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THE MINERAL POTENTIAL
OF
ULTRAMAFIC ROCKS
OF
MANITOBA

BY

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THE MINERAL POTENTIAL OF ULTRAMAFIC ROCKS OF MANITOBA[1]

Introduction

The importance of ultramafic and related rocks as potential sites for ore deposits of nickel-copper, platinum group metals, chrome and asbestos is well known. Deposits of talc and decorative serpentine facing stone are also known in these rocks. A great many ultramafic bodies are found in those areas of Manitoba mapped in greater detail than one inch to four miles (Fig. 1). The large area north of Lynn Lake indicates that ultramafic rocks are not as yet known from this area and not necessarily that they are absent.

Belts of discrete ultramafic bodies (alpine type) are exemplified by the Moak-Setting, Island Lake and Rice Lake-Lake Winnipeg belts. Differentiated, layered bodies are exemplified by the Fox River Sill, Bird River Sill and Lynn Lake gabbro.

A programme of investigation of ultramafic rocks in Manitoba is currently in progress and will provide, among other things, an inventory of the economic potential of these rocks.

Nickel-copper

Exploration of ultramafic and related rocks for various metallic and non-metallic ore deposits began after the First World War when nickel-copper occurrences in the Maskwa-Bird River area of southeastern Manitoba were discovered. Claims were staked in 1917 near Maskwa River and in 1920 near Bird River, covering ultramafic and mafic rocks of the Bird River sill. Several thousand feet of diamond drilling were completed on these properties during the 1930's. The exploration for nickel-copper in this area culminated in 1969 with production of nickel-copper ore by Dumbarton Mines Limited (Fig. 2). This represents a span of 50 years from initial exploration to mine production. Exploration for nickel-copper ores is presently continuing in the Bird River area.

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[1] A paper presented with the permission of the Honourable Sidney Green, Q.C., Minister of Mines and Natural Resources, Manitoba, at the Thirty-ninth Annual Convention of the Prospectors' and Developers' Association, March 7 to 10, 1971, at the Royal York Hotel, Toronto, Canada.

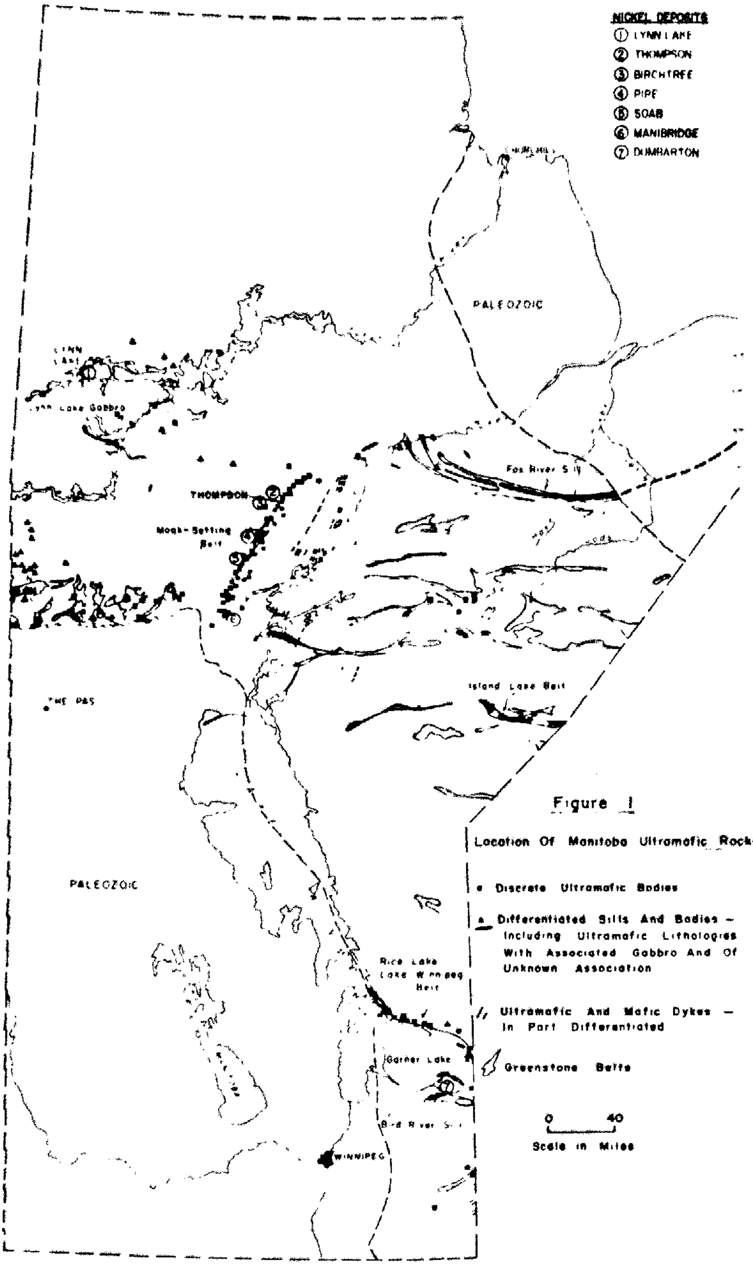

Figure 1

Location Of Manitoba Ultramafic Rocks

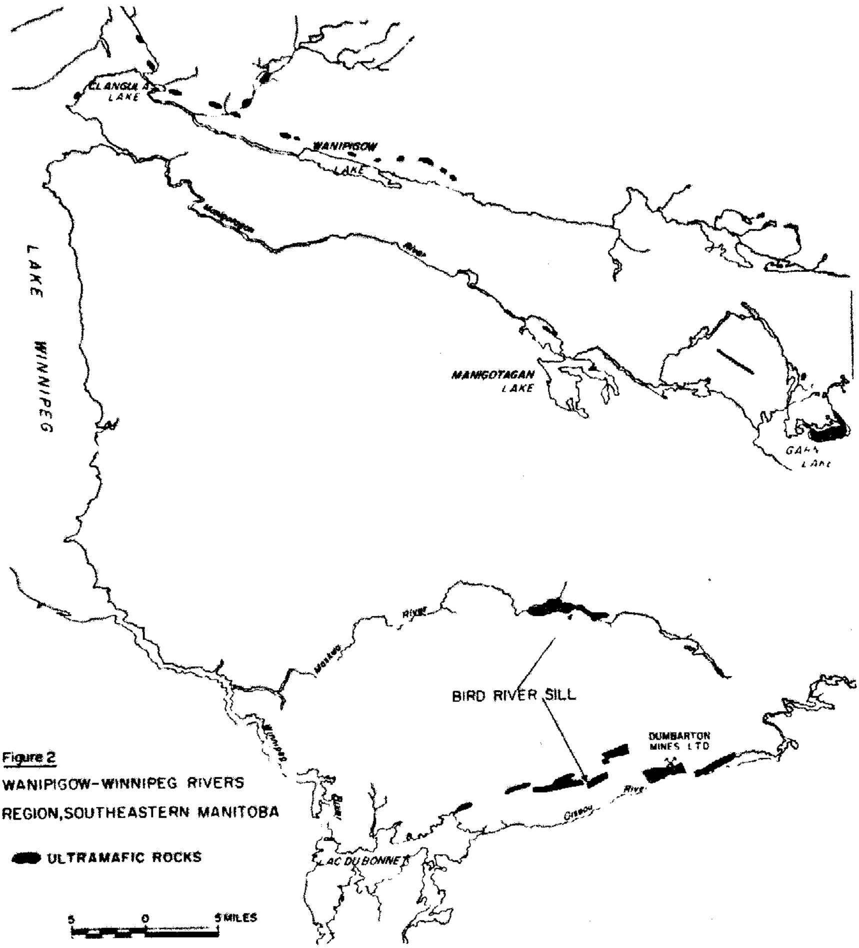

Figure 2
WANIPIGOW-WINNIPEG RIVERS
REGION, SOUTHEASTERN MANITOBA

Three ore zones have been outlined on the Dumbarton Mines Limited property, totalling 1.2 million tons grading 1.23 per cent nickel and 0.37 per cent copper. The ore zone occurs along a granite-andesite contact and is within a few hundred feet of the basal serpentinized peridotite of the Bird River sill.

Nickel-copper ores were discovered in the Lynn Lake gabbro in 1941 and this discovery led to production from Sherritt Gordon Mines Limited Lynn Lake mine in 1953.

The Lynn Lake gabbro is a differentiated layered body which intrudes Wasekwan group rocks of the Churchill province. Lenses of ultramafic rocks occur near the base of the body and display a spatial relation with some of the nickel-copper ore bodies.

Gabbroic bodies which display features similar to the Lynn Lake gabbro, but which are not known to contain ultramafic rocks, or contain only thin layers of pyroxenite or anorthosite, include the Fraser Lake gabbro (Emslie and Moore, 1961), the Melvin Lake gabbro (Hunter, 1952), the Tow Lake gabbro (Hunter, 1958) and the MacBen Lake gabbro (Quinn, 1960; Hinds, 1969).

In 1956, following ten years of intensive exploration, the International Nickel Company Limited announced the discovery of a large high grade deposit at Thompson. Production began from the Thompson mine in 1960 and from the Birchtree mine in 1970. The Soab and Pipe mines are scheduled to begin production in 1971.

South of Wabowden, Falconbridge Nickel Mines Limited is developing the Manibridge nickel deposit, containing an estimated 1.4 million tons of ore grading 2.55 per cent nickel and 0.27 per cent copper. The ore body consists of disseminated to semi-massive ore, contained in a serpentinized ultramafic body (Coats an Brummer, 1970).

The nickel deposits of the Moak-Setting Lakes belt are of two types. The Pipe pit, Manibridge, Moak Lake and Mystery Lake deposits consist of finely to coarsely disseminated nickel-bearing sulphides in serpentinized peridotite. The ores at Thompson and Birchtree on the other hand occur as bands or stringers of massive and disseminated sulphides in gneiss, schist and serpentinite (Patterson, 1963; Quirke, *et al.*, 1970; Zurbrigg, 1963).

Belts of ultramafic rocks, similar to the Moak-Setting belt are the Island Lake belt of northeastern Manitoba and the Rice Lake-Lake Winnipeg belt of southeastern Manitoba. An ore body of low grade copper-nickel ore was discovered at the west end of Island Lake near Linklater Island by Canadian Nickel Company Limited in 1956 (Quinn, 1960). An occurrence of nickel-bearing sulphides in serpentinized peridotite is also known on Island Lake near Loonfoot Island.

A great many other ultramafic bodies are known in both the Superior and Churchill provinces. However insufficient information is available on whether or not some of these bodies form belts.

The development and production of nickel-copper ores in three widely separated areas, each representing a different geological environment, but all closely associated with ultramafic rocks, is considered significant. In an exploration sense, the significance lies in the fact that exploration for nickel-copper sulphides cannot be restricted to any single type of ultramafic or ultramafic-mafic assemblage. All ultramafic bodies, whether they be fault-bounded discrete bodies or differentiated layered sills, can potentially contain nickel-copper sulphide ores or be spatially related to these ores. The fact that the ores may not necessarily be confined within an ultramafic body (e.g. Thompson and Dumbarton) is also a significant factor.

Chrome

The first discovery of chromite was made in a small gabbro sill north of Lac du Bonnet, and subsequent prospecting of the peridotite of the Bird River sill resulted in several chromite discoveries in the summer of 1942. The chromite is contained in and forms an integral part of the Bird River sill, a differentiated, layered, ultramafic-mafic body. The chromite forms well developed layers in the serpentinized peridotite of the sill and the main chromite zone parallels and is within 100 feet of the serpentinized peridotite-gabbro contact (Fig. 3).

Total indicated tonnages outlined are of the order of 16,000,000 tons grading from 4.6 to 25 per cent Cr_2O_3. The chrome to iron ratio ranges from 1:1 to 1.60:1 and this low ratio has precluded further development of these ores. The ultilization of this chromite will depend on whether or not concentration and beneficiation can be achieved economically. In any event they continue to constitute a valuable reserve for future use.

The production of nickel-copper from ores closely associated with the base of the Bird River sill (Dumbarton Mines Limited) and the reserves of chromite noted above, indicate that a single ultramafic-mafic body can be a source of more than one economically significant commodity.

Non-metallic ore deposits

At Clangula Lake, a few miles east of Wanipigow on Lake Winnipeg, an attempt was made to quarry a body of serpentinite for use as decorative stone. Several small quarries were opened up in 1929, but the project was abandoned owing to the brittle nature of the serpentinite. A deposit of talc found in the same serpentinite mass was not developed.

Four occurrences of talc schist on Iskwasum Lake were examined by the Manitoba Mines Branch in 1970. The talc schist forms peripheral zones around small ultramafic bodies. The talc zones are composed of talc and carbonate (calcite-magnesite) and lesser amounts of serpentine and magnetite. Hematization of the talc schist is developed in two of the occurrences. The talc content ranges from 20 to 70 per cent.

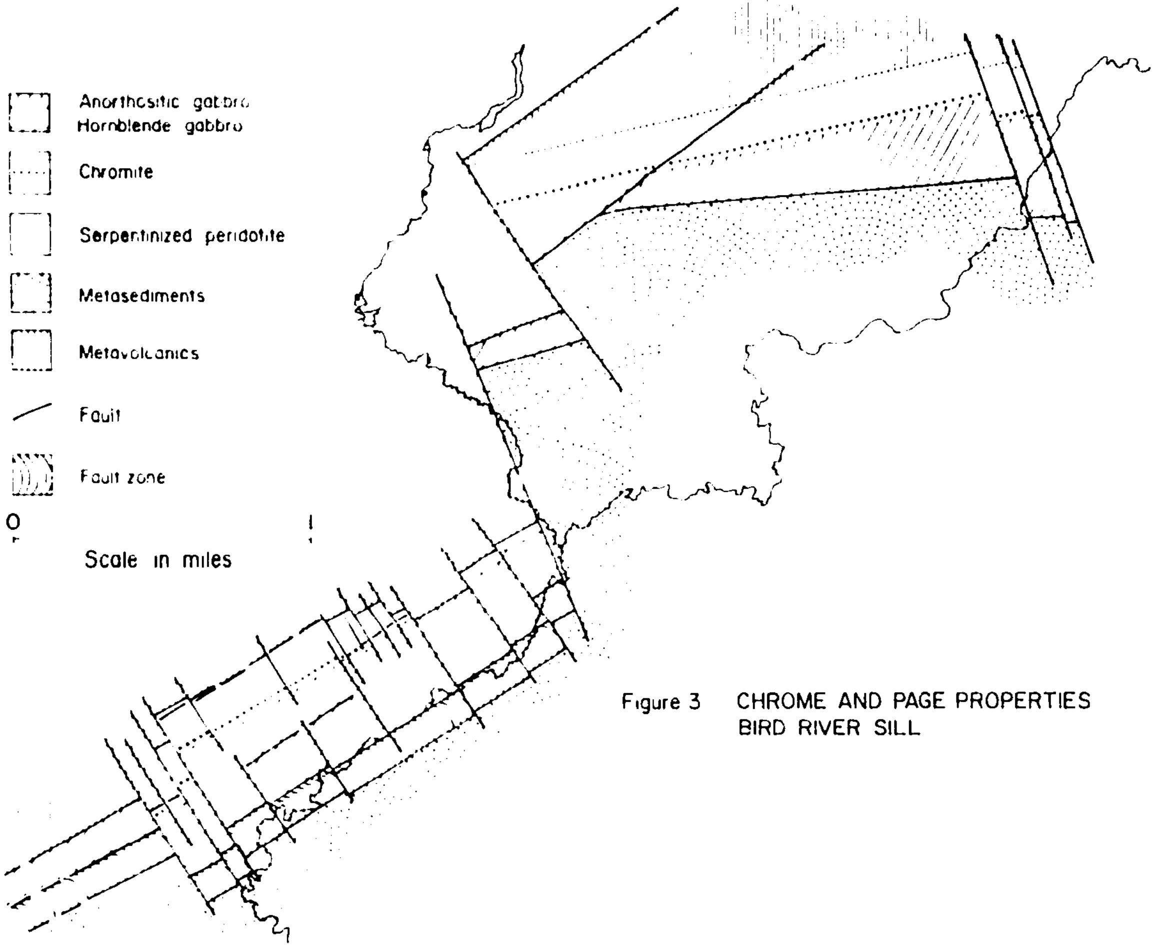

Figure 3 CHROME AND PAGE PROPERTIES BIRD RIVER SILL

An occurrence of talc schist on the east shore of Lake Winnipeg, approximately 3 miles northwest of Clangula Lake, was found in 1969. This occurrence will be investigated in 1971.

Occurrences of asbestos in ultramafic rocks are known from widely separated localities. To date, none of these occurrences has warranted any great amount of exploration.

Future potential

The largest differentiated layered sill known in Manitoba is the Fox River sill, a portion of which is exposed in rapids of the Fox River in northeastern Manitoba. The body appears to be continuous over a length of 155 miles (from $90^{\circ}30'$ to $94^{\circ}30'$ Longitude); this length being the length of the associated aeromagnetic anomaly. The easternmost 85 miles of the body is covered by Paleozoic rocks. The aeromagnetic anomaly ranges from 1.5 to 2.5 miles wide and agrees with an estimated sill thickness in the area of exposure, of 7,000 feet (Scoates, 1969b). The sill is estimated to have a surface area of approximately 200 square miles.

The lithologic variation ranges from serpentinized dunite to gabbro (Fig. 4) and the ratio of mafic to ultramafic rocks is approximately 1:10.

Serpentinized dunite and peridotite are estimated to make up approximately 78 per cent of the exposed portion of the body. If this figure is considered to be representative of the 155-mile length, then the surface area of the serpentinized dunite and peridotite is approximately 163 square miles. Assuming a depth of 1 mile which appears reasonable on the basis of gravity data (Gibb and McConnell, 1969) the volume of serpentinized dunite and peridotite is 163 cubic miles. A cubic mile of average peridotite is estimated to contain 2 million tons of nickel, based on an average nickel content of 0.2 per cent. Utilizing this figure, the contained nickel content of the Fox River sill is estimated to exceed 300 million tons. The great bulk of this nickel content is held in the silicate structure of the mineral olivine, or its principal alteration product serpentine. How much nickel is held in other silicates, oxides or minute grains of sulphide or native metal is not known.

Chamberlain (1968) points out that such values in relatively large rock masses represent tantalizingly high tonnages of nickel. The significance of the Fox River sill is not one of immediate exploitation but rather as a potential future reserve. Exploration for sulphide deposits in the Fox River sill has been conducted by several mining companies over the past 15 years and is continuing.

The Fox River sill by its layered nature can also be considered a potential source of chromite, and disseminated chromite is readily visible in some of the serpentinized dunite layers.

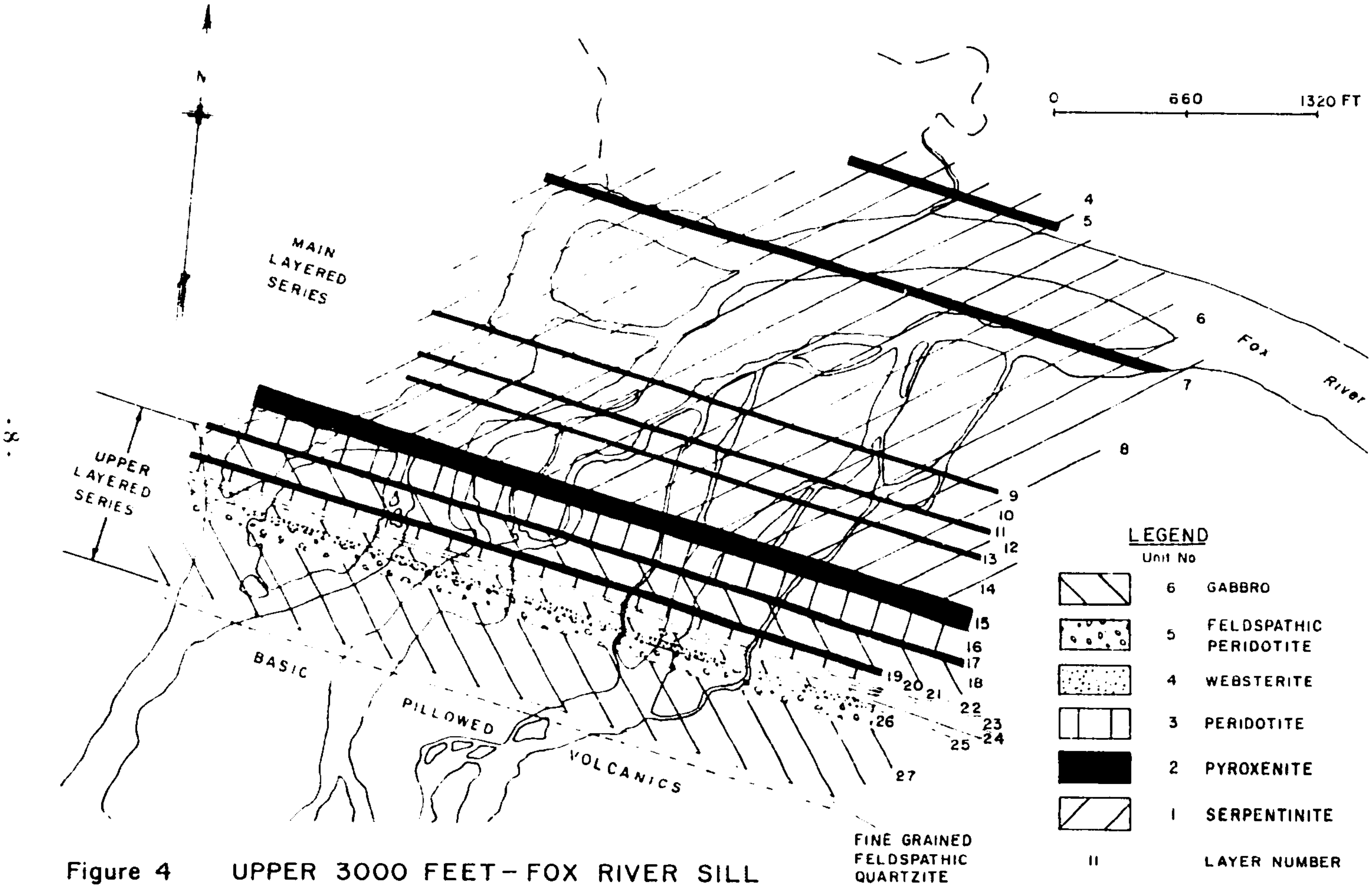

Figure 4 UPPER 3000 FEET - FOX RIVER SILL

Summary

The importance of nickel production to the total value of metal production in Manitoba can be seen in Figure 5. The history of nickel production can easily be read from this graphical representation; the initial production from Lynn Lake in 1953, Thompson production in 1960, Dumbarton production in 1969 and Birchtree production in 1970. Total nickel production in Manitoba for 1970 is estimated at 156 million lbs. valued at $216 million. The continued development of nickel mines in the Manitoba nickel belt will add to this figure over the next few years.

Known deposits of chrome, although not presently economic, constitute a valuable reserve, and the potential for new discoveries is considered high.

Non-metallic ore deposits associated with ultramafic rocks may have some potential. However, there is relatively little exploration for these types of deposits at the present time.

The relationship between certain metallic and non-metallic deposits and ultramafic rocks is well documented. Continuing studies of Precambrian ultramafic rocks will clarify the nature of the relationship, and perhaps lead to guidelines for determining the potential of certain types of ultramafic rocks containing specific metallic or non-metallic ores.

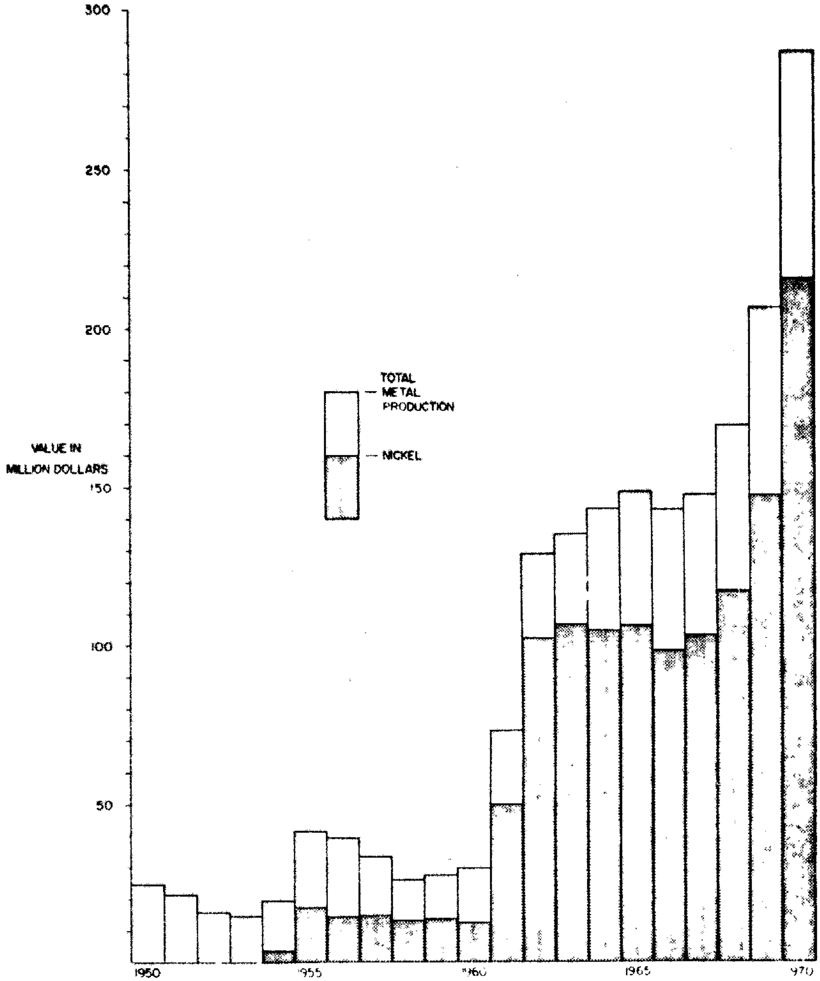

FIGURE 5
VALUE OF METAL PRODUCTION AND NICKEL PRODUCTION FOR MANITOBA 1950-1970

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