Supplementary

REPORT . . .

OF

LEGISLATIVE COMMISSION ON TAXATION OF IRON ORE

SUBMITTED TO

THE MINNESOTA LEGISLATURE OF 1957

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Prepared as a supplement to the Report of this Commission to the 1955 Legislature and as an appendix thereto.

LEGISLATIVE COMMISSION ON TAXATION OF IRON ORE

SENATE MEMBERS

Thomas P. Welch, Chairman
Buffalo, Minnesota

B. G. Novak, 2nd Vice-Chm.
747 Van Buren, St. Paul

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Almelund, Minnesota

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Winona, Minnesota

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Rte. 2, Hopkins, Minn.

Elmer Peterson
Hibbing, Minnesota

Thomas D. Vukelich
Gilbert, Minnesota

Donald O. Wright
Plymouth Building
Minneapolis, Minn.

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Pelican Rapids, Minn.

H. P. Goodin
3415 Knox Ave. N.
Minneapolis, Minn.

Alfred I. Johnson
Benson, Minnesota

Francis LaBrosse
Duluth, Minnesota

Leonard E. Lindquist
Brooklyn Center, Minn.

Martha May Wylie, Secretary

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State of Minnesota
LEGISLATIVE COMMISSION
ON TAXATION OF IRON ORE
238 State Capitol - St. Paul 1, Minnesota
CApitol 2-3013, Ext. 248
Martha May Wylie, Secretary

January 24, 1957

To the President of the Senate
To the Speaker of the House

Honorable Sirs:

In accordance with Laws 1955, Chapter 795, this Commission submits herewith its report on the taxation of iron ore.

Respectfully submitted,

LEGISLATIVE COMMISSION ON TAXATION OF IRON ORE

By Thomas P. Welch
Thomas P. Welch, Chairman

TPW:mw

Preliminary Statement

The work of this Commission was again extended and continued by Chapter 795, Laws of 1955.

There were two changes in the membership of the Commission: — Senator J. R. Keller, Winona, succeeded former Senator A. O. Sletvold, Detroit Lakes; Representative Leonard E. Lindquist, Brooklyn Center, succeeded former Representative Gordon Forbes, Worthington, thereby maintaining an equal number of majority and minority members of both Houses.

The officers elected in 1951 and again in 1953, were unanimously voted to continue in their respective offices in 1955. They are as follows:

Senator Thomas P. Welch, Chairman
Representative Fred A. Cina, First Vice Chairman
Senator B. G. Novak, Second Vice Chairman
Representative Lloyd Duxbury, Jr., Secretary

Also, Martha May Wylie, Secretary, has been continued in her employment by the Commission; and Frank E. Downing, Engineer and former head of the Mining Division of the State Tax Department, Consultant, was employed for short periods of time, in all, about three months.

The Report submitted to the 1955 Legislature by this Commission represents basic factual and statistical material relating to the taxation of iron ore.

This Supplementary Report to the 1957 Legislature refers to the 1955 Report in many instances. Several new factors, conditions and trends, both in the production of iron ore and in the manufacture and consumption of steel, substantially affecting Minnesota's position as an iron ore producer, have become apparent and will be hereinafter referred to.

Brief History of Iron Mining in Minnesota

Under the chapter **Brief History of Iron Mining in Minnesota,** in the 1955 Report, the subject of *Recent Mining Developments* on pages 11 and 12, is supplemented as follows:

It has been reported that Oliver Iron Mining Division of United States Steel has an ore deposit at Virginia with about 27 million tons of good ore which is now being developed for shipment. Actually some shipments of this ore, called Sauntry ore, have been made during the past few years by adjoining mines. Ore from the Sauntry is needed to replace the declining high-grade ore in the Rouchleau Mine.

The Stephens Mine in White Township with 48 million tons of fair ore is also being developed by Oliver for active production.

These two are the last of the large deposits on the Mesabi Range. Remaining undeveloped deposits have substantial total reserves in smaller ore bodies.

At the Tioga No. 2 Mine at the extreme west end of the Mesabi Range, a large new concentrating plant was built in 1955 by Pickands-Mather and Company.

Great effort is being made to improve the grade of both concentrating ore and "direct shipping" ore. Much ore of the grade generally known as "direct shipping" ore will soon have to be upgraded if it is to compete with high-grade imports from Canada and South America.

Digest of Minnesota Laws Applicable to Iron Ore Taxation

In 1955 the Legislature amended some of the laws affecting the taxation of iron ore. With reference to our 1955 Report, the following sections of the law were amended.

OCCUPATION TAX

p. 27—'55 Report
1. Constitution of Minnesota, Article 1 X, Sec. 1-A(d). APPORTIONMENT OF OCCUPATION TAX

Pursuant to Laws 1955, Extra Session, Chapter 6, by an amendment to the Constitution adopted at the 1956 General Election, the distribution of the occupation tax was changed so that 50% of the funds derived from the tax should go to the State General Revenue Fund; 40% for the support of elementary and secondary schools; and 10% for the general support of the University.

p. 27—'55 Report
3. M.S. 1953, Sec. 298.01, as amended by Laws 1955, Ex.S., Chapter 2 OCCUPATION TAX ON PRODUCING ORES

By Laws 1955, Extra Session, Chapter 2, Article 2, there was imposed on producers of iron ore (except taconite) a surtax at the rate of 15% (raising the 11% rate to 12.65%), such surtax to be in effect for two taxable years, 1955 and 1956.

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5. M.S. 1953, Sec. 298.02, as amended by Laws 1955, Ex.S., Chap. 2, Art. II, Sec. 2. LOW GRADE ORE; CREDIT FOR COST OF LABOR

Minnesota Statutes 1953, Section 298.02, had provided a credit for high labor costs of mining or development or beneficiation, which credit served to reduce the rate on high labor cost ores. By Laws 1955, Extra Session, Chapter 2, the basis of these credits was changed to provide as follows:

(a) In the case of underground mines or that tonnage of merchantable ore produced in open pit mines which has resulted from beneficiation within the State by jigging, heavy media, cyclone process, roasting, drying by artificial heat, sintering, magnetic separation, flotation, agglomeration, or any process requiring fine grinding, 10% of that part of the cost of labor in excess of 70¢ and not in excess of 90¢ per ton of the merchantable ore produced, and 15% of that part of the cost of such labor in excess of 90¢ per ton;

(b) The aggregate amount of all labor credits (except labor credits to underground mines and taconite operations) cannot exceed 6.2% of the total amount of occupation taxes (other than occupation taxes upon taconite and underground operations) in that year. At the time of his final determination of occupation tax, the commissioner reduces the credit otherwise allowable to each mine by such equal percentage as would bring the total within such limitation.

(c) In no event can the credit allowed any mine be in excess of 75%, as applied to underground and taconite operations, and 60% as applied to all other operations of the total tax otherwise due.

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14. M.S. 1953, Sec. 298.17, as changed by amendment to the Constitution adopted in 1956. OCCUPATION TAXES TO BE APPORTIONED

By an amendment to the Constitution adopted at the 1956 General Election, all occupation taxes except the 1% dedicated to the Veterans' Compensation Fund are distributed as follows:

50% to the State General Revenue Fund; 40% for the support of elementary and secondary schools; and 10% for the general support of the University.

ROYALTY TAX

p. 30—'55 Report
1. M.S. 1953, Sec. 299.01, as amended by Laws 1955, Ex.S. Chap. 3, Art. III, Sec. 299.01. TAX ON SEVERANCE OF ORE FROM LAND RATE

This section had provided a tax of 11% upon all royalty received during each calendar year for permission to explore, mine and remove ore from lands in Minnesota. By Laws 1955, Extra Session, Chapter 2, Article III, there was imposed an additional tax at the rate of 15% upon all royalty, making the total rate 12.65%. Such additional surtax to be in effect for the two taxable years 1955 and 1956.

TACONITE AND IRON SULPHIDES

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3. M.S. 1953, Sec. 298.25, as amended by Laws 1955, Chap. 729. ADDITIONAL TAXES

Laws 1955, Chapter 729 clarifies the statute by defining the property covered by the lieu provisions of the tax.

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6. M.S. 1953, Sec. 298.28, as amended by Laws 1955, Chap. 728. APPORTIONMENT OF PROCEEDS

Laws 1955, Chapter 728 provides for the distribution of the taconite tax as follows:

22% to the city, village or town; 50% to the school district; 22% to the county; 6% to the State. If the mining and concentration or different steps thereof are carried on in more than one taxing district, the Commissioner apportions the tax between them, giving 40% to the operation of mining and 60% to the processes of concentration.

p. 33—'55 Report
New Law
Laws 1955, Chap. 730 (294.21-294.28). GROSS EARNINGS TAX ON TACONITE RAILROADS

By Laws 1955, Chapter 730 (294.21-294.28), provisions are made for a gross earnings tax on taconite railroads as follows:

1. **Laws 1955, Chapter 730 (294.21-294.28).** A taconite railroad company is defined as a company operating, other than as a common carrier, a railway principally used for the transportation of taconite concentrates. It is required to pay

annually into the State Treasury, an amount equal to 5% of its gross earnings, which are defined as a sum equal to the amount which would be charged under established tariffs of common carriers for the transportation of an equal tonnage of iron ore from Mesabi Range points to ports on Lake Superior, including the charges for loading ore on boats.

2. **Laws 1955, Chapter 730, Section 3 (294.23).** If a company transports the crude taconite from mines to concentrating plants over a railroad (other than a common carrier), the gross earnings are computed on the same basis as if the tonnage, equal to the tonnage of concentrates produced, were transported from the Mesabi Range to Lake Superior.

3. **Laws 1955, Chapter 730, Section 4 (294.24).** The gross earnings taxes imposed on these taconite companies is in lieu of all taxes upon the railway and dock properties of these companies. The effect is to subject them to the same tax which they would pay if they were common carriers. The tax is collected in the same manner as the gross earnings tax of railway companies.

4. **Laws 1955, Chapter 730, Section 6 (294.26).** Division of proceeds of tax. The proceeds of the tax are distributed between the State and the various taxing districts in which railway operations are conducted in the following proportions:

22% to the city, village or town; 50% to the school district; 22% to the county; 6% to the State. If different operations or different steps are carried on in more than one taxing district, the Commissioner apportions equitably the proceeds of the part of the tax going to cities, villages or towns among such subdivisions, upon the basis of attributing 40% of the proceeds to the terminal facilities at each end of the railway line and the remaining 20% to the railway trackage connecting such terminal.

Reserves

Under the chapter **Reserves** in our 1955 Report, pages 109 through 143, the term "Reserves" is defined and an explanation of the method of estimating reserves is given. We supplement this chapter with the following.

The past two years have shown great activity in search for new deposits of iron ore, particularly in Canada and in South America. 1956 would have been a record in the iron ore history but for the five-week steel strike followed by a strike of lake carriers which hampered lake ore shipments for several weeks longer. Shipments from the Lake Superior area were reduced by about 10 million tons. Imports from Labrador and Steep Rock in Canada and from South America, Africa and Sweden will still make up much of the loss due to strikes, giving a total U. S. iron ore consumption of 133 million tons, of which 31 million will be imported ore. Minnesota will supply about 65 million tons. (See Table No. 5, "Imports" on page 000.)

The world-wide search for iron ore and research to find practical means for use of taconite and jaspers continues. Discoveries made since World War II have been enough to remove any fear of an iron ore shortage for some time.

In Venezuela, both the expanding production from the Orinoco Mining Company's Cerro Bolivar and steady production from Bethlehem's El Pao deposit continues and the vast tonnage of ore available in that country will permit a much greater expansion. A new deposit, El Torreno, 60 miles west of Cerro Bolivar has just recently been opened up. Substantial tonnages of iron ore are now coming from Peru and from Chile.

There was some increase in production from Brazilian deposits in 1956 and there will evidently be more rapid future development of those tremendous deposits.

In West Africa, Republic's Bomi Hills deposit continued exporting steadily in 1956. Swedish and U. S. interests have found two new Liberian iron deposits. Other finds are being made in French West Africa.

In Canada both high and low grade deposits are being found and developed because of nearness to markets. The Iron Ore Company of Canada shipped over 12 million tons of direct shipping ore in 1956, and this output is likely to increase to 20 million tons in the next few years. South of the Iron Ore Company of Canada's field and some 150 to 200 miles north of Seven Islands, large low-grade ore deposits have been found and are being developed by both Canadian and U. S. interests. Farther west one U. S. and one Canadian firm are exploring large deposits. Still farther west, work is being done on deposits recently found near the Great Lakes. One U. S. company is developing a mine near Ottawa. Bethlehem's Marmora deposit in Ontario shipped iron ore pellets in 1956. In the Steep Rock Lake area there are two com-

panies with large tonnages of ore:—Steep Rock Iron Mines with an estimated ore reserve to 1,000 feet of depth of 184,000,000 tons and Caland Ore Company with an estimated ore reserve to 1,000 feet of depth of 104,100,000 tons. The total iron ore production in Canada for 1956 was 21 million tons, or an increase of 44% over the 1955 production.

After more than thirty years of research work on low grade iron formation material, the past five years have shown amazing results. High grade agglomerates have become a valuable source of open hearth feed. Present record prices of scrap reflect the acute shortage of this material in the United States.

Direct reduction of iron ore is also being studied and the long-range prospects are reported to be favorable.

The increasing broad demand for steel compels the development of all readily available deposits of both high and low grade iron ores. It is vital to this State, as well as to the whole Lake Superior District that both high and low grade deposits be developed and that the direct shipping ore and the open pit wash concentrates be somewhat conserved to provide a backlog in times of national emergency.

The reserves of merchantable iron ore in the State of Minnesota as of May 1, 1955, are shown in the following table.

TABLE NO. 1

IRON ORE RESERVES OF MINNESOTA

Estimated Reserve Tonnage (Including Stock-piles) in Gross Tons					
Year May 1	Mesabi Range	Vermilion Range	Cuyuna Range	Fillmore Co. Dist.	Total
1920	1,305,926,735	10,927,844	24,819,959	.....	1,341,674,538
1930	1,154,434,031	14,250,540	66,542,939	.....	1,235,227,510
1940	1,139,314,272	13,841,272	65,431,104	.....	1,218,586,648
1945	973,129,581	12,715,183	59,787,900	.....	1,045,632,664
1950	923,769,792	13,183,901	43,415,199	589,000	980,957,892
1951	906,225,928	12,110,218	41,869,807	913,165	961,119,118
1952	869,104,825	12,965,994	44,808,481	574,908	927,454,208
1953	855,380,607	13,286,060	45,751,154	647,500	915,065,321
1954	842,178,641	12,538,740	60,831,429	711,652	916,260,462
1955	805,294,358	11,715,324	60,848,084	793,847	878,651,613

Note: The above figures represent the estimated reserve tonnages as reported by the Department of Taxation, and comprise the tonnage of ore in the ground plus the ore in stock-piles. These figures do not include ore on State lands that were not under lease as of May 1st of each year; the estimated total tonnage for May 1, 1955, was 117,197 tons.

Source: Minnesota Department of Taxation.

RESERVES

TABLE NO. 2
CLASSIFICATION OF IRON ORE RESERVES OF MINNESOTA AS OF MAY 1, 1955

Classification	Mesabi Range	Vermilion Range	Cuyuna Range	Total
Direct Ore:				
Open Pit	432,917,000	.....	14,049,000	446,966,000
Underground	189,155,000	11,307,000	39,573,000	240,035,000
Total	622,072,000	11,307,000	53,622,000	687,001,000
Concentrate:				
Open Pit	131,110,000	.....	4,615,000	136,509,000*
Underground	34,927,000	.....	1,492,000	36,419,000
Total	166,037,000	.....	6,107,000	172,928,000*
Total Ore:				
In Ground	788,109,000	11,307,000	59,729,000	859,929,000*
In Stock-pile	17,302,000	408,000	1,120,000	18,840,000†
Total	805,411,000	11,715,000	60,849,000	878,769,000*†

Note: The above figures represent the total estimated iron ore reserves in gross tons as of May 1, 1955, and include the reserve tonnages shown in Table 1 as of that date, together with the tonnage of ore on State lands that were not under lease as of May 1, 1955.

*Includes 784,000 tons in Fillmore County District.

†Includes 10,000 tons in Fillmore County District.

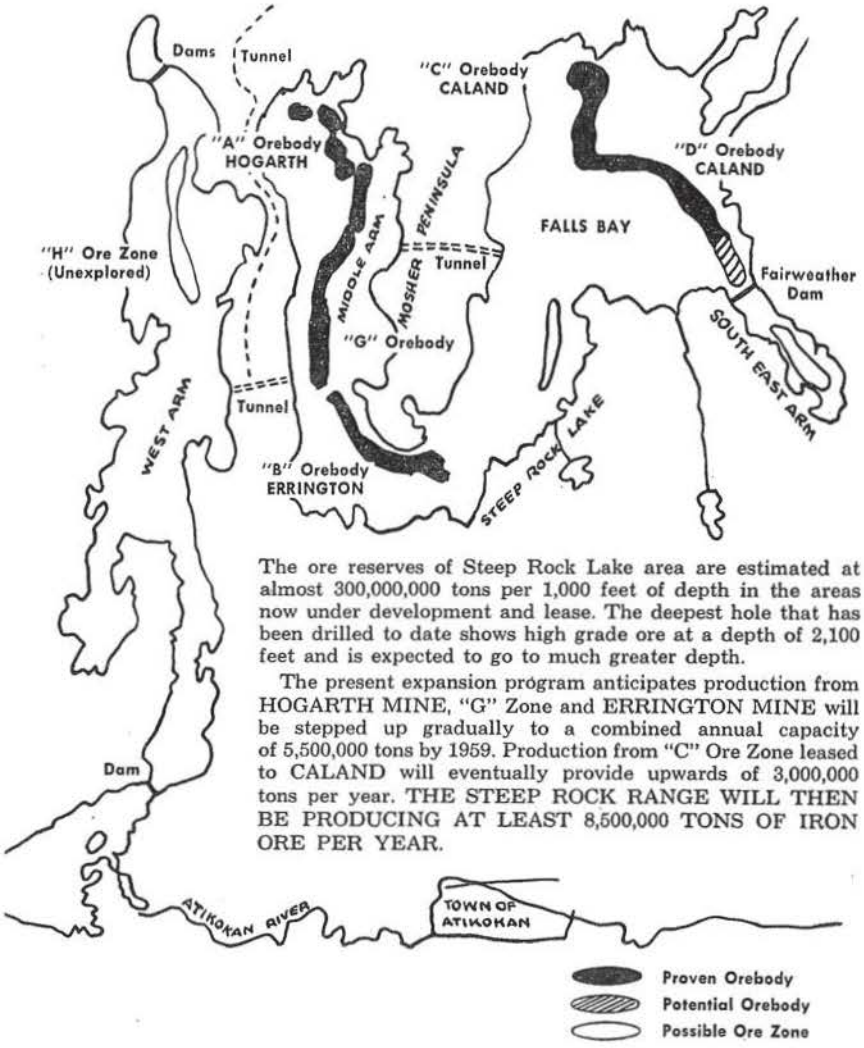
Source: Compiled by the Mines Experiment Station from the records of the Minnesota Department of Taxation.

STEEP ROCK

In our 1955 Report, page 119, under the subject of **Steep Rock** is contained a resumé of an inspection trip made by members of the Commission. In July, 1956, members of the Commission made an inspection trip to this area and the following information was developed to supplement the 1955 Report on Steep Rock.

Steep Rock Iron Mines Limited, incorporated in Ontario in February, 1939, owns a producing hematite iron ore property at Steep Rock Lake near Atikokan, Ontario. The property which covers an area of more than 7,000 acres, all of which is owned in fee, is located on the Canadian National Railway about 142 miles west of Port Arthur on Lake Superior.

STEEP ROCK LAKE AREA



The ore reserves of Steep Rock Lake area are estimated at almost 300,000,000 tons per 1,000 feet of depth in the areas now under development and lease. The deepest hole that has been drilled to date shows high grade ore at a depth of 2,100 feet and is expected to go to much greater depth.

The present expansion program anticipates production from HOGARTH MINE, "G" Zone and ERRINGTON MINE will be stepped up gradually to a combined annual capacity of 5,500,000 tons by 1959. Production from "C" Ore Zone leased to CALAND will eventually provide upwards of 3,000,000 tons per year. THE STEEP ROCK RANGE WILL THEN BE PRODUCING AT LEAST 8,500,000 TONS OF IRON ORE PER YEAR.

Since the company began mining operations in August, 1944, it has produced and sold about 12,000,000 tons of high-grade ore, principally in the United States markets. Ore reserves in the several proven mines of the Steep Rock range are sufficient to sustain operations for decades at the rate of 8½ to 10 million tons annually.

RESERVES

The company has retained the western two-thirds of the Steep Rock Range for its own mining operations. In this area are located the presently developed "A" (Hogarth) and "B" (Errington) ore bodies and the "G" ore body which has been partly explored.

The company has leased its properties on the eastern third of the range to other companies on a royalty basis. The "C" and "D" ore bodies are leased on a development basis to a subsidiary of Inland Steel Company called the **Caland Ore Company** under the terms of which lease Steep Rock Iron Mines has received already an advance of $8,000,000 against future royalties.

Steep Rock Lake ore has very desirable chemical and physical characteristics. The natural iron content is exceptionally high with very low silica and phosphorus content. The low phosphorus content which is well below the limit for ore of the so-called Bessemer grade, makes it valuable for mixing with non-Bessemer grades to reduce combined phosphorus content.

The analysis of the standard ore shipped by Steep Rock in 1954 compared with shipments from the Lake Superior District in 1953, is as follows:

	Steep Rock Ores	Lake Superior District Ores
Iron — Natural	53.261%	50.368%
Phosphorus	.026	.09
Silica	6.22	10.25
Moisture	9.60	10.90

(Source: Iron Age)

The three ore-bearing zones of Steep Rock Iron Mines Limited retained for its own mining operations, and on which the Company is concentrating its production and development work at present, have a combined length of approximately 15,000 feet and a width varying from 100 to 400 feet. Ore is known to exist at depths as great as 2,100 feet and is expected to go to much greater depths. Ore reserves in this area are estimated conservatively at 184,000,000 tons per 1,000 feet of depth. This is the area from which the Company is planning to produce 5,500,000 tons of ore per year.

Up to 1953 all of the production of the Company was from the Open Pit Errington Mine ("B" ore zone). In August, 1953, the Open Pit Hogarth Mine ("A" ore zone) came into production, and all shipments in 1954 were made from this mine which has a capacity of 2,000,000 tons per annum. Development work on the Errington No. 1 Underground Mine continued in 1954 and this mine is ready to be brought into substantial production on short notice, having an ultimate capacity of 1,500,000 tons per annum. When developed the "G" ore zone is expected to yield a minimum annual open pit production of 1,000,000 tons.

Shipments of ores from Steep Rock Iron Mines Limited in the years 1945 through 1954 were as follows:

Year Ended Dec. 31	Shipments (tons)	Gross Value All Ore Sold
1945	504,772	$ 2,891,054
1946	830,409	4,585,782
1947	1,206,246	7,049,559
1948	686,091	4,815,590
1949	1,134,261	8,950,153
1950	1,216,614	10,629,363
1951	1,326,724	11,968,002
1952	1,274,355	11,489,416
1953	1,301,688	13,200,505
1954	1,156,654	12,131,091
1955	2,265,555	23,845,549
1956	3,314,138	.....

The Steep Rock Iron Mines Company does not process iron ore nor manufacture steel. Its ore is sold to U. S. steel plants located on the Great Lakes. It is rail shipped to Port Arthur and thence transported by lake carrier.

ESTIMATES OF FUTURE PRODUCTION FROM STEEP ROCK IRON MINES CO.

1957 3,750,000
1958 4,500,000
1959 5,500,000

Caland Ore Company (Under a 99 year lease from Steep Rock Iron Mines Limited by Inland Steel, leased in 1952) is known as the "C" and "D" ore bodies. Development of this area in Steep Rock Lake, 425 feet below the original water level of Steep Rock Lake's Falls Bay, is expected to cost about $50 million, of which $15 million has already been spent, with production commencing by 1960 and rising quickly to 3 million tons annually, with a potential of 5 million.

The development operations started in 1953 and Caland Ore Company has been dredging the area over a year on a five year dredging program. The dredges are 176 feet long and 58 feet wide and about 16 feet in depth. The cost of the two dredges amounts to about $10 million.

The de-watering of Falls Bay is similar to the de-watering that Steep Rock Mines accomplished in its diversion of Steep Rock. First, a seven mile road costing $600,000 was built by Caland Ore Company on which 800 carloads of machinery and equipment were carried to the future mine site in large low boy trucks and assembled at the site. Each of the two dredges is equipped with 10,000 H.P. motors on the pumps; 10,000 H.P. motors on floating boosters and 10,000 H.P. motors on the shore boosters, which dredges pump the water and the silt from the bottom of the lake up through 42 inch steel pipes. The 42 inch pipeline can handle about 85,000 gallons a minute and the ultimate length of the pipeline will be about 5½ miles.

RESERVES

Tunnels have been blasted in and through the granite to drain off the water. Dams have been built in many spots to prevent the water from returning. Mr. Cayia, General Manager of Caland, explained the whole diversion operation by saying: "Water, water everywhere and it's all trying to flow toward us."

The diversion work goes on all the year around, both summer and winter. When winter temperatures get below zero, reaching 60 below at times, the ice on the lake needs to be broken up and draglines scoop up the chunks of ice, load it in trucks and it is hauled away so that the work of diverting the water from the lake can go on.

The reserve figure of Caland's "C" and "D" ore bodies is 50 million tons but it is expected that ultimately it will be more than that. The ore runs: natural iron 53%; silica 6% and is very low in phosphorus. It is considered a very excellent ore, and will be shipped to Inland Steel Company furnaces at Chicago.

A Consulting Engineer for Steep Rock Iron Mines Limited has estimated ore reserves to 1,000 feet of depth, at 288,100,000 tons in the Steep Rock Lake area, of which 184,000,000 tons are in the area directly owned by Steep Rock and 104,100,000 are in the area leased to Caland Ore Company. The Engineer also reported that there is no reason why the ore bodies at Steep Rock should not continue to considerably greater depths than 1,000 feet. One drill hole now shows ore to occur more than 2,000 feet vertically below bedrock in the lakebed.

A Mining Geologist has also estimated ore reserves at about 250,000,000 tons. This estimate represents about one-sixth to one-seventh of the total reserve of direct-shipping ore and concentrates that will be produced by methods now in commercial use on the iron ranges in the United States.

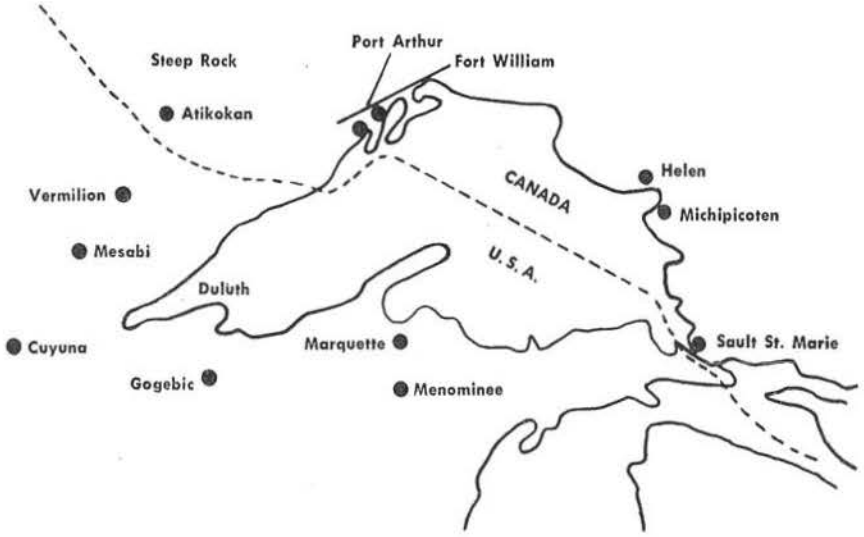
It was pointed out to us that the mining of iron ore by open pit methods is the most economical means of producing large tonnages. But when a depth of four to five hundred feet is reached, increased waste in the walls of the pit and the cost of moving the ore to the loading terminals necessitates sinking of shafts which means that ultimately the Steep Rock iron range will be mined entirely by underground methods.

The Community near these mining operations is known as Atikokan. It has been expanding in population, which is now over 5,000, and in the residential and business areas. Two department stores have erected large new buildings and a third bank was constructed. The municipal assessment almost doubled during 1954. Housing, land-assembly and development are being actively assisted by the Federal Government through the Central Mortgage and Housing Corporation (similar to F.H.A.). The Ontario Government completed a $7,500,000 highway into Atikokan in 1954 and has indicated that it intends to extend the highway 90 miles west to Fort Frances on the Canadian-United States border. Eventually, with all the mines operating, open pit and underground, the population of Atikokan is expected to reach 10,000.

The following statement was made by officials of Steep Rock Iron Mines Limited:

"The steady decline in accessible high-grade reserves of iron ore on other Lake Superior Ranges has placed Steep Rock's deposits in a strong position competitively. Steep Rock has large reserves which have a grade as high or higher than the Mesabi Reserves. The growth of the United States and Canadian steel industries since the war has produced a sharp increase in demand for iron ore and particularly for high-grade direct shipping ores which Steep Rock has available."

IRON RANGES OF LAKE SUPERIOR REGION



Supplementing our report on **South America** and **West Africa** in the 1955 Report, beginning on page 120:

SOUTH AMERICA

BRAZIL

It has recently been reported that Brazilian iron ore production in the State of Minas Geraes will probably increase in the next few years. Since the narrow gauge railroad from these mines to the Atlantic Port of Victoria is inadequate for haulage of iron ore, the reported probable expansion will call for a major relocation and railway construction program.

PERU

Good tonnages of high grade ore are coming to the United States yearly from Peru's Marcona open pit deposits located only a short distance from the Pacific coast loading pier. Ore is being hauled by truck. Part of this ore is sold in the United States on contracts running from five to ten years. While most of this ore comes to the United States, the smaller part goes to a small furnace at Chimbote in northern Peru. Shipments from Peru to the United States began in 1953 with shipment of about 844,000 tons. The shipments in 1954 were 1,930,000 tons and in 1955 some 1,554,000 tons. This ore is said to average 55% to 62% natural iron.

VENEZUELA

Shipments of iron ore from Venezuela to the United States increased from 635,000 tons in 1951 to 1,845,000 tons in 1953; 5,210,000 tons in 1954 and 7,120,000 tons in 1955, with expected shipments of some 9,000,000 tons to this country in 1956. In addition to the 560 million tons of proven ore, several other large deposits are known to exist in the area south of the Orinoco River. The ore potential is ample to warrant substantial expansion of development and ore exports. This ore consistently averages 58% natural iron.

WEST AFRICA

LIBERIA

Swedish and United States interests are reported to have found two new ore deposits in Liberia. In addition, Frobisher, Ltd., controlled by Ventures, Ltd., of Canada, is developing the Ft. Gouraud iron ore deposits in French West Africa.

LABRADOR-QUEBEC, CANADA

On pages 124 through 130 of our 1955 Report, the subject of **Labrador-Quebec** is covered, showing a map of distances and the findings of the Commission based on an inspection of the area by some of the members of this Commission in 1952. Because this area has developed tremendously, some of the members made another inspection trip in September, 1956, and the following report resulted:

IRON ORE COMPANY OF CANADA

The Iron Ore Company of Canada was formed by the original Canadian concession companies – Hollinger Consolidated Gold Mines, Limited; Republic; National; Armco; Youngstown; Wheeling and Hanna. In addition to capital furnished by the partners of Iron Ore Company of Canada, 19 Canadian and American insurance companies loaned $150,000,000.

Proved Ore Reserves of Iron Ore Company of Canada are divided into three groups so that the Company was able to arrange with the Canadian Government to consider each group a separate unit for tax purposes, thereby enabling the Company to take advantage of the three-year Dominion tax exemption as each unit or group goes into production. The reserves are identified as follows:

1. KNOB LAKE AREA (formerly Burnt Creek)–238 million tons within a radius of about five miles.

2. FLEMING AREA–45 million tons within a radius of about four miles.

3. GOODWOOD AREA–95 million tons within a radius of three miles.

This ore *averages* at least 54% natural iron and after the Company has mined for about ten years, the ore will still grade about the same due to the fact that it plans to mine both low and high grade ores during the same time.

Production from the Knob Lake Area from July 31, 1954 to September 11, 1956, is as follows:

Gagnon Mine	6,100,000 tons
French Mine	3,300,000 tons
Ruth Lake Mine	8,600,000 tons
Gill Mine	400,000 tons
Total	18,400,000 tons

The Company had estimated that it would be producing about 2 million tons in 1955 but it actually produced 8½ million tons. It ultimately planned to produce 10 million tons a year but this year, 1956, the actual production reached 12 million tons.

TOWNS

Schefferville—(formerly known as Knob Lake) is a new town located at the mine site. The town has been named for the Catholic Bishop of the region. It is a modern, thoroughly up to date town. Although the roads are still in early stages of engineering, there is an intense interest in automobiles and there are about 150 automobiles belonging to the 2,000 people who live there. The longest drive at Schefferville is four and a half miles out to Squaw Lake, a float-plane base. There is no hotel or public restaurant but there are completely modern and good looking houses. There is a theater which alternates movie showings in French and in English. Hudson's Bay Company is building a store and there is a bank on the main street. Schefferville is growing in size and it is predicted that it will continue to grow.

Sept Iles (Seven Islands) located on the north shore of the St. Lawrence Gulf, has been the place most immediately affected by the Iron Ore Company development. In 1942 this village had a population of less than 1,000 persons and there are now at least 7,000. Since the Company built the ore docks here there has been an expansion of business activity. There are many automobiles, major streets and many others are paved. The older houses no longer outnumber the new ones and there are subdivisions growing. The village never had a road connection with the outside world but a road is now being built to connect with the road from Quebec City, more than 300 miles southwest, which should be completed within the next year or two.

The dock at Sept Iles is 2,200 feet long with a dredged depth at the dock of 37½ feet at low tide. The maximum tide variation is 11 to 12 feet.

The Company owns 72 Diesel Engines, 1750 H.P. each, and 3,000 ore cars. The terminal at Sept Iles maintains a huge repair shop, which is a general repair shop for the locomotives and ore cars. It is equipped to take care of any emergency in addition to constant overhauls of all the Company's equipment and has 155 pound steel rails running into the shop.

A train consists of 125 ore cars carrying 80 to 85 tons of iron ore each and four Diesel Engines. The average weight of a train coming down from Knob Lake is 11,000 tons of iron ore; total weight, including engines, cars, etc., is 16,000 tons. The crew consists of 4 members to each train. Eight trains come down from the mine each day carrying in all 85 to 90 thousand tons of ore. The rail is of 132 pound steel on the main line and 100 pound steel on all sidings and in terminal yards.

The operation of weighing the ore cars is called humping. All of the car loads of ore coming down from Knob Lake are weighed at Sept Iles. The sampling and grading is done at the mines and the information is sent by teletype to Sept Iles. So, when a train load of ore arrives at

Sept Iles, it is known what kind of ore is in each car; where it has been mined; what day it was mined and what time it left Knob Lake, plus expected time of arrival. Approximately four to five cars are weighed every minute and this is recorded automatically by IBM machines on cards which already have been made up with the information teletyped from Knob Lake punched on each card representing a car load of iron ore.

After the cars of ore are weighed, the car continues and is dumped by two rotary dumpers into bins for finer crushing. Two cars are dumped approximately every 67 seconds, or approximately 170 tons every 67 seconds. A Barney Hoist is used to push the cars up to the dump house. The ore is taken by two conveyor belts each 60 inches wide, to the docks, traveling at a speed of 629 feet a minute. Each belt handles 4,000 tons of ore per hour. There is also another conveyor belt going to the stock piles traveling at the same speed and handling the same amount of ore.

The railroad running between Knob Lake and Seven Islands, a distance of 357 miles, is known as the Quebec-Northshore and Labrador and is chartered as a common carrier and therefore must accept shipments from other mining companies in the area. It is operated by centralized traffic control at Seven Islands. There are 20 poles to each mile over the railway carrying 2 wires on top for power transmission; 2 similar wires 14 feet below carry the signal code and telephone circuit, plus 12-channel carrier for telephone and teletype. All rail switches to the 27 sidings are controlled from the traffic control board. The empty cars going up to Knob Lake take the sidings and the ore trains coming down take the main line.

Contrecoeur—(40 miles northeast of Montreal on the south shore of the St. Lawrence). Ore is shipped from Seven Islands to Contrecoeur in ocean-going vessels up to 30,000 tons capacity. At Contrecoeur the ore is transferred by a standard ore bridge to canalers for delivery to lower lake ports and also to rail cars for direct rail shipments to valley furnaces. It is expected that 2½ million tons will be handled through Contrecoeur in 1956. Upon completion of St. Lawrence Waterway, ore can be shipped from Seven Islands to Lake ports in 20,000 ton vessels. Contrecoeur at that time will probably be used largely for trans-shipment for rail haulage.

For 1956 the estimate for shipments is as follows:

12 million tons to be shipped, to be distributed as follows:

7,200,000 tons will go to east coast ports in U. S.
2,500,000 tons through Contrecoeur.
2,300,000 tons overseas.

RESERVES

Some of the activity taking place in Canada, covering a path some 600 miles long from west of Ungava Bay extending southeast, is as follows:

United States Steel Corp.—3 helicopters and six testing drills operating in an area 150 miles northwest of Seven Islands. There are several hundred million tons of material that will yield high grade concentrate.

Canadian Javelin—a billion tons of crude ore grading about 37% iron that will concentrate to 64%. They already have their railroad surveyed which will be about a 40-mile long railroad and will come out to the Iron Ore Company Railroad at Mile 224.

Iron Ore Company—several large ore bed deposits of concentrating material they are now testing and in all probability in the future there will be a concentrating plant.

Jalore (Jones & Laughlin)—are investigating large quantities of concentrating ore in this general area.

Warren S. Moore-Pickands-Mather—are investigating various deposits of concentrating material.

Other mining properties in Quebec are: Cyrus Eaton-Atlantic Iron Ore and International Iron Company; Fenimore Iron Mines, Ltd., Fort Chimo Mines, Ltd.; Quebec-Labrador Development Co.; Norancon Exploration; Hollinger-North Shore; and Quebec Iron and Titanium Corp.

Taconite

In our 1955 Report, beginning on page 147, the subject of **Taconite** is thoroughly covered, giving the History of Taconite, Taconite Reserves, Beneficiation of Magnetic Taconite and also setting forth the Experiments and Developments, together with Taconite Taxes and Problems. We supplement this section on Taconite with the following.

The following recommendations were made by this Commission in its 1955 Report and after each recommendation is stated the action taken by the 1955 Legislature thereon.

1. "It is recommended that the taconite tax remain at its present rate and the law be amended to change the distribution of the tax proceeds so that the local taxing units will receive a percentage necessary to enable them to provide the additional municipal functions brought about by the new industry."

Action taken by Laws 1955, Chapter 728. The legislature increased the percentages of the proceeds of the tax going to the local municipalities so that the taconite tax would be divided as follows: 22% to the city, village or town; 50% to the school district; 22% to the county; 6% to the State.

2. "It is recommended that the taconite tax law be amended so that the State and local taxing units can determine definitely what property is taxable and what property is non-taxable under the 'in lieu' provisions of the law."

Action taken by Laws 1955, Chapter 729. The legislature clarified the statute with respect to the property covered by the lieu provisions of the tax by excluding from the lieu provisions any property used for residential or townsite purposes, and by making clear that if electric power plant, constructed primarily for taconite operation, sold any surplus power, it would have to pay the general property tax on a proportion of the total value of the plant equal to the proportion of power sold or used for other than taconite purposes.

3. "It is recommended that the private railroads of taconite companies be taken out of the 'in lieu' provisions of the taconite tax law and be taxed on a gross earnings basis, the revenue therefrom to be appropriately allocated to the local governmental units into or through which such railroads operate; that the tax be at the same rate as the gross earnings tax on other railroads and that the gross earnings be determined by assuming a freight rate for the merchandise carried which is the same or comparable to the published tariffs of other railroads."

4. "It is recommended that the private loading docks of taconite companies be taxed on a gross tonnage basis and revenue therefrom be appropriately allocated to the local taxing units."

Action taken by Laws 1955, Chapter 730. The taconite railroads were taken out of the lieu provisions of the taconite tax and subjected to a gross earnings tax based on the tonnage of concentrates produced and upon the rate per ton charged by commercial railroads for the transportation of iron ore from Mesabi Range points to Lake Superior ports. The general effect was to subject taconite railroads and docks to the same tax that they would pay if they were common carriers transporting the concentrate from the Mesabi Range to Lake Superior.

5. "It is recommended that the Legislature take note of the fiscal difficulties of local governmental units in the taconite industry area brought about by inordinate demands for governmental service during the construction period, and consider such relief as is appropriate."

A number of laws were passed pursuant to this recommendation. They include the following:

By Laws 1955, Chapter 391, the Aurora School was authorized to levy against taconite companies a special tax in the year 1955 not exceeding $250,000, and in the year 1956 and 1957 not exceeding $200,000 in each year, to defray additional operating and maintenance costs resulting from increased school enrollment resulting from construction of taconite plants.

By Laws 1955, Chapter 423, certain school districts, operating under cash basis laws, in which, as a result of taconite construction enrollment increased by more than 75% over the enrollment of 1951, were authorized to issue emergency certificates of indebtedness to meet the increased costs resulting from such increase in enrollment.

By Laws 1955, Chapter 429, the Aurora School District was authorized to issue bonds in an amount not exceeding $1,715,000 for the construction of elementary school buildings, the bonds to be paid by a special tax levied against taconite companies within the district.

By Laws 1955, Chapter 514, the Lake County School District was authorized to issue bonds in an amount not exceeding $1,825,000 for the purchase and construction of school buildings, the bonds to be paid by a special tax levied against taconite operations within the district.

By Laws 1955, Chapter 576, the Babbitt School District (where Reserve Mining Company's taconite operations are conducted) was authorized to issue bonds in an amount not exceeding $900,000 for the construction of school buildings, the bonds to be paid by a special tax against Reserve's taconite operations.

By Laws 1955, Chapter 540, the Aurora School District was authorized to issue bonds in an amount not exceeding $1,300,000 for expanding and remodeling the Aurora High School and other buildings, the bonds to be paid by a special tax upon taconite operations, to the extent of 65% of the amount thereof, and by excess levies upon other property in the district to the extent of 35% thereof.

NEW DEVELOPMENTS

Since this Commission reported on **"New Developments"** of **Reserve Mining Company, Erie Mining Company** and **Oliver Mining Division, United States Steel Company,** steady progress has been and is taking place.

1. RESERVE MINING COMPANY

Reserve Mining Company dedicated its taconite processing facilities on September 13, 1956, at Silver Bay, Minnesota, now known as the E. W. Davis Works. Some 600 dignitaries, including members of the Legislature and others from many parts of the country were present. Reserve Mining Company is owned 50% by Armco Steel (American Rolling Mill Company) and 50% by Republic Steel Corp.

Among those present at the formal dedication were W. W. Sebald, Vice-chairman of Armco and C. M. White, Chairman of Republic.

Commenting on the future of the taconite industry in Minnesota, Mr. Sebald held that this will depend greatly upon the attitude of the people of the State. He said that a far-seeing Legislature cleared the way for this development in 1941, when it enacted the taconite tax law, substituting a production tax on taconite for the ad valorem tax on direct shipping ore properties. As to what taconite means to the future of Minnesota, he stated that at Babbitt and Silver Bay Reserve Mining Company has created about 2,200 permanent year-round jobs, providing a payroll now at the rate of about $11 million annually. He added that the taconite industry will contribute substantially to state and local taxes. In place of the ad valorem tax, other taxes will amount to about $120,000 for every million tons of concentrate produced.

Mr. White said both companies feel that the people of Minnesota showed excellent judgment in adopting tax policies that sent the first plant of what may become a giant industry off to a flying start. "The future growth of this industry will depend to a great degree on whether or not the people of the State will adhere to such views."

Mr. White explained that eventual depletion of our high grade shipping ores has resulted in the development of many sources of low cost high-grade iron ore both within and outside the United States. He said further that the people of Minnesota are wise to recognize the new competition in a resource in which this state had almost a monopoly for many years.

He stated that reliable ore authorities predict that taconite may supply over 27,000,000 tons annually to the steel industry by 1965 and 40,000,000 tons by 1975. He said that the use of taconite concentrate is working out very well and it is proving to be good blast furnace feed when blended with other high grade ores in large modern furnaces.

"Minnesota is in an enviable position to capitalize on this new industry for it can provide tens of thousands of new year-round jobs for people of the State. If taconite grows and prospers it will cause other large industries to establish operations in the State and provide countless additional jobs. . . . It can point the way toward development of other mineral processes which will unlock more of Minnesota's vast treasure of natural resources."

He also declared that to provide the increasing quantities of steel needed by the United States, and at the lowest costs, it is vital that the growth of the steel industry continue to be primarily in the midwest and that the public and private attitudes of the people of Minnesota can aid in keeping this growth so located.

Babbitt Plant—This is the experimental plant for working out processes to be used at Silver Bay. The major change in this plant is in the method of hardening the taconite pellets to withstand handling. In the pelletizing plant the raw pellets containing about 10% moisture and with a small amount of bentonite as binder, are coated with 2% to 3% of powdered anthracite coal, then discharged in a thin scattered stream onto the bed of a 170 foot sintering machine. The drop is but a few inches, lessening the danger of breakage. The small amount of anthracite is ignited under induced draft from below and the pellets are heated to about 2400° F. The pellets are held at this temperature through a travel distance of about 30 feet at an average rate of about 60 inches per minute, completing the hardening. Cooling then begins by pulling large amounts of cold air down through the bed of hot pellets and this continues through the remaining distance of travel on the moving grate. The pellets discharge freely from the end of the traveling grate and are then sprayed-cooled before loading into ore cars. Air that has been heated during the length of travel of pellets while being air cooled is piped back to the head end of the machine where it is used to dry out and start heating the raw pellets where they enter the machine. This method of hardening is an interesting development in taconite reduction.

Here at Babbitt where the hard taconite rock is mined, installation of the 600-ton crusher set in a rock excavation 167 feet deep and 80 feet in diameter, was completed in 1955. This crusher has a five-foot opening, is driven by two 500-HP motors and has a capacity of 3,500 tons per hour, crushing to an average 8-inch size. Four secondary crushers reduce the chunks to about 3½-inch diameter, ready for shipment to Silver Bay. Part of the crushed taconite is treated at the Babbitt Plant where the rated capacity of 300,000 tons per year has now been achieved. The coarse crushing plant at Babbitt and the 47-mile railroad from Babbitt to Silver Bay are counted as part of the E. W. Davis Plant.

Silver Bay-E. W. Davis Works. There is a large rotary car dumper where each car of a loaded train from Babbitt, equipped with flexible couplings can be gripped in heavy clamps and without being uncoupled from the other cars, is turned completely over, dumping the 3½-inch taconite into a bin. The taconite then goes by conveyor into four large concrete storage bins, each bin holding 5,000 tons. It then goes by conveyor to crushers which reduce it to ¾-inch size, thence to the rod mills and the ball mills where it is ground to a very fine powder. In the large dust-collecting system taconite dust is collected and sent to the pelletizing plant. There are 166 conveyors in the pelletizing building alone.

The fine ore, after recovery from 12 rod mills and 24 ball mills and the magnetic separators, passes under vacuum drums covered with filter cloth. As the lower part of the revolving drum passes through the fine ore in suspension in water, the ore particles are first held to the filter cloth by air suction then discharged by reversal of current, dropping the fine ore, with about 10% moisture remaining, on to a conveyor leading to the pelletizing section. There the pellets are formed by the same method used at the Babbitt Plant. For water use in the plant there are two steam turbines at the dock, each having capacity of 37,000 gallons per minute.

The finished pellets are carried by conveyor belt to the storage area with space to stockpile 1,700,000 tons and five 6,000-ton concrete storage tanks which are kept filled at all times during the shipping season so that there will always be enough pellets ready for loading boats. These tanks are located at the loading docks where two boat loaders can load an ore boat in 4 to 6 hours. Excess pellets are stockpiled by a large bridge, 465-foot main span, with a 200-foot cantilever which stocks the pellets by means of a traveling tripper on the span. Bridge travel is 430 feet and its height is over 100 feet above ground level.

It was reported that the total number of men employed at both Silver Bay and Babbitt in 1956 was about 2,200–half at Silver Bay and half at Babbitt.

At the end of 1956, 434 homes had been completed at Babbitt and 715 homes had been completed at Silver Bay. Current population is approximately 3,000 at Silver Bay and 2,400 at Babbitt. At Silver Bay there is now a fine elementary school and a new junior high school. At Babbitt there is an elementary school.

2. ERIE MINING COMPANY

The Erie Pilot Plant is located about 3 miles north of Aurora and produces about 200,000 tons of pellets per year. Improvements developed in this plant are made a part of the process to be used in the huge new Erie Commercial Plant being built near Hoyt Lakes.

Erie Commercial Plant. There are two pit areas about five miles apart. The surface of the bare taconite appears very uneven and hilly. A rotary drill puts down 9-inch blast holes, using a Hughes roller bit faced with tungsten carbide, one of the hardest known alloys. Other holes are put down by use of the oxygen-kerosene jet making holes about 10 inches in diameter. The extreme heat of the oxygen blast causes the taconite to chip off the walls of the hole in thin pieces which are blown out by the force of the jet. The estimated average drilling speed by use of the jet is about 15 feet to 30 feet per hour. The jet is said to work best in the hardest taconite while the rotary drill is better in softer or seamy taconite. The following costs were given on quarrying machines:

Joy Rotary drill ..... $100,000 to $105,000 each
Jet Piercing drill $130,000
Power shovels ..... up to nearly $250,000 each
Large trucks, 35-ton capacity ..... $48,000 each

Stripped material is used in large quantities for building track grades and for making fills for roads and stockpile grounds. When the plant is completed and in operation it is planned to stockpile about 3 million tons of pellets, requiring a large level area. In leveling off the huge plant site, over 1 million cubic yards of granite had to be excavated. The mammoth concentrating plant, 1100 feet long, and the fine crushing plant are now being erected. The large shop building is completed and in use.

In the main concentrator building are one 60-inch primary crusher and four secondary crushers. Water pipe lines run up to 42 inches in diameter. Pipe lines and electric wiring are all carried in a large concrete tunnel. For the waste rock or tailings there are four thickener tanks each 250 feet in diameter and 8 feet deep. Excess water is drawn off for re-use in this plant. Tailings are pumped to waste dump at 50% water and 50% solids. The fine ore that will be recovered from the taconite rock will run from 62% to 64% iron.

The plant is designed for expansoin to 15 million tons capacity per year but there are no plans at the present time to go beyond 7½ million tons. It is planned that production will start at the end of 1957 and the 7½ million ton annual rate will be reached during 1958. The project, it has been announced, will cost approximately $300 million.

Erie Docks and Power Plant at Taconite Harbor were complete at the end of 1956 and include pellet storage, loading facilities and coal unloading equipment. Here the finished taconite pellets will be loaded

for shipment to the blast furnaces. Taconite Harbor consists of two islands and a connecting breakwater. The east breakwater is said to contain over 1 million cubic yards of rock. The breakwater is "armored" with huge boulders, some of them weighing 25 tons, brought in over a special roadway on 16-wheel trucks. These boulders cover the sides of the breakwater from top to bottom, their purpose being to resist the action of waves up to 20 feet high. In order to provide the full required 30-foot depth of water at all points within the harbor, it was necessary to excavate a large amount of bottom rock in an area several hundred feet wide along the shore. Cells of steel piling, each cell 55 feet in diameter, were closely set on rock bottom, parallel to shore, and the area was enclosed at the ends, then pumped out and rock was removed to full 30-foot depth. The harbor has plenty of room for three vessels, two of which can load ore pellets at the same time.

The railroad from the plantsite, near Aurora, to Taconite Harbor, near Schroeder, was substantially complete at the end of 1956. Trains of 96 cars will bring finished pellets over the railroad, a distance of 73 miles, from the Erie Plant to Taconite Harbor. At Taconite Harbor loaded trains will be handled in three 32-car sections, each section in turn being run out on a bridge above the ore dock and emptied into a long trough-shaped ore bin holding 150,000 tons. For ship loading of pellets there are to be 25 conveyors, spaced 48 feet apart, designed to load two vessels at the same time by use of from four to seven of the 25 conveyors for each boat.

Along the face of the ore dock the shore rock was cut vertically like a rough wall. The seams in the rock dip toward the lake. To prevent any danger of rock slipping, the rock face was close-drilled with holes going down at a steep angle across the dip of the rock seams to a depth of 35 feet. Heavy rods were set in cement in the holes to full depth, tying the rock wall into a more solid and durable mass. The whole rock wall was then faced with two to three feet of concrete, reinforced by the projecting ends of the rods. The finished ore dock is 1824 feet long. Three bridges have been built over State Highway 61 to carry ore trains arriving with pellets.

The power plant is being constructed at Taconite Harbor and electric current will be sent by high tension lines to the giant Erie Plant near Aurora. Power required will be approximately 100 kilowatt hours per ton. On an annual basis of 7½ million tons, power requirements will equal the combined electrical consumption of the cities of Duluth and Superior.

Construction employment hit a manpower peak of approximately 5,500 men in 1956. When the plant gets into operation, plans call for a total of about 3,350 employees of which about 3,150 will be located at the plantsite and 200 to 220 at Taconite Harbor.

The townsite is located near Aurora and is called Hoyt Lakes. The anticipated population is about 10,000 people. Streets, sewers, light,

water, power and other facilities usually found in a modern town or village have been installed according to plan. A modern 23-room grade school was completed at Hoyt Lakes in 1956 at a cost of approximately $1 million.

3. OLIVER MINING DIVISION, UNITED STATES STEEL

The Pilotac Plant at Mountain Lake is now producing at rated capacity of 500,000 tons per year but is expected to increase to 700,000 tons or more, as stated by Mr. L. J. Severson, Vice-President of Oliver Iron Mining Division. The area that will furnish the crude taconite extends nearly five miles west and three miles east of the plant in an area where drilling had shown very little commercial ore. The Mountain Iron Mine will soon be exhausted and will then be allowed to fill with water, forming a reservoir holding about 16,000 acre feet, or enough water to run a 10 million ton taconite plant for about six months.

At the Extaca Plant at Virginia, sintering is done with Dwight-Lloyd sintering machines, using taconite fines and Rouchleau ore fines, since the Pilotac Plant is not yet producing enough fines to run both the sintering and the nodulizing plant at Extaca. Minor changes are being made in the effort to increase production rate.

Success in the nodulizing operation has shown a decided gain in the past two years. The nodules can be used in the open hearth furnaces. This gives them an advantage over regular ore or even high grade natural ore, other than lump ore. The nodules run from ⅜-inch to 1-inch in diameter but effort is being made to obtain a fairly uniform size of about ⅜-inch.

The total employment at both the Pilotac and Extaca Plants is approximately 500 people. As stated in our 1955 Report, the Townsite consists of 126 homes, not company-owned, known as South Grove Addition to Mountain Iron. The Mountain Iron School District issued bonds in the amount of $465,000 for construction of a new school which has now been completed.

COMMENT

The scale of operations at both the Reserve Mining Company (E. W. Davis Plant) and the Erie Plant is so huge and bewildering that any attempt to write a clear and comprehensive description of either operation seems weak and inadequate. Even the old saying that "seeing is believing" almost fails to hold true here. The nearest comparison is that of a modern steel plant. Many steel plants will need and welcome the high-grade manufactured iron ore that will be supplied by the plants herein described and by other similar plants in the Lake Superior District.

A substantial part of the cost of both plants is said to be met with borrowed money. If there is any question as to how many people in America have a financial interest in Minnesota taconite, the answer must be:—all but those who carry no life insurance have a financial interest for the big life insurance companies are its heavy backers.

The problems of taconite reduction have taken the better part of 40 years for their present measure of success. Great credit belongs to Mr. E. W. Davis for his untiring efforts over many years in arousing the interest of mining and steel men in the vital importance of taconite in the economy of both the steel industry and the State of Minnesota.

Much credit is due also to Messrs. John J. Craig and Henry H. Wade for many years of work on these problems at the Mines Experiment Station and to the companies active in research work in Duluth and on the Range.

More recently Mr. Robert J. Linney has given several years of research and hard, grueling work to the many difficult problems of taconite reduction. His experience in the treatment of the silicious magnetite ore of the Adirondacks was of great value in solving some of the even more difficult problems of the taconite industry.

Public interest has shown a marked shift from iron ore mining in Minnesota to the mining and processing of taconite. This interest is due not so much to the direct tax revenue to be derived from the taconite concentrate as to the hope of a great new industry that could continue for many generations, giving employment to more workers than have been employed in the mining of iron ore.

The interests of national security require that Minnesota taconite be developed in a few years far beyond the plants now built or being built. The high-grade iron ore deposits of South America would not be available for use in the United States in times of national emergency.

Two of the main factors affecting the large-scale development of taconite are labor and taxes. A fair degree of stability in both could encourage orderly progress in construction and permit building up the taconite potential to equal that of imports—a goal to be reached in order that Minnesota may be able to hold its competitive position in the iron ore industry.

TABLE NO. 3

TACONITE CONCENTRATE SHIPMENTS FROM MINNESOTA THROUGH 1956

Year	Mesabi Iron Co.*	Reserve Mining Co.	Erie Mining Co.	Oliver Mining Div.	Totals
	Tons	Tons	Tons	Tons	Tons
1920-24.....	156,157	.....	.....	.....	156,157
1949.....	.....	.....	15,756	.....	15,756
1950.....	.....	.....	62,087	.....	62,087
1951.....	.....	.....	137,607	.....	137,607
1952.....	.....	12,861	93,527	.....	106,388
1953.....	.....	245,643	211,240	104,464	561,347
1954.....	.....	344,183	184,314	360,363	888,860
1955.....	.....	333,352	189,829	632,195	1,155,376
1956.....	.....	3,875,736**	180,000***	620,000***	4,675,736
TOTALS.....	156,157	4,811,775	1,074,360	1,717,022	7,759,314

*Experimental plant located near present Babbitt Plant; closed in 1924.
**Combined shipments from Babbitt and Silver Bay Plants.
***Estimated tonnage.

FURTHER TACONITE DEVELOPMENTS

An article appearing in a February, 1956, *Mesabi Daily News*, Virginia, Minnesota, was brought to the attention of the Commission Members, which article reads in part as follows:

"**Michigan Low-Grade Ore Beneficiation Scheduled.** Inland Steel announced today that it is joining Cleveland-Cliffs Iron Company and others in a low-grade iron ore beneficiation project on the Marquette Range of the upper peninsula of Michigan. It is the first entrance of Inland into iron ore concentration and the first major project for complete treatment of low-grade Michigan ores, locally called '**Jasper**' as contrasted with the '**Taconite**' rock of Minnesota.

"Inland will own 20 per cent of the Marquette Iron Mining Company, organized by Cleveland-Cliffs to own and operate the project. Marquette Iron Mining has leases on two mines and is building concentrating and pelletizing plants, the announcement said.

"P. D. Block, Jr., senior vice president of Inland, in announcing the company's participation in the project, said, 'There are no better deposits of low-grade ore in the Lake Superior district and this project is particularly attractive to our company because of its location close to Chicago.' Usable ores outcrop at each mine, he said, and explorations show that open pit operations will be feasible to a depth of 500 feet or more."

It was determined by this Commission that its policy of "on-the-site" information should be followed with respect to the Michigan low-grade ore beneficiation and therefore members were authorized to make an inspection of the Jasper operations at Ishpeming, Michigan, in June of 1956.

Members making the inspection trip were told by officials at Ishpeming that if production of iron ore is to continue at its present level in years to come, the industry must find the means of utilizing the *vast reserves of low-grade non-magnetic taconites and jaspers.* These ores are not suitable for blast furnace use in their natural state, hence various methods must be used to beneficiate or improve their quality. Generally speaking, this beneficiation involves three steps, known to metallurgists as: 1–Liberation; 2–Separation; 3–Agglomeration. In layman's terms:

1. *Liberation:* A crushing and grinding process must first be used to liberate the valuable iron mineral from the worthless gangue material with which it is physically united.

2. *Separation:* A separating process to separate the iron mineral from the impurities by one or more of the various processes which have been developed in the iron industry's research laboratories.

3. *Agglomeration:* "Putting the ore back together"–the crushing and grinding has reduced the ore to a fineness not suitable for shipping and blast furnaces until it is "put back together" and the final product is high in iron content, low in impurities and ideal for the steelmaker's needs.

It should be noted that Michigan Jasper and Minnesota Taconite are very similar in many respects but that the Jasper now being treated is non-magnetic, requiring a different separating process known as the "Flotation Method." The Taconite now being treated is magnetic and the separation is accomplished by a magnetic process.

Humboldt Mine and Republic Mine are the two Jasper Operations. The Humboldt Mine is the first plant in the Lake Superior District to be operated for the recovery of a high grade iron product from Michigan Jasper and the Republic Mine is the second such plant.

Humboldt Mine is owned by Cleveland-Cliffs and Ford Company. Ford Motor takes the fine crushed material down to Detroit and sinters it there for its own use. Humboldt's operations are the same as

Republic's, which Mine the Commission inspected, except the concentrating plant has only one unit compared to two units at Republic and no pelletizing is done. This plant has been operating for about four years. The mine is near the concentrating and crushing plants. The reserves here are not as great as at Republic Mine. The Jasper runs about 31% iron—average, and it takes a little more than two tons to make 62% iron concentrates (dry iron).

Republic Mine. The Jasper at this mine averages about 38% iron and it takes a little less than two tons to make a ton of iron ore concentrates of 63% iron (dry iron). Republic has been in operation for about four months. It was formerly a high-grade underground mine. The ore consists of specular hematite, physically united with an undesirable cherty material. The overburden covering the ore body varies from zero to 50 feet in depth at some points in the pit and in character from fine sand to massive boulders. The mine is about 600 feet wide and three-quarters of a mile long. It is now on only a day shift and produces enough material to keep the mill going on three shifts. The ultimate rate will be at least a million tons per year.

Construction began at Republic late in the year 1952 with clearing of ground for the concentrating plant and excavation for the primary crusher installation. Access roads onto the property were provided as well as other necessary facilities. Crude ore fed into the completed plant began on a trial basis in March of 1956.

Pit development was started in the spring of 1954 with the stripping of over-burden by shovel and truck. Using a bench height of 40 feet, the ore is mined by open pit methods in such a manner as to provide a uniform crude feed to the mill. In the initial pit development, wagon drills were used to establish benches. A jet piercer machine is now used for primary blast hole drilling. The broken ore is loaded by an electric shovel equipped with a five-cubic yard dipper into 34-ton capacity diesel powered trucks for haulage to the crushing plant. A 3½ cubic yard shovel and dragline are being used for stockpile loading, stripping and general utility work.

The ore is dumped into a gyratory crusher for reduction to minus 5½ inches. The crushed ore discharges into a surge hopper below the crusher from which it is withdrawn by a pan feeder. This in turn feeds a belt conveyor transporting the ore to a secondary and tertiary crusher building. Here the ore passes over a double deck vibrating screen which separates the plus 2-inch material from that under 2 inches in size.

The oversize material (plus 2-inch) from the screen is fed to a cone crusher which reduces it to a minus 2-inch in size. The undersize material from the vibrating screen (minus 2-inch) and the product of this secondary cone crusher combine on a conveyor belt and are transported to a second surge bin having a capacity of 150 long tons. The ore is drawn from this bin and discharged into a second double deck vibrating screen. The oversize (plus ½ inch) from this

screen feeds by gravity into a fine reduction cone crusher set to give a product which will be under ½ inch in size. The fine reduction or tertiary crusher product and the undersize material from the second screen are conveyed to a large catenary type bin located in the mill building.

Several openings are provided in the bottom of the bin from which belt feeders draw the crude mill feed for transportation by belt to the grinding section. The closed grinding circuit includes rod mills, a hydroscillator or hydraulic sizing machine, and a ball mill. The crude material passes through the rod mill to the hydroscillator with the plus 65 mesh material fed to the ball mill for further grinding to minus 65 mesh. The product from the ball mill returns by gravity to the hydroscillator. The hydroscillator overflow, or minus 65 mesh fraction, is pumped to a 24-inch cyclone followed by a bank of 6-inch cyclones for de-sliming and thickening. The thickened product from the densifier flows by gravity to the first of a row of four conditioners. The overflow or slimes from the 6-inch cyclones are discarded as waste. The underflow from the 6-inch cyclones discharges into the fourth conditioner.

Frothing reagents (1 to 2 lbs. of fatty chemicals per ton of material) are added to the first conditioner and the conditioned product is pumped to the flotation cells which produce the final tailings and the finished concentrate. (Runs 45% tailings and 52% iron ore.) The concentrates are pumped into a thickener from which the underflow is pumped to drum type filters. The filter cake is conveyed to a 100 ton railroad loading pocket for shipment to the pelletizing plant located at Eagle Mills or trucking to the stockpile area. The filtrate is returned to the thickener for further recovery and the final tailings are pumped to a large tailings basin.

The final high grade product from Republic Mine having a consistency too fine for use in blast furnaces will be pelletized at the Eagle Mills Plant which is now in production. The capacity of the existing Republic Mill is approximately 500,000 gross tons of concentrate per year.

The Pelletizing Plant is about 30 miles away from Republic Mine and about five or six miles from the ore docks at Marquette. It is set up close to the ore docks and centralized so that it can service all mines, thus getting away from small pelletizing plants. There are railroad lines from Republic direct to the pelletizing plant. This location also makes it a less expensive operation because the coal used is brought into Marquette where the docks are located. This plant operates on a 24-hour basis, 7 days a week.

The Republic Mine is operated by the Marquette Iron Mining Company, a corporation in which Inland Steel Company, Jones & Laughlin Steel Corporation, Wheeling Steel Corporation and International Harvester Company are stockholders, in addition to The Cleveland-Cliffs Iron Company, who will also act as manager and operating agent.

NOTES OF INTEREST

The flotation method of separation is used at both Humboldt and Republic because the iron formation is non-magnetic. After the material is crushed and ground to a fine powder (not as fine as Taconite), it is put into a "flotation cell" and a fatty chemical much like common oil is added. This fatty agent puts a very slight greasy coating on the iron oxide so it is water repellent and the iron oxide floats to the surface, air being injected into the flotation cell. The iron oxide, as it floats to the surface is foamy, and is taken off the top of the flotation cell and goes to a filtering container.

A research laboratory is maintained where all experimenting and testing takes place and eliminates pilot plants before going into full production. The Jasper concentrate can be produced at about the same cost as that of underground mining.

COMPARISON BETWEEN MINNESOTA TACONITE AND MICHIGAN JASPER

In Michigan the name "Jasper" is applied to all ore or ore materials requiring any form of beneficiation.

In Minnesota the name "Taconite" is restricted to the two types of hard iron-bearing rock from which the ore deposits were originally formed. The two main types are **Magnetic** and **Non-Magnetic.**

Magnetic Taconite is that from which taconite pellets, sinter and nodules are being made, occurring in large deposits in the eastern Mesabi Range and in scattered areas in the central Mesabi Range.

Non-Magnetic Taconite is receiving extensive research as to reduction methods and this is expected to continue. The long range view is held to be favorable. There are large deposits of this type of Taconite in the central and western parts of the Mesabi Range.

Type	Comparative Quality	Fineness Required in Grinding	Treating Process Used	Comparative Economy of Processing
MAGNETIC TACONITE	3 tons of crude to 1 ton of concentrate	Down to 325 mesh (to 1 inch)	Magnetic	Second lowest cost per ton of product
NON-MAGNETIC TACONITE (Est.)	3 tons of crude to 1 ton of concentrate	Down to 325 mesh	Probably by flotation or by magnetic roasting followed by magnetic-separation	Probably highest cost as now estimated
MICHIGAN JASPER	2 tons of crude to 1 ton of concentrate	65 mesh to 100 mesh	Flotation	Lowest cost per ton of product

Cost of Developing

As stated under **Cost of Developing,** page 161, in our 1955 Report, this is one subject upon which there is little information available.

MINNESOTA IRON ORE PRODUCTION AND LABOR

There was an increase in both ore production and labor in 1955 and a movement of labor from the underground mines to new processing plants. Reference is made to the new plant put into production at the Bennett Mine and to one being built at the Mahoning Mine by Pickands-Mather Company; also to expansion by Hanna, Oliver and W. S. Moore of their facilities for the processing of low grade ores.

The North Agnew Mine, a long time producer of underground ore, has been sealed up, leaving only five underground mines in St. Louis County and only seven in the state. There are no underground mines now operating in Itasca County and only two in Crow Wing County.

MEN EMPLOYED IN MINNESOTA MINING OPERATIONS IN 1955

St. Louis County	10,382
Itasca County	3,631
Crow Wing County	1,112
Total employed – 1955	15,125

WAGE SCALE IN 1955

St. Louis County: There were 24 labor classifications and hourly pay range from $1.685 to $3.065.

Itasca County: 24 labor classifications, with hourly pay range from $1.685 to $3.065.

Crow Wing County: 23 labor classifications underground, open pit and surface labor, hourly pay range from $1.745 to $2.585.
15 labor classifications (underground) hourly pay range from $1.805 to $2.825.

The above information taken from the latest Annual Report of Inspector of Mines in St. Louis County.

Conditions of open pit development and mining in both Labrador-Quebec and Venezuela are much more favorable than in Minnesota from a cost standpoint. Comparisons by grade of ore also favor these two sources. Briefly, the comparison is this.

Minnesota Ore	50.5% natural iron	11% silica
Labrador-Quebec Ore	54.0% natural iron	6% silica
Venezuela Ore	58.0% natural iron	5% silica

COST OF DEVELOPING

Partly offsetting the above two advantages of these two foreign ore sources is Minnesota's much shorter distance to steel plants.

Summing up, Minnesota ore has the advantage of nearness to market. Both Labrador and Venezuela have cheaper production costs and a grade of ore much higher than Minnesota's direct shipping ore or than most of its concentrate thus far produced. As to taconite concentrate, however, it is hoped that its high grade and excellent structure will enable it to compete with either of the two above-named foreign sources after full-scale production has been achieved. For a comparison of cost per ton and cost per unit of iron, see table on page 171 of the Commission's 1955 Report.

Iron unit may be defined as that part of a gross ton of 2240 lbs. represented by 2240 divided by the figure showing the per cent of *natural iron** in the ore. The higher the grade of the ore, the less of that ore (by weight) is required to make one iron unit.

Example:	Minnesota base ore	51.5% into 2240 = 43.495	lbs.
	Labrador base ore	54.0% into 2240 = 41.48	lbs.
	Venezuela base ore	58.0% into 2240 = 38.62	lbs.

Iron Unit Value for Mesabi non-bessemer ore is: $10.85 divided by 51.5%, or $.21068, representing the Lake Erie value of 43.495 lbs. of standard Mesabi non-bessemer ore at 1956 Lower Lake Prices.

Production costs of iron ore in Minnesota for the years 1938 through 1955 are shown in the following tables.

*NATURAL IRON—The metallic iron content of iron as it occurs in its natural bed; or before drying the ore at 212 degrees Fahrenheit.

TABLE NO. 4

AVERAGE PRODUCTION COSTS OF IRON ORE PRODUCED IN MINNESOTA*

Year	Total Tonnage Mined	Total Cost of Development, Royalty, and Other Costs as Indicated, Except Taxes	Average Cost Per Ton of Development	Average Cost Per Ton of Mining and Beneficiation				Average Cost Per Ton of Royalty Paid	Total Cost Per Ton of All Preceding Items	Approximate Total Cost of Ad Valorem and Other Taxes	Average Cost Per Ton of All Taxes Levied	Percent of Total Taxes to Total Costs
				Labor	Supplies	Other Items**	Total					
1938	14,728,556	$ 24,197,575	$ .186	$ .409	$ .254	$ .407	$1.070	$ .387	$1.643	$18,481,639	$1.255	43.3
1939	31,789,650	41,771,509	.215	.241	.168	.258	.667	.432	1.314	22,186,212	.698	34.7
1940	48,304,658	54,780,886	.201	.183	.142	.212	.537	.395	1.133	23 075,470	.478	29.7
1941	63,736,394	72,013,215	.206	.207	.140	.162	.509	.415	1.130	24,787,232	.389	25.6
1942	70,048,716	85,168,023	.190	.234	.161	.240	.635	.390	1.215	23,644,204	.338	21.7
1943	69,004,461	89,147,416	.209	.281	.182	.269	.732	.352	1.293	21,957,593	.318	19.8
1944	65,073,476	86,156,863	.234	.253	.198	.288	.739	.351	1.324	20,667,685	.318	19.3
1945	62,482,046	83,099,814	.208	.251	.201	.324	.776	.347	1.331	20,639,726	.330	19.9
1946	49,650,356	68,658,404	.223	.271	.216	.325	.812	.348	1.383	20,599,468	.415	23.1
1947	59,967,761	89,303,822	.254	.304	.263	.336	.903	.332	1.489	25,278,693	.422	22.1
1948	65,013,706	107,734,083	.298	.308	.284	.405	.997	.362	1.657	26,927,951	.441	20.0
1949	55,187,871	101,501,196	.341	.360	.294	.492	1.146	.352	1.839	31,452,161	.570	23.7
1950	64,793,019	126,736,978	.395	.396	.247	.542	1.185	.376	1.956	36,713,983	.567	22.5
1951	78,307,286	165,854,594	.484	.696		.580	1.276	.359	2.119	46,271,049	.591	21.8
1952	63,374,126	164,759,987	.558	.878		.790	1.668	.374	2.600	41,820,073	.660	20.2
1953	79,083,401	215,691,437	.659	.874		.800	1.674	.394	2.727	54,837,248	.693	20.3
1954	47,142,238	149,952,105	.659	.998		1.074	2.072	.449	3.180	40,728,252	.864	21.4
1955	66,545,405	182,477,851	.646	.788		.851	1.639	.457	2.742	56,638,885	.851	23.7

*Tonnage of all ore mined in Minnesota; total costs and costs per ton of development and operation chargeable to mining; and total costs and costs per ton of all mining taxes, as reported for Occupation Tax purposes, for years 1938-1955, inclusive.

**Includes: administration (local and district), depreciation, beneficiation (including crushing and screening), stockpile loading, and miscellaneous costs.

Authority: Minnesota Department of Taxation.

TABLE NO. 5
AVERAGE PRODUCTION COSTS OF OPEN-PIT AND UNDERGROUND ORE PRODUCED IN MINNESOTA*

Year	Total Tonnage Mined	Total Cost of Development, Royalty, and Mining	Average Cost Per Ton of Development	Average Cost Per Ton of Mining and Beneficiation					Average Cost Per Ton of Royalty Paid	Average Cost Per Ton of All Preceding Items
				Labor	Supplies	Total Labor and Supplies	Other Items (Including Benef.)	Total		
Open Pit Operations										
1938	11,535,101	$15,967,137	$ .225	$ .238	$ .174	$ .412	$ .358	$ .770	$ .389	$1.384
1939	28,033,250	32,953,986	.238	.141	.125	.266	.231	.497	.440	1.175
1940	44,008,093	44,640,364	.217	.108	.109	.217	.184	.401	.397	1.015
1941	58,771,355	60,547,192	.218	.138	.109	.247	.149	.396	.418	1.032
1942	64,951,827	72,290,635	.202	.154	.131	.285	.232	.517	.394	1.113
1943	63,761,539	75,491,717	.221	.195	.152	.347	.267	.614	.352	1.187
1944	61,177,038	75,309,811	.246	.135	.170	.355	.279	.634	.351	1.231
1945	59,012,981	72,960,183	.217	.183	.175	.358	.320	.678	.341	1.236
1946	47,312,655	61,036,079	.232	.199	.188	.387	.325	.712	.346	1.290
1947	56,648,191	77,761,752	.266	.217	.232	.449	.331	.780	.327	1.373
1948	61,075,597	93,888,374	.313	.219	.251	.470	.405	.875	.349	1.537
1949	51,804,480	88,647,173	.360	.260	.258	.518	.500	1.018	.333	1.711
1950	61,098,092	111,225,426	.416	.292	.221	.513	.531	1.044	.360	1.820
1951	74,382,213	148,105,427	.507	.....	.....	.570	.570	1.140	.344	1.991
1952	60,054,675	147,894,220	.587	.....	.....	.727	.785	1.512	.364	2.463
1953	75,789,280	197,481,036	.685	.....	.....	.743	.791	1.534	.387	2.606
1954	44,441,250	134,177,978	.693	.....	.....	.817	1.069	1.886	.440	3.019
1955	63,992,833	167,091,396	.668	.....	.....	.659	.838	1.497	.446	2.611
Underground Operations										
1938	3,193,455	8,230,438	.048	1.027	.544	1.571	.585	2.156	.374	2.578
1939	3,756,400	8,817,523	.042	.997	.494	1.491	.466	1.957	.378	2.377
1940	4,296,565	10,140,522	.040	.947	.487	1.434	.507	1.941	.381	2.362
1941	4,964,992	11,466,023	.060	1.033	.501	1.534	.335	1.869	.380	2.309
1942	5,096,889	12,877,388	.054	1.238	.543	1.781	.347	2.128	.344	2.526
1943	5,242,922	13,655,699	.064	1.353	.550	1.903	.293	2.196	.343	2.603
1944	3,896,438	10,847,052	.043	1.321	.628	1.949	.425	2.374	.367	2.784
1945	3,469,065	10,139,631	.050	1.403	.637	2.040	.392	2.432	.441	2.923
1946	2,337,701	7,622,325	.044	1.734	.780	2.514	.324	2.838	.379	3.261
1947	3,319,570	11,542,070	.043	1.787	.797	2.584	.441	3.025	.409	3.477
1948	3,938,109	13,845,709	.055	1.697	.808	2.505	.390	2.895	.566	3.516
1949	3,383,391	12,853,923	.047	1.896	.846	2.742	.380	3.122	.630	3.799
1950	3,694,127	15,511,552	.048	2.112	.668	2.780	.726	3.506	.645	4.199
1951	**3,925,073	17,749,167	.040	.....	.....	3.077	.764	3.841	.640	4.521
1952	**3,319,451	16,900,867	.051	.....	.....	3.608	.877	4.485	.555	5.091
1953	**3,294,121	18,210,401	.064	.....	.....	3.888	.994	4.882	.582	5.528
1954	2,700,988	15,774,037	.090	.....	.....	3.967	1.172	5.139	.611	5.840
1955	2,552,572	15,386,455	.094	.....	.....	4.024	1.167	5.191	.743	6.028

*Tonnage of all ore mined in Minnesota in years 1938 to 1955, inclusive; comparison of total costs per ton for development and other costs incurred in mining, as between open pit and underground operations.
**Percent of Total: 1940, 8.89%; 1945, 5.55%; 1950, 5.70%; 1953, 4.16%.
Authority: Minnesota Department of Taxation.

Competitive Ores

Supplementing our 1955 Report, **Competitive Ores,** page 167, in former years, Minnesota's competition came from a rather limited field. Ores from Michigan and some of the eastern states were in competition with Minnesota and so were limited tonnages from the very high grade ore deposits from Brazil and Sweden.

Since the recent developments of large high-grade deposits in Labrador-Quebec, Venezuela, Peru, Chile and Brazil, all of which are exporting substantial and increasing tonnages to the United States each year, the term "competitive ores" encompasses all Western Hemisphere iron ores, with the exception of those produced in the southeastern and western areas of this country.

The advantages of higher grade of these imports and their lower production costs more than offset their greater distance from steel plants in the United States. The expected early completion of the St. Lawrence Seaway will make competition even keener for Minnesota ores, until ways can be found to greatly improve their structure and natural iron content. Large scale production of taconite concentrate is being achieved in Minnesota and steadily increasing production of this high-grade manufactured ore now appears a certainty. The next step is the up-grading of Minnesota's remaining reserve of what has been considered "direct shipping" ore and the concentrate from low-grade ore other than magnetic taconite. It is expected that after 1960 the only ore shipped from Minnesota as direct shipping ore without any form of beneficiation will be that from the Vermilion Range.

TABLE NO. 6

IRON ORE IMPORTED INTO THE UNITED STATES*

(Exclusive of ore with 10% or more manganese)
(IMPORTS IN GROSS TONS)

Country	1952	1953	1954	1955	1956 (Estimated)
Brazil	1,010,919	485,282	595,907	1,010,129	1,000,000
Canada	1,822,038	1,840,983	3,522,863	10,072,091	16,000,000
Chile	1,861,575	2,363,401	1,664,300	1,058,899	900,000
Liberia	572,485	710,290	763,610	927,988	900,000
Mexico	114,309	241,636	140,863	176,293	200,000
Peru	.....	844,481	1,931,929	1,554,101	1,500,000
Sweden	2,111,100	2,097,522	1,543,753	1,221,334	1,500,000
Venezuela	1,845,776	1,949,618	5,209,812	7,120,221	9,000,000
TOTALS	9,338,202	10,506,213	15,373,037	23,141,056	31,000,000

*1952-1955 figures are from Table 27 of Minnesota Mining Directory.

(Figures for Algeria, British West Africa, Cuba, Costa Rica, Denmark, Dominican Republic, Iran, Spain, Tunisia, Union of South Africa and United Kingdom are not included above because none of these countries shipped substantial tonnages to the United States.)

COMPETITIVE ORES

It is a fact that trends in iron ore mining follow those of steel manufacturing. Spokesmen for the steel industry and the United States government estimate a required increase in steel ingot production of 3% per annum during the next 10 years to meet demands. This calls for increase in annual pig iron production from the current annual rate of 85,000,000 tons to about 110,000,000 tons at a cost of some $2,000,000 for new furnaces if it were planned to continue the use of the same types of ore as in the past.

The recent rapid increase of imports of high-grade ore coupled with the certainty of ample sources of supply to sustain them and the discovery by steelmakers that these imported ores with 54% to 58% natural iron and 8% or less in silica permit a greatly increased rate of production with smaller amounts of fuel and limestone, all result in lower costs and present an added factor of competition. Also the clean, uniform sized concentrate, a less compact mixture, gives better furnace results because the mixture permits easier passage of hot reducing gases through the furnace, requiring less time and resulting in further lowering of production cost.

The foregoing has resulted in a demand for a changed character of ore and concentrates so that Minnesota direct shipping ore with a natural iron content below 51% and with from 10% to 11% silica will have to be beneficiated to compete with the foreign ores and the concentrates manufactured from taconite and jasper. A large part of the Minnesota shipments will be sized commencing in 1957.

A striking illustration was recently presented to this Commission showing actual comparative results of the weights of pig iron made from several different grades of iron ore. From a ten pound sample of each of four different grades of iron ore from widely separated areas, a bar of iron one inch square was shown as representing the metal obtainable from each ten pound sample of ore.

The following are the results from ten pounds each of four different ores and also the estimated length from 10 pounds of taconite concentrate:

Minnesota ore 50% plus	A bar 1″ square and 19¼″ long
Labrador-Quebec ore 54%	A bar 1″ square and 20¾″ long
Venezuela ore 58%	A bar 1″ square and 22½″ long
Minnesota Taconite 62%	A bar 1″ square and 24 ″ long
Labrador-Quebec concentrate 66%	A bar 1″ square and 25½″ long

While increased imports will be needed to meet increasing tonnage requirements for steel, imports are already replacing Mesabi ores at some furnaces.

COMPETITIVE ORES

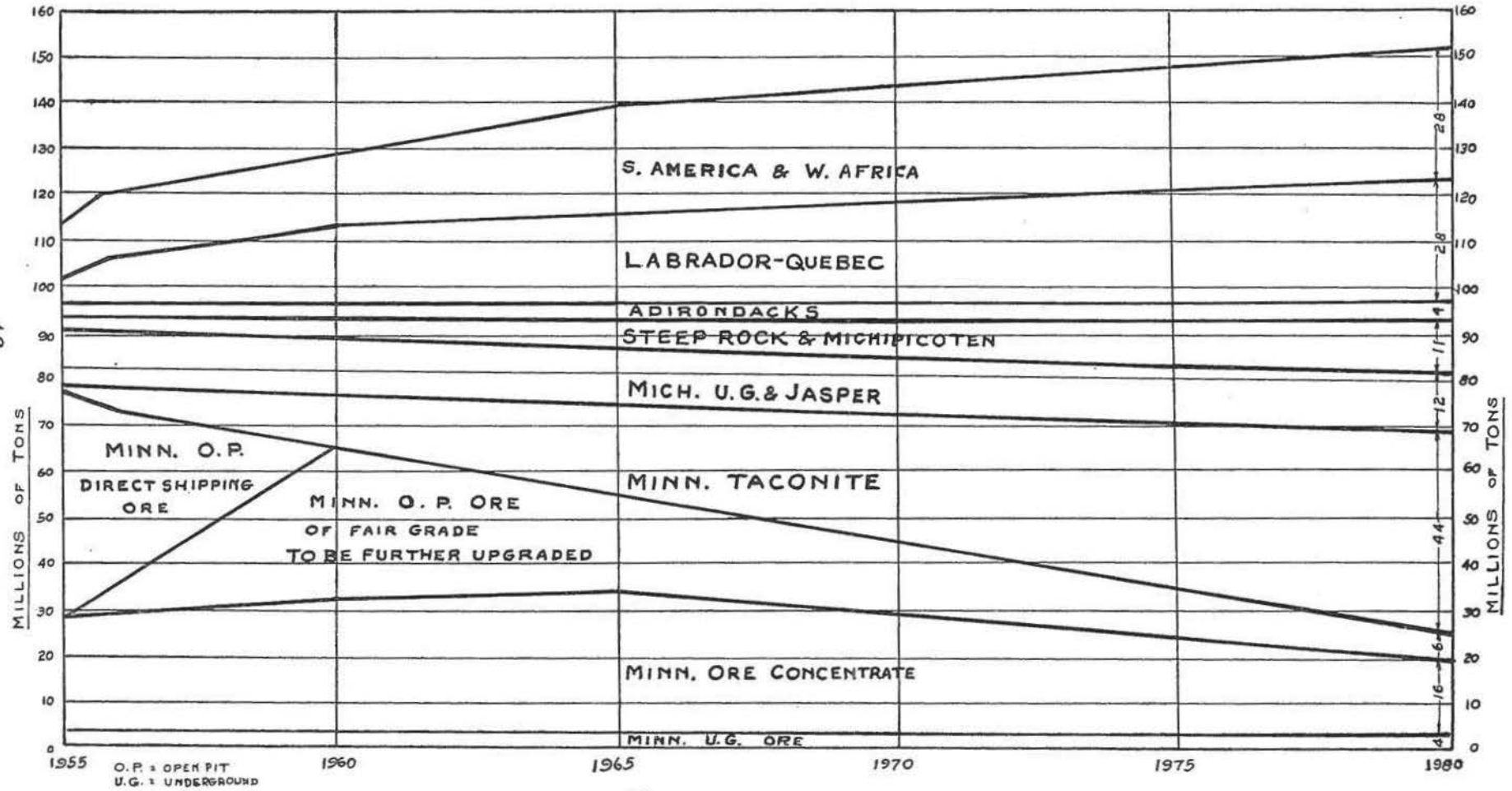
The one premium grade of iron ore now beginning to appear in quantity in Minnesota is the high-grade concentrate being made from taconite. The December 27, 1956, Statistical Report of the Lake Superior Iron Ore Association shows that 3,500,000 tons of this material had been shipped from Silver Bay by boat to the end of the 1956 season. There is no freezing problem present in handling these high-grade pellets, so that lake shipping can continue as long as the Sault locks remain open.

The big plant of Erie Mining Company under construction East of Aurora, is expected to be completed in late 1957 with a capacity of 7,500,000 tons annually. It is planned to expand production at Erie and at the E. W. Davis Works at Silver Bay in coming years. Oliver expects to have a full-scale taconite plant in operation also. These three are the main ones now actively interested in the Minnesota taconite development. Their operations will be the mainstay in maintaining Minnesota's competitive position in the iron ore industry. It is obvious that anything which could interfere with the steady development of taconite as now planned would be against the best interests of the State.

The following diagram shows the relative iron ore supply sources and their possible rate of growth in tonnage of iron ore or iron ore concentrate in the period from now until 1980.

While the quantities shown by this chart may seem too large, it is well to keep in mind first that they are meant to show the potential of each source and not a prediction of the year-to-year production rate. In times of National emergency the only available sources of raw material for steel are those in North America: Minnesota taconite, Michigan Jasper, Labrador-Quebec natural ore and concentrate, Steep Rock and Michipicoten, Minnesota direct and concentrate ores and ores from other Canadian sources–in that order. Nine out of twelve ocean ore boats carrying Chilean ore were destroyed by submarines in World War II. This forecasts that we could not count on help from South America or any other source over ocean routes.

CHART SHOWING PROJECTED IRON ORE SUPPLY SOURCES AND ESTIMATED 1955-1980 POTENTIAL OF ORE FOR USE IN STEEL PLANTS OF EASTERN AND MIDWESTERN UNITED STATES



RAW MATERIALS FOR STEEL, AS SEEN IN SEPTEMBER, 1956

In past years, anything that threatened to curtail an adequate supply of iron ore from the Lake Superior District was cause for alarm on the part of steel-makers. In 1956, however, in spite of a two-union strike that tied up 64 Lake freighters at the peak of the shipping season, steel men seemed to have few worries on that account. They seem more concerned about long range problems such as mounting operation costs and ways of absorbing the coming new wage increases in 1957 and 1958, rather than disturbed about next spring's steel operation.

In 1956 the United States imported about 31 million tons of high-grade iron ore from Canada, Venezuela and other foreign countries, compared to some 23 million tons imported in 1955.

The 1956 goal of Iron Ore Company of Canada, first set at 10 million tons, was raised in August to 12 million tons. Other importers of ore increased their imports enough to cover the shortage due to the strikes.

Another advantage is the increasing tonnage of high-grade iron ore pellets being shipped from Minnesota and Michigan taconite and jasper processing plants.

Mine operators and shippers are working out a preliminary estimate of the increase that should be applied to the price of iron ore for the 1957 season.

NEW BLAST FURNACE REQUIREMENTS

Early methods of treating low-grade iron ores to improve their quality consisted of simple washing to remove free sandy material to make the product equal in quality to that of the direct shipping ore. Even then it was found that washing also actually lowered the moisture content of the ore by removing the finer ore and sand particles, making it less compact, more readily drained and better ore for use in the blast furnaces.

Later it was found that other low-grade ore material could be much improved in grade by methods beyond ordinary washing. Results to date have shown marked improvement both in higher iron and lower silica in the treated ore, but there has been increasing difficulty in re-reducing the silica to an acceptable grade.

Screening of the direct shipping ore has been in use for many years, first to take out large chunks of hard ore before shipping. This was followed by a combination of crushing, screening and washing. Later as the better ores grew scarcer and harder to get, other methods were devised. All were aimed at getting a better product even from ore material that was growing less in iron content, higher in silica and harder to beneficiate.

COMPETITIVE ORES

In 1955 and 1956 there were growing imports of very high-grade ore from Canada and South America. Most if not all of these imported high-grade ores can be used in blast furnaces just as they come from the mines without need of beneficiating and have shown low costs in making steel. These imported ores come from regions where there has been heavy investment in ore reserves and in both development and transportation facilities. Therefore it seems clear that these ores will be used in very substantial amounts annually. This is already starting a major revision in planning methods of so handling Minnesota's remaining ores as to keep them competitive with higher grade imported ores.

It now seems clear that not only the low grade ore but also most of Minnesota's better open pit ore, long known as "direct shipping ore," will need to be up-graded if it is to remain competitive with high-grade imported ores and manufactured concentrates. This means not only improving the iron content of the ore and lowering the silica, but improving its very nature by removing the finer particles from even what has been known as "very good" ore, leaving a product that is more open and therefore better for use in a blast furnace. The finer ore will be treated by one of the three methods: making it into pellets, sinter or nodules.

Another step now being taken to improve Minnesota ore is known as sizing, or screening the ore into different groups of fairly uniform size of ore particles. It was explained to this Commission on November 30, 1956, that some large producers of Minnesota ore are now planning to use this method at many of their concentrating plants beginning in 1957. These innovations are due first to the growing imports of foreign high-grade ore and next to the resulting insistence of steel makers on what is known as "tailor-made" ore. That is, ore that has been so prepared by beneficiating, screening and sizing that it can be readily and quickly melted in the blast furnace.

Added to gains by these improvements will be the great advantage to be gained by mixing the sized Minnesota ore with the very high-grade pellets, sinter or nodules made in steadily increasing amounts from taconite. It now appears that this may be the key to successful competition of Minnesota ore with high grade imported ore.

For diagram showing the estimated potential of various supply sources of iron ore, see page 46 of this report.

EFFECT OF NEW BLAST FURNACE REQUIREMENTS ON MINNESOTA ORE

Blast furnace operators are now calling for tailor-made ore. Until recently they have been satisfied more or less with 50% iron and 11% silica. But those operators have found that by increasing the ore to 54% iron and lowering the silica to 8%, there is a 13% increase in the production of pig iron from the same furnace. In addition to that, the amount of limestone needed is reduced by 250 pounds and the amount of coke required is reduced by 200 pounds per ton of pig iron.

As a result of the blast furnace requirements, Oliver Mining Company has under way in Minnesota a general ore improvement program. They expect in 1957 to ship an estimated 35 million tons of ore, of which about 20,000,000 tons will be sized into fines and varying coarse sizes. The general ore improvement program will make Oliver's ores better able to meet competition from foreign sources. Other Minnesota ore producers are following this same procedure.

This insistent demand for ore of high iron content, less silica and other impurities, less fine material, with more attention given to sizing, avails Minnesota's mining industry of a wonderful opportunity to expand employment and facilities. Iron ore so produced will command a premium and will result in a higher tax yield to the State.

What Impact Will the Great Lakes-St. Lawrence Seaway Have on the Iron Ore Industry in Minnesota

Progress has taken place with reference to the St. Lawrence Seaway since our 1955 Report, page 176, **What Impact Will the Great Lakes-St. Lawrence Seaway Have on the Iron Ore Industry in Minnesota.**

Following the enactment of the Federal Seaway law on May 13, 1954, one of the biggest construction jobs of all time has been pushed at a terrific pace, cutting the channel that will be the gateway from the Atlantic to the Great Lakes. 114 miles of the channel are along the United States-Canadian boundary and the rest is in Canada. Here 12,000 men are at work literally changing the landscape, deepening channels, building massive concrete locks and dams to provide a 27-foot waterway from Montreal to the Great Lakes.

The Seaway, 744 miles from the mouth of the St. Lawrence to the Great Lakes, will be the world's longest inland waterway for ocean boats and its locks will lift ships 580 feet to Lakes Michigan and Huron and 600 feet to Lake Superior. The Suez Canal at sea level is 103 miles long and the Panama Canal, 50 miles long, has a lift of 85 feet.

Electric power to be generated at the dams along the seaway will nearly equal that developed at Grand Coulee Dam which is said to be the world's largest power producer.

In the area directly affected by the seaway are five million industrial workers making 32 per cent of all North American manufactured products.

From tidewater at the mouth of the St. Lawrence, the seaway rises through a series of locks and dams into Lake Ontario, then another 326 feet around Niagara Falls and through Lake Erie past Detroit to Lake Huron. At Huron's north end the channel divides, one arm leading toward Duluth via Lake Superior and the other southward toward Chicago via Lake Michigan. Sailing distances: Atlantic to Chicago—2,250 miles; Atlantic to Duluth—2,340 miles.

Canada led the way to final enactment of the 1954 United States law by its announced decision in 1951 to go ahead and build the seaway with the United States if they could and without United States' help if they must.

Funds for the river section, its navigation works and power plants were appropriated by the Canadian and U. S. governments, the Province of Ontario and the State of New York. Most of the money and ground at the lower end were furnished by Canada. They will also deepen the Welland Canal around Niagara Falls. Above Lake Erie, connecting channels between the lakes must be deepened at an estimated cost of 150 million dollars. This part, except for a number of

dredging jobs on the Canadian side, will be paid for by the United States. Profits from Seaway tolls and from electric power are to be shared by the two countries.

Views on amount of income from the seaway vary widely but well-informed men believe the project will show a profit.

By 1958 it is planned to have the seaway completed to Niagara Falls and in another year, past the Falls, making Toledo the terminus at the west end of Lake Erie. By 1962 Chicago, Milwaukee, Duluth, Port Arthur and Fort William may become ocean ports.

Canadian and United States cities along the seaway have already planned to spend over $300,000,000 and private industry as much more for harbor works. Canada and the United States are good neighbors working together to get a big job done.

(For proof of impact of Seaway see Table on page 171 of 1955 Report.)

SEAWAY TOLLS*

The principle of pay-as-you-go was accepted in Canada before the St. Lawrence Seaway Authority was established by Act of Parliament. In the United States, the Wiley Act also recognized the toll principle.

Canada's Department of Trade and Commerce, after a survey of major interests and industries that would use the Seaway, estimated the traffic potential at 31,000,000 tons per year for the first few years of operation. A similar survey by the United States Toll Committee indicated a yearly traffic of 36,500,000 tons through the Seaway.

Recognizing that the prime purpose of tolls is to recover the capital and operating costs of the Seaway, legislation provides for recovery of construction costs within a 50-year period, though not necessarily at a uniform rate throughout that term.

Agreement is to be sought between the Canadian and United States toll committees on type and amount of traffic through the Seaway during the next half-century; then on a system of tolls adequate to recover cost of building and operating the canals, but low enough to encourage traffic. The committees have been meeting regularly, and realize that by 1958 they will need to reach a joint conclusion.

Here are some of the questions before them: Should there be different rates for different commodities? Will tonnage or commodity have first consideration in fixing rates, or should there be a combination of the two? What should be the basis of dividing toll receipts between the two countries—will it depend on each country's contribution to cost of construction, or be divided according to use? In case final agreement cannot be reached, each country can still set its own toll schedule.

*_The Engineering Journal_ (Canada), October, 1956.

Other Seaway news—*Engineering Journal,* October, 1956.

A United States steel company has optioned a 400-acre tract, with 3,000 feet water front on the south shore of the St. Lawrence, adjacent to the trans-shipment pier of Iron Ore Company of Canada at Contrecoeur. Initial reports suggest that a concentrating plant will be built here for up-grading iron ore before shipping it to plants in the United States' Great Lakes States. Ore might come from Venezuela or Sept Iles. Primary production of steel here is thought to be only a matter of time.

With such a plant in operation, the amount of northern ore going through the Seaway might be less than the estimated tonnage of untreated Labrador ore. However, treatment of Venezuelan ore at such a plant might increase the total of the up-bound Seaway tonnage if such movement proved to be a cheaper alternative to the down-bound shipment of Mesabi ores or taconite from Michigan and Minnesota to Lake Erie ports.

Labor Credits

Supplementing our 1955 Report on **Labor Credits,** beginning on page 185, the 1955 Legislature amended the Labor Credits Law. During the past two years this Commission heard representatives from the Mining Division of the Department of Taxation and representatives from the mining industry on the subject of the effect of the 1955 amendment to the Labor Credits Law.

A compilation by the Mining Division of the Department of Taxation shows the effect of the changes in the labor credit provision of the 1955 Law. First the labor credit was computed under the provisions of the 1953 law, resulting in a computed total of labor credits allowed of $2,258,762. Then the total labor credit allowed, $1,352,282, as computed under the provisions of the 1955 law, was deducted from $2,258,762 ('53 law) showing a total decrease of labor credit allowed of $906,480, amounting to about 40% less labor credit allowed under the provisions of the 1955 amendment to the labor credit law.

Companies most affected were those with the highest proportion of high-cost mines. Among these are the following:

Company — Mine	Decrease in Labor Credits—1955 Amendment, or Increase in Taxes Paid	If 1953 Law Were Applied—Shows Increase in Labor Credits Allowed
Cleveland-Cliffs Iron Company	$ 39,021	$ 95,000
E. W. Coons Company	33,730	56,281
Hanna Coal & Ore Co. (Argonne-Cuyuna Group)	32,347	86,698
Hanna Iron Ore Co. (Portsmouth-Cuyuna Range)	38,884	69,996
Hanna Ore Mining Co. (Mississippi Group)	41,357	61,349
Hedman Mining Co. (Emmett)	3,578	12,005
Jones & Laughlin (Wentworth)	14,895	25,180
W. S. Moore Co. (6 small mines)	10,278	15,480
Morton Ore Company (Morton)	46,987	46,987
Philbin Mining Co. (Weggum)	18,342	53,508
Rhude & Fryberger (Boeing & Troy)	21,739	22,337
Snyder Mining Co. (Webb-Sellers Triangle, Whiteside)	25,122	28,066
Zontelli Bros. (4 small mines)	19,473	43,108
GRAND TOTAL (all mines)	$906,480	$2,258,762

LABOR CREDIT

The following named mines received no labor credit on their 1955 operations:

Agnew Open Pit — Cleveland-Cliffs Iron Co.
Sargent — Cleveland-Cliffs Iron Co.
Douglas — Douglas Mining Co.
Elbern — Haley Young
Spring Valley — Hanna
Section 18 — Hanna
North Yawkey — Hanna
Jessie Mine — Jessie H. Mining Company
Judson — W. S. Moore
Norman — W. S. Moore
Stubler — W. S. Moore
Morton — Morton Ore Co.
Pillsbury-Bradford — Oliver
Albany — Pickands-Mather
Scranton — Pickands-Mather
Embarrass — Pickands-Mather
Mahoning 1 & 2 — Pickands-Mather
Mahoning 3 & 4 — Pickands-Mather
Carmi-Carson Lake — Pickands-Mather
Wade — Pickands-Mather
Rabbitt Lake — Pickands-Mather
Boeing — Rhude & Fryberger
St. James — St. James Mining Co.
Krueger — Schroeder Mining Co.
Webb-Sellers — Snyder Mining Co.
South Agnew — S. Agnew Mining Co.
Susquehanna — Susquehanna Ore Co.
Minnewas — E. A. Young, Inc.
Graham No. 1 — Zontelli Bros.
W. Airport — Zontelli Bros.

Representatives of several of the mining companies appeared before this Commission explaining their operating conditions and all expressed their belief that the effects resulting from the changes under the 1955 amendment to the labor credits law were not what the Legislature had intended to accomplish.

Small operators, or so-called scram operators have felt the change in the labor credits law greatly, and a representative of the scram operators stated that the effect of the amendment was disproportionate, pointing out that the total increase in iron ore taxes occasioned by the amendment was about $906,000. In the whole mining industry, the increase of the occupation taxes amounted to about 3% from the amendment, but the small operators' portion of that increase amounted to 15% as compared to about 2.7% on the balance of the industry. Of the $900,000 increase in taxes from the amendment, the independent companies paid approximately 13% contrasted with the 6% of the total shipments of iron ore from Minnesota.

Typical of the scram operations are mines like Coons-Pacific Co. which are largely of the class of mines that have been operated by others and dropped when the best ore had been mined out.

The Cleveland-Cliffs Iron Company's mines are all in ore requiring beneficiation, some requiring heavy media and spirals.

Tax Evaluation

To supplement our 1955 Report on the subject of **Tax Evaluation,** the following tables: "Iron Ore Taxes" and "Ratio of Concentrates to the Total Production" are inserted:

TABLE NO. 7

	IRON ORE TAXES				Total Tonnage of Iron Ore Produced*
	Ad Valorem 1	Occupation 2	Royalty 3	Total	4
1914-1915	$ 13,935,202	.....	.....	$ 13,935,202	55,411,561
1916-1920	70,168,134	.....	.....	70,168,134	206,588,420
1921	18,185,156	$ 2,238,328	.....	20,423,484	17,495,578
1922	18,411,500	3,440,597	.....	21,852,097	28,770,120
1923	19,655,268	6,126,443	$ 1,027,847	26,809,558	44,843,457
1924	18,736,356	2,859,735	895,825	22,491,916	32,425,027
1925	18,570,829	2,316,432	845,072	21,732,333	37,580,850
1926	17,267,679	2,725,312	910,636	20,903,627	41,662,490
1927	17,342,382	2,183,308	916,825	20,442,515	36,474,549
1928	16,844,349	2,466,257	879,520	20,190,126	38,532,003
1929	17,251,700	3,786,352	1,044,696	22,082,748	46,922,911
1930	17,085,645	2,782,361	921,167	20,789,173	36,239,106
1931	16,617,217	1,383,145	649,804	18,650,166	18,370,526
1932	15,857,490	260,604	415,793	16,533,887	5,496,070
1933	16,582,129	958,388	335,600	17,876,117	12,597,805
1934	17,666,132	1,228,626	364,129	19,258,887	16,206,453
1935	17,323,829	1,387,546	459,951	19,171,326	19,954,430
1936	18,012,178	2,637,977	547,048	21,197,203	32,501,729
1937	17,269,567	9,033,930	1,305,385	27,608,882	49,619,930
1938	16,255,212	1,618,439	607,988	18,481,639	14,728,556
1939	16,431,322	4,888,964	865,926	22,186,212	31,789,650
1940	15,579,856	6,387,700	1,107,914	23,075,470	48,304,658
1941	14,564,253	8,399,387	1,823,592	24,787,232	63,736,347
1942	13,244,037	8,233,102	2,167,065	23,644,204	70,048,716
1943	13,300,103	6,711,683	1,945,807	21,957,593	69,364,022
1944	12,477,270	6,301,570	1,888,845	20,667,685	65,073,476
1945	12,588,313	6,289,279	1,762,134	20,639,726	62,482,046
1946	12,732,769	6,507,835	1,358,864	20,599,468	49,650,356
1947	13,923,528	9,700,773	1,654,392	25,278,693	59,967,761
1948	13,257,828	11,762,769	1,907,354	26,927,951	65,013,706
1949	14,901,587	14,355,466**	2,195,108**	31,452,161**	55,187,871
1950	16,565,954	18,822,662**	1,896,474**	37,285,090**	64,793,019
1951	17,241,113	26,275,375**	2,754,461**	46,271,049**	78,407,263
1952	18,721,241	20,788,836**	2,309,996**	41,820,073**	63,374,126
1953	21,039,931	30,305,803**	3,491,514**	54,837,248**	79,712,363
1954	21,622,447	16,587,915	2,517,890	40,728,252	47,142,238
1955	21,848,319	31,501,136	3,289,430	56,638,885	66,545,405
TOTAL TAXES	$669,077,825	$283,254,035	$ 47,064,152	$999,396,012	1,833,014,594

*Production 1921 to date, as reported for occupation tax purposes.
**These figures include the additional 1% Veterans' Compensation Fund.
Authority for tax figures: Minnesota Department Taxation.

TABLE NO. 8
RATIO OF CONCENTRATES TO TOTAL PRODUCTION

Year	Washed		Other Than Washed*				
	Gross Tons	% of Total Concentrates	Gross Tons	% of Total Concentrates	Total Concentrates Gross Tons	Total Ore Shipments Gross Tons	% Concentrates of Total Ore Shipments
Prior 1907....	0	0.0	0	0.0	0	148,247,423	0.0
1907-1910....	668,136	100.0	0	0.0	668,136	106,968,014	0.6
1911....	1,978,337	100.0	0	0.0	1,978,337	23,336,127	8.5
1912....	2,875,769	93.0	215,585	7.0	3,091,354	34,195,682	9.0
1913....	1,967,632	87.5	281,625	12.5	2,249,257	36,339,962	6.2
1914....	1,831,504	90.9	182,833	9.1	2,014,337	23,352,360	8.6
1915....	2,956,812	99.6	11,805	0.4	2,968,617	32,618,653	9.1
1916....	4,072,420	96.2	162,290	3.8	4,234,710	46,189,617	9.2
1917....	4,370,234	96.8	143,590	3.2	4,513,824	45,393,882	9.9
1918....	4,655,198	94.7	260,290	5.3	4,915,488	44,070,710	11.2
1919....	4,570,863	99.8	7,532	0.2	4,578,395	34,791,866	13.2
1920....	4,973,497	98.8	59,971	1.2	5,033,468	40,348,663	12.5
1921....	3,034,583	99.1	26,298	0.9	3,060,881	17,708,789	17.3
1922....	4,683,906	93.4	332,876	6.6	5,016,782	30,772,162	16.3
1923....	7,202,894	94.6	409,564	5.4	7,612,458	45,305,647	16.8
1924....	4,852,828	91.0	478,456	9.0	5,331,284	31,589,464	16.9
1925....	6,177,417	94.1	389,716	5.9	6,567,133	38,841,968	16.9
1926....	5,288,071	95.1	269,804	4.9	5,557,875	41,919,575	13.3
1927....	4,766,997	94.0	305,688	6.0	5,072,685	36,504,854	13.9
1928....	5,296,789	90.7	544,286	9.3	5,841,075	39,167,842	14.9
1929....	5,874,028	89.5	692,241	10.5	6,566,269	47,478,167	13.8
1930....	4,947,841	78.0	1,391,759	22.0	6,339,600	34,881,010	18.2
1931....	3,171,035	85.8	525,154	14.2	3,696,189	17,309,211	21.4
1932....	266,282	91.0	26,176	9.0	292,458	2,250,200	13.0
1933....	2,331,328	74.4	803,329	25.6	3,134,657	14,953,168	21.0
1934....	2,656,315	77.2	783,726	22.8	3,440,041	15,967,819	21.5
1935....	3,764,388	73.0	1,389,186	27.0	5,153,574	20,532,222	25.1
1936....	6,693,102	86.2	1,071,399	13.8	7,764,501	33,829,341	23.0
1937....	7,484,375	77.2	2,207,716	22.8	9,692,091	49,161,064	19.7
1938....	2,235,037	79.1	591,407	20.9	2,826,444	14,815,811	19.1
1939....	4,609,615	74.1	1,611,748	25.9	6,221,363	33,022,890	18.8
1940....	7,230,091	78.5	1,977,590	21.5	9,207,681	48,949,322	18.8
1941....	11,859,036	80.6	2,854,310	19.4	14,713,346	64,060,726	23.0
1942....	14,268,146	79.4	3,697,070	20.6	17,965,216	75,299,667	23.9
1943....	12,606,056	81.6	2,848,054	18.4	15,454,110	69,971,276	22.1
1944....	12,332,746	82.1	2,696,074	17.9	15,028,820	66,586,264	22.6
1945....	12,222,223	79.1	3,238,620	20.9	15,460,843	62,830,572	24.6
1946....	9,710,307	82.4	2,068,771	17.6	11,779,078	50,010,067	23.6
1947....	13,421,966	80.4	3,281,568	19.6	16,703,534	63,517,190	26.3
1948....	14,466,947	80.4	3,516,420	19.6	17,983,367	69,108,906	26.0
1949....	12,597,107	74.9	4,211,995	25.1	16,809,102	56,825,957	29.6
1950....	13,056,077	65.6	6,841,058	34.4	19,897,135	65,331,865	30.5
1951....	14,332,688	62.4	8,637,637	37.6	22,970,325	79,068,689	29.1
1952....	10,960,437	55.8	8,686,749	44.2	19,647,186	64,719,898	30.4
1953....	15,250,110	56.5	11,752,165	43.5	27,002,275	81,511,479	33.1
1954....	9,829,256	52.8	8,800,011	47.2	18,629,267	49,080,759	38.0
1955....	13,832,977	52.1	12,736,297	47.9	26,569,274	70,191,509	37.9
TOTALS.	318,233,403	75.5	103,020,439	24.5	421,253,842	2,218,928,309	19.0

*Includes jigged, hi-density and other gravity concentrates, magnetite concentrates, sinter, sinter-dried ore, dried ore and taconite magnetic concentrates.

Source: Minnesota Mining Directory, 1956.

Conclusions - Recommendations

DETERMINATION OF TAX BASE

Conclusion: The use of the market value at Lake Erie Ports as a principal factor in determining the base value for computing the ad valorem and occupation tax is just and fair. Its application determines a higher value and therefore produces more revenue than any other formula. It has been approved by the Supreme Court.

Recommendation: It is recommended that the use of the market value at Lake Erie Ports be continued.

RESERVES

Conclusion: Present figures on reserves of Minnesota iron ore indicate that under normal production the range life of high grade direct shipping ore will be about 30 years. Past experience indicates that new techniques for beneficiation of low grade ore may substantially lengthen the range life.

Ore manufactured from taconite is very high grade and a better material for use in blast furnaces than natural ore. When the taconite plants operate at full capacity and new beneficiating methods increase the utilization of low grade ore, the range life of Minnesota reserves, including taconite, will be prolonged indefinitely.

Greatly increasing effort is being made to beneficiate more low grade ores, and more important, most of Minnesota's remaining high grade open pit ore will need to be upgraded to meet the competition of imported ores.

The iron ore reserves of the world which will furnish competition with Minnesota iron ore are those located in Michigan; Labrador-Quebec, Steep Rock, Michipicoten and others in Canada; and Venezuela, Chile and Brazil in South America.

The present method of estimating iron ore reserves has been severely criticized because more ore has been shipped than was originally estimated. It is impossible to estimate the reserves of iron ore in the ground with exactitude. After numerous hearings and consideration of evidence on the subject, the method of estimating reserves has been found to be sound and practical, but has no sanction of law. Heretofore iron ore of low grade had no market value and was therefore not classified as reserves. Modern beneficiating methods improved such ore so as to make it a marketable product so that it is now classified as reserves. This accounts in a large part for the continued increase in tonnages of ore shown as reserves.

Local assessors lack the facilities to determine iron ore reserves and the value thereof for tax purposes as required by present law. Therefore, for practical reasons the University School of Mines estimates the reserves and certifies its findings to the Commissioner of Taxation who then computes and certifies the values thereof to the county

auditors as the base for tax levies. The auditors cause the listings and valuations to be entered on the local assessment books.

Recommendation: In the 1955 Report of this Commission we recommended that for practical reasons above referred to and because the present law prescribing the method of estimating and evaluating reserves is inadequate, a law be enacted placing the duty of estimating and evaluating reserves upon the Commissioner of Taxation after consultation with the University School of Mines and local assessing and taxing authorities. The 1955 Legislature did not act on this recommendation and we therefore resubmit it for consideration.

TACONITE

Conclusions: In our 1955 Report we said that: "Taconite can become Minnesota's greatest source of iron ore in the relatively near future. It may well surpass the total Mesabi tonnage and productive life."

Since then the manufacture of iron ore from taconite has proved to be a substantial source of very high grade ores and has been a very important factor in increasing employment on a year-round basis, adding some $30 million per year to the payroll of the iron ore industry. This results from the operation of the Reserve Plant at Silver Bay. The second large plant at Aurora will, within two years, produce even more high grade ore and contribute substantially more employment and more payroll. The Oliver taconite operation will continue to augment all of these factors. It has been stated that the estimated total investment of these three major companies now interested in taconite beneficiation (Reserve Mining Company, Erie Mining Company and Oliver Mining Division of U.S. Steel), is an amount in excess of the total present assessed value of all mining and other property in Minnesota.

The taxes derived from the operation of the privately owned railroads of the Reserve Mining Company and the Erie Mining Company, in lieu of gross earnings taxes on other railroads, are distributed to the local divisions of government and thereby reduce the ad valorem taxes in those areas. However, the shipments of taconite from the Oliver Mining Company's taconite operations are made over a common carrier railroad and the gross earnings tax accrued from this operation is put into the general revenue fund of the State.

Recommendations:

1. It is recommended that until further experience has been had, the taconite tax remain at its present rate and the distribution thereof be continued for the present as prescribed by the 1955 Legislature.

2. It is recommended that the proceeds of the gross earnings tax derived from the shipments of partially finished taconite or finished taconite concentrates when made over a common carrier railroad be distributed in the same manner as the tax derived from shipments made over taconite railroads.

HEMATITE AND OTHER LOW GRADE NON-MAGNETIC ORES

Conclusion: The processes now applied to the development of Michigan Jasper and similar low grade types of ore can be applied to Minnesota's low grade non-magnetic taconite and should be encouraged.

Recommendation: It is recommended that the same tax formula and distribution as is now applied to the manufacture of iron ore from magnetic taconite be made available to such operations.

COMPETITIVE ORES

Conclusion: In our 1955 Report we said: ". . . recent developments in Canada and other foreign fields indicate that in a few years Minnesota ore will be entering a highly competitive market." It is clear to us now that Minnesota *is competing* in such a market. Imports of iron ore from Canada in 1954 were about 3½ million tons; in 1955 they were over 10 million tons and in 1956 it is estimated that the total imports of iron ore from Canada alone will exceed 17 million tons, – or more than the total of all U. S. iron ore imports in 1954.

Iron ore imports from Venezuela were below 2 million in 1953, reached 7 million tons in 1955 and are expected to reach or exceed 9 million for 1956. Peru, starting with a shipment to U. S. of 840,000 tons in 1953, sent 1,500,000 tons to this Country in 1955 and is expected to equal that amount in 1956. Liberia, West Africa exported 700,000 tons to the U. S. in 1953 and over 900,000 tons in 1955.

All of the above imports consist of high grade iron ore. The estimated total for 1956 is at least 31,000,000 tons, – double the total for 1954. (See Table No. 6. Iron Ore Imported into U. S.) on page .... This demonstrates that our 1955 Report grossly underestimated the importation of ore from foreign sources. But for the fact that the demand for steel has and is increasing at the rate of 3% per year, Minnesota would already be subject to disastrous competition.

Recommendation: In our 1955 Report, we recommended:

> "That the future tax policy on iron ore be such as to aid in keeping Minnesota ore production costs competitive with imported ores and scrap iron. Every factor that enters into the cost of production of iron ore in Minnesota should be carefully considered by the Legislature in formulating its tax policy as it affects the industry."

A study of this report will demonstrate the soundness of this recommendation and the necessity of adhering to it in our future years.

WHAT IMPACT WILL THE GREAT LAKES - ST. LAWRENCE WATERWAY HAVE ON THE IRON ORE INDUSTRY OF MINNESOTA

Conclusion: The net effect of the completed Seaway will be that instead of foreign ores being competitive with Minnesota ores only

on the Atlantic Coast or at furnaces inland as far as Pittsburgh, they will be fully competitive at all major Eastern and Midwestern steel plants. This confirms the statement regarding Labrador ore being competitive with Minnesota ore on completion of the Seaway and extends its application to high-grade imports from South America, the other major supply source.

DRILLING PERMITS AND MORATORIUM

Conclusion: Hearings on these two subjects did not bring to light any facts indicating a need for legislation at this time requiring permits to drill for minerals and it is apparent that a law exempting newly discovered mineral deposits from taxation for a period of years might be unconstitutional.

Recommendation: In our 1955 Report, we recommended: "That there is no need for a drilling permit law at this time. It is also recommended that there is no need for a moratorium law and the Commission has grave doubt as to the constitutionality of such a law."

It is now recommended that a further study be made of applying the principle now applied in Michigan under the terms of the so-called Lindquist Moratorium Law.

LABOR CREDIT

Conclusion: In our 1955 Report we concluded that:

"The 1954 production of Minnesota iron ore to November 1 is about 36% below that of 1953, the all-time record year. This fact alone does not disprove the merits of a specific credit against the gross occupation tax on high cost ores. Such a credit undoubtedly does help to encourage the mining of such ores although in years of very high production the abnormal demand largely obscures that fact.

"The 1954 decrease in the total production of Minnesota iron ore was from an all-time high in 1953 to 79,712,000 tons down to an estimated 50,000,000 tons. There was a sharp reduction in the output of direct shipping ore and straight wash ore. The reduced demand in 1954 is certain to affect some of the more marginal low-grade ore operations even with the labor credit now in effect. Taking away all credit against the tax would close down many more of these low-grade ore operations. This would result in heavy losses of jobs, because many more men are needed to produce 100,000 tons of product from the marginal operations than are needed for producing 100,000 tons of direct shipping or straight wash ore.

"Operators of mines producing only direct shipping ore or straight wash ore are better able to expand or reduce production with changing demand than those mining ores requiring treatment methods other than ordinary crushing and washing.

"The lower the profit margin on any low-grade ore operation the greater the chance that it will not be able to run in any but high-

demand years. Removal of all credit would not only cause the loss of many jobs but would be detrimental to the conservation of iron ore, which is becoming more vital to the State of Minnesota every year. True conservation calls for an increasing rather than a decreasing use of the poorer ores along with the better ores."

It now appears that the amendment enacted by the 1955 Legislature Laws 1955, Extra Session, Chapter 2, Article II, did not accomplish the purpose intended and did substantial harm to the low-grade high cost operations and particularly to the small so-called scram operators.

Recommendation: It is recommended that this whole subject matter be reviewed by the legislative committees and that the inequities of the 1955 law be adjusted.

ARE THE PRESENT TAXES ON IRON ORE TOO LOW; TOO HIGH; OR ARE THEY EQUITABLE?

Conclusion: The history of taxation in Minnesota shows very clearly that iron ore has been taxed on a more onerous basis than any other class of property. The reasons for the higher rate of tax can be traced to the premise that iron ore is a natural resource and a diminishing asset and should therefore stand a heavier burden of taxation.

When Minnesota had a monopoly on low cost open-pit iron ore this premise may have been justified but conditions have changed. High-grade ore is rapidly diminishing – high-cost concentrates made from low-grade ore are increasing – plants to manufacture iron ore from taconite are under construction to supplement the dwindling supply of natural ore – competition from the large deposits of high-grade ore in Canada and Venezuela is now a reality.

Higher taxes on iron ore would have the following effects:

1. Cause foreign ores to become more competitive;
2. Hasten the depletion of remaining high grade ore reserves;
1. Be detrimental to many small high cost mine producers;
4. Tend to discourage further investments in Minnesota's taconite industries.

Recommendation: It is recommended that taxes on iron ore should not be increased unless the financial condition of the State makes it necessary to increase taxes generally to provide the additional revenue to operate the State Government, in which event the additional taxes should be spread equitably upon all taxpayers.

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