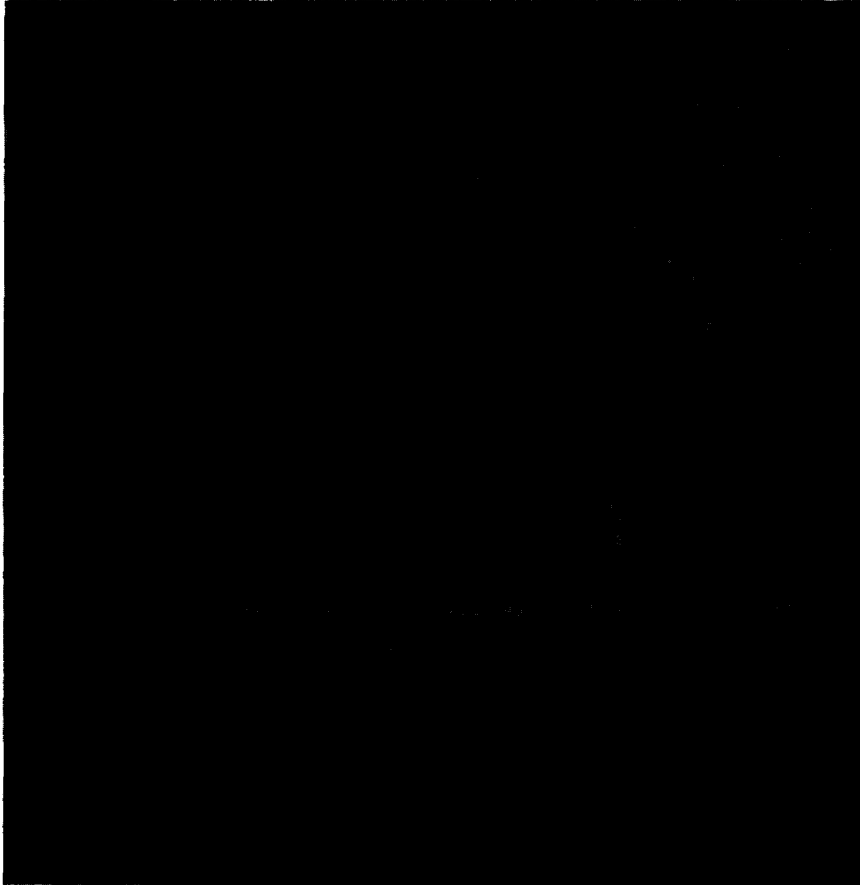
The lowermost beds in the area are exposed near the creek connecting Demorest Lake to Chiblow Lake and on the islands in Chiblow Lake. At these localities, between the quartzite beds there are thin bands or isolated pockets of pebbles of quartz, jasper, and chert; these are usually about $\frac{1}{2}$ inch in diameter but may be up to 1 inch (Photo 3). They are subangular to well-rounded, and the order of sorting is high. Similar pebbles are sparsely scattered within the quartzite beds. Such pebbles are widely distributed in the middle members of the Upper Mississagi Formation—particularly in the western part of the Quirke syncline and the northwestern part of the Chiblow anticline. However, to the east and south the frequency and size of the pebbles diminishes. On the basis of the regional size-distribution of chert pebbles McDowell (1957) estimated that

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the source area of the Mississagi lay 130–250 miles west-northwest of Thessalon. Thin beds of dark grey-green, micaceous, feldspathic siltstone are also found interbedded with the quartzite at the above localities.

The uppermost beds of the Upper Mississagi Formation are again exposed southeast of Holmes Lake. The area of exposure is bounded by faults. Here the formation is represented by coarse-grained, feldspathic, white quartzite.

Photo 3

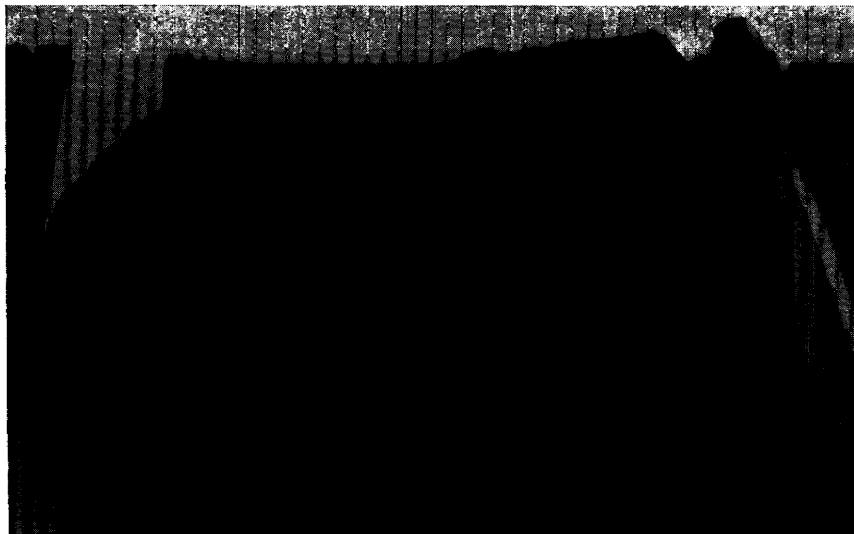


Upper Mississagi Quartzite. Note crossbedding and chert-jasper pebble band.
Large island in Chiblow Lake.

The Upper Mississagi Formation also forms the French Islands in the south-east corner of the map-area. From observations in Cobden township (O.D.M. Maps 1960, No. P.71) it is believed that the greater part of the formation (about 1,200–1,500 feet) is exposed. The quartzite is medium- to coarse-grained, greenish grey when fresh but weathering grey to white with rusty patches, well-sorted, and crossbedded. Individual beds are only a few feet thick and may be separated by argillaceous, silty, or rarely, sericitic bands a few inches thick. Ripple-marks have not been recorded, and pebble bands are not common.

As with the Middle Mississagi Formation it is clear that the beds in the Chiblow Lake area were laid down in shallow water with intermittent exposure, whereas those of the French Islands were deposited in rather deeper water.

Photo 4



Flaggy Upper Mississagi Quartzite, showing ripple-marks; Southwest bay, Chiblow Lake, Patton township.

BRUCE FORMATION

The cliffs around Chiblow Lake are capped by massive, black, siliceous, greywacke conglomerate—the lower slate conglomerate of Murray and the Bruce conglomerate of Collins. This conglomerate lies conformably on the Upper Mississagi Formation and is about 250 feet thick. The typical rock consists of subangular to subrounded boulders and cobbles of white granite, gneiss, diabase, and greenstone, and angular to rounded pebbles and fragments of quartz, feldspar, chert, and jasper, set in a highly siliceous gritty greywacke matrix. The matrix is characterized by well-rounded grains of smoky quartz up to $\frac{1}{10}$ inch across. Pyrite is disseminated throughout the matrix and is often found between the pebbles and the matrix, occasionally replacing the quartz and feldspar fragments. On the weathered surface of the rock this pyrite gives rise to irregular rusty patches. The outer quarter-inch of rock is generally light grey in colour owing to leaching during weathering.

Because the matrix is harder than the boulders the latter tend to weather more rapidly, giving the rock a pitted surface. Frequently both are of similar hardness and weather evenly (Photo 5). In the upper members of the formation, where the matrix tends to be more chloritic, the boulders may weather less rapidly than the matrix.

Occasionally there are small lenses of well-washed, white-to rusty-weathering, white, feldspathic quartzite. These are more common in Scarfe township to the southeast (O.D.M. Maps 1960, No. P.68). The quartzite lenses and, more rarely, the matrix of the conglomerate are slightly calcareous.

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The conglomerate thus is similar to the Bruce Conglomerate as described by Collins. Moreover, recent mapping in the Blind River camp has progressed sufficiently to show that the Chiblow conglomerate is continuous with the Bruce Conglomerate of the Quirke syncline (Robertson 1960; 1961, p. 17; 1963, p. 23. Frarey 1961a; 1961b) and has therefore disproved Collins' contention that the Chiblow conglomerate was the basal member of the Gowganda Formation.

Photo 5



Bruce Conglomerate; east shore of Denman Lake, Patton township.

The outcrop of the Bruce Conglomerate is duplicated in a narrow strip along the west side of a north-trending gabbro body in northwest Patton township and southeast Montgomery township. In this locality neither the lower nor the upper contact is exposed.

The Bruce Formation is again exposed in the northwest corner of the map-area, where the southwest corner of the Parkinson dome is duplicated on the southwest side of a northwest-trending gabbro body. Again the contacts with the underlying and overlying formations are not exposed.

Conglomerate of the Bruce Formation forms cappings on the Upper Missisquoi Quartzite southeast of Holmes Lake. The contact is sharp, and conglomerate can be seen filling vertical fractures in the quartzite. Such dikes of sedimentary rock indicate a break in sedimentation between the two formations.

No Bruce Conglomerate has been observed on the French Islands. Some 60 feet of sparse pebble conglomerate was observed on the shore of Lake Huron in Cobden township, $\frac{1}{2}$ mile west of Comb Point and 1 mile southwest of Blind River (O.D.M. Maps 1960, No. P.71).

The Bruce Formation is thus a thick boulder conglomerate in the north and a thin pebble conglomerate in the south and, therefore, conforms to the north-south facies pattern of the lower units of the Bruce Group.

ESPANOLA FORMATION

Throughout the North Shore area a series of limestones, siltstones, and dolomites overlies the Bruce Formation conformably. In the Quirke syncline it is possible to distinguish three mappable units: a lower, characterized by limestone—the Bruce Limestone; a middle, characterized by mudstone and greywacke—the Espanola Greywacke; and an upper, with a marked development of ferruginous dolomite—the Espanola Limestone. However, elsewhere in the North Shore area, Collins (1925, p. 54) found that it was not possible to make the above distinction, and accordingly he grouped all three as the Espanola Formation. Quirke (1917, pp. 33–38) had previously ascribed formational rank to each of the above-mentioned units as exposed in the Espanola area. In the Iron Bridge map-area, Abraham (1957) had followed Collins in considering the limestone in the Chiblow Lake area as an integral part of the Gowganda Formation. When mapping in the Quirke syncline, Abraham (1956) removed the Bruce Limestone from the Espanola Formation and placed it in the Bruce Formation with the Bruce Conglomerate. This arrangement has the merit of emphasizing the cyclical nature of the Bruce Group, which can be divided into a number of units each characterized by an arenaceous or rudaceous basal member grading upwards into an argillaceous or calcareous upper member. The mine geologists (C.I.M.M. 1957, p. 8) used the following formational names: Bruce Conglomerate, Bruce Limestone, and Espanola Formation. Frarey (1959; 1961a; 1961b), Heinrich (1958), Roscoe (1957), and the author have followed Collins' nomenclature in this respect.

Of the three members of the Espanola Formation, only Bruce Limestone occurs within the Iron Bridge map-area; the upper members were removed by pre-Gowganda erosion.

Bruce Limestone

The Bruce Limestone–Bruce Conglomerate contact is not exposed within the map-area. Elsewhere in the Blind River area it is a conformable and, locally, gradational contact (Robertson 1961, p. 18). The Bruce Limestone is made up of finely-banded, interbedded, creamy limestone, grey siltstone, and rusty-weathering dolomitic limestone. The weathered surface is strongly etched, reflecting the different weathering susceptibilities of the various components (*see* Photo 6). The rock is characterized by contortion of the bedding, which combined with the etching gives the outcrops a striking appearance. Holmes (C.I.M.M. 1957) and Pienaar (1958) have contended that contortion is due to slumpage in the partially consolidated stage. However, the majority of the folds are congruent to the

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limbs of the syncline and indicate that the upper beds have moved away from the axial plane of the syncline and towards that of the anticline. Axial-plane cleavage associated with these folds dips at a steeper angle than the general dip of the bedding. These features suggest that the contortions are dragfolds superimposed on the Bruce Limestone, which acted as an incompetent member during the folding of the region. Well-bedded limestone may pass laterally into breccia consisting of disoriented angular fragments of banded limestone set in a structureless limestone matrix. These breccias are intraformational breccias and are

Photo 6



Bruce Limestone; northwest corner of Patton township.

indicative of slumpage in the partially consolidated sediments. Ripple-marks and mud-cracks have been observed in Bruce Limestone elsewhere, but none have been recorded in the present area.

The limestone bands range in thickness from a few millimetres to 10 or more centimetres. Generally they are composed of fine- to medium-grained, recrystallized calcite. Minor amounts of pale green chlorite, sericite, angular to sub-rounded grains of quartz, microcline, and fresh plagioclase are scattered throughout the rock. Occasional grains of zircon, apatite, and magnetite are also present. Pyrite, and more rarely chalcopyrite, are found as scattered cubes or blebs. The siltstone bands alternate with the limestone and consist of similar materials except that the grains of quartz and feldspar now form about 75 percent of the rock, and carbonate grains are comparatively rare. Calcite forms the cement in both the limestone and the siltstone layers.

The Bruce Limestone is exposed on an island in the northeast corner of Denman Lake and in one isolated outcrop on the shore of the southeast bay of the same lake. The outcrop has been traced to the north and east of Denman Lake into the Quirke syncline, and Collins' contention that the two limestones were of different age has been disproved (Map No. 2032, back pocket). Neither

Abraham, Frarey, nor the author has found any trace of limestone outcrop between Denman Lake and the west side of the Blind River valley, south of Chiblow Lake just east of the eastern limit of the map-area (O.D.M. Maps 1960, No. P.28). From the latter locality the Bruce Limestone can be traced southeast as far as Lauzon Lake north of Algoma. At both the Denman Lake occurrences and at the Blind River occurrence the Bruce Limestone is overlain by the basal members of the Gowganda Formation, which contain numerous small angular fragments of limestone. The total lack of outcrop southeast of Denman Lake may indicate that there the limestone was completely eroded prior to the deposition of the Gowganda Formation.

As with the underlying Bruce Formation, the outcrop of the Bruce Limestone is repeated on the west side of the north-trending diabase in northwest Patton and southwest Montgomery townships. Further outcrops of the Bruce Limestone are found in the northwest corner of the map-area, where the southwest nose of the Parkinson dome is repeated on the southwest side of a northwest-trending gabbro intrusive body (*compare* Frarey 1961b).

Close to the diabase intrusions mentioned above, the limestone is metamorphosed into a tough medium-grained rock, which may contain any or all of the following minerals: epidote, diopside, idocrase, and melanite, in addition to the calcite, dolomite, and quartz. Magnetite, with or without disseminated chalcopyrite and pyrrhotite, is also found close to diabase.

Metamorphosed Bruce Limestone is also exposed on the shore of Lake Huron southwest of Blind River (O.D.M. Maps 1960, No. P.71). The limestone is the youngest exposed rock in that locality.

Nowhere in, or near, the map-area is the full thickness of the Bruce Limestone preserved. A maximum of 50 feet is found in the northwest Patton-southwest Montgomery exposures. Within the Quirke syncline the total thickness of the unit is preserved, and this ranges from 80 to 150 feet but is normally about 100 feet.

No commercial use has been made of the Bruce Limestone within the present map-area. In 1962 a private company, Bridgeland Explorations Limited, was formed to explore the Bruce Limestone outcrop in Montgomery and Parkinson townships and the adjacent parts of the Iron Bridge sheet, on the assumption that the limestone might be a host rock for sedimentary copper deposits or a chemical trap removing copper from post-Huronian hydrothermal mineralized solutions. Minor mineralization has been found along the Cobden valley in Montgomery township and along the outcrop of the Bruce Limestone in northwestern Patton township.

Cobalt Group

The Bruce Group is followed unconformably by the Cobalt Group. The Cobalt Group consists of the Gowganda Formation, the Lorrain Formation, Banded Cherty Quartzite, and finally the Upper White Quartzite and Chert Quartzite (Collins 1925). Of these formations only the Gowganda Formation is exposed within the map-area. The Gowganda Formation is a heterogeneous assemblage of conglomerates, greywackes, siltstones, arkoses, and quartzites. The Lorrain Formation is typically white quartzite with quartz and jasper pebble bands. Boulders and large erratics of Lorrain Quartzite are found in the drift throughout the map-area.

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GOWGANDA FORMATION

By far the greater part of the map-area is underlain by the Gowganda Formation of the Cobalt Group. Many geologists believe that the Gowganda Formation accumulated under glacial or near-glacial conditions. It is generally not possible to trace individual beds for any great distance; though in Thompson and Cobden townships (O.D.M. Maps 1960, No. P.71) both quartzite and conglomerate beds can be followed for distances of up to 2 miles before they lens-out.

Although any one of the rock types mentioned (p. 27) may be found anywhere in the sequence, there is a general progression upwards from a dominantly conglomerate-quartzite sequence, through quartzite-conglomerate-greywacke, to argillite-greywacke-quartzite with minor conglomerate. A similar sequence has been observed in the Quirke syncline (Robertson 1960; 1961, p. 24; 1962, p. 41).

As the Gowganda Formation is the youngest sedimentary formation exposed within the map-area and as it is cut off down dip by the Murray Fault, the total thickness of the formation cannot be computed. The maximum thickness exposed within the map-area is about 1,850 feet, which is comparable to Collins' estimate of 1,600 feet (Collins 1925, p. 64, column 2) and is about the same as the total thickness, 1,700 feet, obtained in the Quirke syncline (Robertson 1963, p. 33) where the top of the formation has been identified. Therefore almost the entire Gowganda succession is probably exposed within the map-area.

The contact of the Cobalt Group with the underlying Bruce Group is not exposed within the map-area. However, in the southeast bay of Denman Lake, to the northeast of Denman Lake, in northwest Patton and southwest Montgomery townships, and in the Parkinson dome, the lowermost exposed conglomeratic members of the Gowganda Formation contain numerous angular to subangular fragments of Bruce Limestone, and the matrix is slightly calcareous. This clearly proves that there was a period of erosion prior to the deposition of the Cobalt Group. Moreover, as it is impossible to trace the Bruce Limestone between the southeast bay of Denman Lake and the Blind River valley in Scarfe township, there is evidence for angular discordance. Further observations within the Quirke syncline (Robertson 1960; 1961, p. 24; 1962, p. 41) indicate that the base of the Gowganda Formation is an angular unconformity and that tectonic disturbance and subsequent erosion had taken place between the deposition of the Serpent Quartzite (the uppermost preserved member of the Bruce Group) and the deposition of the Gowganda Formation.

The conglomerates—the best known rocks of the Gowganda Formation—show wide variations, but typically consist of boulders and cobbles of red granite, gneiss, diabase, and greenstone, with pebbles of the same rocks plus quartz, chert, jasper, siltstone, and, as already noted, in the lowermost members, limestone, scattered through a fine- to coarse-grained, dark green to black, greywacke matrix. Minor quantities of pyrite and occasionally chalcopyrite are disseminated throughout the matrix; the sulphides may surround and partially replace the quartz and feldspar grains. Granite boulders predominate; the majority of these have the same petrological and chemical features as the red phase of the Algoman granite, from which they were probably derived. It may be noted that white, massive to gneissic granite similar to that observed in the Bruce Conglomerate is a significant component in the vicinity of Denman Lake and in the central part of Parkinson township. However, in or near these localities, the Gowganda Formation rests directly on the eroded surface of the Bruce Formation.

The variation of the conglomerate may be expressed in terms of the size, shape, sorting, and packing of the boulders and the nature of the matrix. As Collins (1925) has pointed out, the conglomerates fall into three broad types: (1) dense boulder conglomerates; (2) sparse boulder greywacke conglomerates; and (3) laminated greywacke conglomerate.

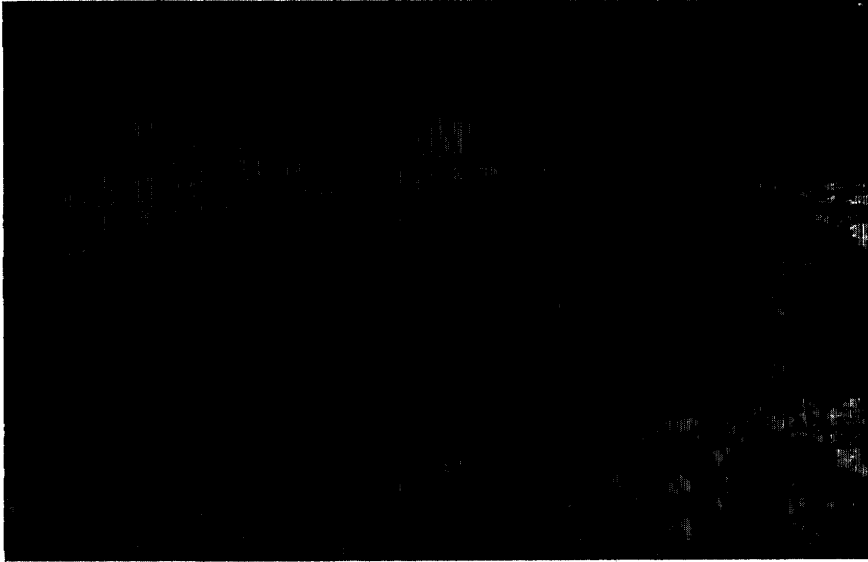
The dense boulder conglomerates occur particularly in the lower part of the formation but may be found throughout. The bedding is normally well-defined but massive, and frequently the basal contact of a bed is a definite erosional surface. The boulders may show considerable variation in size and shape, but normally there is a fairly high degree of sorting and some evidence of rounding, suggestive of water transportation. The matrix is usually a gritty quartzose greywacke and forms a comparatively small part of the total rock. Fragments of quartzite, greywacke, and conglomerate similar to the underlying members of the Gowganda Formation are also found in small quantities. Photos Nos. 7 and 8 illustrate the dense boulder conglomerates found in the Denman Lake area.

The sparse boulder-greywacke conglomerates are made up of the same materials as the dense boulder conglomerates, but the matrix now forms the greater part of the rock; it is medium- to fine-grained, and breaks with a sub-conchoidal fracture. The boulders and cobbles are scattered throughout the rock (Photo 9) and are only rarely in contact with each other. The matrix consists of poorly-sorted, angular to subangular grains of quartz, plagioclase, and microcline in a groundmass of silica, chlorite shreds, and magnetite and other iron oxides. The feldspars are only slightly altered to clay minerals and sericite. Minor amounts of pyrite, and rarely chalcopyrite, may be disseminated through the matrix, around grains or pebbles, or may replace quartz and feldspar. The matrix may show a slight lamination. Where the rock has a cleavage or is well-jointed, the intersection of the laminae and the cleavage allows the rock to break into triangular flakes and "pencils," which are scattered over the outcrop surface. The boulders are unsorted and may range to several feet across, though the majority are from $\frac{1}{2}$ to 3 inches in diameter. Shapes show considerable variation, but are generally subrounded to angular; subrounded boulders and cobbles with one side flattened or "soled" are common. The disparity of the boulder size and distribution compared with the fine grain and the texture of the matrix led Coleman (1914) and Collins (1925) to conclude that these rocks were tillites, i.e., conglomerates of glacial origin.

The laminated greywacke conglomerates are well-bedded greywackes with a few scattered rock fragments and pebbles with no characteristic shape or degree of sorting. The matrix of the conglomerate is finely laminated, each lamina having a medium-grained base and a fine-grained top. These are strongly reminiscent of Recent and Pleistocene varved clays and may be indicative of seasonal deposition under subtemperate conditions. The pebbles cut and depress the laminae beneath them, and the upper laminae are attenuated (*see* shale in Photo 12), indicating that the pebbles were dropped into position prior to the consolidation of the lower laminae and to the deposition of the upper. In Precambrian time, ice-rafting seems to have been the most logical means of transportation for the pebbles. In thin sections the graded bedding of the laminae is clearly revealed. Quartz, feldspar, and small rock fragments show the same relationships microscopically as the pebbles and boulders do megascopically. The weathered surface of the rock is slightly etched, and where there is a cleavage

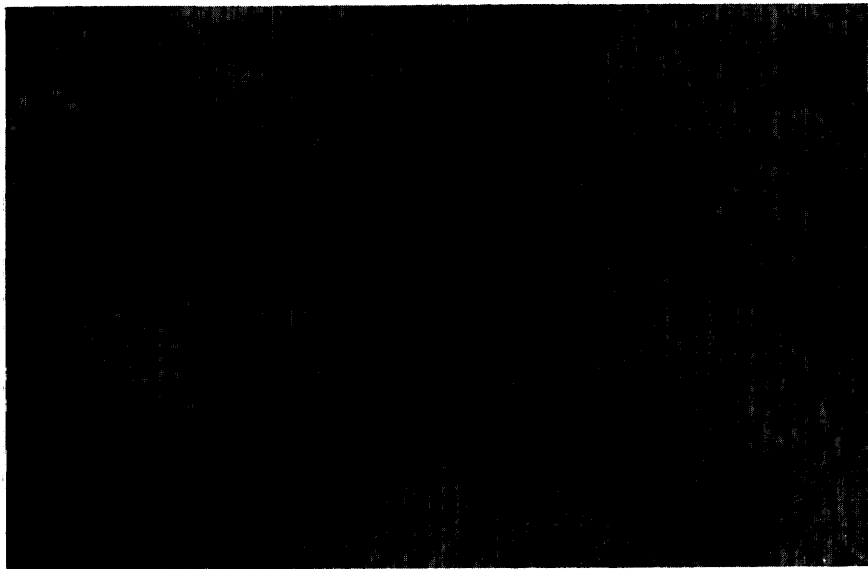
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Photo 7



Gowganda Formation: dense boulder conglomerate; southeast bay of Denman Lake, Patton township.

Photo 8



Gowganda Formation: dense boulder conglomerate; Mapleleaf Lake, Patton township.

the rock readily forms flakes and "pencils." Laminated conglomerates are best-developed in the middle and uppermost parts of the Gowganda Formation in the central and southern parts of the map-area.

After conglomerate, quartzite is the next commonest rock type. Again there is considerable variation in lithology and in composition. The most frequent type is a fine- to medium-grained, red-weathering, pink, feldspathic quartzite with conchoidal to subconchoidal fracture. The outer quarter-inch of the rock is frequently leached, and in the next quarter-inch the red colour is intensified owing

Photo 9



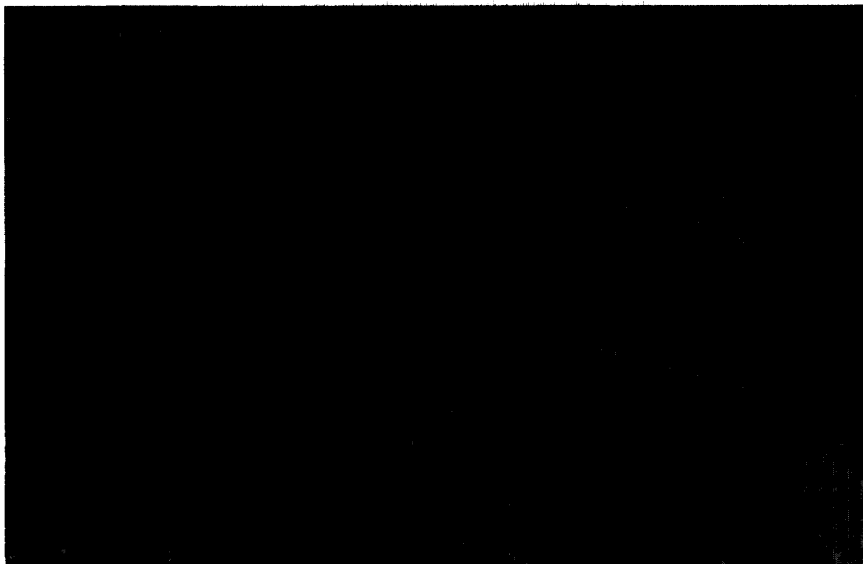
Gowganda Formation: sparse boulder greywacke conglomerate; highway 17, just west of Dean Lake road junction, Thompson township. Note glacial pavement.

to the redeposited iron. Bedding is well developed, and where the dips are intermediate, as in the northern part of Thompson township, a dip-and-scarp topography is formed. In the Dean Lake area, where the dips are steep, and the quartzite is interbedded with shale and, locally, conglomerate, the quartzite beds stand up as ribs (Photo 10). The colour of the rock is apparently a reflection of the amount of hematite enclosed in the plagioclase feldspar grains and in the interstitial dust. In the thin sections examined, sodic plagioclase is the dominant feldspar, and in several sections microcline is lacking; accessory minerals are zircon, magnetite, apatite, muscovite, and chlorite. Where quartzite has been more strongly metamorphosed, near large diabase bodies, the hematite may coat joint planes or appear in quartz-specularite veinlets. More rarely, patches of limonite, with or without associated pyrite, are scattered through the rock.

In the vicinity of Oscar and Darrell lakes in Patton township the dominant rock type is a well-bedded, fine- to medium-grained, white-weathering, grey quartzite, which tends to form high ground (Photo 11). The chief difference between this quartzite and the pink-weathering variety is a reduction in the

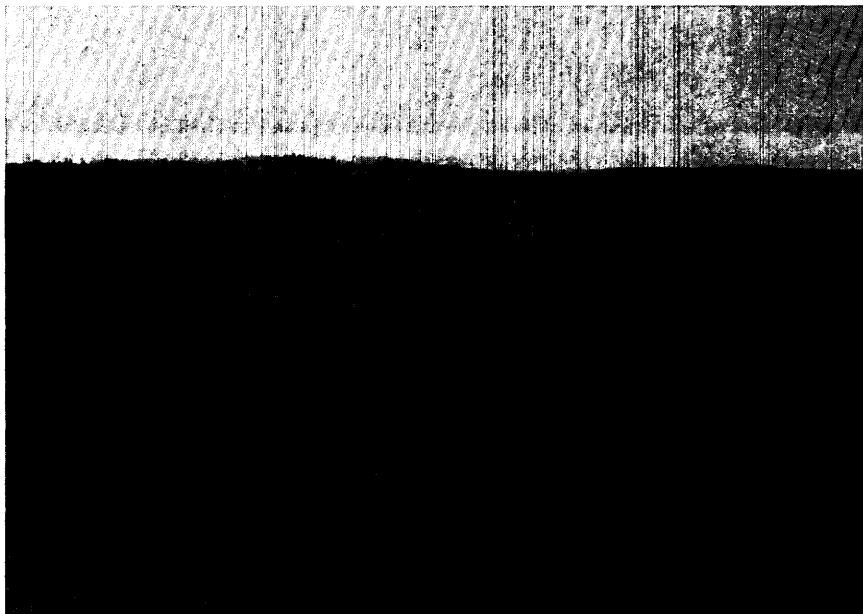
Iron Bridge Area

Photo 10



Gowganda Formation: interbedded feldspathic quartzite and shale; near Dean Lake, Thompson township. Note the differential weathering, the quartzite forming ribs, and the "pencil weathering" of the shale.

Photo 11



Gowganda Formation: south shore of Darrell Lake, Patton township. Cliff in middle distance comprises interbedded quartzite, conglomerate, and greywacke.

amount of disseminated hematite dust and a slight increase in the amount of argillaceous material in the matrix. The outer $\frac{1}{10}$ to $\frac{1}{4}$ inch is white, the next $\frac{1}{4}$ inch is pale brown to dark brown owing to deposition of secondary iron minerals during the weathering process.

Occasionally, and particularly in the northern part of Thompson township, medium- to coarse-grained arkose is developed at the expense of quartzite. These arkoses consist of angular to subangular, moderately sorted, microcline, plagioclase, and quartz grains set in a silica cement with very little matrix—in hand specimens the rock resembles a medium-grained granite. Accessory minerals are magnetite, chlorite, and rarely, zircon, muscovite, and magnetite. Hematite is present both in and around the feldspar grains.

The above-mentioned quartzites show few primary sedimentary features such as crossbedding and ripple-marks, though original grain texture and graded bedding may be observed. Occasionally the rock is completely recrystallized.

Another quartzite type is found in northeastern Gladstone township and the adjacent parts of Parkinson township. This is a fine- to medium-grained, white-weathering, grey, feldspathic quartzite characterized by a faintly discernible cross-lamination slightly oblique to the bedding. At first sight this quartzite resembles the Serpent Quartzite (the uppermost member of the Bruce Group exposed in the Quirke syncline) (Robertson 1961, p. 21). The rock consists of well-sorted, well-rounded to subangular, quartz and feldspar grains in a silica cement. As in the Serpent Formation, the dominant feldspar is sodic plagioclase with only minor amounts of microcline. Accessory minerals are magnetite, hematite, and chlorite.

Greywacke, similar to the matrix of the boulder greywacke conglomerates and the boulder conglomerates, is a common rock type, but no further description is required. Conglomerate beds may be traced laterally into greywacke by diminution in the number and size of the boulders and pebbles.

Argillaceous quartzites and siliceous siltstones may similarly be regarded as rock types intermediate between the quartzites and the argillaceous rocks.

Shales and argillites are well developed in the upper parts of the Gowganda Formation especially near Dean Lake, but are found throughout the sequence. At Dean Lake, beds up to 2 feet thick are found interbedded with quartzite and, to a lesser extent, conglomerate. Owing to differential weathering and erosion, the outcrops have a characteristic ribbed appearance (Photo 10). A cleavage may be present; this cleavage normally dips at a steeper angle than the bedding and, on weathering, the rock breaks up into flakes and "pencils" (Photo 10).

Where the interbeds of quartzite and shale are both thin, or where the quartzite is thin relative to the shale, the quartzite ribs may be contorted and even disrupted. It is believed that in the majority of cases this is due to slumpage in the partially consolidated sediments rather than to differing competencies during tectonic stress.

Ripple-marks and, rarely, mud-cracks have been observed and are indicative of shallow-water deposition. Thus the argillaceous nature of the rock is due to the lack of arenaceous material rather than to deep-water deposition.

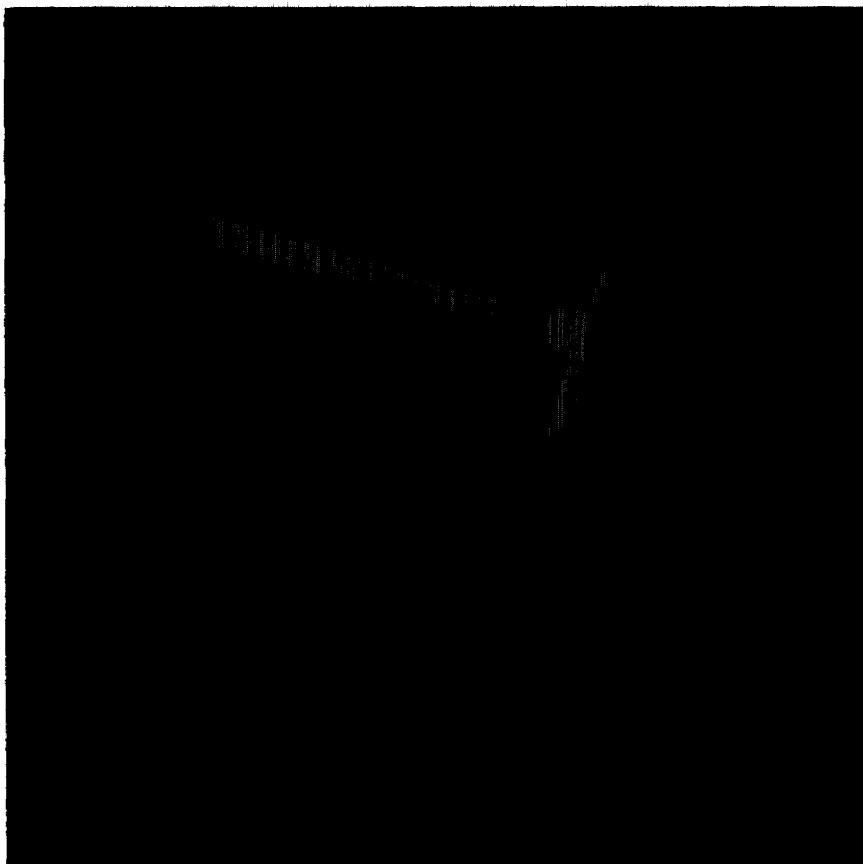
Shales and argillites may pass laterally into siltstones and quartzites, or into greywackes and argillites. Some shales (e.g. Photo 12) may contain scattered pebbles and outwardly resemble the laminated greywackes; however, composition

Iron Bridge Area

and texture indicate that these rocks should be grouped with the shales rather than with the greywackes.

From the foregoing it will be seen that the Gowganda Formation, which underlies the greater part of the area, is a complex of many differing rock types;

Photo 12



Gowganda Formation: shale, base of cliff; west shore of Mapleleaf Lake, Patton township.
Note deviation of bedding around pebble, below hammer head.

some of these are definitely water-laid; some of them probably accumulated under subtemperate conditions characterized by alternate freezing and thawing, and some may represent glacial deposits.

LORRAIN FORMATION

Normally the Gowganda Formation is overlain conformably by the Lorrain Formation: quartzite with interbedded quartz-jasper conglomerate. Locally, as in the Dunlop Lake and Mace Lake areas of the Quirke syncline (Robertson 1963, p. 36), the basal members of the Lorrain Formation are well-bedded, crossbedded arkose with scattered quartz pebbles and fragments. Neither type of rock has been identified within the Iron Bridge map-area. Collins (1925; G.S.C.

1925b) shows an occurrence of Lorrain Formation in the northeast quarter of section 33 of Patton township, but he makes no mention of this locality in the text of his memoir. The area in question is underlain by the sand plain of the Cobden River valley. No outcrop of any type was found by the members of Abraham's field party. If Lorrain quartzite were to occur at this locality, structural considerations would require it to be also exposed on the hills on the north side of the valley. It is assumed that an erratic in the drift was incorrectly identified as outcrop.

Keweenawan

The youngest rocks in the map-area are: intrusive quartz diabase; quartz gabbro differentiated through diorite to granophyre; and rare lamprophyre. These rocks are generally correlated with the Nipissing-type diabase of Keweenawan age. No olivine diabase, which is the last stage of the Keweenawan igneous activity, has been recognized in the map-area. There is no evidence within the map-area for a post-Huronian granite (Robertson 1960, Chap. 6).

Diabase and allied rock types occur either as dikes, particularly in Bright and Thompson townships, or as large irregular sill-like bodies, particularly in Gladstone township and, to a lesser extent, in Patton township.

In Patton township, dikes are up to 150 feet wide and strike slightly south of east, north, northwest, and northeast. There is no apparent difference in lithology or age of the different sets. The slightly south-of-east set, which strikes parallel to the Chiblow fold axis, is the best-developed; and the northwest and northeast sets are well-developed, but the north-striking set is only moderately so.

In Bright and Thompson townships there is a multiplicity of dikes in the Gowanda sedimentary rocks north of the Murray Fault and, more particularly, in the granitic rocks to the south. In the latter there are wide variations in thickness both in the same dike and from one dike to another. The strike-directions show a marked alignment in the northwest quadrant and reflect the course of the Murray Fault.

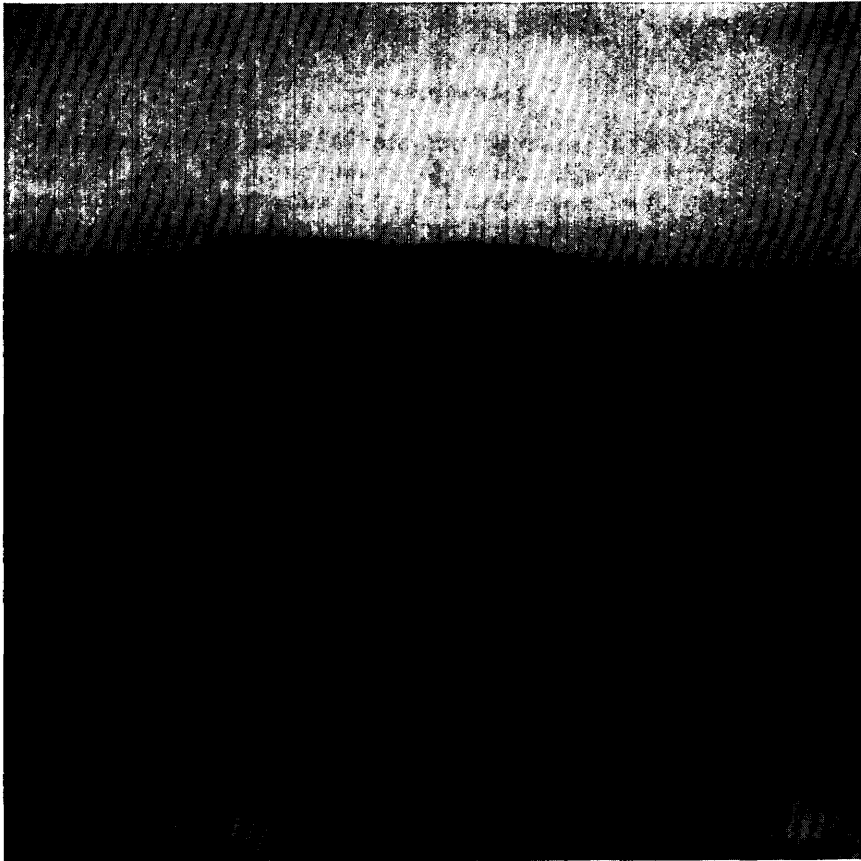
Large, irregular sill-like bodies, which tend to form high, rough terrain (Photo 13), occur throughout Patton and Thompson townships. They range in composition from gabbro through quartz gabbro and diorite to syenodiorite and, in the case of the bodies along the north side of the Cobden valley, to granophyre or "red rock." The granophyre phase of the large gabbro body in southern Patton township was mapped by members of Collins' field party as an outlier of Algoman granite (Collins 1925, p. 28). The area was later lumbered and burned over, and it is now possible to see the gradation from granophyre into diorite and gabbro. Aplitic and albitic stringers and dikelets are common in the upper parts of the bodies and may also be found in the country rock.

Both dikes and sill rocks show chilled margins; these may be either sharp and unaltered or strongly sheared, with the development of veinlets of quartz, calcite, and secondary chlorite. The chilled marginal phase grades rapidly into medium- to coarse-grained diabase with lath-like feldspar crystals, which in turn grades into coarse-grained gabbro. The diabase-gabbro is made up of calcic labradorite (cores about An_{70}), diallagic augite with or without pigeonite, and minor quartz or micropegmatite. The pyroxenes are moderately to strongly uralitized. The accessories include magnetite, apatite, pyrite, pyrrhotite, and chalcopyrite.

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In the coarser gabbroic rock the uralitized pyroxene is replaced by a blue-green pleochroic hornblende. Large flakes of chlorite may also be present. Red-brown, strongly pleochroic biotite becomes a characteristic accessory mineral and can be recognized in the hand specimens. There is an increase in the amount of micropegmatite and free quartz present. The plagioclase consists of markedly

Photo 13

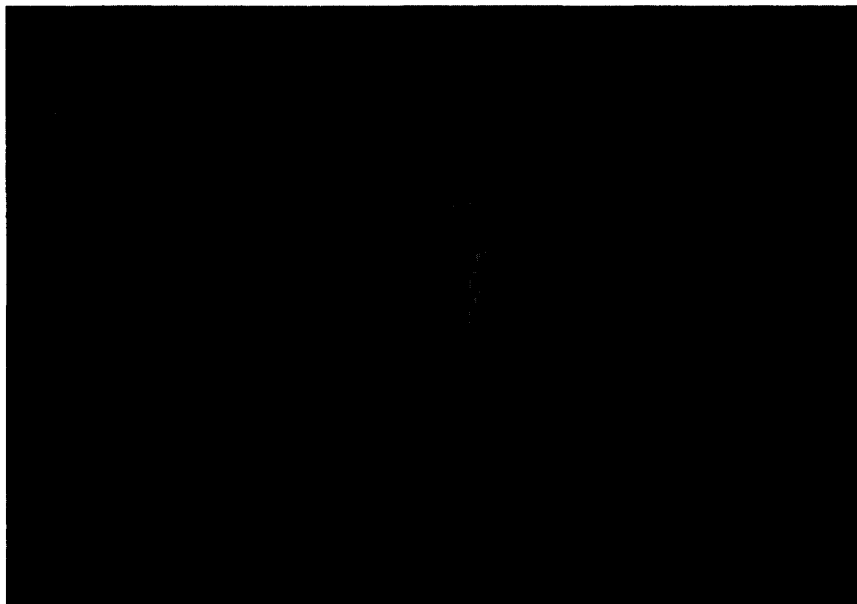


Keweenawan. The hill in the middle distance is a massive gabbroic intrusion; east end of Darrell Lake, Patton township.

zoned bytownite to andesine (An_{80} - An_{33}). Zoning may be continuous normal or, more frequently, broken normal; on occasion oscillatory zoning is observed. The accessory minerals are titaniferous magnetite (partially altered to leucoxene), red-brown biotite, sphene, apatite, and chlorite (penninite), and the sulphides pyrite, pyrrhotite, and chalcopyrite. In the large sill-like bodies the gabbro grades into a syenitic diorite characterized by a development of patches, up to several feet across, of quartz, micropegmatite, plagioclase, and acicular hornblende crystals—the latter are blue-green in colour, may be up to an inch in length, and frequently show twinning. In vuggy patches simple quartz crystals line the cavities. Accessory minerals include sphene, biotite, magnetite, epidote, and the sulphides.

In the upper parts of the sills the above-mentioned syenitic diorite grades into a coarse-grained red rock resembling granite or granodiorite in the hand specimens. In southeastern Patton township, Collins' assistants reported granite and correlated it with the Algomian granite as exposed near Dean Lake about 3 miles to the south (Collins 1925, pp. 28-29). Collins was much perplexed by this and suggested that the "granite" represented a residual mountain; however, the outcrop area has been burned over since 1925, and it is now clear that the "granite" is a differentiate from the gabbro.

Photo 14



Keweenawan: coarse-grained dioritic gabbro cut by later fine-grained diabase dikes; southwest of Bay Lake, Patton township.

In thin sections the rock is seen to consist of cloudy plagioclase, orthoclase, quartz, chlorite, and radiating muscovite. Some of the chlorite has developed at the expense of hornblende and some after mica. The accessory minerals are magnetite, apatite, and a few small zircons. Secondary albite and carbonate are present. Other phases of the red rock consist of hornblende (some altered to aggregates of chlorite, epidote, and biotite), partially chloritized biotite, cloudy plagioclase, quartz, interstitial myrmekite, and accessory magnetite, sphene, apatite, and more rarely zircon. The red colour of the rock is largely due to the hematite dust in the plagioclase feldspars. The rock, therefore, is similar to the "red rock," or granophyre, typical of the Nipissing diabase of the Gowganda area described by Collins (1913) and Bowen (1910).

The large masses of dioritic gabbro in southern Patton township are cut by swarms of thin dikes up to 2 feet wide (Photo 14). These dikes consist of fine-grained diabase and probably represent undifferentiated magma, which had intruded into fractures in the gabbro from depth.

Iron Bridge Area

The sill-like bodies, and rarely the country rocks, are cut by medium-grained dikes or sills of medium- to coarse-grained, biotite-rich lamprophyre (*see* Figure 7). In thin sections the lamprophyre is seen to consist of plates of reddish to colourless mica, probably phlogopite, set in a groundmass of similar, but darker, mica, calcite, and plagioclase, with traces of apatite, magnetite, and other unidentified iron oxides.

Locally, near large diabase or gabbro bodies, the country rock takes on a bright pink colour due to the formation of albite. Quartz-albite-epidote veins are found in the upper parts of the sill-like bodies and in the adjacent country rock. Close to these veins, granite, quartzite, or arkose take on a bright pink to red coloration. Greywacke and argillite found on the south margin of the Patton-Thompson sill are strongly indurated and albitized. It is clear that the diabase gave rise to soda-rich hydrothermal fluids, which were able to migrate outwards, and particularly upwards, from the gabbroic bodies. Elsewhere, the country rocks may be chloritized, but to a lesser extent. Similar features are noted throughout the Blind River–Elliot Lake area (Robertson 1961, p. 29; 1962, p. 47). Inclusions of the country rocks within the diabase and gabbro intrusions are not common; where present they are usually restricted to the border phases. Inclusions may be sharp and angular, and apart from albitization show little sign of interaction with the magma. Others are rounded and have vague boundaries indicating that some assimilation has taken place. The latter are often surrounded by a thin rim of acicular amphibole crystals, the crystals being perpendicular to the contact of the inclusion and the gabbro.

The numerous copper showings of the area (discussed on pages 48–63) occur in the same general zone as the large, differentiated, sill-like, gabbro bodies. These copper showings are in veins of quartz, carbonate, specular hematite, and sulphide, either in the upper parts of the gabbroic masses or in breccia zones in the country rock not far from the upper surfaces of the intrusive bodies. Similar mineralogical and structural associations have been noted in the Whiskey Lake area of the Quirke syncline (Robertson 1962, pp. 46–47).

Within the Iron Bridge map-area there is no clear-cut relationship between the dikes and the sills. Locally, where the basal contacts of sills are visible, dike-like apophyses may be observed. These could represent fractures in the underlying rock filled from above, or they could be part of a feeder system. As already noted, late dikelets are common in some sectors of the differentiated gabbroic bodies; however, none of these has been observed cutting across the contact of the gabbro and the country rock. Elsewhere in the Blind River district, notably in the Whiskey Lake area (Robertson 1962, p. 45), there is some evidence that the dikes tend to be later than the sills.

The structural significance of the distribution of the dikes and sills is discussed on pages 45, 46.

Thus the Keweenawan was a period of hypabyssal and subplutonic basic intrusion. The earlier phase probably formed as sill-like bodies strongly differentiated from gabbro to granophyre (red rock), with lamprophyric segregations and albitic and chloritic end-stage hydrothermal fluids, which invaded and altered the surrounding country rock and deposited sulphides in favourable areas. The later phase intruded as diabase to quartz diabase dikes showing marked structural control.

Post-Precambrian

After the close of the Proterozoic the area was exposed to erosion and reduced to a peneplane. In lower Paleozoic time shelf-sea deposits, now preserved on Manitoulin Island to the south and in the Hudson Bay depression to the north, probably extended over the area. The nearest exposure of middle Ordovician limestone is on Mississagi Island (Frarey 1961a) about 4 miles off-shore from the mouth of the Mississagi River. Occasional slabs of flaggy fossiliferous limestone are found on the beaches along Lake Huron; it is assumed that these have been ice-rafted from the south.

The region was exposed and eroded throughout the greater part of post-Devonian time, with intermittent rejuvenation. The present topography was probably developed essentially between the Laramide revolution and the dawn of the Pleistocene.

During Pleistocene time the area was glaciated, and all the soil, which had formed, was removed. Outcrops were scoured and polished (Photo 9). Striae and chattermarks indicate that the principal direction of ice-flow was S.15°W. On retreat of the ice, till, glaciofluvial sands, clays, gravels, and occasional large erratics (Photo 15) were deposited within the area. This material occupies the low ground between the outcrops. In addition to rock types found within the map-area there are large numbers of boulders of porcellaneous white quartzite with or without well-rounded, quartz, chert, and jasper pebbles—the well-known Lorrain Quartzite. Boulders of gneiss and of porphyritic diabase, with large yellow plagioclase phenocrysts, are also fairly common.

Extensive flat-lying sands and gravels underlie most of the eastern and northern parts of the map-area where bedrock is not exposed. Some attempts have been made to clear and farm these areas, but most of the farms have been abandoned. Better soils with more clay are found north and northeast of Bright Lake (Photo 16) and near the Parkinson-Gladstone townships boundary. In these localities farming has been more successful, but several properties were abandoned during the economic depression of the 1930's. Smaller areas of arable clay, sand, and till are found between Iron Bridge and Denman Lake and near Dean Lake.

The stratified sand and clay deposits in the southern part of the area, i.e., Bright and Thompson townships, the Mississagi valley, and the Cobden valley, may represent material dropped in post-glacial Lake Huron and (or) adjacent ice-dammed lakes. The long swampy areas in the dip-and-scarp area of Thompson township are probably underlain by similar material. Hummocky hills in the vicinity of Patton and Skibo villages are reminiscent of drumlins and are apparently composed of till. The sand flats elsewhere in the map-area probably represent deposits in bodies of water dammed-up by ice or glacial debris.

Along the present shore of North Channel of Lake Huron, raised beaches, filled-in lagoons, and progressive bars characteristic of an emergent coast can be identified on the ground as well as from air photographs.

Along the Mississagi valley, particularly in Gladstone township prior to the flooding above Red Rock Falls, erosional features such as water-polish, pot-holes, and isolated stacks, adjacent to the present stream bed and more rarely on the sides of gorges, indicate that at one time, presumably when swollen by glacial meltwaters, the river was much larger than at present.

There is ample sand and gravel within the area to meet the requirements of the Department of Highways and local construction.

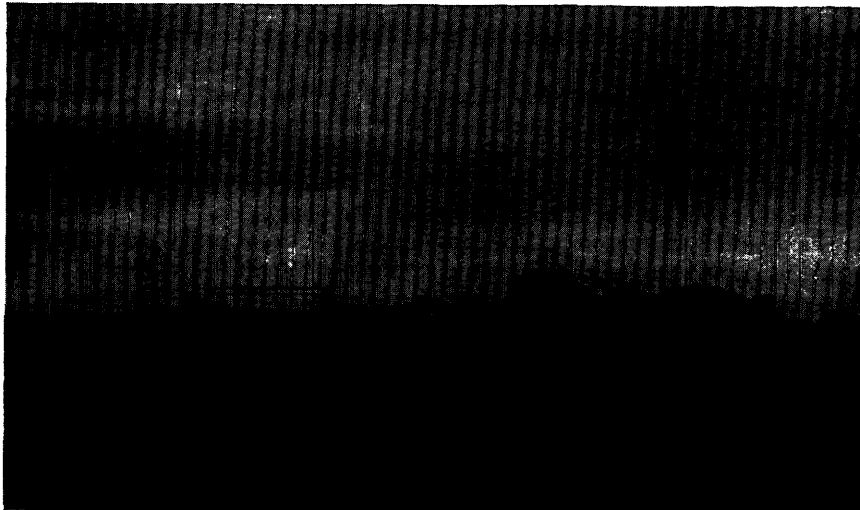
Iron Bridge Area

Photo 15



Cenozoic: large glacial erratic of diorite; large island in Chiblow Lake, Patton township.

Photo 16



Cenozoic: farm-land on glaciofluvial clay; Bright township.

STRUCTURAL GEOLOGY

In addition to the main post-Huronian disturbance of the area, there is stratigraphic evidence to indicate that there were earlier periods of tectonic disturbance. Though locally it has been possible to recognize small folds or faults as belonging to one or another of these earlier disturbances, observations are too limited to permit even a guess at the regional causative forces. The discussion here will, therefore, be limited to the post-Huronian structural elements listed below:

- 1) The major fold—the Chiblow anticline.
- 2) Minor folds.
- 3) Joints.
- 4) Faults.
- 5) The fractures filled by diabase intrusions.

The major structural features of the area are the Chiblow anticline, the axial plane of which lies close to the Patton-Montgomery townships boundary, and the Murray Fault system, which passes through the central parts of Thompson and Bright townships.

1. The Major Fold—The Chiblow Anticline

The axial plane of the Chiblow anticline—the southern part of the Blind River reverse-S structure—strikes slightly north of west across the northeast corner of the map-area. On the shores of Chiblow Lake and in the southwest corner of Montgomery township the outcrop of reliable marker beds and horizons permits reasonable determination of the fold. Where the beds exposed at surface belong to the Cobalt Group, the lack of defined markers and even of reliable bedding makes determination less accurate.

The axis of the fold plunges west at a low angle—between 1° and 8°. The configuration of the axis of the Chiblow anticline is thus similar to that of the Quirke syncline to the north (Robertson 1960, pp. 157-58).

The greater part of the map-area lies on the south limb of the fold. Dips are gentle to moderate throughout the map-area, becoming steep only as the Murray Fault is approached. In the axial-plane area there is apparently no significant difference in the dip values on the north and south limbs of the fold.

Three possible modes of origin for the major fold pattern of the Blind River district have been suggested. These are:

- 1) A compression normal to the axial planes of the folds.
- 2) Compaction folding over pre-existing Archean topography.
- 3) A northwest-southeast, right-hand shear couple associated with north-side-east movement on the Murray Fault.

The compaction hypothesis was developed prior to the extensive drilling and exploration, which has shown that the post-Huronian fold structures are transverse to the principal basement surface structures. From a regional study of bedding-plane lineations, small-scale folds, dragfolds, jointing, cleavage, faulting, and the distribution of fractures filled by diabase, the author (Robertson 1960, Chap. 4) has concluded that compression perpendicular to the axial planes of the major folds is the most likely mode of formation.

2. Minor Folds

Folds of relatively minor amplitude are common, but poorly defined, throughout the area. These generally represent corrugations and crumplings congruent with the main fold and were, apparently, not studied during the original field work. Near the Murray Fault, such folding becomes more intense and better defined, so that it is possible to trace some of the fold axes as indicated in the Dean Lake–Mississagi River sector.

The Bruce Limestone (Photo 6) and, more rarely, some of the argillaceous rocks in the Gowganda Formation show dragfolding. In the Bruce Limestone this dragfolding is normally congruent to the main fold, but other directions and plunges occur—possibly as the result of plastic flow. Some authorities (Pienaar 1958. C.I.M.M. 1957) have suggested that the small-scale folding within the Bruce Limestone is the result of penecontemporaneous slumpage, but the present author has not found widespread evidence to support this view.

Data on minor folds and dragfolds collected by the author elsewhere in the Blind River area, indicate that the major folds were formed by north-south lateral compression.

3. Joints

The attitudes of joints and small-scale faults were recorded at a number of localities throughout the area. As the records list only vertical or near-vertical joints it is assumed that the jointing usually found in sedimentary rocks parallel to and perpendicular to the bedding was ignored and that only jointing of definite tectonic origin was recorded.

The following generalizations can be made concerning joints:

- a) In sedimentary rocks there is a system of joints parallel to and perpendicular to the bedding. These formed as a result of contraction during consolidation but may have become accentuated during later tectonic disturbances.
- b) In diabase dikes and sills the best developed joints are perpendicular to and parallel to the walls of the intrusive body and are cooling fractures. Those joints perpendicular to the wall often form a polygonal or hexagonal pattern. However, within the present map-area, tectonic joints are identifiable in the diabase outcrops, indicating that the diabase was stressed after consolidation.
- c) Joints and small-scale faults are well developed, particularly in the more competent rocks close to faults or diabase intrusions.
- d) The whole area is characterized by vertical or near-vertical joints and small-scale faults. Statistical analysis of the data recorded by Abraham and his assistants indicates that the fractures may be grouped as follows: (1) slightly east of north; (2) northeast; (3) in an arc from east to east-southeast; and (4) southeast.

Group 1 is perpendicular to, and Group 2 is essentially parallel to, the axial plane of the Chiblow anticline and to the Murray Fault. Right-hand and left-hand strike separations have been observed on both the northeast and southeast systems; however, the northeast system is characterized by left-hand strike

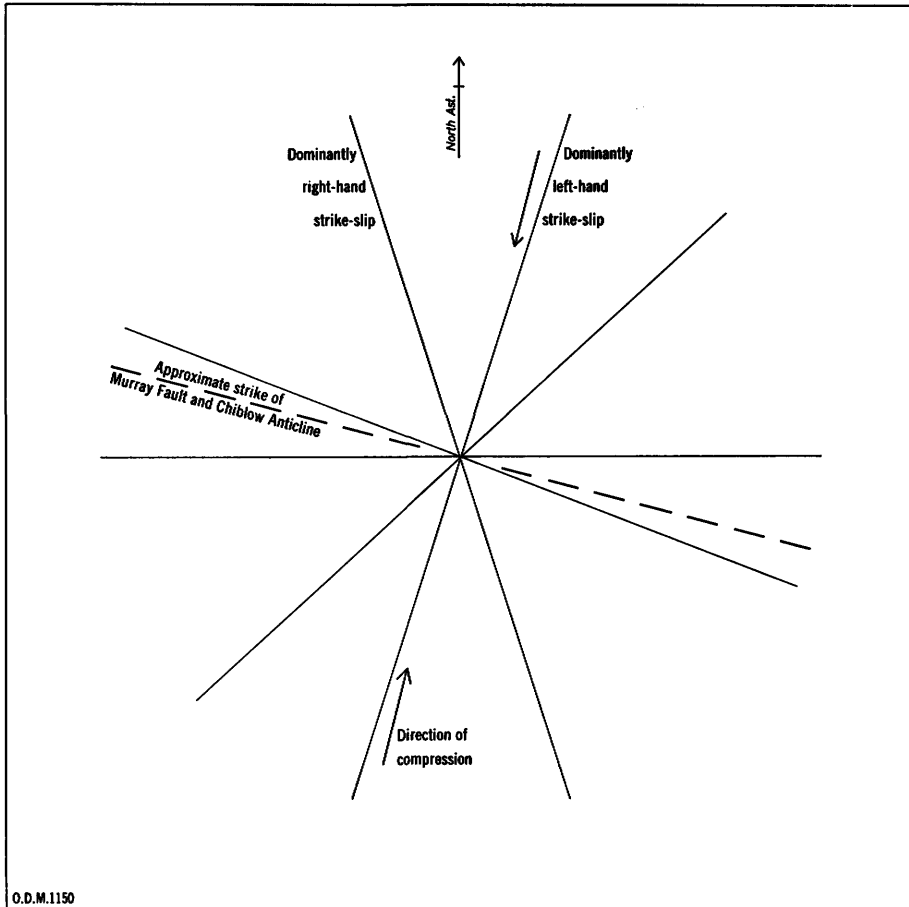


Figure 4 — Schematic distribution of joints, Iron Bridge area.

separation and the southeast system by right-hand strike separation. These observations, illustrated in Figure 4, suggest that the main tectonic influence in the area was a compression trending slightly east of north—slightly west of south.

4. Faults

Several faults enter, or are entirely contained within, the map-area. Faults were mapped largely on the basis of linears visible on the air photographs, together with evidence found in the field such as apparent displacement of outcrop, shearing and shattering of the adjacent rocks, and the presence of small-scale faults in the adjacent rocks. Normally, owing to the similarity of the rock types found on both sides of a suspected fault, it is not possible to define the nature of the fault.

All the faults postulated within the map-area are steep-dipping. It is apparent that the Murray Fault, which crosses the southern part of the area, is a reverse fault probably older than the Keweenaw diabase. The Lake of the

Iron Bridge Area

Mountains fault, which enters the southeast corner of the map-area, is a strike-slip fault younger than the other structural features of the district.

The postulated faults within the map-area fall into following groups on the basis of strike-direction. (See Table III.)

Murray Fault

The Murray Fault strikes east-southeast across Bright and Thompson townships. Bright and Dean lakes are oriented parallel to the fault, and immediately east of the map-area the Mississagi River has eroded a valley along the fault zone. The Gowganda rocks exposed to the north of the fault, and the granitic rocks exposed close to the south of the fault in the vicinity of Dean Lake, are not strongly shattered or sheared as are rocks exposed close to the fault between Blind River and Spragge (O.D.M. Maps 1961, No. P.131). However, both the Gowganda and the Algoman rocks are cut by numerous diabase dikes, the strikes of which are parallel to the strike of the fault. Elsewhere in the North

TABLE III—FAULTS OF THE IRON BRIDGE MAP-AREA GROUPED ON BASIS OF STRIKE

Strike	Fault or Location	Notes
East to east-southeast	Denman Lake fault.....	post-diabase dike.
	Peake Lake fault.....	post-diabase sill.
	N. of Holmes Lake.....	post-diabase dike; older than Montgomery fault.
	S. of Holmes Lake.....	post-diabase; older than Montgomery fault.
	Darrell Lake fault.....	post-diabase dike; older than Montgomery fault.
	Oscar Lake.....	post-diabase.
	near Red Rock Falls.....	post-diabase sill.
Murray Fault.....	reverse fault, south side 6,000 feet up; multiple movement, mainly pre-diabase.	
Northeast	NW. bay, Chiblow Lake.....	age doubtful.
	N. edge of map-area.....	age doubtful.
	NE. bay, Denman Lake.....	age doubtful.
	Skibo fault.....	post-diabase, may be associated with end-stage mineralization near Iron Bridge.
	SW. arm, Oscar Lake.....	age doubtful.
	Mapleleaf Lake.....	post-diabase sill, may be pre-diabase dike and older than Montgomery fault.
Late northeast	NW. corner, Bright twp.....	older than Murray Fault ?
	W. of Dean Lake road.....	age doubtful, right-hand strike-slip.
	SW. of Woman Island.....	age doubtful, left-hand strike-slip.
Late northeast	Lake of the Mountains fault..	northeast-striking, right-hand strike-slip, clearly later than diabase intrusions and other post-diabase faults.
North	NW. Patton and SW. Montgomery twps.....	pre-diabase, west side up.
Northwest	Montgomery fault.....	post-diabase, and later than post-diabase faults.
	NW. bay, Chiblow Lake... ..	age doubtful, SW. side NW.
	SW. of Gladstone Lake.....	post-diabase sill.

Shore region there is evidence that diabase was intruded into the fault zone. This diabase belonged to the Nipissing gabbroic phase, and it may be that dikes of normal to quartz diabase cut across the fault zone. At the east margin of the map-area and in the western part of Cobden township (O.D.M. Maps 1960, No. P.71) the Murray Fault is cut by the Lake of the Mountains fault, which is a northeast-striking, right-hand strike-slip fault with a displacement of about half a mile. From the stratigraphic evidence within the map-area and the area to the east (O.D.M. Maps 1960, Nos. P.71, P.72), the vertical displacement of the Murray Fault is estimated at 6,000 feet (north side down), and this figure is similar to those obtained by Murray (Logan 1863), Collins (1925), and by Ginn (1961) near Espanola. Close to the Murray Fault, Abraham obtained both S- and Z-dragfolds and suggested that these indicated that several movements with different strike-slip components had taken place (Abraham 1957, p. 62). Lineations, on bedding planes in the Gowganda sedimentary rocks at Dean Lake close to the fault, show that there the relative movement of the beds was parallel to the dip; this indicates that at least some of the movement was true dip-slip.

Lake of the Mountains Fault

The Lake of the Mountains fault strikes northeast from Mississagi Bay (in the southeast corner of the map-area) to McGiverin Lake in McGiverin township, whence it swings east to Bellows Lake in Deagle township. In the Lake of the Mountains area it can be demonstrated that the fault displaces both the shallow-dipping Huronian sedimentary rocks and the steep-dipping Keweenawan diabase dikes for distances of up to $\frac{3}{4}$ mile northeast on the northwest side; the fault is therefore a right-hand, strike-slip fault. To the southwest the displacement becomes less, and in the Mississagi Bay area is probably between $\frac{1}{4}$ and $\frac{1}{2}$ mile. The Lake of the Mountains fault displaces the Murray Fault and is probably the youngest major fault in the Blind River district.

Summary

The faults thus fall into the same strike-groups as have been observed throughout the area (Robertson 1960; 1961, pp. 33-38; 1962, pp. 51-55). The east-east-southeast group is the best-developed, especially in the axial zone of the Chiblow anticline. The northeast- and northwest-striking faults are only poorly-developed. In the Quirke syncline, where compression is characteristic of the axial area, the northwest faults are well-developed, the axial-plane group moderately so, and the northeast group is poorly developed. On a regional basis, the distribution and nature of the faults and of the fractures filled by diabase (with the exception of the Lake of the Mountains fault) suggests that they are a series of conjugate fracture systems formed to accommodate a pulsating compression oriented slightly east of north and west of south (Robertson 1960, Chap. 4).

5. Fractures Filled by Diabase Intrusions

The petrology and distribution of the diabase intrusions have already been discussed (pp. 35-38).

Large, differentiated, irregular, sill-like gabbro bodies occur in a zone across the southern part of Patton township, swinging to the northwest across Gladstone township. They thus conform in a general way to the strike of the sedimentary rocks as traced towards the fold axis. In the Blind River reverse-S structure it is

Iron Bridge Area

clear that the gabbro bodies are best-developed in the lower members of the Huronian near the base of the Quirke syncline and in the upper members of the Huronian near the top of the Chiblow anticline; in other words, these bodies intruded the naturally-occurring dilatant areas of the folds. Probably such intrusion took place during a lull in the compressive forces. The bodies were able to crystallize and differentiate *in situ*; end-stage fluids carrying copper mineralization migrated upwards, and quartz-sulphide-carbonate-specularite veins were deposited in suitable traps close to the upper contacts of the intrusions.

The dikes may be either: (1) feeders or apophyses of the sills; or (2) later in age than the sills. Evidence within the map-area is not sufficient to clarify this.

The dikes trend east–east-southeast, north, northwest, and northeast. There is no apparent lithological difference between the dikes of the different directions. Cutting relations are obscure and when found are conflicting. More often intrusions are seen to fork, each branch following a different strike-direction. It is, therefore, concluded (as for the rest of the Blind River area) that the diabase dikes formed at essentially one time from the same magma, and that they intruded a conjugate set of fractures. The best-developed of these fractures were parallel to the axial plane of the Chiblow anticline and to the Murray Fault and were probably axial-plane cleavage fractures, which “gaped” on temporary release of the compressive forces. The north-trending fractures would represent extension joints perpendicular to the axial plane of the fold, and the northwest and northeast fractures conjugate shear fractures, the acute angle between which would define the direction of maximum compression.

The large number of diabase dikes and dikelets in the Algonian complex to the south of the Murray Fault is a reflection of the high competency of granite, which can only yield to compressive forces by fracturing. Diabase dikes parallel to the Murray Fault are also strongly-developed in the Gowganda Formation to the north of the fault. This strong structural control of diabase close to the fault, and the fact that to the east the fault zone is apparently obliterated by diabase intrusions, indicate that the diabase intruded after the major movement on the fault had taken place.

Summary of the Geological History

The geological and structural history of the Iron Bridge area may be summarized as follows:

The oldest exposed rocks are interbedded volcanic, pyroclastic, and sedimentary rocks (Keewatin(?) and Sudbury Group). These were severely folded, metamorphosed, and intruded by granite and now appear as the host rocks in migmatite. The granite consists of elongate elliptical bodies of red, massive, potash-rich quartz monzonite with few inclusions, surrounded by grey to pink, migmatitic to massive, granodiorite to granite with numerous inclusions.

The area was then reduced to a peneplane with a locally preserved regolith probably formed under reducing conditions. Over greenstone areas, valleys and depressions formed; however, there is no indication of such features within the map-area.

Early in Huronian time, the region became one of deposition; rivers draining the land-areas to the north and northwest deposited clastic sediments in a basin, which gradually encroached northwards. In the valleys and other depressions in the pre-Huronian peneplane that are found elsewhere in the Blind River district, uraniferous oligomictic conglomerates were laid down.

The lower Huronian or Bruce Group was a period of shallow-water deposition intermittently interrupted so that there was a series of cycles each grading from a relatively coarse basal member to a fine-grained upper member. Much of this sedimentation possibly took place in a cold climate. At the same time, more argillaceous and, locally, calcareous sediments were being laid down in the Grenville geosyncline to the south and east (Quirke and Collins 1930). Facies variation from north to south within the map-area suggests that deeper water lay to the south and may indicate that part of the Grenville geosyncline underlay the site of present Lake Huron.

A more prolonged period of interruption of sedimentation separates the Lower Huronian or Bruce Group from the Upper Huronian or Cobalt Group. Folding and erosion took place during this interval and several formations at the top of the Bruce Group found elsewhere in the district are missing within the map-area.

During upper Huronian time a heterogeneous assemblage of conglomerate, quartzite, greywacke, and shale was deposited probably under a subtemperate climate. Some rocks are definitely water-laid, some formed under seasonal freezing and thawing, and some may be of glacial origin. Younger quartzites and conglomerates extensively-developed to the north and northwest are not found within the map-area, although the area of deposition probably extended this far.

The district was then subjected to a north-south compression. The Chiblow anticline formed, with the south limb broken by the Murray Fault. Steep-dipping faults, joints, and fractures filled by later diabase dikes were formed and were best-developed along east-southeast, northwest, northeast, and north trends. Gabbro sills show a general conformity to the expectable dilatant areas of the fold. Small copper deposits are apparently genetically related to the gabbro, though the locus of deposition is controlled primarily by structural features and, in the case of the Bruce Limestone, possibly by the chemical nature of the country rock.

Analysis of the structural features, in conjunction with a study of these features throughout the Blind River area, suggests that the area was subjected to a north-south pulsating compression. The diabase was intruded during a lull, or lulls, in the intensity of the compressive forces. The Murray Fault may be one of a series of faults marking the boundary of the Grenville geosyncline.

No late olivine diabase intrusions have been found within the map-area.

During glaciation the countryside was scoured by glaciers from slightly east of north. On the retreat of the ice, glaciofluvial debris was deposited throughout the area. In general this is only preserved in the low ground between outcrops. However, in the southern parts of the map-area more extensive stratified sand, gravel, and clay deposits were probably laid down in post-glacial Lake Huron and smaller ice- or debris-dammed lakes.

ECONOMIC GEOLOGY

The Iron Bridge area has long been prospected, particularly for copper. Small showings, scattered throughout the area, are found in or near the large irregular, differentiated gabbro sills. Minor shipments of selected concentrate were made in the early part of the century. However, in recent years (since the conversion of the mill at the Pronto uranium mine for the production of copper concentrate) prospecting activity has increased. In June and July 1962 attempts were made to work part of the Glagoma mine near Iron Bridge; small shipments

Iron Bridge Area

of copper ore were trucked to the Pronto mine before the operation was closed on 19 July 1962.

Following the discovery of uranium in the Blind River–Elliot Lake area, ground was staked within the map-area, but no active exploration was undertaken. Deep diamond-drillholes were collared near the east end of Demorest Lake and on the north shore of Chiblow Lake, both in Township 167, and in the central and eastern parts of Scarfe township; these all proved negative.

Sand and gravel deposits are sufficient to meet local highway and construction needs.

Description of Properties and Showings

The properties and showings within the Iron Bridge map-area are discussed in order, by townships, from west to east and north to south, beginning with Montgomery township. Bracketed numbers following some property names refer to numbered locations on geological map No. 2012 (in back pocket).

North of Peake Lake, Montgomery Township

Quartz veins and stringers with minor amounts of pyrite and chalcopryrite are found in two outcrops of Gowganda conglomerate and quartzite to the north and east of Peake Lake. The quartz veins are apparently associated with the shear zone of a northwest-trending fault oblique to the Peake Lake fault. On the easterly outcrop a 6-foot zone of rusty-weathering quartz was traced for 15 chains. Apparently no development work has been carried out.

Mississagi River, Gladstone Township

A number of copper showings are indicated on the map by Logan and Murray (Logan 1863, map). No details are given in the body of the text of Logan's report.

In 1902 copper was reported in Gladstone township (O.B.M. 1902, p. 23). Two mining locations (Nos. 1 and 2) were taken up in the northwest corner of the township but were later allowed to lapse.

East End of Wakwekobi Lake, Gladstone Township

There are several small showings near the east end of Wakwekobi Lake. These fall into two groups: those on or near Mining Location No. 3 and the Red Rock Falls Power Station on the Mississagi River, and those between Wakwekobi Lake and Hagen Lake.

Group 1

On the north shore of the easternmost bay of Wakwekobi Lake a series of quartz veins was traced for over 100 feet in granophyric gabbro. A trench, 4 by 20 by 4 feet deep, exposes massive to vuggy, milky quartz veins with brown carbonate and chalcopryrite.

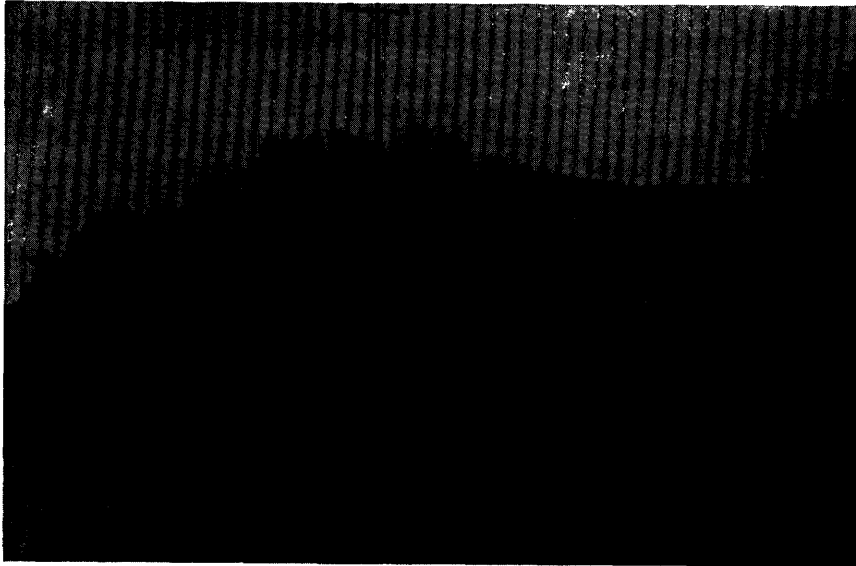
A few small masses of pyrite and chalcopryrite were found in gabbro on the west side of the Mississagi River during construction of the Red Rock Falls dam and generating station. This may well have been one of the showings on the Mississagi River indicated by Logan and Murray.

Group 2

On the south shore of Wakwekobi Lake, at the margin of the map-area, in an outcrop of Gowganda conglomerate, quartzite, and greywacke, there is a 10-foot-wide zone of quartz-veined breccia striking N.85°W. The quartz is locally vuggy and contains minor amounts of carbonate, chalcopyrite, and pyrite.

A quartz vein system striking slightly south of east is intermittently exposed over a strike-length of at least 600 feet between the west end of Hagen Lake and the nearby road. The zone is 15 feet wide, and more than half of it is composed of quartz veins, up to 8 inches in thickness, parallel or subparallel to the strike of the zone. The veins include abundant fragments of the conglomeratic wall rock.

Photo 17



Quartz-veined breccia; south side of highway No. 17, $\frac{3}{4}$ mile east of the Gladstone-Day townships boundary.

Chalcopyrite, pyrite, and specular hematite are found in fracture fillings. Development consists of a trench, 5 by 5 feet by 11 feet deep.

The last showing of this group lies on the south side of highway No. 17, some 50 chains east of the Gladstone-Day townships boundary. Here a 70-foot-wide quartz vein breccia zone (Photo 17) cuts sparse boulder greywacke conglomerate interbedded with brown to pink, medium-grained, feldspathic quartzite. About one-third of the total zone is made up of massive to vuggy, milky to rusty, quartz stringers. The zone and the majority of the stringers strike N.75°W. with near-vertical dip. Oblique stringers cut each other, but there are no consistent cutting relationships. Chalcopyrite, specular hematite, siderite, and calcite are found. The chalcopyrite is found as irregular blebs and patches throughout the vein, the specularite as disseminated flakes, and brown-weathering siderite, as stellate masses near the centre of the vein or as a continuous zone between the quartz and the wall rock; the latter is the more common, pink calcite being restricted to pockets near the cores of the wider veins. The paragenetic sequence is apparently

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siderite, quartz, specularite, chalcopyrite, and calcite. Veined wall rock breccia is common, and the individual angular blocks of conglomerate and quartzite may be up to 8 inches across but are generally less than 3 inches.

An old pit, 6 by 6 feet, is water filled, and there is no indication of recent development work.

Northeast of Bright Lake, Gladstone Township

A test pit on a chalcopyrite-bearing quartz vein in syenitic gabbro is located in the northwest sector of lot 7, concession I, Gladstone township. The vein ranges in width up to 8 inches and has been followed for 100 feet. Mineralization comprises pyrite and chalcopyrite; some calcite is also present. There is no information on grades or development work.

Principle Strategic Minerals Limited, Gladstone Township—(No. 1)

This company's holding, consisting of six claims, lies a mile north-northeast of Iron Bridge. Quartz-chalcopyrite-carbonate veins, striking east with vertical dip, cut syenitic to dioritic gabbro. There are two outcrop showings 30 chains apart. Development work consisting of trenching and drilling (Figure 5) was carried out, in 1957, on the eastern showing by Principle Strategic Minerals Limited.

The vein, with a width of 4-6 feet, was traced for about 940 feet on surface. Channel samples from six trenches along the vein assayed 2.09-4.58 percent copper across 3-6 feet (Northern Miner 1957, and company prospectus quoted in Thomson *et al.* 1957, p. 80). Table IV lists the data on intersections and assays obtained during drilling and is derived from the material submitted for assessment credit by H. E. Martin. No further work was carried out.

TABLE IV—DRILLHOLE DATA, PRINCIPLE STRATEGIC MINERALS LIMITED
(GLADSTONE TOWNSHIP)

(From information submitted for assessment credit (H. E. Martin))

Hole No.	Dip	Total Length	Notes	Length to Intersections	Assay	
					Copper	Core Length
	degrees	feet		feet	percent	feet
1.....	45	164	0.01 oz. silver per ton	122.5	3.41	5.0
2.....	45	230	_____	213.5	0.42	1.0
3.....	45	204	_____	215.5	0.37	1.0
4.....	45	181	_____	175.3	0.20	4.0
5.....	40	155	2-in. vein	86.0	0.57	5.0
			Altered zone	104.8	0.15	1.0
6.....	not given	228	_____	136.0	0.02	2.5
7.....	45	114	_____	110.0	3.08	7.9
8.....	45	197	Altered zone	101.8	1.43	7.0
9.....	58	324	0.005 oz. silver per ton	107.7	4.76	3.0
10.....	58	329	_____	116.0	0.19	4.0
11.....	45	231	_____	226.6	0.62	1.5
12.....	72	140	_____	299	2.49	4.0
8A.....	45	75	Drift	223	0.52	3.0
8B.....	45	35	Drift	226	0.20	4.0

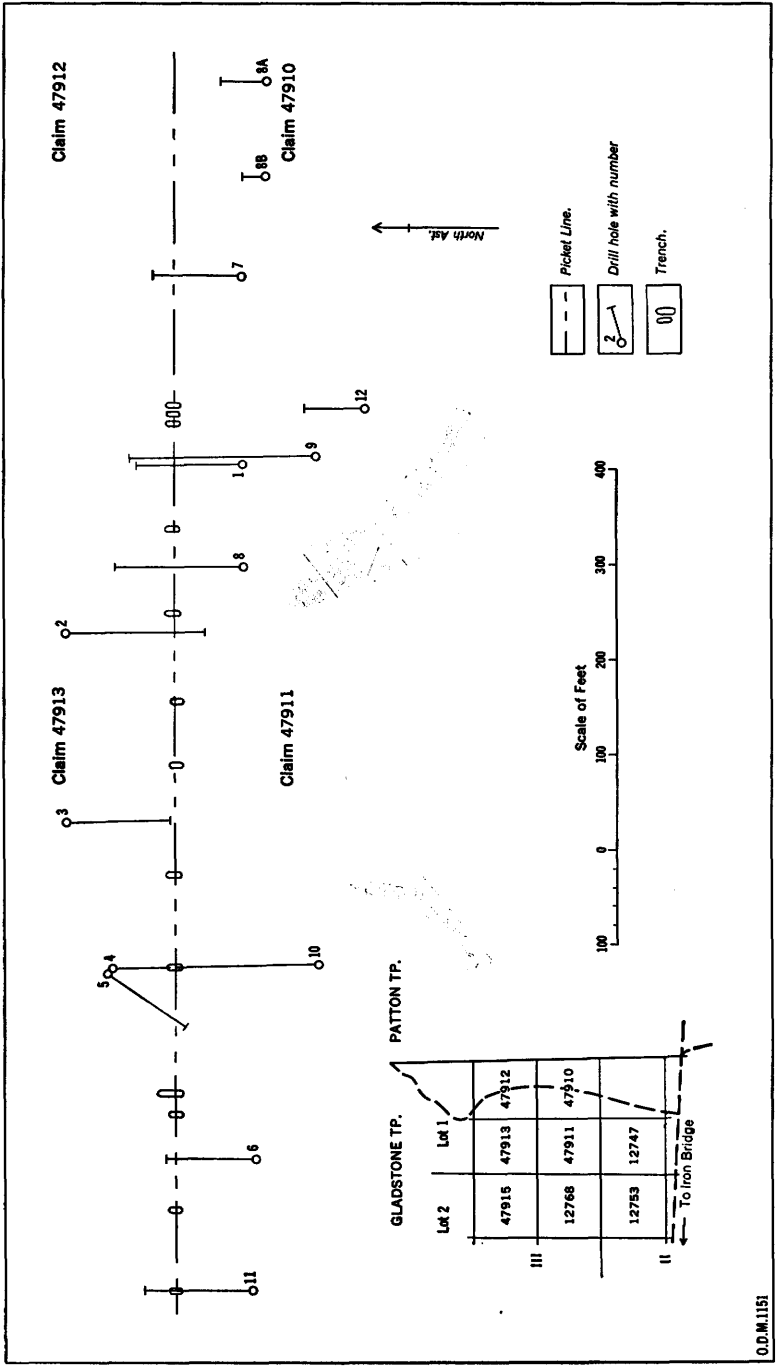


Figure 5 — Location of trenches and drillholes, Principle Strategic Minerals property, Gladstone township.

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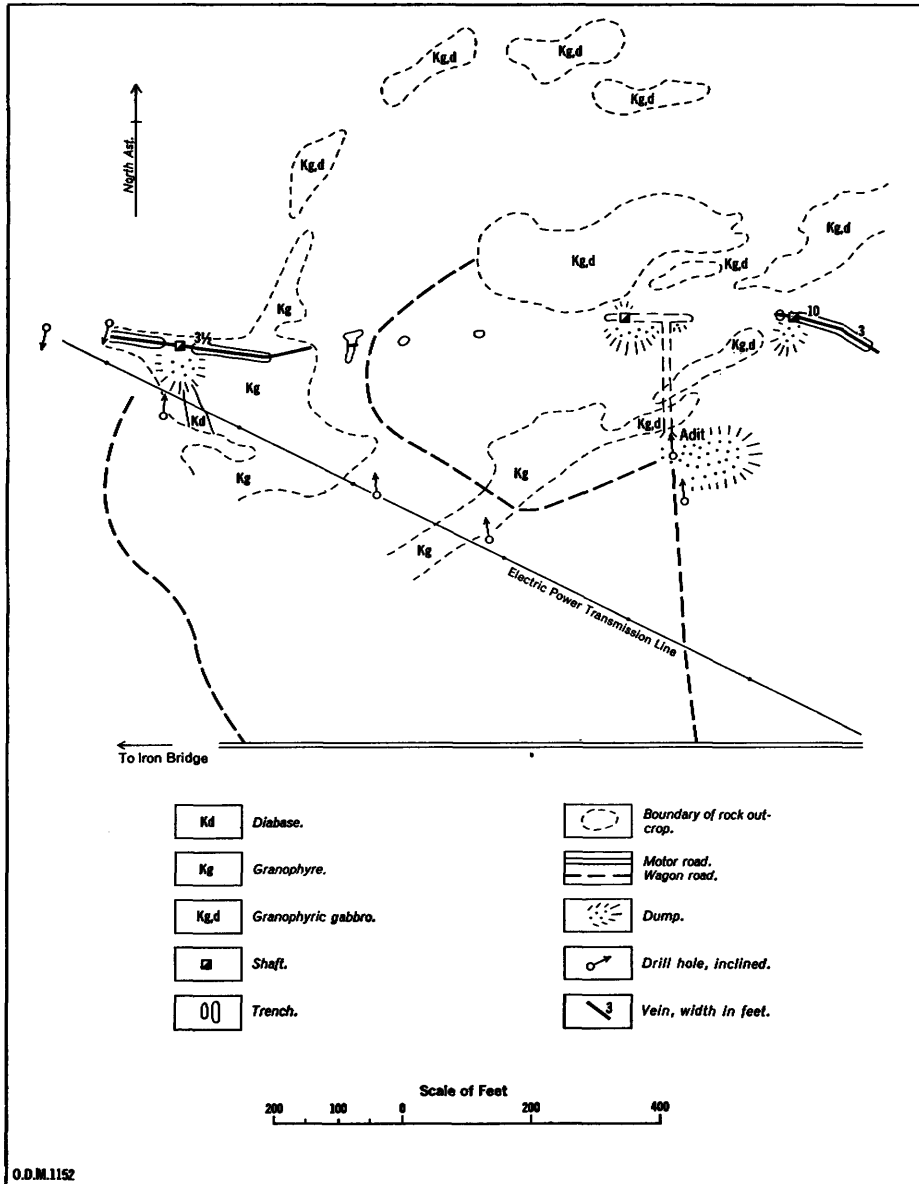


Figure 6 —Surface geology and location of development work, Glagoma mine, Gladstone township.

**Glagoma Copper Mines Limited, Gladstone and Patton
Townships—(No. 2)**

This property consists of seven claims in the northwest quarter of the north half of lot 1, concession II, Gladstone township, and the adjacent parts of Patton township, about 1½ miles northeast of Iron Bridge.

This is the showing that was held by the Sudbury Copper Company in 1916 (O.B.M. 1917, p. 89). By 1918 a shaft had been sunk to 250 feet, with lateral work on the 150- and 250-foot levels (O.B.M. 1918, p. 98). The company was listed as a producer in 1917, deriving 1,785 pounds of copper, valued at \$468, from 28.8 tons of ore (Thomson *et al.* 1957, p. 77).

A quartz-carbonate-chalcopyrite vein, up to 7 feet wide and striking N.80°E., cuts granophyric to dioritic gabbro (Figure 6). The western section of the vein is exposed at the Ontario Hydro transmission line and has been traced for 250 feet (Photo 18). The eastern section includes the shaft and is separated from the western by about 500 feet of drift; it is about 400 feet long.

Glagoma Copper Mines Limited sank six drillholes during 1951. An average width of 4 feet, with grades of up to 3.5 percent copper, was obtained over a 150-foot section of the west showing (Thomson *et al.* 1957, p. 77).

The property was optioned in January 1956 to International Cobalt and Silver Mining Company Limited.¹ D. Gurarie, the company secretary, reported:

Six diamond-drillholes totalling 2,068 feet were drilled, one of these was abandoned in drift after 40 feet. Four of these tested structure to a depth of 300 feet in the vicinity of the main shaft. The results of this drilling were discouraging to our company, and no further work was carried out and the option was dropped.²

In May 1962, Aurora Quarrying Limited, a subsidiary of R. F. Fry and Associates Limited, leased the property from Glagoma Copper Mines Limited. During June and July an adit, bearing N.5°W., was driven on the 70-foot level reaching the vein about 150 feet from the portal. A crosscut was driven west for about 60 feet to the shaft, which was dewatered. A bulkhead was constructed across the shaft, and exploratory stoping was carried out on the west side of the shaft. Timbers in the upper part of the shaft were in good condition, and a bulkhead was constructed 10 feet from the collar in order to protect the workings from loose rock. The drift was extended 30 feet to the east of the junction with the adit, in order to accommodate a slusher. A second slusher operated in the adit. Hand sorting was carried out, prior to stockpiling ore for transportation.

Photo 19 shows the mouth of the adit, at an early stage in the operation.

TABLE V—ORE TRUCKED TO PRONTO MILL
(Data published by permission of R. F. Fry and Associates Limited.)

	Total	Average Grade Copper
	tons	percent
June 1962.....	22.2	1.40
July 1962.....	138.1	0.96

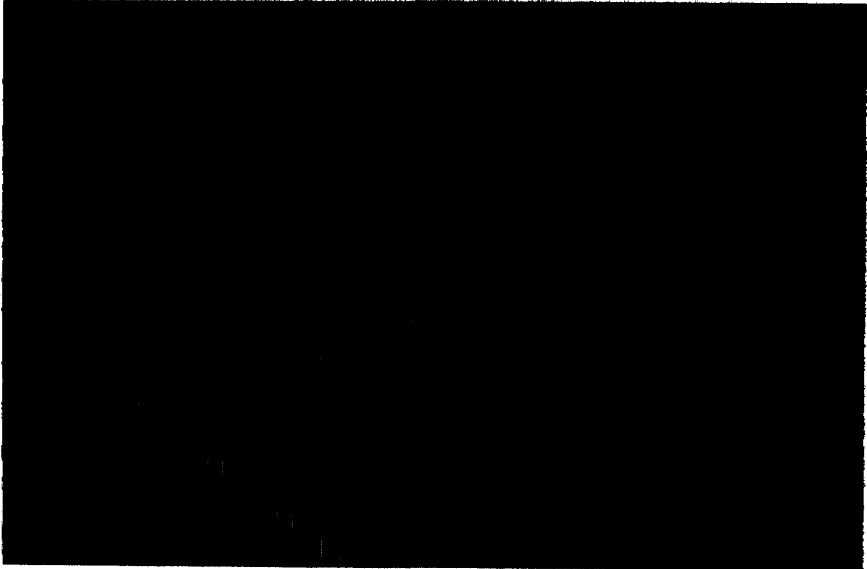
The grade of individual shipments ranged from 0.57 to 1.61 percent copper. Included in the above figures are small quantities of previously blasted rock shipped from the western showing.

¹In May 1958 this company sold all assets to International Copper and Cobalt Mines Limited.

²Written personal communication.

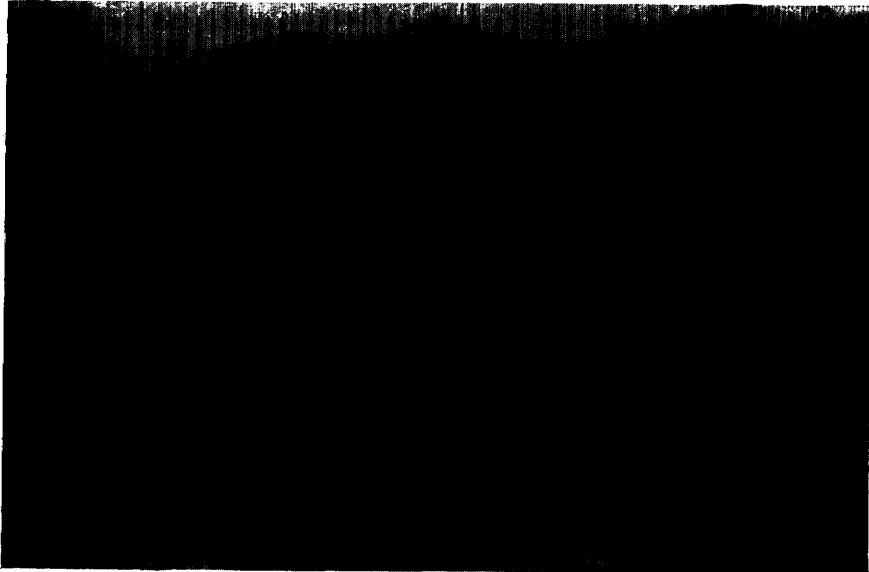
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Photo 18



**Quartz-chalcopyrite vein in granophyric gabbro; west showing,
Glagoma mine, Gladstone township.**

Photo 19



Adit, Glagoma Copper Mines Limited; Gladstone township.

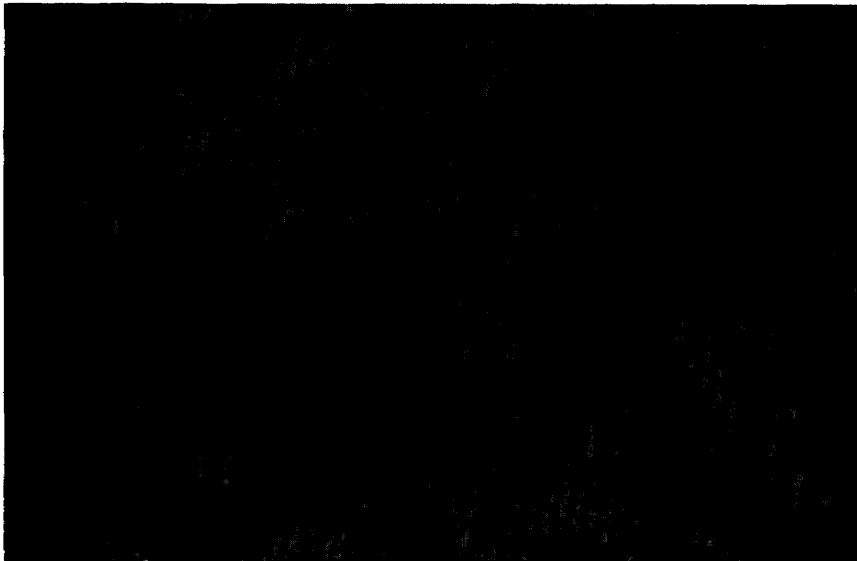
According to the management, the operation failed to achieve a working profit and was closed on 19 July 1962. A bulkhead was constructed across the mouth of the adit.

**Bilton Option, Patton Township—(No. 3)
(Mogul Mining Corporation Limited)¹**

Main Showing

The property consisted, in 1956, of 26 patented claims and 8 unpatented claims, in concession III and sections 28-30 of Patton township. On the west side of the road, ½ mile south of the community of Patton, in an outcrop of Gowganda slaty greywacke, there are good exposures of a quartz-veined breccia containing

Photo 20



Quartz-veined brecciated Gowganda slaty greywacke; in trench at west end of east showing, Bilton Option, Patton township.

chalcopyrite, pyrite, specularite, magnetite, siderite, and calcite (Photo 20). Mogul Mining Corporation Limited carried out a ground electromagnetic survey and an extensive drilling program prior to August 1956. The electromagnetic survey, submitted for assessment credit, obtained only a weak response over the vein; this was believed due to the high quartz content (O.D.M. files No. 63.747). Other weak responses trending parallel to the vein were obtained; one of these was drilled, but no mineralization was intersected (Table VI). Company officials quoted by Thomson *et al* (1957, p. 72) reported:

Quartz-chalcopyrite veins trend east-west in the Gowganda Formation. Twenty-nine drillholes tested a zone 2,600 feet long to a maximum depth of 425 feet and indicated two mineralized zones. The West body was indicated over a length of 450 feet by five drillholes; the East body, which is separated from the West body along the strike by 200 feet of almost barren material

¹Name changed in 1958 to Consolidated Mogul Mines Ltd.

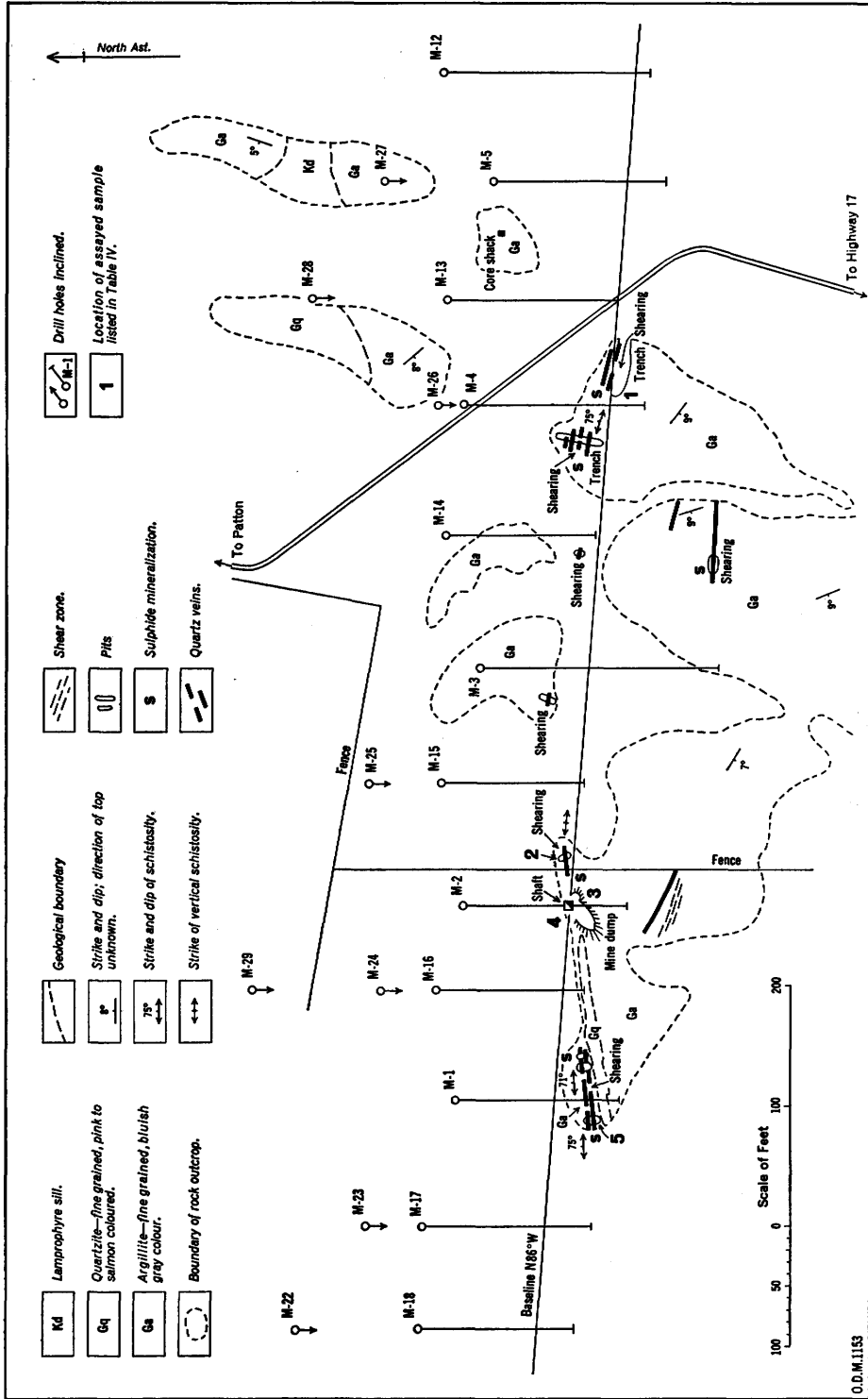


Figure 7 — Surface geology and location of development work, main showing of Bilton option, Patton township.

TABLE VI—DRILLHOLE DATA, BILTON OPTION (MOGUL MINING CORP. LTD.)
(Published by permission of Consolidated Mogul Mines Ltd.)

Hole No.	Dip degrees	Total Length feet	Depth to Hanging Wall		Intersection of Structure footage	Assay	
			Horizontal feet	Vertical feet		Copper percent	Core Length feet
M.1	45	172.1	109	109	137.0-159.0	1.37	11.5
M.2	45	301.0	95	95	134.8-150.5	1.14	9.5
M.3	45	196.0	87	87	122.0-141.5	0.22	9.5
M.4	45	149.2	118	118	167.2-176.1	2.08	6.1
M.5	45	173.2	47	47	67.1-78.2	3.32	11.1
M.6	45	259.7	71.5	71.5	101.2-110.2	0.28	9
M.7	45	170.2	93	93	136.2-147.0	trace	9
M.8	45	189.0	—	—	141.0-150.2	0.30	17.2
M.9	45	129.5	—	—	148.4-169.2	0.42	—
M.10 (abandoned)	45	—	—	—	—	—	—
M.11	45	168.3	93	93	50.2-55.2	low values	—
M.12	45	191.0	114	114	133.2-145.6	1.11	6.8
M.13	45	192.8	81	81	161.1-171.1	1.33	10.6
M.14	45	170.8	91	91	114.2-128.4	0.18	14.2
M.15	45	178.0	101	101	129.2-133.1	1.32	3.8
M.16	45	171.9	101	101	143.1-154.0	1.23	7.9
M.17	45	196.0	107	80	142.4-152.2	3.17	9.8
M.18	45	298.4	115	115	140.5-152.8	0.21	12.4
M.19	45	187.0	87	87	172.0-175.7	0.46	3.7
M.20	45	183.7	78	78	115.5-280	diabase	—
M.21	45	326.7	195	195	127.3-132.5	diabase	—
M.22	60	344.0	126	221	110.7-183.7	diabase	—
M.23	60	310.0	124	217	273.8-281.6	diabase	—
M.24	60	341.7	154	261	257.5-276.0	diabase	—
M.25	60	325.0	143	247	250.9-253.2	0.55	2.4
M.26	60	324	143	247	296.8-301.0	0.65	4.2
M.27	60	481.5	169	292	307.2-313.4	brecciated vein	—
M.28	60	521.0	200	349	285.5-292.8	brecciated vein	—
M.29	50	300.0	—	—	286.0-297.0	0.48	8.2
M.30	45	250.0	—	—	338.0-481.5	diabase	—
M.31	45	—	—	—	401.0-521.0	diabase	—

} These holes tested a separate geophysical anomaly, with negative results.

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has an indicated length of 400 feet by four drillholes. The lower limit of better grade mineralization in both bodies is about 200 feet below surface.

Combined East and West bodies contain an estimated 95,160 tons averaging 1.72 percent copper over an average (true) width of 7.3 feet to a depth of 200 feet (F. C. Knight, August 1956).

The westernmost ore-shoot is exposed about 500 feet west of the road. In addition to the drilling there are three pits and a water-filled shaft of unknown age (*see* Figure 7). Drilling along-strike over a distance of 550 feet west of the western tip of the outcrop (holes M.18, M.19, M.20) failed to give encouraging assays at depths of about 100 feet, and three deeper holes (M.21, M.22, M.23) bottomed in gabbro without intersecting the vein.

Two drillholes (M.19, M.20) were collared northwest of the west showing (M.30—600 feet west and 1,850 feet north of the old shaft, and M.31—1,300 feet west and 2,100 feet north of the old shaft) in order to test an electromagnetic anomaly, of small magnitude, trending parallel to the main vein. The results were, however, negative.

The west end of the easternmost ore-shoot is exposed on the outcrop immediately west of the road. Extensive trenching on the east edge of the outcrop (*see* Figure 7) reveals a zone of quartz stringers with minor amounts of sulphides and iron oxides (Photo 20), but some 50 feet to the west the veins are essentially barren. Diamond-drilling was carried out, on strike with the vein, up to a distance of 1,150 feet east of the road.

Holes M.4, M.13, M.5, and M.12 (*see* Figure 7) had intersections grading more than 1 percent copper over widths of more than 6 feet. Holes M.6 and M.7 contained only traces of copper. The deeper holes, M.26 and M.27, contained little or no copper mineralization, and M.28 bottomed in diabase. An outcrop, about 1,600 feet east and 450 feet north of the intersection of the road and the vein system, had been test-pitted prior to 1954.

Figure 7 includes the location of the majority of the drillholes and of other surface development on the showing, and Table VI lists the pertinent drilling data.¹

TABLE VII—COPPER ASSAYS FROM BILTON OPTION 1962

(Data provided by C. J. Knight, Geologist, Pronto Division Rio Algom Mines Ltd., and published by permission of Consolidated Mogul Mines Ltd. and of Rio Tinto Canadian Exploration Ltd.)

Location on Figure 7	Sample	Grade Copper	Width
1.....		percent	feet
1a.....	(high-grade from above).....	1.25	12.1
2.....		2.08	6.1
3.....	grab sample from pile.....	2.37	2.0
4.....		1.55	
5.....		1.14	9.5
5a.....	}continuous channel.....{	2.08	3.5
		1.15	2.0

In 1962 the property was examined on behalf of Rio Tinto Canadian Exploration Limited by C. J. Knight, geologist for the Pronto Division of Rio Algom Mines Limited. Additional samples as indicated on Figure 7 and listed in Table VII were assayed. Mr. Knight estimated the reserves as between 25,000–30,000 tons with an average grade of 2.0 percent copper.²

¹Published by permission of Consolidated Mogul Mines Ltd.

²Published by permission of Rio Tinto Canadian Exploration Ltd.

Brown Showing

In 1942, Norman Brown of Iron Bridge held a property in the northeast quarter of section 29, Patton township. A number of east-striking veins were seen by E. S. Moore on this property, and old workings were found. Moore reported:¹

In an old pit on the vein nearest to the road 4 feet of quartz was seen with low land on the north and a hump of granodiorite on the south. Strike of the vein is E-W and dip 75°N. About 30 feet to the east there is a pit in which 3 feet of quartz, well mineralized, is exposed. This probably does not represent the full width of the vein. At 120 feet farther east there are some fragments of good ore beside a pit in which no rock is now exposed. In a hillside 150 feet farther east an irregular vein about 6 feet wide carries chalcopyrite and pyrite; estimated at 3 to 4 per cent copper across 6 feet.

This vein, where seen, was estimated to carry between 3 and 7 percent copper but very little of the vein is exposed.

In the northeast corner of the property there is an old shaft which is said to be 27 feet deep and to have been sunk about 35 years ago. [This is the pit shown on map No. 2012 approximately a mile east of the community of Patton.] Here a vein from 6 to 20 feet wide is exposed for over 100 feet. It strikes E-W and dips vertically. The copper would run less than 2 per cent. There is some pyrite which looks as if it might carry gold but an assay made by the Provincial Assayer gave negative results.

Principle Strategic Minerals Option

Northeast of the above locality, four claims (S.S.M. 53150, 53151, 53157, and 53158), forming the south half of lot 8, section III, Patton township, were optioned in 1957 from Mogul Mining Corporation Limited to Principle Strategic Minerals Limited. The area is underlain by massive dioritic gabbro. Near the south limit of this group, a quartz vein striking N.85°W. and dipping 75°-80°N. can be traced for about 700 feet. The vein is exposed in five out of six pits along its strike. The maximum exposed width of the vein is 10 feet, which consists of 6 feet of quartz, with pyrite, chalcopyrite, and minor specularite separated by 1 foot of barren diabase from 3 feet of brecciated diabase in quartz, the latter again containing sulphides. For about 150 feet the vein is 4-5 feet wide, and beyond that it can be traced as shearing in diabase with quartz stringers or a single vein from 6 inches to 1 foot wide. Principle Strategic Minerals Limited drilled four short holes on the property. Subsequently the property was allowed to lapse. In 1960 the property was examined by E. Knott and H. Charbonneau of Iron Bridge. Chip samples taken by C. J. Knight, (geologist, Pronto Division, Rio Algom Mines Limited), which were assayed at the mine laboratory, indicated 1.4 percent copper over 4.5 feet for a strike-length of 150 feet.²

Another vein, about 1,000 feet to the west and slightly south of the above vein, was also investigated by Principle Strategic Minerals Limited. Apparently both test-pitting and drilling were undertaken. However, details of the development work and results are not available.

Northwest Quarter, Section 28, Patton Township

Slightly south of halfway between Patton hamlet and Prospect Lake there are two showings in the northwest quarter of section 28, Patton township.

The more northerly of these consists of a 10-foot-wide zone of quartz stringers with vertical dip, striking N.85°W., in interbedded greywacke, quartzite, and slate about 100 feet from a large gabbro body. The vein contains visible pyrite and chalcopyrite. In 1954 development consisted of a pit, 10 by 30 feet.

¹Report on some mining properties north of Lake Huron; unpublished report of Ontario Dept. Mines, 1942.

²C. J. Knight, personal communication.

Iron Bridge Area

A few hundred feet southeast of the above locality a 4- to 5-foot breccia zone striking N.80°W. in Gowganda shale contains quartz, calcite, and minor pyrite, chalcopyrite, and specularite. Development in 1954 consisted of a north-trending trench, 4-5 feet wide by 12 feet long.

Alma Lake, Patton Township

A prominent quartz vein system, up to 20 feet wide, can be traced in an easterly direction for about ½ mile close to the road leading to Darrell Lake. About 10 chains to the southeast of the junction of the Darrell Lake and the Chiblow Lake roads a small pit revealed only minor amounts of hematite. Elsewhere the vein is apparently barren.

About 40 chains due east of Alma Lake there is a zone of quartz-chalcopyrite veins in coarse-grained, massive gabbro. The gabbro has free quartz and epidote, and the feldspar is pink.

Southeast Quarter, Section 28, Patton Township

This showing is 3,000 feet west of the Jury Prospect (No. 4 on map). It consists of a 10- to 12-foot-wide zone of sheared quartz veins, 4-5 inches thick, in Gowganda conglomerate and quartzite. The zone strikes N.85°W. to W. Development work in 1954 consisted of a trench, 12-15 feet by 8 feet by 4 feet deep. Mineralization is mainly pyrite and specularite with minor chalcopyrite and malachite. Locally the vein is vuggy. The sulphides fill fractures in the quartz and appear to replace it.

Jury Property, Patton Township—(No. 4)

The ground covered by this prospect lies southwest of Prospect Lake and was included in that ground held by Electra Copper Mines Limited in 1961.

The southern part of the area is underlain by a large body of dioritic to granophyric gabbro and the northern part by interbedded Gowganda shale, quartzite, and conglomerate.

In 1906 minor copper production was reported from the Jury mine, but no details are given (O.B.M. 1907a, p. 41).

In 1954 observed development consisted of a trench, 75 feet by 6-8 feet wide by 6 feet deep, and a water-filled timbered shaft.

The zone of quartz veins and brecciated Gowganda quartzite and greywacke strikes from N.70°W. to N.85°W. and contains pyrite and chalcopyrite stained with limonite, malachite, and azurite.

In February 1956, Abila Mines Limited drilled at least three holes, totalling 857 feet, but only traces of chalcopyrite were recorded, and no assays are quoted on the company logs submitted for assessment credit.

Brady Mine, Patton Township—(No. 5)¹

Several copper showings are found in the vicinity of Bay Lake and the southeast corner of Patton township. No mention of this name is made in the early literature, but the original development probably took place in the first decade of the century.

¹Owing to an error in information, the main Brady shaft is wrongly shown on the southwest shore of Bay Lake, on the geological map No. 2012. There is no shaft at this location. (See also page 61.)

In 1957, Horlac Mines Limited took over a property comprising 8 patented and 8 non-patented claims. The patented claims comprise the south half of section 36 of Patton township; the unsurveyed claims approximate to the north half of the southeast quarter of section 35, the south half of the northeast quarter of section 35, the northeast quarter of the northeast quarter of section 35, the south half of the northwest quarter of section 36, and the northwest quarter of the northwest quarter of section 36. The southern part of the property is crossed by the old Patton-Blind River road and by the H.E.P.C. transmission line.

The area is underlain by the east half of a large differentiated gabbro-granophyre body in southeastern Patton township. The south boundary of the body, overlain by albitized Gowganda shales and quartzites, lies close to the H.E.P.C. transmission line and the road near the south boundary of Patton township.

The following information is taken from reports submitted by Horlac Mines Limited for assessment credit.

The Brady No. 1 shaft was located about 3,640 feet west of the southeast corner of Patton township and about 800 feet north of the south boundary of Patton township. One test pit was located 50 feet southwest of No. 1 shaft and another about 100 feet southwest of the shaft. The shaft itself is believed to be 125 feet deep.

No. 2 shaft, estimated to be 60 feet deep, was located 962 feet west of the southeast corner of Patton township and about 400 feet north of the south boundary of Patton township, and is about ½ mile east of No. 1 shaft.

Samples were taken by Horlac Mines Limited, from the dump at No. 1 shaft and from No. 2 shaft; copper and gold contents are shown in Table VIII.

TABLE VIII—ANALYSES OF SAMPLES, BRADY MINE
(Information from O.D.M. File 63A.326)

Sample	Copper	Gold
	percent	oz. per ton
No. 1 shaft:		
Grab.....	3.79	—
Grab.....	12.89	—
Bulk (250 lb.).....	3.60	0.08
No. 2 shaft:		
Grab.....	9.24	—
Grab.....	5.18	—
Grab.....	4.91	0.22

The information given above is from an unpublished company report by F. K. McKean.

A third shaft, 45 feet deep, was located southeast of shaft No. 1, but no details are given.

A fourth shaft is located about a quarter-mile south of Bay Lake. An earlier company report, made available to the author in 1960 by Mr. Stavroudis of Electra Copper Mines, stated that the main Brady showing was just north of the southwest bay of Bay Lake. Although this locality is within the boundaries of the group held by Horlac Mines Limited, no mention of development work in that area is made in the later reports filed for assessment credit.

A total of 32 short X-ray holes were drilled prior to September 1959. Locations of holes and summary logs were submitted for assessment credit. Apparently only slight mineralization was encountered, and no assays are quoted.

Iron Bridge Area

Horlac Mines Limited also carried out some exploration on William Kennedy's claims, which form the south half of the southeast quarter of section 35, Patton township. A prominent aeromagnetic anomaly (O.D.M. Maps, 1955) strikes east-west across these claims and the adjacent claims held by Horlac in section 36.

In 1959, Mr. Kennedy drilled three short holes on these claims, and a fourth was put down in 1960. Three holes were also drilled by Mr. Kennedy in 1958 on two claims forming the south half of the southeast quarter of the northwest quarter of section 36. Summary logs were submitted for assessment credit, but no details of mineralization were given.

Lot 10, Concession VI, Bright Township

Near the southwest corner of lot 10, concession VI, Bright township, a pit 8 by 5 by 8 feet deep, has been sunk in a sheared talcose quartz vein in granite, close to a diabase-granite contact. The vein strikes N.52°E. and is exposed for over 100 feet. It is believed that the pit is over 50 years old. There is no sign of sulphide mineralization.

Northwest Corner, Thompson Township

In the northwest corner of Thompson township, a narrow, northwest-trending, diabase dike cuts exposures of Gowganda conglomerate, greywacke, and shale. Quartz veins are found both at the south contact and within the dike. The veins are massive milky quartz slightly mineralized with minor amounts of specularite, pyrite, and chalcopyrite. Surface blasting has been carried out, but there is no record of any assays or other development work.

Two further showings are recorded near the northwest corner of Thompson township—one on each side of the old road connecting Patton hamlet with highway No. 17. At the more westerly showing, two quartz veins 1½ to 2 feet wide, striking N.80°E., are exposed in two pits, 8 by 4 by 3 feet and 15 by 4 by 2 feet, sunk in Gowganda conglomerate. Chalcopyrite is found as small blebs and fracture-fillings in the quartz. There is no description in Abraham's field notes of the second showing. There is no apparent record of other development work or of any assays.

Bar-Fin Mining Corporation Limited, Thompson Township—(No. 6)

The main showing on the Bar-Fin property is located in the north half of section 13, Thompson township. Easterly-trending breccia zones impregnated with quartz containing pyrite, chalcopyrite, specularite, and calcite cut laminated shales and greywacke conglomerate of the Gowganda Formation. No major diabase intrusion is exposed in the vicinity.

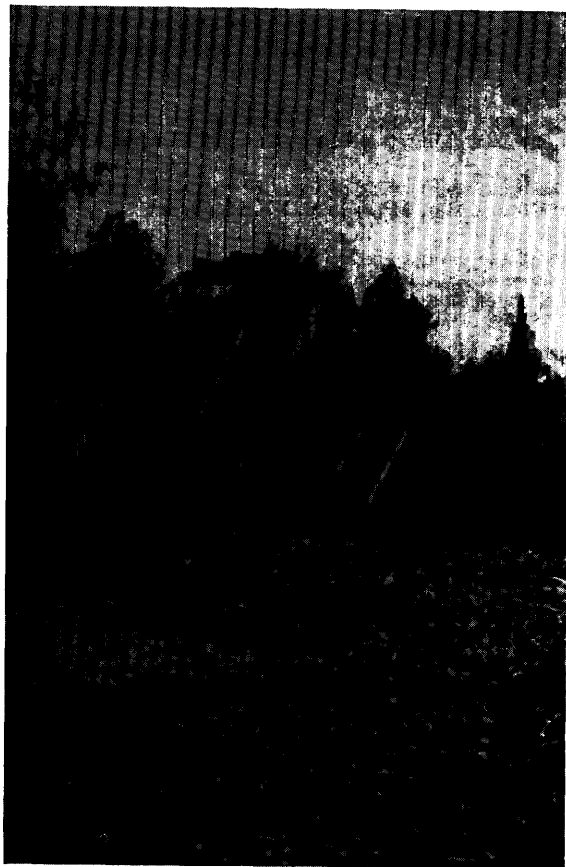
First mention of the property is made in 1906 when the Northern Ontario Consolidated Copper Company Limited¹ began development work (O.B.M. 1906, p. 69). In 1906 a three-compartment shaft had been sunk to 130 feet and some 250 feet of lateral work was done at the 117-foot level. Production of 120,000 pounds of copper valued at \$12,000 was obtained from about 1,500 tons of ore (Thomson *et al.* 1957, p. 71).

¹Formerly Northern Ontario Copper Mining Co. Ltd.

W. H. Collins describes a Moosehorn mine in section 11 of Thompson township (Collins 1925, p. 129); however, the only showing marked on the Lake Huron Sheet (G.S.C. 1933) is apparently the one described above.

In 1952, Strathallan Enterprises Limited put down three drillholes, and further drilling was carried out in 1954 by Parkway Mines Limited (Thomson *et al.* 1957, p. 71).

Photo 21



**Headframe and scrap-heap; Bar-Fin Mining Corporation,
Thompson township.**

In 1954 the property could be readily reached by an old road running along the north side of Pahpashcah Creek. However, in 1960 the old road was impassable east of the bridge over the Pahpashcah Creek owing to flooding caused by beaver.

In 1955 the property was taken over by the Bar-Fin Mining Corporation Limited. Further drilling, details of which are not available, was carried out. The shaft and workings were dewatered, re-timbered (Photo 21), and the underground workings examined. The results were discouraging (Thomson *et al.* 1957, p. 71). Buildings on the site are the headframe, a core-shack, and a stable.

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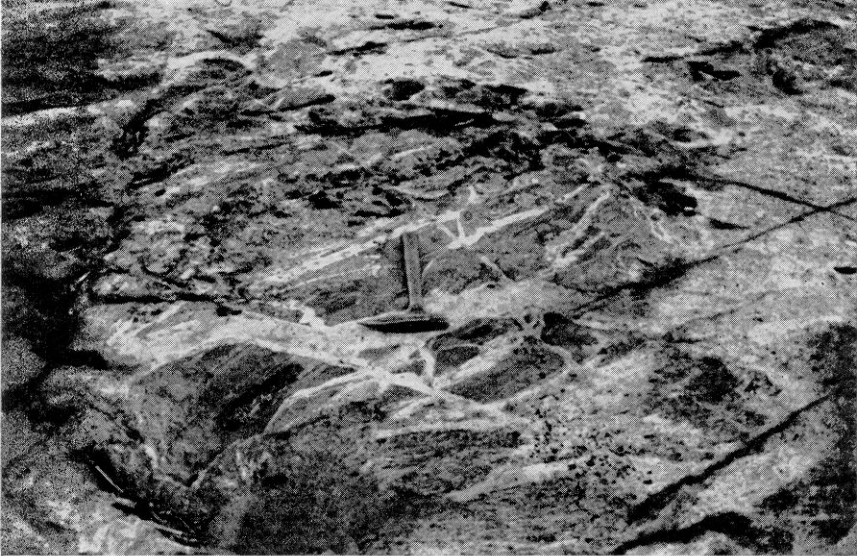
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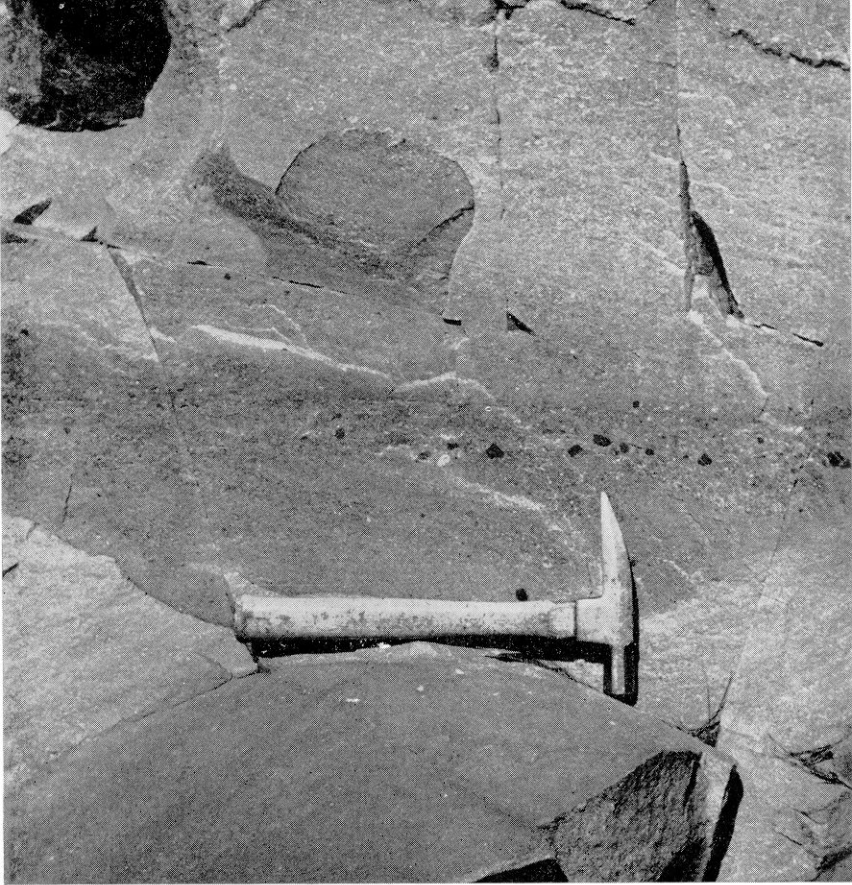
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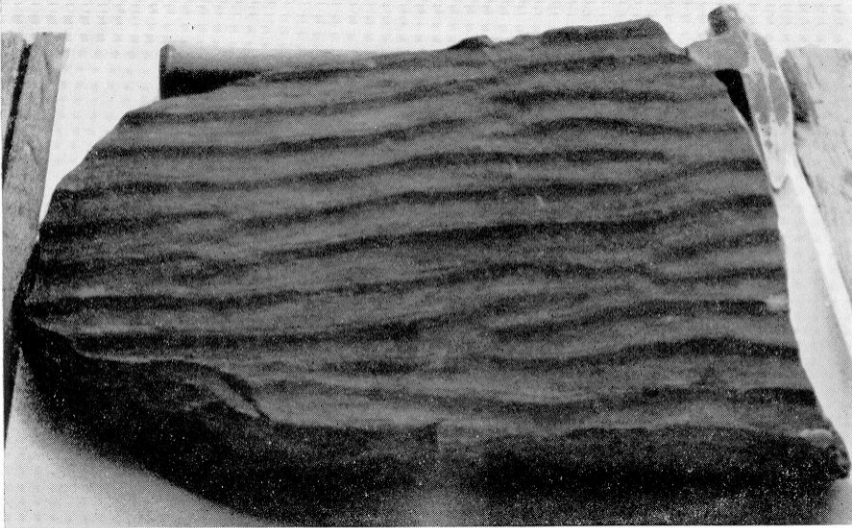
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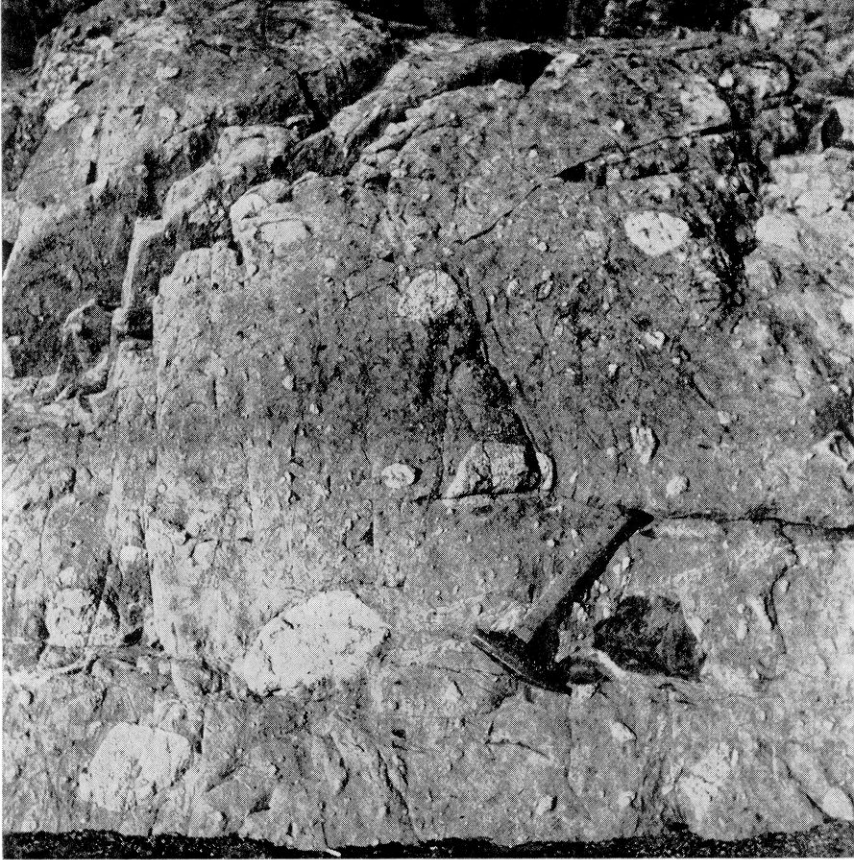
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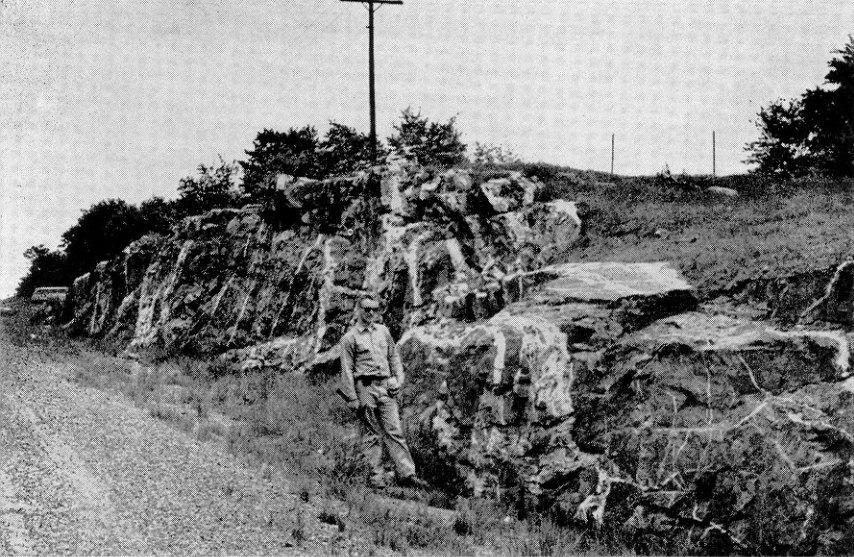


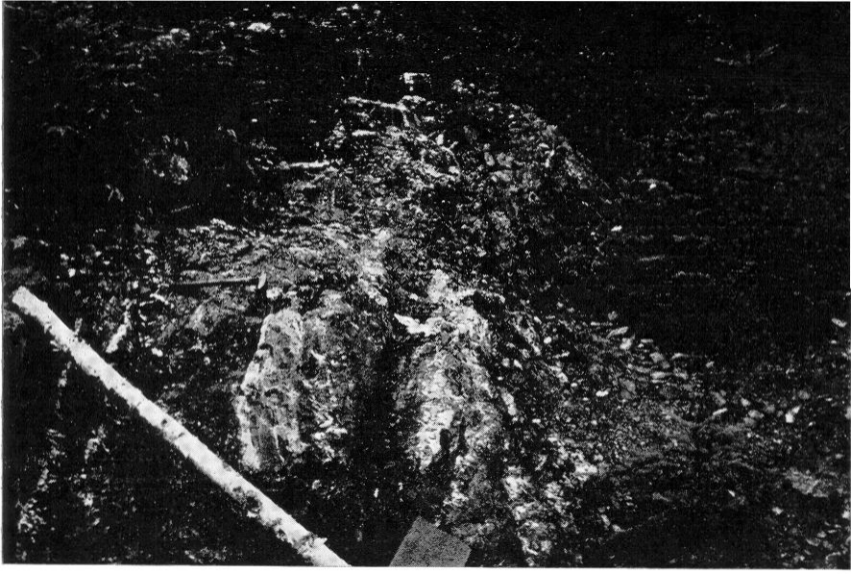


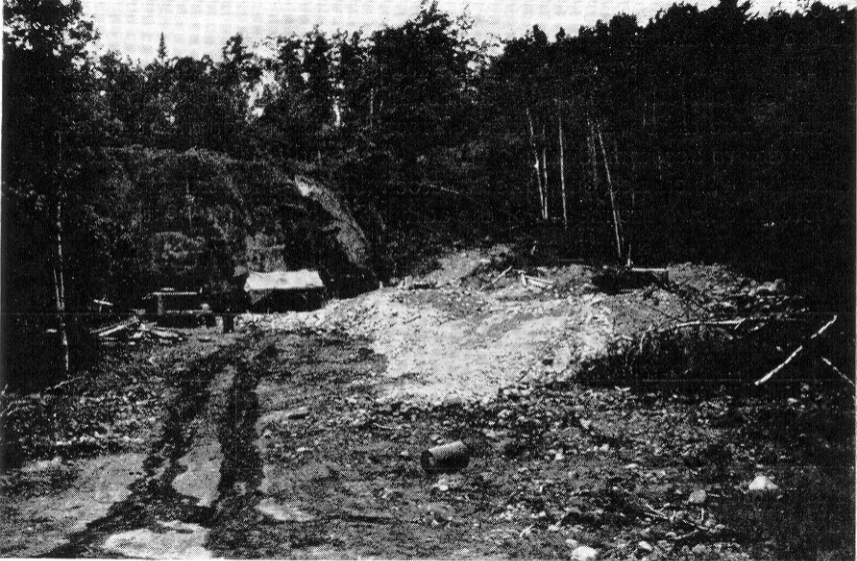






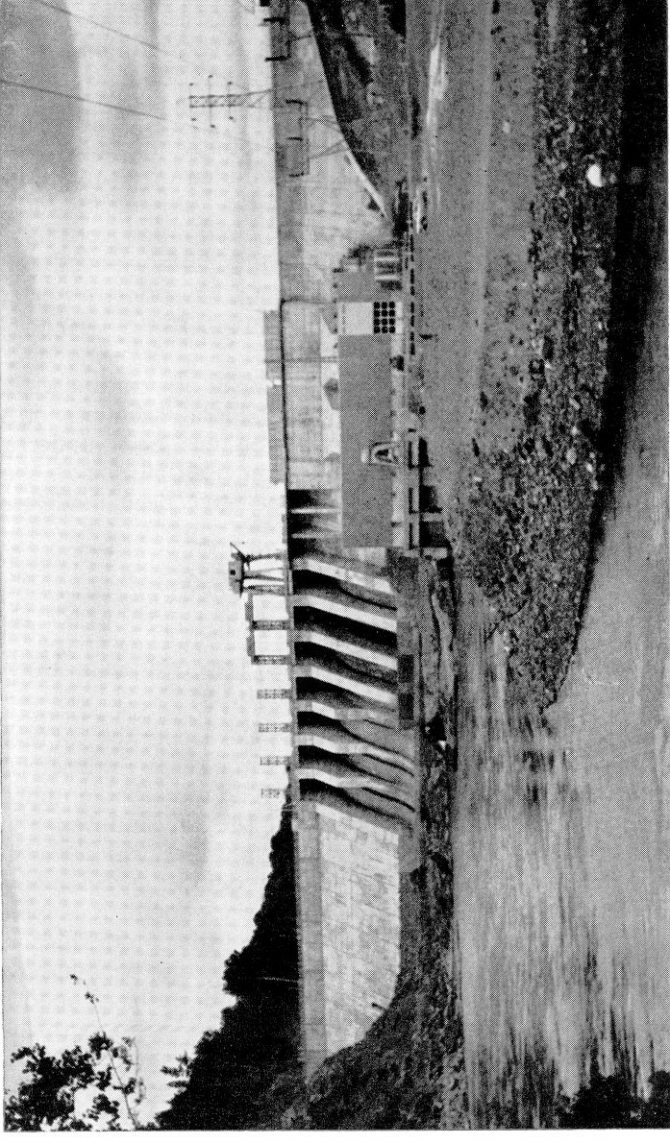










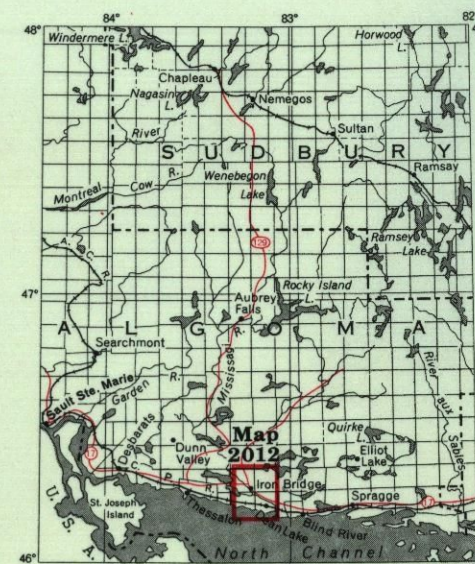




ONTARIO
DEPARTMENT OF MINES

HON. G. C. WARDROPE, Minister of Mines
D. P. Doughton, Deputy Minister M. E. Hurst, Director, Geological Branch

Map 2012
IRON BRIDGE AREA



Scale, 1 inch to 50 miles

LEGEND

- CENOZOIC**
RECENT*
Swamp, lake, and stream deposits.
- PLEISTOCENE***
Gravel, clay, till, sand.
GREAT UNCONFORMITY
- PRECAMBRIAN**
PROTEROZOIC
KEWEENAWAN
- Kd Diabase, gabbro and diorite, cut by thin acidic and basic dikes.
 - Kg Gneiss.
- HURONIAN**
COBALT GROUP
COBALT FORMATION
- Gc Polymictic conglomerate with or without interbedded quartzite, argillite, siltstone, greywacke.
 - Gq Metabasaltic conglomerate, argillite, siltstone, greywacke.
 - Gg Greywacke with or without interbedded conglomerate, argillite, siltstone, quartzite.
 - Ga Argillite, siltstone, with or without interbedded quartzite, greywacke, conglomerate.
- UNCONFORMITY**
BRUCE GROUP
ESPANOLA FORMATION**
Bruce Limestone
- Esl Limestone with some interbedded siltstone.
- CONFORMABLE CONTACT**
BRUCE FORMATION
Bc Polymictic conglomerate with occasional lenses of quartzite and siltstone.
- CONFORMABLE CONTACT**
MISSISSAGI FORMATION
Upper Mississagi
- Mls Feldspathic quartzite, quartzite, argillite.
 - Mml Middle Mississagi? Siltstone, quartzite, greywacke.
 - ML Lower Mississagi? Argillite and quartzite.
- GREAT UNCONFORMITY**
ARCHEAN
ALGOMAN
- Mg Migmatite, granite, gneiss, granite and other rock types with or without basic inclusions.
- INTRUSIVE CONTACT**
KEEWATIN?
Undifferentiated metavolcanics and metasediments (see inclusions in Algonian granite rocks).

*The Recent and Pleistocene deposits are not differentiated on this map. They occur in areas not mapped at all.

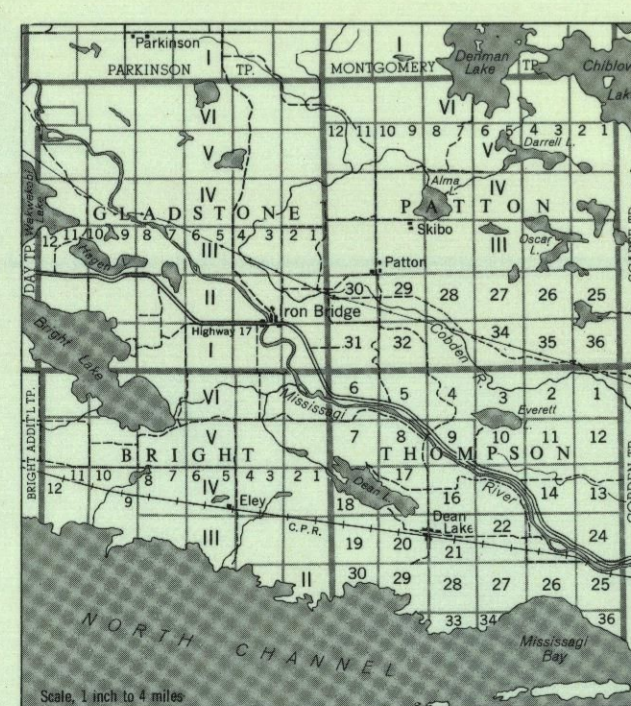
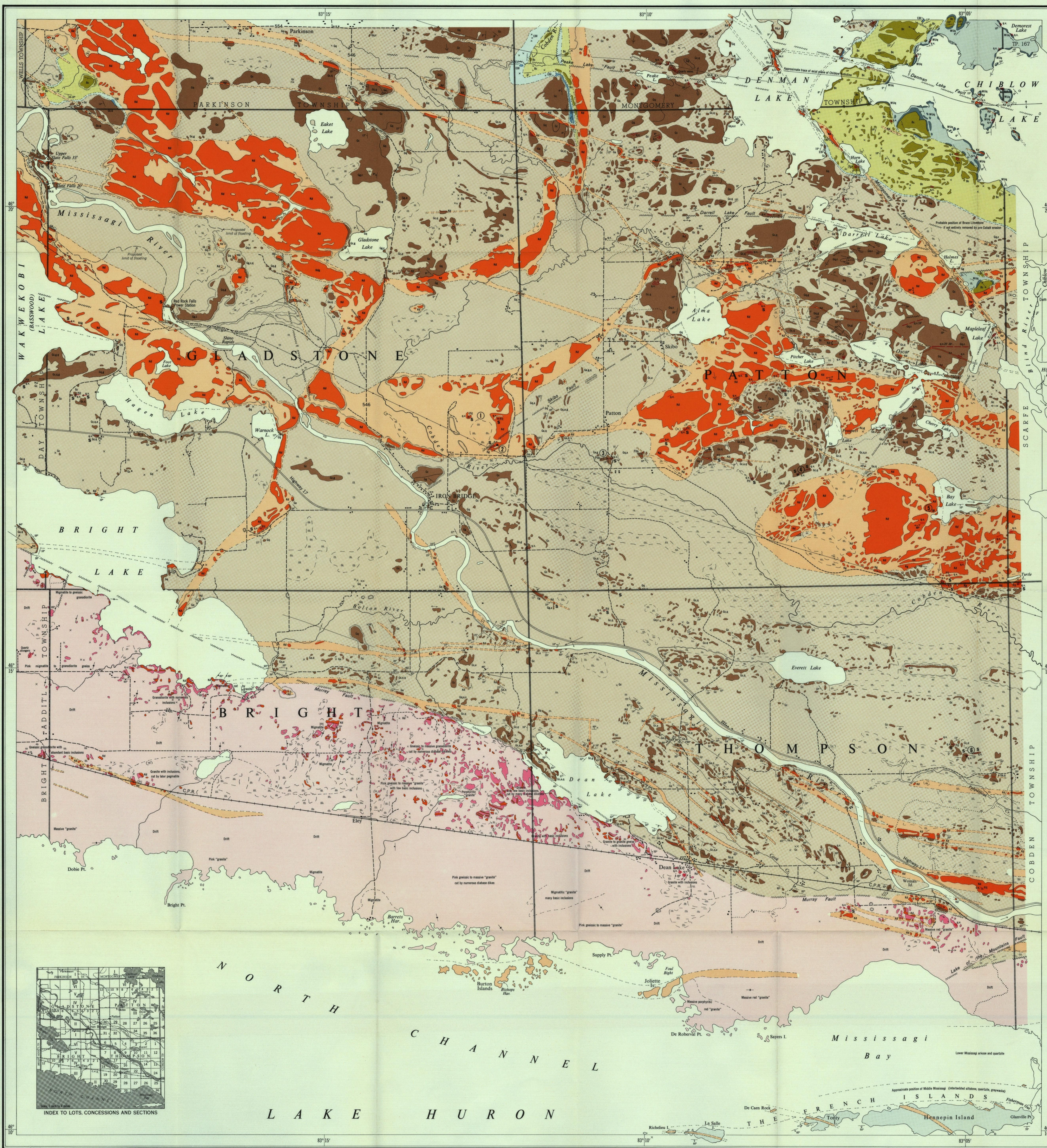
**The upper members of the Espanola Formation were removed by Pre-Gowanda erosion.

† These rocks are not exposed in the sheet area.

Bedrock geology. Outcrops and inferred extensions of each rock unit are shown, respectively, in deep and light tones of the same colour.

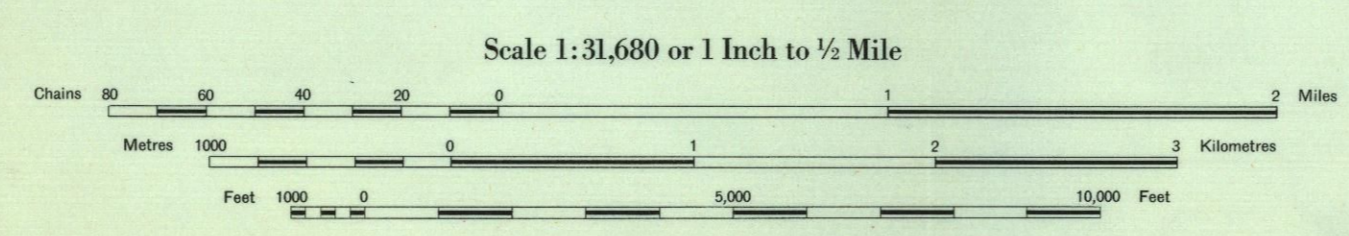
SYMBOLS

- Higher ground.
- Open muskeg, swamp or marsh.
- Muskeg or swamp with boundary.
- River, creek, stream, R = rapids; F = falls.
- Bridge.
- Railway.
- Electric power transmission line.
- Highway.
- Motor road.
- Wagon road.
- Trail, portage, winter road.
- Glacial striae.
- Small rock outcrop.
- Boundary of rock outcrop.
- Geological boundary, defined.
- Geological boundary, approximate.
- Geological boundary, assumed.
- Strike and dip; direction of top unknown.
- Strike and vertical dip; direction of top unknown.
- Strike and dip; top in direction of arrow.
- Direction (arrow) in which inclined beds face as indicated by gradation in grain size.
- Direction (arrow) in which inclined beds face as indicated by cross bedding.
- Synclinal axis.
- Anticlinal axis.
- Strike and dip of schistosity.
- Strike and dip of gneissosity.
- Strike of vertical gneissosity.
- Drag-folds. (Plunge added if known).
- Fault, indicated or assumed; arrows indicate horizontal movement.
- Building.
- Shaft.
- Test pit.
- Gravel or sand pit.
- Trench.
- Quartz vein, width in feet where indicated.
- Sulphide mineralization.
- Township boundary. Location approximate and not to be relied on.
- Mining property, approximate location.



INDEX TO LOTS, CONCESSIONS AND SECTIONS

Map 2012
IRON BRIDGE AREA
DISTRICT OF ALGOMA, ONTARIO



SOURCES OF INFORMATION

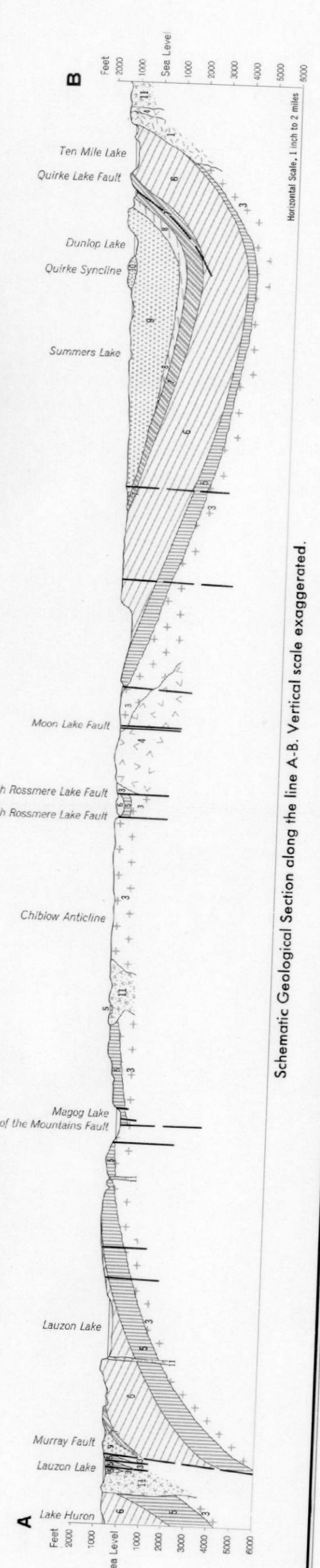
Geology by E. M. Abraham and assistants, 1935, 1954, and assistants, 1960.
Geology and compilation by J. A. Robertson and assistants, 1960.
Geology south of the C.P.R. by M. J. Frery, Geological Survey of Canada, Map 1-1877, Owen Lake and Map 1-1878, Wrennwood Lake.
Geological maps and plans of mining companies.
Cartography by J. Stankiewicz, Ontario Department of Mines, 1956, 1961.

Base map derived from maps of the National Topographic Series, the Federal Resources Inventory of the Ontario Department of Lands and Forests, and of the Hydro-Electric Power Commission of Ontario, with additional information by E. M. Abraham and J. A. Robertson.

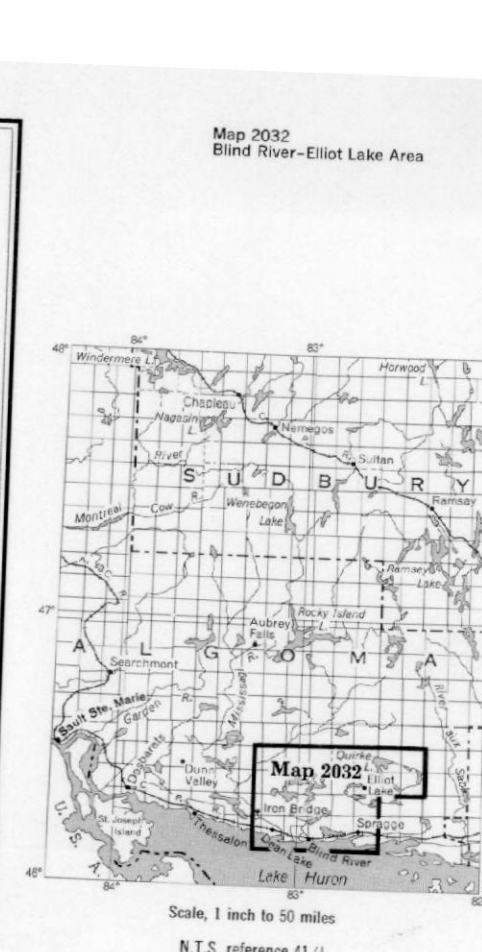
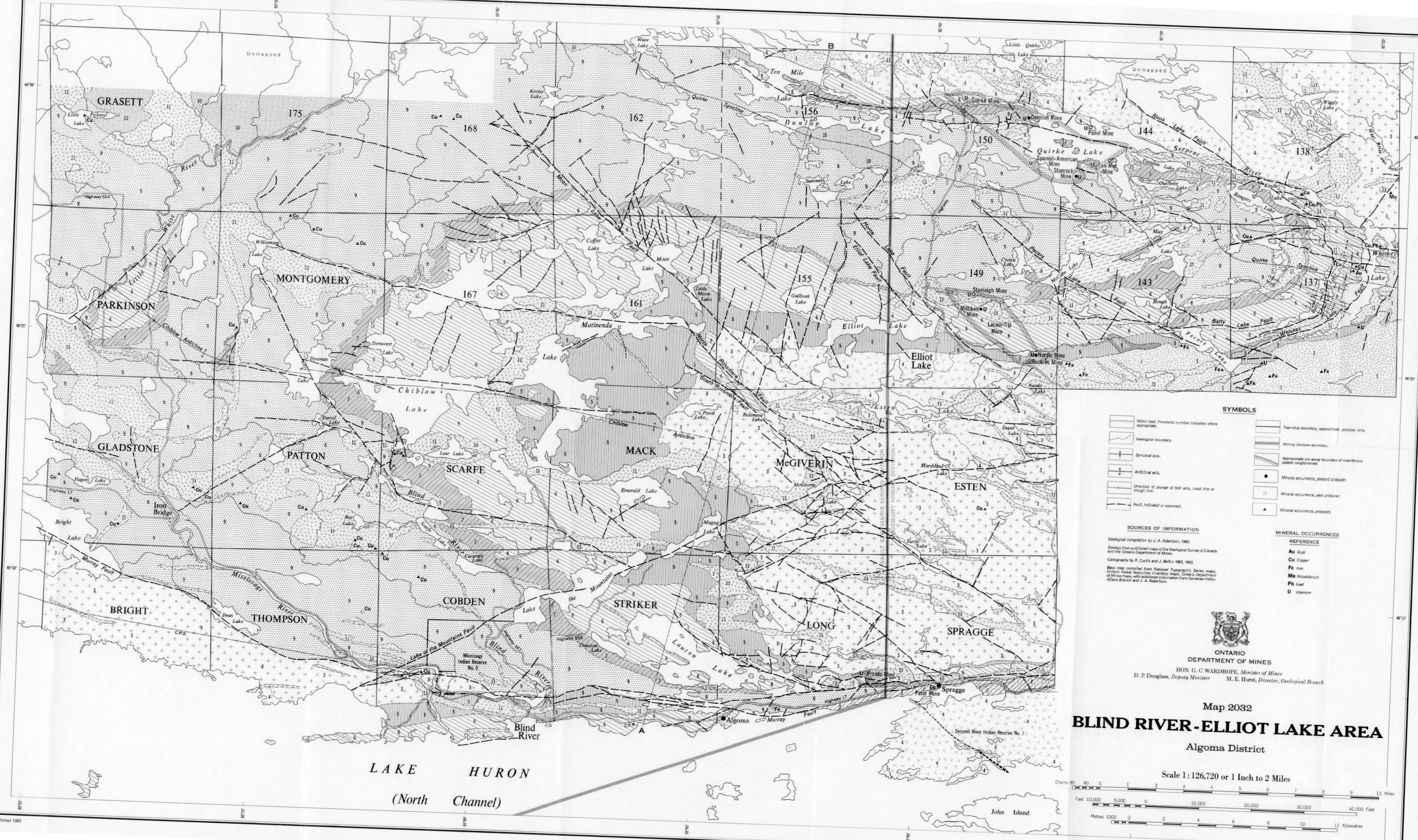
The magnetic declination in this area was approximately 8° 30' W., 1960.

LIST OF PROPERTIES

- 1 Gladstone Township
- 2 Principle Strategic Minerals Ltd.
- 3 Glogona Copper Mines Ltd.
- Patton Township
- 4 Juby Mine
- 5 Brady Mine
- Thompson Township
- 6 Bar-Vin Mining Corp.



Schematic Geological Section along the line A-B. Vertical scale exaggerated.



- SYMBOLS**
- Motor road. Provincial number indicated where appropriate.
 - Geological boundary.
 - Synclinal axis.
 - Anticlinal axis.
 - Direction of plunge of fold axis, crest line or trough line.
 - Fault, indicated or assumed.
 - Township boundary, approximate position only.
 - Mining Division boundary.
 - Approximate ore assay boundary of unclassified possible conglomerates.
 - Mineral occurrence, present producer.
 - Mineral occurrence, past producer.
 - Mineral occurrence, prospect.

- SOURCES OF INFORMATION**
- Geological compilation by J. A. Robertson, 1962.
 Geology from published maps of the Geological Survey of Canada and the Ontario Department of Mines.
 Cartography by R. Curtis and J. Belin, 1962, 1963.
- Base map compiled from National Topographic Series maps, Ontario Forest Resources Inventory maps, Ontario Department of Mines maps, with additional information from Canadian Indian Affairs Branch and J. A. Robertson.

- MINERAL OCCURRENCES REFERENCE**
- Au Gold
 - Cu Copper
 - Fe Iron
 - Mo Molybdenum
 - Pb Lead
 - U Uranium

ONTARIO DEPARTMENT OF MINES
 HON. G. C. WARDROPE, Minister of Mines
 D. P. Douglass, Deputy Minister M. E. Hurst, Director, Geological Branch

Map 2032
BLIND RIVER-ELLIOT LAKE AREA
 Algoma District

Scale 1:126,720 or 1 Inch to 2 Miles

Chains 80 0 1 2 3 4 5 6 7 8 9 10 Miles
 Feet 10,000 5,000 0 10,000 20,000 30,000 40,000 Feet
 Metres 1000 0 2 4 6 8 10 12 Kilometres

- LEGEND**
- CENOZOIC**
RECENT AND PLEISTOCENE*
 Sand and gravel, and clay.
- GREAT UNCONFORMITY**
- PRECAMBRIAN**
PROTEROZOIC
KEWEENAWAN
 Olivine diabase.
 Quartz diabase.**
- INTRUSIVE CONTACT**
- HURONIAN**
COBALT GROUP
 Gairn Formation: Quartzite.
 Givens Formation: Conglomerate, quartzite.
- UNCONFORMITY**
- BRUCE GROUP**
 Serpent Formation: Quartzite.
 Bruce and Esthère Formations: Conglomerate, limestone, iron-ore.
- Middle and Upper Mississagi Formations: Conglomerate, quartzite, quartzite.**
Lower Mississagi Formation: Quartzite, conglomerate.
- GREAT UNCONFORMITY**
- ARCHEAN**
ALGOMAN GRANITE
 Massive red granitic rocks.
- INTRUSIVE CONTACT †**
 Gneiss to massive, grey to pink, granitic rocks.
- INTRUSIVE CONTACT**
- SUDBURY GROUP**
 Spragge Formation*** and basic intrusions: Schists, quartzite, Magnetite.
- RELATIONSHIP UNKNOWN**
- KEEWATIN (†) GROUP**
 Metavolcanics and metasediments.
- *These deposits are not shown on this map.
 **Quartzite diabase is widely termed Mississagi diabase or Post Huronian diabase and the term Keweenaw is then restricted to the olivine diabase. Only the large diabase bodies are shown.
 ***These rocks here named Spragge Formation have previously been correlated with the Mafic Formation.