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Ir 6 **UPPER GREAT LAKES IRON ORE INDUSTRY
PROBLEMS**

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HEARING
BEFORE THE
SUBCOMMITTEE ON
MINERALS, MATERIALS, AND FUELS
OF THE
COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS
UNITED STATES SENATE
EIGHTY-SEVENTH CONGRESS
FIRST SESSION
ON

PROBLEMS OF THE UPPER GREAT LAKES IRON ORE INDUSTRY

JUNE 22, 1961

Printed for the use of the Committee on Interior and Insular Affairs



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UPPER GREAT LAKES IRON ORE INDUSTRY PROBLEMS

THURSDAY, JUNE 22, 1961

U.S. SENATE,
SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS,
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS
Washington, D.C.

The subcommittee met, pursuant to call, at 10 a.m., in room 3110, New Senate Office Building, Senator John A. Carroll (chairman of the subcommittee) presiding.

Present: Senators John A. Carroll, of Colorado, Henry Dworshak, of Idaho, and Jack Miller, of Iowa.

Also present: Jerry T. Verkler, clerk, and Robert P. Dwyer, professional staff member.

Senator CARROLL. The committee will come to order.

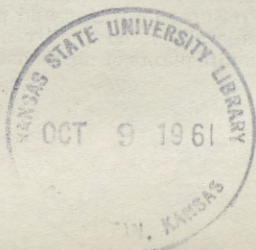
The purpose of our hearing today is to inquire into facts and conditions affecting the Great Lakes iron ore industry. We, of course, all realize that steel is perhaps the bellwether of our economy. No other single commodity is as important to the maintenance of our high standard of living, which we have come to expect, as steel itself.

Of course, without iron ore, we can have no steel. Thus, it is of extreme importance to our way of life as well as to our national security that we do everything possible to foster and maintain a profitable, expanding iron ore industry.

This industry, like other segments of our economy, has its problems. We are here not to consider specific legislation, but rather to learn what these problems are. If we do that, and implement by action the recommendations which are bound to be made by our list of expert witnesses, we will, I believe have performed a splendid service.

We have this morning a number of witnesses and it has been our custom always, if we could, to recognize Members of Congress and give them an opportunity to make a presentation on behalf of their district, their State, or their area.

At the outset, I am going to recognize for the record Congressman Blatnik of Minnesota, who wanted to come over this morning. He was under the impression that Congressmen would not testify, but, without objection, we will have Congressman Blatnik's statement included in the record at this point.



(Representative Blatnik's statement follows:)

STATEMENT OF HON. JOHN A. BLATNIK, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MINNESOTA

Mr. Chairman, I certainly appreciate your considerate remarks and providing for my statement to appear first in the record of these hearings on research needs for the development of low-grade iron ores. Senator Carroll, the people of northern Minnesota, I am sure, remember you well from your appearance in Hibbing in 1957. Your familiarity with the problems of my area and experience with the problems of the mining industry in general, I am certain, will result in the record of this hearing being a successful and highly informative probe into problems and issues involved in the development of our iron ore resources.

I have been associated and concerned with the problems of iron ore utilization and development for many years. My first work in the iron ore development field came at a time when taconite development was in its nascent stages way back in the late thirties and early forties. At that time I was a member of the Minnesota State Senate and did extensive work to promote the development of this valuable mineral. We were able to enact into law a bill which I had authored which gave companies investing in taconite processing plants preferential tax treatment. This law is still on the books today and has proved to be a real stimulus to the taconite industry.

The stages of development to final utilization of various processes used to convert the hard magnetic taconite ores are easy to follow and should be important in charting the course which should be taken to encourage further development.

First came the basic research on the feasibility of converting what before seemed to be useless rock into a material which could be utilized in the blast furnaces. Taconite is a granitelike rock, containing small particles of high-grade iron ore. The problem involved is the separation of the high-grade ore particles from the rock. The early research and final breakthrough were accomplished on a cooperative basis by the Minnesota Mines Experiment Station, the Bureau of Mines, and private industry. A great deal of the credit for this breakthrough must go to Prof. E. W. Davis who was primarily responsible for working out the technical process.

The technological feasibility of the process had been determined by 1940. At this stage came, through the taconite tax law, the encouragement to invest in facilities which would utilize the research and technical achievements for production purposes.

However, because of the pressures for quick production during World War II and the plentiful supply of direct shipment ores, investment in taconite processing plants was delayed until after the end of the hostilities. During the post-war years construction of taconite processing plants finally began. The first experimental production took place in 1948. The initial shipment in that year from the pilot plants in Minnesota was 1,000 tons.

Additional impetus was given to the construction of taconite production facilities by the provision in the Internal Revenue Act of 1950 which permitted rapid amortization of taconite processing installations.

The State of Minnesota took additional steps to encourage the processing of taconite ores by exempting the taconite industry from certain increases in iron ore occupation and royalty taxes. The taconite industry's tax liability was also further reduced by extending a labor credit allowance to taconite royalty taxes.

The intensive research, the breakthroughs in technology, and the encouragement given through various tax measures have combined to induce private industry to invest over \$650 million in taconite processing facilities. From the small pilot plant output in 1948, shipments increased to 1.1 million tons during 1955, and in 1960 reached a level of 11,368,147 tons of taconite concentrates. The important advances in this field of production are a tribute to all those who have been involved—the men in research, the firms with their farsighted vision, and the Government officials who tried to make the climate for the promotion of this venture as favorable as possible.

Before moving on to demonstrate why action must be taken to stimulate iron ore production in the Lake Superior region and pointing to what must be done, some mention must be made about the quality and competitiveness of taconite pellets produced in the taconite plants of northeastern Minnesota.

Use of taconite pellets has become of major importance in blast furnaces for the production of pig iron for a number of reasons. The pellets themselves have three distinct advantages.

(1) Pellets normally have a higher iron content and a more favorable ratio of iron to silica. The natural iron content of pellets varies from 61 to 66 percent with an average at present of 63 percent. With addition of new plants it is anticipated that this average can be increased to over 64 percent.

(2) Pellets have a physical structure that is most suitable for blast furnace use.

(3) Pellets have a maximum uniformity in chemical analysis and physical structure.

Also, a great number of benefits are derived from the use of pellets for blast furnace operations.

(1) The daily iron production per furnace is increased, thus reducing the unit capital charges for a blast furnace plant.

(2) The limestone consumption per ton of iron is decreased.

(3) The slag volume per ton of iron is lowered.

(4) There is also a decrease in the amount of flue dust per ton of iron. And, the direct operating costs per ton of iron are reduced. In other words, the use of pellets results in a large increase in pig iron production at a correspondingly lower cost per ton of pig iron. To be more graphic, steelmen point out that these blue ribbon concentrates allow five blast furnaces to produce now as much as six and a half used to turn out.

These iron ore concentrates also are competitive with any marketable iron ore, including that which is being shipped from the rich mines in foreign countries. There is very little disagreement among the experts that this is the case. The taconite pellets which are being shipped from northeastern Minnesota are competitive with both high grade direct shipments ores and concentrates that are currently being imported into this country. This fact is affirmed by the repeated contention of the managers of both the Erie taconite facilities at Aurora, Minn., and the Reserve Mining facilities at Babbitt and Silver Bay, Minn., that they are fully competitive. The best evidence of faith in their competitiveness is the current expansion undertaken by the Reserve Mining Co. to expand their output over 50 percent by 1963.

The estimated cost of the taconite facilities already constructed by the Reserve Mining Co. and the Erie Mining since 1950 is slightly over \$658 million. These firms do not seem to be inhibited by what might be considered an adverse business climate. They know that their product is competitive. They also do not feel encumbered by the tax climate under which they operate. Just recently the chief executive of one of these mining companies stated that his company believed they had received fair and understanding treatment from the State of Minnesota with regard to tax matters.

Both Reserve Mining Co. and Erie Mining Co., it can be said are relatively small when compared to some of the other mining firms in the Lake Superior area. Despite their disadvantage in size they have proceeded to make huge investments in taconite processing facilities. They now not only have a blue ribbon quality product, but they have also made a significant contribution toward the stability of the area and provided the United States with a stable production capacity for certain amounts of ore.

It is noteworthy by way of contrast, that one mining company, United States Steel, which owns a great portion of the taconite ore reserves, and which has the assets and easy access to the sources of venture capital had only elected to invest a minute fraction of other investments for the processing of taconite ores during the life span of the quick amortization law in order to offset depletion in direct shipment ore reserves. The reasons for this decision obviously must lie outside of the problems of availability of capital, tax climate, or competitiveness of product and estimated reserves of low-grade ores which conservative estimates predict will last for many generations. The flourishing taconite facilities of the two other operators in the area are evidence enough that these are not the reasons for their lack of investment.

Development in the utilization of the magnetic taconite ores has been very helpful to northern Minnesota by providing employment for our people, and making Minnesota ores competitive. But the degree of development has not been sufficient to offset the loss of ore tonnage shipped due to depletion of direct ores and the steady increase in tonnage of iron ore imported into the United States from abroad—particularly from Canada and Venezuela where

high-grade deposits have been discovered and developed by U.S. corporations.

Some figures will clearly illustrate the tremendous increase in imports which has taken place in the last decade. In 1950, the total tonnage of ore imported into this country was 7,142,000 tons according to the Department of Commerce. By 1955, this figure had increased to 23 million tons, and by 1959 iron ore imports had skyrocketed to 35,263,000 tons. Department of Commerce figures for 1960 show a slight drop, or 34,319,000 tons.

But these figures in themselves do not demonstrate injury. Had shipments from lake Superior district increased proportionately, the economic blight and structural decay in northern Minnesota would most likely not have occurred.

This has not been the case, however. The ratios of Lake Superior ore shipments to imports as compared to the sum of the two should clearly demonstrate the impact of imports on the Minnesota iron ore industry.

Year	Ratio of Lake Superior shipments to all imports	Sum of Lake Superior shipments and imports (thousand of tons)
1951.....	10.34	102,561
1952.....	8.36	86,395
1953.....	9.29	105,776
1954.....	3.92	74,975
1955.....	3.72	108,413
1956.....	2.57	106,480
1957.....	2.56	114,404
1958.....	1.86	79,544
1959.....	1.25	79,320
1960.....	1.94	101,205

Source: Department of Commerce Report FT110, "U.S. Imports of Merchandise for Consumption 1950-60" and the Minnesota Mining Directory, 1961.

These statistics clearly demonstrate that the trend has been toward greater reliance on imports at the expense of northeastern Minnesota. This trend has been continuing despite the fact that a large body of iron ore deposits which can be competitively utilized still exist in the Lake Superior district, particularly of the kind which are used in the production of taconite pellets.

The move toward greater reliance on imports gives no evidence of slowing down. In June of 1960, the American Iron and Steel Institute estimated that they would import as much as 65 million tons a year by 1965. This shift away from use of the Lake Superior ores might be more palatable to the people in this region if there was a real scarcity of iron ore deposits which could be competitively utilized. But this is not the case. Conservative estimates place the reserve of useful direct shipment ore at around one-half billion tons. Because of the absence of reliable data on the reserves in this area, little credence can be placed in statements which use the absence of deposits as a rationale for curtailing production in the area, particularly where direct deposits are concerned. It must be admitted that depletion of direct shipment ores has taken place, of course; but the extent to which this has happened is controversial. Assuming that usable direct deposits have been depleted to an extent which no longer makes them economically useful, it still is difficult to comprehend why greater utilization has not been made of the low-grade taconite and semitaconite ores which exist in large quantities in the Lake Superior region.

Expansion of operations in other countries by U.S. corporations has been highly detrimental to the economy of the Lake Superior district, and now the resentment over this occurrence has been compounded by what might be considered the most dramatic development in the whole import question. A great number of iron and steel companies have announced plans for processing, on a large scale, some of the immense deposits of very low-grade iron formation in the Quebec-Labrador area of Canada and various parts of Ontario. Attention has been swinging away from the new kinds of high-grade, direct-shipping ores in foreign countries and toward beneficiation of the low-grade, iron-bearing deposits. In other words, these large mining concerns are beginning to move away from the high-grade deposits which served as a justification for abandoning a good part of domestic production, and are moving toward the utilization of low-grade ores which are in ample supply domestically and can be competitively utilized. It is very questionable whether this development is in the national

interest, especially when employment, taxation, and domestic production capacity considerations are taken into account.

The consequences of the decreasing utilization of domestic ores for the Lake Superior region have been highly injurious to the economies of the areas involved. Northern Minnesota has been severely affected, as well as parts of Wisconsin and Michigan. In a short period of 4 or 5 years, the mining areas of my district have changed from a relatively healthy economic environment to one of persistent and substantial unemployment. All of northeastern Minnesota is now classified as a depressed or redevelopment area. Prospects for revitalization of the mining industry in the Lake Superior region will remain very bleak unless measures are taken to expand and develop the vast deposits of iron ore available there. The continuing lag in our economic growth pace, further drops in Minnesota iron-ore shipments, as well as anticipated increases in the importation of foreign ores, all point to a very difficult future for the mining industry and the people of this area.

Shipments from Lake Superior ports for the first half of 1961 only amounted to 12,009,278 tons as compared to 26,516,555 tons for 1960. Another indicator of the steady decline of the Minnesota iron ore industry is the percentage comparison of this year's receipts of iron ore at U.S. mills relative to imported ores. Lake Superior ores were 49 percent of shipments to U.S. mills for the first half of 1960, but dropped from an already small proportion to 41 percent for the first half of 1961.

It is very clear that iron-ore resource development outside our continental boundaries has worked to extend the delay in the development of the usable ore resources in Minnesota, as well as curtailing the demand for current Minnesota production.

Resolution at the private level of the issue of whether to invest abroad or at home has produced serious public consequences. Unemployment in the Lake Superior region has become chronic, costing government at various levels millions of dollars.

Another grave ramification of this reliance on foreign ores is the potential encumbrance to this Nation of inadequate domestic production facilities in the event of a national emergency. Finally, and of great importance to the State of Minnesota, this decision has delayed the development of the taconite and semi-taconite ores in this country with its correlative, tertiary benefits to State and Federal Governments in the form of increased income taxes, business and personal, and savings which result from the reduction in welfare programs when business is flourishing.

The trend from domestic to foreign iron-ore supply over the last 10 years, if continued, will deprive the United States of a substantial part of its basic income from iron-ore mining, and will eventually put the Nation in the position of having to depend on deposits overseas for most of its iron ore. The crux of the problem, then, is to devise ways to modify the trend and assure that the Nation's future iron-ore supply will come principally from domestic sources, and also to assure that iron will be available to supply our expanding industry when and where it is needed.

To accomplish this end, Mr. Chairman, I recommend the following measures: The recommendations which I am about to make are also consistent with the philosophy inherent in the Area Redevelopment Act which seeks to develop each area in its own right, utilizing whatever resources and commercial opportunities are available.

1. Basic to any intensified program of development, of course, is a thorough knowledge of the resources available, their ownership, and their quality. I, therefore, recommend that adequate funds and authority be given to the U.S. Bureau of Mines to make an immediate survey of the extent of the iron ore deposits in the United States, the ownership of all these iron-ore resources, and the quality and utility of the deposits discovered. I also suggest that the data gathered from this survey be made a matter of public record so that public authorities at all levels can avail themselves of the information available in proposing potential uses and prospective developments of these resources. It is imperative that this survey be undertaken immediately since our information in this area is woefully inadequate. The dictates of national defense under new strategic concepts also demand that complete information be made available in order to revise present policy concerning utilization of domestic iron-ore reserves.

2. Additional funds should be allocated to the U.S. Bureau of Mines to be used on a cooperative basis with university research units and other public develop-

ment agencies actively engaged in research and development in iron-ore resources. These funds should be allocated for basic research in the use of low-grade iron ores, and to specific projects which the various academic institutions are now working on relating to the refinement of technology for commercial utilization of low-grade iron ores. An example of current research which merits assistance is the University of Minnesota Mines Experiment Station's project on the development of a commercially feasible process for the utilization of nonmagnetic taconite. Their process, utilizing a new mechanism for the magnetic roasting and concentration of nonmagnetic taconite (estimates place nonmagnetic reserves at around 300 years) has proved to be feasible on a laboratory scale. Funds are now needed to build and test a large-scale experimental machine so that potential users can be assured that the device will function satisfactorily in large commercial use. Funds could also be made available to public regional agencies through the Bureau of Mines to make ores from the Lake Superior district available to firms and developers of various concentrating and direct reduction processes to determine the commercial feasibility of the vast deposits of Lake Superior taconite and offgrade ores. The authorization and appropriation of such funds is completely justified both from the standpoint of the development and efficient utilization of our national resources, and also from the standpoint of promoting a healthy economy in the areas where lack of development has brought on deterioration in order to provide employment and tax revenues for government at all levels. If this has not been the policy of the National Government in the past, it must become an explicit objective of the Federal Government today. A healthy domestic economy and our long-range national defense needs demand that we wisely develop all our mineral resources.

3. Basic to the development of any particular mineral resource is the availability of adequate and cheap transportation so that it can be transported to the marketplace, which in the case of iron ore are the steel mills at the lower end of the Great Lakes. The mode of transportation primarily used in the shipment of iron ores today is the boat plying the Great Lakes. But this kind of transportation is not available all year round. The alternative, railroad transportation, is not frequently utilized because, it is alleged, the costs are prohibitive. I urge that an investigation of all transportation rates from the Lake Superior region to lower lake ports and eastern steel mills be made immediately to determine the effects of these high rates on the development of the iron ore mining area, and also whether these rates will inhibit the development the direct reduction of iron ores which is now coming of age. That transportation rates have slowed the diversification of the economies in the Lake Superior region by discouraging new business and industrial ventures is an accepted fact. Since all of the mining areas of the upper Midwest are now considered redevelopment areas, it should be a matter of public policy to assure that transportation, which is basic to development and diversification, not be an inhibiting factor in the development of the redevelopment area.

4. Sound economics demonstrate that it is mandatory that cheap power be available for industrial use if development in any country or area is to take place. In this respect, the Lake Superior region is at a deplorable disadvantage. For example, in 1958, the average wholesale cost per kilowatt of energy in Minnesota was 12.2 mills as compared to a national average for the United States of 7.4 mills. If the figures for that year were further broken down, I am certain that they would demonstrate how that rates in northeastern Minnesota were at least double the national average. When compared with the 3- to 5-mill rate that is paid in the Tennessee Valley and Columbia River Valley, it is easy to see at what a great disadvantage northeastern Minnesota is placed. More recent figures derived from tabulations published by the Edison Electric Institute on large commercial and industrial power costs show that the State of Minnesota ranked fifth highest in the Nation. If this data were broken down within a State, instead of using the average figure, I am confident that the commercial and industrial power costs for northeastern Minnesota would at least be higher than the highest State average.

It is ironical that power rates in this area are as high as they are since two of the greatest potential fuel sources, peat and lignite, lie within the boundaries of Minnesota or within the boundaries of an adjacent State. In the State of Minnesota there are some 7 million tons of peat, half of the Nation's supply, located in close proximity to the iron ore fields. The potential of this peat for fuel and power is enormous. The successful use of peat as fuel in Finland, Sweden, France, Ireland, and Russia shows what can be done with this resource.

The power generated using peat as a fuel in Russia exceeds that generated by all the great hydro systems in the Tennessee Valley and the Bonneville Dam. We need this peat as a fuel for steam generation, and it is a serious social waste to delay development of this valuable resource any longer.

The giant lignite fields of North Dakota and Montana also provide another excellent source for the production of cheap power. It is an accepted fact that power can be produced more cheaply if the generating facilities are located at the source of the fuel and transmitted to the user. Utilization of these lignite deposits on a large scale for steam generation has become all the more feasible now since it is now possible to increase transmission voltage to as high as 500,000 volts and transmit power over these lines for at least 300 miles without any appreciable loss. In Sweden, West Germany, and Russia 400,000 to 500,000 volt transmission is already coming of age. An American firm, the Applachian Electric Power Co., has already undertaken a project at Apple Grove, W.Va., to develop long-time transmission systems capable of power loads of 750,000 volts. Location of steam-generating plants of large-kilowatt capacity at the lignite fields, and transmission of this power to northeastern Minnesota is entirely feasible with the great advances that have been made in generation and transmission technology.

In northern Minnesota, the Mesabi iron ore range is now approaching depletion of its high-grade, direct-shipment ores. Yet, in this great area, lower grade ores such as taconite and jasper are available in even larger quantities than the high-grade ores of the Mesabi, Cuyuna, and Vermillion Ranges. To recover the iron from the taconite and offgrade ores either through gravity methods of concentration for magnetic taconite, roasting and other methods for nonmagnetic taconite, or by direct reduction requires very large quantities of low-cost electricity. In order to expedite development of these ores, I strongly urge that the Bureau of Reclamation and other Federal agencies responsible for power development, immediately undertake a study to determine the feasibility of utilizing either the lignite or peat resources in the upper Midwest for the production of cheap power, and at the earliest date possible submit a proposal to the Congress for the creation of power generating facilities using either of these two sources of fuel so that the necessary funds may be authorized and appropriated.

Presuming that complete utilization of the low-grade iron ore deposits is necessary, and I believe that in the interests of our domestic economy and national defense it is essential, then it must be concluded that the development of cheap power is an indispensable corollary to such a policy.

5. During the last 10 years the rate of percentage depletion allowed for iron ores, including taconite, has been and now is 15 percent. This depletion rate applies to domestic production, as well as production by domestic corporations from foreign sources. The rationale behind extending the depletion allowance to nondomestic production is not a sound one since it provides another inducement to domestic corporations to invest in the development of iron ore resources in foreign countries which already are extending very liberal inducements to American corporations. Mr. Chairman, I submit that it should not be the policy of the Federal Government to enhance the attractiveness to domestic corporations of foreign mineral resources development when the Nation in which the resource is located is already providing incentives to companies which cannot be met in the United States, and are resulting in competition which is injurious to domestic production and development. Therefore, I strongly recommend that the depletion allowance on iron ore and taconite ores be confined to the territorial boundaries of the United States.

Mr. Chairman, many other recommendations might be made as to how the development of the low-grade iron ore deposits might be accelerated, but I feel that if the means I have suggested are quickly and vigorously pursued, a rapid recovery can be brought about in the iron ore mining industry of the United States so that we can be assured of adequate domestic production to meet our future national defense needs, as well as providing jobs to alleviate the chronic unemployment which now afflicts these areas.

Should measures not be taken within a short time to develop and revitalize the iron ore mining industry in the Great Lakes region, then it will be unavoidably necessary to advocate and strongly pursue in the Congress more negative measures in order to stem the trend which is now jeopardizing domestic development and our national security interests.

For further emphasis, Mr. Chairman, I would like to insert a letter I received from a firm in Ironton, Minn., proposing construction of a reduction plant.
(The letter follows:)

ZONTELLI BROS., Ironton, Minn., June 19, 1961.

HON. JOHN BLATNIK,
Congressman, State of Minnesota, House of Representatives, Washington, D.C.

DEAR CONGRESSMAN BLATNIK: This letter is being written relative to an iron ore reduction plant which we would propose to construct and operate and which would be capable of economically processing the low-grade, nonmagnetic ores of northeastern Minnesota, upper Michigan, and northern Wisconsin. This plant would produce a desirable metallic iron product from crude materials consisting of low-grade iron ore, limestone, and a noncoking type of coal such as Illinois fines or North Dakota lignite char.

We have been studying the progress of direct reduction methods for several years and it has only recently been demonstrated that one of these processes, known in industry as the Krupp-Renn process, is capable of producing a directly reduced metallic iron product economically from the above-mentioned raw materials.

We would propose to construct a facility capable of an initial production of 300,000 tons of metallic product per year, with provisions for expansion to 1 million tons per year. The logical location for such an initial plant would be at the lakehead near Duluth where it could handle ores from the Mesabi, Cuyuna and Vermillion Ranges of Minnesota or from the Gogebic Range of upper Michigan and northern Wisconsin. The successful operation of this initial plant would result in the construction of similar, but larger plants at the mining centers by the major mining and steel producing companies. Thus our proposed operation would have an immediate effect on the local economy of northeastern Minnesota and a large potential effect on the entire Lake Superior iron ore district.

Before discussing this project further, it might be well to mention earlier ventures that have been successfully pioneered by Zontelli Bros. in both the mining and metallurgical fields. One of the first to use mobile-type equipment in the stripping of open pit iron mines, they demonstrated the desirability of utilizing large rubber-tired scraper equipment in the place of steam shovel and trucks. In 1949, they built the first heavy-media plant in the State of Michigan designed for the processing of iron ore and the following year constructed and operated a similar but larger plant on the Cuyuna Range in Minnesota. Today, there are some 18 similar heavy-media plants in Minnesota and Michigan and these plants constitute the backbone of the nontaconite iron ore industry. In 1953, after studying the preliminary results of experiments conducted on a new Dutch process by the M. A. Hanna Co., which was known as the Dutch State Mines cyclone process, Zontelli Bros. constructed the first such unit on the Cuyuna Range and the second unit in the State (inasmuch as the M. A. Hanna Co. was operating a full scale unit). Much valuable information was obtained at this plant and disseminated to the other mining companies and today the treatment of the $-1/4''$ iron ores by the Dutch State Mines cyclone process is standard practice in the industry with some 10 plants utilizing this process. In 1953, Zontelli Bros. participated in the formation of the Gopher State Silica Co. which operates a large silica sand processing plant located near St. Peter, Minn. The products of this plant include "Hydro-frac" oil sands (used in the fracturing of oil wells whereby the life of an oil well is prolonged), high quality glass sands, foundry sands, and abrasive sands as well as silica flour which is used in the paint and chemical industry. Products from this plant are shipped domestically as far south as Texas and west to Oregon. These products also enjoy an export market with shipments to western Canada, South America, and Europe. In 1958, Zontelli Bros., through their fully-owned subsidiary Dakota Aggregate Co., constructed the first gravel concentration plant in the State of North Dakota. This plant benefited the local gravel beds, discarding shale and other deleterious materials, with the resulting production being a very high quality concrete aggregate. In 1959, Dakota Aggregate Co. supplied approximately a quarter of a million tons of aggregate which was consumed in structures and concrete pavement on Interstate Highway No. 94 extending west from Jamestown, N. Dak. This aggregate was supplied at a five-figure saving to the Federal and State highway programs. Prior to the operations of Dakota Aggregate, the bulk of the concrete aggregate utilized in the State of North Dakota was shipped long distances by rail with much of it coming from Minnesota

gravel operations. Therefore, through the utilization of sound metallurgical experience gained on the Minnesota iron ranges, Zontelli Bros. proved that North Dakota can use her own natural gravel resources to meet her concrete aggregate requirements. At the present time, two additional North Dakota gravel plant operators have utilized the same processing equipment in the construction of similar facilities to utilize local gravels for the production of concrete aggregates. We thought that it might be well to mention a few of the above instances as it will give you a brief history of the successful pioneering by the Zontelli organization. In each case, a large amount of careful research preceded the above-mentioned ventures and, although they were "firsts" in the industry, they were only initiated after a sound appraisal of the possibilities for success.

A study of direct reduction metallurgical processes shows that there are some 26 processes that show success in the laboratory, a few of which have been continued to the pilot plant and commercial stage. These processes which require either a high-grade iron ore or large amounts of low-cost electric power must be eliminated for economic considerations. Other processes must necessarily be eliminated because of certain metallurgical difficulties. The Krupp-Renn process, developed by the Freid Krupp Industry of Germany, has been successfully proven in many countries with operating plants located in Germany, Spain, and Japan. This process requires a high silica ore for the most efficient operating results with an ideal feed containing from 40 to 43 percent iron with approximately 30 percent silica. As you know, there are many millions of tons of such ores in Minnesota, Michigan, and Wisconsin which cannot be processed by conventional means. The Krupp-Renn operation does not require a high quality coking-type coal as must be utilized in the blast furnace. Such a facility, operating in Minnesota, would initially utilize either Illinois or anthracite fines. However, the lignite coal fields of North Dakota would provide a suitable fuel for such an operation providing that an equalization of freight rates could be obtained.

We would, therefore, propose to construct and operate such a plant in conjunction with another of the independent iron ore operators here in Minnesota providing that we could receive certain assistance from a Federal Government agency. Our studies indicate that the finished product from such an operation would be very desirable in the steel industry and would command a price of somewhere between \$37.50 and \$40 per net ton. Since the successful operation of such a plant would be so vital to all of those peoples in northeastern Minnesota as well as to the mining districts in upper Michigan and northern Wisconsin, we feel that it would be quite urgent to obtain your views as to whether or not a Federal agency would support a base price for such a product at approximately \$37.50 per net ton. We feel that this plant could be operated without any subsidy on the part of the Government, but since an operation of this type is as yet untried in this country, we feel that it would be necessary to obtain support at this level. Our studies show that this base price structure would provide for an economical operation by a plant capable of producing a minimum of 300,000 tons of product per year and we estimate that this facility could be built at a cost of approximately \$22,600,000. Participation on the part of a Federal agency would only be required in connection with the initial 300,000 tons per year facility and no guarantee on the part of the Government would be anticipated should this operation be expanded to produce 1 million tons per year of finished product. The assistance of the Federal Government in obtaining a loan to cover the construction of this plant would also be entertained. The support of such a base price and the financing of such a plant would have several precedences and it might be well to consider, for example, the White Pine Mining Co. copper operation located near Ontonagon in the Upper Peninsula of Michigan which was financed and operated under a plan whereby the Government would guarantee base price of approximately 24.5 cents per pound of copper. Since the initial operation of this plant, the Government has not been required to pay any subsidies as the market price of copper has been maintained at a price above this base level. This operation has, however, provided a large amount of employment to families in the Ironwood, Bessemer, Wakefield, and Ontonagon, Mich. areas and the foresight of those responsible for the success of this operation must be acclaimed as without the employment now offered by White Pine, this district in upper Michigan would be subject to more severe depressed conditions than it realizes at the present time.

We are enclosing for your examination, certain Krupp-Renn tests run on iron ore samples from both the Mesabi and Cuyuna Ranges. You will not that these samples represent some of the most difficult ore and resist concentration not only

by standard methods but also by methods utilizing the magnetic roasting principle. These ores could, however, provide an excellent feed to the Krupp-Renn process resulting in a highly desirable metallic iron product. We are also enclosing a copy of a recent paper by Mr. Max Kennard, vice president of Southwestern Engineering Co., in which he briefly describes the process and an artist's sketch of a Krupp-Renn plant located at the lakehead near Duluth, Minn., which shows certain details as to the general plant arrangement. If you feel that the necessary assistance might be arranged for the fulfillment of this project, we would be very happy to meet with you to discuss this further. We had felt that it might be well to notify certain other congressmen and individuals at the State level of our proposed project due to the effect that such a facility would have on the economies of the depressed areas of Minnesota, Michigan, Wisconsin, and North Dakota. We will however, await your views on this matter before discussing this further.

Your very truly,

ZONTELLI, BROS.,
By JOHN J. SIMMONS.

Senator CARROLL. We have with us Congressman Bennett of Michigan. We will be happy to hear from you, Congressman.

STATEMENT OF HON. JOHN B. BENNETT, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN

Representative BENNETT. Thank you very much, Mr. Chairman. I am only going to take a few moments of your time. I would like permission to file a statement, however.

Senator CARROLL. Yes, sir.

Representative BENNETT. I represent the second largest iron ore producing area in the United States. That is the western half of the northern peninsula of Michigan. The iron ore producing industry in our area—I will only speak for our area—has been in the doldrums, serious doldrums, for the past 5 or 6 years. There are many differences of opinion as to the reason for this situation.

We are consuming as much steel as we ever consumed as a nation and the need for iron ore is just as great now, and, in fact, greater than it has ever been in the past, but in the last 5 or 6 years, we have been confronted with vastly increased quantities of iron ore from both Canada and Venezuela.

These ores for the most part are higher in iron content than the ores in Michigan or Minnesota, although we still have vast reserves of high grade iron ore, that is, high grade in the sense that we use it in this country, but not equal in iron content, of course, to ores from Canada or Venezuela.

Some of the big domestic steel companies own these reserves in Canada and South America and it is more profitable for them, and certainly they have a right to exploit those foreign reserves.

Senator CARROLL. Where are their reserves in Canada?

Representative BENNETT. In Labrador mainly. Many of us think that the answer to this problem is to place a quota on the importation of foreign ore on a reasonable annual tonnage basis, on a basis that will permit the domestic mines to operate. For example, in 1952 we imported approximately 9 million tons of ores from Canada, and Venezuela, and other foreign countries.

In 1959 this figure had grown to 37 million tons, or four times the amount in 1952. If you take a graph you can see that the domestic production of iron ore in this country decreased almost in direct ratio to the increase in the imports from Canada and other places.

Senator CARROLL. What is the domestic production in this country? Are you familiar with that?

Representative BENNETT. Just roughly. I may have it here. I am sorry. I do not have that readily available. It is something over 100 million tons.

Senator CARROLL. I was thinking in terms of in 1952. What was our domestic production, and what was our domestic consumption?

Representative BENNETT. Our production has decreased. Our production decrease is in the same ratio to the increase in imports. We have suffered as a result and I do not think anybody can dispute that fact.

The foreign iron ore is higher grade; it is cheaper to produce, and naturally, they want to bring it here in preference to operating our deep mines, which have good ore, and can be operated on a profitable basis, although not quite as profitable as the foreign mines, so for selfish reasons, the steel company is operating the mine that is most profitable to it.

My suggestion for the consideration of this committee, is this: that some reasonable quota be put on the annual importation of this commodity, and have it under the control of the Secretary of Commerce, so that in a given year, if the demand here is strong and the domestic capacity is not adequate, the amount that could be imported could be increased on a sliding scale basis.

I do not propose that we shut off entirely the importation of ore. All I am suggesting is that we do it on a reasonable basis. These companies, if you leave it to them, are not going to do it on a reasonable basis, because that is not the way they operate. I am not saying that in any derogatory sense to them, because they are in business to operate for a profit, but they do have these mines in Michigan and in Minnesota where we have zillions of tons of reserves that can be exploited.

I think as a matter of fairness and common decency that the steel companies ought to be forced to operate their domestic mines as long as the operation of those mines is profitable. Not necessarily as profitable as mining ore in Canada, but I mean if they can operate them at a profit they ought not abandon their domestic properties.

I think we have the same situation as in other mining areas. Towns and small cities grew up around these mines, and for the last 75 or 85 years, the people have been living there and depending in large measure, upon the exploitation of this natural resource. I do not think it is unreasonable to have a program that will permit a reasonable flow of this commodity from overseas, but not on such a basis as it is at the present time where it has practically ruined the domestic iron mining industry in Michigan, and I think probably in Minnesota; so I hope, Mr. Chairman, that you and your committee in studies of this matter, will look carefully into what I think is the basic cause for the decline in domestic iron mining.

It is not the only cause, but it is a basic cause, and the most basic cause for the slopping off and the depressed condition of the domestic iron mining industry.

Senator DWORSHAK. Congressman Bennett, I have known you for a number of years and I know you are not an unreasonable man. You would not expect preferential treatment like that for the iron ore industry.

The copper industry, the lead-zinc industry, and every industry in the United States is subjected to the same difficult competition of low-cost production in other areas.

Why are you hopeful that they will do anything about this? We have had some quotas set up. I agree with you. You know that. I have been crusading for years to get recognition. Yesterday, I sat all day in the subcommittee on appropriations handling the State Department budget, and we will have a big printed hearing.

We do not need hearings like this to get information. It is all available. It has been available year after year, showing that the professionals in the State Department under every administration, Democratic and Republican, have deliberately sought to give preferential treatment to countries abroad because that generates friendly relations. It is part of our foreign diplomatic program, and as a result, we are destroying industry; we are causing widespread unemployment, and we are going down the road to complete financial and economic destruction unless the American people wake up before it is too late.

You agree with me, do you not?

Representative BENNETT. I was discussing iron ore because that is subject before you today. I agree with you 100 percent. I say this: That the reason that our trade policy is unrealistic is because it is not based upon economics; it is based upon foreign policy, and when economics conflict with foreign policy, foreign policy prevails and the domestic industry affected can suffer at the expense of our being on allegedly friendly relations with our so-called allies.

Senator DWORSHAK. Is your section of Michigan in the so-called distressed area?

Representative BENNETT. It certainly is.

Senator DWORSHAK. But you do recognize it is only one segment?

Representative BENNETT. That is right.

Senator DWORSHAK. And the entire raw product industry, you might say, in the United States?

Representative BENNETT. That is right. Michigan has the only copper mines in the Midwest.

Senator DWORSHAK. And they are not operating like they were decades ago?

Representative BENNETT. They are not.

Senator DWORSHAK. They are high-cost mines compared with production in South America?

Representative BENNETT. That is right, and there is a similar problem. I am speaking only about iron ore because that is the subject of your inquiry today, but, of course, other minerals are affected.

Senator DWORSHAK. What you say is pertinent.

Representative BENNETT. I certainly think the committee should give careful study and consideration to this problem.

Senator DWORSHAK. And then what shall we do after we have done that?

Representative BENNETT. I think we should put a quota on iron ores and probably some of the other minerals as well.

Senator DWORSHAK. This committee?

Representative BENNETT. No.

Senator DWORSHAK. Senator Carroll and I will do that?

Representative BENNETT. I think probably you would, if you could.

Senator DWORSHAK. I know my friend from Colorado is very persuasive and influential in this new administration, but I question whether you are reasonable when you expect him to achieve those results.

Representative BENNETT. This is just one man's curbstone opinion, but I think if this reciprocal trade legislation was up for consideration this year that a different result would come about.

Senator DWORSHAK. It is up next year, is it not?

Representative BENNETT. Yes.

Senator DWORSHAK. That is an election year.

Representative BENNETT. There are more and more areas of this country—you brought this up so I will say it—being adversely affected by our shortsighted trade policy, and the more areas that are affected, the more votes there are going to be in Congress against this stupid reciprocal trade policy of ours.

Mr. Chairman, thank you very much.

Senator CARROLL. May I make an observation here?

I am always intrigued when I hear my able friend from Idaho give forth on this subject. It is very impressive. But if I understand your testimony, this is not a question of foreign aid. This is a question of an American corporation that has gone into another country and purchased some reserves, and that American corporation, having nothing to do with the State Department, as I understand it, has used its money and its capital to purchase reserves both in Canada and, I assume, in Venezuela.

Representative BENNETT. Right.

Senator CARROLL. As I look here at the report—and I have in my hand a publication of the American Iron Ore Association—I find out in 1951, in the case of Canada, Newfoundland, Labrador, now referring to gross tons, it was 1,961,990 gross tons in that year. This bears out exactly what Congressman Bennett has been saying about iron ore imports to the United States, by the country of origin.

Now, we swing on up and it is beginning to move up. It indicates that in 1952 it was approximately 1.8 million.

In 1953 it held about the same. In 1954 it jumped to 3.5 million; 1955, 10 million; 1956, 13.7 million; dropped again in 1957 to 12.5 million; dropped in 1958 to 8 million; but in 1959 up to 13.4 million.

I will place this in the record at this point.

(The table is as follows:)

Iron ore imports to United States by country of origin, 1951-60

[Gross tons]

Country	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Algeria.....	446,273	66,008	21,150	29,100	20,255	10,600				
Angola.....				595,907	1,010,570	1,223,047	1,430,880	831,788	16,500	
Brazil.....	1,037,828	1,010,919	458,282	250,820	137,699	161,698	48,789	48,789	1,199,532	1,401,004
British West Africa.....	255,817	217,760	231,600	3,537,489	10,077,238	13,722,656	12,536,809	8,293,436	13,453,191	45,779
Canada, Newfoundland-Labrador.....	1,961,940	1,822,038	1,840,983	1,664,300	1,035,399	1,553,783	2,740,709	3,256,613	3,577,380	10,607,222
Chile.....	2,767,207	1,861,575	2,363,401							3,951,148
Costa Rica.....		449	3,076	32,165	42,697	93,041	33,166		4,172	2,820
Cuba.....	4,223	87,536	196,676	89,160	101,394	169	149,295	245	800	862
Denmark.....		18,408	80,401			162,612		21,000	50,370	
Dominican Republic.....										
French West Africa.....										5,672
Germany, West.....							29			
Iran.....	1,500	2,972	2,953	2,953		3,937		2,461	2,756	1,968
Italy.....									2,416	
Liberia.....	110,123	572,485	710,200	763,610	927,988	1,217,960	1,012,626	837,531	1,090,255	907,201



Senator CARROLL. I am saying this for the record out of fairness because I think it is a mistake to confuse, when we talk about our foreign-aid program, that program with something, that I think has nothing whatever to do with the foreign-aid operation.

Senator DWORSHAK. If the chairman will yield at that point, I guess I did not make myself clear. I did not want to take too much time. The only reason I brought in the State Department is that instead of having quotas, instead of having tariffs, duties of some kind, to offset the higher cost of production in this country, since 1934 when the trade agreements program was initiated down through the 27 years since that time, there has been no tendency on the part of the State Department to recognize the need of some protection for our domestic industries. That is the point I want to emphasize.

Congress delegated its authority to the State Department to control tariffs and so Congress is more or less impotent to cope with this situation. That is what I meant.

Senator CARROLL. Yes. I appreciate it and I know that Congressman Bennett will agree with me, as Senator Dworshak has said, in lead and zinc.

Representative BENNETT. It is true, Mr. Chairman, if you let me comment on that.

Senator CARROLL. Yes, I would be happy to.

Representative BENNETT. As you said, these reserves are owned by our domestic steel companies and to that extent the problem is different than if the same reserves were owned by a foreign government, or by foreign people, but the effect upon the economy of this country is the same and in order to deal with the problem, you have to deal with the same. In other words, as long as they control it, the same factors have to come into play. You have to put a quota on them, or a tariff, or something that will either equalize the cost of production, or will prevent the wholesale shipment of the commodity in here.

Senator CARROLL. In other words, no matter what are the motivating factors, if you take a look at the effect upon your own State and upon your Great Lakes area it is not good. I just wanted to emphasize that and I did not want to get this mixed up with foreign aid.

Representative BENNETT. No, I had not mentioned that either, but our good friend Henry did.

Senator CARROLL. Henry waxes very enthusiastic on this subject.

Senator DWORSHAK. I was not referring to our foreign aid so much as I was our diplomatic policy. I did not intend to inject foreign aid into this.

Senator CARROLL. I think Congressman Bennett made a good point. This is not by a foreign corporation in the sense that they are flooding us, as they have often done with lead and zinc, but some of our own American corporations own these areas, too. We have to get relief whether it be by tariffs or by quotas. No one seems to know what to do.

May I say the previous administration did not know what to do and I suspect this obtains today, too. But we will find out as we get through with this hearing.

Representative BENNETT. In the case of the iron ore, you would not find the industry going to the Tariff Commission. I do not want to speak for the Steel Workers Union today, because they can speak for themselves, but their policy heretofore has been opposed to any quota on iron ore.

They know it has adverse effects, but they look at the overall picture. They have more people in the big steel industry than they have in the iron mines and consequently, their position has been one of opposition.

I hope they are going to change it. The steel companies themselves will not go to the Tariff Commission and ask for relief because it would be relief in reverse for them, so you are up against a proposition here where you cannot even get before the Tariff Commission, because the people involved, for other reasons and for other motives, are not concerned with the effect that it is having on the industry in this country.

Senator CARROLL. In other words, the steel industry is not suffering; it is benefiting from this.

Representative BENNETT. That is right.

Senator CARROLL. Here is a segment of that major industry that is suffering in an area which is a great producer.

Representative BENNETT. That is right.

Senator CARROLL. I think you have made a very fine presentation. We thank you for coming here this morning.

Representative BENNETT. Thank you very much.

Senator CARROLL. Congressman Thomson, we are happy to have you this morning. You may proceed.

STATEMENT OF HON. VERNON W. THOMSON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF WISCONSIN

Representative THOMSON. Mr. Chairman, I appreciate the opportunity of appearing. I know that you have many witnesses that have come a great distance, and I expected to file and do file with you a joint statement by Senator Wiley, Congressman Bennett of Michigan, Congressman O'Konski of Wisconsin, and Congressman Thomson of Wisconsin.

Senator DWORSHAK. What district are you from?

Representative THOMSON. I am from the Third District, and I want to say to the chairman that the constituents of mine in that district who are producers of lead and zinc would be very heartened at the comments that you have made in that area today, and I want to say that I, from the other body, will join you in making a determined effort to correct it. As a matter of fact, we have dispatched a telegram to the President requesting a personal audience with him in an effort to move these bills that are now pending in the same committee in the other body in the field of lead and zinc.

Senator CARROLL. We are happy to have your support. Senator Dworshak can tell you that we have, at least in Colorado, most of our lead and zinc mines closed down. There are different reasons.

However, basically, this is a problem we have to face somewhere along the line, and nobody knows how to get hold of it. We think we know, but no one pays attention. Senator Dworshak knows, and sometimes he convinces me on this subject, most of the time. By this hearing, we hope to learn the facts.

I have been up in what I guess you call the iron ore country, the iron range, in Minnesota and I know how important this is to that area. I do not know that I have been in your particular district. Where are you from?

Representative THOMSON. I am from the southwest corner of Wisconsin, adjoining Illinois and the Mississippi River on the west, but I have for some time been concerned about the Superior iron ore ranges which have been the Nation's primary source of ore and steelmaking for more than a century.

Senator CARROLL. They are all in the distressed area, too, are they not?

Representative THOMSON. That area. I want to say it is America in steel and steel in Americans that forge the mightiest force for freedom on this planet.

I had been chairman of the Iron Ore Resources Committee, appointed by former Governor Kohler in 1954, and I submit here this joint statement with a letter from Senator Wiley for the consideration of this committee.

Senator CARROLL. Without objection, it will be placed in the record at this point.

(The joint statement and letter referred to follow:)

U.S. SENATE,
Washington, D.C., June 21, 1961.

HON. VERNON W. THOMSON,
House Office Building, Washington, D.C.

DEAR VERN: I consider it a real privilege to join in the fine statement to be presented to the Subcommittee on Mineral, Materials, and Fuels.

I am hopeful, along with yourself, that because of this and ensuing efforts we can get something done to help stimulate the taconite industry in northern Wisconsin.

With best regards, I remain,
Sincerely,

ALEXANDER WILEY.

JOINT STATEMENT OF SENATOR WILEY, CONGRESSMEN BENNETT OF MICHIGAN,
O'KONSKI AND THOMSON, OF WISCONSIN

Members of Congress from States bordering on Lake Superior welcome this hearing by your honorable committee of the problems of our iron ore industry. Many of us—whether in Congress, State or local government, or in private life—are looking for answers to these problems. We work separately, and together, to solve them. Coming as we do from the States where the ore is produced, we surely are learning at first hand of the imperative need for national concern about them.

A century or longer Lake Superior ranges have been our Nation's primary source of ore in steelmaking. It is America in steel—and the steel in Americans—that forge the mightiest force for freedom on this planet. Let us keep it that way. Most of us know, too, that the Superior iron ranges comprise the only developed major source of ore in the United States. We also realize that any threat to their unimpeded development can impair our national security. Yet, this contradiction persists: while use of ore in steel manufacture mounts steadily, the share of Superior ore in our production steadily declines.

Why should this be so? Is it because Lake Superior ores are decreasing in quality, although increasing in known reserves? Can it be said truthfully that demands of either labor or capital—or of both—are unrealistic in the mining operation? Or that tax rates, local and State, are excessive? Or that freight rates are exorbitant? Investors are timid? Foreign ores are too cheap? Or can it be said that technology in treating low-grade ores is lagging?

Mr. Chairman, these queries lash at every desk and job in every home and plant in every community on Lake Superior. Congress is not the first, nor alone, in contending with them. And the time is past when we can afford to run away from them. In the 2 hours available here, much can and should be told about recent and impending advances in technology. But what about other basic problems of this industry? The Members presenting this statement have participated in "on the site" hearings of our ore problems. Senator Wiley and

Representatives Bennett, O'Konski, and Thomson (Mr. Thomson was then attorney general of Wisconsin) joined with mining officials at such a hearing at Ashland, Wis., in October 1956. Also, they took the lead in enlisting the aid of officials of the Government of Canada to obtain Alberta natural gas, because the fuel is a valuable help in ore processing.

At Ashland, too, as they do here, researchers and technologists spoke to us. Mining firms, public utility and pipeline companies, municipal and county governments were represented. Members of a Michigan Senate committee reported on efforts to obtain natural gas for the Upper Peninsula. Wisconsin's public service commission chairman, Mr. George P. Steinmetz, and Prof. Edwin Shorey, ore research director, University of Wisconsin, assisted us. The Special Committee for Development of Iron Ore Resources in Northern Wisconsin, appointed by Governor Kohler, with Attorney General Thomson as chairman, called the meeting. In every way it was worthwhile, as this meeting is worthwhile.

We learned that Minnesota is far ahead in processing low-grade ores because of pioneering in research. But we are compelled to ask why its preeminence is widening so swiftly today over Michigan and Wisconsin, where research is also flourishing. Minnesota is in a giant stride this year.

We learned that the upper peninsula in 1956 was about to embark on a strong program of ore upgrading, subject to availability of natural gas. We are now compelled to ask why the Michigan program has been curtailed, relatively speaking, despite advances in technology. Is it because a blockade has been imposed against the entrance of competitive natural gas supplies?

About Wisconsin, we learned that while primary ores of rich content are nearing exhaustion on the Gogebic range, its low-grade deposits are more extensive even than Michigan's, and can be marketed profitably if—and this still remains the big if these 5 years later—low-cost natural gas can be obtained. The mining firms, supported by their research experts, listed the natural gas requirement as a basic need. They told us that economic supplies of natural gas for treating low-grade ores would enable the Superior ranges to compete vigorously with foreign ores at American mills.

Consider these contentions of the industry, as reflected by natural gas events on the ranges since 1956. The fight of Wisconsin and Michigan to procure Canadian natural gas for our mining areas has failed. We wanted and worked for a supply low in price—as promised; and for a supply independent in control and genuinely competitive—as promised. The supply has come. It is in Wisconsin. It is even at Menominee, Mich. But it is not low in price, because it is not independent. The Canadian gas has not been piped to the Wisconsin and Michigan iron ranges because it is so high in price that our low-grade mining processors cannot use it. Insofar as benefits to them are concerned, the gas might just as well have remained underground in distant Alberta, because it has been monopolized and hiked in price, a usual consequence.

Nevertheless, a tangential value has developed. In the brief period when Canadian gas posed as a competing supply, its posture did rouse one American pipeline company from its torpor. The company moved ahead with pipeline service it had long proposed to Duluth and Superior, so that natural gas from the Southwest is now in use there. A major taconite processor negotiated successfully for a supply and a pipeline is to be constructed before next winter to the "taconite towns" of Silver Bay and Two Harbors, Minn.

Owners of the Canadian supply had talked about it with enthusiasm at our Ashland meeting. Three months later they told us that their rivals were demanding that they surrender majority control, and these demands formed the basis of a complaint by the State of Wisconsin to the Attorney General of the United States. A grand jury at Milwaukee, after examining the scheme, indicted three major pipeline firms and their chief executives. Charged with criminal violations of the Federal antitrust laws, they are awaiting trial at Chicago. It is true, however, that the projected piping of Canadian gas by its owner directly across Wisconsin to Chicago, and across Wisconsin to the ore-processing plants of the Michigan upper peninsula, has been abandoned. Instead, two of the rivals who opposed the competitive pipeline—and are under indictment—absorb most of the Canadian gas.

Mr. Chairman, thousands of new jobs in Minnesota are expected to result from the planned increase in taconite production, and the availability of American-produced, low-priced natural gas is an important cause for the increased production. There is a need for new jobs also in northern Wisconsin and the Michigan upper peninsula, and an increase in the processing of low-grade iron ores there can help to provide them. Hence, the availability of a low-priced natural gas

supply is correspondingly required. The mining people and their experts tell us so.

We ask that the Congress and the Government assist our mining firms in obtaining American-produced gas from the pipeline that will provide supplies for taconite processing at Silver Bay and Two Harbors, which is a known, contracted price very substantially below the price proposed for delivery of Canadian gas in the upper peninsula. Originally, when the Canadian supply was offered for ore processing in the upper peninsula as an independent and competitive service, the price for it which was proposed to ore processors was very close to the price which will be paid at Silver Bay and Two Harbors. Since the Canadian supply became monopolized, it is no longer economically available and a pipeline to the upper peninsula mining centers has not even been built. We further ask the Congress and the Government to take note of and examine into the circumstances of this situation.

If American-produced gas becomes available in northern Wisconsin and the Michigan upper peninsula, new jobs for our citizens will be created in ore processing, a new triumph for research and technology can be observed, and an American bastion of defense will be fortified.

A means must be found for attracting independent and competitive supplies of low-cost natural gas to our low-grade ore reserves, even at a risk of slight return during an initial period of pipeline sales. Our colleague, Mr. Bennett of Ontonagon, Mich., urged this course directly to pipeline operators at the Ashland meeting. Our colleague, Mr. O'Konski of Mercer, Wis.—and, Mr. Chairman, Ontonagon and Mercer are in the mining areas—has proposed that a natural gas pipeline be constructed from Duluth and Superior across northern Wisconsin and eastward to Marquette, Mich., in order to supply the fuel for ore treatment—and also to a large copper plant at White Pine, Mich. To this program, also, the attention and support of Congress are invited.

May we extend to you, Mr. Chairman, and to the Subcommittee on Minerals, Materials and Fuels, the grateful appreciation of our fellow citizens in the wonderful Lake Superior country. Your consideration of the iron ore problems of this region can bring new hope and fresh zeal to an economically distressed region.

Senator CARROLL. We are happy to have you. Thank you very much for coming over, Congressman Thomson.

Representative THOMSON. Thank you, Mr. Chairman.

Senator CARROLL. Are there any other Members of Congress here that want to make a presentation?

I think at this point, without objection, I will leave the record open for any Senator or Congressman from this area affected who desires to submit a statement at this point.

(The following statements were subsequently submitted:)

STATEMENT OF HON. HUBERT H. HUMPHREY, A U.S. SENATOR FROM THE STATE OF MINNESOTA

I would like to address myself to a subject of extreme national importance—the full development of the iron ore potential of the Lake Superior region.

In doing so, I speak with a note of urgency about our national steel-production picture. I am sure we are all aware that the production of steel is a basic factor in the industrial preeminence of any nation. One statistic highlights this fact: total production of steel is 20 times as great as the combined production of copper, lead, zinc, and aluminum.

If the United States is to maintain its industrial posture domestically and internationally, it must in turn maintain a healthy expanding steel industry. Implicit in this is the idea that it must also assure itself of adequate supplies of iron ore in the best condition for steel furnaces. During the past decade over 84 percent of the domestic supply of iron ore which fed the American steel furnaces came from the Lake Superior region. Of the remaining domestic iron ore reserves both measured and potential, 78 percent lies within the Lake Superior region. Therefore, the importance of the Lake Superior district to the national security and national economy is obvious.

There is a substantial body of evidence that the Soviet Union also recognizes the importance of steel production to its own economy and to its plans for

dominance of the world economy. It likewise has recognized that it must provide its steel furnaces with a supply of topgrade iron ore, and the evidence is strong that the Soviet Union has provided for a program of intensive research with the intent of rapidly expanding its iron ore production facilities.

In short, iron ore production has become an area of keen competition with the Soviet Union. It behooves us therefore, to inquire seriously into the situation of the Lake Superior iron ore region and to determine, from a standpoint of our national security and national economy, and our standing among the industrial nations of the world, whether proper steps are being taken by the American iron ore industry to develop the ore potential of the Lake Superior iron ore district.

Some days ago Senator McCarthy and other Senators from the Lake Superior region joined with me in requesting this Subcommittee on Minerals, Materials and Fuels of the Committee on Interior and Insular Affairs to specifically inquire into the facts and conditions affecting the Lake Superior iron ore industry. This request was prompted by the fact that there is widespread unemployment in the Lake Superior iron ore region. Unemployment in this region has been averaging 12 percent of its labor force. The President's Council of Economic Advisers tells us that we have reached a danger point when national unemployment figures rise to 6 percent. Certainly a 12 percent unemployment rate over such a widespread area indicates that the Senate of the United States should become seriously concerned about the underlying reasons for such unemployment, affecting as it does both the lives of the iron ore workers in the mining areas and very national security. After briefly reading the testimony and statements before this subcommittee, I must say that I am appalled at the lack of information and the apparent lack of knowledge on a subject which is so important in the life of our Nation and to the lives of the iron-ore workers in the Lake Superior area. If the Congress of the United States is to chart the proper course for this Nation and maintain the prestige of a free economic system, it is imperative that we secure information through appropriate and intensive research studies in several areas vital to a proper understanding of domestic and foreign iron ore production.

The first area of inquiry and research should be into the extent of reserve areas and the ownership of these reserve areas. From the testimony before the committee it does not appear that there is available in any single place complete and accurate information as to the location and ownership of the various types of ore bodies in the Lake Superior area. People from my own State of Minnesota for many years have felt concern about our inability to secure such data.

Many people in my constituency allege that the ownership of a very substantial amount, perhaps a dominant amount, of the iron ore reserves is under the control of a single steel corporation. They further allege that this single corporation is expanding iron mining considerably in foreign countries, but has not developed its production facilities in the Lake Superior region in the same proportion and relationship that other smaller steel corporations have in recent years. If one of the largest steel producers in this country is developing foreign deposits, while neglecting to make similar investments in the Lake Superior district, there may be a substantial imbalance in the strategic posture of the United States. Such foreign sources are, of course, particularly vulnerable to adverse political and military actions.

I am also advised that there are steel and ore companies which would consider expanding in the Lake Superior area if reserves were available to them. Therefore, it becomes imperative that the Congress seek to determine whether, in the ownership of iron ore reserves, there are monopolistic procedures now preventing the proper and timely development of the Lake Superior, and particularly Mesabi Iron Range, ore deposits.

Secondly, from the testimony before the subcommittee it has become obvious that the Federal Government must provide more aggressive leadership in securing detailed geological surveys of the Lake Superior iron ore region. With iron ore so basic to our economy, it is quite shocking to learn that we have such a limited knowledge of the geological details of the Lake Superior district. In contrast, adjacent to the Lake Superior district, Ontario, Canada, has developed detailed geological surveys and provides valuable detailed geological maps to encourage further investigation and ore development by industry. A more detailed study into the extent of the geological makeup of the Lake Superior iron ore area to determine the exact extent of the formation, the quality and quantity of ore reserves is imperative if we are to have sufficient facts to make proper decisions.

Thirdly, more intensive research into the methods of commercially beneficiating low-grade nonmagnetic ore should be supported by the Federal Government. Nonmagnetic ores exist in nature at about the ratio of 10 to 1, over magnetic ores. Although the technological breakthrough has been made in the area of magnetic low-grade ores, more encouragement is needed to provide a substantial commercial development of the nonmagnetic low-grade ores. Such a development would assure the United States a supply of iron ore for hundreds of years into the future. Testimony before the subcommittee indicates that the Mines Experiment Station at the University of Minnesota is in need of \$75,000 to establish a pilot plant to test the commercial feasibility of a system which it has devised for this purpose.

Fourth, an investigation into the impact of railroad transportation rates upon the competitive deposits from the Lake Superior region should be undertaken. It has been reported to me that railroad transportation rates in certain areas tend to give an advantage to imported iron ore.

Perhaps one of the most important phases of research and inquiry should be into the further expansion of taconite production facilities in the Lake Superior iron ore region. I believe that expansion of taconite facilities is vital to our national security and to a resolution of the serious unemployment problem in the Lake Superior iron ore region. Several American steel companies have already proceeded by cooperative efforts to establish two large taconite production facilities in Minnesota with a total investment of approximately \$600 million. However, the largest steel producer in the country, through its subsidiary, the Oliver Iron Mining Division, has failed to make a proportional expansion and investment in taconite production facilities even though it is reported to own over 50 percent of the remaining natural ore reserves in the Mesabi Iron Range area, and probably holds an equal or even greater proportion of taconite reserves. This corporation has failed to develop proportionately its taconite production facilities, and yet by its substantial ownership precludes other companies from being able to develop such iron ore reserves. The failure of the largest steel producer in the country to develop these reserves is particularly incomprehensible when one considers the fact that the Minnesota taconite pellet is competitive with both domestic and foreign direct shipping ores.

The development of taconite beneficiation facilities in the Lake Superior iron ore region is so strategically important to the United States that a special mention is in order at this time as to the history, development, and competitive position of the taconite industry.

Taconite is the original iron-bearing formation from which the high grade shipping ores were derived. The basic taconite formation is a fine grained ore containing from 25 percent to 30 percent iron. It is the magnetic taconite which has presently been commercially derived in Minnesota. This taconite process is designed to improve the chemical and physical structure of the taconite ore by first grinding the ore to a fine mesh, separating it by magnets, and putting it back together in the form of a taconite pellet. The vast size of the Minnesota taconite furnaces and the procedures involved in producing the taconite pellet might imply that the cost of this procedure would be in excess of the profit available from direct shipping ores from the United States or foreign countries. On the contrary, there is evidence that the taconite process is actually a more economical method to produce pig iron than by the utilization of direct shipping ores, because of tremendous savings in the cost of using blast furnaces when a taconite pellet is used. This is not new to the 20th century. Over 60 years ago Thomas Edison developed a similar system for grinding a hard, lean, low-grade ore, separating it magnetically and reconstructing it in the form of a briquette. Edison's reasons for developing this system are clearly stated as recorded in the Iron Age magazine in 1897:

"Mr. Edison has started from the general proposition that a finished product of iron ore of the best quality and in the most suitable form for the first man can be obtained at the lowest cost by treating on an adequate scale a large body of low grade ore. He also states that it is cheaper to process low grade ore and combine it than to attempt to mine over adverse circumstances a limited high grade ore."

Dr. E. W. Davis, one of the pioneers in the development of the Minnesota taconite industry similarly predicted the outcome of the taconite system in a brochure on magnetic competition of iron ore published in 1921:

"* * * it is certain that the cost of facilities or heat units is going to increase gradually if the supply of coal is exhausted. The direct results of an increase in fuel costs will be a demand for iron ore requiring less fuel in the

production of steel. Undoubtedly the physical structure and chemical composition of the manufactured ores can be made such that the fuel consumed in smelting them will be less than the fuel consumed in smelting natural ores. The furnace operators will also be assured of a perfectly uniform cost. Supply will not vary in physical structure or chemical composition. It would therefore seem that, in the future, manufactured ores would be in greater and greater demand and would be recognized as a superior product more valuable than the direct smelting ores."

The truth of these predictions is evident in the Minnesota taconite industry, since the large taconite reserves of the Mesabi Range and Lake Superior district have produced the "adequate scale" large mass-production type facilities referred to by their experience in 1897.

This permits the application of mass-production techniques to provide low unit costs in the amortization of large plant facilities over a 50-year or longer duration.

Substantial savings in costs of expensive metallurgical coke, limestone, and manpower required in the blast furnaces, result in tremendous overall savings. This saving in the blast furnaces is said to result in a substantial net gain in the cost of producing the taconite pellet, so much so that industrial spokesmen have indicated the taconite pellet is superior to and competitive with any foreign and domestic shipping. More specifically, in terms of the process of going from an iron unit in the ground to a unit of pig ingot out East, the total process appears to be much more economical than the use of direct high-grade ores.

The use of the taconite pellet is said to provide an additional advantage to the blast furnace owner. Spokesmen for the taconite industry, metallurgists representing the steel furnace users, and people in the field of iron ore research indicate use of taconite pellet permits an increase in the efficiency of the blast furnace from 50 percent to 100 percent. Production in a typical blast furnace has been increased from 1,400 tons per day to 3,400 tons per day using taconite pellets. The cost of such a blast furnace may run as high as \$100 million. It can be readily seen that if capacity is developed by the use of the taconite pellet the furnaceman can save himself \$100 million which would normally be necessary to provide an additional furnace.

It is the judgment of some individuals that this creates a third and additional advantage, because it frees a substantial amount of capital which the furnaceman normally had to reinvest for increasing the production capacity of his blast furnace. This capital amount having been freed is available for investment to secure his own captive ore supply; thus freeing him from the open iron ore market which is subject to varying prices and supply.

In effect, the taconite pellet is said to pay for itself both in terms of the plant cost and the cost of operation.

If any proof of these contentions is needed, one should note that in addition to the \$600 million originally invested in Minnesota taconite facilities, the Reserve Mining Co. has announced an additional \$120 million expansion to increase its production of taconite pellets to an amount in excess of 9 million tons per year.

I wish to emphasize to my colleagues that much of the data which I have used today has been pieced together from scattered information from technical and nontechnical sources. From the testimony before the subcommittee it is already demonstrated that there is no complete and accurate compilation of data relating to the costs and the value of the taconite pellet, nor to the cost of producing a ton of pig iron. Again I emphasize that information of this type is vitally important if the Congress is to make the decisions necessary for this country to maintain a healthy and free economy, and to resolve with firmness and dispatch the serious unemployment problems of the Lake Superior iron ore district.

Another fact of great significance is revealed in studies made by the State of Minnesota, under former Gov. Orville Freeman. These studies indicate that the State taxes are quite comparable to the Province taxes in Canada, and that if there is any disparity in the tax picture it comes in the U.S. Federal taxes and the Canadian Dominion taxes. Secondly, in the case of Venezuela, the next largest competitor to the Lake Superior district, recent reports indicate that the Venezuelan Government continues to get an increasingly large share of the income from Venezuelan iron ore production. Engineering and Mining Journal of April 1961, indicates that the tax in Venezuela is now 63 percent of the net

profits in mining. In addition to this a recent Time magazine article indicates that the Venezuelan Government has a \$340 million investment of its own in steel production facilities where they intend to utilize a new direct reduction process. It is not likely that the Venezuelan Government is going to permit any substantial degree of competition after these facilities are put into operation.

In the course of the subcommittee hearing on the problems of the Lake Superior iron ore district, I believe Senator Carroll asked the direct question whether any ore or steel company was holding back in the development of taconite beneficiation facilities. I do not believe the question received a satisfactory answer. Evidence does indicate that the Oliver Iron Mining Division has undertaken substantial preliminary work including a taconite pilot plant producing 750,000 tons annually; but its president states that it will not build a full-scale taconite plant until the Minnesota Legislature and the voters of Minnesota approve the constitutional amendment which they have been seeking.

Any restraint of progress in the American iron ore industry should concern this body. For example, testimony before our Senate subcommittee indicates that the American iron ore industry is spending less than 3 percent of its sales value on research. Other industries spend as much as 10 percent to maintain their competitive position. Both industry and Government should intensify research efforts to keep ahead of the Soviet threat by finding new and more efficient ways of producing iron ore and steel. Direct reduction of steel from iron ore is of significance for the Lake Superior district and for all areas of the United States. Direct reduction is a system by which low-grade and other ores may be made directly into steel in a continuous process without the expensive investment in additional blast furnace facilities. This system would permit many smaller concerns to erect their own steel production facilities.

The following excerpt from Time magazine of April 7, 1961, indicates that commercial direct reduction is already in practice:

"INDUSTRY

"NEW ERA FOR STEEL?"

"To old steel hands used to the authoritative roar of a huge blast furnace, the new plant that began operating this week at Niagara Falls, Ontario, neither looked nor sounded like an iron smelter. The plant, owned by New York's Strategic Materials Corp., is the first commercial operation of a new smelting process that could open a new era for the steel industry. It could also lead to the quick building of a steel industry in underdeveloped countries. The smelter is designed to take low-grade ores, contaminated ores, and ores so fine that they would choke a blast furnace, and produce iron so pure that it can be turned into steel in half the usual time.

"When all the bugs are worked out, the smelting furnace will be the Nation's biggest producer of ferrochrome, an ingredient vital to stainless steel. It will be smelting low-grade chrome ore from Africa. The output will go to Universal-Cyclops Steel Corp.

"Other plants in the works that will use the new process:

"Texas' Lone Star Steel Co. has made a deal to use the process to smelt low-grade Texas ores, the first big steelmaker to sign up.

"Sovereign Resources, Inc. plans to build a steel plant in Anderson County, Tex., to use low-grade east basin ores and local lignite instead of the expensive metallurgical coking coal that a blast furnace needs.

"St. Lawrence Steel Co. will begin building this year in Quebec a 100,000-ton-a-year mill to make steel out of low-grade Canadian ore.

"North American Coal Corp. is building a million dollar plant at Powhatan Point, Ohio, to use another strategic materials process to recover 40,000 tons of aluminum sulphate (alum) a year from coal wastes.

"*Practical dream.*—The biggest test of the new process will come in Venezuela, where a Stratmat furnace is being installed in the Government's new \$340 million steel plant. After building the plant, the Venezuelans found that they would have to import expensive coke to run it. But with Stratmat's process, they expect to run on local poor-grade coal. If it works as expected, the Government is considering converting the whole plant to the process.

"Another plan that should be under way soon is a blue-sky dream of William Zeckendorf's Webb & Knapp Inc.—made practical by cheap power from Bonne-

ville Dam and Stratmat's smelting process—to retrieve iron, copper, and zinc from waste copper slag cast off by copper companies. A Webb & Knapp subsidiary, in which Stratmat is to have a minority interest, plans to build a mill in Montana and buy slag from Anaconda Co. at 25 cents a ton. The slag heap contains iron, copper, and zinc ores worth an estimated \$1.4 billion. Zeckendorf even hopes to sell his leftover steel slag to go into the concrete of the Government's proposed Libby Dam in Montana.

"Two-step process."—Stratmat's process is the idea of the late Metallurgist Marvin J. Udy. A Montreal millionaire, John C. Udd, became interested 9 years ago and formed Strategic Materials Corp. to develop Udy's ideas.

"Udy broke smelting down into two processes, versus one in the blast furnace. The first, a horizontal, slowly rotating, gas-fired kiln, removes 55 percent of such impurities as oxygen and sulfur from ores of such low grade that blast furnaces cannot handle them, conditions them for the second step. This is a Udy-designed electric smelting furnace that finishes the job. The slag from the electric furnace can be put through a series of similar furnaces to draw off other metals such as chrome, copper, zinc, and manganese. Thus, for the first time, a smeltery can work iron ore over with the same thoroughness that an oil refinery uses to squeeze every last product out of crude oil.

"Udd and Udy were a long time making a go of it. Udd poured at least \$3 million of his own money into Stratmat. Then, in 1957, the prestigious Koppers Co., Inc., which designs and builds steel mills, saw the possibilities and added its money to the development, in return for stock and the right to engineer and design plants using the Udy process. Shortly afterward, Frank W. Chambers, 52, a one-time Koppers executive and director of engineering at Kennecott Copper, took over as Stratmat president and set to work to make the process a commercial success.

"Little mills."—Chambers is now working with businessmen in India to build as many as 15 small (150,000 tons a year) steel mills, scattered about the country, that would use local ore and coal to meet the needs of nearby markets. Each mill would cost less than \$12 million. Other countries interested are Nigeria, Egypt, Chile, Argentina, Brazil, South Africa, the Philippines, and Morocco.

"Thus far, more than \$12 million has been poured into Strategic Materials without a cent of profit, but by the end of this year Chambers hopes to start breaking even and by next year to show some earnings. In Venezuela alone, the company expects to get a quarter of what its process saves the government, an estimated royalty of more than \$1 to \$1.50 per ton. Says Chambers: 'We won't put Gary or Pittsburgh out of business. But we can use materials they can't, and we are heading a trend to build little mills close to raw materials and the markets.'"

Certainly we should know how far along the industry is in this regard, and whether advances in this area may be held back by a few segments of the industry which may desire to maintain the advantage the high-cost blast-furnace system affords them.

I do not wish to imply that I have made a detailed authoritative study of the iron ore industry. Much of what I have concluded has had to be inferred from public statements, technical journals, and news reports. The fact is that neither Senator Humphrey nor the U.S. Government has available sufficient data in a comprehensive and authoritative form upon which sound judgments and conclusions can be made relative to the present and future problems of the Lake Superior district, the foreign ore situation and the iron and steel industry in general. Therefore, I urge that the subcommittee recommend the following projects:

1. A study to determine the ownership of iron ore reserves, both foreign and domestic;
2. A study to determine the cost of producing taconite pellets;
3. An immediate detailed geological survey to indicate the location and extent of ore deposits in this country;
4. Research concerning the direct reduction of iron ore;
5. Further research to develop known methods of processing nonmagnetic taconite;
6. An investigation of transportation rates and their effects on the development of iron-ore mining.

U.S. SENATE,
COMMITTEE ON FINANCE,
July 20, 1961.

HON. JOHN CARROLL,
*Chairman, Subcommittee on Minerals, Materials, and Fuels,
Senate Committee on Interior and Insular Affairs,
Senate Office Building, Washington, D.C.*

DEAR MR. CHAIRMAN: Attached is a copy of a brief statement which I would like to have included in the record of the recent hearing which you conducted on the need for further research in the uses of taconite and other low-grade ores.

I wish to thank you for holding this hearing. The people of Minnesota are concerned about the decline in production of regular iron ore and look hopefully to the development of new uses for taconite to supplement the regular ore production. I shall look forward with interest to reading the record of these hearings.

With best wishes.

Sincerely yours,

EUGENE J. MCCARTHY.

STATEMENT OF HON. EUGENE J. MCCARTHY, A U.S. SENATOR FROM THE STATE OF MINNESOTA

I should like first to thank the chairman of this subcommittee for holding this hearing. Considerable progress has been made in the processing of taconites, subtaconites, nonmagnetic hematites, and other low-grade ores. I believe that Minnesota has been one of the leaders in this field. The taconite plants located at Silver Bay, Babbitt, and Hoyt Lakes, Minn., were among the first to produce this metal.

Production of the Silver Bay plant, operated by the Reserve Mining Co., has exceeded the original expectations. It concentrates the 30-percent taconite ore into pellets containing 60 percent iron. This plant has a capacity of 6 million tons of taconite concentrates a year and represents a \$190 million investment by the Reserve Mining Co. I would like permission to insert into the record, after my statement, a brief summary which appeared on page S-56 of Standard & Poor's Industry Surveys under the section "Steel, Basic Analysis, August 4, 1960," showing developments in taconite production in recent years.

Prof. Henry H. Wade, director of the mines experiment station at the University of Minnesota, testified before this committee. He also testified before the Special Senate Committee on Unemployment Problems, of which I was chairman, on this subject in 1959. He is one of the leaders in the development of taconite, and I am sure the committee will find his testimony informative and helpful. I am also pleased to note the presence of Professor Wade's colleagues from the Universities of Michigan and Wisconsin as well as the other expert witnesses who will testify.

Research is the key to the expansion of the infant taconite industry. I have read with interest of some of the new scientific discoveries for processing taconite by direct reduction. This technique, because of its importance, merits further study.

The quantity of regular ores mined in Minnesota has dropped alarmingly in recent years, particularly in northern Minnesota, Wisconsin, and Michigan. This has been due to a number of factors, but the result has been chronic unemployment and a decline in the economy of these areas. It is essential that every effort be made to hasten the integration of taconite into the steel industry. I would anticipate that these hearings would indicate the progress that has already been made in low-grade ore research and the areas where further research and experimentation are required. It might also be helpful to have the witnesses indicate whether additional funds are necessary for this research and whom they believe might best carry out this research: whether it would be the industry, the universities or the U.S. Bureau of Mines, or some other private groups.

[From Standard & Poor's Industry Surveys, Aug. 4, 1960, p. S-56]

STEEL, BASIC ANALYSIS

TACONITE

In addition to its development of major foreign ore bodies, the steel industry has undertaken construction of major facilities to concentrate low-grade domestic ores testing as little as 30 percent Fe. Several ventures are in production.

One of the largest is Reserve Mining, a \$190 million enterprise that concentrates taconite (a 30-percent ore) into pellets testing 60 percent Fe or better. Owned jointly by Republic Steel and Armco, this venture has exceeded original expectations, and presently has an indicated capacity of some 6 million tons of taconite concentrates per year. The ore is obtained from property leased from Mesabi Iron.

Another low-grade beneficiation enterprise is Marquette Iron Mining, owned by Cleveland Cliffs and several large steel companies. This company's capacity for concentrating jasper, a nonmagnetic ore, into pellets is being raised from 650,000 tons to 800,000 tons.

Cleveland Cliffs also owns jointly with Ford Motor Co. and operates Humboldt Mining, a concentration plant with a present capacity of 300,000 tons of concentrates.

Erie Mining, a \$300 million plant with an initial capacity for 7,500,000 tons of taconite pellets, began production in late 1957. It is owned by Bethlehem (45 percent), Youngstown (35 percent), Interlake (10 percent), and Steel Co. of Canada (10 percent).

Thus, the steel industry has a capacity for upward of 14 million tons of high-grade concentrates. Assuming 60 percent Fe content, the iron content from these concentrates is equivalent to about 16,800,000 tons of 50 percent Fe iron ore. The high-grade feed has proved popular in the steel industry as it has for all practical purposes increased the pig iron output of existing blast furnaces. In view of the relatively large investments involved (over \$500 million to date), it seems probable that these taconite and other concentrating plants will be operated at capacity as much as possible.

Further growth of the country's taconite concentrating facilities seems certain over the longer term.

Senator CARROLL. The next witness will be Mr. Ankeny, Director of the Bureau of Mines, Department of the Interior.

Mr. Ankeny, come forward, please.

Senator Hickey spoke to me personally and wanted to be here this morning, but he had to go to Wyoming. However, I am assured, and I know of his interest, he will read the record and we will have the benefit of his advice, too.

Mr. Ankeny, if you want to, read your whole statement, or, if you want to summarize it, you may proceed.

STATEMENT OF MARLING J. ANKENY, DIRECTOR, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR, ACCOMPANIED BY H. G. IVERSON, CHIEF, BRANCH OF METALLURGY RESEARCH; NORWOOD B. MELCHER, RESEARCH DIRECTOR, MINNEAPOLIS METALLURGY RESEARCH CENTER; AND HORACE T. RENO, ASSISTANT CHIEF, BRANCH OF FERROUS METALS

Mr. ANKENY. Mr. Chairman, I have a very brief statement and I have brought with me Mr. H. G. Iverson, chief of the Branch of Metallurgy Research, Bureau of Mines, who will describe the Bureau's iron and steel research program, and Mr. Norwood B. Melcher, who is research director of our newly dedicated Minneapolis Metallurgy Research Center, to describe the center's current research applicable to the marginal iron ore deposits in the Lake Superior district.

We are delighted at the opportunity to testify at this hearing. We have had a deep and unremitting interest in the welfare of the iron ore industry of the Lake Superior district from our beginning over 50 years ago.

First, let me say a few words about the Bureau's iron ore program. It is designed to assure the Nation a reliable, adequate, and continuing supply of ore at competitive prices for its ever-expanding needs.

When the Bureau began its iron ore research about 1915, the Lake Superior district, with the great Mesabi Range, open-pit mines in Minnesota and vast high-grade underground mines in Michigan and Wisconsin, was thought to be adequate to supply iron to the Nation's iron and steel industry for over 100 years or more. The Bureau, therefore, was concerned mostly with basic research and with developing the iron resources in southern and western United States around the periphery of the eastern steel complex.

Much of the technology that is the basis for the magnetic taconite industry was conceived in the Bureau's research laboratories on the campus of the University of Minnesota. The Bureau's first experimental iron blast furnace was built in these laboratories, and the fundamental concepts of iron ore reduction developed with this furnace are today common practice.

In World War II years the Bureau was active in developing the iron resources of the West.

Senator CARROLL. Let me interrupt just a moment. Do I understand you to say that the Bureau of Mines, through its basic research, has been largely instrumental in developing taconite?

Mr. ANKENY. No, I did not say that.

Senator CARROLL. Again, if you will for the record, tell me what you have done in these years.

Mr. ANKENY. In these years leading up to World War II, the basic research work that brought about the development of the taconite industry was done in our laboratories at Minneapolis on a cooperative basis with the industry and with the people connected with the university, but all of the basic work was done there before the process was upgraded to the point where commercial plants representing an investment of about \$600 million, was established in the iron range.

Senator CARROLL. How long have you been with the Bureau of Mines?

Mr. ANKENY. I joined the Bureau in 1928 and with the exception of several years of military duty, and 4 years in private industry during an interim period, I have been with the Bureau during all of that time.

Senator CARROLL. So often we hear criticism about departments of government and the bureaus within the Government that they are leading us down the road to socialism.

If I understand the import of your testimony, you are saying that as a result of your basic research, industry itself later created plants. What was your total there? How many hundreds of millions?

Mr. ANKENY. Approximately \$600 million investment in the taconite industry today.

Senator CARROLL. And this has been developed over a period of years in cooperation with the Bureau of Mines and the industry itself in the research?

Mr. ANKENY. And the universities, and this came to a culmination about 5 years ago when these plants were established in the area to upgrade this low-grade magnetic taconite to the point where it had commercial value.

Senator CARROLL. What was the investment then about 5 years ago?

Mr. ANKENY. The investment by industry in the plant was approximately the \$600 million investment that I am speaking of.

Senator CARROLL. Tell us what has happened since, if you will, please?

Mr. ANKENY. These taconite plants have continued to produce with this type of an investment, and they must continue to produce, at full capacity, even though it may be advantageous for companies to utilize the very high-grade imported ores that come from Canada and Venezuela and other foreign countries.

Once this investment is made, if it is in the economic area at all, it must operate. Otherwise, your investment is lost.

Senator CARROLL. What is the significance of your statement now when you say it must continue to operate? Is it operating today?

Mr. ANKENY. It is operating today, yes, sir.

Senator CARROLL. How is it operating today?

Mr. ANKENY. As far as I know, it is operating at approximately full capacity; is that not correct?

Mr. IVERSON. Yes.

Senator CARROLL. Are you saying because of this operation today, it has to use the Canadian ores?

Mr. ANKENY. It does not use Canadian ores. It uses the local low-grade magnetic taconite ores that, without this great amount of research and this great investment, would be of no value to the economy.

Senator CARROLL. I remember discussing this some 2 years back with Congressman John Blatnik, who comes from that area, and who has taken a great interest in this field. He has been very helpful in giving information to me. With all this development that you have spoken about, there is still great unemployment in that area, is there not?

Mr. ANKENY. That is true. My view of this situation is that the high-grade ores of this area are largely depleted. This means that in order to keep the steel industry supplied with ores, foreign ores must be imported, high-grade ores, or the vast deposits of low-grade ores in the area that we are speaking of must be developed.

Before these low-grade, nonmagnetic taconite and semitaconites can be developed, there must be technology to bring about their development. The technology for the beneficiation of nonmagnetic taconites is altogether a different problem from the magnetic, which has been largely solved.

The Bureau considers that its principal objective at the new Minneapolis Research Center is to bring about this technical development that will make possible the utilization of the low-grade nonmagnetic taconites and the semitaconite ore.

Senator CARROLL. Again, if I may come back to this unemployment problem, what can we do immediately to help the people in this area? What can we do immediately to help the unemployment situation?

Mr. ANKENY. Sir, it is my view that nothing can be done immediately unless you want to put an extreme burden on the American pub-

lic by vastly increasing the cost of steel by forcing the use of these lower grade ores from this area.

The grade of an ore has a very marked effect on the efficiency of operation of a blast furnace, so if a steel maker would have the choice of an extremely high grade ore, and one that was not so good, the economies that result in the operation of the blast furnace itself may make uneconomic the use of the lower grade material.

Senator CARROLL. You heard the testimony of Congressman Bennett, did you not, this morning?

Mr. ANKENY. Yes, sir.

Senator CARROLL. Are you saying then, in effect, that the Bureau of Mines would not recommend the imposition of a quota on Canadian ores?

Mr. ANKENY. Sir, the Bureau of Mines is not in a position to make a recommendation of that type one way or another at this point.

Senator CARROLL. But you people are the experts in steel. I am not trying to put you on the spot, but I mean you people have done research in this for years, and if I understand the purport of your testimony, it is that the Canadian ores are absolutely essential to the operation of this industry, unless, as you said, we are going to put a great burden upon the consuming public.

Do I misinterpret your testimony?

Mr. ANKENY. That is essentially what I said; yes, sir.

Senator CARROLL. I understand you also to say that these blast furnaces operate more economically with a high-grade ore.

Mr. ANKENY. Yes, sir.

Senator CARROLL. Congressman Bennett, who comes from this area, has testified that he thinks they can make a good profit, that is, the steel industry, from using the present ores under present conditions, but in a sense, they can make a greater profit, just like skimming off the cream, by using the Canadian ore. What is your observation on that statement?

Mr. ANKENY. This is a matter of opinion, of course.

Senator CARROLL. You are an expert and we all like opinions from experts.

Mr. ANKENY. I think I would have to disagree. I do not think at this point in the economy that the importation of some foreign ores is essential. I do think that when technology is developed that will beneficiate these vast deposits of low-grade ore, the United States could again become self-sufficient in its iron supply.

Senator CARROLL. If I understand your testimony, initially you said you thought in 1915 that you had enough for 100 years.

Mr. ANKENY. That is correct.

Senator CARROLL. Are you saying that our iron ore deposits are deficient today?

Mr. ANKENY. Yes, sir, they are, that is, the furnace grade iron ore, iron ore that can be mined and fed directly into the blast furnaces. We are very deficient today.

Senator CARROLL. Therefore, until you do more basic research on these nonmagnetic ores, in a sense, the unemployment will continue; is that right?

Mr. ANKENY. Yes, I believe that that is so as it applies to this particular area.

Senator CARROLL. Then, if we follow that to its logical conclusion it means that the solution of these problems is a long way from us in this area.

Mr. ANKENY. I think that Mr. Melcher, who is here today and who has charge of our research work at Minneapolis, could give you a better appraisal of what our efforts are in this direction and what the prospects might be in the relatively near-term future.

Senator CARROLL. What is our productive capacity of steel in this country? I am referring now to the need in gross tons of iron ore.

Mr. IVERSON. Approximately 147 million tons.

Senator CARROLL. 147 million tons. What are we capable of producing? Let us forget about Canadian ore and Venezuelan ore. What are we capable in this country of producing?

Mr. IVERSON. I would imagine that this would be the capacity, this 147 million tons.

Senator CARROLL. Can we meet the demand in this country today without Canadian ore and Venezuelan ore? In an industry in which they say, "We need so much ore to meet the demand of the American public."

Mr. IVERSON. When you are speaking of today, I would say we need the imports.

Senator CARROLL. Then, how much do we produce without Canadian and Venezuelan ore?

Mr. RENO. 87 million last year.

Senator CARROLL. What did we have prior to that in production, when we were at full employment in these areas? Come forward here, if you will, please. This is all informal. What we are seeking at this point is information. May I have your name, please, for the record?

Mr. RENO. My name is Horace Reno, Assistant Chief, Branch of Ferrous Metals, Bureau of Mines.

Senator CARROLL. What I want to find out is what was the productive capacity at the time of full employment in this area. Will you give us an idea of what happened, its decline, and then when the imports from Canada and Venezuela began to come?

Mr. RENO. I believe in 1957, when there was relatively full employment in the Lake Superior district our production that year was 106 million.

Senator CARROLL. Senator Proxmire is in the room. Will you come forward? We will be glad to have you seated at the table, Senator Proxmire. I understand you are going to present some witnesses, but we will be happy to have you sit up here and join us. I know of your great interest in this matter.

Mr. Reno, will you repeat your last statement, please?

Mr. RENO. I said I believe that there was full employment in the Lake Superior district in 1957. That was the year of our peak, as I remember, of domestic production. We produced 106 million tons of iron ore. The average for 1950 to 1954 is 101 million.

Senator CARROLL. So 1957 you say was a good employment year in this area?

Mr. RENO. Yes.

Senator CARROLL. And they were, therefore, producing 106 million gross tons?

Mr. RENO. Yes.

Senator CARROLL. And today, they are down to 87 million, I think you said.

Mr. RENO. Yes, last year.

Senator CARROLL. Give us the reason why there has been this decline in production from 1957. What did they produce in 1958?

Mr. RENO. Senator, historically, the domestic iron production has peaks and valleys. In the peak year they build up the stocks and maybe in the year of high activity the iron ore producers would anticipate that that would continue and they would have top production.

Then, the next year, they would reverse themselves and they would cut back, and it is not available. It has never been a stable industry at all.

Senator CARROLL. What was the production in the year 1956?

Mr. RENO. 97 million. In 1958, it was 67 million.

Senator CARROLL. In 1958 it was what?

Mr. RENO. 67 million.

Senator CARROLL. So you had a drop from 1957, in the peak year, in one year down to 67 million?

Mr. RENO. That is right.

Senator CARROLL. Is there a reason for that sharp drop in production in this area?

Mr. RENO. I think they had the strike in the industry.

Senator CARROLL. Was that the time of the steel strike?

Mr. RENO. Yes, sir.

Senator CARROLL. Then what was it the following year?

Mr. RENO. 60 million.

Senator CARROLL. 60 million?

Mr. RENO. Yes, sir.

Senator CARROLL. What was it the following year?

Mr. RENO. This was 1960. That would be 87 million.

Senator CARROLL. Now, you have had a peak. What was the reason for the decline? The ore was there, was it not, if they wanted to produce it?

Mr. RENO. Iron ore production depends on the requirements for ore.

Senator CARROLL. 1957 was the peak year of employment. This is American iron ore being produced in that area.

Mr. RENO. As I remember, 1957 was the year of high industrial activity in contrast to 1959 and 1960, when it was sort of a depression.

Senator CARROLL. I observe here that in 1957 Canada was shipping in approximately 12.5 million gross tons. Then in 1958, the time of our decline in production of American iron ore, Canada dropped almost 33 percent. Then what do your figures reflect in 1959 of our production?

Mr. RENO. 60 million.

Senator CARROLL. We continued to decline, but Canada went up. The importation of Canadian ore went up in that period around 4.5 million gross tons, from 1958 to 1959. Can you give us an idea of the reason for that?

Mr. RENO. As I remember it, Senator, the iron ore companies of Canada completed a new plant about that time, and their plant reached full production capacity and that ore came to the United States. In other words, this was the culmination of 4 or 5 years of expansion of

their operation. I believe it was 1957 and 1958 that the iron ore industry in Canada reached the production of 12 million tons.

Senator CARROLL. Therefore, we had a period of iron ore in production in 1957 and suddenly, there is a drop. That ore had been adequate, I assume, for all those years prior to the creation of this plant in Canada. Then the Canadian imports moved up substantially, but we still have the same ore up in the iron range country they had been using before. It has not worsened in that period of time. The quality and the structure has been the same?

Mr. RENO. That is true.

Senator CARROLL. It is just that they have gone into another area and gotten higher grade ore. I assume that is true of the Canadian ore, is it not?

Mr. ANKENY. That is correct.

Senator CARROLL. Senator Miller.

STATEMENT OF HON. JACK MILLER, A U.S. SENATOR FROM THE STATE OF IOWA

Senator MILLER. I just wanted to square the figure I have regarding this 1960 production with the figure you gave. It shows on the table I have here the figure of 81,553,000 and I believe you said your figure was 87 million. Perhaps you can reconcile those. Maybe I am not looking at the same figures you have.

Mr. RENO. I believe, Senator, you have quoted the shipment figures, not the production.

Senator MILLER. Then, if you look at the production figures here they are much higher.

Mr. RENO. I have been quoting what we term useable ore, which is a combination of the direct-shipping ore, the iron ore concentrates and the iron ore pellets.

Senator MILLER. What would be the difference between your figure and this? I am trying to get down to Senator Carroll's problem.

Mr. RENO. I would say if I had the shipment figure here, which I do not have, that our shipments would be identical. In the Lake Superior district the Iron Ore Association statistics are identical with those of the Bureau of Mines.

Senator CARROLL. I want to put my question to you bluntly to see if I am on the right track. Are we confronted here with a situation where an industry for many years has been operating up in this iron range, and suddenly, or over a period of years, producers begin to develop in another country another ore bed with a higher quality?

However, have they found this high-grade ore in another country and have they left this area down here with attendant unemployment problems and economic distress?

Mr. RENO. Senator, you are asking me to interpret the industry's motives and I do not know what their motives are.

Senator CARROLL. I am not asking you to give anybody's motives. I am asking you, as experts in the Government who devote your life to it, what has happened in this change.

Mr. ANKENY. I could subscribe to your statement that they have done exactly what you have said they did.

Senator CARROLL. It is amazing that a person like myself who knows nothing about this industry and its problems can pick this up in 5 minutes. I want to know if this is the nub of the issue we are confronted with. If it is, what are we going to do?

Mr. ANKENY. This is the nub of the issue disregarding the economics of the problem.

Senator CARROLL. Yes. Whether this is a wise thing to do, the fact is this is the effect of what has happened. You people watch these things and therefore, you have to give your advice to the Congress when we are looking into this sort of an issue.

Senator MILLER. I would like to ask Mr. Ankeny a couple of questions along this line. As I understand it, the blast furnaces can operate so much more efficiently with this high-grade ore and even with the increased cost of transporting it from way up in some of these Canadian ranges down to the furnaces, they have found it at least sufficiently economical to justify bringing it in; is that correct?

Mr. ANKENY. That is correct.

Senator MILLER. If the price of the ore from our own domestic sources was reduced, I suppose there would be a point at which because of the reduced cost of that ore, even though the blast furnaces were not operating efficiently, the reduced costs of the raw product would be sufficient to enable them to take a look at the overall picture and say, "Well, I think we will forget about the Canadian ore."

Could that point not be reached?

Mr. ANKENY. Yes, but we cannot disregard the fact that the furnace grade ore is rapidly becoming depleted and that if this country is going to retain its supremacy in iron and steel production we are going to either have to continue to import these ores, or we are going to have to find some way of using the vast resources that we have under any circumstances of economics that are not usable today.

Senator MILLER. This is the very point I wanted to get to. You said under any circumstances. You mean on the basis of the present cost of the ore, the cost of the ore is not so low as to enable them to take into account the decreased efficiency of the blast furnaces in coming up with a result which will enable them to say that it would be cheaper for them to produce, using this ore from the domestic sources, rather than from the Canadian sources?

Mr. ANKENY. I am not so sure I followed your question.

Senator MILLER. What I am trying to get at is this: Let us say that the cost of the ore is zero, furnished to them free from domestic sources. This ore is not nearly as efficient for them to use in their blast furnaces, but because they are getting it for nothing, might they not say that "This is such a low cost of the raw product that we could come out better this way than if we use the high-grade ore from Canada."

Could that point not be reached?

Mr. ANKENY. What you say is true as long as you are talking about the very limited reserves of furnace-grade ore.

Senator MILLER. What about taconite?

Mr. ANKENY. Even if they got their taconite ore for nothing, in order to convert that to a usable product, that can be used in a blast furnace, first a vast capital investment must be made to make this conversion into a furnace-grade product that can be shipped to the furnaces and used in the furnaces. Even if they got the taconite for nothing, they would still have a problem of upgrading that to the point where it can be used to make steel.

Senator MILLER. And that problem is such that it could not be handled on an equal basis, or at least a break-even basis, with how they are handling the thing now; is that correct?

Mr. ANKENY. Today, that is true.

Senator MILLER. Forgetting taconite and getting back to the domestic furnace-grade ores, is it a case of where we are running out of it, or is it a case of where the furnace-grade ore is not as efficient in these blast furnaces as this Canadian ore is and therefore, it is more economical for them to bring in the Canadian ore?

Mr. IVERSON. The import ores are higher in grade, perhaps around as much as maybe 10 percent. This results in economy in the blast furnaces. Therefore, from a standpoint of economics, this is the reason, in a large measure, I would say, why the imports have succeeded in taking up a part of our consumption.

Senator MILLER. Suppose the cost of the domestic furnace-grade ore was reduced. Might we not reduce it to a point at which they would be able to say, "Well, even though the blast furnaces will operate at, let us say, 10 percent less efficiency using this than the Canadian ore, because of the reduced cost, we will find it economically feasible to forget about the Canadian imports and to use the domestic ore"?

Mr. IVERSON. As Director Ankeny has mentioned, the reserves of this 55 percent, or 50 percent ore that we have are not great, not tremendous, from the standpoint of our consumption. In any case, we would run out of that in a few years where we are solely dependent on it, so then we come to the next problem.

We do have the largest reserves of the low-grade nonmagnetic taconite. This numbers billions of tons. The technology for the utilization of these nonmagnetic taconites has not yet been developed, as Director Ankeny mentioned. That is one of the reasons why we are not ready today to embark, as we might be, on that investment.

Senator MILLER. Let us say we have 10 years of usable reserves. Let us just use that as a figure. Possibly during that 10-year period if we would continue to use that, and ease this unemployment situation during that time, the technology might be developed so that by the time the 10 years are up, the taconite products might be used. Is that possible?

Mr. IVERSON. Possibly.

Senator MILLER. Then, what are we going to do to try to, let us say, get into the use of this domestic ore for, let us say, the next 10 years to increase that to ease our unemployment situation, and possibly diminish some of the imports from Canada? I take it that as things are now, it is not economically feasible to do that, but, as I see it, if we could reduce the cost of the raw product, the cost might be reduced sufficiently that, even though it is less efficient to operate the blast furnaces using this, because of the lower cost of the raw product, it would be economically feasible to do so. Are you following my line of reasoning on this?

Mr. IVERSON. You lost me there in the last.

Senator MILLER. I am trying to suggest that if the raw product is reduced in cost to the blast furnaces, even though it is less efficient to operate the blast furnaces with this, because of the lower cost of that raw product, it will be economically feasible to operate this way. Would you agree with that?

Mr. IVERSON. If economics were such, I would imagine that would be true.

Senator MILLER. Then, we get into a question of how much would we have to reduce the cost of this raw product in our domestic sources, and there must be a point at which economists or accountants can figure out at least a break-even point to match this 10 percent increased efficiency of the Canadian ore to offset that by the lower cost of the raw product.

Mr. IVERSON. The cost extends all the way from mining to transportation, to beneficiation, to blast furnaces, smelting, to preparation of steel, and I am not prepared to answer that.

Senator CARROLL. But you can answer this, can you not? In 1957, there was full employment and they were producing, I believe you said, 106 million tons. Then after the strike and then maybe another year with the development of a plant in Canada the production in this area dropped downward and the imports from the area of Canada rose. As I understand Senator Miller's question, if we have reserves for 10 years, and the operators were making a profit in 1957, which evidently was adequate, to keep employment in this country, we could continue with these nonmagnetic ores for a 10-year period and during this period we would also do the basic research to bring the other taconites in.

Now, of course, you could say this is really not a function of the Bureau of Mines because this is a question of economics for the industry itself, but the question is really what do we do to keep employment in these areas. This is what we are talking about.

Mr. RENO. I would be happy to give you my ideas.

Senator MILLER. I would like to interrupt for just one observation. Granted this is for the industry to determine, I think before we could even ask the industry to determine that, we ought to find out whether the theory is feasible, and that is where these gentlemen come in. As I understand, it is feasible. It is a matter of reducing the cost. You are not prepared to say whether it is the cost of transportation, or the cost of waste of the mine, or the cost of machinery and other things that enter into this, but you do accept the fact that theoretically these costs might be reduced to the point of where they would offset the 10 percent increased efficiency of using Canadian ore which would enable our blast furnaces to utilize these ores; is that correct?

Mr. IVERSON. Yes, sir.

Mr. RENO. I believe that our domestic companies are exploiting foreign ores to supplement our own supply and I believe that they went into the foreign countries exhibiting a great deal of foresight that we were going to need this ore, and realizing that we could not continue to maintain this high production. A hundred million tons of ore is a lot of ore. It takes acres and acres or square miles. They went into the foreign countries planning to exploit those deposits to supplement our own ores as our own domestic reserves were depleted, and going into those foreign countries, they have to maintain a balance of profits to operate in those countries, and the Canadian mining companies have about as much flexibility as we have in our own country.

Outside of United States, in Latin America, for example, they do not have that flexibility. Once they start they have to continue to produce. There is a break-even point. There has to be. We do not know what that is. You get involved in the technology of 10 per-

cent, and that seems to us a terrific amount to knock off of the operating cost of the blast furnace. There has to be a break-even point.

Senator MILLER. Then, the point I am trying to make here is that certainly during the next few years, when this technology on taconite can be developed, or we would hope that it would be developed, within that period of time, we might ease our own employment problem by continuing to mine our own domestic ores, provided that we can do something to at least bring about this break-even point that you are talking about.

Mr. RENO. Senator, we are mining the taconite now.

Senator MILLER. I am not talking about the taconite now as far as this break-even point is concerned. I am talking about our own domestic ores.

Mr. IVERSON. You are talking about the 50, 55 percent.

Senator MILLER. Yes, sir. The question I would have is what can we do during the next 5 or 10 years which will encourage our producers to use in their blast furnaces our own domestic ores? What can we do to bring about a break-even point?

Mr. RENO. I can tell you what we are trying to do. We are trying to devise some way to upgrade those ores so they will be used, our resources.

Senator CARROLL. Along this line, I have in my hand here a statement from Christian Science Monitor newspaper of March 24, 1961. It states:

M. A. Hanna Co., one of the Nation's largest and most experienced iron ore firms, believes its researchers may have uncovered the solution.

Do you know about this Hanna Co.?

Mr. IVERSON. Yes, sir, we do.

Senator CARROLL. It says:

That is why it has just built and put into operation a \$2 million semi-taconite processing pilot plant at Cooley, Minn., 14 miles west of Hibbing. Recently, it showed off the new plant to newsmen and Minnesota State senators and representatives.

This is in March.

If it proves successful, it will be an invaluable aid to various presently depressed Minnesota iron ore communities in making an economic comeback.

What has been their progress?

Mr. RENO. They have been cooperating on research with the Bureau of Mines.

Mr. ANKENY. Mr. Melcher.

Senator CARROLL. May we have your name?

Mr. MELCHER. My name is Norwood B. Melcher. I am the research director of Minneapolis Research Center.

Would you repeat this question, sir?

Senator CARROLL. The question was about the M. A. Hanna Co. First of all, this is an article out of Hibbing written by George R. Reiss, special to the Christian Science Monitor. Do you know Mr. Reiss?

Mr. MELCHER. No, sir.

Senator CARROLL. It says:

Minnesota's billions of tons of a heretofore worthless hard rock that for generations defied and exasperated iron ore miners may yet prove one of the Nation's most valuable industrial resources—a gigantic new metallic supply for the steel industry.

Then it talks about the M. A. Hanna Co. I will put this article in the record.

(The article referred to follows:)

[From the Christian Science Monitor, Mar. 24, 1961, p. 14]

PROCESS MAY TAP HIBBING TACONITES

(By George R. Reiss)

HIBBING, MINN.—Minnesota's billions of tons of a heretofore worthless hard rock that for generations defied and exasperated iron ore miners may yet prove one of the Nation's most valuable industrial resources—a gigantic new metallics supply for the steel industry.

These are semitaconite, a relatively softer rock that contains a large percentage of nonmagnetic iron particles, and a nonmagnetic variety of taconite, a flint-hard rock. These underlie much of northern Minnesota's fabulous Mesabi, Cuyuna and Vermilion iron ranges. For years, iron miners, trying to get at richer direct-shipping ores, had to remove enormous quantities of the troublesome rock.

The solution of the problem was to find a feasible and economical method of separating these nonmagnetic iron particles from both types of rock, then processing them into a valuable and rich blast furnace feed material. The key to the problem seems near at hand.

BOOST TO MINNESOTA

M. A. Hanna Co., one of the Nation's largest and most experienced iron ore firms, believes its researchers may have uncovered the solution. That is why it has just built and put into operation a \$2 million semitaconite processing pilot plant at Cooley, Minn., 14 miles west of Hibbing. Recently it showed off the new plant to newsmen and Minnesota State senators and representatives.

If it proves successful, it will be an invaluable aid to various presently depressed Minnesota iron ore communities in making an economic comeback. It should also benefit the harried American-flag Great Lakes fleet which lost much of its business to low-cost foreign competitors in hauling foreign iron ores destined to the United States blast furnaces.

And it will give the American steel industry a new, safe and sure domestic metallics supply.

Hanna expects to make the findings of its pilot plant operations available to the whole iron-producing industry.

For generations, the rich iron ranges of Minnesota, Wisconsin and Michigan furnished 85 percent of the ores smelted in U.S. blast furnaces, transporting most of the ore by U.S.-flag Great Lakes ships to lower Great Lakes ports. This iron went into the millions of tons of steel used annually for manufacturing new automobiles, bridges, steamships, household appliances, toys, railroads, buildings, tin cans and other containers and innumerable other items.

RESERVES RAN LOW

Then after World War II, some richer deposits began playing out. Steel and ore firms developed big new foreign deposits such as in Venezuela, Labrador, Liberia and elsewhere, but they also turned to extracting magnetic iron particles from one variety of taconite.

This is done by crushing the rock to face-powder fineness, then magnetically extracting the iron. These then are rolled into marble-sized pellets, testing 64-percent iron. The richer Lake Superior ores tested about 51 percent iron.

These rich pellets have proved one of the most exciting and significant developments in steel plant operations in years. Mixed with other ores, the pellets helped boost production of many blast furnaces by 25 to 50 percent—with attendant big savings in capital, materials, wages and other costs.

That is why steel and iron ore firms in the last half dozen years spent nearly \$1 billion in building plants in Minnesota to process magnetic taconite, and in Michigan to process another rock, iron-bearing jasper. Biggest of these developments is a \$350 million project owned chiefly by Bethlehem Steel Corp. and Youngstown Sheet & Tube Co., and Reserve Mining Co., a \$250 million venture jointly owned by Republic Steel Corp. and Armco Steel Corp.

EXPLOITATION DEFIED

But the much more plentiful nonmagnetic taconites and semitaconites defied exploitation until now.

Hanna's director of beneficiation, studious S. E. Erickson, who spends his leisure in writing highly technical articles or in prowling iron mines of the Philippines or other distant places, believes success of Hanna's pilot plant in processing semitaconites will clear the way for economically processing the nonmagnetic taconites. There are enough of these to supply the whole world's steel industry for hundreds of years, he believes.

Presently, he believes, costs of processing semitaconites, by the Hanna method, will be higher than of processing magnetic taconites, although mining costs will be cheaper (because the rock is softer).

"But," he said, "perhaps the pilot plant may show a method of cutting costs."

RICH ORES VANISHING

Hanna's six-story galvanized metal pilot plant sits on a wide reddish shelf overlooking Harrison Mine, a huge open pit 300 or 400 feet deep. In a half century, it has produced millions of tons of ore. These are rapidly diminishing, but plentiful supplies of semitaconite are about.

Ore comes into the plant via a rubber conveyor belt, passes over a series of screens. Larger chunks go to a crusher to reduce it to a uniform size. Then the sized material goes into a water-filled vessel containing finely ground ferrosilicon. The ferrosilicon is lighter than iron-rich chunks, but heavier than silicious waste.

Thus, the high-grade ore sinks, the silicious material floats. The high-grade material is ready to ship without further processing. However, the waste or tailings, along with other ore material, goes into a gas-fired rotary Lurgi kiln, merely an 80-foot long tank which is seven feet in diameter, which revolves at seven r.p.m. Gas for it is produced from coke.

B. M. Andreas, Hanna's Minnesota mines manager, feels that the development will prove an enormous boost to Minnesota's economy; providing more stable employment, since these plants require more help, and may also work year-round, unlike the direct shipping mines which halt operations when the Great Lakes navigation season closes.

Mr. MELCHER. Yes, I am familiar with that.

Senator CARROLL. And the \$2 million plant that they put up at Cooley, Minn., 14 miles west of Hibbing. The question I have asked is, What progress have they been making? What do you see in the immediate future?

Mr. MELCHER. The process involved here, although I am speaking for Hanna, is a process for using the nonmagnetic taconites or semitaconites in the western Mesabi. It involves what we call magnetic reduction roasting, altering the nature of the taconite so that it can be concentrated magnetically. This is one method. The Bureau of Mines also has studied this process for many years and we have, as a matter of fact, a cooperative agreement with the Hanna Co. on this and other related phases of iron ore beneficiation.

Senator CARROLL. Are they using their own money? Is this \$2 million their own money?

Mr. MELCHER. Yes, sir.

Senator CARROLL. Is any of this Government money?

Mr. MELCHER. Not to my knowledge.

Senator CARROLL. What are the prospects for the future?

Mr. MELCHER. I think the prospects are very good for that area. We are developing processes, this magnetic separation, and also a flotation technique developed by the Bureau of Mines. Both of these have shown very good promise, have produced a high-grade concentrate competitive with just about any source available to our furnaces.

We are working at full speed in these areas to try to make these processes feasible and economic as soon as we can.

Senator CARROLL. Do you think that if we continue to import Canadian ore in great quantities as we are doing, this will retard the basic research in this? For example, we have oil shale in Colorado. We have had the Bureau of Mines. It has been in there for many years. I have forgotten how many, but a long, long time. We put \$20 million in the Bureau of Mines in that area for oil shale and we got private companies into this. The Union Oil Co. of California, I think, has spent \$10 or \$15 million. The process is slow and, of course, we find other forces that do not want us to develop that oil shale because it would interfere with their own production.

What worries me and concerns me here as I think about it, is if we permit the importation of ore in such great quantities it may put a blanket on your basic research in these nonmagnetic ores.

Mr. MELCHER. The industry and the laboratories in the iron range as well as the Bureau of Mines are actively engaged in beneficiation and research and I do not believe these forces are in any way obstructing. I think they may tend to stimulate it.

Senator CARROLL. In other words, you are going to need the ore up there in addition to the Canadian ore. Do you think you need more iron ore from both?

Mr. MELCHER. Yes, sir. We need more iron ore from both.

Senator MILLER. Will you yield?

Senator CARROLL. Yes.

Senator MILLER. As I understand Mr. Ankeny's testimony, as of today, even if this taconite was furnished free to the blast furnaces, they could not compete with Canadian ore.

Mr. MELCHER. Yes, sir. I believe that the iron ore that has not been beneficiated by these new techniques, after it has been treated in that area, it is competitive with these other sources.

Senator MILLER. Of course, you have the cost of treatment which enters into this thing.

Mr. MELCHER. Oh, yes.

Senator MILLER. And that would still prevent, at least as of now, the economic feasibility of using that compared to the Canadian ore.

Mr. MELCHER. We are working on that phase. Certainly the magnetic taconite has been resolved and is in direct competition with those ores and we believe that these processes may well be economic very soon.

Senator MILLER. I would like to try to wrap this thing up because I am searching for something here. We are trying to reach at least a break-even point as far as these blast furnaces are concerned, as between our own domestic ores, either our domestic ores, as I believe you termed them, or the treated taconite, as against the Canadian ores. In reaching that break-even point, I suppose that you might look in the area of wages that are paid the miners. You might look in the area of transportation that is paid for transporting the ore. You might look at other costs of overhead and, finally, I am wondering if we might look into the average of percentage depletion for tax purposes. What is the percentage depletion now? Can any of you gentlemen tell me?

Mr. RENO. Twenty-three percent.

Senator MILLER. For what kind of ore?

Mr. RENO. Iron ore.

Senator MILLER. What about taconite?

Mr. RENO. The same.

Senator MILLER. Twenty-three percent?

Mr. RENO. Yes.

Senator MILLER. Might it be that we might find one area of bringing about a break-even point in the area of percentage depletion by increasing this. That would be a possibility.

Mr. MELCHER. Are you referring to the cost of producing pig iron from these various sources and materials?

Senator MILLER. No, I am referring to percentage depletion of mining the raw product which is allowed as a write-off for income tax purposes, like 27½ percent of percentage depletion. As I understand it, it is 23 percent for iron ore and taconite. Whether or not it should be the same for iron ore as for taconite or vice versa, I do not know, but I am just wondering if it would be feasible to work in this area of percentage depletion. I am advised by a member of the staff that the percentage depletion for income tax purposes of iron ore is 15 percent.

Now, suppose it was increased to 23 percent. I am wondering if that would possibly bring about a break-even point so that we could use our own domestic ore for the next few years, maintain our full employment, and then trust that in the meantime the technology on taconite would come through so that we would sort of phase out our domestic ore and phase in the taconite from an economic standpoint.

I wonder if there might be a percentage depletion increase.

Mr. ANKENY. I would say in answer to your question that it certainly would be worth looking into. Since it has been brought up, I think the other phases of the tax problem would bear some scrutiny, too. That might contribute to this objective that you are talking about.

Senator MILLER. What other parts of the tax problem are your referring to?

Mr. ANKENY. I am not familiar with the tax structure particularly, but it is entirely possible that taxes——

Senator MILLER. You are referring to what they call the severance tax up in Minnesota.

Mr. ANKENY. Yes.

Senator MILLER. Possibly that might be reduced and percentage depletion for the Federal income tax be increased. In other words, the point is that we might come up with a practical package from a tax standpoint that would enable this break-even point to be reached.

Senator PROXMIRE. Would the Senator yield?

Senator MILLER. Yes, indeed.

Senator PROXMIRE. I am just wondering if you can ever make any kind of a tax concession that will bring us close to a break-even point. You could have a 10,000 percent depletion allowance and until you began to make money you could not possibly begin to get closer to a break-even point.

The only way you can get closer to a break-even point, it seems to me, is to reduce your cost before taxes.

Senator MILLER. May I say this?

Senator PROXMIRE. Is that not correct?

Senator MILLER. I am not sure that we are talking about the same thing. When I am using this term "break even" I am using the term in the sense that Mr. Ankeny used it, namely, the blast furnace operation would break even using the domestic ore with the profits that they are making, using the Canadian ore.

Senator PROXMIRE. So you would have a new concept of not giving depletion on foreign holdings?

Senator MILLER. That is going to be up to the foreign government. I am thinking in terms of increasing the percentage depletion. We have done so. For example, a few years ago, we considerably increased the percentage depletion of sand and gravel for purposes of furnishing an incentive for our own domestic producers to mine our sand and gravel in connection with highway development. These percentage depletion figures varied from time to time and there is no question but what one of the reasons for varying them is to enable our own producers to have a better chance to make a profit in comparison with using foreign production.

I am not talking about breaking even and coming up with neither profit nor loss. I am talking in terms of the break even, as Mr. Ankeny termed it, in terms of making the same amount of profit that they are now making with Canadian ore.

Senator PROXMIRE. If the Senator would yield, it would seem to me that you have to permit then the domestic producer to have a higher depletion allowance than the domestic producer who owns foreign mines, which is what the competition is with, as I understand it, and would take advantage of American tax laws to, as he does now with oil, use the same kind of depletion allowance with foreign production.

If we discriminate against ownership of foreign mines, or foreign oil holdings and so forth, that might be a very interesting, and a very useful kind of proposal, but it would mean a change in the tax laws. Otherwise, you have one kind of tax law affecting taconite and iron ore and another affecting the oil industry, is that not correct?

Senator MILLER. We already have it now.

Senator PROXMIRE. We certainly do not. The depletion allowance and all the other tax advantages are available to the persons who own oil holdings abroad, is that not correct?

Senator MILLER. I am not sure that I can answer your question regarding the production in foreign areas.

Senator CARROLL. I can answer it. They get a depletion allowance just like the domestic production, in addition to which, they have an offset statute. If American capital goes into Canada, into a foreign country, it is not a deduction, it is an offset dollar for dollar. We have gone into the ARAMCO situation in the Anti-monopoly Committee and we know about these things. We have discussed it. One time, we thought we would put a bill to limit the depletion allowance to the continental limits of the United States: If I were a steel company and I had holdings in this range, which I could see were slowly expiring, and I could reach into another country and get high-grade ore, of course, I would do so. The cost of production is lower and there is higher concentration, greater yield. I am not trying to prevent people, as I use this expression, from "taking the cream off." But our real problem here, as I see it, is how are we going to get employment again in this area and pro-

duction that gives employment? This is the tenor, I thought, of Senator Miller's remarks. How do we bring this into a balance at the same time that we move ahead and develop this new process?

Senator MILLER. This is precisely my question.

Senator CARROLL. So I think that Senator Proxmire's observation here is very pertinent, too. We know that depletion allowance with reference to oil was initiated some 30 years ago, longer than 35 years ago, there never was a concept that it would extend into the foreign countries, but they began to develop ARAMCO, I think, about 1932 or 1933. Then in 1939 it had tremendous production and they are getting, I think, in one financial report I looked at, \$120 million in depletion allowance. Their cost of production was about 25 cents a barrel. It may have gone up a little bit, 5 cents or so. In this country, it is a dollar-something, and this is the complaint of the domestic producers, but now here we have in this area, as I understand the purpose of this hearing, the question of what do we do to get production back in this area so we can relieve the economic distress.

Obviously, we cannot do it if they are going to import this other ore and going to keep U.S. production down to 60 million gross tons.

You are not going to relieve the unemployment situation.

Do you agree with that?

Mr. ANKENY. Yes, sir.

Senator CARROLL. You have to have more production. You have to have more production in these areas if you are going to cure the unemployment problem.

Mr. ANKENY. That is correct.

Senator CARROLL. You are not going to have more production in that area if you keep drawing in the ore from Canada and Venezuela. Maybe they will die on the vine like we do in lead and zinc in our area.

Senator MILLER. Does the Senator know whether this percentage depletion is granted in the case of ore production in foreign countries just as oil?

Senator CARROLL. I will be honest with you. I do not know. I have never been into this and this has opened up some new avenues of thinking for me.

Senator PROXMIRE. I am not positive, but I would be amazed if there would be any difference. There is a fundamental principle involved that would apply to oil and I do not imagine they would make any exceptions for people who own foreign oil wells as compared to people who own iron ore mines.

There should be exactly the same kind of principle applied right across the board. If not, we certainly would have a real basis for doing what Senator Carroll and I have tried to do for a long time, to limit the depletion allowance.

Senator CARROLL. Senator Miller.

Senator MILLER. I think there is another factor that enters in and that is in many of these foreign countries a foreign corporation is organized and the percentage depletion of the foreign country is allowed to the corporation. It may be even higher.

Senator PROXMIRE. You do not even need that, I might say, because they have a golden gimmick set up so that whatever taxes they do pay abroad, they can deduct from their American tax here, and the taxes are so equalized that it is very, very hard to get at that and to equalize or to give a differential advantage on the basis of tax concessions unless

you have a situation in which you eliminate that opportunity, which American industry has opposed right along, to subtract their foreign taxes in computing their American taxes.

Senator MILLER. I am sure that is correct, and the only thing I would suggest is that we might have somebody look into this and see whether or not, by increasing the percentage depletion allowance for domestic ores, we might enable us to reach this break-even point during the next few years so that, as I pointed out before, we can have a phasing out of our domestic ore and a phasing in of the taconite from an economic standpoint.

Senator CARROLL. Do you gentlemen desire to make any observations on these comments? This is kind of a roundtable discussion instead of a hearing but, as long as the reporter can keep the record straight here, I think this has been very healthy for us.

Mr. Director, do you have any observations further? Is there anything you want to put in the record at this point?

Mr. ANKENY. I must say that I agree with your premise entirely that this is an economic situation and, if we are going to obtain the objectives which you are seeking, we must in some way lower the cost of production in this area, and that brings up the question of how much concession everybody is going to make, how much of a concession will the local tax authorities make, how much will the companies themselves make from the standpoint of profit, and how much of a concession would labor be willing to make, which is a big factor in this matter of cost. If people are willing to make concessions, maybe we could reach this point that you are talking about.

Senator CARROLL. There is this prospect. If you put a quota limitation on imports into this country, would not the industry itself be forced to go back to the production in this area?

Mr. ANKENY. Yes, but the public would bear the cost.

Senator CARROLL. But in 1957 when they had the 100 million they were doing all right that year, as I recall, and the cost could be no greater than it was in that year unless we are assuming there are certain economic changes, but no substantial changes.

Mr. ANKENY. There have been wage increases in the interim which affect the public.

Senator CARROLL. Of course, those would have to be taken into consideration and into account. This has all been very helpful. The sugar quota system goes back a quarter of a century or more. We had to establish this on sugar. We do not produce enough sugar in this country to take care of our consumption need. That is the reason for Costigan-Jones Sugar Act. There, we established the quota system. There was a processing system, very technical, very involved, and we were doing all right with it. The consumer had to pay more than he paid in other countries. The farmer was at least quite, though not fully satisfied. They were all getting along pretty well until Castro blew his top. This has upset that quota system. You have been very helpful.

Do you have any further comment along this line?

Mr. MELCHER. Mr. Chairman, I have a statement, that I would like to have appear in toto in the record. Attached to it are the statements of my colleagues.

Senator CARROLL. Your statement and those of Mr. Melcher and Mr. Iverson will go into the record at this point.
(Statements referred to follow:)

STATEMENT BY MARLING J. ANKENY, DIRECTOR, BUREAU OF MINES

The Bureau of Mines is delighted at the opportunity to testify at this hearing; we have had a deep and unremitting interest in the welfare of the iron ore industry of the Lake Superior district from our beginnings over 50 years ago.

First let me say a few words about the Bureau's iron ore program. It is designed to assure the Nation a reliable, adequate, and continuing supply of ore at competitive prices for its ever-expanding needs.

When the Bureau began its iron ore research about 1915, the Lake Superior district, with the great Mesabi Range open-pit mines in Minnesota and vast high-grade underground mines in Michigan and Wisconsin, was thought to be adequate to supply iron to the Nation's iron and steel industry for 100 years or more. The Bureau therefore was concerned mostly with basic research, and with developing the iron resources in Southeastern and Western United States around the periphery of the eastern steel industry complex. Much of the technology that is the basis for the magnetic taconite industry was conceived in the Bureau's research laboratories on the campus of the University of Minnesota. The Bureau's first experimental iron blast furnace was built in these laboratories and the fundamental concepts of iron ore reduction developed with this furnace are today common practice.

In World War II years the Bureau was active in developing iron resources of the West. Most of its research was conducted in laboratories at Salt Lake City, Utah, and to a lesser extent at Reno, Nev. Some of its successes are reflected in the new steel plants of the West.

Since the war the Bureau has been increasingly concerned with declining national self-sufficiency and the steeply rising percentage of iron ore requirements being met by importation. Exploration of high-grade iron ore deposits was continued in the West with moderate success, and the washing and cleaning processes employed by industry to upgrade the traditional ores in the Lake Superior and Birmingham districts were improved and more widely applied; Bureau research laboratories participated in such work. The principal research to strengthen the U.S. position, however, has been directed toward utilization of the vast resources of low-grade ore. Inasmuch as the Lake Superior district contains by far the Nation's largest known low-grade iron deposits, most of our attention has been focused on the iron formations in that area. The Bureau, believing that full utilization of these ores would require radical changes in mining, beneficiating, and smelting practices, directed its iron research in the last decade to encompass all these activities.

In view of the urgency of the complex technical problems involved in making the low-grade deposits of the Lake Superior district competitive with the much higher grade foreign ores, the Bureau of Mines recently reviewed its iron ore research program, with specific emphasis on taconite.

This month the Department of the Interior dedicated a large modern research center in the Minneapolis-St. Paul area. Although the research at this new \$2½ million facility is national in scope in various mineral technologies, it was constructed to accommodate expanded work on regional resources, notably iron ore. Several scientists from other installations have been assigned to the iron ore projects at this center, and Bureau projects at the pyrometallurgical laboratory in Pennsylvania have been oriented to complement projects at Minneapolis.

The combined research efforts of industry, Federal and State Governments, and educational institutions have facilitated the transition from high-grade ores, to the utilization of low-grade domestic ores. The Bureau's role in this effort is relatively small but nevertheless important. We anticipate steady progress with significant contributions to metallurgical science and to the economics of processing marginal iron ores.

For the details of the Bureau of Mines program I have arranged for H. G. Iverson, Chief of the Branch of Metallurgy Research, to describe the Bureau's iron and steel research program and Norwood B. Melcher, Research Director of the newly dedicated Minneapolis Metallurgy Research Center, to describe the center's current research applicable to the marginal iron ore deposits in the Lake Superior district.

STATEMENT OF NORWOOD B. MELCHER, RESEARCH DIRECTOR, MINNEAPOLIS
METALLURGICAL RESEARCH CENTER, BUREAU OF MINES

LAKE SUPERIOR IRON ORE INVESTIGATIONS

Bureau of Mines research pertaining to Lake Superior iron ores is assigned to the Minneapolis Metallurgy Research Center. The center is housed in new laboratories only very recently dedicated in the Twin Cities of Minneapolis and St. Paul. In addition to the facilities at that station, a part of the research is conducted at Bruceton, Pa., near Pittsburgh. At the latter station the most significant facility with relation to iron ore investigations is the Bureau's experimental blast furnace, which has received wide recognition in the past few years for its varied experiments. The combination of the experimental blast furnace and the Minnesota laboratories enables the Bureau to attack the Lake Superior iron ore problems on all fronts from the mine to the steel mill. The major processing steps are beneficiation, agglomeration, direct reduction, and smelting. Because of the preponderance of so-called taconites in the Lake Superior region and the tremendous potential supply of this material for the Nation's blast furnaces, it is only natural that our major effort is in the utilization of this resource.

Taconite originally referred to the fine-grained ferruginous, cherty, and lean ores of the Mesabi range, but has through general usage, been extended to all hard low-grade iron ores of Michigan, Minnesota, and Wisconsin, which do not respond to simple beneficiation processes. Throughout the area the existence of two categories has been recognized, these being nonmagnetic and magnetic depending upon the nature of the preponderant mineral. Within these groups are ores which can be treated by applications of known technology, and, therefore, are the ores of the present and immediate future. Other materials by virtue of their complex mineralogy, or physical structure, will require new concepts of iron beneficiation and are not likely to be used in the near future.

A large potential of nonmagnetic taconite is known to exist on the western Mesabi range and estimates of these reserves reach several billions of tons. However, these ores do not respond to magnetic treatment such as that used in the eastern end of the Mesabi range. However, by application of reductive roasting the nonmagnetic iron oxides can be converted to artificial magnetite, after which magnetic separation could be used. The possibilities of reductive roasting and magnetic separation are being widely studied by both industry and Government. The Bureau's interest, however, is in special applications with longer-range possibilities. For example, the Bureau is studying the application of the magnetic principle to the separation of iron from other metallic constituents.

Reduction roasting has long been known as a method for converting nonmagnetic iron oxides to artificial magnetite. Increased interest in the beneficiating of the taconites of Minnesota has led to further studies of the kinetics and economics of the reduction process. Pilot plants have been erected employing different types of reactors to determine their efficiency.

Reductants are primarily hydrogen and carbon or compounds of these in either the solid or gaseous state. The reaction takes place at the solid-gas interface and if the reductant is solid it must be converted to gas at a reasonably low temperature. Although the kinetics of reduction of pure oxides has been studied, little is known of the effect of the gangue minerals on the equilibria of this system. Variables that affect the reaction are the nature and rate of the ore feed, temperature, and composition and flow-rate of gases.

The types of reactors used for reduction roasting pilot plants include vertical shaft furnaces, rotary kilns, fluidized reactors, multiple hearth furnaces, and horizontal traveling grates. The basic requirement for good reduction in these reactors is that the ore feed should be in contact with reductant for sufficient time at an optimum temperature. Reactors must be efficient in heat conservation and utilization of the gases.

The Bureau of Mines has studied the possibility of using lignite and lignite chars as reductants. The proximity of the enormous lignite deposits of North Dakota to the iron ores of the Lake Superior district suggests an attractive economic potential. It has developed that lignite is the most reactive of the solid fuels tested, and therefore is well adapted to reduction processes.

Another important method for treating nonmagnetic taconite is flotation. Flotation is a physiochemical process whereby small amounts of chemicals are mixed with finely ground, dilute ore slurries thereby modifying the mineral sur-

faces and selectively inducing certain of these mineral surfaces to be attached to air bubbles. The select minerals are then collected and removed in a froth to effect a separation. Either the desirable or the undesirable component can be removed.

Flotation is the workhorse of virtually every other segment of the mining industry, but has found only limited acceptance in processing iron ores. The only flotation installations (floating iron minerals) at present are located in northern Michigan. However, flotation will soon be employed in Minnesota.

Variations in mineralogy, presence of substantial quantities of slime, and inability to make concentrates of acceptable grade and poor recovery have been reasons advanced for not using flotation in processing taconites. However, recent encouraging research results by the Bureau of Mines and industry has stimulated revival of interest in the flotation process.

The Minneapolis Metallurgy Research Center began an investigation of flotation of nonmagnetic taconites from the western Mesabi range in 1958. At that time, the study was confined to the conventional approach whereby the iron oxide minerals were induced to float. Some materials were responsive to this approach but others were very unselective. Gradually, emphasis has shifted to a reverse flotation process in which the silica (the chief gangue mineral) is carried over in froth and discarded. From a metallurgical viewpoint this process overcomes many deficiencies attributed to other flotation processes and seems to be applicable to most western Mesabi ores. It is capable of treating materials with high slime content and of yielding acceptable concentrates where other flotation systems have failed. Because of these successes, the Bureau of Mines was joined in a cooperative effort by a private company late in 1960. Over two dozen ore samples from the western Mesabi range have been tested successfully. Six semitaconites taken during a 1960 sampling campaign averaging 36.7 percent iron were beneficiated in the laboratory by silica flotation to give concentrates averaging 61.2 percent iron and 5.4 percent silica. Average iron unit recovery obtained in the laboratory was 78 percent. Experience in both laboratory and pilot plant suggests that the recovery can be raised to approximately 90 percent in continuous operations wherein process middlings are recirculated. Results similar to the above were also obtained in the laboratory on six taconite samples averaging 31.8 percent iron in the feed.

Investigations on Michigan specular hematite ores also were conducted as part of the cooperative arrangement. After initial laboratory studies a pilot plant campaign was conducted which produced concentrates containing 61.6 percent iron and 5.5 percent silica.

Other samples from Michigan and Minnesota are being investigated in the laboratory to evaluate their response to silica flotation system, and to determine their thickening, filtering and pelletizing characteristics. Wisconsin ores will be investigated as samples become available. While the silica flotation system has demonstrated its technological merit, it frequently employs a high cost reagent suite.

As part of the cooperative agreement, continuous tests will be made to determine the minimum reagents requirements, and to establish the best metallurgy under operating conditions.

Manganiferous iron ores of the Cuyuna district contain between 2 and 10 percent manganese and between 20 to 40 percent iron and have long been discussed as to their usability for the production of ferrograde manganese. Bureau investigations of this taconite material are directed not only toward obtaining a manganese product but also toward recovering the valuable iron minerals. Studies indicate that the manganese may be efficiently recovered by chemical methods and progress is being made in developing procedures for separating the iron from the high silica gangue.

Although simple washing methods are not effective for producing an iron concentrate, flotation techniques and magnetic roasting studies on some of the low-grade ores have been encouraging in that acceptable concentrates are produced and manganese minerals are rejected along with the gangue. The manganese can then be removed separately.

All of the taconite and semitaconites, and many of the foreign ore concentrates consist of fine particles which must be agglomerated prior to blast furnace charging. The industrial trend, to date, indicates that sintering is the preferred means of agglomeration at the steel plants, while pelletizing is preferable at the mining site. During sintering the ore is mixed with a fine fuel dust and burned to cinder

on a grate. Pelletizing is the forming of green balls, somewhat analogous to snowballing and hardening at high temperatures.

The pelletizing process which has been well established at magnetic taconite plants such as Silver Bay and Hoyt Lakes, Minn., produces a manufactured blast furnace feed of high strength with good reducibility. The application of this process to nonmagnetic materials encounters several problems in preparation of the green pellets as well as in firing.

The green balls as formed must have sufficient strength to withstand handling in the plant and during hardening. The strength of the green pellet is determined by the specific surface and the ease of wetting of the particles, and to a lesser degree by the pellet porosity. To attain a high-specific surface, the material must be ground finely. Some operations producing magnetic concentrates require grinding to about 80 percent minus 325-mesh; this size or finer is suitable for pelletizing. Other taconites or low-grade ores may not be ground as fine and, therefore, may require additional grinding prior to pelletizing or means must be developed to produce pellet strength with relatively coarse particles.

As water wets magnetite particles readily, pelletizing of magnetic concentrates is facilitated; however, with flotation concentrates in which the iron oxide has been floated from the gangue, residual flotation may inhibit this wetability, and, in doing so, create pelletizing problems.

Bentonite, a silicious clay, is normally used as a binding agent to strengthen green pellets and is added at a rate of 12 to 15 pounds per ton of concentrate. Bentonite was one of the first additives used in pelletizing, and research has not yet presented a better one.

During pellet hardening the green pellets or balls are heated at high temperature and pellet strength is developed by the grain growth between the ore particles which in effect welds them together. The magnetic concentrate consists almost entirely of magnetite (Fe_3O_4) which is ideally suited to this form of hardening because grain growth will proceed at a somewhat lower temperature and it can be oxidized during the process to provide a significant amount of the heat requirements. Hematite, on the other hand, requires a higher firing temperature to promote grain growth; moreover, it does not provide heat of oxidation. The hydrated iron oxides such as goethite and limonite present even more problems in that removal of water by hydration not only requires additional heat, but also results in undesirable shrinkage of the ore particles.

Another promising technique, under development at the Minneapolis Metallurgy Research Center, is referred to as prereduction. In this procedure an excess of solid fuel is added to promote reduction simultaneously with hardening. Two significant ends are achieved by this procedure: First, the ore is reduced from hematite successively to magnetite, wustite (FeO), and finally to metallic iron. Fortunately, magnetite and metallic iron undergo grain growth at lower temperatures than hematite. Secondly, the iron content is increased to about 80 percent, most of which is present as metallic iron. As the metallic iron will require no further reduction in the blast furnace, it is to be expected that coke requirements in the blast furnace would decrease and productivity would increase.

The benefits of taconite pellets have already been well established by the consuming industry. Higher and higher grade pellets have been possible through improved technology, and blast furnace efficiency has been improved correspondingly; fuel rates have been reduced and productivity has increased. One of the Bureau's outstanding developments has been to establish the superiority of pellets and to increase blast furnace productivity through the introduction of fuels in the tuyere zone. The latter development has been adopted by at least 27 domestic blast furnaces. Some of the research described above is designed to improve still further this new and superior blast furnace feed and to make a better product through prereduction. New ideas are being sought and new projects proposed and a review of activities at the Minneapolis Metallurgy Research Center in a very few years will reveal a marked change in program as new approaches develop and as present research is accepted and put in practice by industry. The big problem still unsolved, however, is to shift a greater share of domestic raw material requirements for the iron and steel industry to the still untapped sources of the Lake Superior region. We believe that the technical problems involved constitute important barriers to the full and rapid development of the area and a continued and accelerated research program is needed.

STATEMENT BY H. G. IVERSON, CHIEF, BRANCH OF METALLURGY RESEARCH
IRON AND STEEL METALLURGY PROGRAM

The iron and steel industry in the United States has undergone significant changes in the last two decades. These changes embrace the severe depletion of high grade or direct shipping ore; increased imports of ore; increased utilization of low-grade domestic materials with attendant changes in mining methods and greater application of beneficiation; and improved blast furnace operations occasioned to some extent by the use of the high-grade beneficiated products; and by new developments in steelmaking technology. All of these segments, together with the tremendous expansion in domestic steelmaking capacity, are pertinent to the iron ore situation in the Lake Superior district.

The Lake Superior district including parts of Minnesota, Wisconsin, and Michigan has been by far the largest domestic source of iron ore, and it has the largest resources in the form of low-grade ore that gives promise of commercial use. Over this large area the ore varies structurally and mineralogically, as well as in iron content. Taking the Mesabi range as one example, a zone averaging several miles wide and approximately 100 miles in length, only relatively small discontinuous areas have been shown to contain magnetite as the chief iron mineral. This iron mineral is easily recovered by magnetic separation. However, most of the low-grade ore in this range contains iron, chiefly in the form of hematite, which is nonmagnetic. Retrieval from such ore of both the hematite and the magnetite minerals is essential to satisfactory recovery and such an economic method has not been devised.

Hence, the economic utilization of the low-grade iron ores in the Lake Superior district involves the entire spectrum of iron technologies. These include resources measurement, ore classification, mining, beneficiation, agglomeration of the concentrate to prepare suitable blast furnace feed, blast furnacing, steelmaking, and alternative reduction methods.

The Bureau of Mines in cooperation with industry is continuing research on all of these technologic "fronts," specializing in areas that complement industry efforts. Major breakthroughs in any of them could significantly benefit the Lake Superior district. In dwelling briefly on the Bureau of Mines program it is convenient to begin with the end product, steel. In steel the research is confined principally to (1) fundamental aspects which may permit a greater elimination of impurities and, thus, the production of better steel, (2) in techniques for making superstrength steel as special materials, and (3) in improving steelmaking practices. The blast furnace product, pig iron, is the intermediate product between blast furnace feed and steel. Hence, the blast furnace operation is a key step, as significant economies achieved there could affect markedly the increased use of the low-grade iron resources. In its blast furnace research the Bureau of Mines, for the first time in the United States, demonstrated that such economies could be achieved by injecting fuel in the smelting zone of the furnace. This research is continuing to evaluate various types of injected fuels for various types of blast furnace feed. This development has been adopted by industry and is being used on a number of industrial furnaces.

Further important economies in blast furnace operation may spring from Bureau research in preparing better blast furnace feed through basic and applied research, taking advantage of the remarkable uniformity and purity of concentrates as compared with ore. This includes devising methods for making from finely ground concentrate strong and easily reduced iron pellets of uniform size and composition as feed to the iron blast furnace. Beneficiation or concentration of the low-grade iron ores is intensively studied, particularly the low-grade hematite-bearing materials occurring in the Lake Superior district. Promising results have been achieved on the ores studied in making exceptionally high grade concentrate at high recoveries. Inasmuch as approximately 3 tons of the low-grade iron ore must be mined to produce one ton of iron blast furnace feed, mining research directed toward lower mining costs is an integral part of the Bureau's research program. This recently initiated research includes basic and applied study of fragmentation which in turn calls for efficient drilling for the most effective placement of selected explosives. Lastly, a study to delineate and classify the low-grade iron ore resources in the Lake Superior district is continuing. A result of this study was the Bureau report on the Lake Superior Iron Resources, Report of Investigations 5670. Through further study of the deposits the Bureau and industry will obtain a better understanding of these resources which will guide the mining and metallurgical research investigations.

Senator MILLER. Mr. Chairman, I wonder if I could ask if the chairman could direct the staff to obtain from the Internal Revenue Service a short statement showing the percentage depletion allowances to our domestic ores, taconite and iron ore, what they have been, let us say, for the last 10 years, and also the percentage depletion that is allowed in the case of foreign-produced ore.

Senator CARROLL. That is right. I think the staff member will know what we are getting at here. We know there is domestic depletion. If American corporations go into a foreign country, does it take depletion allowances outside the continental limits? You understand the import of Senator Miller's question?

Mr. DWYER. Yes, sir.

Senator CARROLL. Let us put that in the record at this point. Take a look at that offset statute, too.

Mr. DWYER. We will direct a memorandum to the Internal Revenue Service.

(The following communication was received, responsive to a request for the information:)

U.S. TREASURY DEPARTMENT,
INTERNAL REVENUE SERVICE,
Washington, D.C., July 12, 1961.

Hon. CLINTON P. ANDERSON,
U.S. Senate, Washington, D.C.

DEAR SENATOR ANDERSON: Your letter of June 26, 1961, asked us to supply the U.S. Senate Committee on Interior and Insular Affairs with a statement setting forth the percentage depletion allowed producers of taconite and other iron ores for the past 10 years.

During these last 10 years the rate of percentage depletion allowed for iron ores, including taconite, has been and now is 15 percent. This rate applies to domestic production, and also to production by domestic corporations (or other domestic producers) from foreign sources. The applicable citations are secs. 613(b)(3)(A) and 613(c)(4)(C) of the Internal Revenue Code of 1954, and secs. 114(b)(4)(A)(iii) and 114(b)(4)(B)(iii) of the Internal Revenue Code of 1939, and Rev. Rul. 184, 1953-2 C.B. 158.

You also asked what percentage depletion to their own nationals or to American business enterprises, is allowed by the foreign iron ore producing countries that provide the largest tonnages of our iron ore imports. According to data on page 556 of the U.S. Bureau of Mines Mineral Yearbook for 1959, iron ore imported into the United States in that year totaled 35,613,000 long tons, and we note that 98.6 percent of this total came from Venezuela, Canada, Chile, Peru, Brazil, and Liberia in descending order, and that 75.8 percent came from Venezuela and Canada. The latest information on the tax laws of the countries named is not available here. Therefore, to expedite assembling the data, we are taking the liberty of referring copies of your letter and our reply to the Department of Commerce, Bureau of Foreign Commerce, Office of Economic Affairs, for the attention of Mr. A. M. Liveright, Assistant to the Director, with whom your question has been discussed.

Sincerely yours,

NED W. ARICK,
Director, Special Technical Services Division.

(The following letter and memorandums were subsequently submitted for the record:)

U.S. DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN COMMERCE,
Washington, D.C., July 24, 1961.

Hon. CLINTON P. ANDERSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR SENATOR ANDERSON: Your letter of June 26 to the Commissioner, Internal Revenue Service, has been referred to this Department for reply to the question concerning depletion allowances granted to United States and domestic produc-

ers by the governments of the leading foreign iron ore producers exporting to the United States.

A partial reply to you from the Internal Revenue Service, dated July 12, indicated that the major suppliers of iron ore to the United States are Venezuela, Canada, Chile, Peru, Brazil, and Liberia. Accordingly, we are enclosing memorandums giving the available information for these countries.

If you have further questions on this matter, we shall be glad to try to answer them.

Sincerely yours,

JOHN C. BORTON, *Acting Director.*

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN COMMERCE,
Washington, D.C.

BRAZIL: DEPLETION ALLOWANCE FOR MINING ENTERPRISES

The Brazilian income tax law does not specifically prescribe the extent of the allowable annual deduction for depletion. The law merely states that the deduction must be reasonable and not in excess of the amount commonly accepted in similar cases. The deduction is based on cost.

The rate of amortization for mining operations is determined in each individual case by the Income Tax Division, acting on the basis of data supplied by the Bureau of Mines, of the Ministry of Mines and Power. The following explanation of the method used in fixing the rate is excerpted from "Taxation in Brazil" (Harvard Law School, World Tax Series, Little, Brown & Co., 1957) :

"The contents of the deposit are estimated by the Bureau of Mines in proceedings preparatory to the issuance of a mining permit. The time limitation for the concession is stated in the permit and based on the expected life of the mine, which in turn depends on the claimant's own estimate of the intensity of operations. In examining this estimate, the Bureau considers the equipment of the claimant. On the same basis, the claimant then secures from the Income Tax Division a determination of the applicable rate of amortization, which is, in effect, merely an approval of the data established by the Bureau of Mines. In principle, this forecast should be reviewed from time to time on the basis of the miner's experience or a change of equipment, but this is rarely done. In actual practice, the estimates of the Bureau of Mines are always kept low, with the result that the deposit is never exhausted when the concession expires. Since the Bureau then grants an extension of the concession, mining companies do not usually secure a revision of the amortization rate during the life of the concession.

"If an extension of the concession is granted because the original estimate was too low, a new appraisal is made and the rate of amortization is redetermined."

DEPLETION ALLOWANCE FOR U.S. AND DOMESTICALLY OWNED ENTERPRISES PRODUCING TACONITE AND OTHER IRON ORES

PERU

Article 54 of the Peruvian Mining Code of 1950 provides for a depletion allowance based on the gross value of the product sold during the year. A depletion allowance of 15 percent of that figure is allowed for metallic mines and 5 percent for coal and nonmetallic mines up to a limit of 50 percent of the net profits for the fiscal year. In computing net profits, the depletion allowance is deducted. This allowance is free from all taxes except the surface tax. Taconite and other iron ores have a depletion allowance of 15 percent, subject to the limitations mentioned above. The Peruvian Mining Code does not distinguish between foreign and domestic enterprises in regard to determination of depletion allowances.

CHILE

Category IV of the Chilean income tax law provides for the taxing of income derived from metallurgical and mining activities. For all practical purposes Chile does not permit deductions for depletion of mineral deposits to taxpayers in this category, although mining and metallurgical enterprises which use their own real estate parcels exclusively for earning income in this category

are permitted to exclude from gross income 7 percent of the assessed value of that property. In category IV, net income is taxable at 32 percent. For corporations or limited partnerships where the shareholders or partners pay taxes under category II (income derived from dividends, annuities, or other personal property) the tax in category IV is reduced to 25 percent.

However, separate legislation has resulted in special tax regimes for the principal mines now being operated in Chile. Since 1929, the Chilean President has been empowered to sign long-term contracts with iron mining companies. In these contracts, he may commit the Government to a refund of the part of the normal category IV income tax which exceeds 6 percent of net income. Bethlehem-Chile Iron Mines Co., the largest producer in Chile, enjoys this 6 percent ceiling with regard to its El Tofo mine, but, in 1950, as a condition for the contract which it signed for the working of its El Romeral property, the company waived any right to a refund of the applicable category IV tax which might exceed 6 percent. The latter property is therefore subject to the full 32 percent rate now applicable under category IV.

As far as is known the foregoing tax law provisions apply equally to domestic and foreign owned companies. Local companies enjoy certain other types of tax benefits.

VENEZUELA

The partial reform of the income tax law of Venezuela of February 13, 1961 (published in Official Gazette No. 669 Extraordinary, of February 17, 1961), "Chapter V: The Tax Upon Benefits from Mining and Hydrocarbons and Related Activities," article 16 states: "To determine the net income, there shall be deducted from the gross revenues the costs incurred in the country, the deductions expressly set forth in this chapter and the other normal and necessary expenses incurred in the country for the purpose of producing income."

Chapter V, article 19, states: "In accordance with the provisions of article 16, the following are also deductible—a reasonable amount to cover the depreciation of fixed assets."

Venezuelan law does not specify a percentage or other quantitative limitation on its depreciation deduction, but calls for a reasonable amount. In arriving at a reasonable amount, the practice has been to base such a deduction on production in the taxable year as related to known reserves of the mining property.

Venezuelan law makes no distinction between domestic and U.S. owned enterprises in the mining industry.

CANADA: DEPLETION ALLOWANCES FOR IRON ORE MINES

Canadian iron ore production is in greatest volume in hematite, magnetite, and siderite in that order. There is also small byproduct output from ilmenite, copper, and nickel production. No specific information is available on depletion allowances granted to individual producers. The following data pertain to allowances stipulated in the Federal income tax regulations.

Operators.—An operator of a metalliferous or industrial mineral mine (except a gold mine) may deduct 33⅓ percent of the net profits reasonably attributable to production.

Regardless of the cost of the properties, the depletion allowance is continuous as long as production is secured, with the exception of the initial 3 years of mine operation during which profits are exempt from Federal income tax.

The cost of an industrial mineral mine where the mineral is contained in a bedded deposit may be amortized over the production life of the mine. The rate of amortization is determined by dividing the cost of the property, less residual value, by the total number of units of commercially mineable material estimated to be contained therein. The allowance in respect of any fiscal period is then computed by applying this rate to the number of units mined during the period.

Nonoperators.—Where a person, other than an operator, has an interest in the proceeds or receives a rental or royalty computed by reference to the amount or value of production, the deduction allowed is 25 percent.

Shareholders.—Shareholders resident in Canada, who receive a dividend from a corporation resident in Canada, may deduct an allowance in respect of dividend

if 25 percent or more of the corporation's income is derived from mineral profits. The rate of allowance varies from 10 to 20 percent, depending on the ratio of mineral profits to the total income of the corporation paying the dividend.

Source: "Summary review of Federal taxation and other legislation affecting mining, oil and natural gas enterprises in Canada," Canadian Department of Mines and Technical Surveys, Ottawa, 1959. (Current, so far as above provisions are concerned.)

LIBERIA

Arrangements for all tax agreements for foreign businesses are effected on an ad hoc basis, by special agreement with the President of Liberia and upon approval of the legislature, since there is no governing statute.

The following excerpt is quoted verbatim from the Liberian Code of Laws of 1956: Chapter 46. Fiscal.

"1200. *President may monopolize sale and export of gold and minerals.*—The President is authorized, either directly or through such agency as he may designate, to:

(a) Monopolize for the benefit of the Republic of Liberia the sale and export of gold and other minerals taken from Liberian soil;

(b) Establish prices at which gold and other minerals shall be sold;

(c) Enter any agreement he may deem necessary to carry out the purposes of this section; and

(d) Issue such rules and regulations relating to mining, sale, and export of gold and other minerals as he may deem necessary to carry out the purposes of this section, such rules and regulations to have the full force and effect of law.

"1201. *President may modify taxes on gold and minerals.*—The President is authorized to suspend, abrogate, or modify any tax, fee, royalty, or duty applicable to gold and other minerals: * * *

As an example of a tax agreement made in 1957, that between the Liberia Mining Co., and the Government of Liberia is shown:

The Liberia Mining Co. (in which the Republic has an interest) pays a royalty of \$1.55 per ton of iron ore mined.

It is also required to pay an exploitation tax of \$0.05 per acre during the first 5 years of its 80-year concession, \$0.06 during the next 5 years, \$0.10 during the next 10 years, and \$0.25 thereafter. During the exploration period, the company paid an exploration tax of \$250 per month. Beginning April 1, 1957, the company paid a 25-percent income tax on net profits which is carried for a 5-year period, which will rise up to 35 percent for the next 10 years and 50 percent thereafter.

The Department of Commerce is not aware of any specific tax legislation relating to depletion.

Senator DWORSHAK. Mr. Ankeny, you intrigued me a few minutes ago and I regret I had to attend an Appropriations Committee meeting and did not hear all your testimony. You mentioned that there is an urgent need of reducing the labor cost of production. Do you have any suggestion in mind on that?

Mr. ANKENY. No, sir, I do not have. I merely mentioned that as one of the factors that would have to be taken into consideration if we are going to reduce the cost of the product in that area.

Senator DWORSHAK. Of course, you know that we have had a seamen's strike recently and information indicated what I have known for many, many years—I presume all Members of the Congress have—that we subsidized, through the payment of millions of dollars out of the Federal Treasury about three-fourths of the wages paid in most of our merchant ships by the operators in order to make it possible to hire American seamen instead of seamen from foreign countries who would work at a much lower wage scale.

You are aware of that?

Mr. ANKENY. Yes.

Senator DWORSHAK. I wonder sometimes if maybe that is where we are heading in mining of lead-zinc and the production of about everything in this country; let the Government take over and subsidize about half the cost of production to maintain high living standards but to make it possible for us to compete in world markets. Have you ever considered that? All of us recognize we have to reduce the cost of production, not only of iron ore, but of everything. Have you any real suggestions?

Mr. ANKENY. No, sir: I have no suggestion.

Senator DWORSHAK. Do you think we could apply this same policy that is used in the merchant marine that costs us \$60 or \$70 million a year to subsidize the wages of the seamen. Could we apply that same principle in the iron ore mines, the lead-zinc mines, and the copper mines of this country?

Mr. ANKENY. I am sure we could, but I don't think we should.

Senator DWORSHAK. That is a very fine answer. Thank you.

Senator CARROLL. Gentlemen, thank you very much. When we recess this hearing today I am going to keep the record open because there may be others who want to file statements and if you have any further observation you want to make on this issue I will be glad to hear from you. We are seeking an answer. These are very difficult problems that we are facing, not only in this industry, but in many industries. It may be that we will have to come up with some sort of a subsidy. If we have a national policy that drives an industry out of business we may have to do something about it. This is exactly what we did in a sense with sugar. It was easier there because we couldn't produce to meet the needs of the Nation. Then we could impose quotas and this has been successful and nobody contended that it was socialistic because most of the refineries and the farmers who benefited, at least in my State, are all in the Republican area, and it never made them Socialists, the benefits didn't even make Democrats out of them.

Senator DWORSHAK. The refineries are largely in eastern Democratic areas.

Senator CARROLL. We thank you very much, gentlemen.

Now, Senator Proxmire, you may present your witnesses.

Senator PROXMIRE. Yes. Your next witnesses, Mr. Chairman, are Professors Tiemann and Clark.

Senator CARROLL. Will you kindly come forward together. Do you want to come together, or separately?

Senator PROXMIRE. I would like to say, Mr. Chairman, that Professor Tiemann and Professor Clark are both from the University of Wisconsin and they are highly and warmly recommended by the university as the outstanding experts in our State on this subject on which you are holding hearings. I think, gentlemen, that the chairman and Senator Miller have done a very fine job of setting forth the problem that confronts us in this State here in differentiating between the situation as far as furnace, domestic furnace-grade iron ore is concerned, which I understand is now a somewhat lower grade, and foreign furnace-grade ore, which is a higher grade, on the one hand and taconite, on the other, and I think with the testimony we have had from the Bureau of Mines setting forth the fact that we obviously need research, and experimentation, and a great deal of work in taconite to make it

competitive, it seems the testimony we have had so far indicates the prospects may be quite good that it may become competitive. This is the kind of enlightenment we need. I might say just one more word, Mr. Chairman. Up in northern Wisconsin this is just overwhelmingly important. We have very heavy underemployment and unemployment in the mining areas. We have considerable taconite prospects and possibilities up there and the people of Wisconsin are tremendously interested. We have already had the former Governor, Governor Thomson, who is now a Congressman, appear before this committee earlier today. Also he is a former attorney general.

We have in the audience a man representing the AFL-CIO in this area, Mr. Peter Bensoni, who I understand is going to submit a statement for the committee, so that that will be available, and I think there is just such an overwhelming feeling on the part of business, labor, farm people, and all of our people in Wisconsin that we are just earnestly hoping that research can solve the problem that will make taconite useful and competitive.

Senator CARROLL. What is your unemployment, Senator Proxmire, in that area, in Wisconsin?

Senator PROXMIRE. It varies a great deal. If I could call on Mr. Bensoni perhaps he would tell us what the unemployment is in the Hurley area, for example. Here is where we have a concentration.

Mr. BENSONI (Peter J. Bensoni, representative, United Steelworkers of America). At the last report it was running around 16 percent; 16 and a fraction percent.

Senator PROXMIRE. In the iron ore mining area right around Hurley?

Mr. BENSONI. Yes.

Senator DWORSHAK. How long has it been that high?

Mr. BENSONI. It has been continuously declining since December of 1957. It started to decline and has been declining almost progressively since then.

Senator MILLER. Might I ask how many that would be in terms of numbers of people? What does 16 percent mean? Does it mean 10,000, 5,000, or could you give us a rough idea?

Mr. BENSONI. No, in Iron County in Wisconsin there are only two mines. They are both underground. They totally employ, I would say, at peak production about 1,200 people. Of course everything else is dependent upon those two mines because that is the only industry in that area. When they go down everything else goes down with it—logging, milling, timbering, and everything else, commerce, shipping. With the dock facilities in Ashland, Wis., a town located about 140 miles away, which is dependent upon mining, that town suffers and everything within the region suffers.

Senator PROXMIRE. If the Senator would yield, I think we can make those available to you for the record and I will consult today with the Wisconsin authorities and get that from the unemployment compensation records.

(The information referred to follows:)

For the week ending August 18, 1961, the Wisconsin unemployment compensation division received 830 claims for employment benefits from the area comprising the counties of Iron, Ashland, Price, and Bayfield. Workers in these counties who are covered under both the regular and the extended program of unemployment compensation benefits total 6,045. This represents a current unemployment

figure of 13.7 percent, as compared to an unemployment rate of 5.3 percent of covered workers for the State as a whole. These figures suggest a far higher rate for Iron County itself, in view of the fact that employment in Iron County is so overwhelmingly dependent on the mines at Hurley.

Senator CARROLL. I think it would be a good idea to have it in the record and not only show the employment, but the effect upon the service establishments in the whole area. In 1957 I was up in Hibbing—I will speak for Congressman John Blatnik—and it seemed to me there was great prosperity in that area. My reading indicates that there has been a decline as this last gentleman has said. It is reflected in the charts here, and I think we ought to know what has been happening in that area.

Senator PROXMIRE. I might say that our difficulty is somewhat different from both Michigan and Minnesota. Hurley is the one area that has suffered for many, many years, for generations. We have had also a long-term depression because of the lumber industry in the cut-over area. Because of this kind of a situation we have had people who have looked forward to the prospects of developing taconite and moving from the depressed lumber industry into possibly mining. They want to do this and they are looking forward not only from the standpoint of trying to have an industry that has functioned in the past recover, but I think to a greater extent perhaps from the standpoint of hoping that we can rebuild our economy in northern Wisconsin on the basis of mining, so it is a double situation. Before closing I would like to insert in the record an article from a publication called the Thirtieth Star.

(The article follows:)

[From the Thirtieth Star, May 1960]

LOW-GRADE IRON ORE IN WISCONSIN

(By George F. Hanson, Wisconsin State geologist)

Iron is a very common element. In fact, the rocks that compose the crust of the earth contain, on an average, 5 percent iron. However, most of the iron ore that our industry demands must contain at least 50 percent iron. Therefore the iron-bearing minerals must be concentrated by nature, or by man, or by both, before they can be used in our blast furnaces to produce the metallic iron upon which our civilization depends.

The first step in concentrating occurred over 1,000 million years ago when shallow seas covered parts of the world which are now dry land. In some areas during this period a unique type of sediment which consisted of thin, alternating layers of silica (chert) and iron carbonate (siderite) was deposited on the sea floors. Just why this type of sediment should have been deposited during only one relatively short period of geologic time is still an unanswered question, but it is found on every continent except Antarctica, where it also may very well be discovered when we learn more about the geology of this vast, unexplored continent.

These iron-bearing sediments, now very solid rocks, are called Lake Superior-type iron-formation as they were first studied in this area. The iron formation contains about 25 percent iron, and although this represents a fivefold concentration over the average occurrence in nature, it is still not high enough to be used as ore in the furnaces.

Nature's second stage of concentrating took place during the eons of time that followed the deposition of the iron formation. The iron carbonate was turned into iron oxides and, in a few select areas, the silica was dissolved away to leave masses of almost pure iron oxide containing 50 to 60 percent iron. These masses constitute our high-grade ore bodies of direct shipping ore, so-called because it may be mined and shipped to the blast furnaces without any further processing.



The first shipment of ore from the Lake Superior region was in 1852 and, as new deposits were discovered, the area soon became the main source of iron ore for the country. At first the deposits seemed limitless, but as time went by, it became obvious that our supplies of direct shipping ore would not last indefinitely. The high-grade ore bodies were few and far between like plums in a pudding, but there still remained vast quantities of iron formation. Therefore intensive research was undertaken to find an economical method to improve Nature's handiwork and to convert the iron formation into high-grade ore.

We have been talking about ore and probably everyone feels quite certain he knows what the term means without having it defined. Actually very few people realize that ores are special kinds of rocks from which one or more metals may be extracted at a profit. The essential idea is that if the metal cannot be extracted at a profit, the rock is not ore. Thus the same rock may be ore one day and not the next, depending upon the fluctuating market price of the metal involved. Similarly a rock which today is valueless may become ore tomorrow as new demands and advanced technology permit it to be profitably mined.

The problem of making high-grade concentrates out of iron formation presented many difficulties. Surprisingly, the amount of iron in the formation was of secondary concern, as this remained fairly constant.

The first concern was with the mineralogy, as the iron could be present in many different mineral forms. Some iron oxides are very soft and some hard, some are magnetic and some are nonmagnetic. As magnetic iron oxide can be separated fairly simply and inexpensively, areas where the iron was predominantly in the form of magnetite were first to be investigated.

The second concern was with the texture of the iron formation. In order to liberate the iron minerals from the inclosing impurities it was necessary to grind the rock as fine as flour. The larger the size of the mineral grains—that is, the coarser the rock texture—the easier and less costly it is to separate them.

The third concern was with reserves, that is to say the amount of suitable iron formation available. In the case of high-grade ore bodies only a relatively small investment was necessary to open a mine, and the profits from the sale of the ore could be used to enlarge the operation. However, in the case of a beneficiating plant it is necessary to invest about \$40 for every annual ton of concentrate production. As the smallest plants are designed to produce about 1 million tons of concentrates a year, the operators must spend some \$40 million in plant construction before they can earn one penny. It is, therefore, obvious that there must be enough ore available to permit them to operate for very many years in order to recover their investment.

So far we have been talking of the physical requirements for the successful operation of a concentrating plant. A fourth, and very significant, requirement is what might be termed "favorable political climate." This means that the State, and its legislators, must understand the industry and its problems; that the tax laws shall be fair and equitable; and that they not be changed indiscriminately over the years. In other words, all other things being equal, a mining company will establish itself preferably in an area where it feels it is wanted and where its contribution to the economy will be appreciated.

In 1953 the Oliver Iron Mining Division of the United States Steel Corp. completed the first pilot plant, which they called Pilotac,¹ and the first production of manmade iron concentrates containing 63 to 65 percent iron began. This was on the Mesabi Range of Minnesota where the hard, magnetic iron formation is called taconite and this term has now become rather generally misapplied to all iron formations and the concentrating industry as a whole. Soon plants were developed to process coarse, nonmagnetic iron formation in Michigan (where they call it jasper).

It was not long before the companies found that the processed iron ore suited their purpose much better than the direct-shipping ore they had been using, and even producers of some premium grade ore found increasing difficulty in marketing their product in the face of the competition from the concentrated ores.

The future of the iron ore industry in the Lake Superior district had definitely been established; it was, however, no longer based on the direct-shipping ores but on the beneficial iron formation.

What can Wisconsin look forward to from this new industry?

¹ Readers who are interested in the technology of concentrating may obtain the booklet called "This Is PILOTAC—An Experimental Taconite Plant" by writing to the Oliver Iron Mining Division, United States Steel Corp., Wolvin Building, Duluth, Minn. A limited supply is available.

Lake Superior type iron-formation is known at several localities (see p. 4) but only three offer promise of development in the near future. These are, (1) the Gogebic Range, (2) the Pine Lake area, (3) the Butternut area.

The Gogebic Range is about 80 miles long, of which some 53 miles lie within Iron, Ashland, and Bayfield Counties of Wisconsin. The high-grade ore bodies are found in the eastern end of the range, but toward its western end the iron-formation becomes more and more magnetic, hence more desirable for concentrating. In spite of its magnetic nature the iron-formation is very fine-grained, hence it is both difficult and costly to liberate the iron minerals. It is hoped that this problem will be solved as technology improves, but, whereas no immediate development of the range can be contemplated, it is almost certain that these very large reserves will be utilized in the years to come.

The Pine Lake area lies about 12 miles south of Hurley in Iron County. Here the iron-formation is also magnetic a fact which gave the name Magnetic Center to a small lakeside community that has disappeared. Tests are being conducted in this area by a mining company to determine whether the nature and amount of iron-formation is suitable for concentrating.

The Butternut area in southern Ashland County has been the most extensively explored to date, and if any readers may be dubious about the nature of magnetic iron-formation, here is a good place to demonstrate its effect. A band of the magnetic iron-formation passes under Highway 13 at the southern end of town, and if you drive slowly up the main street with a compass you will find that at one place the needle will suddenly swing around so that its north end will be pointing toward the south.

Preliminary tests in this area have been very encouraging and the construction of a plant to produce a million or more tons of concentrates per year is in the talking stage. Unfortunately the complex and changing economics of the iron ore industry do not permit predictions with certainty, but at present this area seems most likely to attract development.

What would a million-ton plant mean to the economy of an area?

Increased tax revenues to be sure, but these are only a fraction of the benefits. If we can make a comparison with the Erie Mining Co. of Minnesota, the payroll should be on the order of \$1,500,000 per year. This in turn would be spread through the community to support a host of other business enterprises.

What can we do to encourage the development of our low-grade iron ore resources?

We cannot change the nature of our iron-formation but we should undertake basic research on its location, mineralogy, and texture in order to learn not only how it differs but why, and thus perhaps find new approaches to problems of exploration and beneficiation.

Our present tax laws are as favorable to the development of low-grade iron ore as those of Michigan and somewhat more favorable than those of Minnesota.

The State administration and legislators have made every effort to understand the industry and its special problems and, where necessary, to pass legislation to overcome obstacles to its development.

We hope that we can attract this new and much-needed industry to northern Wisconsin, but our success will only be known with time.

Senator CARROLL. I thank the Senator very much.

Professor Tiemann and Professor Clark, do you gentlemen want to lead off here? I might say for the record this is Prof. T. D. Tiemann and Prof. L. D. Clark of the Department of Mining and Metallurgy, University of Wisconsin. Proceed.

Do you have a prepared statement?

STATEMENTS OF PROF. T. D. TIEMANN, AND PROF. L. D. CLARK, DEPARTMENT OF MINING AND METALLURGY, UNIVERSITY OF WISCONSIN

Mr. TIEMANN. No.

Mr. CLARK. I have no prepared statement. The chairman of the department, I think, sent a statement in which I will refer to here,

but I wanted to say that my main effort has always been in the area of mining engineering, so naturally my interest in this hearing lies from that standpoint, and since we have been talking in the main here this morning in connection with processing and costs of processing I think there isn't too much that I can say at this point and perhaps Professor Tiemann could make some statements in that respect.

Senator CARROLL. Since the discussion has been mainly from the standpoint of processing of ores, I think perhaps this lies more in Professor Tiemann's field at the moment. First of all, as far as I am concerned, it is a national issue that you have to consider. I cannot help but consider the State of Wisconsin itself, as Senator Proxmire has mentioned, so perhaps Professor Tiemann can discuss the problems of research and so forth that we are conducting at Wisconsin in connection with the processing of these ores.

First, is there a serious economic condition?

Mr. CLARK. As Senator Proxmire said, yes, in the northern part of the State, in the area of where these low-grade ores occur, which we refer to as the Gogebic in Wisconsin, particularly the western end.

Senator CARROLL. And you are familiar with the importation of Canadian and Venezuelan ores?

Mr. CLARK. Yes, I know that situation. I don't pose as an expert on the statistics involved, but I do know of course that we are confronted with the importation of foreign ores.

Senator CARROLL. What we would like to do is to have your opinion about the possibility of immediate progress in basic research and whether or not we should impose quotas. What do we do to help the people in this area? What do we do to reestablish the economy of this area?

Mr. CLARK. I think it has already been stated that it is a matter of cost to begin with. If it were possible to put out a product that would be in competition with the foreign imports the situation would be considerably improved. There is no question about that. This involves processing, of course, but again I remark that my interests lie in the mining end of it, and of course it would involve economic mining processes likewise. If it costs too much to mine it, then right on down the line it is going to cost too much. Dr. Tiemann has been carrying out research at the university on particularly the nonmagnetic taconite ores and at this point perhaps he would say it from there and then I could add anything about which you might wish to know.

Senator CARROLL. All right. Thank you very much.

Mr. TIEMANN. It has been of quite some concern to me, the fact that so much of our money in this country is going abroad, and I think we are somewhat in the situation similar to that of the aluminum industry during World War II. In other words, I think that money spent on research to develop our ore deposits, the low-grade ones, within our own country is very necessary, particularly from a standpoint of national security. I think you will recall, Mr. Chairman, that during World War II there were no shipments of bauxite into this country and yet our aluminum industry depends on about 90 percent of the imports of bauxite into this country. I think we have the same situation here from a longtime aspect and from a national security aspect of developing extremely low-grade deposits. I think in the field of research the universities and the U.S. Bureau of Mines,

or let us say the Government, State and National, are the ones that are in the position to carry out this type of research rather than an industry which cannot afford to do so because they are interested of course in profit.

In this respect I will read from a statement by Professor Rosenthal of our department:

University laboratories are particularly suited for conducting this type of research required to establish the foundation for economical treatment of low-grade ores. Not only do they have the equipment available and the expert staff to guide the research, but the students who earn their degrees while working on these problems add to the supply of technical personnel available to the country to continue work in this field.

I think this is an important point from the standpoint of university research.

Senator CARROLL. In university research do you operate under contract with the Bureau of Mines?

Mr. TIEMANN. No, most of our research at Wisconsin in our department is simply supported by the experiment station of the school or by the Wisconsin Alumni Association.

Senator CARROLL. Do you have any Federal help at all?

Mr. TIEMANN. We have some through National Science Foundation but not on this specific project.

Mr. CLARK. That, if I might interrupt for a moment, brings up a point, in that insofar as the funds from National Science Foundation are concerned, they are generally earmarked for particularly basic and fundamental research that doesn't usually apply to development research of this nature, and we find ourselves a little handicapped in that area through National Science Foundation funds in that we have not, at least up to now, been able to use those funds for a particular type of development research in such an area as this low-grade ore.

Senator CARROLL. Has industry contributed to the university to help you in this?

Mr. TIEMANN. Not in this particular field, no.

Senator DWORSHAK. Are they doing anything on their own?

Mr. CLARK. Oh, yes.

Mr. TIEMANN. Yes, but I would not say in the extremely low-grade nonmagnetic taconite which Mr. Ankeny discussed.

Senator CARROLL. You heard my statement here about the M. A. Hanna Co. Are you familiar with that company?

Mr. TIEMANN. Yes, I am.

Senator CARROLL. That is a low-grade ore, is it not, nonmagnetic?

Mr. TIEMANN. Yes, that is a low-grade, nonmagnetic ore.

Senator CARROLL. Can you tell us about the nature of their work and what they are doing?

Mr. TIEMANN. I am not familiar with it, Mr. Chairman. I think this is essentially a magnetic roast fold by a magnetic concentration.

Senator CARROLL. I am really thinking not so much of the process, but the possibilities of success, of a breakthrough in this area. If this is important, as it must be, to Wisconsin and Minnesota what are the prospects for the future?

Mr. TIEMANN. In my opinion the prospects for the future through technical development are very good, but this is a longtime proposition. Particularly in the taconite field we are talking about.

Senator DWORSHAK. Isn't there a big taconite enterprise near Virginia, Minn., that is operating very successfully?

Mr. TIEMANN. Yes, sir. I believe this though is magnetic taconite and we are discussing the nonmagnetic, which is a much more difficult process.

Senator CARROLL. You think that is really a long way in the future?

Mr. TIEMANN. The nonmagnetic.

Senator CARROLL. Yes.

Mr. TIEMANN. Particularly in our own area. This is very low-grade ore that we have. This is due primarily to the fact that the iron minerals and the silica are so extremely fine and intimately associated that it takes an extreme amount of fine grading to separate them. This in itself adds problems to the process subsequent to the grinding.

Senator CARROLL. Are you familiar with the amount of reserves in the area of Wisconsin and Minnesota?

Mr. TIEMANN. Yes, generally speaking. In the Gogebic Range, as stated by the Bureau of Mines, the tonnage runs into billions of tons when we are talking about this low-grade taconite. I think Professor Clark is more knowledgeable on that than I am.

Senator CARROLL. Let us forget about the nonmagnetic for a while because I think you have indicated this will be a long time in the future. What do we do about unemployment? Let us go over to the magnetic ores. What are our reserves?

Mr. CLARK. In Wisconsin the last report that I have indicates about 350 million tons of concentrated ore. The final result will be about 350 million tons on the western end of the Gogebic Range in Wisconsin. That is only a portion of the Gogebic Range, but I am referring to Wisconsin here.

Senator PROXMIRE. Roughly where is that?

Mr. CLARK. North and west, about 250 or 300 miles.

Senator PROXMIRE. It extends into Michigan?

Mr. CLARK. Yes.

Mr. TIEMANN. The Gogebic Range runs from, say, west of Mellen right across extending into the eastern end.

Senator CARROLL. 350 million?

Mr. CLARK. This is a concentrate. This is a high-grade product sent to the blast furnace.

Senator CARROLL. Right at this point, Mr. Director, in 1957 you said national production was about 106 million gross tons. What would that mean in concentrates?

Mr. RENO. That includes concentrates. That is in terms of usable ore, direct shipping ore, iron ore concentrates, and iron ore agglomerates. That is the total. Crude ore is something more than that, probably 150 million tons. I don't have the figures.

Senator CARROLL. I was thinking of the statement by Professor Clark of the 350 million tons of concentrates. What is the need of the Nation each year in terms of concentrates?

Mr. RENO. It depends on the grade of concentrates.

Mr. CLARK. I assume this would be in the neighborhood of 65 percent or thereabout.

Mr. RENO. I would say at the present time about 110 million tons of that.

Senator CARROLL. That is what I wanted to get at. In other words, you are saying that this range—

Mr. CLARK. This portion of the range. This is not the whole range. It would run into many times that if you considered the whole Gogebic Range. That is concerned with the western part in the State of Wisconsin, not including the Marquette or the Menominee.

Senator CARROLL. So in the State of Wisconsin we would have approximately enough for about 3 years in that section?

Mr. CLARK. On a national level consumption.

Senator PROXMIRE. For the whole country.

Senator CARROLL. Yes, for the whole country.

Mr. CLARK. That is what the figures would suggest, yes.

Senator CARROLL. And that is in the western part of Wisconsin?

Mr. CLARK. Yes, in the area that we are speaking of.

Senator CARROLL. Where does that range extend outside of that State?

Mr. CLARK. I could show you clearly here.

Senator CARROLL. We are talking now about the magnetic ores?

Mr. CLARK. Yes. If you take a look here, there is the Gogebic Range. There is the Wisconsin boundary. Here are the other ranges. This is the section I refer to.

Senator PROXMIRE. It extends over into Michigan. What would you say?

Mr. CLARK. Yes, I would imagine so.

Senator CARROLL. What is this?

Mr. CLARK. That is the Minnesota range.

Senator CARROLL. The range around Hibbing is called what?

Mr. CLARK. The Mesabi.

Senator CARROLL. Are you familiar with its potential?

Mr. CLARK. On a general basis, not anywhere near the detail that these gentlemen have with whom you have been discussing it.

Senator CARROLL. Mr. Director, can you tell us about the Mesabi Range and what its reserves are at this point?

Mr. RENO. I think the Geological Survey has estimated them at 5 billion tons of magnetic concentration.

Senator CARROLL. Five billion?

Mr. CLARK. I think they said that. Mr. Guild of the Geological Survey is here and perhaps you can get it exactly.

Mr. PHILIP GUILD (U.S. Geological Survey). I don't have an exact figure, but Professor Gruen of Minnesota in 1946 estimated 7 billion tons of magnetic taconite on the eastern end of the Mesabi Range, the end which contains the bulk of the magnetic material, as opposed to the western end which you were speaking about here recently in connection with the Hanna Co.

Mr. TIEMANN. Would that be in tons of concentrate, or ore in place?

Mr. GUILD. He was speaking here of in terms of ore in place to a mining depth of 220 feet as I recall. This is by no means the total that is available, but that part which is close enough to the surface that he felt there would be no problem whatsoever in extracting it economically if the other factors had been taken care of, and I may say that this estimate was published before any economic concentrating plants had been erected there around the Mesabi Range so this was an advance estimate of what might be available.

Senator CARROLL. In the Hibbing area, there is a great body of magnetic taconite. There is great unemployment up around Hibbing, too, isn't there, in the Hibbing area in Minnesota in the Mesabi Range?

Mr. ANKENY. Yes.

Senator CARROLL. You have great beds of magnetic taconite up there. Why do we have to concern ourselves so much about the basic research of the nonmagnetic ore when you have this great body of ore up there? I am not saying you shouldn't go ahead with basic research, but these are the researchs that are in being.

Mr. MELCHER. The magnetic taconites, sir, are located east of Hibbing quite a little way and are presently in commercial production. The area near and west of Hibbing are of the nonmagnetic variety.

Senator CARROLL. The point I had in mind is we know what this field can do, do we not?

Mr. ANKENY. Yes.

Senator CARROLL. Seven billion? Did I hear correctly?

Mr. GUILD. Yes, sir.

Senator CARROLL. That is an awful lot of ore, isn't it?

Mr. ANKENY. Yes.

Senator PROXMIRE. Professor Tiemann, you were talking about ore in place as compared with concentrate?

Mr. TIEMANN. Yes.

Senator PROXMIRE. How would you compute the 350 million with 7 billion?

Mr. TIEMANN. If you have 7 billion tons of concentrate of blast furnace grade, of a low-grade ore, you would require many times this of actual ore in place. Vice versa, if you had 7 billion tons of low-grade ore in place, it would not produce but a fraction of this in blast furnace concentrates.

Senator PROXMIRE. So this 350 million tons that you are talking about, and the chairman properly referred to as enough for a 3-year supply—

Mr. TIEMANN. This would be blast furnace feed.

Senator PROXMIRE. And the other was something that is not comparable at least until we correct it for the difference between ore in place and the concentrates?

Mr. TIEMANN. That is right.

Senator CARROLL. Do you follow my thinking on this? If we have 7 billion tons of ore in the Mesabi Range—

Mr. TIEMANN. Pardon the interruption, Mr. Chairman. I understand this statement as being 7 billion tons of magnetic?

Senator CARROLL. Magnetic ore. I was under that impression. This was the question I asked for, being magnetic ore.

Mr. GUILD. This is what Professor Gruen stated in writing.

Senator CARROLL. Now, I ask Director Ankeny, Is this statement accurate? Have you studied the Mesabi Range? Do they have that much ore up there?

Mr. RENO. We accept the Geological Survey's evaluation of it. From the work we have done we have had no reason to question it. In fact we would think that probably it would be closer to 10 than 7.

Senator CARROLL. Assuming we have 10 billion tons of ore up there, what would that mean in concentrates?

Mr. RENO. About 3 billion—3½—about a 3 to 1. It takes 3 tons of crude taconite to make 1 ton of concentrate.

Senator CARROLL. That would be for about 30 years, wouldn't it?

Mr. RENO. That is correct.

Senator CARROLL. This is just on the Mesabi Range alone. When you consider all these other ranges what is your estimate of our researches for the future? I was under the impression that the director or somebody said we only had enough for 10 years.

Mr. RENO. I think the director was referring to the direct furnace.

Mr. ANKENY. Direct furnace.

Senator CARROLL. This is why I am confused. The emphasis has been that we will be a long time getting a breakthrough on the non-magnetic ore, but the magnetic ores we already have. You must have enough. If you have enough for 30 years in the Mesabi Range I assume you have as much as that in other ranges so you have enough for 50 years. The magnetic taconite ore is now in production, that is to say, you are using it. Isn't that so?

Mr. MELCHER. That's true.

Senator CARROLL. How much of the production in 1957 of 106 billion was taconite ore and how much was furnace ore?

Mr. RENO. Approximately 8 to 10 million.

Senator CARROLL. Of the 106 million?

Mr. RENO. Yes.

Senator CARROLL. In other words, less than 10 percent?

Mr. RENO. That is correct. This last year I believe the total was about 12 million taconite-type concentrates.

Senator CARROLL. Which is preferable? The nonmagnetic taconite, or the magnetic?

Mr. RENO. At the present time the magnetic ore is the only type that can be treated economically as far as we know.

Senator CARROLL. Therefore, even if you had a breakthrough in this nonmagnetic ore it would not affect much the employment situation. It would take years, would it not?

Mr. RENO. The immediate employment situation it would not affect.

Senator CARROLL. Because even with the magnetic ore it only takes 10 percent, so your real unemployment problem comes from your blast furnace ore. Is that right?

Mr. ANKENY. That is right.

Senator CARROLL. Will you agree with that statement? These gentlemen are nodding their heads and they say that is right.

Mr. CLARK. Yes. As I understand it, the present blast furnace ores are, however, lowering this grade and could well be replaced by the lower grade or the concentrated lower grade ores eventually, so it is a case of one thing taking the place of the other eventually.

Senator CARROLL. Professor Clark, I am not quarrelling with the idea that we must continue on with basic research in the nonmagnetic ore or that we shouldn't continue to use magnetic ore, but it is so small compared to the real problem of how do we get these people back to work.

Senator PROXMIRE. Would the gentleman yield at this point?

Senator CARROLL. Glad to yield.

Senator PROXMIRE. I think the chairman is just at the crucial point here. You gentlemen talked about the importance of university research and also that there was no Federal assistance, although there was some university money and State money available. Do you have

any specific promising projects in applied research here, either in processing or mining, for magnetic ores that would enable us to make some kind of a breakthrough if we could get more work done on them, get more Federal money or more State money some way to get an opportunity to go to work on it?

Mr. TIEMANN. The work since I have been there at the university has been directed at the nonmagnetic taconite problem.

Senator PROXMIRE. Can you tell this committee then whether or not there is anything through research in your judgment that can be done in the short-term future that would help us open up this area, provide employment and provide an opportunity for the Nation to utilize its researches, to protect this from a national security standpoint.

Mr. TIEMANN. Could I ask what you mean by short-term?

Senator PROXMIRE. A few years, 2 or 3 years.

Mr. TIEMANN. We have been studying a number of processes and this, of course, is a pretty leading question to inquire just when we are going to make a breakthrough on.

Senator PROXMIRE. I understand that. I just wonder about the promise.

Mr. TIEMANN. I do feel there are one or two things that we have been working on that, should it go in the direction we hope it goes in, might within let us say the possibility of 3 or 4 years turn up some means of processing this ore. I think this is the reason that the university and, of course, the Bureau of Mines should carry on direct research principally at the low-grade nonmagnetic taconite because in the treatment of magnetic taconite there is really no great problem.

Senator PROXMIRE. Why wouldn't it be very useful for you to work with the steel companies and so forth who I understand have expressed interest in this range and have made substantial investment there to see if we can work out some kind of a practical development that would make this economically advantageous and do it as quickly as possible.

Mr. TIEMANN. This could be done, but unfortunately, as I say, they are principally interested in the magnetic type of taconite.

Senator PROXMIRE. That is what we have been talking about, 350 million tons.

Senator CARROLL. That is exactly the point I want to make. You have the magnetic ore. You have that body of ore right now. We don't have to do any basic research on that. You have that. What type of ore is being mined at Hurley, for example, where there is this unemployment?

Mr. CLARK. That is underground ore. That is shipping ore. That is not low grade or taconite.

Senator CARROLL. This is furnace ore.

Mr. CLARK. That is furnace ore, yes.

Senator CARROLL. So really on the taconite—I am not offering this as a positive statement—your basic research for the future cannot really help Hurley immediately.

Mr. CLARK. No.

Senator CARROLL. Secondly, on your magnetic ores, Hurley has the blast furnace ore there right now, doesn't it?

Mr. TIEMANN. That is right.

Senator PROXMIRE. If I could just interrupt at this point, the taconites are all around Hurley, too.

Senator CARROLL. They have the furnace ore but evidently they are not mining it.

Mr. CLARK. It has become uneconomical I believe recently.

Senator CARROLL. Because of the depth of the mine.

Mr. CLARK. Yes.

Senator CARROLL. The prospects I must confess to you do not look too good for Hurley.

Senator MILLER. Would the gentleman yield for just a moment?

Senator CARROLL. Yes.

Senator MILLER. Dr. Tiemann mentioned 3 or 4 years as a possibility of developing something. I am wondering if this would tie in with this process then the Hanna people must be using in their plant up at Hibbing. As I read from this article it points out that Hanna's director of beneficiation, studious S. E. Erickson has pointed out that processing semitaconites by this bill on the plant will clear the way for economically processing the nonmagnetic taconites. They put in 2 millions in developing this pilot plant up there. Are you referring to that area as a breakthrough area?

Mr. TIEMANN. That is only possibility. In other words, from the technology you can take the nonmagnetic taconite and I believe the Bureau of Mines many years has done work along these same lines, roast it to give a nonmagnetic roast, and then in combination make any separation and flotation to approach the possibility of a grade to ship, and of course it becomes a matter of economics of how much this process is going to cost in order to put it out at a competitive price.

Senator CARROLL. I am sorry. It is not that I am confused, but I still don't understand. If you have the magnetic ore which is directly today usable—I don't know whether it is competitive or not, but it is usable now—you don't need any research on that and you have a great amount of it right in your area. Can that be mined today in your area? I mean is it economically sound?

Mr. CLARK. This is a question, of course. The economics of it involve a considerable amount of research in that very area of economics, the mining of it, the processing of it, the marketing of it, and the transportation. This is very difficult to answer, but offhand I would say it would have good possibilities in Wisconsin.

Senator PROXMIER. That is exactly the point that I think should be stressed. With this vast magnetic taconite that we have there, it is the applied research and economics of it which in my judgment can best be done with the people who have made an investment there and are interested in moving ahead and have every profit incentive for doing it, which should offer the quickest kind of results and perhaps the most economical from the standpoint of the Government because these people are going to put their own money into it and they are going to be working closely with you, and you can through trial and error and experimentation right on the spot, it seems to me, have the most desirable kind of an atmosphere for productive research.

Senator CARROLL. Let us raise the question now in western Wisconsin. Have you ever produced magnetic ore?

Mr. CLARK. Not from a commercial standpoint. There has been some you might call the pilot work.

Senator CARROLL. But I mean from a commercial standpoint.

Mr. CLARK. No.

Senator CARROLL. Because if I understand Director Ankeny, there was approximately a 10-percent production in this peak year of 1957 of magnetic ore. Am I right on that, Mr. Ankeny?

Mr. ANKENY. Yes, that was the statement we made. I would point out, Senator, though, one of the fallacies in the statement is that now we have magnetic taconite and no more research needs to be done.

Senator CARROLL. I don't think that that should be in the record. That was not the intent of any person here. The research continues.

Mr. ANKENY. On the magnetic because there are still many problems which will improve the economics of the magnetic taconite processes.

Senator CARROLL. Where is the largest production of taconite ore?

Mr. MELCHER. The east end of the Mesabi Range and along the north coast of Lake Superior.

Senator CARROLL. And what was their production as of last year?

Mr. MELCHER. I think that was the 8 to 10.

Mr. RENO. 12 million last year.

Senator CARROLL. In other words, if you didn't have the production of magnetic ore you would have greater unemployment in that area, would you not?

Mr. RENO. Yes.

Senator CARROLL. Do you know how many men are employed in that area in the production of that magnetic ore or taconite?

Mr. RENO. I don't believe, Senator, there is a great deal of unemployment in the areas where they are mining taconite. Quite the contrary, I think it has been extending the last 5 or 6 years.

Senator CARROLL. That is a very significant statement. I am glad to have it in the record because at least here are known bodies of ore, and while the research continues, they are being produced commercially successfully now as I understand the statement.

Mr. RENO. Yes, sir.

Senator CARROLL. And this is not being done in western Wisconsin and could be done with some proper investment and continued research. You continue on, either one of you gentlemen. You have been very helpful here developing these ideas.

Mr. CLARK. I might add that the tonnage that I gave is only a very superficial depth, very shallow depth, possibly 100 to 200 feet, and this could be doubled or tripled actually with deeper mining. Insofar as the mining of the ore is concerned there would be problems of no great severity. They wouldn't be difficult to overcome, but there are certain problems in connection with mining that demand the selection of the ore from a given body, from the higher grade sections and so forth. Speaking from that standpoint the economics of the mining ought to be good. I am speaking now of northwestern section, western end of the Gogebic. The transportation facilities I would say are good and I would think also the climate, if I may refer to it in that way, that is, with respect to freight rates, as I understand it, would be attractive because I believe the railways coming down through that area could well stand some shipments of ore to Cleveland, Chicago, or other places where it would go, or concentrates.

Senator PROXMIRE. It is not too far from the lake either.

Mr. CLARK. Not far from the lake. The labor pool, if I may use the word, in the area I am sure would be good. From that stand-

point it bears a certain attraction in that particular location. However, as I have said, at the present time there is nothing going on except some exploration on the part of substantial mining companies who I believe recognize certain of these facilities.

Senator CARROLL. How much investment would it take to put a plant in this area?

Mr. CLARK. It depends on what capacity the plant would be expected to operate.

Senator CARROLL. A plant sufficiently large to take care of some of your unemployment problems.

Mr. CLARK. Let us say offhand 5,000 tons a day. Maybe that is low, maybe 10,000 tons of ore. This is a guess. I have to do a little arithmetic here, I am afraid. Supposing we said 10,000 tons a day. It would be \$10 million to \$15 million I would expect. I am not too much of an authority on the cost of the pellet producing plants or the concentrating equipment.

Senator CARROLL. How many people would that employ?

Mr. CLARK. I don't believe I can answer that question.

Senator CARROLL. May I have the attention of the gentleman from the AFL-CIO? May I have your name for the record again because I am going to ask you questions.

STATEMENT OF PETER J. BENSONI, REPRESENTATIVE, UNITED STEELWORKERS OF AMERICA

Senator PROXMIRE. It is Peter Bensoni.

Senator CARROLL. What is the unemployment in Hurley?

Mr. BENSONI. In Hurley proper it is about 400; 400 miners unemployed right now out of the 1,200 that would be working with full production, so that would be about one-third right in Hurley.

Senator CARROLL. What about your statement here, How many tons?

Mr. CLARK. I used the figure of 10,000 tons a day of ore, which would be possibly half of that, or in that neighborhood, of actual shipping product.

Senator CARROLL. Are you familiar with taconite mining?

Mr. BENSONI. To some extent, yes.

Senator CARROLL. How many men would this employ?

Mr. BENSONI. I am sorry sir. I did not hear your question.

Senator PROXMIRE. May I suggest that Mr. Bensoni come to the witness table.

Senator CARROLL. Yes. What we are talking about is unemployment in western Wisconsin. Here they have magnetic ore. There is an investment in there. I think you said a \$10 million investment.

Mr. CLARK. I said from \$10 million to \$15 million.

Senator CARROLL. Yes, and what would be the production of the mine per day?

Mr. CLARK. I am speaking on the basis of 10,000 tons of ore mined per day, the treatment of 10,000 tons of ore. This is big.

Senator CARROLL. What would that mean in employment in the mines? How many miners would it take to mine that much ore?

Mr. BENSONI. 10,000 tons of low-grade ore that would be beneficiated.

Mr. CLARK. Yes.

Senator MILLER. We are not talking about furnace; magnetic?

Mr. CLARK. Yes.

Mr. BENSONI. As they build these plants they build them more modern every time they build one and it is hard to sell, and with automation in process as well as other things, so each time they build one of these new plants it is built more efficiently and naturally takes less men, but a plant of that type in the Wisconsin area I would say would absorb a great deal of employment. As to the exact number it is difficult to estimate.

Senator CARROLL. This is just a speculation, an idea. What would it take to restore the economy of this area? How much money do we put into a plant? What would it do? There is a market I assume. I ask the Director here. There is a market for this sort of taconite, is there not?

Mr. ANKENY. Yes.

Mr. BENSONI. I would venture to say a plant that would produce 2 to 3 million annual tons of finished product in the northern part of Wisconsin would absorb practically all of the unemployment that you have there now.

Senator CARROLL. This would also give you a new industry and would stimulate your other industries, too.

Mr. BENSONI. That is correct. It would stimulate the shipping industry, the railroad industry, lumbering, and everything else.

Senator DWORSHAK. Who would build such a plant if it is not economic to operate?

Mr. BENSONI. There are several companies at the present time working in Wisconsin currently exploring in the area around Upson and Mellen, Wis. Actually a subsidiary of McLaughlin Steel in Detroit 3 or 4 years ago explored quite extensively the area around Butternut, Wis. Prior to that Jones & Laughlin Steel Corp. explored around the Pine Lake area in Wisconsin. These companies hold vast areas of land in that area.

Senator DWORSHAK. That is just the point I am making.

Mr. BENSONI. And they are purchasing more of this land.

Senator DWORSHAK. No one would have a greater incentive to go in there and develop a profitable mining venture in these nonmagnetic ores than the companies which own the land and which would profit from the subsequent development, is that correct?

Mr. BENSONI. I would say so.

Senator CARROLL. Unless they also owned land in Canada.

Mr. BENSONI. They do. The same companies own land in Canada.

Senator MILLER. What is there about the Minnesota production that enabled them to go in there and produce 12 million tons last year that is so attractive that they have not done the same thing in Wisconsin? Is there a difference in the quality of ore?

Senator CARROLL. If I may suggest, I think there is a greater mining activity in and around Hibbing.

Mr. BENSONI. The Minnesota Range is a much larger range than the Wisconsin.

Senator DWORSHAK. Different taconite too, isn't it?

Mr. BENSONI. Much larger. The Mesabi Range is much larger. There is a large deposit of direct shipping ore that has a much larger deposit of the low-grade stuff than Hibbing would have.

Senator PROXMIRE. Is it true, in spite of the transportation advantages and so forth that Professor Clark spoke of in the Wisconsin area, that Minnesota too would have these because they have operated on such a large scale for so long they would have transportation, they would have labor, and they would have everything perhaps to a somewhat greater extent than we have at the moment in Wisconsin?

Mr. BENSONI. In Minnesota they could put in completely new railroads.

Senator PROXMIRE. I see.

Mr. BENSONI. The Erie Mining Co. with their large plant at Aurora, Minn., had to put in a railroad approximately 75 miles in length from the plant to the shore of Lake Superior to ship their ore. The Reserve Mining Co. had to do the same thing. They had to put in a railroad, poor facilities, and everything, and started from scratch, brand new. In this area of northern Wisconsin, the lakeshore is closer. In some places they are only 15 miles away from the resource of the raw material. There are railroads in there already.

Senator CARROLL. Historically there has been a greater mining background in the Mesabi Range area than in northern Wisconsin?

Mr. BENSONI. That is right. It is much larger. There are other parts in Michigan as well. There are three iron ore ranges incidentally in Michigan and three iron ore ranges in Minnesota.

Senator CARROLL. I understand you have a prepared statement that you want to offer for the record?

Mr. BENSONI. Yes, I do.

Senator CARROLL. Without objection we will take your statement and place it in the record at this point. (The statement is as follows:)

STATEMENT OF PETER J. BENSONI, REPRESENTATIVE, UNITED STEELWORKERS
OF AMERICA

As a labor union we are primarily concerned with people and their problems—the conditions under which wage earners work, their living standards, and how they maintain their families. Under our present industrial order most people are dependent upon an employer, usually a large corporation, for their employment and their livelihood. They cannot earn a living by merely working for themselves as was true in our country at one time. Since our present economic order is well established it has a tremendous hold on the people. When industry, for whatever reason, decides to move or relocate, not only does it leave large numbers of people without any means of earning a livelihood, but it results in the loss of practically everything that people have worked for and acquired during their lifetime. Properties are depreciated, communities are suddenly hit without any source of sustaining income, social problems of great magnitude immediately present themselves.

This is now happening to the people and many of the communities of the Lake Superior iron ore mining region. This is a vast region stretching across the northern part of three States—Minnesota, Wisconsin, and Michigan. Iron ore mining has been the main industry across this Lake Superior region for almost a century. Originally, most of the workers who came to this region to seek employment were immigrants from Europe. Many of them were recruited by agents of the mining companies. The mining communities of that time were considered company towns and the workers located there almost solely for the employment that the industry provided. Their ties in the community were not too strong. Many of them, in fact, felt that when they reached the point when they would have accumulated some money they would go back to their native country. But this was only an idle dream. Instead they settled in the mine camps and became a permanent part of towns and small cities and in time established all the modern facilities of any other American industrial city. They raised families and succeeded in most cases to own a home

and oftentimes other property. Consequently, the so-called mining camp of the past no longer exists. These towns are inhabited by people who are a definite part of what they consider to be a permanent community.

Now the question arises—Can something be done to save these towns from becoming ghost towns? There are many such towns with a very uncertain future across the Lake Superior region. The problem is perhaps even more serious in the communities that are dependent upon deep shaft underground mining only, such as Ely, Minn.; Hurley, and Montreal in Wisconsin and Ironwood, Bessemer, Wakefield, Iron River, Caspian, Champion, Negaunee, and Ishpeming in Michigan's Upper Peninsula. Several mines in these cities have been closed permanently in recent years. There are some being closed permanently now and many that are closed down completely with great uncertainty as to when they will ever open again. I have reference to such mines as the Leonidas Mine in Eveleth, Minn.; the Cary Mine in Hurley, Wis.; the Newport-Geneva mines at Ironwood, Mich.; the Peterson Mine at Bessemer, Mich.; the Sunday Lake Mine at Wakefield, Mich.; the Buck Mine at Caspian, Mich.; the Mather "A" at Ishpeming, Mich.; the Morris at North Lake, Mich.; the Tobin at Alpha, Mich.; the Champion at Champion, Mich.; the Book at Alpha and the Buck at Caspian, Mich. Let us take, for example, the Gogebic Range which extends across the western part of upper Michigan and into Wisconsin as far as Mellen. At one time there were 34 mines in operation on this range. During the World War II period there were 15 and today there are only 2. It should be added that even these two are currently operating with great uncertainty.

The reason for the permanent closing of many of these mines is not necessarily because of the exhaustion of the ore deposit. As an example, the Sunday Lake Mine at Wakefield, Mich., and the Buck Mine at Caspian, Mich., were recently closed permanently. Both of these mines were operated by the Pickands Mather Co. and owned, 100 percent in the case of Sunday Lake and 50 percent in the case of the Buck, by Bethlehem Steel Corp. The Newport, Geneva, and Peterson Mines are owned to a great degree by the Youngstown Sheet & Tube Co. and also operated by Pickands Mather. It is a known fact that all of these mines still have many millions of tons of iron ore reserve. That has been stated publicly by mining company leaders, by State geologists, and has been published in various trade publications. Yet these companies, along with others, have gone into Canada and in South America and invested millions of dollars for vast outlays to exploit new deposits of iron ore. As an example, I quote an article which appeared in the June 17, 1961, issue of *Skillings' Mining Review* as follows:

"Wabush Iron Co., Ltd., will build a beneficiating plant at its low-grade iron ore project at Wabush Lake in Labrador, Newfoundland. The Honorable Joseph R. Smallwood, Premier of Newfoundland, announced that Henry J. Kaiser Co. (Canada) Ltd. of Montreal, Quebec, will do the design and future construction of the plant, as tentatively arranged in April 1959. At that time Kaiser was awarded a contract for the design and construction of the present pilot beneficiating plant, which Wabush Iron has been operating since early 1960 to test various ore processing methods.

"Design work on the new plant will begin immediately, but no date has been set for the construction. The future plant will be part of the large-scale mining, processing, and housing installations required to develop the Wabush Iron property for commercial production of high-grade iron ore concentrate. Full production of the project is scheduled for 1965.

"The Wabush program for 1961 also includes the building of the 25-mile Arnaud Railway from Point Noire on the Gulf of St. Lawrence west of Seven Islands to mile 8 on the Q.N.S. & L., dredging of the Pointe Noire Harbor and construction of the dock, storage area, and service facilities.

"Wabush Iron Co. is owned by the Steel Co. of Canada, Ltd., the Youngstown Sheet & Tube Co., Interlake Iron Corp., Inland Steel Co., Pittsburgh Steel Co., and Pickands Mather & Co., which is also managing agent."

Iron ore is not presently in the same situation as other minerals that have been displaced because of the introduction of substitutes such as oil having been substituted for coal as a fuel, nor does it appear likely that the requirement for iron ore will diminish. In fact, the opposite has been true because the consumption of iron ore has been constantly on the increase and it has been estimated by the steel industry that before the end of this century the United States will need 200 million annual tons of iron ore. What then is the reason that American companies are suddenly abandoning domestic iron ore mines and

areas where there are still substantial reserves in favor of new developments in other countries? In many cases we have personally witnessed instances where only the best ore, or so-called cream, has been taken out and the remainder has been left only to be caved or flooded and lost forever. Something should also be said of the vast areas of mineral lands that are being held by mining companies or so-called fee holding companies across the Lake Superior region. Vast acreages across northern Minnesota, Wisconsin, and Michigan are held by these companies and cannot be used by anyone for any other purpose. For example, in an area between Montreal, Wisconsin, and Mellen there are hundreds of millions of tons of known iron ore. This is also true on the Menominee and Marquette Ranges of upper Michigan and the Cayuna, Messabi, and Vermillion Ranges of Minnesota. Companies have made their own geological surveys and test drilling or test pitting has been done at various times over the years. There is an area between Upson and Mellen in Wisconsin where a considerable amount of test drilling has been done during the past 2 years by the Oliver Iron Mining Division of United States Steel. There are other areas such as east of Pine Lake in Iron County, Wis., where the Jones & Laughlin Corp. did some drilling about 5 years ago. There is also an area east of Butternut, Wis., where the Asland Mining Co., a subsidiary of McLouth Steel Co. of Detroit, did some extensive test drilling about 4 or 5 years ago. This sort of testing has also been done recently and also during periods in the past on the other ranges of Michigan and Minnesota.

It has been stated repeatedly by industry people that there are practically unlimited quantities of these low-grade ores throughout the Lake Superior region. The statement has been made that the future development of these vast potentials is not a question of the availability of the mineral reserve but that it is one of investment of capital. Yet it is strange that the same companies who control and hold all of this reserve in the Lake Superior region have apparently not hesitated to go elsewhere, and to a very great extent outside of our country's borders, to exploit deposits which require enormous investments of capital for the construction of completely new facilities. Such costly installations as railways, powerplants, and dock loading facilities are built in their entirety at these places, whereas all of these and more are in most cases already available in the areas of Lake Superior which I referred to above. Besides, the geographic location of some of the areas of upper Michigan and Wisconsin are no further away from the steelmaking areas of the lower Great Lakes than it is in some of the currently developed projects of Canada to get the raw ore from its source to the boat.

Free enterprise is wonderful. It is the system which is intended to provide the greatest amount of competition and to ultimately result in giving the consumer, who pays for everything, the best product for his money. But one sometimes wonders if the American steel companies have not embarked upon a campaign to get control of as much iron ore mineral reserve in the Western Hemisphere as they possibly can. This would indeed be considered important and strategic if it were done in order to prevent some unfriendly country from getting control of these sources over us. But if, in the process of doing this, our own people and our communities are merely left to find a way for themselves or to disappear entirely from the social and economic scene, then we are without any doubt creating, not only economic and social problems, but political problems as well within our own border, which could be of a serious consequence. It is impractical to expect, and immoral and un-American to permit whole communities and its people to pass into a state of becoming economic graveyards. Not only does industry have an obligation to meet the challenges of the times and thus to continue to provide a means for these people to live, because that is as our system was intended; but when industry fails to do so it becomes incumbent upon the people of the Nation as a whole, our Federal Government in other words, to do something about it. When the profit motive becomes so important that it disregards and neglects completely the people who have helped originally to establish the industry then we are in for some serious trouble. Ever since 1954 the number of employees working in the mines of Michigan, Wisconsin, and Minnesota has been on the decline. It is impossible for all of these workers to pick up their families and relocate themselves somewhere else with some other industry. Many of them would need retraining, but even then it would be a very despairing thing for them to sacrifice by leaving behind their home and all that they own in order to make a new start.

Thus it appears that the time cannot be delayed any longer when our Federal Government must make a determination. If there are sufficient quantities of low-grade ore, as there are, in this region to continue to sustain the steel industry and processes have to be developed in order to beneficiate it for commercial purposes, then a way must be found to do so whether it be by industry action or by Government encouragement.

It has been stated by industry that some of these low-grade ores have certain characteristics which do not lend themselves as well to known beneficiating processes as do ores in other countries. This should be investigated by Government and if it is so, then a way must be developed to process these ores advantageously. If it is not so, then the people should know the truth and industry should be exposed.

Senator CARROLL. What is your opinion as you take a look at this situation? I am sure these professors don't mind this informal exchange here.

Mr. BENSONI. My opinion is this: that mining has been going on in this area, the Lake Superior region in general, Michigan, for the past 75 years or so and in some areas even longer. In the Marquette Range of Michigan it started earlier than that. Communities and towns have grown up and people have established themselves there. Their roots are quite deep in these areas. They own property there. Our feeling is that industry has a responsibility to these people that have helped to build this industry. They have the responsibility at least to continue mining to a degree to sustain the economy of these areas.

I think that it is immoral and it is unfair and it is contrary to everything for industries to abandon these communities and these people, to leave just for the sake of the profit motive alone, to go in other areas in Canada and elsewhere and forget and leave these communities to the will of the Almighty, you might say. If this raw material is still there and still developed I think a way should be found, whether it is industry alone or whether they need some encouragement from Government, to continue to sustain the employment in that area.

Senator CARROLL. This is why I asked the question about this plant and the cost of a plant. I think Senator Dworshak is right in this. They own the land and assuming that there is a profit, they would have an incentive to make an investment. As you say, Jones & Laughlin and these other people have made exploratory ventures at least in the area, but they haven't done anything about it, at least in your own area, certainly not at Hurley. Quotas wouldn't affect Hurley, would they? You have to have some entirely new actions?

Mr. BENSONI. The mine is still there in Hurley. So far as I know the iron ore deposits have not been exhausted. They are deeper, that is true, but there is still ample ore there and direct shipping type of iron ore.

Senator CARROLL. But by virtue of the depth has it made the mining uneconomic?

Mr. BENSONI. I don't think so.

Senator CARROLL. For the people who own the mines?

Mr. BENSONI. They say that, but I don't think that this is entirely so. The grade is still the same. The beneficiated type of ore might be better, but the grade of the direct shipping ore is still the same. There has been new technology in underground mining, you know, and it has made that more efficient than it used to be in the past, even

though it is deeper. You can build better and bigger hoists today than you could 10, 15, or 20 years ago and hoist it easier than you could. The new methods introduced in mining, new types of explosives, now building, make it easier to mine.

Senator CARROLL. Would you say the productivity of each miner has increased?

Mr. BENSONI. It has increased progressively over the years, yes; that is why I say that the miners have earned their own wage increases that they receive. There was mention here about wages. I submit that the miners have earned their own wage increases by virtue of their increase in productivity.

Senator DWORSHAK. Are imports of finished steel products from Europe to this country increasing now rapidly?

Mr. BENSONI. In steel?

Senator DWORSHAK. Steel and steel products.

Mr. BENSONI. There have been certain types of steel shipped into this country. It is none of the heavy stuff.

Senator DWORSHAK. What do you mean by heavy?

Mr. BENSONI. Real heavy stuff—frames.

Senator DWORSHAK. How about ingots?

Mr. BENSONI. Not that I know of.

Senator DWORSHAK. Are there any imports coming in from abroad now?

Mr. BENSONI. Certain types of steel, yes, barbed wire, and nails, and things of that kind.

Senator DWORSHAK. To a much greater extent than in the past?

Mr. BENSONI. Yes.

Senator DWORSHAK. Why are those coming in here? Because the products can be produced abroad more cheaply, or what? Why would American consumers buy these foreign products containing steel?

Mr. BENSONI. I suppose the American steel companies have gone into Belgium and West Germany and those places and established themselves, too.

Senator DWORSHAK. Oh, but is there not a lot of steel coming in from Japan and West Germany and other places where American concerns, so far as I know, may have a financial interest, but so far as I know they do not have? Are there not many products coming in from those countries?

Mr. BENSONI. I think it has been overly exaggerated to a great degree. I said that nails and barbed wire come in. On the other hand, we sell an awful lot of steel, too, automobiles.

Senator DWORSHAK. You put your finger on it. Why are more automobiles coming in from Europe than we have had in the past that jeopardize employment in the automobile plants in Michigan?

Mr. BENSONI. Well, in the production of the compact small cars.

Senator DWORSHAK. We make compact cars in this country, too.

Mr. BENSONI. Now, yes. It has had the effect of getting our industry to produce them.

Senator DWORSHAK. It has been very beneficial. We should have done it a long time ago, probably.

Senator CARROLL. The reason I put the question to you is that the quota system would not help in this case. For example, in Hurley. I do not think it would help it at all. It might.

Senator DWORSHAK. What would you put the quotas on?

Senator CARROLL. That is the point. Really what they need to do is to acquire some new type of investment in there. As I understand this witness' testimony, he thinks that the industry has an obligation to go in there and build some sort of a plant. Whether the industry has that obligation and will not do it, that is another question. The question is what can we do. We have to face some of these problems. What can the Government do? Can the State government do it alone, the Federal Government, with perhaps a long-term loan to restore an economy. In a sense, that is what has happened to the farmer. This is a way of life that you people are talking about. That is all you have known. This is your way of life. If you do not get some help, we are going to have to get off the land. This is what is happening to the wheat farmers in my area. This is a way of life. We subsidize them and I always vote "aye." I am in favor of it. These are very complex economic problems and I do not profess to know what the answer is.

If anyone has ever found the answer in the farm program, I would like to know who he is.

Senator PROXMIRE. Senator, would you yield at that point? I think Professors Clark and Tiemann have indicated that we could do a great deal of very productive applied research on the economics of the situation as far as magnetic taconite is concerned that would help this area near Hurley and would very greatly relieve the unemployment problem in that area.

So I think it is not simply a matter of saying that Jones & Laughlin and United States Steel will move when the opportunity improves. I think that this kind of research can help, as it has historically in America, and I think that apparently there is not this kind of research being done now at our university.

It is not being done as much by the Bureau of Mines as has been brought out this morning, as perhaps it might be, and I think that this kind of collaboration between the Universities of Wisconsin, Minnesota, and Michigan, where they have fine people who want to do it very much, and the Bureau of Mines in collaboration with the businesses concerned can open up some great economic opportunity here and help our national security at the same time.

Senator CARROLL. I agree with that completely. When we get all this collaboration, you really have to have some investment in there. To do what? For production, for employment?

Senator DWORSHAK. Who will employ the miners? They do not work on research.

Senator CARROLL. This is like building a house. We have to have this applied research. We have to do these things to show business and industry that they ought to invest in and build the productive facilities. I agree with that statement, but this really does not help us immediately to get into this problem which is to relieve the unemployment in some of these areas. This is a long-range program. These people want to know, "What are you going to do for me tomorrow, for a week from now, a month from now, or maybe 6 months from now? What is the solution to our problem? How are you going to handle this thing?"

Unemployment is one thing. I am not speaking in opposition to anything that the Senator from Wisconsin has said. I agree with it. What are we going to do with these families and these people? This is our problem.

Senator DWORSHAK. That is the same problem, Mr. Chairman, that you and I have faced in our respective States when the lead and zinc mines have closed down everywhere causing widespread unemployment. What are we doing for those families?

Senator CARROLL. That is right. Those mines are closed. I think 54 mines were closed in Colorado, and, of course, this is directly attributable, however, I think to the influx of lead and zinc coming from foreign countries. I think there is a little different situation here. They have the ore. They are doing basic research in one end and applied research at the other, and the question is how do we get industry to do something, and what can Government do and what can the State do to get this thing on the track.

Mr. CLARK. That is correct.

Senator CARROLL. I would like to have appear in the record at this point a communication that I have received from G. F. Hanson, State geologist for the State of Wisconsin.

(The letter is as follows:)

THE UNIVERSITY OF WISCONSIN,
GEOLOGICAL AND NATURAL HISTORY SURVEY,
Madison, Wis., June 19, 1961.

Senator JOHN A. CARROLL,
Chairman, Subcommittee Minerals, Materials, and Fuels,
New Senate Office Building, Washington, D.C.

DEAR SENATOR CARROLL: I have your telegram of June 15 and appreciate the opportunity to express my views on the problems of the upper Great Lakes iron industry.

You note that special consideration will be given to research designed to develop the low-grade ores economically hence I infer that you will have many competent opinions on that subject and will not elaborate on it here. There is however one problem that is of major concern to me, namely the closing of the underground iron mines on the Gogebic Range of northern Wisconsin and Michigan.

Only a few years ago ore from these mines was considered of premium quality. However due to the availability of higher grade direct-shipping ore from foreign sources, and high-grade concentrates, this is no longer the case. All but two of the mines have been closed down and the future for these two does not look bright. Some have been abandoned, others continue to maintain pumping to prevent flooding but it is questionable how long this will continue. Once these iron mines, some as deep as 4,000 feet, are abandoned and permitted to flood the underground conditions will deteriorate to the extent that reopening them will be virtually impossible, yet millions of tons of ore remain.

It is obvious that the steel industry cannot be expected to utilize ore, during a peacetime economy, that increases, even fractionally, the unit price of steel. On the other hand too great reliance on foreign ores and concentrates would not seem wise during a wartime economy. Foreign sources can be cut off and taconite plants easily sabotaged.

The life of the Gogebic Range is not going to be long and there is little prospect for stable, long-term operation of the underground mines. The future of the area therefore lies in benefiting the low-grade ores, as your committee recognizes. But I believe consideration should be given to mining the accessible underground ore, while it is yet possible to do so, and putting it on the surface as a Federal stockpile where it would not deteriorate and would be available for immediate use in case of emergency.

While I realize that there are many arguments both for and against such a proposal it does not appear to me to be wise, and it is certainly anticonserva-

tional, to throw away millions of tons of high-grade domestic ore which, under different conditions, could be of greatest strategic value.

Very truly yours,

G. F. HANSON, *State Geologist.*

Senator CARROLL. We have Professor Wade here from the University of Minnesota and then I have Professor Volin from Michigan. I would like to hear them today.

Senator DWORSHAK. Have you not had a representative of American Ore Association?

Senator CARROLL. Is Mr. Hugo E. Johnson here?

I am perfectly willing to go through with this thing, except I do not want to wear out our reporter. While we are taking it easy, he is working.

Mr. CLARK. I want to say that I was quite low on that statement with regard to the cost of the plant. I had in mind the processing plant alone, but when you consider the whole operation, it would run, I would say, well over \$50 million. This is everything; the equipment, the land, the plant, everything in connection with the 10,000-ton-a-day operation. I was quite low if that figure is taken as the cost of the whole operation. I would say it would be well over \$50 million. I would like that corrected.

Senator PROXMIRE. I would like to make one concluding statement, too, while professors from the University of Wisconsin are here, and that is that I quite agree with the chairman and Senator Dworshak that we do need immediate action. There is no question about it.

At the same time, I think that should not obscure, really, the necessity for this longer term action and research is never something, or almost never something from which you can expect to realize benefits in a matter of months, but you can in a relatively few years, I think, see tremendous benefits to the Nation as well as to the State of Wisconsin, and to these families that are involved here by the kind of research which the universities have so well demonstrated in the past.

Senator CARROLL. There is no doubt that this type of research must continue. I could just give the experience in our own States in lead and zinc. By the time they have gone through the Tariff Commission, by the time the Tariff Commission has made a report to the President, by the time we protested year after year after year, the industry is gone. This does affect great numbers of people. That is, I think not only of northwestern Wisconsin, but in Minnesota and all these other areas we are dealing now with. I do not know how many thousands of people who are engaged in this industry are heavily hit. This is why we talk about what we are going to do and how can we do it quickly.

I thank you.

Mr. TIEMANN. May I make a remark, Mr. Chairman.

Senator CARROLL. Please do.

Mr. TIEMANN. In regard to what Senator Proxmire stated there, I would again like to emphasize that I feel that the university is in a position to do long-term research, basic engineering research, which industry cannot afford to do, and in addition, I would like to re-emphasize the fact that in doing this research, we train men who are available for future industry in this particular field.

Senator CARROLL. I agree with that completely. Gentlemen, we thank you very much for coming and we appreciate your patience.

Now, we will have Mr. Volin and Mr. Wade. Do you gentlemen want to testify separately or together? Will you come forward, Professor Wade?

We have Prof. M. E. Volin, director, Institute of Mineral Research, Michigan College of Mining & Technology, and Prof. Henry H. Wade, School of Mines, University of Minnesota. You may proceed, Professor Volin.

STATEMENT OF M. E. VOLIN, DIRECTOR, INSTITUTE OF MINERAL RESEARCH, MICHIGAN COLLEGE OF MINING & TECHNOLOGY, ACCOMPANIED BY PROF. HENRY H. WADE, SCHOOL OF MINES, UNIVERSITY OF MINNESOTA

Mr. VOLIN. I have a statement and I will turn it over to you. I will touch on some of the things that have been discussed already. Senator CARROLL. Please do. First, however, we will put your entire statement into the record.

(Mr. Volin's statement follows:)

**STATEMENT OF M. E. VOLIN, DIRECTOR, INSTITUTE OF MINERAL RESEARCH,
MICHIGAN COLLEGE OF MINING & TECHNOLOGY**

NEED FOR RESEARCH ON IRON ORE

Iron ore is a basic raw material for the steel industry which supports our high standard of living and leading position among nations. With less than 6 percent of the world's population, the United States produces and has the benefits of over one-third of the world's output of steel. As the largest consumer of iron ore, the Nation must be assured of adequate supplies of this commodity, but it is paradoxical that while we have one of the world's great reserves, our iron mining industry is furnishing a progressively declining part of our total ore requirements. It is the purpose of this statement to discuss some of the factors in the changing iron ore picture and indicate how research can help the position of the domestic industry.

Iron formations occur in many places throughout the world. In general, only large reserves are exploited, but many economic considerations along with the quality of the ore determine which deposits can be worked at any time. Historically about 80 percent of the iron ore produced in the United States has come from the Lake Superior region, Minnesota's open-pit mines furnishing about 68 percent and Michigan's underground mines 12 percent. Shipments from the Lake Superior region reached a peak in 1953 and have shown a generally declining trend since that time. This changing pattern of ore supply is just a part of the overall picture for the iron ore industry, which in the past decade has grown from essentially a domestic enterprise to one of world-wide proportions.

The iron ore picture can best be shown by some statistics for the past decade. Shipments from domestic mines in the Lake Superior region in 1950 were 79 million gross tons, while imported ores totaled 8.3 million tons. Shipments rose to a peak of 95.5 million gross tons in 1953, and imports to a peak of 35.6 million tons in 1959. In 1960, the Lake Superior mines shipped 62.9 million gross tons while imports were 34.9 million tons, only slightly less than the record level of the previous year. The principal sources of imports in the order of the tonnages supplied were Venezuela, Canada, Chile, Peru and Brazil, these countries supplying 97 percent of the total.

The reasons for the growth in imports are largely economic. Not only are the foreign ores much higher in iron, but they are generally lower in cost than the traditional Lake Superior direct shipping ores averaging 51.5 to 52 percent Fe. The net result is that the steel produced from the foreign ores is more competitive pricewise than that produced from domestic ores. Two significant factors in the lower cost of foreign ores are cheap foreign labor and low rates for ocean transportation.

A small increase in the grade of the domestic iron ore over the 10-year span is noteworthy because it reflects the growing use of beneficiation. About 25 percent of the ores shipped in 1950 had received some sort of simple beneficiation. The taconite industry was still in the experimental stage then, and only 82,000 gross tons of pellets were shipped. In 1960, over half of the ores shipped from the Lake Superior region had received some sort of beneficiation and they included 11.7 million gross tons of taconite pellets from Minnesota and about a million gross tons of jaspilite concentrates and pellets from Michigan. The domestic pellets vary in iron content from 61 to 66 percent and average about 63 percent; this is expected to increase gradually to over 64 percent. Recent blast furnace performance records with all-pellet burdens have shown this feed to be superior to the natural ores. Besides having a higher iron content, the pellets have a more favorable ratio of iron to silica than the Lake Superior direct shipping ores and they are uniform in grade and physical structure. Some of the benefits derived from the use of pellets are increased production per furnace which reduces the unit capital charges for a blast furnace plant, decreased coke and limestone consumption per ton of iron, decreased slag volume, and decreased flue dust, all of which amount to a decrease in direct operating costs per ton of iron. In other words, the use of pellets results in a significant increase in pig iron production with a corresponding decrease in the cost of smelting a ton of iron.

The outlook for the next 10 years is that our annual iron ore requirements will rise by at least 20 million gross tons, but that domestic ore production will remain at an annual level between 90 and 100 million gross tons, the additional requirements being met by imports principally from South America and Canada. It is expected that more of the domestic production will be in the form of pellets and other highly beneficiated products and that pellet production will reach 35 million gross tons by 1970. Within the present decade, it is foreseen that production of direct shipping ores from the Lake Superior region will decline further to a level of about 40 million gross tons per year.

The trend from domestic to foreign ore supplies is a matter of economics and not a result of lack of iron ore, but if it continues it will deprive the United States of substantial income from iron ore mining, cause a dislocation of the labor force in this industry, and eventually put the Nation in a position of dependency on oversea supplies. It is important to the Nation that the iron and steel industry be competitive and at all times be assured of adequate domestic supplies of reasonably high quality. It is reasonable to believe that the most constructive thing that can be done for this situation is a well-planned and coordinated, long-range program of research into the utilization of our domestic iron resources.

A brief description of the Lake Superior iron formations is necessary to understand the problems of utilizing them; but only very general information about the size and character of these resources can be given in the time permitted here. The Mesabi Range of Minnesota is by far the largest resource and has been the most productive. Various estimates of tonnages in the Minnesota ranges have been given and 75 billions of tons is given here as an order of magnitude only. Geologically the formations are divided into cherty and slatey members, but the divisions are generally gradational rather than distinct. As a whole the formations are heterogeneous in mineralogy, structure, and texture. Complex classifications have been set up to describe the segments of the iron formations according to the events in their geologic history including the varying degrees of oxidation and leaching to which the parent iron-bearing rocks have been subjected. It is sufficient to state here that there are numerous variations ranging from the virtually unaltered parent rocks to the highly altered and leached portions classified as ore.

The Michigan iron formations are made up of cherty and slatey layers which are interbedded instead of occurring in more or less separate divisions. Compared to the Minnesota formations, they generally have less stratigraphic thickness, show more banding of an irregular nature, contain less magnetite and have greater variation in mineralogy and types of alteration over short distances. Tonnage estimates range from 2 to 7 billions depending upon the limits taken, with about a billion tons accessible to open pit mining.

It was a fortunate circumstance of nature that parts of the iron formations were exposed to weathering processes that altered the iron minerals and enriched them by leaching away the silica; the alteration resulted in a relative increase in the amounts of higher oxides of iron and the leaching resulted in a porous structure and coarser texture. Intensive weathering of this kind produced the natural ores that have contributed so much to the great industrial

growth of this country. It was fortunate, too, that large ore deposits in Minnesota's Mesabi range were left exposed for low cost open pit mining. Such mines have furnished over 2 billion tons of ore for our iron and steel industry, but the reserves accessible to this kind of mining are approaching exhaustion.

In the last 30 years or so, simple beneficiation processes such as crushing and screening, washing, classification, jigging, sink-float, and spiral concentration have come increasingly into use. These processes not involving fine grinding have been applied to types of ores amenable to such treatment to improve their grade and structure. In Minnesota, many plants are in operation to utilize the so-called wash and intermediate ores. However, these and the direct shipping ores are the ones that are being displaced by the higher grade foreign ores which can better fill the need for increased blast furnace yields.

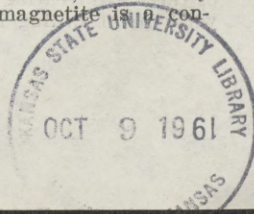
An obvious question is this: "Can the natural ores be beneficiated to such grades as to compete with the foreign ores?" The answer is a matter of economics as well as technology. Such improvement in grade is not achieved by the simple beneficiation processes without fine grinding, and the fine grinding adds a large increment of cost. Furthermore high grades can be attained only by sacrificing too much recovery of the iron. The iron minerals are largely non-magnetic and thus are not amenable to magnetic separation, while the flotation process has not proven efficient for the earthy oxides. The open pit reserves are not sufficient to encourage research along this line and the high cost of underground mining leaves no margin for absorbing beneficiation with fine grinding as an additional cost.

Some segments of the iron formations were subjected to metamorphism of a type that promoted grain growth and crystallinity of the iron minerals. The eastern part of the Mesabi Range near the Duluth Gabbro exemplifies the effects of metamorphism which caused recrystallization and grain growth of magnetite and resulted in massive, hard formations that have been relatively impervious to subsequent alteration processes. The cherty members, richer in magnetite, supply the ores for the taconite plants; about 5 billion tons are estimated to be accessible to open pit mining. The technology for the utilization of the magnetic taconites was worked out by the Mines Experiment Station, University of Minnesota, and demonstrated by industry in pilot plants. Now there are two large enterprises in Minnesota with an annual capacity of about 12 million gross tons of pellets and plans for doubling the size of one of the plants will provide an increase of 5 million tons. This part of the domestic iron ore industry can expand as rapidly as the economics of enterprise and competitive position of the product will permit, and it appears that industry can take care of the problems of finding ways to cut costs so as to make the taconite pellets fully competitive in U.S. markets.

In Michigan, metamorphism is evident in the Marquette Range at Humboldt and Republic where coarse-grained, crystalline specularite and magnetite occur in a banded structure with chert. The iron minerals are liberated without intensive grinding and respond to flotation. The reserves of these and similar jaspilite ores are of the order of 500 million tons. Three open pit mines and plants with an annual capacity of about a million tons of pellets and concentrates are in operation now and development of a low-grade magnetite deposit is being started. When the new development and announced expansions of the present plants are completed, Michigan will have an annual production of 2 million gross tons of pellets. It is worthy of note, however, that other specularite or magnetite deposits are not known among the Michigan formations.

A large part of the oxidized formations are not leached or disintegrated sufficiently to be amenable to the simple beneficiation practices now in use on wash and intermediate ores. These oxidized formations called semitaconites in Minnesota are the potential ores of tomorrow; they deserve consideration because of their apparent magnitude. Large tonnages can be inferred as extensions of the ore bodies that have been mined and are being mined, and the predominantly cherty members accessible to open pit mining are thought to be more extensive than the near-surface reserves of magnetic taconite. However, the semitaconites are quite heterogeneous in their mineralogy, texture, and structure. Hematite, goethite, magnetite, and martite may occur admixed and in intimate contact with iron silicates and gangue minerals. Some of the iron minerals may be of an amorphous or noncrystalline type, or they may be in fine grains enclosed in the gangue. These conditions pose many problems to the physical beneficiation processes.

If the iron oxides are relatively coarse grained, free of slimes, and loosely bound to the gangue, they may respond to flotation. If magnetite is con-



siderable portion of the iron minerals, magnetic separation may be effective, either alone or in combination with other methods. Some of the fine-grained earthy types might be treated by magnetizing roasting to convert the oxides to artificial magnetite, followed by grinding and magnetic separation. This process may give a higher recovery of the iron than flotation, but it is generally a more expensive treatment method. It is of more than passing interest that industry has recently put into operation in Minnesota two medium-sized pilot plants to study the application of magnetizing roasting to selected types of the semitaconites. A small kiln has been installed at the Michigan College of Mining & Technology to study applications of the process to the jaspilites.

It is apparent that the conventional physical beneficiation methods can be applied only to those portions of the semitaconites and jaspilites that are fairly uniform in grade, mineralogy, structure, and texture. The economics of applying these methods as they are now practiced would seem to rule out the formations containing less than 30 percent iron as higher oxides. Aside from grade, an important factor in the application of the methods is structure and mineralogy such that a considerable portion of the gangue minerals can be eliminated at a relatively coarse size by a low-cost preliminary treatment such as magnetic cobbing or some kind of gravity separation. Perhaps the most important factor, however, is the effective liberation and efficient recovery of the iron minerals within economic grinding limits; the principal problem in beneficiating any of the low-grade formations is liberation of the desirable iron minerals. Combinations of the various processes probably will be too costly to consider except for special conditions, although magnetic separation might be considered for use with other processes.

If physical beneficiation employing fine grinding is used, the concentrate must be agglomerated to a form suitable for shipping, stockpiling, and feeding to the blast furnace. The process in common use at the beneficiation plants is pelletizing, while sintering is used at the blast furnaces. Other processes under study but not yet in much use are briquetting and extrusion. The pelletizing and sintering processes utilize heat energy and the briquetting and extrusion processes, mechanical energy. Nearly all of the processes employ binders. The cost of agglomeration is about as much as the cost of grinding the iron ores and separating the iron minerals.

The other kinds of iron formations, slaty members and the unaltered parent rocks, seem beyond the reach of the physical beneficiation methods. In general, the slaty members contain more iron carbonate, or siderite, than the cherty members, and the iron minerals are so fine grained and intimately joined to the gangue that extensive grinding is required to free them. Primary slimes as well as those generated by grinding interfere with the subsequent separation processes. The iron minerals are largely nonmagnetic except in some of the slaty taconites, and thus magnetic separation would not be effective even if liberation could be achieved. These slaty formations requiring grinding to micron sizes are not amenable to flotation in its present state of development. Magnetizing roasting would require extensive grinding after the roast to liberate the artificial magnetite. The principal problem in beneficiating these slaty formations is liberation of the iron minerals. The unaltered parent rocks contain much iron silicate in which silica is chemically combined and cannot be rejected by any physical means.

It might be worthwhile to briefly review the various beneficiation processes for iron minerals and note their shortcomings. Magnetic separation has become well developed and through the establishment of the magnetic taconite industry. Wet magnetic separation is a relatively low cost process that is effective on even fine-grained magnetite. However, dry magnetic separation has been developed only for the coarser sizes and is used largely as a cobbing method. High intensity magnetic separation is in the experimental stage for weakly magnetic iron minerals, but it has not given sharp separations. Induction of electric charges on the surfaces of the iron minerals also is an experimental process, but the conditions for its application are so critical that it has not found much use as a beneficiation process and the feed must be completely dry.

Flotation is used more in mineral beneficiation than any other process and its application to the iron oxide minerals has been extensively investigated, but only four plants are now operating in the Lake Superior region. Three of these are treating Michigan specularite ores and the fourth is treating Mesabi wash plant tailing in Minnesota. All of the plants use anionic flotation, but

the method is limited to ores relatively free of slimes. Flotation of the silica gangue can be done with either anionic or cationic collectors, but this method has problems which discourage its commercial use. The flotation phenomenon through widely practiced still remains somewhat obscure; it is still in the category of an art rather than a science. New knowledge about the phenomenon is necessary to extend its ranges of use to the fine-grained iron oxide minerals. Basic research is going on at a few colleges and universities to quantify the mechanisms of the phenomenon, but it is apparent that much more work must be done to give it a scientific basis. Judging by the volume of their literature on the subject, the Soviets are making a determined effort to find out the basic factors of flotation, and they are already applying the process under conditions not yet tried in this country. It appears that they have more people working on the basic aspects of flotation than we have in this country.

Magnetizing roasting has been widely studied, but few industrial plants have been built. While it is an established metallurgical process, the mechanisms of transforming hematite to magnetite are not well understood. Thermodynamic data for the reduction of pure iron oxides seem well established, but the kinetics have not been extensively studied. The treatment of ores rather than pure oxides introduces factors that have not been fully investigated even though it is obvious that the presence of gangue minerals may modify the equilibria of the pure systems.

The use of magnetizing roasting depends upon the availability of reducing gas at low enough cost to make it economic. The gases that have been studied most are hydrogen and carbon monoxide; these are readily obtained from natural gas, oil or even coal, but natural gas is the most economic under normal conditions. The near future availability of domestic natural gas in northern Minnesota at 35 to 36 cents per thousand cubic feet is the factor encouraging pilot plant studies of the magnetizing roasting process there. Canadian gas at 52 cents per M c.f. has been talked about for the Upper Peninsula of Michigan, but such a disparity in gas prices will discriminate against the use of the magnetizing roasting process on Michigan low-grade iron ores.

The roasting reaction is affected by the mineralogy, porosity and grain sizes of both iron oxides and gangue minerals. The reaction rate is governed by size of feed and its porosity, while the grain size of the iron minerals and nature of their locking with the silica determine both reaction rate and amount of grinding for liberation after roasting. Temperature, gas composition, and gas flow largely determine the operating conditions and greatly influence the time necessary to complete the reduction, and thus the production rate. The reactor must be efficient in utilization of the reducing gases and in heat conservation.

For those types of iron formation that will not yield to any of the physical beneficiation processes, pyrometallurgical and chemical processes must be considered. Direct reduction has been extensively investigated but not found comparable to the modern blast furnace in capacity and economy, and thus it has come into limited use only under special economic and resource conditions. There are many direct reduction methods; most of them employ carbon monoxide, hydrogen or a combination of these gases. Although the technology of direct reduction is growing, the actual mechanisms and kinetics of reduction are still not well known. Since large amounts of heat energy are required, the future of direct reduction in the treatment of the iron formations is closely tied to the cost of fuel and electricity. These forms of energy must be low in cost and available in large quantities since exploitation of the low-grade formations necessarily will be accomplished in large tonnage mines and plants. It might be pointed out that direct reduction accomplishes both beneficiation and agglomeration. The product may be used as a feed to the blast furnace, or if it is highly reduced, as a substitute for scrap iron in the open hearth. Fully reduced and purified iron powder is increasingly in demand for molding and sintering purposes.

In conclusion, it should be recognized that while the magnetic taconites are a resource of important magnitude and the technology for utilizing them has been worked out, there is an urgency to solve the problems of utilizing the other types of iron formations that are available in much greater tonnages and are accessible to low-cost mining. Though the problems are complex, work on them may reveal some advantages for these formations over the magnetic taconites that will make them more competitive as a raw material. Moreover, the concentration of industry resulting from dependency on the magnetic taconites as a primary source of iron would not be a healthy strategic condition. Another

reason for research on the other types of iron formation is that further changes in the iron and steel industry can be expected to take place, such as development of new smelting methods and even relocation of industry.

The complexity of the problems is such as to require persistent research of a basic as well as an applied nature. This research should be concerned with the discovery of new knowledge about the iron minerals and the applications of presently known basic knowledge to the development of new techniques and processes to make competitive products from the low-grade iron ores. The research might also include investigations to develop lower cost mining methods.

Although the iron ore industry has shown initiative in demonstrating known processes, it has not expended much of its income on research to develop new ones to utilize the domestic iron ore resources. Industry has been supporting five iron ore research laboratories since the war at an annual cost believed to be about \$20 million. Minnesota and Michigan both support research programs devoted largely to their iron ore resource problems. The mines experiment station at the University of Minnesota has conducted a small but comprehensive iron ore research program since 1917. The Institute of Mineral Research at the Michigan College of Mining and Technology has been active since 1955 with emphasis on the low-grade iron ore problems. The annual expenditure for these programs is in the neighborhood of \$250,000. The Federal Bureau of Mines has been supporting an iron ore research program since the establishment of stations at the University of Minnesota in 1917 and the University of Alabama in 1911. This program was stepped up recently with the construction of a new research station at Minneapolis. It is thought that the Bureau allocates about \$500,000 annually for iron ore research.

Most of the research being done by industry is of an applied or development nature. The industrial research organizations are so fully occupied with production problems that they cannot devote a continued effort to basic research. It appears that basic research directed toward physical beneficiation processes is being carried on by perhaps half a dozen colleges and universities having mineral industry departments, and not much of it is related to iron minerals. The two State agencies and the Federal Bureau of Mines are devoting some effort to basic research, but in total it is thought that less than 10 percent of the iron ore research is of a basic nature. This is an area where much work is needed to discover new knowledge that will permit breakthroughs in the development of new processes for the domestic iron ore resources. The nature of basic research is such that many different people must think about the problems, conceive ideas, and painstakingly investigate many of them to develop one that is useful. Thus many individuals and organizations should be devoted to this work, not just two or three.

It appears that the colleges and universities are in the best position to do this type of work, as has been shown by their past performance. It is logical to encourage a greater effort by those institutions having the staffs interested in and capable of working on the problems related to the utilization of the iron resources. It is recommended that funds be made available to the National Science Foundation for allocation to colleges and universities for basic research related to the utilization of the domestic low-grade iron ores. An expenditure of a half million dollars a year distributed among 10 to 20 colleges and universities should in the next 5 to 10 years produce gratifying and startling results in the development of new knowledge which will give impetus to the applications of processes needed for our iron ore industry.

Mr. VOLIN. I think we ought to look at this iron ore picture by maybe a 10-year span, looking at it for the past decade. For instance, in 1950 the shipments from the domestic mines in the Lake Superior region were 79 million gross tons, while imported ores were 8.3 million. Then the shipments rose to a peak of 95.5 million in 1953 and imports to a peak of 35.6 million in 1959.

In 1960 the Lake Superior mines shipped 62.9 million gross tons while imports were 34.9 million tons, just a little less than the record of the previous year, and, as brought out, the principal sources of imports in the order of the tonnage supplied were Venezuela, Canada, and some others. The reasons for the growth in imports are largely

economic. Not only are these foreign ores much higher in iron, but they generally are lower in cost than the traditional Lake Superior direct shipping ores which average 51.5 to 52 percent Fe.

The net result is that steel produced from the foreign ores is more competitive pricewise than that produced from domestic ores and there are two significant factors in the lower cost of the foreign ores. This is cheap foreign labor and low rates for ocean transportation. There has been an increase in the grade of domestic ores over the 10-year span. This is noteworthy because it reflects the growing use of beneficiation.

About 52 percent of the ores shipped in 1950 had received some sort of simple beneficiation. The taconite industry had not come in yet. They were still in the experimental stage, and there were only 82,000 tons shipped that year.

In 1960, over half of the ores shipped from the Lake Superior region had received some sort of beneficiation and this included 11.7 million gross tons of taconite pellets from Minnesota and about a million gross tons of Jaspilite concentrates and pellets from Michigan. Here are some things about these pellets.

These domestic pellets vary in iron content from 61 to 66 percent and average about 63. This is expected to increase gradually to over 64. Recent blast furnace records with all-pellet burdens have shown this to be superior to the natural ores.

Besides having a higher iron content, the pellets have a more favorable ratio of iron to silica than the direct shipping ores and they are uniform in grade and physical structure. Some of the benefits derived from the use of pellets are increased production per furnace which reduces the unit capital charges for a blast furnace plant, decreased slag volume, decreased coke and limestone consumption per ton of iron, decreased slag volume, and decreased flue dust, all of which amount to a decrease in direct operating cost per ton of iron.

In other words, the use of pellets results in a significant increase in pig iron production with a corresponding decrease in the cost of smelting a ton of iron.

We have talked about the past 10 years. Let's look at the next 10 years and see what is going to happen. They figure that our annual iron ore requirements will rise by at least 20 million gross tons, but that the domestic ore production will remain at an annual level between 90 and 100 million tons, and these additional requirements will be coming from South America, Canada, and other imports. It is expected that more of the domestic production will be in the form of pellets and other highly beneficiated products. The pellet production in the next 10 years is expected to reach 35 million gross tons and it is foreseen that production of direct shipping ores from the Lake Superior region will decline further to a level of about 40 million gross tons.

Senator CLARK. Let me interrupt there just a moment. Would you say that again? You are going to have a decrease from this region?

Mr. VOLIN. It looks that way. This is direct shipping ores, now.

Senator CARROLL. Is that what you call furnace ore?

Mr. VOLIN. That is what we have been calling furnace ore.

Senator CARROLL. And that is going to decrease to 40 million?

Mr. VOLIN. Yes, that is the projection.

Senator CARROLL. Would there be an increase on the pellets, which is really the taconite?

Mr. VOLIN. Yes, there will definitely be an increase in the pellets. When you project the curve or the line upward, 35 million tons by 1970 seems quite reasonable and it might be more than that.

Senator CARROLL. All right. Go right ahead.

Mr. VOLIN. This trend is a matter of economics and not at all a result of lack of iron ore, but certainly, if it continues it is going to deprive the United States of a substantial income from iron ore mining and it is going to cause a dislocation of labor force in this industry, and eventually put the Nation in a position of dependency on overseas supplies.

I think it is quite important to this Nation that the iron and steel industry be competitive and at all times be assured of adequate domestic supplies of reasonably high quality.

Senator CARROLL. May I interrupt to ask you this?

If there is going to be this decrease on the furnace ore and the increase on the pellets, that only gives us a production of about 75 to 80 million, if I understand, 40 million blast, 35 million pellets.

Mr. VOLIN. Yes.

Senator CARROLL. And our total consumptive needs will be going up?

Mr. VOLIN. By about 20 million, according to this projection.

Senator CARROLL. Are you then saying that that differential then will come from imports?

Mr. VOLIN. That is what the projection looks like.

Senator CARROLL. And this means, therefore, that you destroy almost the mining labor force of this country. I say destroy it. It will have to move into other areas.

Mr. VOLIN. Some of it, of course, will move into pellet production. Some of it that is being displaced out of the direct shipping ore production will move into the pellet production, certainly.

Senator CARROLL. If I understand correctly, for 1957 there was 106 million and of that about 10 percent was the pellet production, and therefore, the 95 million was what we call furnace ore production.

Mr. VOLIN. There is another thing that has not been brought out here. Some of that was beneficiated ore. It had received what is called simple beneficiation. This simple beneficiation does not involve the fine grinding, the costly fine grinding that the taconite ore does. This simple beneficiation does not improve the grade of these ores to the grade that the taconite pellets are, either.

Senator CARROLL. What was our production in 1960? Was it around 60 million, did I understand?

Mr. WADE. In the United States?

Senator CARROLL. Yes.

Mr. WADE. In 1960, I have the figure 83,600,000. That does not agree with the Bureau of Mines' figure. It is a preliminary figure that we got from them some time back.

Senator CARROLL. 83 million?

Mr. WADE. Yes.

Senator CARROLL. How much of that is furnace ore?

Mr. WADE. I would have it for Minnesota, but not for the United States.

Senator CARROLL. Mr. Ankeny, can you tell me what was the total production of ore in this country, both furnace and taconite?

Mr. ANKENY. Last year?

Senator CARROLL. Yes.

Mr. RENO. I do not have those figures. If I may borrow one of these American Iron Ore Association books, I believe they have it.

Mr. VOLIN. In 1960, the shipments from the Lake Superior region were 62.9 million gross tons. This was shipments, which is an important thing we are talking about. That is the ore moving to the blast furnaces.

Senator CARROLL. What portion of that would be furnace ore and what would be taconite?

Mr. VOLIN. Let's look at the pellets first. Part of that is pellets. There is about 12 million tons of pellets in that, almost 13 million.

Mr. WADE. 11,368,000 tons of taconite concentrate.

Mr. VOLIN. There was another million tons in Michigan. There was 12.6 million tons of highly beneficiated product in that. Of the rest, that would be 12 million from 62 million, practically 50 million tons. Over half of that had received some sort of beneficiation, so the direct shipping ores were of the order of 25 million tons that had received what you call no beneficiation.

Senator CARROLL. I think I ought to put in the record at this time the 1961 booklet from the American Ore Association. It says "Iron Ore Originating Areas, United States, Lake Superior Production (Crude Ore), 123 million."

These are just round figures. Northeastern, 11 million; Southern 7 million; Western 6.5 million: The total in the United States was almost 149 million.

Mr. VOLIN. That was production?

Senator CARROLL. That is right. Direct shipping ore: Lake Superior, 15 million, almost 16 million. The total for the United States was almost 22 million. In sized ore, the total for the United States was 14 million; for concentrates, et cetera, 45 million giving a total of 81,553,621, 81.5 million.

(Information referred to follows:)

Iron ore mined and shipped,¹ United States and Canada, 1960

[Gross tons]

	Iron ore originating areas				
	United States				Total United States ²
	Lake Superior	North- eastern ²	Southern ²	Western	
Production (crude ore).....	123,691,682	11,128,048	7,548,678	6,576,971	148,945,379
Direct shipping ore.....	15,819,610	-----	3,103,374	3,041,821	21,964,805
Sized ore.....	14,368,350	-----	-----	16,481	14,384,831
Concentrates and agglomerates.....	37,243,864	3,672,697	1,770,745	2,516,679	45,203,985
Total shipments.....	67,431,824	3,672,697	4,874,119	5,574,981	81,553,621

¹ Includes iron ore with 5 to 10 percent manganese.

² Includes byproduct ore.

Mr. VOLIN. This is from the whole country.

Senator CARROLL. Yes.

Mr. VOLIN. I would think it would be desirable to take a look at the type of resource because several questions have been asked about magnetic taconite and so on and actually the whole resource is of somewhat different character. The principal part of the resource, of course, the Lake Superior iron resource is in the iron formations in the Mesabi Range, and there are various estimates of tonnages which have been given. About all I can say is that 75 million tons can be given as an order of magnitude. Geologically, these formations are divided into cherty and slaty members. As a whole, the formations are heterogeneous as to mineralogy structure and texture.

In Michigan, you have much the same situation and the tonnage estimates range from 2 to 7 million depending upon the limits taken, and you can figure about a billion tons accessible to open-pit mining.

The ores themselves were formed by a rather fortunate circumstance of nature that iron formations were exposed to weathering processes. We do not need to go into that.

Senator CARROLL. I agree with you on that. This is the question: If our production of furnace ore is going to go down substantially, as you have indicated, even though our taconite comes up, we are going to get a tremendous import into this country. What are we going to do about this? What are we going to do to save this industry? This is the real question here.

Mr. VOLIN. Right.

Senator CARROLL. Your remarks will be put in the record here, but how do we meet this problem?

Mr. VOLIN. There are these matters of what you can do. Here is a good question in this regard. Why can't we beneficiate the natural ores that we have so that they will compete with foreign ores? Why can't we upgrade those to 62 or so percent, but this is not feasible. It is a matter of economics as well as technology. It cannot be achieved by simple beneficiation, with the fine grinding and, if you do the fine grinding, that adds an instrument of cost which is of considerable magnitude and, furthermore, you cannot make these into high-grade concentrates without sacrificing too much recovery of the iron, and the iron minerals are largely nonmagnetic and thus, they are not amenable to low-cost magnetic separation, and they are not amenable to flotation, which is another process that is available for ore separation.

The open-pit reserves are not sufficient to encourage research along this line. The high cost of underground mining leaves no margin for absorbing beneficiation with fine grinding as an additional cost.

Here are some of the factors which answer your question of why these direct shipping ores are losing out. The foreign ores are higher grade. We cannot do too much with these direct shipping ores to bring them to competitive level with those foreign ores and do it cheaply enough.

Senator CARROLL. Is this true of the furnace ore?

Mr. VOLIN. The furnace ore is natural ore. That is 51.5 percent. The furnace people do not want it any more.

Senator CARROLL. Is that so?

Mr. VOLIN. Yes. You can get much higher productivity from your furnaces with these higher grade ores and the pellets. Here is an example of that.

The same blast furnace that produced about 1,400 tons per day on natural ores recently produced 3,200 tons per day on pellets and they think they are going to get it to 3,400 tons. There is over a doubling of capacity from exactly the same furnace.

Senator CARROLL. We will talk about the pellets.

Mr. VOLIN. The pellets are competitive, let us say, metallurgically. I mean that in a blast furnace they are fully competitive, perhaps even better than the foreign ores. They have very good blast furnace characteristics.

Senator CARROLL. But you have the economic factors that go into the beneficiation and making of the pellets.

Mr. VOLIN. Yes, sir. You were asking why don't we increase the pellet production. We have this 5 or 7 billion tons of magnetic taconite accessible to open-pit mining and I think part of the answer to this is actually the industry is increasing. The Reserve Mining Co. has already announced a doubling of capacity. In other words, their capacity now is 5 million tons a year and they are going to double and have 10 million. This will mean that Minnesota will have 17 million tons of pellet capacity pretty soon. In Michigan, the same thing is taking place. We have about a million tons of concentrate in pellet capacity now and that is being doubled and will soon be 2 million tons, but this is not growing fast enough to take the place of the industry that we are losing.

Senator CARROLL. Have you heard the testimony a little while ago of Mr. Benson about the ore in these underground mines?

Mr. VOLIN. Yes.

Senator CARROLL. Are you saying that there is really no demand for that sort of ore anymore? I do not say not any demand, but there is not a substantial demand for it.

Mr. VOLIN. They have a criterion which they call the price-quality ratio. If you have low enough price, with low quality it is still economic, but if you have a high quality and a low price, that is pretty hard to beat.

Senator CARROLL. And this is what you are getting from Canadian ore, I assume, and Venezuelan.

Mr. VOLIN. Right.

Senator CARROLL. High quality, low price.

Mr. VOLIN. Yes, low cost.

Senator CARROLL. Have you gentlemen who studied this an opinion about increasing the tariff?

Mr. VOLIN. That is an economic question. I am only concerned with the technology of the industry, and I do not have any opinion on this. I would not want to give an opinion on quotas.

Senator CARROLL. We are agreed we have to continue basic research. I would say generally, there ought to be more devotion to applied research. We have to go ahead in this field. You have indicated that these pellets are going to continue. This is important. The theory is accepted. The assumption is accepted that there is no longer the demand for the natural ores because of this high quality ore.

Mr. VOLIN. The demand is decreasing all the time.

Senator CARROLL. Then, one of the real reasons for this hearing this morning is to see what we are going to do about the unemployment in this area. The cost factors are so completely out of line, as you have indicated, with the high quality and the low cost coming in. There is only one way they can meet it, it seems to me. That is by tariffs, or quotas. I do not think even the quota would affect it, as I listen to the testimony.

The high tariff might affect it.

Mr. VOLIN. I think there is plenty of place in this picture for more research and not only applied research, but basic research, also. Actually, we are neglecting basic research and what it can do in the way of providing new knowledge. You can count on your fingers the number of people that are doing basic research on iron ore.

For instance, it might be related to iron ore. When I talk about basic research, I am talking about perhaps a more fundamental level research than Mr. Ankeny was talking about. I am talking about the development of new knowledge that will mean breakthroughs in knowledge which will permit the applied research to go forward.

Senator CARROLL. Are you thinking in terms of just the technology, metallurgy? I am thinking in terms this morning of people, employment. The question is, How do we get people and families back to work, families, as one of the witnesses said here this morning, for 75 years that have been in mining? They were born and their children born in this area. They know no other way of life. Can research save them? I know it can improve the quality of ore, but can it help the unemployment problem?

Mr. VOLIN. Unfortunately, I do not have the answers and I do not think anybody else has the answers to save this situation right now, this year or maybe next year, or the year after, but I can say if we had had an adequate volume of research going on starting 10 years ago, we would have the answers today for these problems.

Senator CARROLL. I agree with you. That is what is happening in many fields. This is what is happening in all fields of science. If we had devoted more time to basic research instead of having people look at what makes potatoes turn brown, or grass turn brown, we would be further ahead in the whole field of science. I think this is true in metallurgy, too. I do not mean to shut you off.

Have you summarized your statement? Is there anything else you want to say on this subject?

Mr. VOLIN. You were asking for some figures on this taconite industry. I thought I would put a couple of things in the record that might be helpful. The number of people that are employed per million tons produced annually is about a thousand, so you can figure how much this would mean.

Senator CARROLL. Would you repeat that please?

Mr. VOLIN. A thousand people—this is an average figure—are employed in the industry to produce a million tons annually of taconite pellets. This is about the same ratio as we are producing in the underground mine, about the same number producing the underground ores. The only thing is when you change from one industry to another, you might relocate a man out of an underground job into a mechanic's job, or something like that.

Another useful figure is the tremendous capital cost of these taconite plants and maybe part of the reason this industry is not developing faster is if you look at the cost of the industry now, per 12 million tons of pellet production industry has invested \$600 million. This figures out to over \$50 million per million tons of annual production.

Senator CARROLL. Who are the private investors in the taconite?

Mr. VOLIN. The investments are so large that it takes combines. There are several companies involved in research.

Senator CARROLL. Have any of the big steel companies gone into taconite?

Mr. WADE. The Reserve Mining Co. is 50 percent Republic and 50 percent Armco. Erie Mining Co. is 45 percent Bethlehem, 45 percent Youngstown, and a steel company of Canada; 5 percent I believe, or approximately that.

Senator CARROLL. So the big steel companies know the value of taconite and they have invested great sums in it.

Mr. VOLIN. Yes. They are the ones behind this industry and are building it. As has already been pointed out, the problems of the non-magnetic taconite are far different. Also, we point out that the nonmagnetic taconite resources are much larger than the magnetic taconite.

Senator CARROLL. Are these large steel companies doing research in this field, too?

Mr. VOLIN. You have the information on the Hanna Co. It is interesting. That is not the only company that is doing work on the semitaconites. The Oliver Iron Mining also has an experimental camp. These are demonstration plants, what you might call medium pilot plant size, and they are trying to demonstrate this known metallurgical method, the magnetizing, roasting of selected semitaconites, not all. These semitaconites are very heterogeneous and they hope to apply this method on some types of semitaconites and it seems to have good possibilities, but this is not the only method that we should pay attention to.

We should go back and review the possibilities for flotation. Flotation is a much lower cost method and it has not found much use, but with the basic research that I am talking about, I think it might find use. There are two other methods that have not been mentioned, the high-intensity magnetic separation and electrostatic separation. They are both experimental methods, but we do not have the knowledge to apply these methods in actual applications.

Senator CARROLL. All right, sir. That has been very helpful to us. Your whole statement will be read very carefully. I would like you to remain at the stand while we hear from Professor Wade.

(Subsequently, Mr. Volin transmitted the following communication:)

THE MICHIGAN COLLEGE OF MINING AND TECHNOLOGY,
Houghton, Mich., June 29, 1961.

Hon. JOHN CARROLL,
U.S. Senate, Washington, D.C.

DEAR SENATOR CARROLL: Some of the statistics I gave at your hearing on June 22 were questioned and apparently need further explanation and substantiation.

I stated that the new iron ore pellet-producing enterprises provide employment for roughly 1,000 people per million long tons of pellets produced annually. This figure includes both direct and indirect employments. The number directly employed in the mine and beneficiation plant is about 300 per million annual

gross tons, but another 700 people find indirect employment in supporting or related industries such as transportation, supplies, etc. It is interesting to note that the low-grade ore developments support about the same number of employees as the direct shipping mines they replace.

I also made the statement that the capital investment in a pellet enterprise is about \$50 per annual gross ton of production. This is the total investment for mines, plant, transportation system, docks, towns, etc. Actually the investment for the mining and pellet-producing part of the enterprise is roughly \$30 per annual gross ton and the rest of the investment goes for the other things necessary for the enterprise to operate.

Mr. Hugo Johnson of the American Iron Association asked where I obtained the information for my statement that the expenditure for iron ore research in 1960 was less than 3 percent of the gross value of the iron ores shipped. I would like to clarify this statement as I had to make certain assumptions about expenditures by industry. I assumed that the five industrial iron ore laboratories (three in Minnesota and two in Michigan) had annual budgets of \$4 million each; this is based on a personal communication that the operating budget of one of the Michigan laboratories was \$4 million. The Mines Experiment Station of the University of Minnesota had a budget of \$150,000 and the Institute of Mineral Research here at the Michigan College of Mining and Technology had a budget of \$125,000. It is my understanding that the Federal Bureau of Mines allocated approximately a half million dollars for iron ore research. This is a total of less than \$21 million spent on research dealing with the utilization of iron ore as a raw material. Taking the average value of the iron ore at this Lake Superior region mines as \$8.50 per ton and 62.9 million gross tons as the shipments from the Lake Superior region last year, the expenditure for research works out to 4 percent of the gross values of the ore instead of 3 percent as I stated at the hearing. I might reiterate that many other industries find it necessary to expend 10 percent of their annual gross income on research to maintain their competitive positions, and the problems of treating the low-grade iron ores are just as difficult as those encountered in the other industries.

I tried to emphasize at the hearing that very little of the research is of a basic nature and that this kind of research is being neglected. The industrial organizations do not perform much basic research because they are quite fully occupied with work on problems immediately related to production. The basic research is going on in perhaps a half dozen colleges and universities as graduate studies and work performed by the faculties concurrently with their teaching. Many people can't see the value of this kind of research, but the flotation method of beneficiation, one of the most widely applied ones in use today, has found only limited application to the iron ores because of a lack of scientific understanding of this complex phenomenon. As more basic research is done to understand the mechanisms of flotation, we will be able to extend the usefulness of this low-cost method to the iron oxide ores.

My plea for funds to be appropriated to the National Science Foundation for encouragement of basic research directly related to iron minerals was based on recognition of the need for this kind of research. A modest annual expenditure in this area continued over a number of years could eventually bring great benefits to our domestic iron ore industry, but immediate results should not be expected.

Sincerely,

M. E. VOLIN,
Director, Institute of Mineral Research.

Mr. WADE. I have a statement that would perhaps take about 15 minutes to read. Is that too long?

Senator CARROLL. You may testify as you wish. I want to hear from Mr. Hugo Johnson, of the American Iron Ore Association, also. Would you gentlemen like to go to lunch and come back? What is your pleasure, Mr. Johnson? I am thinking also of the reporter here. He has been here a long time. I thought we would be out of here at 1 o'clock. It is 1:10. That means we will be back at 2, and I think maybe the reporter ought to have something to eat. I do not need the calories, but he does. Let us return at 2:30. Mr. Johnson, how does that strike you?

Mr. JOHNSON. That is perfectly satisfactory.

Senator CARROLL. All right. We will be here at 2:30 and I want to say to the gentleman from the Bureau of Mines, I know you have many things to do. We will be glad to have you, but unless you want to challenge what Mr. Johnson says, or he wants to challenge what you have said, you need not return. You can use your own judgment on whether you want to come back. We will stand in recess until 2:30.

(Whereupon, at 1:10 p.m., the subcommittee was recessed, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION

(The subcommittee reconvened at 2:30 p.m., Senator John A. Carroll, chairman of the subcommittee, presiding.)

Senator CARROLL. The subcommittee will be in order.

We will now hear Professor Wade. You may proceed, Professor.

STATEMENT OF HENRY H. WADE, PROFESSOR, SCHOOL OF MINES, UNIVERSITY OF MINNESOTA

Mr. WADE. I believe I will give you this little pamphlet¹ which I had not submitted before. It is something I prepared for another occasion, but I thought it might be of interest to you in light of the discussion this morning.

This has to do with the situation in Minnesota. This is one curve that I can show you which is simply a cumulative plot of direct ore shipments, that is, ore that is not treated in any way. This is by years. It is the sum of all that has been previously shipped.

The dotted portion is gravity concentrate. The sum of these two was the total shipment, until taconite came into the picture. This upward curve is the reserve added to the previous shipments.

So this was what was originally in the ground, as far as was known in 1910 having something like 1,700 million tons that had originally been available, but only the amount indicated had been shipped. This has been increasing because of the fact of new exploration, new technology, and so forth.

It has increased from year to year until, in 1954, I believe it reached a peak.

Senator CARROLL. Have the record show that the witness is testifying from chart No. 1. The statement will be placed into the record at this time.

(The charts referred to are on file with the committee. The statement is as follows:)

STATEMENT OF H. F. WADE, DIRECTOR, MINES EXPERIMENT STATION, UNIVERSITY OF MINNESOTA

The mining and transportation of iron ore has been an important industry in northeastern Minnesota for the past 65 years. The industry has provided support for most of the people in the various towns of the iron range area and has been an important factor in the economy of the State and of the Nation. During the years of World War I and World War II mining production rates were greatly increased and employment was high. Since 1953, produc-

¹ Filed with the committee.

tion rates have decreased. Employment has been declining and this part of the State is now frequently referred to as a distressed area. It may be of interest to discuss briefly the background, to point to some of the reasons for the present situation, and to try to suggest remedies.

Up to the present time most of the production of iron ore from Minnesota has consisted of either direct shipping ore or beneficiated ore which for simplicity I will refer to as gravity concentrate. These two types of material have been mined at irregular but generally increasing rates, and through 1960, a total of 2.4 billion tons of material of this type had been shipped from Minnesota. The original reserve of this type of material occurring in Minnesota was large. Through 1910 Minnesota had shipped a total of 255 million tons and published reserves at that time amounted to 1,376 million tons. The sum of these two figures, 1,631 million tons, is the estimate at that time of the original reserve of iron ore in Minnesota. During the succeeding years there has been additional exploration and improvements in technology that have increased this estimated tonnage of original reserve. In 1956, this sum of cumulated total shipments and estimated reserves reached a maximum of about 3 billion tons.

During the past 10 years market conditions and specifications for iron ore have been changing. Some ores that were formerly usable are no longer marketable. Some marginal ore, formerly included with the reserve tonnages, has been removed from this classification. The estimated reserve of direct ore and gravity concentrate has consequently decreased more rapidly than the depletion resulting from shipments alone. While it is true that some additional ore will undoubtedly be discovered as a result of further exploration, it does seem that if the present trend toward high-quality blast furnace feed continues, the marketable reserve of direct ore and gravity concentrate in Minnesota will decrease rapidly. Shipments of these types will undoubtedly vary considerably from year to year, as in the past, but it is probable that the trend will continue to be downward.

For the past few years there has been a somewhat limited need for iron ore. Steel production has been below normal and an increasing portion of the ore requirement has been supplied from sources other than the Great Lakes area. With increased steel production there will be an increased demand for Minnesota ore, but the situation mentioned above points to the conclusion that the general trend of production of direct ore and gravity concentrate in Minnesota will be downward. This is the situation that any mining community dependent upon the production of high-grade ore must face. When mines are producing, reserves are decreasing and will eventually become exhausted.

Most mining communities have large reserves of low-grade material. If these are unusable, the mining communities will thrive only as long as the high-grade ores can be produced. If by technological improvements the low-grade ores can be made into a usable form, the mining communities may continue to flourish long after the high-grade ores have been depleted. Minnesota has reached the stage where important decisions will determine which course will be taken. Many of these factors are not related to technology, but for the successful utilization of low-grade ores, it is imperative that an economic technology be available. This technology must be metallurgically and mechanically operable. It is the purpose of the mines experiment station of the University of Minnesota to develop technology that can be applied to the problems of Minnesota iron ores.

In Minnesota it is probable that the original reserve of direct shipping iron ore amounted to about 2.15 billion tons. Gravity methods of concentration have added about 0.85 billion tons of concentrate to this reserve. This gives an original reserve of 3 billion tons of these types, of which more than 80 percent has already been used. There is, however, in Minnesota an enormously large amount of rock containing potentially usable quantities of iron. This is commonly referred to as taconite. The overall reserve of iron oxide in these rocks is sufficient to supply the iron needs of this country for many generations. Some of these rocks contain iron oxide in the form of magnetite. When rocks of this type are ground sufficiently fine, the magnetic iron oxide is liberated from the associated gangue minerals, and the iron oxide being in a magnetic form can be recovered by the use of magnetic concentrating equipment. The technology for recovering iron minerals from this type of rock is well developed. Several large plants are presently in successful commercial production of pel-

letized concentrate from magnetic taconite. The two large magnetic taconite operations are located at the extreme eastern end of the Mesabi Range. They are so far from the communities that have served the older Mesabi mines that completely new towns have had to be built. Future magnetic taconite operations will probably be located close to the older municipalities and will provide them with renewed vitality. There are undoubtedly a number of valid reasons why industry has not moved more rapidly to establish additional magnetic taconite processing facilities. It is probable, however, that lack of a suitable technology is not a major cause for delay since large-scale successful operation has been demonstrated, pilot-scale testing facilities are available, and improvements in mining and processing details are continually being studied.

There is in Minnesota another very large reserve of iron-bearing material, also called taconite or semitaconite, in which the iron minerals are not in the form of magnetite. In these rocks the nonmagnetic iron oxides are associated with various gangue minerals and fine grinding is necessary for liberation. In their natural form these iron minerals cannot be recovered by the use of normal low-intensity magnetic separators. However, one of the most frequently proposed methods for recovering the nonmagnetic oxide from rock of this type is to heat the material in an atmosphere that will remove a small portion of the oxygen from the iron mineral, thus converting it to the mineral magnetite. After a conversion of this sort, a processing procedure very similar to that used for magnetic taconite can be used. This method and other methods have received serious study by various organizations.

During recent years the mines experiment station at the University of Minnesota has devoted much of its effort toward the development of the technology of magnetic roasting and concentration. The utilization of the magnetic taconites has resulted in much progress in the fields of mining, crushing, fine grinding, magnetic separation, and agglomeration of taconite rock. When the mines experiment station undertook a serious study of the technology of concentrating the nonmagnetic taconites, it seemed impractical to attempt a thorough study of all possible methods and it was, therefore, decided that our effort could best be concentrated on the method that appeared to us most promising—that of magnetic roasting and concentration. We had some background of experience in this field and our laboratory facilities could be adapted to this study. Magnetic roasting equipment available to the industry was considered and it was decided that improved equipment to perform this function was needed. There are a number of types of equipment that can be adapted to magnetic roasting but we could see drawbacks and limitations to those that had come to our attention. The experiment station, therefore, undertook the problem of trying to develop an improved type of equipment for performing this conversion. We followed the procedure of using a relatively shallow bed of ore moving horizontally through chambers in which the proper operating conditions could be carefully controlled. Work on this device continued through a number of years of experimental work and a very serviceable piece of equipment has been developed. It provides roasted material which can be ground and concentrated in our semipilot scale flowsheet and we now have the facilities at the mines experiment station laboratory for crushing, roasting, grinding, concentrating, and agglomerating nonmagnetic taconite. With the greater proportion of samples that have been tested, it is possible to produce an agglomerated concentrate that is of high quality and possessing the physical characteristics desired for feed to a blast furnace.

The work of developing a new technology for utilizing a vast reserve of material of such varying properties as the nonmagnetic taconites and semitaconites possess is a long and painstaking undertaking. Many people have to become familiar with the various problems, details must be studied from different points of view, and progress is necessarily slow. The mines experiment station has worked for many years on this problem in connection with the other iron ore problem of the State; Federal and private laboratories have been working on it; industry has spent time, effort, and money in the investigation of this problem. Two pilot plants were established by mining companies during the past year at very considerable cost. These are presently in operation. Conscientious efforts are being made by these different groups and the outlook for an eventual satisfactory solution for this problem is encouraging.

It is my understanding that the purpose of this hearing is to determine whether there is something that the Federal Government may do to speed up

these investigations and shorten the interval that must elapse until commercial plants are in successful operation. If magnetic roasting and concentration is the most promising procedure, as we believe it to be, then the selection of the type and design of the device for performing the roasting operation is a most important decision. This is a costly step in the process and a device is needed in which the operation can be done most efficiently and at the lowest cost. In each of the two pilot plants now operating in Minnesota, rotary kilns of German manufacture are in use. There is no doubt that the roasting operation can be accomplished in this type of equipment. There is, however, serious doubt that this is the most effective device for doing the job. There is need for pilot plant scale testing of other devices for making the magnetic oxide conversion.

The horizontal moving grate type of roasting equipment developed at the mines experiment station appears to have a number of desirable features. The prototype equipment that has been built in our laboratory is about as large as can be conveniently handled as a laboratory unit. This has operated very satisfactorily and is extremely useful for our purposes. It has been estimated that if this type of equipment were engineered for large-scale operation, the capital cost and operating cost would be attractive. The great expense required to design, build, and test a large experimental machine of this type has to date prevented its being done. Until such tests are made, a potential user will hesitate to gamble that the device will function entirely satisfactorily in large commercial use. Here is a situation where Government assistance could be very useful.

For example, if a sufficient sum of money were appropriated to the regents of the University of Minnesota, a license to manufacture the device could be granted to a qualified company. If an agreement could be made with the operator of one of the present pilot plants, the cost of duplicating most of the other necessary processing and handling facilities would be eliminated. This arrangement would also permit direct comparisons of this equipment with any other devices available at the pilot plant for accomplishing the conversion to magnetite. Such an arrangement would also provide an operating organization capable of handling the records and recruiting the staff to operate, service, and repair the equipment. The operation would have the great benefit of close cooperation with an experienced staff, skilled in coping with the great variety of problems that can arise at all points of the procedure, from the original mining of the rock to the shipment of an agglomerated concentrate. The horizontal moving-bed type of equipment can be adapted to the use of various fuels. The particular fuels that are most economical for use in the area could be tested.

Such an arrangement would not be in competition with the efforts of industry to solve this very complicated problem, but would be intended to assist them in more quickly obtaining the necessary answers.

In my discussion this far I have attempted to point out that direct ore and gravity concentrate, which have been the principal products of Minnesota's mining activities during the past 65 years, are starting to decline in importance. Magnetic taconite processing is now a commercial reality, and while it is not expanding as rapidly as many would like, the technology is well advanced. The large reserve of nonmagnetic taconite and semitaconite is not being utilized but efforts are being made to develop the technology. One important detail that needs investigation is the development of more effective equipment for converting the nonmagnetic oxides to magnetite. A prototype machine for doing this work was described and the need for assistance in expanding this to commercial dimensions was stressed.

In order to find other avenues through which the University of Minnesota might be of assistance, Prof. E. P. Pfeider, head of the school of mines and metallurgy, and others were consulted. Mention was made of a continuing need for funds for carrying on sponsored research. Relatively modest amounts of money spent in this way may result in the development of embryonic ideas into practical uses of great importance. Professor Pfeider has made a specific suggestion which could be of very real significance. This relates to the vast amount of iron-bearing material that lies down the dip of the Mesabi Range south of what is commonly referred to as the southern boundary of the iron formation. Little is known as to the concentration characteristics of this material and whether or not it is susceptible to low cost underground mining techniques. This proposal for studying these materials is attached.

Appropriations needed to carry out proposals:

- | | |
|--|-----------|
| (a) Horizontal moving-bed roasting device: For design, construction installation, and operation, including feed preparation equipment----- | \$750,000 |
| If all auxiliary equipment and operation expense is borne by the project, an additional \$2,000,000 will be required. | |
| (b) Deep drilling program----- | 150,000 |
| (c) Sponsored research (basic studies)----- | 25,000 |

Senator CARROLL. Please proceed.

Mr. WADE. This sum of shipments, plus reserve, has been decreasing for a number of years. I have projected these shipments on to 1980, on no particular basis other than based on the estimated reserve, and have just made it a smooth projection. But it shows clearly that the reserve of direct ore and gravity concentrate is rapidly decreasing.

We will go to the next chart, which is simply annual shipments, with such variation that you cannot see trends very well.

I will go to chart No. 3, where I have averaged these. These are 9-year averages. The lower curve indicates direct ore, increased during World War II, and during the depression it was down, with an increase during World War II, and it is now rapidly decreasing. In 1960 it was quite low.

The gravity concentrate started being used along about 1910, and this added to the direct ore gives the curve of the shape that you see it, with the peak in World War II and in the early 1950's. The sum of these is the total shipments up to this time, and we are now rapidly declining.

The hatched area indicates the shipments of taconite from Minnesota. It indicates a sizable tonnage in 1960. It has been gradually increasing. I have projected that on to 1980 on the basis of the total capacity for taconite production in Minnesota after the reserve and new and expanded facilities have been added.

You see that even that curve added to the balance of our ores is rapidly decreasing. This is not a pleasant picture so far as employment is concerned.

I have indicated a dotted line that shows what must be done if we are going to maintain production in Minnesota comparable to what we have had in the past. If we assume that the 1960 production is normal, we would need something of the order of 30 million tons of annual capacity, new capacity, of taconite production. At \$40 per annual ton, that is a sizable investment involved, 30 million times \$40, or some such figure.

Senator CARROLL. Who would put up that money, do you think?

Mr. WADE. In the past it has been the mining companies that have borrowed the money, I believe largely from insurance companies.

Senator CARROLL. Who owns the lands mostly in Minnesota?

Mr. WADE. It is largely owned by the steel companies and iron mining companies.

Senator CARROLL. The same companies that own the Canadian deposits?

Mr. WADE. Yes, sir; in many cases that is true.

Senator CARROLL. What would be their inducement? Why should they develop this area when they have the Canadian lands?

Mr. WADE. The principal factor in our favor, I think, is the quality of the product that can be made from this. The pellets made from

taconite concentrate have proven to be very desirable, much preferable to the older type of iron ore.

Senator CARROLL. But the ore that they are getting from Canada, if I remember the testimony, today is superior to the ore that they are getting from elsewhere?

Mr. WADE. It is superior in the chemical analysis. In physical structure it is not. It can be made, by further treatment, it can be agglomerated into a desirable physical shape.

Senator CARROLL. Is it comparable to the pellet? It seems to me that there was some testimony here that our pellets have the same degree of quantity, at least, as the ore that comes in from Canada.

Mr. WADE. I think that is true. Canadian ores frequently have to be agglomerated in some way. Their common procedure is to sinter them rather than to pelletize them. I think that in general the feeling is that pellets have some superiority over sinter. But that is perhaps questionable.

Senator CARROLL. What about the cost of production, the comparative cost between the two?

Mr. WADE. I am afraid I cannot answer that question. I know that the Minnesota taconite operations, from all appearances, seem to be doing well, and they are expanding their facilities. From that I would take it that they are economic.

Senator CARROLL. Who has invested in the Minnesota taconite industry—the big steel companies, for example?

Mr. WADE. Yes. The Reserve Mining Co. is half owned by Republic Steel and half by Armco. Erie Mining Co. is Bethlehem Steel Co., Youngstown Sheet & Tube, the Steel Co. of Canada, and Inter-Lake Iron, I believe.

Senator CARROLL. Let us assume, and I will not use any names here, that the A steel company, a very powerful company, has extensive holdings in Minnesota, and also extensive holdings in Canada.

To have a successful taconite industry, if you are not as big as A, you have to have large reserves, do you not?

Mr. WADE. You must have large reserves; that is a necessity.

Senator CARROLL. But if A is holding the great segments of the reserves and still drawing from Canada, how can you build the taconite industry, if my assumption is correct?

Mr. WADE. I think there are some reserves available in the present field.

Senator CARROLL. Let me put this question to you, and we are not here to censure, to castigate, to expose, but to explore. Who is the biggest holder of taconite reserves in Minnesota today, and what percent of the reserves do they control?

Mr. WADE. I do not think that information is available. The eastern end is controlled. The Reserve Mining Co. has a length of perhaps 8 miles, I believe, on the eastern end. Then Erie has a section adjoining them to the west, in which they hold a good share of the reserves in, I would guess, some 6 or 8 miles.

I do not know the figure. Then I would say it was rather mixed from there on. It is rather divided.

Senator CARROLL. The largest holdings, then, are held by whom?

Mr. WADE. The magnetic taconite—Reserve has control of the eastern perhaps 6 or 8 miles, and then Erie has control of a section of a number of miles.

Senator CARROLL. Who is Reserve?

Mr. WADE. Reserve Mining Co. is the operating name for the company that is owned by Republic and Armco. Erie is the operating company name for the property controlled by Bethlehem, Youngstown, Inter-Lake and the Steel Co. of Canada.

Senator CARROLL. Does United States Steel have holdings there?

Mr. WADE. United States Steel has extensive holdings further west. They have magnetic taconite in the area just west of Virginia, and then they have large holdings—

Senator CARROLL. I am not saying this to be critical, but I am wondering in that area of land, and we will call it taconite land, that which contains the reserves, what percent of that land is owned by, we will say, the large corporations.

Mr. WADE. I do not know the number, but I would say they own a major portion of it, control it.

Senator CARROLL. This is what I have in mind. If the industry, as I understand it, is developing this industry, they must have adequate reserves to sustain them for future progress.

Mr. WADE. It is absolutely necessary that they must have enough to last them during the life of their operation, which may be 25 or 50 years or more.

Senator CARROLL. Which one of these three groups, if any, have installations in there now, productive facilities in there?

Mr. WADE. The Reserve Mining Co. has production there in large scale, and they will expand it to about 9-plus million tons when their present expansion program is completed.

Erie Mining Co. also has a large plant that has a capacity of some 7½ to 8 million tons, in pellets. United States Steel has a so-called pilot plant that is producing on the order of three-quarters of a million tons. That is located at Mountain Iron, which is more or less in the center of the range. If they were to expand their operations, it would be in an area that is now where there are old towns that would benefit considerably.

Senator CARROLL. Your analysis, then, is very similar to that which we have had before. The expansion and development is really going to be in taconite?

Mr. WADE. I believe that firmly; yes, sir.

Senator CARROLL. I think one witness has said that there is not the same demand that there was for furnace ore.

Mr. WADE. For that which was being described this morning; yes. The taconite pellets are much more desirable as blast furnace feed than the older type of ore was, not only chemically but physically, in particular.

Senator CARROLL. Wouldn't you say in the magnetic ore that this has progressed far enough now, that you know enough about what we call applied research. There is already production, there is heavy investment in this in the certain fields that you have indicated—

Mr. WADE. Yes, sir; I believe that is true. I do not believe it is technology that is delaying the advancement or expansion of this industry. There will be improvements, of course. Everyone is trying to make improvements.

Senator CARROLL. Do you know what the holdings are of American corporations in Canada? I assume that there must be some particular area, some particular range in Canada, that has this rich ore.

Mr. WADE. Yes. The Labrador Trough area is the area that is being talked of principally.

Senator CARROLL. Who is the heavy holder up there?

Mr. WADE. Originally it was the M. A. Hanna Co., but now most of the steel companies, I believe, are represented up there.

Senator CARROLL. Do you mean most of them have a piece, a part of the area?

Mr. WADE. Yes, sir.

Senator CARROLL. Do you know who is the largest holder up there? Who is the greatest importer of the ore?

Mr. WADE. I presume that the Hanna operation still is, but there are a number of plants under construction which will perhaps change that picture in the near future.

Senator CARROLL. Is Hanna connected with any of the big steel companies?

Mr. WADE. National Steel, I believe, and Great Lakes Iron.

Senator CARROLL. Is there any company that owns an area in Canada which is importing in large quantities that is not developing its area in Minnesota? The purpose of my question is this: Are they holding back the development of an area in Minnesota because they can exploit the situation in Canada, and holding back in a sense to the detriment of the extension of the taconite industry itself?

Mr. WADE. I do not know the reasons. Of course, whenever they build a plant in Canada, and there are several of them under construction and several that are in operation, that does, naturally, decrease the production from Minnesota. It is not particularly now, during a time when there is not a high demand for steel. I think when the steel demand increases there will be need for additional supply from both areas. But in times such as the present, Minnesota is undoubtedly affected.

Senator CARROLL. What is the scope of the unemployment problem in Minnesota?

Mr. WADE. I am not too familiar with that.

Senator CARROLL. This is not your field?

Mr. WADE. That is not my field.

Senator CARROLL. Would you feel that the development of the taconite industry in Minnesota will help alleviate the unemployment there?

Mr. WADE. I am sure it would be of great help.

Senator CARROLL. Do you see that the expansion will be slow in this field?

Mr. WADE. It takes a number of years to build a plant after the decision is made, so that you cannot decide today to build a plant and have it in production next month.

Senator CARROLL. If there is unemployment in Minnesota, I take it it is heavy in that area.

Mr. WADE. Yes, sir.

Senator CARROLL. What is the answer? How can we help those people? Have you any ideas about that?

Mr. WADE. I think that the permanent solution is the construction of taconite plants, and I think that that eventually will be done and will improve the situation greatly. It is a matter of when it will be done, in my opinion.

Senator CARROLL. I am reminded it is 10 minutes to 3, and we still have the head of the Iron Ore Association here.

Well, your statements have been put into the record now, professor. This is all very interesting and helpful to us, but to really meet the problems of unemployment in the area now, we must move swiftly.

You know, some advocate the quota system, or increasing the tariff. If we impose the quota system, a system of quotas, or increased tariff, in your expert opinion would this alleviate the unemployment problem in this area?

Mr. WADE. I am certainly not an expert in that field, but I do not think that is the proper solution. It could help temporarily, but I think the permanent solution is to develop our low-grade reserves. I think that is a natural development that should be encouraged.

Senator CARROLL. We still have what we call the natural ore, the ore that has been mined all through these years.

Mr. WADE. We think of that as perhaps a half billion tons. I believe our records here show 600 million tons.

Senator CARROLL. That would still be enough to keep us afloat for 10 years if we could keep these people employed.

Mr. WADE. Yes, that is true, but I do not think that is as desirable a thing. It is important and it is being operated. We are shipping sizable tonnages of that material, but I think in general the trend is for that material to be bound to be downward. I think we must develop new sources, and I think we have what is required for it.

Senator CARROLL. I agree with you completely. I think all are agreed that this has to be done. But this does not help a man who has a hungry family, who is unemployed, to say that this may develop in 5, 6, 7, or 10 years. There is no doubt about that.

But in the interim period, what do we do about people? How do we handle people? How do we handle people who have lived on the land and their history is in mining? Suddenly they see it dying on the vine, and they see the other things moving. But the basic question we are trying to explore this morning is what can we do to help people in an area where the industry to which they have devoted their life is dying on the vine. You can't do it quickly.

Mr. WADE. That certainly is true. In this statement that I submitted, I did suggest one factor that may or may not be a solution. I might mention that, if I can have the time.

Senator CARROLL. I do not want to cut you off, but I only have now a few minutes for Mr. Johnson. Mr. Johnson has been very patient and I do not want to give anybody the impression that we are trying to cut off the American Iron Ore Association.

Mr. WADE. May I ask you to read the statement that I have, and if you find that there are any questions that I can help you with later, would you call on me?

Senator CARROLL. As a matter of fact, I will ask the staff member to read that statement. We will read it together, and he will propound some questions.

Thank you very much.

Mr. WADE. Thank you.

Senator CARROLL. Now we will hear from Mr. Johnson.

STATEMENT OF HUGO E. JOHNSON, AMERICAN IRON ORE ASSOCIATION

Mr. JOHNSON. Senator, I just want to say that I came here with the understanding that we were going to direct our attention to the technical research. That was what your wire read to me, and I devoted my attention to that.

I just wanted to qualify that that is what I directed my remarks to.

Senator CARROLL. My purpose in conducting this hearing was at the request of the Members of the Senate and House of this area, and I assumed that what they wanted to do was to explore the possibilities of reemploying their people somewhere, and what do we do about the future economy of the area.

I must ask the staff member if that was not the purpose of the meeting.

Mr. DWYER. My understanding, Senator, was in line with the wording of that telegram. That telegram is substantially a draft of a wire I received from Mr. Welsh, of Senator Hart's personal staff.

Mr. JOHNSON. I only bring this out, Senator, because the men you have had here are very competent technical men, and I know them from reputation and I know them from working with them. I fear maybe we did not have enough witnesses on the economic side, which has been, maybe, the subject of most of your questioning. This is the point I want to make.

Senator CARROLL. If somebody wants me to help them get appropriations for basic research and for applied research, they would not need a hearing for that. I will be glad to do that. But I thought the purpose of this hearing was to find out what we are going to do about people in an area, such as Hibbing, where I visited some years ago, and where we find unemployment in distressed areas. How we are to meet the unemployment problems is what I understood to be the purpose of this meeting.

Mr. JOHNSON. We can go on and maybe from the questioning we will be on firmer ground.

I have left copies of this booklet with the committee, which we think tells a comprehensive story of the iron ore industry of the United States and Canada. I think you will observe if you examine the book that the iron ore industry is still a very virile industry.

It has spotty employment, definitely. We find mines operating over the world, with 40 different countries operating them, and 23 different States in the United States operating mines. The upper Great Lakes always has and always will be an important factor in our iron ore mining industry.

The iron ore mining industry has for over 40 years been conducting research in the low-grade field. You have heard a lot of that, and many millions of dollars have been spent. Heavy annual expenditures are continuing. This research effort has been conducted by private companies in their individual laboratories, supplemented with the excellent research you heard about from research institutes at universities, the agencies of the Federal Government, such as the U.S. Bureau of Mines and the U.S. Geological Survey—they have all done fine work.

These research efforts and subsequent process developments that have come about have resulted in technologies that have been applied successfully in seven commercial low-grade iron ore processing plants in the upper Great Lakes area. Research and process development initiated in these areas have been applied in many other areas of our country.

The industry does not intend to let up on its research efforts. Already several companies have constructed pilot facilities. You have heard about Hanna and about Olivers.

Senator CARROLL. Incidentally, I placed in the record this morning the Christian Science Monitor statement of March 24, 1961. This article gives the story of Hanna and the Hibbing taconites.

Mr. JOHNSON. There are three such installations now in that area, pilot installations in an effort to develop engineering data to determine if we can do this economically. This work, incidentally, Mr. Chairman, is applicable also to other oxidized materials of the Upper Great Lakes area. It is conceivable that if these processes prove favorable on the basis of overall economics, new facilities will be constructed providing additional employment and large tonnages of high-grade iron ore from previously uneconomic iron ore.

I can assure you that as of now, extensive research is being conducted by most of the iron ore companies on all of the iron ores of the Upper Great Lakes Area. As in the research conducted today, these studies will be carried to a definite conclusion, but we must keep in mind that it takes many years to bring a successful research program into application for commercial production.

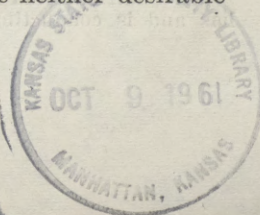
Mr. Chairman, the iron ore industry has and is conducting a continuing, intensive research program on the uneconomic iron ores of the upper Great Lakes area. The research is supplemented with the fundamental studies at the University of Minnesota and the Michigan College of Mining, and the University of Wisconsin, with other similar laboratories. This effort, along with the work that has been done and which should continue in the facilities recently opened by the Bureau of Mines in Minneapolis, we feel, is going a long way toward ascertaining the technology.

We believe that the iron ore mining industry is well prepared from a technical standpoint, not on the basis of our research, but on the basis of all of this research. This research is discussed in technical sessions that are held by proper societies and so forth.

As we have in the past, we will obtain private funds to make those uneconomic iron ores completely available to the U.S. iron and steel industry. We do feel, though, that other factors enter into the picture, and then I wrote this I mentioned that they were not a subject for your deliberation, are more important factors than the technology.

The concerted efforts of industry, labor, Federal, State, and local officials, along with the cooperation of people in the mining communities, could provide the atmosphere necessary for such developments.

We must, therefore, conclude that any additional expenditures over those now being carried out by the Federal Government on research of the iron ores of the upper Great Lakes area are neither desirable or appropriate at this time.



We appreciate the opportunity to appear before you today, Mr. Chairman. We are gratified to know that you are devoting valuable time to our industry. We look forward, with you and this committee, to a time when all the problems of our industry are resolved to the mutual benefit of our country.

(Mr. Johnson's prepared statement follows:)

STATEMENT OF HUGO E. JOHNSON, PRESIDENT, AMERICAN IRON ORE ASSOCIATION

Mr. Chairman and members of the committee, I am Hugo S. Johnson, president of the American Iron Ore Association with headquarters at 600 Bulkley Building, Cleveland, Ohio. I am honored to be asked to appear before you and sincerely hope that I will be of some assistance to you in your deliberations on the problems of the upper Great Lakes iron ore industry.

I am a graduate metallurgical engineer, and most of my career has been spent in the iron and steel industry. For over 15 years, I was actively engaged in research in the iron and steel industry and at Battelle Memorial Institute in Columbus, Ohio. Much of the research was concerned with iron ore, its beneficiation, and the efficient utilization of this important raw material.

Since 1954, I have been associated with the American Iron Ore Association and its predecessor association, The Lake Superior Iron Ore Association. Since 1958, I have been serving as president of the association.

The American Iron Ore Association and its predecessor associations has represented the iron ore mining industry since 1882. Today, the membership of the association is made up of companies who mine over 90 percent of the iron ore mined in the United States and Canada. We have followed closely the efforts of the iron ore mining industry in research. The industry has always endeavored to maintain an adequate reserve and sufficient production for our ever-expanding economy and at the same time provide improved quality to meet the changing demands of the iron and steel industry.

I would like to direct your attention to the publication "Iron Ore—1960" which I made available to each of you with this prepared statement. You will observe that the iron ore industry is a virile industry. We find mines operating in over 40 countries in the world and in over 23 States of the United States.

The upper Great Lakes iron ore always has been and always shall be an important factor in supplying our expanding steel industry.

The iron ore mining industry has for over 40 years been conducting research directed toward making the low-grade iron ore deposits of the upper Great Lakes area available to industry. Many millions of dollars have been spent in this effort and heavy annual expenditures are continuing. This research effort has been conducted primarily by private companies in their individual laboratories, supplemented with research conducted at research institutes, universities, and agencies of the Federal Government such as the U.S. Bureau of Mines and the U.S. Geological Survey.

These research efforts and subsequent process development work have resulted in technologies that have been applied successfully in seven commercial low-grade iron ore processing plants in the upper Great Lakes areas. Research and process development initiated in the upper Great Lakes have been applied in many other areas.

The industry does not intend to let up its research program. Already several companies have constructed pilot plant facilities to determine engineering and economic data for the processing of the large deposits of so-called semitaconites of the western end of the Mesabi Range and other oxidized iron formation materials of the entire upper Great Lakes area. It is conceivable that if these processes prove favorable, on the basis of overall economics, new facilities will be constructed providing additional employment and large tonnages of high-grade iron ore from a previously uneconomic iron ore.

I can assure you that as of now extensive research is being conducted by most of the iron ore companies on all of the iron ores of the upper Great Lakes area. As in the research conducted to date, these studies will be carried to definite conclusions. We must keep in mind that it takes many years to bring a successful research program into application for commercial production.

Mr. Chairman and members of the committee, the iron ore mining industry has and is conducting a continuing and intensive research program on the

uneconomic iron ores of the upper Great Lakes area. This research is supplemented with the fundamental studies of the University of Minnesota, the Michigan College of Mining and Technology, and other similar laboratories. This effort along with the excellent work that has been done and should continue from the excellent facilities and competent staff at the new research center of the U.S. Bureau of Mines in Minneapolis is adequate.

The iron ore mining industry will be prepared from a technical standpoint, as it has in the past, and will obtain private funds to make these uneconomic iron ores competitively available to the U.S. iron and steel industry.

We feel that other factors which we know are not a subject for your deliberation are more important factors than technology. The concerted efforts of the industry, labor, Federal, State, and local officials, along with the cooperation of the people in the mining communities could provide the atmosphere necessary for such developments.

We must, therefore, conclude that the additional expenditure over those now being carried out by the Federal Government on research of the iron ores of the upper Great Lakes area are neither desirable or appropriate at this time.

We appreciate this opportunity to appear before you today. The iron ore mining industry is gratified to know that you are devoting your valuable time to our industry. The industry looks forward with you on this committee to a time when all of the problems of our industry are resolved to the mutual benefit of our country.

Senator CARROLL. Mr. Johnson, that is a very fine statement.

I have here a communication from Senator Philip Hart, the junior Senator from Michigan, and I want to read some excerpts from it. I thought this was the purpose of this hearing. He said:

As the expert witnesses will testify, there are vast resources of low-grade iron ore throughout the Lake Superior Basin. In recent years, significant technological advances have permitted the utilization of certain types of low-grade ores. I believe further significant breakthroughs resulting from basic research are possible if there were a concerted effort by Government and private industry.

I need not remind you that these low-grade iron ores are a tremendous resource, most important to our national security. But progress in developing these ores has been handicapped by a shortage of funds to the institutions and organizations which might be expected to make the needed advances.

As you know, the Upper Peninsula of Michigan, especially the iron ore communities, is plagued with continuing serious, high unemployment. The urgency of getting on with the job of developing these low-grade ores is a matter not only of national security, but of utilizing the skills of our people.

Senator Hart says:

There are those who have called for quotas on importation of foreign-developed iron ores. After the most careful study, I am convinced that such a narrowly conceived solution to our economic problems in these areas, while politically easy, is neither wise nor desirable. I am told by experts that the iron and steel industries of our Nation find concentrate and pelletized ores highly economical in the making of steel.

With the necessary funds and technological attack through institutions, such as the Institute of Mineral Research at the Michigan Institute of Mining & Technology, the decade ahead could well bring the revitalization of the iron mining industry in Michigan and the other Lake Superior States.

So you see, he recognizes not only the necessity for technological advance, but he calls, on the other hand, for what? Not only for the industry, but for the employment, not only for the national security and the national interest, but for employment on all these things moving together. But he says here:

But progress in developing these ores has been handicapped by a shortage of funds to the institutions and organizations which might be expected to make the needed advances.

(Senator Hart's letter follows:)

U.S. SENATE,
Washington, D.C., June 22, 1961.

HON. JOHN A. CARROLL,
Chairman, Subcommittee on Minerals, Materials, and Fuels,
Senate Interior and Insular Affairs Committee,
U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: First let me commend and thank you and the members of the subcommittee for conducting these extremely important hearings into the development and further utilization of the iron ore resources of the Lake Superior region. Senator McNamara and I joined in the request to hold these first congressional hearings into how we can further develop this potentially great natural resource.

As the expert witnesses will testify, there are vast resources of low-grade iron ore throughout the Lake Superior Basin. In recent years, significant technological advances have permitted the utilization of certain types of the low-grade ores. I believe further significant breakthroughs resulting from basic research are possible if there were a concerted effort by government and private industry. I need not remind you that these low-grade iron ores are a tremendous resource, most important to our basic national security. But progress in developing these ores has been handicapped by a shortage of funds to the institutions and organizations which might be expected to make the needed advances.

As you know, the Upper Peninsula of Michigan, especially the iron ore communities, is plagued with continuing serious high unemployment. The urgency of getting on with the job of developing these low-grade ores is a matter not only of national security but of utilizing the skills of our people.

There are those who have called for quotas on importation of foreign-developed iron ores. After the most careful study, I am convinced that such a narrowly conceived solution to our economic problems in these areas, while politically easy, is neither wise nor desirable. I am told by experts that the iron and steel industries of our Nation find concentrate and pelletized ores highly economical in the making of steel. With the necessary funds and technological attack through institutions such as the Institute of Mineral Research of the Michigan Institute of Mining & Technology, the decade ahead could well bring the revitalization of the iron mining industry in Michigan and the other Lake Superior States.

You and your subcommittee members are to be commended for the time and effort you have given to studying this problem and helping all of us privileged to represent those so vitally concerned with this problem.

Sincerely,

PHILIP A. HART.

Senator CARROLL. I understood from your statement that you think there is no shortage of funds in this regard.

Mr. JOHNSON. We feel that way, sir.

Senator CARROLL. You feel that way?

Mr. JOHNSON. Yes, sir.

Senator CARROLL. The Bureau of Mines, and it covers many fields, does many types of research. We know that the military is always letting contracts to universities for research in space and meteorology, which is all basic. Many people hooted at that, but now we find out that if they had done this many years ago we would not be as far behind as we are in the field of technology. If we had really made an attack upon this taconite thing, a spirited, vigorous attack 10 years ago, would we have advanced beyond where we are today, do you think?

Mr. JOHNSON. No.

Senator CARROLL. You do not think so?

Mr. JOHNSON. No, sir.

Senator CARROLL. Do you think if the universities in the area had a little bit more money to do some basic research that they could help revitalize this industry? They do not seem to have very many funds today to work with.

Mr. JOHNSON. I am an enthusiastic supporter of research, sir. I do not think it would cure the unemployment problem next year.

Senator CARROLL. I agree with that.

Mr. JOHNSON. That is the point your comments have been directed to this morning.

Senator CARROLL. I think we have agreed on that.

Mr. JOHNSON. They are doing fine research, and I have no objection. I think it is a fine way to handle research, to contract to universities, as the services and other groups in your Federal Government have been doing it. I do not know that the Bureau of Mines has been doing that, but I do know that that is seriously contemplated.

Senator CARROLL. My question was directed to this: Are they getting enough money, the universities, to do the sort of a research job of which they are capable for this field?

Mr. JOHNSON. I must confess, I really do not have a firm answer on that, Senator.

Senator CARROLL. Does the industry make any contributions to the University of Michigan or the University of Minnesota and the experts who testified here this morning, who give their full time?

Mr. JOHNSON. They would have to answer that. Most all the companies in our industry have scholarships and activities like that in the various universities.

Senator CARROLL. Is Professor Wade still here?

Professor, where do you get your moneys from for research?

Mr. WADE. Most of it is from legislative appropriations.

Senator CARROLL. From the State?

Mr. WADE. From the State.

Senator CARROLL. Is it adequate?

Mr. WADE. Never adequate.

Senator CARROLL. How much do you get a year? What is your annual appropriation?

Mr. WADE. We have \$150,000 plus special appropriations for this particular field.

Senator CARROLL. For this particular field?

Mr. WADE. Yes, sir. And we have a support appropriation which is indefinite, but I suppose it is \$75,000.

Senator CARROLL. What is your honest opinion? If you had more funds, what would you do with it?

Mr. WADE. I have suggested, in my statement that I prepared, three items. One of them is a very small one for basic research, which would permit us to put competent students on the job of solving special problems. That is a very nominal amount.

The one I asked for particularly had to do with the development of a machine that we have been working on for conversion of hematite to magnetite. For example, in the pilot plants that you mentioned, they have a device, a rotary kiln purchased in Germany, which will do the work, there is no question but what it will do it, but we feel that there may be better ways of doing it.

Senator CARROLL. In industry, itself, are there different processes by different industries, different companies?

Mr. WADE. There are different pieces of equipment. I am speaking of this equipment for converting hematite to magnetite. There are perhaps a half dozen different types of equipment that could be used.

They have selected one that has been tried considerably and is available. We have been working on one that has not been tried.

We have a laboratory model working rather well. We have come to a point where we have developed it about as far as we can.

Senator CARROLL. How much would you need in funds for that?

Mr. WADE. I put in a figure there of three-quarters of a million dollars to do that. It will not cost that much to build one, but in order to find out the answers, I think it would take some such sum of money to do that.

Senator CARROLL. Do you think it would be a vast improvement on the other one?

Mr. WADE. I cannot answer that. I think it may be. We think it has some desirable features. We have one in the laboratory that can produce three-quarters of a ton an hour.

Senator CARROLL. Have you talked to some of the steel companies about this?

Mr. WADE. They are familiar with it; yes, sir. But I think in time they will undoubtedly want to try it.

Senator CARROLL. They have their own research laboratories, do they not?

Mr. WADE. Yes, they do.

Senator CARROLL. Do they do that individually or collectively?

Mr. WADE. Individually, I believe.

Mr. JOHNSON. It is highly competitive research at this stage of the game, improving the processing.

Senator CARROLL. It is highly competitive research within the industry itself?

Mr. JOHNSON. Yes, to improve their picture on a competitive basis.

I do not know if Mr. Wade pointed out the fact, but I just happen to have here a table showing the Minnesota taxes collected exclusively on the iron ore production up there, iron ore taxes, not based on production. This figure here reports \$1,204,854,690 collected by the State of Minnesota since 1914. In 1951 they collected \$41,524,527.

Senator CARROLL. In revenues?

Mr. JOHNSON. This is iron ore, special taxes on the iron ore.

Senator CARROLL. Do they have a severance tax?

Mr. JOHNSON. No, it is an ad valorem tax. They have an occupation and a royalty tax that is paid by the mining industry in Minnesota.

Senator CARROLL. Coming back again, if I may, to the question, Do you have a third category of the need of funds?

Mr. WADE. I had a third one. I inquired of the school of mines to see if they had any suggestions, and they made a proposal to study the projection of the iron range to the south of what is now considered the southern edge of the Mesabi. The formation extends down under slate rocks to unknown depths. Very little is known of that area.

Mining people are quite interested in the possibility of low-cost underground mining which might develop a big reserve there that is presently not considered reserve at all. They are suggesting a project in which they would drill some holes to find the nature of the material, both from its metallurgical point of view, whether it is suitable for treatment, and from a physical point of view as to whether it can be cheaply mined by underground methods.

Senator CARROLL. I have asked you some questions here before. I did not mean in any way to draw you in, where you have the field of science and technology.

Now, you do not have to answer this if you do not want to, because you are a professor at the school of mines and you have to live in your State.

Mr. WADE. I do not have the title of professor, but I am at the school of mines.

Senator CARROLL. If you are not a professor, you are an educator. You are an expert in this field.

Mr. WADE. I have been in this field for many years; yes, sir.

Senator CARROLL. And you know where the lands are, do you not, where the reserves are?

Mr. WADE. Yes, sir.

Senator CARROLL. Is anyone interfering with the development of taconite by holding back on these reserves? You do not have to mention any names.

Mr. WADE. I doubt if that is the case. I do not believe that is true.

Senator CARROLL. Has it ever been said that that was true in your State?

Mr. WADE. Perhaps. I doubt it.

Senator CARROLL. On the political platform has this been said in your State?

Mr. WADE. I am sure that it has.

Senator CARROLL. I just wondered if I had had the right information. It was offered to me, and I said I knew nothing about this, that it was a new field for me. I have indicated to you that many years ago, in 1957, I was up in Hibbing. I had never been in that country. I had never been in Minnesota before.

I met with those people who worked on the iron range and I talked to them about their problems. Of course, I have known John Blatnik of Minnesota, and he has been most helpful to Colorado in getting its road program. I want to help John Blatnik and the iron range, if I can help him and help his people, and all the rest of them, too.

But we in Colorado owe John Blatnik a special award because he put us on the interstate highway after 50 years. The UP went to the north of us and the Santa Fe went to the south of us, and on the interstate highway program, due to the efforts of John Blatnik, we are going through the mountains with the highway. I want to help him and his people in Minnesota if I can.

Well, you have been very helpful. You can see, this is a meeting for technological advancement. You do not think they need funds.

Mr. JOHNSON. No, I do not want to speak for Mr. Wade. He knows his own particular situation. I made the statement that we are moving forward adequately in technology. We are not in the field of economics.

Senator CARROLL. We might as well hit the subject once more. Is Professor Volin still with us?

How do you feel about the need for funds? We are now getting into basic research.

Mr. VOLIN. I feel very strongly on that subject. I would like to offer a figure which has not been brought out.

The amount of money being spent for research now by industry and everybody else on iron ore is less than 3 percent of the sales value

or the value of the iron ore that is sold. This is not enough. Other industries spend as much as 10 percent to maintain their competitive position.

Mr. JOHNSON. What would that figure be, Professor, the 3 percent? In dollars, what would that be?

Mr. VOLIN. I do not know. You would have to take the value of the iron ore and work it out. I had an estimate of what was being spent on research and I made it in general terms. But I would say it is less than 3 percent.

The records of the National Science Foundation show that the metal industries all together are spending less than 2 percent of their income on research.

Senator CARROLL. Do you feel that the industry itself should do more in this field?

Mr. VOLIN. I think all of us should do more. I am not talking about industry alone. I am talking about all of us.

Senator CARROLL. What contributions do you think the Federal Government can make in this field?

Mr. VOLIN. Well, for one, I think the Federal Government could sponsor basic research, and I mean fundamental research which hardly anybody is doing. There are a few people in the colleges and universities doing it, just as a matter of professional interest and scientific interest. Otherwise, it is not being done at all. This is a real area of neglect, I feel.

Senator CARROLL. Suppose we were willing to do it. How should we do it? Would we do it through contracts with universities? How do we achieve this?

Mr. VOLIN. I suggest that a modest amount of money be allocated to the National Science Foundation to farm out research related to iron ore, this is fundamental research related to iron ore, and this research could be done by colleges and universities having staffs and mineral departments that are interested in it and capable of doing it.

This is one way of doing it. I think maybe the Bureau of Mines could step up their basic research program, that is, their fundamental research program. This is another way.

It should not all be with one organization because it takes many different people working with many different ideas to achieve a breakthrough. One group of people cannot do it, or one small group of people cannot do it.

Senator CARROLL. Have there been any studies by any group, private industry, education, or the Congress, to know what the Soviet Union is doing in this field?

Mr. VOLIN. Yes, sir.

Senator CARROLL. Can you give us a quick summary of what the Soviet Union is doing in this field?

Mr. VOLIN. Well, I read a good deal of their literature, but I am sure that I do not cover all of it. I can say this: that they have done work in flotation, basic work in flotation, that we certainly have not done yet. I would guess, judging by the volume of their literature, that they must have many more people working on the particular problems of flotation and on understanding the basic phenomenon of flotation than we do. They are applying flotation in ways that we have never tried to do in this country.

Senator CARROLL. Would you care to make an observation on that, Mr. Johnson? What is industry doing? When we say the American Iron Ore Association, this is an association of what?

Mr. JOHNSON. Iron ore mining companies.

Senator CARROLL. And that involves some of the big steel companies, too?

Mr. JOHNSON. Yes, sir.

Senator CARROLL. Of course, they have tremendous research potential.

Mr. JOHNSON. Excellent facilities, excellent staff.

Senator CARROLL. What are they doing?

Mr. JOHNSON. I cannot name the programs, sir. But every one of these large research facilities devotes a substantial part of its budget to fundamental studies, without question.

Senator CARROLL. In the basic research field?

Mr. JOHNSON. In the basic research field, in addition to their enormous expenditures for applied research, if I may do that different.

Senator CARROLL. You may not have come here today prepared for this, but if they have it, and if it is available, not asking for anybody's trade secrets, what is the Soviet Union doing?

Mr. JOHNSON. I think generally speaking we are, and I would say that a quick, offhand guess is that technically, as regards iron ore, we are way ahead of them.

Senator CARROLL. You are?

Mr. JOHNSON. Yes.

Senator CARROLL. What about the Bureau of Mines, the Bureau of Mines of the U.S. Government. Have we studies along this line?

Mr. TIEMANN. I think Mr. Melcher could answer that.

Mr. MELCHER. Your question was about the Russian developments?

Senator CARROLL. Yes.

Mr. MELCHER. On the occasion of my visit to the Soviet Union, which has been 3 years ago, at that time we visited two of three research centers in the Soviet Union related to minerals. Much of it was on iron ore. There were about 1,500 people in each of these two organizations. They have a third one that we did not have an opportunity to visit.

But there were at least 3,000 people, at least half of which are technically well-trained people. Many of these were working on iron ore, although not all of them. It would be impossible to give an estimate of how much of this effort was going into beneficiation of iron ore.

The problems in the Soviet Union are similar to ours. They are behind in their treatment of the vast low-grade ore, but at the time of our visit they were making very fast advances in this area.

Senator CARROLL. How do they compare with our problems, in what they are doing? Did you learn anything while you were over there? Are we ahead of them or behind them? What is the situation?

Mr. MELCHER. Their main problem, Mr. Chairman, is in beneficiation. The grade of ore that they were using at the time of our visit was below that that we are using now. But they were very conscious of this fact and were making every effort they could to improve the grade of their material. In their haste to expand steel production, they were obliged to use what iron ores were available, and they have

not yet put in the large projects of what we consider are taconite-type in their areas. But they were under construction and they had plans to do so.

Senator CARROLL. Do you feel that industrywise, governmentwise, we are doing as much as they are doing in the field of basis research?

Mr. MELCHER. I subscribe that we are not doing as much research as we should and perhaps as we could. Those of us involved in research would like to be doing more. We feel that there is an opportunity to do more.

Senator CARROLL. What is preventing you from doing more?

Mr. MELCHER. I suppose there are a lot of reasons, of putting money into research as compared to putting it into more immediate things.

Senator CARROLL. If you have the money, do we have the scientists to put in, or a sufficient number of scientists to work in this field, the people who know the industry?

Mr. MELCHER. Speaking of my own work, we would have the facilities and the plant to do it. We have the core of the organization. We would have to expand this group, and that takes time. The scientists that we have are, I would say, a very high caliber. With added help they could expand. We cannot do this overnight.

Senator CARROLL. As a member of the Bureau of Mines of the Federal Government, do you have access to the facilities, the information, that is in the hands of private industry?

Mr. MELCHER. Much of it; yes, sir. As I mentioned this morning, we do have cooperative work with private companies in which instances we share the information on an equal basis and the information is obtained and published as it becomes available. We exchange information with the universities and the private companies. We are doing that regularly.

Senator CARROLL. Here is what I have in mind. Here are some of the richest, most powerful corporations in America, with their own research facilities, with their own staffs. They have a lot of money to do things with.

Are they keeping up on basis research, do you think?

Mr. MELCHER. Are they what?

Senator CARROLL. Are they doing their job of basic research? They have the money and they have the personnel.

Mr. MELCHER. Well, I know a lot of them that would like to do more.

Senator CARROLL. I do not mean to embarrass you. If you think they are not doing it, say so, and tell them where they are making a mistake.

Mr. MELCHER. I am not in a position to make a statement of that type. I think that they are doing a job, doing a good job, and I think that the people that I am acquainted with would like to have the resources to proceed faster than they are.

Senator CARROLL. In the field of basic research, that is.

What do you think of the professor's concept of the National Science Foundation? Suppose the Congress appropriated more money, specifically earmarked for basic research in iron ore, with some of it going into your office.

Suppose we gave you another \$1 million in the Bureau of Mines just for this project alone, for 1 year. Do you think you could do a great deal with that small amount of money in this big field?

Mr. MELCHER. It would make a tremendous difference. It would be a very substantial increase in the amount of money we have available; \$1,400,000 is our total budget for iron and steel.

Senator CARROLL. \$1,400,000 was your total budget for iron and steel?

Mr. MELCHER. Yes, sir.

Senator CARROLL. This fiscal year, do you mean?

Mr. MELCHER. This current fiscal year.

Senator CARROLL. The reason I raise this question is because we have had this problem. They hooted at us at one time because I got \$2 million for Dr. Walter R. Roberts, who is now going to have the big laboratory out in Boulder. I think he is the foremost meteorologist of the Nation. He is a young man, very capable. He is going into basic research in weather.

We find that the Soviet Union has made tremendous strides in this field. Some of the stories that are told are fantastic, unbelievable.

Dr. Roberts has been making a tremendous advance, simply because we took a gamble on basic research. Some of it that has been developed is highly classified information.

Mr. MELCHER. Mr. Chairman, the reserves of iron ore that we have been talking about here today, some of these can be treated by known technology, but there are many that cannot be treated by any technology that we know today. We need very basic knowledge in order to know what to do with these materials. We just do not know.

There are many large reserves of which we do not know how to treat, to make them usable. They are readily accessible, but we need to go back to the ore itself and determine its nature and perhaps learn more about what to do with it.

Senator CARROLL. I do not know whether you answered my question about the National Science Foundation. Do you think this is a good idea to let some of the universities take contracts as they do from some of the military now for basic research?

Mr. MELCHER. I don't know how to answer the question, Senator.

Senator CARROLL. Let me give you an example.

The Air Force might use MIT to do certain research and the latter in turn farms out to universities under contract work on specific projects. They are using the scientists and groups in these universities to do basic research.

Mr. MELCHER. We do not do that in my line of work, Senator. We, perhaps similar to the universities, do work in cooperation with industry that is financed by the private firm.

Senator CARROLL. Let me ask Mr. Johnson a question.

You said that is a highly competitive field. You represent an iron-ore association. Within that association, are large efficient groups who have many years of experience, each of them is doing its own research.

Mr. JOHNSON. Yes, sir.

Senator CARROLL. Consequently, being highly competitive, when they find out something they are not about to give it to their competitor.

Mr. JOHNSON. That is right, but the science moves on and the technical publications are full of the results of their research. There seems to be no trade value to fundamental studies and other studies.

Mr. Melcher can attest to the fact we had an international symposium on agglomeration in Philadelphia in April. Prior to that we had a symposium of the mine and metallurgical engineers on use of the materials in blast furnaces, all of which was reporting research that was being done by universities, private institutions, company research laboratories, and so forth.

Senator CARROLL. Are any of the large companies entering into contracts with universities for basic research that you know of?

Mr. JOHNSON. Yes.

Senator CARROLL. Some are?

Mr. JOHNSON. Yes, indeed.

Senator CARROLL. In this field?

Mr. JOHNSON. I think in this field, too.

Senator CARROLL. I know that they are in other fields, but I am wondering whether they are doing it in this field of iron ore.

Mr. JOHNSON. I think so. I can't name any specific examples, but I am certain they are doing it.

Senator CARROLL. Will you find out who is doing it and what universities are in it? What we want to do is probe.

It is very obvious to me that there may be an effort later on to provide funds, maybe more funds to the States, maybe more funds to the Bureau of Mines.

Again it may not be a great amount, but it is implicit in the statement here that progress in developing these ores has been handicapped by a shortage of funds to the institutions and organizations which might be expected to make the needed advances.

To me this makes it quite clear that there may be such an effort.

Now, if there were an effort made like this, to get funds through the National Science Foundation, would there be any reason why your association would resist this?

Mr. JOHNSON. No.

Senator CARROLL. Would you say that any reasonable allocation of Federal moneys for basic research that would give strength and sustenance and vitality to the industry might be worthwhile?

The thought is if you think it is necessary.

Mr. JOHNSON. If you ask me is it necessary, we think there are other factors much more important that would bring about the points that Senator Hart is trying to make, the utilization of these so-called uneconomic ores of the upper Great Lakes area.

There are other ways, as I understood, beyond the scope of this committee.

Senator CARROLL. When you compile this information please send it to this committee for its use.

Mr. JOHNSON. I will do that.

Senator CARROLL. What we are seeking here is information.

Mr. JOHNSON. That is right.

Senator CARROLL. This goes to each and every witness who is testifying. In view of what we have said here today, you may want to go home and think about this thing and study it and bring in your recommendations.

You know what we are aiming for, the purpose of this hearing. It is not only to relieve an unemployment situation. We all agree that this cannot be done quickly.

This is a general agreement, I believe on the question of quotas and tariffs, but this has been a revelation to me as a person who has no previous experience in this industry to see what your problems are—the Bureau of Mines has problems, industry has problems—and what the universities are willing to do in basic research.

I should think that the record should be kept open and let us stick to the facts as nearly as we can, and try to document.

If you reach a conclusion, document it with facts.

If the industry, the association and any witnesses here can do that, it would be most helpful to this committee.

I, therefore, thank you very much, Mr. Johnson, and all you other gentlemen.

Is there anybody who wants to make a last concluding observation before I recess.

As I do recess, I announce that this record will stay open for 1 week from today to give anyone an opportunity who is testifying here or any interested witness to file a statement.

I think I ought to confine it to those who have been witnesses and to final supplementary statements.

Are there any other observations here?

Thank you very much, Mr. Johnson, and all you gentlemen. You have been patient.

The committee will stand in recess and the record will remain open.

(Thereupon, at 3:40 p.m., the committee was recessed, to reconvene subject to call.)

There is a great deal to be said for the view that the industrial revolution was a result of a series of accidents and coincidences. It is true that the invention of the steam engine, the spinning machine, and the power loom were all accidents. But it is also true that these inventions were not made in a vacuum. They were made in a world in which there was a demand for more power, more speed, and more efficiency. The industrial revolution was not a series of accidents, but a series of responses to a demand. The demand for more power, more speed, and more efficiency was the result of a number of factors. One of the most important factors was the growth of the population. As the population grew, the demand for food, clothing, and shelter increased. This led to the development of new technologies and new industries. Another important factor was the growth of the market. As the market grew, the demand for goods and services increased. This led to the development of new technologies and new industries. The industrial revolution was a response to a demand, and it was a response that changed the world. It was a response that led to the development of new technologies and new industries, and it was a response that changed the way we live. The industrial revolution was a great achievement, and it was a response to a demand that we can still see today. The demand for more power, more speed, and more efficiency is still there, and it is still leading to the development of new technologies and new industries. The industrial revolution was a great achievement, and it was a response to a demand that we can still see today.

APPENDIX

(The following statements and communications were submitted for inclusion in the hearing record:)

SILVER BAY, MINN., June 21, 1961.

JOHN A. CARROLL,
Chairman, Subcommittee on Minerals, Materials, and Fuels, Senate Interior Committee, Washington, D.C.:

Thank you for your invitation to file a statement for your subcommittee's hearing on June 22. Illness has kept me away from my office and I have had no opportunity to prepare a statement on this important and complex subject. However I understand that representatives of other companies in the industry as well as others who are extremely well informed will be appearing in person or file statements, so I feel certain the subject will be adequately covered. Appreciate very much your invitation.

ROBERT J. LINNEY,
President, Reserve Mining Co.

JESSIE H. MINING CO.
West Duluth, Minn., June 14, 1961.

SENATE INTERIOR COMMITTEE,
Senate Office Building, Washington, D.C.

GENTLEMEN: With reference to the hearing to be conducted June 22, 1961, on low-grade uneconomic iron ore deposits, I wish to state that in my mind the most practical direct way of helping this situation would be to make funds available to the Mines Experiment Station of the University of Minnesota for the development of a commercial size roasting furnace. They have done a great deal of work on this and I believe they would be able to proceed promptly. The problem of concentrating the ore after it has been made magnetic has been well established.

Yours very truly,

R. N. MCGIFFERT, *Partner.*

NORTH RANGE MINING CO.,
Negaunee, Mich., June 20, 1961.

SUBCOMMITTEE ON MINERALS, MATERIALS, AND FUELS,
SENATE INTERIOR COMMITTEE,
New Senate Office Building, Washington, D.C.

GENTLEMEN: This letter is being written as a statement which may be placed on file in connection with your committee's hearing on June 22, 1961, to inquire into the problems of the upper Great Lakes iron ore industry with particular attention to research designed to make low-grade uneconomic ore deposits economic.

At the present time as a result of the widespread search for iron ores in Canada and other foreign countries, the development of the taconite industry of Minnesota and to a more limited extent, in Michigan, it appears that the requirements of the steel industry for iron ore during the short-term future are provided for to a very large extent. Investments by consumers in the United States in foreign iron ore developments are very large and are growing every day. I have the feeling, however, that further expansion of development may be limited to projects already visualized. Whether or not this is so will depend upon a variety of factors including the business and tax climate in Minnesota, Wisconsin, and Michigan, the availability of natural gas as a lower cost fuel and the development of technical ability to upgrade the available iron-bearing materials in this area.

Extensive programs of research have been carried on by the Bureau of Mines, the University of Minnesota, and more recently by Michigan College of Mining

and Technology as well as by private industry. Large amounts have been spent along these lines and I am sure more is available from industry.

I feel that there is a need for more basic research in iron ore of the kind not ordinarily tackled by industry in its search for practical solutions to the more immediate problems and also that there is a need for more personnel and facilities which might be available for work on particular projects of the smaller independent mining companies.

Additional funds should be made available for these purposes under a well-designed program as to the longer range projects and for the particular problems of smaller concerns. It would be my thought that these projects should be carried on through existing agencies such as the U.S. Bureau of Mines, University of Minnesota and Michigan College of Mining and Technology.

Yours very truly,

ROBERT ARCHIBALD,
Executive Vice President.

UNITED STEELWORKERS OF AMERICA,
Pittsburgh, Pa., June 15, 1961.

Hon. JOHN A. CARROLL,
Chairman, Subcommittee on Minerals Materials,
U.S. Senate, Washington, D.C.

MY DEAR SENATOR CARROLL: Thank you for your invitation to appear before your subcommittee on June 22, 1961, with reference to the iron ore situation.

I have consulted with President McDonald and it was determined that the United Steelworkers of America should not make an appearance at this time.

We are currently making a study of the iron ore situation in Minnesota and hope to have that study concluded by the end of the summer. Under the circumstances, I think that you can understand why we would rather defer any statement until we have completed this study.

We are deeply interested in the work of your subcommittee. We hope that you will explore not only the taconite, but also the underground and open-pit aspects of iron ore mining. We hope that you will delve deeply into the economics of iron ore mining and explore the relationships between the major steel companies and the iron ore producers, with particular emphasis on the status of the so-called independent iron ore producers.

One of the problems we expect to run into in our study is the lack of production cost data. Much of the pertinent data would be available only from the major steel and iron ore producers. We would hope that your subcommittee would be successful in securing such data as are now not publicly available.

If we can give you any other help at this time, we will be happy to cooperate.

Sincerely yours,

OTIS BRUBAKER,
Director, Research Department.

REPUBLIC STEEL CORP.,
Cleveland, Ohio, June 15, 1961.

Senator JOHN A. CARROLL,
Chairman, Subcommittee on Minerals, Materials, and Fuels,
Senate Office Building, Washington, D.C.

DEAR SENATOR CARROLL: Your telegram informing us of the 1-day hearing by your subcommittee on June 22 is appreciated.

Republic Steel has pioneered with Armco Steel in developing and utilizing Minnesota taconites as a source of excellent blast furnace feed material.

The question of inquiry into the economic possibilities of low-grade iron ore, other than taconite, has occupied the interests of most of the large iron ore producers in the Lake Superior region for a number of years. Many have spent large sums of money on research. I am sure the possibilities of this potential resources to our country have not been neglected, and I think that you will learn of the scope of this work by private companies in your hearings.

Because of this extensive research work, it is doubtful as to whether the Federal Government should initiate a separate research program, bearing in mind that the established agencies of the Government; namely, the U.S. Geological Survey and the U.S. Bureau of Mines have always been quite active in this work.

Very truly yours,

C. H. DEWEX.

W. S. MOORE Co.,
Duluth, Minn., June 13, 1961.

HON. JOHN A. CARROLL,
*Chairman, Subcommittee on Minerals, Materials, Fuels,
Senate Interior Committee,
New Senate Office Building, Washington, D.C.*

DEAR SIR: In response to your telegram of June 13, announcing a 1-day hearing in Washington to inquire into problems of upper Great Lakes iron ore industry, particularly attention to research designed to make low-grade uneconomic iron ore deposits economic, would say that the problems beclouding the iron ore industry today do not primarily lie in the field of research. We know how to make uneconomic ore deposits economic. We do not know how to sell such material once it is improved because of severe competition from foreign ores. We respectfully suggest three areas wherein the Government could help the iron ore business. Such would be of much greater benefit to employment in this area than work on research. They are:

1. A fast writeoff on new plant construction. This would help finance beneficiating plants. It is particularly needed by small companies like ourselves.
2. A moratorium on development of new iron ore sources with taxpayers money in such countries as Peru, Chili, Africa, and elsewhere in the world. There is a great oversupply of iron ore hanging over the market, much of it coming from countries where money from the U.S. taxpayers has built iron ore production facilities that are now preempting our market.
3. A decrease in transportation costs. Much of our competition comes from across the ocean. Ocean freight rates have been going down steadily since the Suez Canal crisis. Railroad freight rates, upon which we, in the central part of the United States, are so dependent, have not decreased. In some instances, rates on iron ore movement in the United States has actually increased.

In these three areas, we respectfully direct your attention. In essence, the problem is competition, not technological.

Very truly yours,

WARREN S. MOORE.

SOUTHWESTERN ENGINEERING CO.,
ENGINEERING AND CONSTRUCTION DIVISION,
Los Angeles, Calif., June 13, 1961.

HON. JOHN A. CARROLL,
*Chairman, Subcommittee on Minerals, Materials, and Fuels,
U.S. Senate, Washington, D.C.*

DEAR SENATOR CARROLL: In regard to your telegram advising of the hearing on June 22 may we offer the following suggestions:

1. In the interest of developing the nonshipping grade iron ores of the upper Great Lakes, both for the benefit of the local areas and the U.S. iron and steel industry, we enclose eight reprints of an article by M. O. Holowaty and G. H. Craig of Inland Steel Co., which was presented at the January 9, 1961, meeting of the Minnesota section of the AIME in Duluth, Minn.

We believe this article presents, in the most concise form, a picture of the future of the technology and economics of the low-grade iron ore problem. Dr. Holowaty is known as a raw materials and process expert in the United States and the world, and has participated in this capacity as a member of the U.S. steel delegation to the Soviet Union in 1958.

2. We believe that a hearing of the type indicated would be well served by the actual presence of representatives of the iron ore consumers (steel companies) who are vitally concerned in this area and whose economics constitute one of the critical factors.

3. If after reading the enclosed article you feel that personal appearance before the committee, now or in the future, by the authors, would be desirable, we suggest that they be contacted through Mr. Carl Jacobs of Inland Steel Co.

4. In case you have not included in your request for suggestions the Armco Steel Co. at Middletown, Ohio, we would suggest Mr. Edward Marshall, associate director of research, as an authority worthy of consultation.



Although Southwestern Engineering Co. is merely the representative of a commercially successful direct reduction process, we feel strongly that the U.S. economic welfare is best served when our own mineral resources are given an opportunity to economically compete with imported raw materials. We feel that this goal can be attained by providing more favorable tax structures to our mining and process industries. This policy is being followed by most of the nations supplying raw materials to the world market.

Please feel free to call upon us if you feel we can render any further assistance.

Very truly yours,

OTIS R. FITZ, *Project Engineer.*

STATEMENT OF E. P. PFLEIDER

DEEP DRILLING PROGRAM, MESABI RANGE—A PROPOSAL FOR FINANCING BY FEDERAL FUNDS

Introduction

For many years the geologists and mining engineers of Minnesota have conjectured as to what the Mesabi iron formation is like in depth. Is the iron in magnetic form? Is the grade high enough to give low ratios of concentration and hence low milling costs? Are the rocks stable enough to support low-cost, high-volume mining by large underground quarrying methods?

If these probabilities were verified, long-range planning could be established so as to utilize the tremendous reserve potential. Underground mining of low-grade magnetic ores is already a reality in Missouri and plans are progressing for another property in Canada. Companies that are not in the favorable position of controlling large blocks of near-surface taconite reserves could acquire large blocks of selected, high-grade underground reserves and develop methods for exploitation.

This might seem to be a "dream," but so was taconite development in 1910. Those pioneers of 50 years ago had vision. Do we have less vision today, in the age of space shots, lunar exploring, etc.? Or must all of our aspirations and research be directed toward outer space—at far greater costs.

The proposal is to drill about 10 deep holes along the southern edge of the Mesabi Range at locations so selected that the iron formation (dipping to the southeast) would be encountered at depths of 600 to 1,000 feet. The cores would be studied closely by rock mechanics experts to determine the underground mining characteristics and by metallurgical engineers for beneficiation results.

Objectives

The objectives of such a drilling and investigation program on the deep-seated iron formation are manifold:

1. To determine the depth, thickness, and iron grade.
2. To study the physical properties of the bedded rocks in order to ascertain whether large underground rooms can be driven for cheap mining.
3. To find whether there are extensive areas containing high-grade layers (80 to 90 feet thick) running 26 to 30 percent magnetic iron, from which 1 ton of pellets can be produced from only 2.5 tons of ore.
4. To run metallurgical tests on the drill cores to determine amenability to concentration.
5. To justify a later program (if above information indicates this to be warranted) of small-scale underground mining and pilot testing.

Procedure

The following procedure is tentatively suggested:

1. Study the information available on some four to five deep-drill holes put down by current operating companies.
2. Lay out a program for drilling some 10 additional deep holes along the length of the range, much as shown on accompanying plan and cross section. The iron formation will be diamond drilled, giving BX or larger cores.

Phase I

3. Drill an additional 6 to 8 holes on closer centers around the best of the initial group.

Phase II

4. Make exhaustive tests on the physical and metallurgical properties of the drill cores recovered.

5. If feasible, sink an exploration shaft, drive mining tests rooms to determine maximum safe mining span, use ore so produced for pilot plant tests.

*Phase III**Budget*

Phase I: Drill 10 holes, at 1,200 feet, average, or 15,000 feet, at \$6 per foot.....	\$72, 000
Phase II : Drill 6 additional holes, or 7,000 feet, at \$6 per foot.....	42, 000
Engineering, metallurgical, and rock mechanics testing, etc.....	25, 000
Miscellaneous and contingencies.....	11, 000
Total, phase I and II.....	150, 000

U.S. SENATE,
Washington, D.C., July 5, 1961.

Hon. JOHN A. CARROLL,
U.S. Senate, Washington, D.C.

DEAR SENATOR CARROLL: In connection with the hearings your subcommittee held recently on the economic development of iron ore, I would like to submit for the hearing record the enclosed documents and letters which have come to my attention during the past year.

Information contained in these documents, when printed as part of the record of the subcommittee hearings, would contribute greatly, I believe, to a better understanding of this problem.

With every best wish,

Sincerely yours,

PHILIP A. HART.

MADARAS CORP.,
Detroit, Mich., June 14, 1961.

Hon. PHILIP A. HART,
U.S. Senate, Washington, D.C.

DEAR MR. HART: I was interested in the recent UPI dispatch which featured your interest in utilizing the billions of tons of low-grade iron ore located in upper Michigan, Wisconsin, and Minnesota.

In this connection I thought you might find interesting a process which is ideal for the reduction of this very difficult and costly ore to handle and dispatch. The process permits the construction of a plant close to the source of ore.

A plant producing 400 or 500 tons of ore a day has been in use in Mexico for 5 years. The first American plant is in the process of completion at Coolidge, Ariz. It is a 75-ton-per-day plant which can possibly be ideal for some of the areas mentioned in the news dispatch.

I would be pleased to provide you, or interested persons, with additional information. The attached brochure will tell you the long and hard battle Mr. Madaras has had to get his ore reduction process recognized against the constant and unsurmountable obstacles of the steel and coke companies down East.

Sincerely,

ROBERT B. POWERS, *Vice President.*

[From the Skillings' Mining Review, May 27, 1961]

ARKOTA IRON ORE REDUCTION PROJECT IN ARIZONA

Situated in the Arizona desert between Tucson and Phoenix, the iron ore and steel operations of the Arkota companies are expected to commence shortly. Comprising these developments, financed by South Dakota capital, are the exploitation of a low-grade deposit of magnetic black sands and the construction of an iron ore reduction plant.

At its open pit mining site, 42 miles north of Tucson, Arkota Mining, Inc., recently completed a plant to produce high grade iron ore concentrate. About 25 miles northwest, at the community of Coolidge, Arkota Steel, Inc., is in the final stages of erecting facilities to pelletize the concentrate, reduce it to sponge iron, and refine it to produced steel.

MINING AND CONCENTRATING OPERATION

Through magnetic separation Arkota Mining, Inc., is producing a concentrate of 65 percent iron from crude material averaging 5 to 7.5 percent iron; Arkota estimates that the deposit, which it holds under lease, contains a total of 500 million tons of iron-bearing sand. About 25 tons of crude are required to produce 1 ton of concentrate. The capacity of the plant is 250 tons of concentrate per day.

In the pit, dozers load the crude onto a belt, and the material goes to a series of $\frac{1}{4}$ -inch screens. Next, the crude goes to the first magnetic separator, and the resulting product, containing 25 percent iron, is sent to a rotary dryer. From the rough concentrate dryer, the material goes to the second magnetic separator and then to an impact crusher.

After crushing, the material is run over three high-frequency vibrating screens. The minus-35 mesh goes to the third magnetic separator, whereas the plus-35 mesh is returned to the impact crusher in the closed circuit. Upon discharge from the third magnetic separator the concentrate is conveyed to the loading point, from where it is trucked 25 miles to the stockpile area at the Coolidge iron ore reduction plant.

MADARAS REDUCTION PROCESS

On an 80-acre tract 2 miles north of Coolidge, the iron ore reduction plant of Arkota Steel, Inc., is nearing completion. Through the Madaras process the plan, erection of which started during November 1960, will have a capacity to produce 75 tons of sponge iron per day. The plant was moved to Coolidge from Longview, Tex., where it was operated on an experimental basis by Madiron, Inc. In addition to the reduction section, other units of the plant include a pelletizer and an electric furnace.

UTILIZE NATURAL GAS

In the Madaras process Arkota will charge 16 tons of hot iron ore pellets from the pelletizer, in which the concentrate will be agglomerated, into a steel pressure retort, lined with firebrick; the company expects to consume 120 tons of pellets per day. The 8-foot diameter, 10-foot deep retort is then sealed gastight. The plant's fuel, natural gas, is converted in the catalytic reformer to the reducing gas, a mixture of hydrogen and carbon monoxide.

Through the inlet valve the reducing gas, heated to 1,800° to 1,850° F., is injected into the retort. The gas, penetrating the entire mass of pellets, reacts immediately with the iron oxide, combining with its share of oxygen. The exhaust valve is then opened to automatically discharge the spent gas. Alternately injecting reducing gas and expelling waste gas in a pulsating manner continues until the oxygen has been removed and the iron ore is reduced.

The spent gas, as exhausted from the retort, contains some dust and much CO_2 and H_2O . The dust is removed by a cyclone separator and dust filter, and the water vapor is removed through a quench tower. The remaining unreacted CO , H_2 , and CO_2 is recompressed and mixed with fresh hydrocarbon gas. This flows through the hot superreformer where it is regenerated into 2CO and 2H_2 and the gas is then recirculated through the retort. In this way the reducing gas is nearly completely used.

RED-HOT PELLETS GO INTO FURNACE

About 2 hours are required to produce a batch of 10 to 11 tons of sponge iron averaging 94 to 96 percent iron with 4 to 6 percent sand. The retort, the trunnions of which rest on a moving rack, is moved to the 60- by 120-foot melt shop building. At this point the pellets, which, though red hot, are not fused together, are discharged into a continuous batch-type electric furnace. The retort is refilled with another charge of pellets and is reconnected to the gas circuit.

After refining, the molten sand is flushed off, and the product is cast into ingots for shipping. The capacity of the plant, situated on the main line of the Southern Pacific at a spot 65 miles northwest of Tucson and 56 miles southeast of Phoenix, can be expanded as demand requires.

ARKOTA PERSONNEL

The Madaras iron ore reduction process was invented in 1936 by Julius D. Madaras, Detroit, Mich., president of Madaras Corp., who is vice president and general manager of steel operations for Arkota. Arkota is the first company in

the United States to acquire a license to use the Madaras process. Hojalata y Lamina S.A., Monterrey, Mexico, holds a license to use the process in the Mexican State of Nuevo Leon.

In addition to Mr. Madaras, officials of Arkota are Patrick H. Feeney, Pierre, S. Dak., president, and Marnel Lindekugel, Mitchell, S. Dak., vice president of mining operations. Other personnel include J. L. Healy, who is in charge of construction; Ralph Fenton, reduction plant superintendent; Mathew Rose, project engineer; W. O. Randall, who is in charge of compressor operations; and B. D. Cadwell. The company took the name "Arkota" from the words "Arizona" and "Dakota."

JESSIE H. MINING CO.,
West Duluth, Minn., January 19, 1961.

Senator PHILIP H. HART,
Senate Office Building,
Washington, D.C.

DEAR SENATOR HART: I wish to thank you for your letter of January 11 concerning the possible help that the Bureau of Mines could give the mining industry. You state that possible topographical and geographical maps would be of help. They would be to some degree; however, the big problem is to know what we can do with the low-grade ores we already have. The greatest help that could be given is in laboratory work on these low-grade ores to assist the small operator in developing means to improve their quality so that they could be marketable. I would think that the most practical and quickest way to accomplish this would be to make funds available for this purpose to the university mines experimental station.

Yours very truly,

R. N. MCGIFFERT.

REPUBLIC STEEL CORP.,
Cleveland, Ohio, January 23, 1961.

Senator PHILIP A. HART,
U.S. Senate, Washington, D.C.

DEAR SIR: I have been asked to reply to your letter of January 11, 1961, in which you inquire about our reaction to proposals for stepping up the exploration of additional minerals and for the Bureau of Mines to expand its research activities.

We believe that research on this subject—both private and public—should and will continue and that it will help in the development of new ore projects, which will, of course, in turn provide the new jobs of interest to you. In our opinion, however, the greatest contribution which the Government could make to encourage such a development would be to help in assuring the existence of a business climate conducive to making the large investments needed for the expensive plants which must process the low-grade ore. We particularly have in mind the great impetus to business investment which comes from the right kind of tax laws. We believe it is important for the tax laws to be set up on a constructive basis; for the mining ventures involved here this has particular reference to realistic and flexible depreciation policies and to the continuing need for the depletion allowances. It seems clear to us that the Government can do more toward solving the unemployment problem as a result of providing favorable tax laws than by making any substantial increase in Government activities and hence expense.

Very truly yours,

C. H. DEWEY.

W. S. MOORE CO.,
Duluth, Minn., January 19, 1961.

Hon. PHILIP A. HART,
Senate Office Building, Washington, D.C.

DEAR SENATOR: In response to your inquiry of January 11, asking for my comment on recommendations contained in the report by Prof. William Haber, of the University of Michigan, please be advised that I do not have a copy of the report.

You specifically ask if the completion of topographical maps of this area would be useful to firms interested in exploration for minerals, my answer is a definite "Yes." Furthermore, an appropriation for further work by the U.S. Geological Survey in upper Michigan and northeastern Minnesota would be helpful.

Appropriations through the Bureau of Mines to expand research activities, I think, it is worth while. However, you should include, along with such authorization, appropriation to the Michigan Research Institute, at Houghton, and the mines experiment station at the University of Minnesota and the Iron Range Resources and Rehabilitation Commission. These are responsible bodies. They all have a definite program on which to work, the results of which would be of benefit to their respective areas. If desired, I could go into greater detail.

Thanks for your interest in this important business.

Very truly yours,

WARREN S. MOORE.

E. A. YOUNG, INC.,
Hibbing, Minn., March 3, 1961.

Hon. PHILIP A. HART,
U.S. Senate, Washington, D.C.

DEAR SENATOR HART: I wish to apologize for my late reply to your letter of January 11. However, I have had ample opportunity to give considerable thought to it.

The recommendations made by the task force appointed by President Kennedy are well taken. However, the economic factors having a direct bearing on the iron ore mining industry in the upper Great Lakes region are varied and many. The statements that I make herein, will be strictly based on the views of the smaller independent mining operators. It follows that those economic conditions that help and assist the prosperity of the smaller mining operators, will also inure to the benefit of the larger operators.

The specific recommendations for development of methods to increase the utilization of low-grade ores are well taken. However, standing alone, it does not have much meaning. I think that this program could be speeded along by making money available for the construction of plants, and also quick write-off of the expenditures in the construction of the plants would generate an enthusiasm for the building of the same. From the standpoint of the smaller mining operators, custom plants should be made available so that the smaller mining concerns could have their low-grade ore processed into a merchantable product, which would be acceptable to the iron ore trade. It might be well for the Government to consider a stockpiling program whereby they would purchase from the small mining operators the ore that they process through these custom plants.

Better topographical and geographical maps would help considerably in the exploration of new ore bodies, and also help the small independent mining operators, if the custom plants were built for them and a stockpiling program was initiated to purchase the excess concentrated product produced by the small operator.

The factors above, however, are not the basic factors in the iron ore mining industry, but are ancillary thereto. As I stated above, the factors directly affecting the iron ore mining industry are many and varied. Basically, I think that foreign competition is one factor that is presently affecting the industry to a great degree, and in order to combat that detrimental factor, I think that domestic costs should be scrutinized carefully both as to the iron ore and steel industry. I think that the situation requires the cooperation of the labor unions, mining operators, railroad companies, and steamship companies. These are the parties directly interested, and they should make every effort possible to reduce the cost of the delivered price of a ton of ore to the steel centers. If the cost could be made competitive with the cost of the foreign ore, I think that the results would be very gratifying. Taxation, which is a necessary evil, should be scrutinized carefully, and the industry should be taxed on a basis that would be in line with other industry in the area. Careful studies of the many factors involved in the mining industry should be made with an effort to eliminate those factors which would tend to place our products at a disadvantage with foreign imports.

In conclusion, I would suggest that a meeting should be held with all the parties mentioned above in an attempt to get their full cooperation, and also their views as to what should be done to reestablish the iron ore mining industry and steel industry to its former prominent position.

Much could be said concerning this situation, but it is for the powers to be, in cooperation with one another, to make decisions that would be put into effect for the best interest of the industry.

If at any future time I can be of any further assistance, please advise. With every best wish, I am,
Sincerely yours,

E. A. YOUNG, *President.*

OLIVER IRON MINING DIVISION,
UNITED STATES STEEL CORP.,
Duluth, Minn., February 2, 1961.

Hon. PHILIP A. HART,
U.S. Senate,
Washington, D.C.

DEAR SENATOR HART: We have your letter of January 11, 1961, outlining possible areas of legislative assistance for those parts of Michigan suffering from chronic unemployment. We appreciate the opportunity you have given us to comment with respect to recommendations which might be of benefit to our industry in Michigan. The following points might be considered with respect to any such legislation:

1. Topographic maps are very useful to all industries and people working on natural resources, particularly in mineral exploration. The extension of modern topographic mapping throughout the Lake Superior region would have a beneficial effect, as it is useful to mining, timber, recreation, etc. An expansion of this program might be justified.

2. Michigan College of Mining and Technology at Houghton, the University of Wisconsin, and the University of Minnesota Mines Experiment Station are well equipped and staffed with very experienced personnel capable of doing research work on utilization of low-grade ores of the Lake Superior district. If Federal funds are to be used in bolstering this area, it would appear that discussions with personnel supervising the work of these institutions would be fruitful, and it is possible that the contributions these institutions are making to the development and utilization of low-grade ore might be accelerated if additional funds were made available.

3. The one area which might have a beneficial effect on the general mineral exploration picture would be to open the Federal forests and State forests to exploration on a basis which would attract mining companies and justify their expenditures of funds on exploration and research. To support this contention, I quote the following policy adopted by the American Mining Congress for 1960:

"Productivity and full utilization of the public lands should be a fundamental principle in the maintenance of our military strength and economic growth.

"We believe that the public interest is served by assuring that the public domain is kept open for prospecting and the location of minerals. We therefore oppose the withdrawal of any area or any extension of a closed area unless it is established that the closing of an area is of far greater importance to the national welfare than the full utilization of such area for the development of its potential mineral resources. We believe that existing withdrawals should periodically be reviewed and reduced and the area of new withdrawals strictly limited, to the end that public lands closed to prospecting shall be kept to a minimum.

"The enactment of any measure or establishment of any rule or regulation, or the determination of any executive agency, which would preclude or obstruct or limit access to or utilization of the mineral and other natural resources on the public domain, is contrary to the public interest—not only of the State directly affected but of the Nation—and is vigorously opposed by the American Mining Congress."

4. In those instances where exploration and preliminary development work may have disclosed deposits of natural resources capable of being economically opened up (or expanded, in the case of existing operations), the point has been advanced that accelerated amortization may be helpful. This is particularly true in the absence of some legislation which will effectively correct the inadequacies of depreciation allowances permitted today which fail to recognize the replacement costs of property. It is our understanding that a bill, which is in some manner tied in with the distressed-areas legislation, is now under consideration to provide accelerated amortization for new or additional investments in certain areas which fall within the definition of an unemployment or distressed area per the provisions of the bill. Enactment of a bill providing for deduction of accelerated amortization for Federal income tax purposes of such investments might have the effect of substantially stimulating the flow of investment capital into these

areas, in competition with other areas which are competing for investment capital by offering more liberal depreciation allowances and other tax incentives.

The American Mining Congress in its declaration of policy for 1960 takes the following position in connection with depreciation for income tax purposes:

"The present depreciation provisions must be liberalized to stimulate investment of the funds necessary for a dynamic economy. Our present depreciation policies stifle economic growth because they fail to cope with the problem of inflation and to deal adequately with the increasingly significant problem of technological obsolescence."

5. The mining industry of the Lake Superior district has historically been plagued with a heavy State and local taxload which oftentimes results from unfair and discriminatory ad valorem tax assessments sanctioned by the very citizens who are most dependent upon the mining industry for their jobs and livelihood. Strange as it may seem, this propensity to overtax is perhaps as great today as ever before in history, despite the quality limitations which are forcing our remaining poorer grade ores out of the existing competitive ore markets. Any action which you can undertake at the Federal level to force a greater realization of this problem and secure a greater degree of equalization between mineral and nonmineral properties (thus giving each citizen a greater interest in controlling governmental expenditures) will help keep present mines from closing, with consequent further loss of existing jobs.

I wish to thank you for your interest in the raw materials industries and for the opportunity to prepare my comments for your consideration.

Yours very truly,

C. F. BEUKEMA.

JONES & LAUGHLIN STEEL CORP.,
Pittsburgh, Pa., January 27, 1961.

HON. PHILIP A. HART,
U.S. SENATE, Washington, D.C.

DEAR SENATOR HART: In reply to your inquiry of January 11, 1961, we feel that research work by the Bureau of Mines would be helpful in seeking a solution to some of the problems which now face the iron mining industry of northern Michigan.

It is our feeling that there are two major areas in which such research could be justified; namely (1) the reduction of underground mining costs and (2) the economic beneficiation of Michigan nonmagnetic iron formation.

An answer to the first of these problems could extend the life of the present iron mining operations in northern Michigan, all of which are faced with the prospect of being unable to meet competition of lower cost open-pit operations. Only a revolution in mining methods resulting in more favorable costs can insure the future of these properties.

While solution of this problem, if it comes in time, would provide immediate relief, the long-range future of the iron mining industry of northern Michigan lies in the solution of the second problem above, the economic beneficiation of Michigan iron formation or jasper, the "taconite" of Michigan. Much work is being done on this problem by the mining companies but assistance from the Bureau of Mines would be justified.

Assistance by the Bureau of Mines in either or both of these projects can only be successful if it is coordinated closely with the work which has been done and is being done by private industry and by certain public institutions, for example Michigan College of Mining and Technology. For the Bureau of Mines to initiate a program without such coordination would only result in duplication and waste of both effort and of the taxpayers' money.

These two problems we regard as basic, urgent, and a proper concern of the Government. Although we heartily support the Government's program of mapping, we do not feel that an increase in such work at this time would be of any major assistance in meeting the problems now facing the iron industry in northern Michigan. Our problem is that of economic exploitation of known reserves rather than the exploration for additional sources of iron.

Very truly yours,

C. J. HENNING,

General Manager of Ore Mines and Quarries.

ACTION—NOT WORDS—CAN SAVE UPPER MICHIGAN'S VITAL MINING INDUSTRY

An address by Ben W. Heineman, chairman, Chicago & North Western Railway Co., to the People of the Gogebic Range at Ironwood, Mich.

Thank you Mr. Chairman, and gentlemen. I am here this evening because you and the Chicago & North Western Railway share vital interests, and I think we should get to know each other better.

Moreover, I am delighted to have the opportunity of addressing so influential a group of upper Michigan and Wisconsin businessmen, civic leaders, and citizens whose genuine concern for the welfare of the mining industry of the Gogebic Range is matched by our own determination to do whatever we can in cooperation with you to keep your mining industry sound and profitable and healthy.

It seems to me that, in this very room, we have ample manpower, energy, ingenuity as well as plain old-fashioned know-how and guts to resolve most of the competitive problems now plaguing Gogebic ore. From among the various interests represented here tonight, we should be able to provide both leadership by individuals and groups, and the kind of teamwork and cooperative effort by all of us that always characterizes effective group action against a common problem.

We have a common bond. Each of you gentlemen here tonight has a stake in the growth and welfare of Michigan mines. And so that we will understand each other better, let me explain the stake of the Chicago & North Western Railway in your mining industry, for we have been partners with you in the commerce of Michigan iron ore for almost a century.

We can't pull up our tracks here and re-lay them in Canada, or Venezuela, Peru, or Liberia, or other newly found areas where iron ore is mined. The Chicago & North Western is as firmly rooted to this region as your own mine shafts and underground deposits of ore, your homes and business establishments. Our investment here is of the same kind of investment as those that have been made through the years by your mining industry represented by fee owners and mine operators, and by your citizens and merchants.

To a very great extent, the economic welfare of the nine-State Chicago & North Western Railway Co. is as inextricably bound up with the welfare of the Michigan mining industry as are the retail stores in this town or any business establishment in this area.

Our new freight car shop more than 300 miles south of here in Clinton, Iowa, where North Western now does most of its heavy repairs to freight cars, has not fully recovered up to the present moment from drastic cutbacks in production that became necessary during the long strike in the steel industry in 1959. For, like the wages and sales dollars and buying power which were lost in this region that year, our revenues on iron ore which were lost in 1959 were, to a great extent, lost to the Chicago & North Western Railway forever.

Total iron ore revenues of the North Western Railway last year of \$9,106,000 represented slightly more than 5 percent of our overall freight revenues for all commodities. Let me say bluntly and regretfully that if the Michigan underground mines are eventually abandoned for whatever economic or competitive reasons, or combination of reasons, then, like your communities on the Gogebic Range, the North Western Railway at this moment has no alternative source of revenue to which it may turn to pick up such slack. And so, as I said earlier, we share vital interests—your mining industry, your citizens, your communities, and the North Western Railway.

If your mines are shut down permanently, the railroad tracks which serve this region may become vulnerable to the same fate.

It is understatement to say that our stake in maintaining the competitive position of Michigan ore—yours and ours—is high. The stakes are so great that, in my opinion, the economy of the Upper Peninsula and adjoining areas hangs in the balance at this precise moment. Its direction will be determined this year and for years to come by such men as have assembled here, who, while representing separate interests, must become united by an overriding determination to meet and solve our present problem.

I hope that we all agree before we leave here tonight that the ability to help one's self is not lost in America, or in this region in particular. The economic problems which threaten to strangle the competitive position of Michigan's underground ore in its traditional domestic markets at lower lake mills are not as subtle or complex as such sophisticated mathematical and technical problems as putting a space satellite into orbit, for example, or returning it to earth at the

touch of a button. Stripped of all side issues, vested interests, and extraneous conversation which may tend to cloud the central issue, it is simply this: Ways must be found—and found quickly—to reduce the laid-down cost of Michigan ore at the mills.

This far-reaching industrial and social problem for upper Michigan communities is as simple as that. This is the central issue.

Those who would manipulate situations and introduce extraneous issues for selfish advantage, those who would cling to traditional concepts which evolved in the period when you enjoyed captive markets for your ore and which no longer exist, these and other individuals or groups must not be allowed to muddy the water or obscure the issue.

I have not come here tonight with any quick cures or patent medicine to be administered by the Chicago & North Western Railway, or any other railway in this region, in the form of further substantial freight rate reductions. On the contrary, I believe the time has come for each of the several interests involved to say, and say quickly, what each proposes to do, so that we all may know where we stand. Our common interest in this problem requires no less. Many of you who traveled some distance to be here, as I did, did not come merely to hear a speech by Ben Heineman. You are here, as am I, to resolve what must be done for the common good of this region.

As each of you is aware, mine operators on the Gogebic Range have been talking for years about their troubles. Now all of us know that problems and troubles never disappear when we turn our backs on them. This is especially true of economic problems. They have a nagging habit of staying exactly where we left them the day before; in fact, they have an exasperating faculty of spreading like cancer if allowed to go unchecked.

Forthright surgery and other remedial measures are now long overdue to bring the Gogebic mining industry back to sound health and vigor, to give it backbone and muscle to compete in the expanding ore markets of the world. Delay, in my opinion, will certainly be fatal. There will be little consolation for any of you or for the Chicago & North Western a year or 2 or 5 years from now if, after finally going ahead with surgery, you and we discover that while the operation was a success, in the meantime the patient had died!

Now we know at the North Western, and surely you must know that there is no scarcity of ore in the world today, and that there is little or no likelihood of a shortage in the foreseeable future. You are marketing a product which is now a world commodity, and your ore must compete not only with ores from other Lake Superior ranges, but with ores from foreign sources, including our neighbor, Canada, to the north.

The situation which faces Gogebic ore today is almost identical to the situation which faces the railroad industry in our country. For almost a century, the Lake Superior region enjoyed a virtual monopoly in the United States iron ore market, and in the short span of less than a decade all this has changed. Today, foreign ore is coming into our country from all directions. Last year, Canada exported 10,500,000 tons to the United States. Within the next 4 or 5 years, it is reliably estimated that Canada will be capable of exporting 34 million tons annually to the United States and Europe.

Imports of oversea ore to our country last year totaled almost 19 million tons, exclusive of Canadian ore, and which when added to the Canadian total exceeds 29 million tons of foreign ore which found its way into the furnaces of U.S. mills.

In South America, where exports of iron ore are currently in the area of approximately 20 million tons a year, we learn that the potential is double or triple that amount. Major deposits in both east coast and west coast countries of the South American Continent are under development or study.

Peruvian ore started coming up the Mississippi River a few years ago through the port of New Orleans to compete with Lake Superior ore at mills in Illinois. Oversea ore through New Orleans is now approaching 1 million tons a year.

In west Africa where most current iron ore development is now centered, we learn that the small country of Liberia can now export 3 million tons a year and in a relatively short time that this could exceed 13 million tons.

I need not reiterate to you gentlemen that these higher grade ores from Canada, South America, and Africa have placed the underground mines of the Gogebic in jeopardy because of your lower iron content and higher costs. For today the U.S. producer of iron can choose his raw materials from ores of the Lake Superior region including taconite and jasper concentrates, and higher grade ores from Canada or overseas.

The captive markets for your ore, plainly, no longer exists. They are gone forever and no amount of wishful thinking will turn back the clock or the march of economic development in the world in the past decade.

But you and we face far more than the immediate problem of keeping Gogebic ore competitive, price-wise, at U.S. mills. Still another, and perhaps more omnious and far reaching, competitive race is underway. The result of this race will affect the life and pocketbook of every individual in this room in the years ahead, and the lives and pocketbooks of your children.

I refer, of course, to the competition for capital investment in new and expanding iron mining facilities on the major continents of the free world.

The winner of this long-term race for capital investment in Venezuela, Brazil, Chile, Peru, Liberia, Canadian Provinces, or right here on the Gogebic Range, will win long-term rewards; for the history of your own industry here is proof that iron mining is a long-term industrial investment. With limitations based only upon tonnage reserves in the ground, iron mining can be virtually a perpetual industry so long as it remains competitive with operations in other areas.

Developments in your neighboring State of Minnesota are an example of this long-term race for capital investment. The Reserve and Erie taconite plants there represented an investment in the neighborhood of \$500 million. It has been estimated that they created about 5,000 new jobs, or an investment of approximately \$100,000 per job. These new jobs and this new capital investment in Minnesota were established, moreover, to process an iron-bearing rock that was regarded as practically worthless as recently as 15 years ago.

Such capital investments, wherever they are now being made by the mining industry, mean long-term employment and benefits. If the Gogebic Range loses in this domestic and international race to attract new capital investment for exploration, further research, and new methods to improve the competitive position of Gogebic ore, the future of the underground mines on the Gogebic is behind us and we're all heading downhill.

Now if there is anything clear to me, it is that we must work together on this problem. No single segment of the various interested groups, operators, fee owners, labor, the railroads, or government, holds the solution to this problem, alone.

There is no magic wand that the Governor of this State, or your legislators, or city mayors can wave to make this problem disappear. No amount of talking or further studies are needed. I think it's time that each of us starts doing something about it and that we start doing something about it together.

For years the mining companies in the State of Michigan have pointed to discrimination in taxation. It is a fact that iron ore mines believed to be captive have been valued and assessed for tax purposes at 100 percent, while nonmining property principally locally owned is assessed at a fraction of that amount. Some mines are paying nearly double the tax they would pay if assessed on the valuation of nonmining property. In January 1961, the executive vice president of Pickands-Mather stated at the mining symposium at Duluth: "If it becomes necessary to abandon the Michigan underground mines, one of the major causes will be the heavy fixed tax load, which also has been one of the major factors making it necessary to terminate and abandon similar operations in Minnesota."

The same warnings have been expressed the year before, and the year before that. The fact is that selfishly, shortsightedly, and, indeed, stupidly, it has been believed that inequity will or can be endured forever.

But the reduction of taxes, while vital, will not provide the entire solution. Nor is increased productivity by mine labor the entire solution; nor lower royalty payments to the fee owners; nor lower transportation charges.

What is needed is all of these and more. What is needed is cooperation by all of us. Let me explain.

Recognizing the responsibility of the Chicago & North Western Railway to this region which it has served for approximately 85 years, and our own self-interest in the economy of upper Michigan, a year ago the Chicago & North Western reduced its rates on ore from Gogebic mines to docks at both Escanaba and Ashland. These were substantial reductions from \$2 a gross ton to \$1.45 to Escanaba, or 55 cents a ton, and from \$1.25 to 87 cents a ton over the dock at Ashland. These were no halfway measures, for we were determined to do our part.

This contribution by the Chicago & North Western last year through reduced rates exceeded \$1 million.

In addition, we applied to reduce our dock charge at Escanaba from 19 cents to 11 cents a ton when no special services were required. Here we were frus-

trated by the Interstate Commerce Commission which suspended this reduction. We renounced the blanket rate increase on all rail rates last October which would have added another 5 cents a gross ton on your ore to the docks, and 11 cents on ore to other destinations on the Chicago & North Western. Applying a new principle to freight pricing known as the "multiple-carload" freight rate, the North Western took the lead in establishing another 55-cent reduction on all-rail ore moving in lots of 20 carloads from the Gogebic Range to Granite City and East St. Louis. Reductions were also made on all-rail movements to Chicago. We're not standing still.

But lower freight rates are not enough.

There are probably no more capable miners in the entire world than yours on the Gogebic Range. Years of experience are on your side. And the miners have a massive stake in the maintenance of these mines. The roots of your people are sunk deep in these rocky hills. The mineworkers are homeowners; their children are going to your public schools. None can find satisfaction in relief to distressed areas or in unemployment compensation.

Now we know that labor is a major part of the cost of Michigan's underground ore—approximately 65 percent of the cost, according to many estimates. Labor's responsibility goes beyond automatic wage increases to its members and fringe benefits which, in themselves are well and good, but which mean nothing once the pumps are shut down and a mine property is given back to mother nature. I firmly believe that the enlightened self-interest of labor can work wonders in bringing about higher productivity, backed up by new capital investment to streamline methods, new research, and the development of mining technology yet unknown. But this enlightened self-interest of your mine labor must be mobilized here and now.

But increased productivity by itself is not enough.

In my opinion, royalty contracts with fee owners must be reexamined and, where appropriate, readjusted to realistic levels. Otherwise, the royalty revenue may disappear forever.

A survey made by the Chicago & North Western a few weeks ago among the various ore companies in upper Michigan disclosed that present production schedules for 1961 call for only a little more tonnage than was handled during 1959—the year of the most prolonged strike in steel history!

This gloomy estimate was made by the Chicago & North Western for its own purposes to forecast our requirements for equipment and manpower this season. But it may be related in your own terms in the form of reduction of employment, loss of wages, reduction of earning power, and loss in the general well-being of your communities.

If you are as disappointed as I am in the gloomy outlook for your underground mines this year, let's do something about it right now. I must frankly tell you that I am appalled and almost frightened to encounter such situations as the North Western faced just a year ago when the city of Ashland for its own reasons actually fought the North Western's rate reduction on iron ore to Escanaba. If individual cities and individual civic officials are so insensitive to the overall areawide problem as to be unable to subordinate their own interests for the interests of the economy of the whole region; if labor displays an unwillingness to bring the full weight of its enormous power to bear on the problem of increased productivity; if fee owners are unwilling to reduce their royalties and if the people of upper Michigan are unwilling to lift such hardships as disproportionate taxes off the backs of its mining companies—in short, if we are unable to unite and make mutual concessions—who will we have to blame if the iron mines in Canada, Chile, Peru, or Liberia take away more of our markets at domestic mills?

I said earlier that the ability of a region to help itself is not lost in America. The urgency of the problem on the Gogebic Range suggests action now—not next month, or even next week.

We know many of the answers to the problem of keeping Gogebic ore competitive at the marketplace. We don't have all the answers, for there are big "ifs" and question marks in public and governmental attitudes. Your (and our) domestic, Canadian and foreign competition is not standing still; and action we take here may trigger counteraction elsewhere. But I, for one, will place my bets on the ingenuity and determination of Michigan's citizens to get on with the job that must be done.

As a start, I would suggest the immediate formation of a steering committee from labor, government, the fee owners, mine operators, railroads, and

the public to explore every avenue for improvement and cost reduction. Our problem won't wait. This can be done tomorrow.

If you are convinced that a vigorous and healthy mining industry here to create jobs and payrolls for your citizens is more important in your long-range interest than the short-range benefits of inequitable taxation of your mining properties—then insist that your legislators and local taxing bodies act quickly to correct such inequities. They are your servants, and welcome public support on such vital public issues.

If constructive steps are to be taken in the direction of fee-owners' payments, the mine operators may welcome public and political support. But don't anticipate a contribution by any interested group unless you are prepared to make some substantial contributions of your own, individually and collectively. You will find, however, that real cooperation is contagious, and your enthusiasm will rub off on others along the way.

The Chicago & North Western Railway was convinced a year ago that no halfway measures are needed here. You need no watered-down or stopgap measures to bring back the sound health and growth of your mines. Such steps will not work; for temporary relief will not attract new capital for costly research, exploration, further mechanization, or multimillion dollar processing facilities for upgrading Gogebic ore.

Many of you have heard the term "business climate" in recent years. "Business climate" can best be defined, I believe, as the sum total of all factors in a community or region which work for or against the profitability of a business enterprise in one area as compared with others. More than anything else, "business climate" is the sum total of attitudes—attitudes of government, merchants, citizens, labor.

There isn't a person in this room, I would imagine, who would not wish to see the mining industry in this region, vigorous, healthy, and with a future of expansion and growth ahead of it in 1961 and the years to come. But wishing for it will never bring this about. It will require action on every front.

I need not even remind you that the so-called business climate in those parts of the world as far as 4,500 miles away from upper Michigan must be favorable, or the ore from other continents or from Canada—however high in grade or quality—would never have found such markets in our country. In Canada, for example, mining receives very preferential tax treatment. I am informed that in such countries as Venezuela, Peru, and Chile, property or provincial taxes are at minimum levels compared with State and local tax policies in our Lake Superior region.

Now let's explore the stake of this region and all of upper Michigan in your mining industry—your own stake, if you please, whether you are on the payroll of a mining company, an allied industry, a merchant who operates a retail store or any other business enterprise here, a taxpayer, or just plain citizen. Let's look at this problem strictly from our own selfish point of view. Who holds the big stake in the future of the mines of this region? Who has the biggest stake on the Menominee, Marquette, or any other range?

Is it the mining companies, the fee owners, your taxing bodies, the railroads, labor—or is there an overriding interest which transcends and dwarfs the separate interests of each of these groups? I am talking about the economic stability of the Upper Peninsula to which is tied the purse strings of your wage earners, your farmers, your resorts, your investments in homes and businesses and, as I have made clear, the health of the North Western Railway as well. This we may term "the common good."

The answer is obvious.

That the mines have been here for the past 80 years is no guarantee that they will be here tomorrow. You, and each of you, must believe that.

When a mine can no longer be operated with any prospect of profitability and its ore is no longer competitive in the marketplace, that mine disappears. The abandonment years ago of some of Michigan's deep underground copper mines for low grade open pits in other areas is an example of this. You have had other examples closer to home.

You and we, all of us, must free ourselves from the thinking of the past. Only by so doing can we meet the problems of today.

If you are as tired and alarmed as I am of watching the Gogebic Range go downhill and losing its once-strong position—let's do something about it.

Let's tackle the job without any preconceived notions about who is to blame, who is at fault, or any pointing of fingers.

Our job is to discover new ways to make upper Michigan iron ore competitive at lower lake steel plants, in Pittsburgh, Youngstown, and the Ohio Valley, southern Illinois and wherever an ore market exists.

Gentlemen, we cannot afford to lose another day. I urge the immediate organization of a steering committee of your most able and dedicated citizens. This group of public-spirited men should find out from the mine operators precisely what is required locally in the form of lower taxes, greater productivity, lower royalties, and indeed if necessary still lower transportation rates. It should then use its local prestige to make certain that what is required is forthcoming now. These men will need the help of other able people as their plan of action develops. We need a brand of men in these groups who will drop what they are now doing for a week, or a month if necessary, to devote full time to this task because it cannot be accomplished at an evening rally or mass meeting. Further talk won't help. Let's not establish a debating society.

The legislators who represent you at Lansing, and at Madison as well, and your own Governors, must help you to solve this growing problem, and I am confident that they will.

Needless to say, the Chicago & North Western Railway welcomes its responsibility to join the good people of upper Michigan in meeting this challenge.

Thank you very much.

PICKANDS MATHER & Co.,
Cleveland, Ohio, June 28, 1961.

Hon. JOHN A. CARROLL,

Chairman, Subcommittee on Minerals, Materials, and Fuels, Senate Interior Committee of the U.S. Senate, Senate Office Building, Washington, D.C.

DEAR SENATOR: At the time of the iron ore hearings before your committee on June 22, I was out of the country and did not have opportunity to appear.

As you undoubtedly learned at the hearing, the iron ore industry does not need Government help for research or development programs, as this industry is energetically researching and developing on its own, and through such research has, over the past several years, radically improved its product offered to the iron and steel industries, and this has been a major factor in enabling those industries to accomplish revolutionary changes in their production methods and results.

There is, however, a very important feature with regard to the Lake Superior iron ore industry in that the industry is being, in effect, driven out of Minnesota and Michigan by unrealistic, unfair, and extortionate taxing policies. I think your committee should know this, and in this connection I am filing herewith three copies of a talk I made at the University of Minnesota mining symposium on January 10 of this year, which explains the influence of taxes on new iron ore investments in Minnesota, and incidentally also referred to is the situation in Michigan.

Since the time of this talk it has been necessary to close permanently at least two underground mines in Michigan, and one of the principal factors in such closing was the excessive fixed annual tax extortion.

Sincerely yours,

H. C. JACKSON,
Executive Vice President.

THE INFLUENCE OF TAXES ON NEW IRON ORE INVESTMENTS IN MINNESOTA

(Presented by Herbert C. Jackson, executive vice president, Pickands Mather & Co., Cleveland, Ohio, at the University of Minnesota mining symposium, Jan. 10, 1961, Duluth, Minn.)

"Death and taxes," said Benjamin Franklin, are the two things certain in this world. This comment is peculiarly applicable to the iron ore mining industry in Minnesota as the life or death of that industry depends to a large extent on the future tax policy to be followed in Minnesota.

Minnesota can well pause to consider the success it has had in attracting the taconite concentrating industry to the State, solely by protecting that industry from the burdensome taxes levied on the balance of the present iron ore mining industry, and in lieu thereof adopting a program of fair taxation for the taconite-type industry. Minnesota should further consider the history of iron ore taxation in this State and the changed conditions affecting iron ore supply for the

iron and steel industry that have evolved during the past partial decade, and to what extent these changed conditions require a change in the future tax policy of the State in order to meet competition from other iron ore sources and preserve and expand the iron ore industry in this State.

In the decade of the 1880's when Leonidas Merritt and his brothers won fame and glory by discovering vast deposits of iron ore on the Mesabi Range, the firm of Pickands Mather & Co. had its beginning, and for other 70 years has been promoting and operating iron ore properties in the Lake Superior district, and more than half that time I, personally, have been associated with these operations. Our business has been to bring to the iron and steel companies for whom we operate, an iron ore supply suitable for their immediate and long-range requirements, and to manage and operate such of the iron ore properties in which they and ourselves decide to invest.

Historically, in the course of our conduct of this business, we and our associates have clung to the Lake Superior district as the logical ore supply for the domestic iron and steel industry.

As early as 1930 we, however, anticipating the time when the natural ores of suitable quality in the Lake Superior district would become exhausted, directed our attention to what was then considered an almost worthless iron-bearing rock, commonly called taconite. In cooperation with the University of Minnesota and other mining interests, years were spent in research. It was necessary to find new methods and new machines for drilling and grinding the toughest granitelike rock of this area. It was also necessary to find the means for extracting the finely disseminated iron ore particles from the mass of silica in which they had been contained, all at costs which would make it possible to bring this new industry to Minnesota.

Finally, after years of work, it appeared to us and our associates that taconite production could be economically feasible, but only if reasonable tax treatment would be applied to that industry. The investments required for plants and related facilities were so great that the necessary capital could not be risked under the then existing tax laws and administration thereof applying to the iron ore mining industry.

Fortunately, governmental leaders had the wisdom and foresight to agree with us that it would be economically impossible to operate these high-cost taconite plants in Minnesota without protection from the burden imposed by excessive taxation on other types of iron mining. Minnesota owes a debt of gratitude to the State legislators and administrative officers who sponsored and passed special taconite laws in 1941, and to those who have continued since that date to encourage the taconite industry. Without these special laws and administrative cooperation, taconite developments would not have been possible in Minnesota.

Upon our advice and recommendation, Bethlehem Steel Corp., Youngstown Sheet & Tube Co., Steel Co. of Canada, and Interlake Iron Corp. were willing to invest over \$300 million in this yet untried industry. Erie Mining Co. was formed and at one time the construction of its taconite facilities was said to be the largest single nongovernmental construction project in the United States. In operation today, Erie's payroll will normally be more than \$20 million per year, and expenditures for equipment, tools, and supplies will even exceed that amount. Also as a result of fair tax principles applying to the taconite industry, there was another large taconite plant built by Reserve which, together with Erie's plant, makes the total investment in taconite facilities in Minnesota over \$500 million.

Thus Pickands Mather & Co., throughout the years, has operated its business of iron ore mining to the extent possible in the Lake Superior district, for here we have our roots, our organization, and our skilled employees. Surely everyone in Minnesota must share with us our desire to bring new industry into this State, and just as surely the people of the State of Minnesota must share with us the concern we have over the impediments which exist to the achievement of this common objective.

While we are anxious to bring iron ore investments into Minnesota and will make every effort to do so, Pickands Mather & Co. cannot lose sight of its responsibility to the steel companies it represents. In our service to these companies that employ us, we must make iron ore available to them which is at least equal in quality and cost to that used by competitive steel mills in the United States and foreign countries.

Therefore, when the demand occurs for iron ore, we must present our best recommendations for prospective ore supplies. In doing so, we know well the available reserves in Minnesota and we are well aware of the factors which might favor investment in this State. On the other hand, Pickands Mather & Co., and every other iron ore producer, knows full well the advantages of iron ore production in other States and nations.

In locating an iron ore supply for the iron and steel companies, all factors must be weighed, including size of reserves, quality of the production, the capital investment per annual ton of production, all costs of production, including labor, supplies and taxes, as well as transportation to the point of consumption. In States, provinces and countries outside of the Lake Superior District, the cost of taxes is not a controlling factor, but in the Lake Superior District, particularly Minnesota, the cost of taxes and the threat of confiscation by taxes, as borne out by the iron mining taxes in Minnesota, is a controlling factor.

In order to understand the importance and influence of taxes on the future of iron ore mining in Minnesota, it is well to review the tax laws and administration as developed in Minnesota over the years since the beginning of the Mesabi Range.

During the latter part of the 19th century, and almost up to the present time, our Nation has been hungry for steel for expanding railroads, industrial buildings, machines and tools and steel for the machines and tools of warfare. Year after year this demand for steel has increased and with it grew the iron ore industry of the Lake Superior District, being the logical source of metallic units for the iron and steel industry. During all of this time, except in the last decade, the domestic iron and steel industry had no substantial source of iron units to turn to, except the Lake Superior District. This created the idea in the local communities and the legislative halls of Minnesota that Minnesota had a monopoly on iron ore supply and could name its own tax policy, regardless of how inequitable and onerous, and still keep the iron ore mining industry captive.

In such a favorable environment for collective taxes from the absentee owners of the iron ore mining property in Minnesota, a tax system has grown which could not prevail except under something approaching monopoly conditions, which no longer exist. In this system, to the extent that there are not enough built-in discriminations and penalties by statute against the iron ore mining industry, these have been supplemented over the years by further discriminations and penalties through interpretation and administration of the laws.

The Minnesota taxing system on the iron ore mining industry, other than tonnage, as administered and applied on the Mesabi Range, pyramids six atrocious inequities and by so doing, compounds the tax penalty to the point that any new development of a large-scale iron ore mining operation requiring substantial capital would likely be effectively discouraged unless the needed tax changes are promptly made.

A review of the six major inequities would convince any prospective investor looking for a development of direct shipping or medium-grade iron ores that he should go elsewhere than Minnesota.

The first statutory inequality is that, by law, iron ore mines are assessed at 50 percent of an appraised full and true value, whereas all other property in the State is assessed at rates from 40 percent of so-called full and true value to as low as 20 percent. As a result of this classification, iron ore reserves are, by statute, taxed at a rate of 25 percent higher than any other commercial or industrial property of the same value as arbitrarily appraised, and up to twice as high as homestead property.

The second inequality of the Minnesota property tax literally compounds the discrimination created by law. The tax assessment authorities at the State level have long stated frankly and publicly that they value mineral reserves at what they consider to be 100 percent of full value. At the same time the State tax department maintains statutory "full and true" valuation on all other property at a substantially lesser level. Even the public utility companies are valued by the commissioner of taxation upon a standard of less than 50 percent of full value.

For the most part, local assessors on the iron range vigilantly maintain a standard of so-called full and true value for assessment purposes on nonmineral property substantially below State average levels. The standards of appraisal of full and true value on the iron range in 1959 for nonmineral property ranged from an average of 9.8 percent of actual full value in Mountain Iron to an average appraisal of 22.3 percent in Fraser. In many cases homesteads are

valued at a lower level than nonmining commercial property. For example, according to the same State figures for 1959, the so-called full value of commercial property in Hibbing was only 25.8 percent of actual full value, and so-called full value of residential property was only 13 percent of actual full value. Since mineral reserves are valued upon a 100 percent standard of full and true value, it means that mineral properties are valued at a rate of four to ten times higher than other property, depending upon the taxing district and kind of property involved. The complete abandonment by the Minnesota authorities of the meaning of the word "true" in the statute as applied to value is representative of the taxation policies imposed on the iron ore mining industry other than taconites.

The result of the discrimination in so-called full and true value on nonmining property compared to iron mining property, when coupled with the statutory discriminations mentioned, is that the assessed valuation of mining property, and consequently the assessed taxes, are relatively up to 20 times higher than nonmining property of equivalent value. For example, a house in Mountain Iron, with an actual sale value of \$10,000, would be appraised by the local assessor at a full and true value of \$1,000 and then would carry an assessed value of \$250. A mining property in that same taxing district worth \$10,000, would be reported to the local assessor by the State tax department at a full and true value of \$10,000, and the assessor would then apply the 50 percent statutory percentage and put it on the tax rolls at an assessed value of \$5,000, to compare to the \$250 assessed value of the house, which actually has a full and true value of \$10,000, the same as the mining property. By this combination of statutory and administrative discrimination against iron ore, other than taconite, throughout the Mesabi Range, such iron mining mineral property pays property taxes for each dollar of actual value of from 6 times to 20 times that paid by nonmining property for each dollar of its actual value.

The third feature of the property tax inequity is the high rate of municipal and school spending, and is a direct result of the unequal tax standards, as just described, applied to mining and nonmining property. With the mining companies paying a disproportionate share of the taxes, the residents of the local Mesabi Range communities can afford to have their communities spend large amounts without any material effect on the property taxes they pay.

Following practices which are traditional on the Mesabi Range, the cities, villages, and schools spend substantially more than any comparable off-range communities of the State.

Over the years, public expenditures have exceeded even the most extravagant requirements for municipal services. According to our information, the public examiner's report for the village of Hibbing in 1916 indicated that in the year 1914 there were 1,178 votes cast for mayor and over a thousand men on the village payroll. In 1915 when 1,710 votes were cast, there were as many as 1,296 men on the village payroll. This report also cited violations which included paying salaries when no work was done, and paying telephone charges for private telephones.

The history of school expenditures shows they do not lag far behind the municipalities in extravagant spending. The race to see which school district could build the most ornate and expensive school buildings became legendary. As a matter of fact, municipal and school spending became so rampant that it finally resulted in the imposition of per capita limitations, and even these limitations were only partially effective in halting public extravagance and waste.

I can recall a couple of typical examples of some of the extravagant expenditures 30 to 40 years ago in the Mesabi heyday. One school district, for instance, hired an expert picture placer from New York City at a cost of \$10,000 to tell the school board where to hang an expensive oil painting in the new school building.

Another recollection is that one of the municipalities on the Mesabi Range bought a luxury Pierce Arrow limousine for the convenience of its school janitor, transporting him between the school and his home.

It was in these earlier years of Minnesota's iron mining that the tradition of high spending was established. Today almost every school district with a substantial amount of mineral reserves still continues to impose the last dollar of taxes allowed by law. At the present time comparisons of maintenance or operating cost per pupil as reported by the Minnesota State Department of Education, show that Range school districts in many instances pay out almost

twice as much per pupil as off-range school districts. The statistics also show that during the last school year, Coleraine, for instance, had a maintenance cost of \$502 per pupil, whereas the highest cost district of comparable size off the Iron Range, that is, Wayzata, spent only \$334 per pupil unit. Coleraine thus was 50 percent higher than Wayzata. Similar comparison could be made with the Virginia and other Mesabi Range school districts.

In total dollars it can be stated that if Virginia had spent no more per pupil in the past year than the highest off-range school district of comparable size, its operating cost could have been reduced by about \$460,000 and Coleraine's cost, similarly, could have been reduced \$540,000 per year. These are large amounts of money which comparisons indicate are unnecessarily spent and which inflate the tax bill of the mining companies—who are the chief employers in these range communities.

Similar comparisons of Mesabi Range municipalities with off-range cities and villages of comparable size, indicate similar excessive expenditures by the range communities. In 1959 Taconite, for instance with 395 people, levied eight times as much in general property taxes as Avon with 436 people. In the same year Chisholm, on the Mesabi Range, levied, for operating purposes, \$728,000—being more than eight times as much as Hutchinson, which levied \$88,000 in property taxes.

While these comparisons do not necessarily reflect a comparison of total municipal expenditures because of other sources of income, such as special assessments, etc., they do show very definitely that the Iron Range municipalities collect a much greater property tax load than the off-range communities, and by far the largest part of these taxes are paid by the mining industry.

The fourth significant feature of property tax on the Iron Range is the reduced amount of taxable property as a result of mine exhaustion. It is one thing to be the owner of one of several mines in a taxing district all sharing the costs of the village and schools. It is an entirely different thing to be the owner of the last remaining mine carrying the principal portion of the tax load alone. Largely as a result of mine exhaustion, the assessed value of Eveleth went down from \$4,600,000 in 1946 to \$1,500,000 in 1958, while mill rates increased from 199 to 588 mills in the same period. The assessed value of the village of Hibbing went down from \$27,500,000 to \$13,600,000 in the same 12 years, while Hibbing's mill rate went up from 91 to 271 mills. The village of Mountain Iron had an assessed value in 1946 of \$6,200,000 with a rate of 83 mills. In 1957 Mountain Iron had an assessed value of \$750,000 with a mill rate of 749 mills, i.e. 75 percent, which to the best of my knowledge, is the highest mill rate of any taxing district in the history of the United States. This means that in Mountain Iron the tax payable in 1957 was 75 percent of the assessed value. Mountain Iron's mill rate has been somewhat reduced since 1957, but not materially.

The above four enumerated features applicable to the Minnesota general property tax has steadily increased the property tax cost of mining companies each year from an average of 20 cents per ton of iron ore produced in 1945, to 98 cents per ton of production in 1959. These figures are for property tax only and do not include the occupation tax and royalty tax, nor the taxes paid by the taconite industry.

Thus the above four discretionary features of the iron ore mining tax system in Minnesota is only part of the tax burden imposed upon the iron ore mining industry, other than taconite. There are two more grossly discriminatory tax penalties.

The first is the occupation tax paid to the State of Minnesota for the privilege of mining iron ore in this State. The rate of this tax is 14.25 percent of the value of the ore at the mouth of the mine, subject only to certain direct costs of mining. No other industry in Minnesota pays an occupation tax for the privilege of doing business here. These other industries do pay a corporate income tax at the rate of 9.3 percent of net income but, to make a fair comparison, consideration must be given to the deductions allowed under the income tax law which are not allowed to the iron mining industries. Such deductions include Federal income taxes, a large portion of the ad valorem taxes paid to the State of Minnesota, exploration and research costs, overhead and administrative expenses, charitable contributions, advertising costs, losses from related operations and many others. With these considerations, the effective rate of tax paid by the mining industry is up to 30 percent of computed income, compared to the 9.3 percent income tax paid by other industries in the State. This comparison does not give weight to the fact that Minnesota manufacturers

and merchants have only a part of their income taxed in Minnesota if they sell their product or otherwise do business in another State. No such privilege is afforded the mining industry.

We do not wish to imply that all mines pay as much as 30 percent of their income for occupation tax. The occupation tax law provides a labor credit for high cost operations but, in spite of this, the average occupation tax per ton of ore produced went up from 12.8 cents per ton in 1945 to 54 cents per ton in 1957, the last normal year of ore production, and this was caused chiefly by statutory tax rate increases.

The second additional tax, over and above the property tax, borne by the mining industry, is the royalty tax. This tax is at the same rate as the occupation tax and is paid by the mining companies on the royalty which it pays to the fee owners, thus this tax is a tax on a cost of mining, and not on a profit. In addition to this, the fee owners, when they receive the royalty, pay the State income tax on this royalty. In other words, Minnesota has no compunction about collecting a double tax on the same money as long as the second tax is paid by the mining industry.

Thus there are six features of Minnesota taxation on the iron ore mining industry, other than taconite—four related to the property tax and two, the occupation and royalty tax—which are, in effect, discriminatory against the iron mining industry. It is these features, with their constantly increasing costs over the years, which constitute the tax threat which Minnesota holds over the natural iron ore mining industry and which is the real deterrent to new iron ore investments in Minnesota in the future. A look at the last 12 to 15 years, that is, from 1945 up to and through 1957, being the last normal iron ore mining year, reveals that the total annual tax burden on iron ore, other than taconite, has increased from \$20 million to \$63 million. The total tax per ton of ore shipped has increased from 33 cents in 1945 to \$1.48 per ton in 1959.

The total taxes assessed and paid by the iron ore mines have increased since 1945 by 211 percent, or an average of about 18 percent per year, while all other taxes collected by Minnesota and the communities have increased 153 percent, or an average of about 13 percent per year. This means, in terms of dollars, that if the mining taxes since 1945 had increased at the same rate as taxes on the balance of industry in Minnesota, that the iron mining industry would now be paying \$10 million per year less than it now is. Actually, taxes on iron ore mining, which is a depleting industry, should have been decreasing in this period instead of increasing, and the actual excess which the iron mining industry is now paying, compared to other industry in Minnesota, is considerably more than \$10 million per year.

Thus we can see that the Minnesota tax system imposes on the iron ore mining industry, other than taconite, inequity multiplied by inequity, compounded by unfairness, multiplied by penalties, and so on for at least six additional or compounding, statutory and administrative discriminatory tax features, as compared to other industry in the State.

You can well understand that no State, Province, or foreign country, unless it wished to prevent iron ore mining within its boundaries, could tolerate such a tax system against an industry which it would want to encourage.

The attitude of other States and foreign countries in taxing their respective mining industries can be illustrated by making a comparison, or rather contrast, of the taxes levied in such locations where sources of iron ore are in competition with the Lake Superior district. In no State in the United States where iron ore is mined, other than Michigan, are ad valorem tax assessments administered in such a discriminatory manner as in Minnesota. Taxes in such States, other than Michigan, are on a reasonable, fair basis, with no discriminating classifications between iron ore and other property. There are no taxes in any State of the Union which subject its iron ore mining industry to a special tax comparable to the occupation tax of Minnesota. A review of other States income and severance tax laws indicates that Minnesota's occupation tax exceeds by 3 times its closest rival, and in some cases the Minnesota tax is 10 times greater than the tax which would be assessed against a comparable operation in any other mining State. There is no tax in any State which taxes costs, as Minnesota does in the case of its royalty tax and the occupation tax in disallowing certain costs, including the ad valorem taxes which the mining companies pay to the State.

In the State of Michigan there is discrimination against iron ore mining companies in that the iron ore mines have been valued and assessed for tax pur-

poses at 100 percent, whereas the nonmining property is assessed at only a fraction of 100 percent, thereby causing some mines to pay nearly double the tax they would pay if assessed on a valuation relative to the nonmining property, and this procedure is definitely putting in immediate jeopardy the future operation of Michigan underground mines. If it becomes necessary to abandon the Michigan underground mines, one of the major causes will be the heavy fixed taxload, which also has been one of the major factors making it necessary to terminate and abandon similar operations in Minnesota.

With regard to the taxes in the provinces in Canada, where iron ore is currently being mined or developed in large quantities, the Provincial taxes that would compare with the State property, royalty, and occupation taxes of Minnesota, are all on a tonnage mined or a percentage of net-income basis and when added up, will only total a fraction of the Minnesota tax.

In other countries, such as Venezuela, Peru, and Chile, the property taxes or Provincial taxes compared with the Minnesota taxes are a minimum. The taxes on iron ore mining in these countries are in the nature of Federal taxes, and these in general do not exceed the taxes collected by the United States in comparable situations.

It should be obvious that the Minnesota tax policies, as they relate to iron-ore mining, should be drastically revised, and I will give you my ideas of what should be done to put Minnesota in a competitive position to keep the properties it now has in operation and to expand iron-ore mining operations in Minnesota in the future. I believe this could be done with proper tax treatment and will be done when the people of the iron-ore range communities and State legislators understand the conditions that prevail and why. The situation with regard to iron ore now is different than it has been over the long history of the iron-ore mining industry in the Lake Superior district.

Great changes have taken place in the requirements of iron and steel companies for their iron ore supply. In addition, large iron-ore reserve in Canada on this continent and in foreign countries located within economic range of the U.S. markets for iron ore have or are being developed. From them highgrade iron ores are produced with which the present natural and intermediate ores of the Lake Superior district are not competitive at present.

Through research in the iron-ore and steel industries and by their experimental and commercial production over the last 5 years, it has been firmly established that the most desirable blast furnace metallic feed is an iron ore with the highest possible ratio of iron units to silica. As a practical matter, there should not be less than seven units of iron of each unit of silica. Other essential requirements are that the iron-ore feed should be of uniform size and of consistent metallic content. Pellets from Minnesota first established these facts, and now we all know that a properly sized highgrade iron ore of around 64 percent iron and 9 percent silica will increase the production of a furnace by 20 to 30 percent over that obtained with a Mesabi ore having 50 to 52 percent iron and only about five units of iron for each unit of silica. Fortunately for Minnesota, taconite pellets now meet this test and so long as they can meet competitive costs of production, they should be marketable for many years to come.

Blast furnaces and related facilities cost in the neighborhood of \$55 million each. When capacity can be increased as much as 30 percent by using a high-grade iron ore feed, there is eliminated the necessity of large capital investment to increase markedly an iron or steel company's hot-metal production. In addition to this, the cost per ton of hot metal is greatly reduced by the use of this high-grade material because the fluxing and reducing materials of limestone and coke are less per ton of product and all costs of production are decreased.

While these revolutionary changes in the iron ore requirements have been developing, there have been made available, in addition to the taconite-type concentrates of the Lake Superior district, large amounts of iron ore from Canada and other countries. These foreign ores fulfill the grade and size requirements of the iron and steel industry and they can be and are being put into the U.S. markets on a competitive basis with the Minnesota taconite. Consequently, they will displace the natural and intermediate ores of Minnesota unless the domestic iron ore industry can see its way clear to invest the sums necessary to grade such intermediate and so-called direct shipping ores up to the standards required by the iron and steel industry. It is evident that these upgraded materials must be competitive in cost with the ores from other sources.

When it comes to choose whether the investment to secure these ores on a captive basis for a long-range supply can be made in Minnesota, or in a foreign

country, the tax history of Minnesota presents a fatal handicap. It must be apparent that appropriate legislation be passed to assure protection of the large capital investments and treating plants necessary to upgrade intermediate and so-called direct shipping ores to the necessary competitive standards.

The question may be raised in answer to Minnesota's problem—"Is a U.S. tariff on the importation of iron ore the answer to Minnesota's problem regarding the future of the intermediate and direct shipping ore industry?" To answer this question you must understand that Minnesota now has, in effect, an export tariff of its own on the iron ore produced within its borders. The excessive and burdensome taxes on this segment of the iron ore industry acts, in effect, as an export tariff. Thus any tariff which the United States would put on the importation of iron ore would not make present mines more competitive, but merely serve to continue in Minnesota the tax processes which can be and should be revised to a reasonable basis so that Minnesota can ship these ores to the iron and steel industry.

In addition to this, the U.S. Tariff Commission has just released its report of its finding and recommendation in connection with a possible tariff on iron ore. The Commission found that iron ore is not being imported into the United States in such increased quantities, either actual or relative to domestic production, as to cause or threaten serious injury to the domestic iron ore industry. The Commission, therefore, advised the President of the United States that there was no need for a tariff on iron ore.

In answer to the suggestion regarding unemployment being caused in the area by reason of the foreign and domestic ores outside of the Lake Superior district taking the market away from the Lake Superior district ores, the facts should be considered. As the production from concentrated and upgraded product of the medium and direct shipping ores and concentrates from taconite increase in the Lake Superior district, the outlook for employment should be very much improved because the ratio of crude ore necessary to produce a ton of usable ore will be increasing. As the grade of the raw ores is improved, the ratio of crude to final product will require ever larger total material movements. For example, in the past in producing so-called direct shipping ores, the total tonnage mined is, in effect, shipped. However, in the case of the taconites, it will be necessary to mine up to three tons of crude ore to each ton of shippable product, and in natural ore beneficiating plants, up to twice as much crude ore is moved as the amount shipped. The increased manpower required for this mining and treating operation is bound to increase employment.

To an extent, this is reflected in the total number of employees presently in the domestic iron ore industry. The U.S. Bureau of Labor Statistics shows that in 1955, the largest steel year in history, the total number of employees in the domestic iron ore industry was 34,200 and the statistics for September 1960 show 33,200 employees, which is no significant reduction on a national scale. This total employment figure was held up by the fact that new iron ore mining operations have been opened up in Wyoming, Missouri, Pennsylvania, Utah and other States within the continental United States. Minnesota, however, has not kept pace with the national average and this is why it is so important to Minnesota's future economy that it attract more investments in taconite and natural ore beneficiating plants instead of permitting those investments to go elsewhere.

To continue my subject, "The Influence of Taxes on the Future of the Minnesota Mining Industry"—it is evident to me that there is dire need for changes in the Minnesota statutes and assessment procedure to encourage further development of the intermediate and direct shipping ores on a large scale and, to an extent, some modifications in the taxation of taconites to insure large-scale developments of these industries in this State. It is obvious that very little attention by the localities and the State has been paid to the changed situation in the iron ore mining industry which has taken place within the last several years, with the result that even during the past 3 years, large iron ore developments which might have been in Minnesota have been scheduled where there is no tax penalty but, on the contrary, a tax policy to encourage development of mining ventures.

Minnesota and the Lake Superior iron ore district have something real to offer the iron and steel industry. In this area there are more iron units than in any other known area of the same size in the United States. These iron units also are tributary to a large segment of the domestic iron and steel industry. The problem is to make them available in product of the proper standard to

compete in quality and cost with iron units from other areas in this country and outside our borders.

We believe we have so succeeded in case of taconite, as the production of high-grade pellets under present conditions is a competitive and desirable furnace feed. I must add, however, that some prospective investors are genuinely concerned about taconite investment in the central Mesabi area, where the threat of public spending has been relatively unchecked and where the natural ore mines may no longer carry the major portion of this spending. If there is an impediment to more taconite investments in Minnesota, it lies in this fear that experience of the past will mark the threat of things to come.

With Minnesota's successful experience of the past with attracting the taconite industry, which is in direct competition with low-grade ore sources in Canada, and the consequent employment in Minnesota of 5,000 men by the two commercial taconite plants, I feel sure that ordinary prudence and commonsense of the people of Minnesota will lead to a successful future for the expansion of the taconite industry in this State, rather than all of the future industry going elsewhere.

Similarly, as to the intermediate and so-called direct shipping ores, there are great opportunities in this State for development of the large reserves of this type of material. In order, however, to bring up to a competitive grade, it will be necessary to beneficiate a very large percentage of the presently so-called direct shipping and intermediate-grade ores. Even now there is little, if any, ore which can be shipped without some type of treating, including one or more of the processes of sizing, beneficiating, agglomerating, such as pelletizing, briquetting or compacting by some other method. The treating plants to process the raw materials available in Minnesota will require large additional investments.

With the great potential for the production of competitive furnace feed in this State from the presently called direct shipping and intermediate ores, we would certainly hope that Minnesota would profit by its experience in the taconite industry and revise the tax laws applying to all iron ore mining so that the future of the industry in the State can be assured.

It seems apparent that two things must happen to encourage further large-scale iron ore development in this State, and I would hope that they will, when the situation is properly understood. One is the change in the tax laws, including valuation equalization in the administration of these laws, and the second a drastic cut in the present operating expenses of the mining communities. In connection with this, it will be necessary for the nominating industries and the local population to start to pay their fair share of the tax load. The resultant increased tax load on other than mining property will develop in any event and it would be better for the State and the local communities to face up to it now and save the iron mining industry for this State, with the consequent employment, rather than lose the industry and the employment and then be required to bear the entire taxload without the traditional iron mining industry.

If Minnesota really wants a healthy and expanding mining industry—if it wants an industry which will not bear the first brunt of every reduction in iron ore demands—if it wants an iron ore industry which will employ more, rather than fewer and fewer men—then that desire must be shown by changes in the Minnesota tax picture.

The occupation tax should be reduced to the level of taxes imposed against other industries by reduction in rates and allowance of all costs as deductions. The royalty tax should be repealed. The people who receive royalties pay income tax on such receipts. The royalty tax is clearly a separate and additional surcharge on the mining industry. The classification of mineral reserves for property tax purposes should be no higher than the classification of other industrial property in Minnesota. Also, by law, it should be required that all property in any given taxing district be valued for tax purposes at the same ratio of full and true value.

In most communities comparable in size to Iron Range communities, municipalities and schools are principally supported by taxes on local business and homes. In these areas the taxpayers, who are also voters, are vigilant in watching public expenditures. Very few communities have the advantage of natural resources to share their tax burden. Even with full tax equalization, the mining companies would continue to pay the major portion of the cost of government on the Iron Range. If Faribault, Albert Lea, Crookston, Brainerd, and all the other fine communities of this State can furnish good local government and good

education with a tax load 25 to 50 percent less than Iron Range communities now are levying, the Iron Range can do it too—if it wants to. A willingness to permit fair and equal tax assessment by the people of the Iron Range would probably be a greater incentive to economic development than any other single factor could be.

The principal effort our company has made toward the attraction of new investment to Minnesota has been in the area of taconite development. We have been encouraged and assisted by the special taconite tax laws. Without these special laws, Erie's great taconite plant would not have been built. There is no doubt, however, that new investments in taconite would be further encouraged and, in some cases, made possible by a constitutional amendment which would limit occupation and royalty taxes paid by taconite companies to an amount no greater than income taxes paid by other industries. The State of Minnesota should not pass by this opportunity to furnish a greater incentive for the construction of large taconite facilities.

I think all of us in the iron mining industry feel a close bond with the people of Minnesota that we have known so well for so many years. We are working as never before to keep the operations we have here and to bring new developments here, if possible. We would like to be able to sell Minnesota on the grounds that in Minnesota we are treated like other industries and like other citizens. We would like to say that we are taxed fairly, equally, and impartially—that we will pay only our share of governmental costs. Unfortunately we cannot in good conscience make these statements about the natural ore mines of Minnesota until the people of the State of Minnesota make the changes in tax policies that are so obviously needed to attract new investments here.

It would be unfortunate indeed, for all of us, if the facts regarding the importance of proper tax treatment of the iron ore mining industry are not appreciated and appropriate legislation and administration adopted. If not, this would truly be to the iron ore industry in Minnesota "Death by taxes."

U.S. SENATE,
July 18, 1961.

HON. JOHN A. CARROLL,
*Chairman, Minerals, Materials, and Fuels Subcommittee,
Interior and Insular Affairs Committee,
U.S. Senate, Washington, D.C.*

DEAR MR. CHAIRMAN: Within the past few days the enclosed report of the factfinding committee on the problems of the iron mining industry on the Gogebic Iron Range has been brought to my attention.

Because of the extremely useful information and detailed study which this committee undertook, I would hope it could be made part of the record of the hearings of your subcommittee's study of the iron mining industry in the upper Great Lakes area.

Thank you again for all the cooperation you have shown on this project. With every best wish.

Sincerely,

PHIL HART.

REPORT OF FACTFINDING COMMITTEE APPOINTED TO INVESTIGATE AND REPORT ON
THE IRON MINING INDUSTRY ON THE GOGEBIC IRON RANGE, GOGEBIC COUNTY,
MICH., AND IRON COUNTY, WIS., JUNE 1961

JULY 8, 1961.

MR. ROY AHONEN,
*Chairman of the Steering Committee, Gogebic Range Mining Industry Study
Commission, Ironwood, Mich.*

DEAR SIR: The factfinding committee which was appointed by your group on April 11, 1961, has now completed its work and presents herewith a report on its findings.

For the record, the appointment of this group is the outgrowth of warnings sounded over the past few years by the producers and others that the deep-shaft mining industry on the Gogebic Range is threatened with extinction because of rising costs of production and declining demand for its product. The factfinding committee was given the responsibility of determining in essence whether the

mining companies were crying "wolf" or whether the mining industry on the Gogebic Range is actually being priced out of the market. The factfinding committee was also instructed by the steering committee to determine and report on the facts and not to submit conclusions or recommendations.

The committee agreed that its approach to the problem should be that of costs and values as outlined in the annual bulletins of the Michigan Department of Conservation entitled "General statistics covering costs and production of Michigan iron mines." The Wisconsin mines submitted their costs in conformance with the Michigan outline.

The committee met and conferred with all parties concerned with the problem, as listed elsewhere in this report, and received complete cooperation from all of them. None of the information requested by the committee was denied it. On the contrary, confidential contractual terms were disclosed by the fee owners, and cost information, books, records, audit reports, and tax returns were furnished by the mining companies. Based on a study of the voluminous data thus assembled and conferences with numerous persons connected with the situation, the committee wishes to report as findings of fact the following:

1. The Gogebic Range mining industry is caught in a pincers of rising production costs on the one hand and declining value of raw ore on the other. The margin between cost and value has for some time been insufficient to either attract new capital investments or to hold the continued interest of capital already committed.

2. Unless cost reductions can be effected of approximately \$1.50 to \$2 per ton, the deep-shaft mining industry on the Gogebic Range appears prematurely doomed.

3. There is a substantial supply of known and prospective reserves, and if the necessary cost reductions could be accomplished, the present mining operations could have a life expectancy of many years.

4. Even if the cost reductions as above stated were accomplished, the mine operators and owners can give no assurance of continued operation of the mines.

5. The principal areas within which cost reductions can be accomplished are local property taxes, royalties, transportation, certain supplies, labor costs, and management costs.

6. Some reductions have already been accomplished in all of these areas. Further reductions are possible in all of these areas. However, none of the areas enumerated in (5) above can effect the necessary reduction alone. Unless there is a willingness on the part of all the interested parties to make their fair share of contribution, there is little hope for a solution to the problem.

7. Assurances have been received from management, owners, fee holders, transportation, and power that they can and will make further concessions, provided all parties will yield to some extent.

8. In the area of property taxes, Iron County, Wis. and the cities of Hurley and Ironwood have already recognized the need and have made a substantial effort toward reducing tax costs. It remains for the other taxing units in Gogebic County to make their contribution.

9. Because the nature of underground mining is such that labor, both salary and wage, is a major item of expense, it follows that reductions must come from this area also. Even if all the other costs were drastically reduced, they would not add up to an amount sufficient to insure an adequate margin between the cost and value of a ton of Gogebic Range ore. The labor cost reduction is a problem which only labor and management working together as partners, in mutual trust and respect, can solve.

The committee feels that its intimate knowledge of all the facets of this problem, and deep impression of the gravity and urgency of the situation, dictates that there needs to be a meeting between the officials of organized labor and the executive officers of each mining company on the Gogebic Range, who will bring their combined talents to bear toward a fair solution of the problem.

In the following pages of this report, the basis for the above findings of fact are set forth in substantial detail.

Respectfully submitted.

RAY LUTWITZI, *Chairman.*
 Rev. E. M. KETCHAM, *Hurley.*
 CHARLES SANTINI, *Ironwood.*
 E. J. OAS, *Bessemer.*
 V. LEPISTO, *Wakefield.*

INDIVIDUALS, FIRMS, AND ORGANIZATIONS CONSULTED BY THE COMMITTEE

Pickands Mather & Co.:

Duluth office:

Everett Joppa, general manager.
Joseph Abdnor, counsel.
E. A. Anundsen, industrial relations.
W. E. Seppanen, assistant manager.
Thomas Manthey, counsel.

Cleveland office:

John Sherwin, president.
W. Howard Prescott, vice president, mining.
William Hamilton, assistant tax counsel.
Ray Hiscox, controller.
Paul Free, accountant.

North Range Mining Co.:

Robert Archibald, executive vice president.
J. M. Archibald, director of personnel.
John C. Kirkpatrick, manager of operations.
Joseph Zuraw, superintendent, Penokee mine.

Oglebay, Norton & Co.:

W. D. Hamilton, vice president, mining.
J. J. Dwyer, vice president, general counsel.
Dan Young, superintendent, Montreal mine.
Robert Holgers, assistant superintendent, Montreal mine.

United Steelworkers of America:

Peter J. Bensoni, international staff representative.
Bernard Krause, president, Cary Local.
Joseph Soltis, president, Mauthe Local.
Percy Treloar, president, Penokee Local.

Chicago & North Western Railway Co.: Ben Heineman, chairman.

Interlake Iron Corp.: Thaddeus F. Bell, president.

Newport Land Co., Ironwood Mines Corp., and Keweenaw Land Association, Ltd.:

Frederick L. Heinrich, secretary.

Gunnar Lorensen, local agent.

Longyear Realty Corp.: William Todd, agent.

Lake Superior District Power Co.:

G. A. Donald, chairman.

M. E. Juhl, president.

Michigan State Tax Commission:

Robert Eckhardt, chairman.

Ben Goldman, member.

Michigan Department of Conservation: Harry J. Hardenberg, Geological Survey Division.

GENERAL COMMENTARY REGARDING OVERALL PROBLEM

Since before the turn of the century and until comparatively recently, the Gogebic Range, along with the rest of the Lake Superior district, has enjoyed a preeminent position in the iron ore mining business, amounting to a virtual monopoly. Now in a relatively short space of time all of this has changed. Many of us residing here have seen mine after mine close up and several operators including Oliver Iron Mining Co., Republic Steel Corp., Jones & Laughlin, Hanna Iron Co., Castile Mining Co. pull out of the area completely. In 1920, almost 8 million tons of ore were shipped from Gogebic County alone and last year, in 1960, the amount was less than 2 million. Although statistics for Iron County are not readily available, a similar decline has taken place there. As of June 15 this year, there were less than 1,000 persons employed in our mines on the Gogebic Range and this is, perhaps, an all-time low. That we are faced with the most serious economic crisis in the history of the Gogebic Range, no thinking person can deny. If the unfavorable trend of the past several years cannot be arrested and turned upward, the future presents a dreary picture indeed. The combined populations of Gogebic and Iron Counties have declined almost 10 percent in the last decade, from 35,767 in 1950 to 32,200 in 1960. This decline in population, which is the reverse of national and most State trends, is almost directly attributable to the lack of employment opportunities. Assuming

that many of us are not happy with this situation, which should be borne out by the fact that this committee was established, and the general interest in its work and progress which has been indicated, there naturally follow these two questions:

A. What factors have created this situation?

B. What can be done about it?

In seeking the answer to the first question, the committee has concluded that the primary reasons are these, not necessarily in the order indicated:

1. The competition from foreign ores, taconite, jasper, and other newly discovered domestic sources.

2. The changes in ore quality requirements.

3. Rising costs of production of Lake Superior underground mines.

In respect to outside competition, the committee found that 15 years ago the United States exported more iron ore than it imported, while in 1957, 26 percent of the ore consumed in this country was imported, and by 1965, it is estimated that imports, taconites and jasper ores will account for close to 60 percent of total U.S. ore consumption. While the ratio of imports to consumption has risen from 0.4 percent in 1943 to 26 percent in 1957, it must be remembered that at the same time consumption in the United States has risen from 100,457,000 tons in 1943 to 129,375,000 tons in 1957. Other statistics which shed further light on the problem are these:

In 1959, direct shipping ores produced in the United States amounted to only 28,294,000 tons as compared to 63,250,000 tons in 1955. During the same period, the production of concentrates or beneficiated ores declined from 20,656,000 tons to 11,515,000 tons. While this was taking place, the production of agglomerates, which are the taconite and jasper pellets, increased from 7,115,000 tons in 1955 to 13,240,000 tons in 1959. In fact, in 1958 the shipment of taconite pellets from just two plants, the Erie Mining Co. and the Reserve Mining Co. in Minnesota, amounted to more than $7\frac{1}{2}$ million tons which rivals the annual production of the entire Gogebic Range at any time in its history. These taconite pellets, it must also be remembered, have a natural iron content of well in excess of 60 percent, as compared to something a little more than 52 percent for the Gogebic Range iron ores.

In considering further the question of the competition from importation of foreign ores, the committee found that neither the steelworkers union nor capital interests felt that imported ores were taking away the normal markets for Lake Superior ores. The following is a quote from the U.S. Tariff Commission report "Iron Ore", Washington, December 1960, Joseph E. Talbot, Chairman. "On the basis of this investigation, including the hearing, the Tariff Commission finds that iron ore, including manganiferous iron ore * * * is not being imported in such increased quantities, either actual or relative, as to cause or threaten serious injury to the domestic industry producing like or directly competitive products." Elsewhere the report reads: "The United Steelworkers of America which, according to their representative, Mr. Meyer Bernstein, represents practically all of the iron ore miners in all of the significant iron-mining areas in the United States, oppose any import restrictions, tariffs, or quotas on iron ore imports. On the contrary, both Mr. Johnstone (representing the American Iron & Steel Institute) and Mr. Bernstein indicated that imposition of import restrictions would have injurious effects."

While the findings stated in the previous paragraph may apply to the Nation as a whole, your committee feels that they do not apply to the Gogebic Range.

The committee next sought to answer this question: "Where are the former consumers of Gogebic Range production buying their ore?" The committee finds that the consumers formerly using Gogebic Range ores are turning in part to other domestic sources and imports which offer improved ores with higher iron contents and lower impurities at a price that is in effect lower than the costs of producing Gogebic Range ore. Everyone must be aware from reading their daily papers that as the production of taconite increases, underground mines are closed. We are competing against other sources of iron ore, including communities in the United States, that are evidently more anxious to take over our markets than we are to hold them.

A second reason for the decline in the competitive value of Gogebic Range iron ores is that in recent years new standards of quality have been established.

For many years Gogebic Range ores were considered premium ores in the industry. Many residents on the Gogebic Range are of the opinion that this is still true. Nothing could be further from the truth. The important elements

affecting the value of iron ore are the amount of natural iron and the amount of the principal impurity, silica. Excessive amounts of silica in ores require more limestone and more fuel and reduce the efficiency of the blast furnaces. Today an iron ore is considered unsatisfactory if the ratio of iron to silica is less than 7 to 1. In 1957 the Gogebic Range shipped 4,366,018 tons of ore which averaged 52.87 percent natural iron, and 8.05 percent natural silica, making a 6.57 ratio of iron to silica. During the same period foreign ore imports of over 33½ million tons averaged from 52.71 to 72 percent natural iron with a silica content ranging from zero to 6.61 percent, and a ratio of iron to silica as high as 144 to 1. Taconite pellet shipments in 1958 averaged 61.08 percent iron, 7.90 percent silica, and a ratio of 7.73 iron to silica, and this product is being continually upgraded and improved in quality. For example, Erie Mining Co. increased its shipments from 2,673,678 tons in 1958 to 5,574,081 tons in 1960, increased the iron content from 60.84 to 61.58, reduced the silica content from 8.60 to 8.44, with a resulting improvement in the ratio of iron to silica from 7.07 to 7.30. These advances in quality control are not possible in the underground mines.

There has been an increasing demand of blast furnace operators for ores of higher quality which is evidenced by the fact that the average iron content of usable ore produced in the United States has increased from 49.4 percent in 1950 to more than 53 percent in 1959. The influence of imported ores which have an iron content ranging up to 72 percent, and the availability of taconite pellets with an iron content in excess of 61 percent has been the primary influence in the increased demand for ores of higher quality. Because of the fact that steel mills by using better ores can secure increased production from their present facilities with little capital investment in new plants, it appears almost certain that there will be in the future an increasing demand for higher quality ores with a corresponding decrease in the demand for ores of the type produced on the Gogebic Range.

A question frequently asked locally is, "What can be done about improving the quality of Gogebic underground ores?"

Present technology, we have been informed by an independent source, affords only limited means of economically improving the quality of our ore. Because the nonore or poor-ore fraction of the material mined tends to break in larger pieces, it is possible to improve the iron content of the shipping product by screening off and discarding the larger fraction. This presents a problem, however, in that most of the ore is wet and sticky and does not lend itself to screening by conventional methods. This can be overcome by drying the ore.

Screening in itself is costly not just because of the cost of equipment and cost of operation, but also because of the loss of a portion of the tonnage of ore mined and hoisted. This can be up to 10 or 15 percent of the mine hoist, and even higher depending upon the size to which the ore is screened. And each ton of material discarded carries the same cost of mining as those tons finally shipped.

Drying before screening will mean added costs both by way of capital investment and operation. There is also a loss in this operation which is not commonly appreciated. This is the loss in tonnage due to the driving off of moisture. Therefore, although the dried product contains a greater percentage of iron, there are actually fewer tons.

The Gogebic mine product could undoubtedly be improved by sintering. However, we understand that this costs \$2 to \$2.50 per ton. Further we understand that sinter is not the best shipping product, being subject to breakage. Processes involving fine grinding such as are used in the low-grade plants are to the best of our knowledge not applicable to the Gogebic soft ores because of the large amount of slimes which would be created.

A third reason why the underground mines of the Lake Superior district are losing their competitive position in the production of iron ore is the constantly increasing rise in costs of production.

The figures in the following table have been taken from the bulletin "General Statistics Covering Costs and Production of Michigan Iron Mines," prepared by the department of conservation, and show the per-ton statistics for the mines in Gogebic County. Total direct ore costs in the table include labor, supplies, deferred costs, taxes except income taxes, general overhead, transportation, and marketing. These are the allowable costs for computing the value of a mine for property tax purposes. Royalty is separately stated because it is not an allowable cost in mine valuation.

Year	Total direct ore costs	Royalty	Total costs	Lake Erie value	Tons mined	Tons shipped
1951.....	7. 5756	0. 6107	8. 1863	8. 8145	3, 033, 439	3, 318, 519
1952.....	8. 5793	. 6028	9. 1821	9. 6172	2, 784, 076	3, 003, 861
1953.....	8. 5897	. 5947	9. 1844	10. 2300	3, 237, 779	3, 188, 352
1954.....	9. 3437	. 5673	9. 9110	10. 2887	2, 287, 476	2, 377, 743
1955.....	8. 7034	. 5622	9. 2656	10. 4468	2, 889, 620	3, 182, 532
1956.....	9. 9134	. 7081	10. 6215	11. 4131	2, 999, 084	2, 958, 076
1957.....	10. 4311	. 6923	11. 1234	12. 1802	2, 711, 852	2, 837, 407
1958.....	12. 4715	. 6992	13. 1707	12. 2526	1, 417, 830	1, 393, 528
1959.....	12. 2928	. 6542	12. 9470	12. 2018	1, 642, 126	1, 250, 786
1960.....	10. 9900	. 4874	11. 4774	12. 3222	2, 168, 684	1, 889, 986

It will be noted from an examination of the above table that costs increased almost without interruption each year during the last decade. The notable exception is the year 1960, when total costs dropped almost \$1.50 per ton from the previous year. A contributing factor to this improvement was the increased production of almost half a million tons over 1959. This, together with concessions made by the railroads, fee owners, and taxing authorities resulted in the following decreases per ton:

Labor.....	\$0. 3381
Supplies.....	. 0387
Deferred costs.....	. 0456
Taxes.....	. 2901
General overhead.....	. 1324
Transportation.....	. 4447
Marketing.....	. 0132
Royalties.....	. 1668
Total.....	1. 4696

While there was a steady increase in costs during the 10-year period shown above, there was also a similar increase in the Lake Erie value. However, at no time was there a substantial excess of Lake Erie value over costs, and in 2 years, 1958 and 1959, total costs exceeded value. In this connection, it should be pointed out that the costs as tabulated by the appraiser of mines do not necessarily represent all the costs of mining, and the Lake Erie value does not necessarily represent the sales value of the ore. The foregoing statement requires some clarification.

Approximately 80 percent of the iron ore produced in the United States is produced by captive mines—that is, mines owned by the consumers, usually the steel companies, and only 20 percent of the domestic iron ore output is produced by independent concerns that sell ore on the open market. On the Gogebic Range, the Penokee mine and the Montreal mine are independents while all other mines are captive. To determine the profit for an independent mine is an easy matter as the actual selling price of the ore is known. However, the ore produced by the captive mines is not sold ordinarily but is usually consumed by the owners or trade for other ores. Its operations, therefore, must be gaged by assigning a value to the ore, and this is done by reference to the published Lake Erie price. These prices are set by the independent sellers at the beginning of each shipping season and are a yardstick for measuring iron ore values. There have been no changes in the published Lake Erie prices since January 1957, and the price for Gogebic Range ores, which is classed as old range non-bessemer ore containing 51.50 percent natural iron, delivered at rail of vessel at lower lake ports, is \$11.70 per long ton, or 22.718 cents per iron unit. Iron ore is seldom if ever sold at the quoted Lake Erie price, as price adjustments are made for iron content, phosphorus content, chemical and physical characteristics, etc.

The Lake Erie values shown in the foregoing table are the computed Lake Erie prices and do not take into account the discount at which the independent producers sold their product in recent years or the discount the captive mines would be forced to take if their ores were offered on the open market.

The composite statistics shown on the foregoing table have been taken from published reports, as previously stated. However, the committee has been submitted confidential information in detail by all the mining companies involved,

in respect to costs and sales values of ore, and has verified this information to its complete satisfaction. On the basis of this verification the committee can state without reservation that on the average the cost figures on the table are representative of the operations of all Gogebic Range mines, and that the Lake Erie values shown thereon are in excess of the actual selling price of the ore sold.

The obvious conclusion to be drawn from the foregoing, therefore, must be that, on the average, the profit margin during the past several years has been negligible or nonexistent.

Can the Gogebic Range mining industry be saved?

Despite all of the gloomy statements heretofore made, all of the entries are not on the debit side of the ledger. There are many factors on the credit side as well, such as:

1. The actual population growth of the immediate past and the projected population growth of the immediate future, and the fact that the center of population in the United States is now just south of Chicago, which is second only to New York City as a major trading area.

2. The close proximity of the Gogebic Range to this area, and the possibility of year-round all-rail shipments of iron ore in the future.

3. The availability of substantial reserves of direct shipping ores on the Gogebic Range, and the possibility of producing as much as 350 million tons of high-grade concentrates on the western end of the range in Wisconsin.

4. The apparent unrelenting spread of areas of unrest in the world and the influence of the cold war which makes iron ore located close to the steel centers of our country more attractive in comparison with Venezuelan and Liberian ores.

We cannot, of course, peer into the future and tell what is in store for us. The present crisis we are facing is acute and needs immediate attention, however, and it is entirely possible that a short period of minor sacrifice will insure our community a prosperous industry for many years to come. The committee has given a great deal of its time and effort to the study of this problem and the drafting of this report. This has been done gratuitously and with a sincere desire to make a contribution to the community which means so much to us. We hope our work will help point the way to a solution of what we are unanimously agreed is a serious problem requiring the unselfish and concerted effort of all the folk on the Gogebic Range, who can easily solve the problem if they have the will to do so.

TAXES

Tax findings are confined to Gogebic County because there are no protests by the mining companies in regard to tax loads in Wisconsin.

To make Gogebic Range ores competitive, mining companies assert that there must be a cost reduction of at least \$1.50 per ton. This is 13.07 percent of total reported costs of \$11.4774 per ton for the year 1960 for Gogebic County mines. General property taxes in 1960 amounted to \$0.4537 per ton or 3.95 percent of total reported costs per ton. The tax levy on mining in the six mining communities in 1960 was \$200,728 less than in 1959. Had 44 percent of the Wilkins appraisals been used in all units as proposed by the mining companies, there would have been a further reduction of \$212,177 in general property taxes on mining. This would have amounted to a contribution of 11.2263 cents per ton toward the reduction of at least \$1.50 per ton which the mining companies state is necessary to warrant continued operation.

Aside from cutting costs of government, taxes on mines are reduced whenever the ratio between the local assessed valuations on mining property as compared with nonmining property is changed in favor of mining. This brings up the matter of assessments.

Section 12 of article XIV of the Michigan constitution states that "property shall be assessed at its cash value." In the case of nonmining property, assessments can be checked by making comparisons with sales of property. Sales of mines, however, are rare and some other method must be resorted to in order to determine the value of this type of property. Michigan uses the Finlay system, an adaptation of the Hoskold method. It may be briefly described as a capitalization of a profit factor.

In 1957 an advisory group composed of Dr. F. S. Turneure, professor of geology, University of Michigan; Dr. Bennett T. Sandefur, professor of geology, Michigan State University; and Prof. Walfrid Been, head, Department of Mining Engineering, Michigan College of Mining and Technology, made an exhaus-

tive study of the methods being followed by the State mine appraiser in the valuations of Michigan mines, and concluded that "the present practice is in accord with accepted principles of valuation."

The following is an example of the method used in determining the valuation of a mine for tax purposes:

Present value table: 6 percent is allowed for return of capital and 6 percent for return on investment

[Based on \$1 profit]

Year	Value	Year	Value	Year	Value
1 -----	0. 94340	9 -----	6. 80169	17 -----	10. 4773
2 -----	1. 83339	10 -----	7. 36009	18 -----	10. 8276
3 -----	2. 67301	11 -----	7. 88687	19 -----	11. 1581
4 -----	3. 46511	12 -----	8. 38384	20 -----	11. 4699
5 -----	4. 21236	13 -----	8. 85268	25 -----	12. 7834
6 -----	4. 91732	14 -----	9. 29498	30 -----	13. 7648
7 -----	5. 58238	15 -----	9. 71225		
8 -----	6. 20979	16 -----	10. 1059		

Reserve tonnage: 3,000,000 tons.

Average production per year: 500,000 tons.

Life of mine: 6 years.

Average profit per ton: \$1.

Present worth \$1 profit per ton for 6 years (\$6 according to table: \$4.91732.

Average production times profit per ton times present worth as per table equals value of mine: 500,000 multiplied by $1 \times 4.91732 = \$2,458,660$.

Discount is granted for hazards such as sand, water, or caving ground. Assume that the appraiser grants a discount of 10 percent for one of the above factors:

Value of mine-----	\$2, 458, 660
Discount of 10 percent-----	245, 866

Recommended value of mine-----	2, 212, 794
--------------------------------	-------------

The recommended value of the mine must be sent to the local tax officials not later than February 15. The local board of review may entertain a protest from the mining company. The final decision of the board of review becomes the local assessed valuation of the mine. If the mining company is dissatisfied they may appeal to the State tax commission. This body then determines the final valuation of the mine. There is no appeal from the decision of the State tax commission. Its figure supersedes that of the board of review and is entered as the local assessed valuation.

A question frequently asked by folk in Gogebic County is the following: Why is a mine on which approximately \$18 million has been spent in exploration and development, the sinking of a shaft, the erection of buildings, and installation of machinery and equipment, valued in the neighborhood of only \$3 million? How can mining companies contend that their properties are being assessed at 100 percent of their value when it is apparent to everybody that the appraiser's figure is only one-sixth of the original cost of preparing the mine for operation? The answer is that the mine value is a capitalization of the profit factor and not the original cost of the enterprise. The principal justification for this method of valuing a mine is that a mining property is a diminishing asset. When the mine has been depleted, the owner should have recovered his capital plus interest on his investment. If provision is not made for the owner to make such recoveries, chances are that he would not have risked the investment in the first place.

It can be contended that nonmining property is also a wasting asset when looked at from a business or investment standpoint because as mines decline, the value of a rental property declines proportionately. However, capitalization of a profit factor does not happen to be the law when it comes to assessing

nonmining property. Some cognizance of relative values of nonmining property is taken by the State tax commission. Their appraisers apply an economic factor to their valuations to compensate for differences in economic activity as between areas or communities.

A general impression seems to prevail that assessors have compensated for the two different bases for determining the values of mining and nonmining property by paralleling their appraisals of nonmining property with those made by the State geologist for mining, thus maintaining a more or less constant ratio between mining and nonmining. This is not strictly true.

From 1932 to 1950, mining valuation in Gogebic County declined at a greater rate than nonmining, mining dropping from \$32,001,000 to \$15,735,000, while nonmining went from \$18,418,348 down to \$14,579,340. In 1952 there was a reversal of the trend, mining values being increased \$2,497,000 while nonmining was increased only \$21,220. Since 1952 mining valuations have declined from \$19,030,000 down to \$12,940,000 in 1960 while nonmining has increased from \$15,132,160 to \$17,784,228 in 1959, and thence to \$25,020,695 in 1960. The large increase in nonmining property values from 1959 to 1960 of approximately \$7 million is due primarily to Ironwood's use of 44 percent of the Wilkins figures. Below is a table showing the contrast between valuations in 1932 and 1960 for Gogebic County as a whole.

Local assessed valuations, Gogebic County, 1932 and 1960

Year	Local assessed value, mining	Local assessed value, nonmining	Percent mining	Percent nonmining
1932.....	\$32,001,000	\$18,418,348	63.5	36.5
1960.....	12,940,600	25,020,695	34.1	65.9

Tables 1 to 5 appended hereto show relations between local assessed valuations of mining and nonmining property for the years 1959, 1960, and 1961. The townships of Ironwood, Wakefield, and Watersmeet are not included in this study, because they have no mines and because the mining companies are apparently satisfied with the share of the county tax load borne by these three political units. The latter comes about because 44 percent of the Wilkins appraisal for nonmining plus the State appraiser's value for mining were used in arriving at the county equalized valuation of each political unit in Gogebic County.

TABLE 1.—Mining valuations, Gogebic Range, Mich., 1959 and 1960

Political unit	1959 valuations	Change	1960 recommended valuations	1960 second reductions	1960 final valuation
Bessemer.....	\$2,820,000	—\$230,000	\$2,590,000	\$321,000	\$2,269,000
Bessemer township.....	5,508,000	—253,000	5,255,000	790,500	4,464,500
Erwin township.....	1,990,000	—190,000	1,800,000	277,000	1,523,000
Ironwood.....	3,242,000	—637,000	2,605,000	-----	2,605,000
Marenisco.....	40,000	—10,000	30,000	-----	30,000
Wakefield.....	2,260,800	+132,500	2,393,200	344,100	2,049,100
Total.....	15,860,700	—1,187,500	14,673,200	1,732,600	12,940,600
Recommended reduction, 1960.....					\$1,187,700
Second reduction, 1960.....					1,732,600
Total reduction, 1960.....					2,920,300

Second reductions were made as a result of appeals made by mining companies, these appeals being taken because units affected did not use 44 percent of the Wilkins appraisal in arriving at their local assessed nonmining valuations.

TABLE 2.—*Mining valuations, Gogebic Range, Mich., 1960 and 1961*
(1961 valuations as of Apr. 20, 1961)

Political unit	1960 final valuation	Change	1961 recommended valuations	Reduction	1961 valuation
Bessemer.....	\$2,269,000	+\$311,000	\$2,580,000	-----	\$2,580,000
Bessemer Township.....	4,464,500	-44,500	4,420,000	-----	4,420,000
Erwin Township.....	1,523,000	+137,000	1,660,000	-----	1,660,000
Ironwood.....	2,605,000	-480,000	2,125,000	¹ \$150,000	1,975,000
Marenisco.....	30,000	-----	30,000	-----	30,000
Wakefield.....	2,049,100	-61,600	1,987,500	-----	1,987,500
Total.....	12,940,600	-138,100	12,802,500	150,000	12,652,500

¹ Voluntary reduction made by Ironwood Board of Review:

Recommended reduction, 1960..... \$138,100

Reduction by Ironwood Board of Review..... 150,000

Total reduction as of Apr. 20, 1961..... 288,100

TABLE 3.—*Mining and nonmining valuations, Gogebic Range, Mich., 1959*

Political unit	1959 local assessed valuation	1959 mining	1959 nonmining	1959 mining	1959 nonmining
				Percent	Percent
Bessemer.....	\$4,194,250	\$2,820,000	\$1,374,250	67.2349	32.7651
Bessemer Township.....	6,235,299	5,508,000	727,299	88.3358	11.6642
Erwin Township.....	2,146,250	1,990,000	156,250	92.7199	7.2801
Ironwood.....	11,220,100	3,242,000	7,978,100	28.8946	71.1054
Marenisco.....	1,347,135	40,000	1,307,135	2.9693	97.0307
Wakefield.....	3,343,750	2,260,700	1,083,050	67.6097	32.3903

TABLE 4.—*1960 mining and nonmining valuations, Gogebic Range, Mich., 1960*

Political unit	1960 local assessed valuation	1960 mining	1960 non-mining	1960 mining	1960 non-mining
				Percent	Percent
Bessemer.....	\$3,959,850	\$2,269,000	\$1,690,850	57.3001	42.6999
Bessemer Township.....	5,300,449	4,464,500	835,949	84.2287	15.7713
Erwin Township.....	1,782,075	1,523,000	259,075	85.4622	14.5378
Ironwood.....	17,422,300	2,605,000	14,817,300	14.9522	85.0478
Marenisco.....	1,344,450	30,000	1,314,450	2.2314	97.7686
Wakefield.....	3,134,535	2,049,100	1,085,435	65.3718	34.6282

TABLE 5.—*Mining and nonmining valuations, Apr. 20, 1961*

Political unit	1961 local assessed valuation	1961 recommended mining	1961 non-mining	1961 mining	1961 non-mining
				Percent	Percent
Bessemer.....	4,231,275	2,580,000	1,651,275	60.9745	39.0255
Bessemer Township.....	5,254,678	4,420,000	834,678	84.1155	15.8845
Erwin Township.....	1,894,825	1,660,000	234,825	87.6070	12.3930
Ironwood.....	15,904,200	1,925,000	13,979,200	12.1037	87.8963
Marenisco.....	1,356,175	30,000	1,326,175	2.2121	97.7879
Wakefield.....	3,023,840	1,987,500	1,036,340	65.7277	34.2723

Mining companies have used the following methods in seeking reductions in taxes:

1. Dissemination of information regarding the plight of the underground mines in the hope that political units concerned would voluntarily make the adjustments desired.

2. Appeal to the local board of review for a reduction in valuation. The North Range Co. appealed to the Ironwood Board of Review this year and secured a reduction of \$150,000 (see table 2).

3. Appeal to the State tax commission for reduction in mine valuations because the mining companies feel that the mines are appraised or assessed at too high a figure or because they feel that the local assessor has assessed nonmining property at too low a figure and compensation is needed in the form of reduction in mine values.

In 1960, mining companies protested valuation placed on their properties in Bessemer, Bessemer Township, Erwin Township, and Wakefield because these communities did not use 44 percent of the Wilkins appraisal in assessing nonmining property. As a result of this protest mining valuations were reduced \$1,732,000 (see table 1). (The proper method to settle a dispute of this type is to raise nonmining valuations, not lower mining valuations. However, that entails revaluing each individual description, so the tax commission chose the more practical "back door" approach to achieve the same goal—change in the relative values of mining and nonmining property. However, use of this practical method lowers the overall valuation and necessitates an increase in millage to produce the tax levy. Tables 8 and 9 appended hereto show increases in local assessed valuations that would have produced the same distributions of tax levies as were produced by lowering mine valuations. These increases amount to about 3 percent of the Wilkins figures.)

4. Secured appraisal of nonmining property by making a contribution of \$84,500 for this purpose. The appraisal was made by the Wilkins Co. Pressure to use 44 percent of the Wilkins figures in 1960 assessments caused considerable irritation because time was not afforded to make adjustments occasioned by errors in the appraisal. Ironwood was the only political unit which used 44 percent of the Wilkins appraisal.

The State tax commission was asked by this committee about the reliability of the Wilkins appraisal. They stated that there was a high degree of correlation between the Wilkins figures and spot check appraisals made by their own men.

Tables 10 through 14 show what would have been the effect on valuations and tax levies in 1960 had 44 percent of the Wilkins been used in the six mining communities in Gogebic County. Recommended mining valuations and not final valuations are used in these tables because apparently there would have been no protests on the part of mining companies if 44 percent of the Wilkins figures had been used. Note that Ironwood, Wakefield, and Watersmeet Townships are omitted from these tables because of reasons previously stated in this report.

The percentages in table 10 mean that: If a parcel of real estate had been appraised at \$10,000 by the Wilkins firm in each of the taxing districts of Gogebic County, it would be placed on the tax assessment rolls at the following values:

Ironwood	\$4,400
Marenisco	2,262
Bessemer	1,976
Bessemer Township	1,709
Erwin Township	1,663
Wakefield	1,554

The second reduction in mine values made in 1960 by the State tax commission in the four mining communities which did not use 44 percent of the Wilkins appraisal for tax purposes, resulted in shifting a portion of the tax levy from mining to nonmining, in those communities, or expressed in terms of valuation, it had the effect of a small increase in the values shown above, increasing Bessemer from \$1,976 to \$2,256, Bessemer Township from \$1,709 to \$2,011, Erwin Township from \$1,663 to \$1,966, and Wakefield from \$1,554 to \$1,815.

It appears to the general impression that because the county board of supervisors had adopted the Wilkins appraisal as the basis for county equalized value, that there is no discrimination in spreading the county tax levy among the taxpayers of Gogebic County. This is only true insofar as allocating the total county tax levy among the various taxing units is concerned; it is not true in respect to spreading the county tax levy equitably within each unit. To illustrate, for the

year 1960, a parcel of real estate appraised at \$4,000 by Wilkins would have allocated to it county taxes approximately as follows:

Ironwood.....	\$21. 92
Bessemer.....	15. 81
Wakefield.....	13. 61
Bessemer Township.....	11. 49
Erwin Township.....	11. 16

House bill 161: This bill proposed to put mining property in a separate classification, to be known as metallic. The effect would have been to make the State appraiser's valuation of the mines the State equalized value, instead of the local assessed, as at present. Any increase necessary to bring the local assessed value of a political unit up to the State equalized level would then have to be borne by nonmining property. This would decrease considerably the tax load on mining property.

Tables 15-18 show the effect of House bill 161 using 1960 valuations and tax levies. Increases on nonmining taxes under House bill 161 would have been greater than the increases had 44 percent of Wilkins figures been used.

House bill 676: This bill provided for a tonnage tax on underground beneficiated iron ore. The tax would be average annual shipments of ore during previous 5-year period multiplied by 2½ percent of the value per gross ton at the mine. The city in which the beneficiation plant was located would get 40 percent of the proceeds. This bill was defeated.

TABLE 6.—*Tax levies in 1959: 6 mining communities in Gogebic County (does not include excess of roll or collection charges)*

Political unit	1959 mining	1959 nonmining	1959 total
Bessemer.....	\$259, 594	\$126, 506	\$386, 100
Bessemer Township.....	381, 007	50, 310	431, 317
Erwin Township.....	124, 611	9, 784	134, 395
Ironwood.....	294, 721	725, 265	1, 019, 986
Marenisco.....	2, 803	91, 592	94, 395
Wakefield.....	211, 694	101, 418	313, 112
Total.....	1, 274, 430	1, 104, 875	2, 379, 305
Percent of total levied against mining.....			53. 5631
Percent of total levied against nonmining.....			46. 4369

TABLE 7.—*Tax levies in 1960 (does not include excess of roll or collection charges)*

Political unit	1960 mining	1960 nonmining	1960 total
Bessemer.....	\$225, 183	\$167, 806	\$392, 989
Bessemer Township.....	350, 112	65, 557	415, 669
Erwin Township.....	103, 558	17, 616	121, 174
Ironwood.....	165, 192	939, 740	1, 104, 932
Marenisco.....	2, 297	100, 664	102, 961
Wakefield.....	227, 360	120, 435	347, 795
Total.....	1, 073, 702	1, 411, 818	2, 485, 520

1959 distribution of tax levy:

Mining (percent)..... 53. 5631

Nonmining (percent)..... 46. 4369

1960 distribution of tax levy:

Mining (percent)..... 43. 1971

Nonmining (percent)..... 56. 8029

Tax levy mining, 1959.....\$1, 274, 430

Tax levy mining, 1960.....1, 073, 702

Reduction, mining levy.....200, 728

Tax levy nonmining, 1960.....1, 411, 818

Tax levy nonmining, 1959.....1, 104, 875

Increase, nonmining levy.....306, 943

TABLE 8.—*Increase in local assessed nonmining valuation needed to compensate for 2d mining valuations in 1960*

Political unit	Nonmining valuation needed	Nonmining valuation, 1960	Increase in local assessed valuation needed to compensate for 2d reduction in mining valuation
Bessemer.....	\$1,930,061	\$1,690,850	\$239,211
Bessemer Township.....	983,965	835,949	148,016
Erwin Township.....	306,194	259,075	47,119
Ironwood.....	(1)	-----	None
Marenisco.....	(1)	-----	None
Wakefield.....	1,268,059	1,085,635	182,424

1 No reduction.

TABLE 9.—*Total local assessed valuation needed to compensate for 2d reduction in mine values in 1960*

Political unit	Recommended mine valuation	Nonmining local assessed valuation needed	Total local assessed valuation
Bessemer.....	\$2,590,000	\$1,930,061	\$4,520,061
Bessemer Township.....	5,255,000	983,965	6,238,965
Erwin Township.....	1,800,000	306,194	2,106,194
Ironwood.....	(1)	-----	None
Marenisco.....	(1)	-----	None
Wakefield.....	2,393,000	1,268,059	3,661,059

1 No 2d reduction.

TABLE 10.—*Percent Wilkins appraisal used in local assessed valuation of nonmining, 1960*

Political unit	Wilkins appraisal	Nonmining local assessed valuation	Percent
Bessemer.....	\$8,556,366	\$1,690,850	19.7613
Bessemer Township.....	4,890,755	835,949	17.0924
Erwin Township.....	33,680,220	14,817,300	43.9940
Ironwood.....	1,557,440	259,075	16.6364
Marenisco.....	5,809,164	1,314,450	22.6271
Wakefield.....	6,983,930	1,085,635	15.5447

TABLE 11.—*Increases in nonmining local assessed valuation in 1960 needed to reach 44 percent of Wilkins appraisal*

Political unit	Wilkins	44 percent Wilkins	Nonmining 1960	Increase to reach 44 percent
Bessemer.....	\$8,556,366	\$3,764,801	\$1,690,850	\$2,073,951
Bessemer Township.....	4,890,755	2,151,932	835,949	1,315,983
Erwin Township.....	1,557,440	685,273	259,075	425,198
Ironwood.....	33,680,220	14,817,300	14,817,300	None
Marenisco.....	5,809,164	2,556,032	1,314,450	1,241,582
Wakefield.....	6,983,930	3,072,926	1,085,435	1,987,491

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TABLE 12.—*Local assessed valuations in 1960 if 44 percent of Wilkins appraisal had been added to recommended mining valuations*

Political unit	44 percent Wilkins	Recommended mine valuation	Total	Percent mining	Percent nonmining
Bessemer.....	\$3, 764, 801	\$2, 590, 000	\$6, 354, 801	40. 7566	59. 2434
Bessemer Township.....	2, 151, 932	5, 255, 000	7, 406, 932	70. 9470	29. 0530
Erwin Township.....	685, 273	1, 800, 000	2, 485, 273	72. 4266	27. 5734
Ironwood.....	14, 817, 300	2, 605, 000	17, 422, 300	14. 9522	85. 0478
Marenisco.....	2, 556, 032	30, 000	2, 586, 032	1. 1601	98. 8399
Wakefield.....	3, 072, 926	2, 393, 200	5, 466, 126	43. 7824	56. 2176

TABLE 13.—*Tax levies in 1960 if 44 percent Wilkins and recommended mining valuations had been used in arriving at local assessed valuations*

Political unit	Mining	Nonmining	Total levy
Bessemer.....	\$160, 169	\$232, 820	\$392, 984
Bessemer Township.....	294, 905	120, 764	415, 669
Erwin Township.....	87, 762	33, 412	121, 174
Ironwood.....	165, 192	939, 740	1, 104, 932
Marenisco.....	1, 194	101, 766	102, 961
Wakefield.....	152, 273	195, 522	347, 795

TABLE 14.—*Increases in nonmining taxes in 1960 over what was actually levied if 44 percent of Wilkins appraisal plus recommended mining valuations had been used as local assessed valuations*

Political unit	Nonmining levy	Actual non-mining levy	Increase	Percent increase
Bessemer.....	232, 820	167, 806	65, 014	38
Bessemer Township.....	120, 764	65, 557	55, 207	84
Erwin Township.....	33, 412	17, 616	15, 796	89
Ironwood.....	939, 740	939, 740	None	None
Marenisco.....	101, 766	100, 664	1, 102	1
Wakefield.....	195, 522	120, 464	75, 058	62

TABLE 15.—*State equalized value of mining and nonmining property in 1960 if recommended mining valuations were considered to be at State equalized level (House bill 161)*

Political unit	State equalized value	State equalized value—mining	State equalized value—nonmining
Bessemer.....	\$7, 498, 957	\$2, 590, 000	\$4, 908, 957
Bessemer Township.....	8, 694, 621	5, 255, 000	3, 439, 621
Erwin Township.....	2, 922, 449	1, 800, 000	1, 122, 449
Ironwood.....	21, 731, 608	2, 605, 000	19, 126, 608
Marenisco.....	2, 976, 120	30, 000	2, 946, 120
Wakefield.....	6, 486, 304	2, 393, 200	4, 093, 104

TABLE 16.—*Recent mining and nonmining under House bill 161 based on 1960 recommended mine valuations*

Political unit	Percent mining	Percent non-mining	Political unit	Percent mining	Percent non-mining
Bessemer.....	34. 5381	654. 619	Ironwood.....	11. 9871	88. 0129
Bessemer Township.....	60. 4396	395. 604	Marenisco.....	1. 0082	98. 9918
Erwin Township.....	61. 5921	384. 079	Wakefield.....	36. 8962	63. 1038

TABLE 17.—Increases in taxes on nonmining property under House bill 161 based on 1960 figures and recommended, not final, mine valuations

Political unit	Levy under House bill 161	1960 levy	Tax increase	Percent increase
Bessemer.....	\$257,259	\$167,806	\$89,453	53.3
Bessemer Township.....	164,440	65,557	98,883	150.8
Erwin Township.....	46,540	17,616	28,924	164.1
Ironwood.....	972,483	939,740	32,743	3.5
Marenisco.....	101,923	100,664	1,259	1.25
Wakefield.....	219,472	120,464	99,008	82.1

TABLE 18.—Comparison of 1960 nonmining taxes with tax levies that would have been made had 44 percent Wilkins or House bill 161 governed (based on 1960 recommended, not final, mine valuations)

Political unit	1960 taxes	Taxes, 44 percent Wilkins	Taxes under House bill 161
Bessemer.....	167,806	232,820	257,259
Bessemer Township.....	65,557	120,764	164,440
Erwin Township.....	17,616	33,412	46,540
Ironwood.....	939,740	939,740	972,483
Marenisco.....	100,664	101,766	101,923
Wakefield.....	120,464	195,532	219,472

ROYALTIES

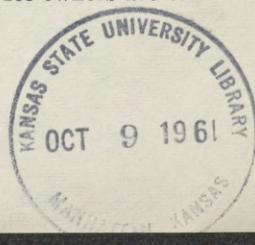
The royalties which are paid by the mining companies to the owners of mineral rights represent an important item of cost attached to mining operations. During the last 10 years, average royalties paid by all Gogebic County mines have ranged from a low of 48.74 cents per ton in 1960 to a high of 70.81 cents per ton in 1956. The amount of royalty is usually a price per ton arrived at by negotiations between the fee owner and the mining company, and varies considerably from mine to mine, depending principally on the character of the ore body. Over the past 5-year period royalty payments in some mines on the range have run as high as \$1 per ton and in others to less than 40 cents per ton. It is not possible to compare reported royalty costs between mines and the various iron ore ranges because some mining companies own the fee and therefore do not have this cost of operation.

In Gogebic County, during years of normal production such as 1957 and 1960, royalty costs per ton exceeded general property taxes per ton.

Comparison of royalty and general property taxes per ton for years 1957 and 1960

	Royalty per ton	General property taxes per ton
1957.....	0.6923	0.4896
1960.....	.4874	.4537

In the year 1957, a year of large production, our Gogebic County mines produced 2,711,852 tons of ore. Royalty costs, using the average cost of 69.23 cents per ton, amounted to \$1,877,415. In the year 1960, another normal year, Gogebic County mines produced 2,168,684 tons of ore. Royalty costs, using the average cost of 48.74 cents per ton, amounted to \$1,057,016 for that year. Your fact-finding committee would like to point out that as far as the fee owners are con-



cerned, they do not pay any general property taxes. [The owners and/or operators of the particular mines are obligated under their leases to pay general property taxes and fees are adjusted accordingly. However, if the lease on a mine is terminated, the fee owners have to pay these taxes in order to retain their mineral rights. It is also fair to point out that the fee owners do pay all other State and Federal taxes normally paid by any business enterprise, and that the royalty per ton paid to a corporate fee owner is reduced more than half by State and Federal taxes alone. Profits distributed in the form of dividends are, of course, further taxed to the recipient.

Ownership of mineral rights is a public record. Any interested person may search the records in the office of the register of deeds and determine who are the owners of mineral rights on any given description of real estate. For the convenience of the committee, all of the mining companies have voluntarily furnished information as to the owners of mineral rights on their mine properties.

It is well known in our area that Keweenaw Land Association, Ltd., Ironwood Mines Corp., Newport Land Co., and Northern Chief Iron Co. are the substantial owners of the mineral rights on the Gogebic Range. These companies and their predecessors have a long history and have had many years of experience in negotiating on matters of royalty with mineowners and operators. The committee met with officials of Keweenaw Land Association, Ltd., Ironwood Mines Corp., Newport Land Co., and Longyear Realty Corp. but were unable to effect a meeting with the Northern Chief Iron Co., Wausau, Wis., although an invitation was extended to the latter.

Keweenaw Land Association, Ltd., is a Michigan partnership association similar to a corporation and has about 235 shareholders including trusts, etc., so that it represents ownership by perhaps 400 to 500 individuals. Its shares are publicly traded over the counter. Ironwood Mines Corp., which owns most of the fee on the Penokee mine, is a wholly owned subsidiary of Keweenaw. Newport Land Co., which owns the fee on the Newport and Geneva mines, is a trust, the principal beneficiary of which is a trust for a hospital for retarded children in Providence, R.I. These three companies have a common management or agent.

Longyear Realty Corp. has a small interest in the fee on the Penokee mine and a substantial interest in the Peterson mine. The mineral rights on the Sunday Lake mine are owned by a large number of individuals and trusts scattered in various parts of the country, some of whom have very minute interests. Because they have no common representation, negotiations between fee owners and the mining company are an extremely difficult and complicated procedure. The principal fee owner of the Cary mine is Northern Chief Iron Co. of Wausau, Wis., and at the Montreal mine most of the mineral rights are owned by the mining company itself.

It should be readily apparent that the owners of mineral rights are vitally interested in the continued operation of the mines, for the simple reason that an idle or abandoned mine pays no royalty. While the past substantial royalties have been collected by the fee owners, in recent years many concessions have been made by them to the mining companies to encourage the continued operation of each property. A mining operation is not a day-to-day proposition, and entails much long-range planning. To perpetuate a mine, there must be simultaneously carried on three activities: Production, development, and exploration. For this reason most of the concessions made by the fee owners have been contingent upon substantial annual production and the taking of specific steps to insure the continued operation of each property, primarily specified development and/or exploratory work.

This committee has been given confidential and detailed information in respect to all the leases held by Keweenaw and its affiliates, and it is satisfied that this group of companies has done much in recent years to assist the mining companies. Besides reducing royalty rates, in at least one case as much as 50 percent, it has made loans interest free for working capital, in certain instances assumed liability for subsidence damages, deferred collection of royalties, and advanced moneys for exploration and development work.

Following is a schedule showing a comparison of average royalty rates in the Gogebic County mines, the figures being cents per ton:

Year	Keweenaw Land Association, Ltd. and Ironwood Mines Corp.	Newport Land Co.	Average Gogebic County mines
1954.....	52.8	50.0	56.7
1955.....	53.6	50.0	56.2
1956.....	59.3	58.3	70.8
1957.....	61.9	62.4	69.2
1958.....	63.2	61.9	69.9
1959.....	53.4	62.6	65.4
1960.....	38.6	48.5	48.7
1961 (estimated).....	38.5	42.5	-----

The fee owners to whom we talked assured us that they fully recognized that the Gogebic Range mines were today facing brutal foreign and domestic competition on both a price and quality basis. They further assured us that in addition to the concessions already made, they were definitely willing to consider further royalty concessions, tailored in each case to the particular problems of each mine. However, they made it plain that these further concessions were contingent upon:

1. The mining companies following programs looking to the continued operation of the properties; that is, a long-range rather than a "crash" or "bailout" program.
2. Other interested groups making concessions consistent with those already made by the fee owners.

TRANSPORTATION

One of the largest, and at times the largest, factor in costs of ore to the consumer is transportation. This has always been true in the Lake Superior ore trade. There are several ways by which ore can be shipped from the Gogebic Range depending on the desires and location of the consumer. They are as follows:

1. Directly from mine to consumer by rail.
2. By rail to Ashland ore docks, then by boat to consumer.
3. By rail to Escanaba, then by boat to consumer.
4. By rail to port city, by boat to lower lake ports, and thence by rail to the consumer.

Transportation costs include rail freight, boat freight, and cargo insurance. The following table shows the trend in transportation costs during the past 10 years:

Range	Cost per ton		
	1951	1959	1960
Gogebic.....	\$2.7803	\$3.7225	\$3.2778
Marquette.....	2.2864	3.0767	2.9902
Menominee.....	2.4035	3.2221	3.2221

It is of interest to note from the above table that there were comparable increases on all three ranges from 1951 to 1959, but there was a considerable variance in the rate changes effective in 1960. Whereas there were no rate changes in 1960 on the Menominee Range, and only an 8.65 cents decrease on the Marquette Range, there was an appreciable decrease of 44.47 cents on the Gogebic. Up until 1959, very little was done to reduce costs in the field of transportation and handling of iron ore, other than the unique pooling arrangement established between our two local railroads in the 1930's. This particular arrangement between the Chicago & North Western and Soo Line Railways tended toward greater efficiency in the transportation of our local ores, but did not reduce the costs of transportation to the mining companies.

In 1950, less than 10 million tons of iron ore were imported into the United States whereas in the year 1960, over 35 million tons were imported into this country. In 1950, there were few ocean ore carriers of over 20,000-ton capacity but today the majority of the ocean-going carriers are over 25,000-tons capacity.

and a very large percentage of the long-water-haul ore is carried in ships of over 30,000 tons and up to 100,000-ton capacity. These large ocean shippers of foreign ores have been able to hold down rates while our rates on the Great Lakes have been steadily increasing, thus decreasing the competitive advantage of our domestic ores.

Transportation by water represents a different problem because the vessels used are owned by those either selling or consuming iron ore. These owners have indicated that they are attempting to cut costs wherever possible. It is a fact that the larger, more powerful, and faster ore carriers with their reduced cost per ton-mile of ore hauled have been the main factor in keeping water transportation rates as low as they are today.

Great Lakes water rates are extremely high when compared to ocean ore-shipping rates. Ocean ships with foreign flags carrying up to 100,000 tons and having a 12-month operation, made high-grade foreign ores very competitive even when transported up to eight times as far as lake ores, and even though transferred to lake ships for delivery to Great Lake ports, or to barges on the lower Mississippi for delivery to St. Louis or Chicago.

In March of 1960, the Chicago & North Western Railway Co., made the first appreciable attempt to reduce costs of transportation in the handling of Gogebic ore. This company came to the conclusion that if the mining companies would absorb certain switching and blending expenses, and if sufficient Gogebic ores could be shipped through their docks at Escanaba, the North Western would be able to reduce its transportation rate from the Gogebic Range. Thereupon, with the approval of the ICC, the North Western reduced its freight rate from the Gogebic Range to Escanaba from \$2 to \$1.45 per gross ton. Shipping to Escanaba by rail eliminated 1,000 miles of water transportation on the route from Ashland to the Chicago district.

The Chicago & North Western Railway Co., has taken other steps to make Gogebic ores competitive. They have established for Gogebic ore moving all-rail to mills at Granite City, Ill., a new rate of \$4 per ton as compared to the previous rate of \$4.55 per ton. This rate was approved by the Interstate Commerce Commission and became effective on October 15, 1960. To facilitate the movement of ore, the North Western has also completed a modern thawing facility at its docks at Escanaba, Mich. There is also a possibility that the dock handling charge now in effect, of 19 cents per ton, can be reduced because of new efficiencies.

It is apparent that the North Western has made a vigorous attack on the problem of transportation costs. Unfortunately, this committee overlooked contacting the officials of the Soo Line. If time is granted the committee will arrange to confer with the Soo Line officials and render a supplemental report.

ELECTRIC POWER

Electric power constitutes the largest single item of supply costs in producing iron ore on the Gogebic Range. The present depth and automation of our underground mines makes this an obvious fact. Electric power costs per ton of ore mined during 1960 averaged 47 cents per ton which represents 4.1 percent of the total costs. Future development and expansion of underground workings to greater depths will increase this particular cost item.

The following table shows total power costs, tons mined, and average costs per ton, for all mines on the Gogebic Range for the 10-year period 1951-60.

Year	Total cost of power	Total tons mined	Cost per ton
1951.....	\$1,151,745.27	3,374,912	\$.34
1952.....	1,138,693.27	2,838,449	.40
1953.....	1,291,025.82	3,203,873	.40
1954.....	1,263,927.82	2,683,515	.47
1955.....	1,348,835.17	3,456,768	.39
1956.....	1,614,748.04	3,649,646	.44
1957.....	1,772,914.99	4,183,688	.42
1958.....	1,494,810.15	2,570,108	.58
1959.....	1,418,337.71	2,501,790	.57
1960.....	1,728,584.48	3,652,510	.47

The power costs per ton of iron ore mined in the year 1960, which was a normal year of mining on the Gogebic Range, showed a low of 34.8 cents per ton of ore at one mine to a high of 61.6 cents per ton at another mine.

All electric power used to operate the seven mines on the Gogebic Range is purchased from the Lake Superior District Power Co., a public utility, having its principal office at Ashland, Wis. This company serves 13 counties in northern Wisconsin and two in the Upper Peninsula. Since the power company is a public utility organized under the laws of the State of Wisconsin, it is regulated by the public service commissions of Wisconsin and Michigan as to the rates that it may charge all consumers.

The Lake Superior District Power Co. is very anxious to keep the Gogebic Range mines in operation, since their revenue from mines represents more than one-fifth of their total income.

The company supplies the Gogebic Range through the medium of numerous high-voltage transmission lines direct from its main steamplant at Ashland, Wis., and 10 hydroplants and 2 diesel plants located throughout its system. It has recently built a new addition to the Ashland plant in anticipation of continued normal consumption of power by the Gogebic Range mines. The additional construction and improvements made by the Lake Superior District Power Co. to supply the Gogebic Range mines involved a very large investment on the part of the company. Their executives informed this committee that every effort would be made to reduce the costs of power to our local mines if other costs would also be reduced, and if there was some assurance that the Gogebic Range mines would operate at normal production.

The company assured the fact-finding committee that if the range mines were on a 5-day-week basis and operated continuously on such a basis that increased consumption and constant load would reduce power costs substantially. If 6 days a week were worked, still further reductions would result.

Any reduction in power costs is an important factor in keeping the Gogebic Range mines in operation. This committee recommends to the steering committee that a meeting of the officials of the respective power and mining companies be held for the purpose of exploring possible reductions in power costs.

LABOR COSTS

As has been stated elsewhere in this report, the cost of labor is a major item of expense of underground mining. The committee has studied the labor costs of our Gogebic Range mines, as compared to other mining operations, and has found that it is difficult to make meaningful comparisons. Costs vary from mine to mine because the physical characteristics of the mine vary. In some mines a lower labor cost may result because the mining chance is better, but this may be offset by increased cost of supplies, due again to the physical characteristics. For example, as the depth of the mine increases, power costs of pumping and hoisting also increase. Labor costs per ton of ore produced are also affected by the amount of exploration and development work carried on in any particular year. In some mines the working places are more widely scattered, necessitating increased costs of supervision.

Payroll costs of a large open-pit operation, not requiring concentration, may run from 50 to 75 cents per ton; in the same open-pit operation producing ore which requires concentration, the cost may run from \$1.25 to \$2.10 per ton. A taconite operation might have a labor cost of between \$2 and \$2.50 per ton, and the labor cost in underground mines might vary from \$3.25 to \$4.50 per ton. The labor costs per ton in a recent representative year for the seven mines on the Gogebic Range ran from a low of \$2.636 to a high of \$3.784 per ton. For the year 1960, according to the State mine appraiser's report, the average labor cost per ton of ore produced in Gogebic County was \$3.2179. This wide variation in the labor cost per ton of producing essentially the same product, iron ore, is perhaps unique in American industry.

In many industries increases in wage costs have been combated by greater mechanization and capital investment in more efficient plants and machinery. Generally speaking, it has not been possible to achieve this in the underground mines, although some improvements in production have been accomplished.

The following table shows aggregate costs and production for Gogebic County mines:

Year	Labor	Supplies	Total	Production tons per man-day	Year	Labor	Supplies	Total	Production tons per man-day
1951-----	2.5610	1.1068	3.6678	4.973	1956-----	3.0688	1.4928	4.5616	6.240
1952-----	3.0264	1.2614	4.2878	5.194	1957-----	3.1505	1.6134	4.7639	6.831
1953-----	3.0124	1.2834	4.2958	5.998	1958-----	3.6077	1.9363	5.5440	6.733
1954-----	3.2036	1.6289	4.8325	5.492	1959-----	3.5560	2.1251	5.6811	7.180
1955-----	2.7846	1.2000	3.9846	6.583	1960-----	3.2179	2.0864	5.3043	7.640

According to the Gogebic County mine inspector's reports, production of iron ore has increased from 4.973 tons per man-day in 1951 to 7.64 tons per man-day in 1960. Even so, the total cost of labor and supplies in the Gogebic County mines has increased over the years both in dollars and in percentage of f.o.b. mine values. The following table shows a comparison of these costs with the other two Michigan ranges:

5-year average, labor and supplies, percent of f.o.b. mine value

Years	Gogebic	Marquette	Menominee	Years	Gogebic	Marquette	Menominee
1947-51-----	58.9	61.0	58.9	1952-56-----	59.0	55.1	54.5
1948-52-----	59.3	61.5	49.2	1953-57-----	59.1	52.4	53.8
1949-53-----	59.6	60.0	50.1	1954-58-----	59.3	50.6	53.6
1950-54-----	61.8	60.2	51.7	1955-59-----	61.6	50.1	52.7
1951-55-----	61.2	57.9	53.7	1956-60-----	60.6	49.7	52.3

As can be seen from the above table, the Gogebic costs of labor and supplies have remained at approximately the same percentage of f.o.b. mine value of ore, while there has been a marked decrease in that percentage on the Marquette Range and to a lesser extent on the Menominee Range since the 1952-56 period. The committee has been informed that the decrease on the Marquette Range has been due primarily to an increasing amount of ore being mined by bulk mining methods, such as block caving, which results in increased tons per man. Whereas some of the Marquette and Menominee ore bodies, because of their size and physical characteristics, afford opportunity for bulk mining or for lesser amounts of supplies, the Gogebic ore bodies on the whole do not have these characteristics. Therefore, it is much more difficult to change mining methods on the Gogebic Range to reduce the costs of labor and supplies.

According to testimony presented to the President's Fact-Finding Commission in 1959, the Lake Superior underground common labor rate has increased more than 200 percent since 1939 whereas, during the same period, production increased only 29 percent, from approximately 0.85 ton per hour worked in 1939 to approximately 1.1 tons per hour worked in 1958. This increase in productivity has been attributed to the following:

1. The minimization of development work at underground mines in recent years thus increasing the productivity of those employed. This postponement of development work, of course, will have the effect of either shortening the life of the mine or increasing operating costs at some future date.

2. The switch from costly selective mining methods to more efficient quantity methods. However, this use of bulk mining methods increases the contamination of the ore.

Lake Superior underground ores have become marginal, and the decline to this status has been accelerated because of the economics of deep underground mining as set forth in this report.

Prior to the year 1952, our Lake Superior ores were dominant in the market because they were premium ores, but that is no longer true. In 1957, the Gogebic Range produced 4,183,688 tons of iron ore. This was the highest rate of production during the last 10 years. However, it represented only 3.94 percent of U.S. production and only 3.24 percent of U.S. consumption of iron ore. The present market is very poor because of the reduced rate of steel opera-

tions and the availability of cheaper and better ores from both foreign and domestic sources. In addition, the carrying charges for our underground operations have risen so much in recent years that both the captive and independent mines on our range find it most difficult to carry some of these mines with the hope that there will be a better future market for Gogebic ores. The cost of continuing and carrying an idle or partially operated mine for any length of time in the hope that market conditions will improve has become a vital factor in the survival of such a mine. The committee has found that the cost of carrying a Gogebic Range mine that is idle averages from a low of \$50,000 to a high of \$120,000 per mine per month.

All iron ore mines operated on the Gogebic Range have written contracts between either the mine owners or operators and the United Steelworkers of America. These agreements constitute the basic labor agreement covering rates of pay, hours of work, and conditions of employment. Each of these contracts is based on the national wage pattern for the steel and iron mining industry and can be amended only by mutual consent.

It has become a generally accepted philosophy of employer-employee relationship today that workers, both labor and white collar, are paid for certain time not worked. Paid vacations, paid holidays, sick leave, and other benefits are commonplace. However, in respect to the underground mine, the collar-to-collar provisions which were instituted in recent years and the paid lunch period for underground employees, both of which are peculiar to underground mining operations, have added to the competitive disadvantage of the underground mine in comparison with surface operations. There is some indication that as much as 1 hour to 1½ hours of nonproductive time is paid for in every 8-hour shift. Assuming a \$3.25 payroll cost per hour, and a production of 6¾ tons per man-day, with two-thirds of the work force underground, this can be translated into a cost per ton of more than 40 cents. It appears to this committee that the above-mentioned areas afford an opportunity for substantial improvement in the labor costs, without a reduction in the basic wage and salaries schedule now in effect. Improvements can also be made in the field of labor and management efficiency. It is this field that can be explored and studied by both labor and management if there is a sincere and mutual desire on the part of both groups to keep the Gogebic Range mines in full operation.

ADMINISTRATION AND OWNERSHIP

Because for many years the great bulk of the iron ore consumed in this country came from the Lake Superior region, it is only natural that at one time or another most of the steelmakers had interests here. Initially the iron ore holdings in the various ranges were widely scattered, but through a series of pooling, joint ventures, mergers, and consolidations, a great deal of centralized control has been achieved, out of which has emerged United States Steel Corp. as the unquestioned leader. It should be of great significance to the people of the Gogebic Range that United States Steel, which occupies a dominant position in the control of domestic iron ore reserves, long ago terminated the activities of its ore-mining subsidiary, Oliver Iron Mining Co., on the Gogebic Range. Now we are told that Bethlehem Steel Corp., the second largest company in the iron and steel business, is losing interest in our underground mines.

Pickands Mather & Co., Oglebay Norton Co., and North Range Mining Co. are the only operators left on the Gogebic Range. They are what is known as "iron ore merchants"; that is, they are in the business of producing and marketing iron ore, as distinguished from an integrated steel and iron manufacturing business. Pickands Mather is the largest and one of the oldest iron ore merchants in the country, and is unique in that it sells virtually no ore on the open market. It has no significant interest in steel companies, and does not share in the ownership of any of the mining companies for which it acts as managing agent on the Gogebic Range. Practically all of the ore produced from the mines which Pickands Mather operates goes to the steel companies which own the mines, approximately in proportion to their respective ownership.

Prior to July 1, 1960, Pickands Mather & Co. operated under the partnership form, but is now a corporation. It performs a management function on a fee basis for the owners of the mines, and as such makes recommendations to its employers; however, its freedom to operate the mines is limited and top level policy decisions are made by the board of directors of the various companies which own the mines, although in some instances there is Pickands Mather representation on these boards.

Oglebay Norton Co. is a somewhat diversified company whose business includes the operation of a fleet of lake vessels (Columbia Transportation Division), iron and coal mining, operation of general cargo docks, and distribution of various raw materials. The company operates the St. James mine for the St. James Mining Co., which is owned by Bethlehem Steel Co. It is one of the smaller iron ore merchants.

North Range Mining Co. is by far the smallest operator on the Gogebic Range. In addition to the Penokee mine, it also operates the Zenith mine at Ely, Minn., in partnership with W. S. Moore Co., the Nahma mine at Eveleth, Minn., and the Champion mine at Champion, Mich.

The following chart shows the operation and ownership of the various mines on the range:

	Company	Owner	Per- cent
Pickands Mather & Co.:			
Sunday Lake mine.....	Sunday Lake Iron Co.....	Bethlehem Steel Corp.....	100
Peterson mine.....	Puritan Mining Co.....	do.....	50
		Youngstown Sheet & Tube Co.	50
Geneva mine.....	Mauthe Mining Co.....	do.....	50
Newport mine.....		Interlake Iron Co.....	25
		Steel Co. of Canada, Ltd.....	25
Cary mine.....	Odanah Iron Co.....	Bethlehem Steel Corp.....	50
		Interlake Iron Co.....	50
North Range Mining Co.: Penokee mine.	North Range Mining Co.	North Range Mining Co.....	100
Oglebay Norton Co.: Montreal mine..	Oglebay Norton Co.....	Oglebay Norton Co.....	100

[Marquette Mining Journal, Michigan]

CCI TO SHIP 3.5 MILLION TONS OF PELLETS ANNUALLY FROM THIS RANGE BY 1963

One of the pioneer iron ore mining companies in the Lake Superior region, the Cleveland-Cliffs Iron Co., now in its 111th year, is pioneering the exploitation of the low grade jasper iron formation on the Marquette range. Including the share of partners, the company is well advanced to increasing its total annual capacity to 3.5 million tons of iron ore pellets on the Marquette range by 1963.

In that year Cleveland-Cliffs, which enlarged the Humboldt mine in 1960 and will complete part of the Republic mine expansion in 1962, is scheduled to start operating the Empire mine. Ultimately the capacity of the three projects will total 6.1 million tons of pellets per year.

NATURE OF OWNERSHIP

The jasper ore being treated at Humboldt and Republic is specular hematite, whereas the iron is in the form of magnetite at Empire. Cleveland-Cliffs owns both the Humboldt and Republic mines in fee and holds the Empire mine partly in fee and partly by lease.

The history of the mines is similar, as all three were operated intermittently for direct shipping grade iron ore in past years. Through metallurgical processes developed since the mines were closed, the low-grade jasper ore, uneconomical to treat at the time that the direct shipping grade material was exhausted, can now be beneficiated into high-grade blast furnace feed in the form of pellets.

LARGE JASPER RESERVES

In the early days the Humboldt property and the Republic mine were worked by underground methods, and the Empire mine was on open pit. All three ore bodies are now exploited by the open pit system.

Cleveland-Cliffs owns large reserves of jasper on the Marquette range, the first iron range to be discovered in the Lake Superior region. The company is the leading producer of iron ore on the Marquette range.

HUMBOLDT MINING CO.

Since 1954 Humboldt Mining Co., owned 50 percent each by Ford Motor Co. and Cleveland-Cliffs and operated by the latter, has been producing iron ore concentrate on the Marquette range at a site 10 miles west of Ishpeming. Humboldt was the first mine to recover a high-grade iron ore product from the low-grade jasper iron formation in Michigan.

In 1958 Cleveland-Cliffs commenced to increase the capacity of Humboldt to 700,000 tons of iron ore pellets annually. This program, completed in 1960, included doubling the mining and concentrating facilities and adding an agglomerating plant to pelletize the concentrate.

TYPES OF EQUIPMENT USED

At Humboldt Cleveland-Cliffs is hauling 4,800 tons of crude, averaging 30.5 percent iron, daily to the primary crusher at the concentrator. Comprising the company's fleet of diesel-powered mine trucks are four 40-ton Darts, four 34-ton Euclids, and three 22-ton Euclids. The 22-ton units, however, are not used for production; they serve as spares and are used in stripping.

For primary blasthole drilling Cleveland-Cliffs has a JPM-3 Linde jet piercer and a 60-BH Joy rotary drill. Secondary breakage is accomplished by a steel drop-ball crane.

Operating the Humboldt mill at capacity, Cleveland-Cliffs is recovering 21,000 tons of iron ore concentrate per day through the flotation process. Equipment at the mill includes three rod mills, two ball mills and two classifiers. The concentrate is agglomerated into pellets, averaging 62.5 percent iron, 9.5 percent silica, and 2.5 percent moisture, by the Allis-Chalmers grate-kiln system at the double-strand Humboldt pelletizing plant.

MARQUETTE IRON MINING CO.

Marquette Iron Mining Co., operated and owned 53.76 percent by Cleveland-Cliffs, commenced producing iron ore pellets on the Marquette range in 1956; partners of Cleveland-Cliffs are International Harvester Co., Jones & Laughlin Steel Corp., and Wheeling Steel Corp. The Republic mine and concentrator of Marquette Iron Mining are situated near the town of Republic, 5 miles south of Humboldt, and the pelletizing plant is at Eagle Mills, on the main line of the Lake Superior & Ishpeming Railroad 15 miles east of Republic.

Cleveland Cliffs is increasing the annual capacity of Republic to 1,600,000 tons of iron ore pellets from 800,000 tons. This program, expected to be completed in February 1962, will be followed by further expansion to a total of 2,400,000 tons of pellets per year. The M. W. Kellogg Co. has the contract to enlarge the mills, and Arthur G. McKee Co. is erecting the pelletizing plant.

GRATE-KILN SYSTEM

In the new section of the concentrator, Kellogg has completed the foundations for the silos and for the rod and ball mills; no steel for the mill building has been erected yet. Just south of the concentrator, McKee is constructing the 500-foot long, 140-foot wide pelletizing plant which will use the grate-kiln system. Units in place include four concentrate storage bins, four benetomite bins, and four limestone bins.

McKee is fairly well along with all structural steel; the steel is in for the first single strand, but erecting steel in the grate area is just beginning. The second strand is excavated nearly to the end of the grate. Both strands, capacity of which is 800,000 tons of iron ore pellets per year each, are larger than the double strand in Humboldt.

RAILED TO EAGLE MILLS

Partially poured at present, the foundation for the lower kiln on the first strand will be completed this month. All foundations, not including concrete flooring, will be ready by August. The personnel employed at Republic totals 517, of whom 209 are with Kellogg, 167 with McKee, and 141 with Cleveland-Cliffs.

The flowsheet of the Republic concentrator is similar to Humboldt and follows conventional crushing, grinding, and flotation. Recently Cleveland-Cliffs increased the annual capacity of the mill to 800,000 tons of concentrate from 700,000 tons by adding a second 7-foot Symons short-head cone crusher and a third rodmill. The material from the three rodmills is now split between the two ballmills. In the new section of the concentrator, the company will refloat the concentrate to raise the iron and lower the silica content of the final product.

At present the existing Republic mill is treating about 6,000 tons of crude per day, from which about 3,200 tons of concentrate, averaging 63.1 percent iron, are produced daily. This tonnage is railed to the Eagle Mills pelletizing plant.

FLEET OF 7 TRUCKS

When the expansion of Republic is ultimately completed, the mill will have the capacity to produce 2,400,000 tons of concentrate per year, and the agglomerating plant will be capable of pelletizing 1,600,000 tons annually; the excess 800,000 tons will be pelletized at Eagle Mills.

Cleveland-Cliffs, operator of a fleet of seven 34-ton Euclid trucks at the Republic mine, will add three 60-ton Euclids when expansion is completed; the company plans to standardize on 60-ton units at Republic. Cleveland-Cliffs, which acquired a C-850 Reich drill last year for the Republic mine, recently ordered a second jet piercer.

EMPIRE IRON MINING CO.

The newest jasper ore development of Cleveland-Cliffs on the Marquette range is the Empire project near Palmer, 6 miles south of Negaunee. This property was transferred from Marquette Iron Mining to a new company, Empire Iron Mining Co., operated and owned about 50 percent by Cleveland-Cliffs. Partners of the company are Inland Steel Co. and International Harvester.

The Empire open-pit mine, which made its first iron ore shipment in 1907, has been operated by Oglebay Norton Co., the M. A. Hanna Co., and Clement K. Quinn & Co. It is situated adjacent to the old Volunteer open-pit iron mine of Pickands Mather & Co.

When completed in 1963 the Empire project of Cleveland-Cliffs will have an annual capacity to produce 1.2 million tons of pellets, containing 65 percent iron, from crude ore of 30 percent iron. Ultimate capacity of Empire, the first magnetic jasper ore body to be exploited in Michigan, is 3 million tons of pellets per year.

PROGRESSING RAPIDLY

At present preliminary development of the Empire mine by Cleveland-Cliffs is progressing rapidly. The company is working on the flow sheet and is erecting the pilot plant at the Volunteer plant site. An important part of the testing phase will be constructing and operating a 24-foot-diameter, 7-foot-wide Cascade mill, one of the larger known.

Cleveland-Cliffs, which has stripped a slot across the ore body to obtain large bulk samples, plans to run pelletizing tests during the fall. The Empire agglomerating plant will use the grate-kiln system. Arne E. Hill, formerly superintendent of the Holman-Cliffs open-pit mine at Coleraine, Minn., on the Mesabi range for Cleveland-Cliffs, is superintendent of the Empire project for the company.

OTHER OPERATIONS

In addition to the jasper ore developments, Cleveland-Cliffs is operating three underground mines on the Marquette iron range. These are the Mather mine between Ishpeming and Negaunee, the Bunker Hill mine at Negaunee, and the Cliffs shaft mine at Ishpeming. The company also expects to ship a small tonnage of siliceous iron ore this season from the Tilden open pit south of Ishpeming.

Nearly all underground iron ore produced by Cleveland-Cliffs on the Marquette range goes to the company's ore improvement plant at Eagle Mills. Drying, screening, and heavy media separation are used at this plant to upgrade the iron ore product.

