THE MINNESOTA GEOLOGIST

OFFICIAL BULLETIN

OF

THE GEOLOGICAL SOCIETY OF MINNESOTA

VOL V MARCH 15TH, 1948 NO 2

GEOLOGICAL SOCIETY OF MINNESOTA

831 SECOND AVENUE SOUTH
MINNEAPOLIS 2, MINNESOTA

The Society is devoted to the study of GEOLOGY and MINERALOGY for their cultural value.

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MEETINGS: October to May inclusive, 7:30 P.M. every Monday, not a holiday, large auditorium, 4th floor, Public Library, Hennepin Avenue and 10th Street, Minneapolis, Minnesota.

FIELD TRIPS: June until September inclusive.

ANNUAL DUES: Residents of Hennepin and Ramsey Counties $3.00 plus $1.00 additional for husband, wife, or dependent family members; for students and non-residents, $1.00.

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MIDWEST FEDERATION OF GEOLOGICAL SOCIETIES

Professor William C. Bell has concluded his course of 17 lectures on Elementary Geology. The last lecture was a summary consisting of a showing of more than 100 colored slides on geological subjects taken by Junior F. Hayden, and given to the University by him. The running description of the slides by Mr. Hayden, and of the geology by Professor Bell was unique and very much appreciated by everyone. The popularity of Dr. Bell's lectures is attested by the fact that the average weekly attendance was 90. Dr. Bell brought to his lectures a freedom of address and repartee which enlivened his lectures and made many friends. Dr. Bell had eminent success in holding the interest of beginners, as well as those of our members who are fairly well advanced in the subject. This is no little accomplishment. We extend to Dr. Bell our sincere appreciation. We now look forward to next year when we hope to have a course on historical geology.

Our DeLuxe Field Trip this year will coincide with the first annual meeting of The American Federation of Mineralogical Societies, to be held in Denver, June 13th to 16th. Professor Richard M. Pearl of Colorado College, and Vice President of the National Federation is General Chairman. He reports that Ward & Company of Rochester, New York, largest mineral collectors in the world, will have an exhibit and representatives at the Convention, and that there will be many other exhibitors. This will give those who attend an opportunity to acquire excellent specimens. Incidentally, it will also give those who attend an opportunity of meeting many people interested in rocks, fossils, crystals, lapidary equipment, etc., as well as many Editors, Authors and Professors of Geology. Don't miss the opportunity if you can help it. You will shortly receive a special notice regarding the trip. Most of our members will go by bus leaving Minneapolis on June 12th. Reservations will be booked in the order in which they are received, with your deposit of $10.00.

Our Field Trips Committee has been activated well in advance of the necessary time. The Bulletin Board gives a list of our summer field trips. We would say, it is positively the best program we have ever been privileged to enjoy. Trip leaders will be announced later. The field trip program is equally as important as our lecture program. These trips give you a real opportunity to enjoy geology, to become well acquainted with your fellow members and to develop friendships which are lasting. It also gives you an opportunity of applying your knowledge of geology and of learning much in the field. You will benefit greatly by forming the habit of attending every trip and permitting nothing to interfere with your attendance.

We will hold our annual banquet, auction and election in the Banquet Hall in the Minneapolis Y. M. C. A., Monday, May 3, 1948, at 6:30 O'clock P. M. A more specific announcement will be made in due time.

Since printing the map contained in this issue showing the Continental Shelf of the West Gulf Area, the announcement has been made by two of the major oil companies, acting jointly, of the successful completion of a 900 barrel per day well producing at 1700 feet, located 10 miles off the Louisiana Coast. This is the first producing well drilled out of sight of land. The drilling was conducted from a steel "Island" built on piling at the location.

The north shore of Lake Superior from Duluth to Grand Portage Island is underlaid almost entirely by a series of lava flows and later intrusives of similar composition. These are of Keweenawan age, and in fact represent part of the same series of rocks that are found on Keweenaw Point on the south shore. There the rocks dip to the northwest on the south limb of the Lake Superior syncline and in Minnesota they dip to the southeast owing to their position on the north limb of this great structural basin. Gooseberry State Park therefore shows exposures of lava flows which dip gently toward the lake. Gooseberry River has its headwaters about 20 miles back from the shore and drains an area of about 75 square miles. In such a cool, moist region this is sufficient to maintain a fairly good flow throughout the year.

The land rises rather rapidly from Lake Superior inland to as much as 300 feet above lake level at the hilltops in the northeastern portion of the park. About where the Gooseberry River enters the park it begins a series of rapids and falls that drop the water 60 feet within about 700 feet. These are referred to as the Upper Falls and in common with the Lower Falls are a result of erosion of lava flows. Below the Upper Falls the river runs in a low gorge with rapids separated by quiet water.

The Lower Falls is a series of separate falls with the uppermost just above the bridge for Highway 61. This has a fall of nearly 30 feet and is followed just below the bridge by the middle fall also about 30 feet. Below this fall the river splits around an island and drops over two falls with a total descent of about 50 feet.

The origin of these various falls is perhaps the most interesting feature of the park. As previously noted the rocks exposed in the park consist almost entirely of basalt lava flows. These flows vary in thickness from one foot to between 60 and 70 feet. Robert Grogan mapped the geology in detail as a CCC student technician in 1937 and counted 19 flows from the shore to the point where the river enters the park.

The upper parts of lava flows are normally vesicular owing to gas bubbles rising in the molten rock and collecting beneath the upper chilled scum at the surface of the flow. Often the vesicules become filled with various minerals, such as agate, and are then called amygdules. Usually the vesicular portion of the flow is much softer and more easily eroded than the massive portion. Therefore, when water flows over a series of flows it tends to erode the vesicular portion of a given flow more rapidly than the massive portion of the flow above. This develops a cliff and as it is undercut tends to break off in large blocks, thus maintaining a vertical face over which the river plunges to form a fall. It follows that each fall represents the massive portion of a flow. Thus five flows can be counted in the Lower Falls. The flow forming the upper fall displays fairly well developed columnar jointing. When the water is low it is easy to climb over the rocks and observe these features. At places in the stream bed well developed pot holes have formed by the whirling water in the rapids.

Below the falls the river has eroded a sizeable depression around which the river swings in a large meander. The east side is against a rock wall 80 feet high with a talus slope at the base. Along the lake a nearly vertical cliff is maintained by wave erosion at the base. The west side of the river is largely glacial drift and lake clay and the area is much more accessible and has been utilized for service to the public.

The beach gravel near the mouth of the river is a good place to search for agates and other pebbles of interest. The agates are worn out of the Amygdaloidal tops of the flows along shore. Other minerals such as calcite, zeolites, quartz and epidote also occur in the amydgules and veins in the lava flows.

DR. GEORGE M. SCHWARTZ is director of the Minnesota Geological Survey, University of Minnesota. Reprinted from the Conservation Volunteer.

BULLETIN BOARD

LECTURES

MARCH 22, 1948	OUR OIL RESOURCES	DR. FREDERICK M. SWAIN
MARCH 29,	CLASSIFICATION OF ROCKS	MR. LYNN GARDINER
APRIL 5,	TO BE ANNOUNCED	
APRIL 12,	GEOLOGY OF THE BISBEE ARIZONA COPPER DISTRICT	DR. GEORGE M. SCHWARTZ
APRIL 19,	IMPORTANCE OF CRYSTAL STRUCTURES IN THE INDUSTRIES	DR. JOHN W. GRUNER
APRIL 26,	GEOLOGY OF COLORADO	CHARLES H. PRESTON
MAY 3,	BANQUET & ELECTION	

FIELD TRIP SCHEDULE - 1948

MAY 2, 1948 Sun	FORD PLANT AND GLASS MAKING
MAY 16, "	SPRING VALLEY MINNESOTA IRON MINES
JUNE 6, "	GLACIAL GEOLOGY STUDY
JUNE 12-20	DENVER -AMERICAN FEDERATION OF MINERALOGICAL SOCIETIES
JULY 3, 4, 5 Sat-Mon	SOUTH SHORE, LAKE SUPERIOR
JULY 11, Sun	MISS NORENBERG'S MINNETONKA ESTATE
JULY 17-18 Sat-Sun	MESABI IRON RANGE
AUGUST 1, Sun.	GRAVEL PIT - EAGLE LAKE AND OSSEO
AUGUST 15, Sun,	TO HUNT FOSSILS
AUGUST 29, Sun.	MISSIPPI RIVER TRIP
SEPT. 11-12 Sat-Sun	NORTH SHORE, LAKE SUPERIOR
SEPT. 26, Sun	WASHINGTON COUNTY- GLACIAL TOPOGRAPHY
OCT. 10, Sun.	ALMA CENTER. WHITE QUARTZITE (Bus trip)

EDITORS NOTE: At the Minneapolis meeting of the Midwest Federation of Geological Societies held in October 1946, a resolution was adopted pledging the Federation to the active support of teaching "Earth Science" in the Secondary Schools, for its culural value.

Dr. George A. Thiel, Chairman of the Department of Geology, University of Minnesota, has long been active in sponsoring this phase of the subject and at present is serving as Chairman of the National Committee of the Geological Society of America, on Geologic Education.

An outstanding leader in this movement is Mr. Ben Hur Wilson, head of the Department of Earth Sciences in Joliet Junior College, Joliet, Illinois. Mr. Wilson is also President of the American Federation of Mineralogical Societies and past president of our own Midwest Federation of Geological Societies. Mr. Wilson is personally known to many of the members of our Society and enjoys a national reputation as a leader in this subject, as well as author of many articles on Geological and Mineralogical subjects.

Mr. Wilson recently published the following article in the Earth Science Digest, Box 581, Ann Arbor, Michigan. We reproduce the article here with permission of the Author and Publisher. The article is very timely and we congratulate Mr. Wilson, as well as Earth Science Digest, for bringing the matter so forcibly to our attention.

A question which we are frequently asked and one which we often mull around in our mind is: Why is not more Earth Science being taught in the secondary schools of America? We only wish we knew the entire answer. In part, however, I would say that it is largely because those who are sold on it and believe in it most thoroughly do not, as a rule, go to bat for it and put up a fight to get it incorporated into the school curriculum.

In spite of the fact that it is the most basic of all sciences, and the one which could contribute most to the cultural welfare of the individual in the field of intelligent and useful living, educators in general sit complacently by, seeming to be wholly unaware of its great possibilities, and, therefore, do little or nothing about it. This condition must be speedily changed. The preparation for citizenship in a modern world demands it.

It appears to the writer that the greatest stumbling block to immediate widespread introduction of Earth Science studies is the lack of adequately trained teachers in the field. In our own department at Joliet where, for example, over a period of nearly fifty years, we have employed on an average, about ten full time instructors, many have had to be trained within the department itself. Here, then it seems, is a definite challenge and problem to which we must look to our teacher training colleges for solution. There are many who feel that in the immediate past, perhaps, too much attention has been given to the so-called frills of popular education, at the expense of other more stable subjects, which in the long run might possibly accomplish a great deal more good.

"Erdkunde", that is Earth Knowledge, early became a favorite subject in the schools of Europe, even before many of the other sciences developed. In this country, however, for some reason it got off to a poor start so far as the secondary schools are concerned. Some think that this was partly due to the unfortunate use of the name Physiography, the meaning of which, not being well understood, caused many pupils, as well as administrators, to shy away from the subject. The newer term "Earth Science" insofar as its present usage is concerned, more clearly defines the modern subject and brings its true meaning out into the open. This seems to have had a wholesome effect upon its rapidly increasing popularity and acceptance.

Earth Science is a comprehensive, composite term which embraces all such subjects concerned with the physical and dynamic Earth. This would include physiography, geography, and certain phases of the geological sciences. It is, therefore, one of the broadest of subjects, and by reason of the great breadth and versatility of its content can easily be made one of the most interesting subjects in the entire school curriculum. It, too, is a subject which lends itself readily to any and every local situation, and one need not go far away from his own classroom to find many excellent examples for study. In this respect, it has for most students a great carry over value into their actual living experience, which is always one of the best recommendations for any subject.

While we feel that nothing need be said in defense of Earth Science, we do believe on the other hand, that it has a great deal to recommend it. To begin with, the Earth being definitely our home, in a larger sense, for the duration of our natural lifetime, we should come to know it intimately from every possible angle, just as we should want to become fully acquainted with our own local home and its physical environment. Through the study of Earth Science, we should arrive at an awareness that we actually know the Earth, and likewise into a realization that we are a part of it and it is a part of us, and that we should live in complete harmony with it. This in itself should make for better and more satisfactory living.

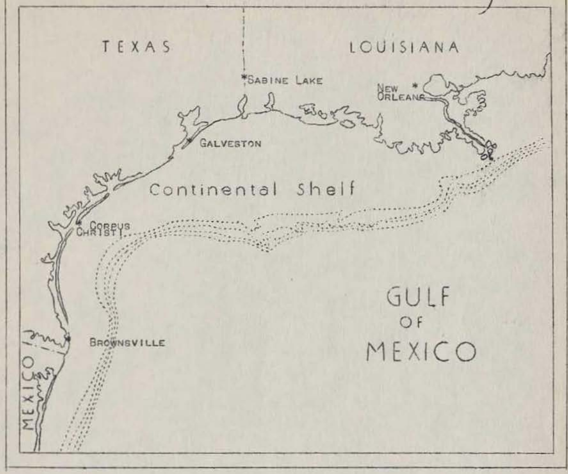
Furthermore, we are indebted to the Earth for all of our natural resources. In other words, for all that we are, have, or make use of. It is that vast storehouse from which we derive, either directly or indirectly, all of our food, shelter, and raiment, as well as our oil, fuel, building materials, and the raw materials for all of our industries. Is it not natural to assume, then, that anyone who goes through life without a true understanding of all this and how it came about, must be unnecessarily handicapped in his thinking and in the method of his attach on and solution of the problems of life? This alone is reason enough for the universal adoption of an elementary course in Earth Science in all secondary schools.

Aside from these benefits, there are other more academic reasons for which I would recommend it. As an orientation or beginning course on entering high school, there is nothing that can equal it. It has in it the elements which involve reading with understanding and expressing oneself in writing with exactness and clarity. There is enough in the historical background of the subject to create a wholesome interest in man's past. Enough mathematics is present to afford a review and a reasonable promise that it will instill in the students a realization of its practicability, for which many at that age can see no particular use.

Insofar as a necessary introduction and background for the other natural sciences is concerned, it seems most indispensable, In our studies at Joliet of the "Earth as a Planet" and its relationship to the rest of the Universe, we have an excellent preview of Astronomy. In our study of the "Rocks and Materials of the Earth's Crust", we give the student a preliminary approach to the subject of Chemistry. This is likewise done in our study of the "Nature of the Atmosphere and Natural Balances", which also gives us an introduction of Meteorology. And finally the teaching of the dynamics of "Weathering, Erosion, Transportation, and Deposition of Earth Materials" leads us a long way through the ramification of the physical sciences.

I believe that we should be able to convince even the most skeptical of the value and desirability of expanding the teaching of Earth Science. The outline of subject matter, methods and manner of presentation are things which we are not concerned with in this paper. The big question before us at present is how to get more Earth Science in the secondary schools, and this no doubt can be done in a variety of ways. For one thing, a great deal more inspirational work will have to be done on the part of all who are vitally interested, which includes specifically the geologists of our universities, our societies, and hobbyists, who often have even more influence over local situations. We need the encouragement of our State Geological Surveys and the authors and publishers of texts, maps, and other teaching materials. This is not a one man job, but one on which we should all pull together. With proper cooperation, the next ten years should see a complete reversal of the present attitude toward Earth Science in the secondary school of America.

Continental Shelf



The above diagram shows the "Continental Shelf" of the Texas Gulf area. The continental shelf is the boarder of the continent. It extends from the shore outward, generally until the sea reaches an approximate depth of 600 feet. From that point the land mass drops off rather suddenly, to greater depths and to the abysmal deep.

The four contour lines shown on the diagram represent additional depths of 50 fathoms or three hundred feet each. The one nearest shore represents a depth of 300 feet and the fourth or last 1200 feet. It is significant to note that the slope of the sea bottom between the first or 300 foot contour line and the fourth contour line is three times greater than the slope between the shore line and first contour line. Also the distance between the shore and the "drop-off" varies greatly. Thus at Corpus Christi this distance is 65 miles, at Sabine Lake 125 miles and at the Mississippi only 10 miles. The shelf is part of the land mass of the continent and has all the characteristics of the continental surface, although it is generally low-lying. Thus on the Texas shelf shown above geophysical explorations indicate that there are salt domes, as there are throughout East Texas, as well as other structural "highs", which may have resulted in accumulations of petroleum. Much work is being done here by the oil companies and their hopes are high. Legal title to the shelf has been claimed by both the States and the Federal Government. It is all very intriguing, and it invites your further study. Watch this area.

ARS

IRON ORE RESOURCES OF MINNESOTA

NOTE: Excerpts from an address by Elting H. Comstock formerly Dean, School of Mines, University of Minnesota, at 75th Annual Convention, American Society of Civil Engineers, Duluth, Minnesota, July 16-18, 1947. Reprinted from Skillings Mining Review, July 19, 1947 issue.

The first shipment of Minnesota ore was made in 1884 from what is now known as the Soudan mine near Tower on the Vermilion range. This range is located about 75 to 80 miles north of Duluth and extends from the vicinity of Tower to and beyond the international boundary. Merchantable bodies of ore have been found in but two localities, one near Tower, at the Soudan mine, and the other at Ely, 21 miles east. The Mesabi range lies from 50 to 75 miles north and northwest of Duluth. It extends in a northeasterly direction from the neighborhood of Grand Rapids to Birch Lake, some 40 miles beyond Virginia and Eveleth. It has a total length of a little over 100 miles. The first shipment from this range was made in 1892. It is by far the greatest source of iron ore in the state, having produced 91.6% of the total. Of the known reserves of ore as reported by the Minnesota Department of Taxation 93% are listed as on this range. The Cuyuna range lies southwest of Duluth some 90 miles. The productive portion of this range extends from northeast of Brainerd to Rabbit Lake, about twelve miles east. The first shipment from this range was made in 1911.......

In the ores of Minnesota the iron occurs chemically combined with oxygen. The oxides of iron may be made up of three atoms of iron with four of oxygen forming the mineral called magnetite; two atoms of iron with three of oxygen forming hematite; or the latter with combined water forming limonite. The ores consist of iron oxide together with certain impurities; a sandy part containing silica; a clayey part containing alumina; moisture, which may appear both asfree water or combined with minerals; and various amounts of lime, magnesia, sulphur, phosphorus, manganese, titanium and perhaps other elements. With the high cost of transportation to the smelting centers an ore should contain at least 50% natural iron, and impurities should be of such kind and amount that a satisfactory quality of pig iron may be made in the blast furnace. Associated with the ores are cherts and slates. Chert is a mass of fine sand grains firmly cemented together with a natural cement. Most of the sand grains are quartz, chemically SiO_2. Slates are dense, fine grained rocks formed from mud and clay which has been subjected to great pressure and in many cases to heat.

SOUDAN FORMATION. The ores of the Vermilion range occur in what is called the "Soudan formation" which consisted originally of cherty iron carbonate, banded chert and iron oxide. The orebodies were formed by waters circulating through the formation and leaching out the silica thus concentrating the iron oxide. The orebodies are irregular and lensshaped. Some of the deposits are connected with each other, while others are disconnected. Many of the orebodies are relatively deep, in some mines from 1,500 to 2,000 ft. Both the Soudan formation and the associated rocks are hard and difficult to drill. As a result of these factors exploration is not carried on to the extent that it is on the other ranges where the formations are not so hard or so deep. Any estimates as to the amount of ore remaining in the mines are merely guesses........

OREBODIES OF THE CUYUNA. The orebodies of the Cuyuna range are in the form of steeply inclined narrow lenses. Their width ranges up to several hundred feet, the length, in some cases, may approximate a mile but many are much shorter. In depth they vary from shallow deposits up to some which have a depth of 500 to 700 ft. Surface drilling is not difficult and as a result we have a very good idea as to the extent and quality of the orebodies where drilling has been carried on.

THE MESABI RANGE. The Mesabi range was not subjected to the intense folding which tilted the beds on the other ranges. As a result the formation in which the ore deposits occur is comparatively flat dipping from 6 to 12 degrees on the eastern end and from 4 to 10 degrees farther west. The name "Biwabik" has been given to the iron bearing formation though the material in the formation is commonly called "taconite." The taconite is a vast mass consisting of alternate layers of chert and slate, both of which contain granules of iron bearing material. After glacial times the entire surface was covered by a layer of glacial drift, in some places a few feet thick while in many localities the iron formation lies two hundred feet or more below the present surface. This glacial drift is a mixture of sand, gravel and boulders left when the ice finally melted and the water made its way to lakes and rivers. The horizontal distance across the formation underneath the glacial drift is from one to three miles. As before stated the length is somewhat over one hundred miles. Extending on in a southerly direction the Biwabik formation is overlain by so-called Virginia slate, which gradually increases in thickness up to a thousand feet or more. In the eastern end of the range, however, the formation is overlain by Duluth gabbro instead of slate.

Through the ages cracks developed at various places in the formation allowing water to enter. As time went on this water carried away great quantities of silica in solution. It is probable that the water had iron in solution when it entered the formation, which was deposited as the silica was dissolved, thus serving to increase the actual iron content. These two processes working together have produced iron ore which runs as high as 55% iron in places. Not all of the iron formation developed cracks and allowed water to enter and change the taconite to ore. The final result was an enormous mass of taconite containing scattered orebodies. Some of these are as long as four miles, have a width of half a mile and are from 200 to 500 feet deep. From this size they grade down to many which are comparatively small........

ORE GRADED INTO FIVE CLASSES. Iron ores from the Lake Superior region are graded into five classes: Old Range Bessemer; Old Range Non-Bessemer; Mesabi Bessemer; Mesabi Non-Bessemer, and high phosphorus ores. Old Range ores are hard, while Mesabi ores are soft and earthy. This designation therefore classifies ores according to physical structure. Bessemer ores are those in which the phosphorus content is below 0.45%; Non-Bessemer ores have a phosphorus content between 0.045% and 0.180%; while high phosphorus ores contain more than 0.180% phosphorus. The basic iron content for all ores is 51.50% natural. An ore low in silica but with a high moisture content and a given percentage of iron is more desirable than an ore with the same percentage of iron but high in silica and low in moisture. The moisture is driven off by the high temperatures in the furnace while high silica requires more limestone in the charge to the blast furnace and produces more slag. In either case freight must be paid on a worthless material in the ore.

CERTAIN ORES FOR CERTAIN FURNACES. The value of any given ore to a particular furnace depends upon the iron content; the phosphorus content; the structure of the ore; the percentages of maganese, silica, alumina and sulphur in the ore; the cost of transportation from Lake Erie ports to the furnace; the cost of coke and limestone at the furnace; and the amount and kind of impurities in the coke and limestone. It is possible then for a particular ore which would be useless to one furnace to be an ideal ore for another furnace operating under different conditions. To the first furnace it would have no value while to the second its value might be high. The value of an ore to a particular furnace determines what price that furnace is willing to pay for the ore.

ORE SAMPLING HIGHLY IMPORTANT. Operating conditions of a blast furnace must be kept constant to insure its successful operation. The proper proportions of limestone and coke must be charged with the ore that the impurities may flux properly and the desired grade of pig iron be produced. The proper proportions of fluxing material and fuel vary as the quality of the ore varies. It is therefore essential that the quality of the ore remain uniform. This means that each cargo of ore moving to a Lower Lake port for a particular furnace must analyze the same as every other cargo, and also that the cargo itself must be uniform throughout. To insure that the conditions will be met an extensive system of ore sampling has been set up. The ore in place in the mine is sampled to determine what grades of ore are to be loaded into cars. After the cars are loaded they are sampled in groups of from three to ten, five cars being a common unit, that the proper grades of ore may be sent to the dock to make up the cargo to meet the specifications set up for that shipment. The cargoes are sampled at Lower Lake ports during the process of unloading. Finally when the ores are shipped by train from Lower Lake ports to the inland furnaces the cars are again sampled........

BENEFICIATION. Any method of treating iron bearing material so as to increase the percentage of iron in the product or to improve the structure of the material, or both, is called beneficiation. Iron bearing material falls into one of three principal classes. (1) That which can be converted into merchantable material by the simple and relatively inexpensive process of crushing, screening and washing. (2) That which requires treatment by roasting, sintering, agglomeration, or drying through the use of fuel, or by jigging or by heavy medium separation to make it suitable for blast furnace use. (3) This class consists of the all-inclusive material which we call taconite.

Geologists have divided the Biwabik formation into four main divisions; the Upper Slaty, the Upper Cherty, the Lower Slaty and the Lower Cherty. The orebodies occur in all four of these divisions. In many parts of the range material requiring beneficiation is also found in these layers. Much experimental work has been done by the various mining companies operating on the range and the results of this work have led to certain conclusions. At the present time not much can be done to improve the grade of the material in the two slaty divisions on account of the extreme fineness of the grains. Particularly on the west end of the range the so-called "wash ores" in Class 1 are found in the two cherty layers. The better portion of the intermediate ores in Class 2 are found in the lower cherty layer.

Crushing and screening may be used merely to reduce the size of the chunks to make a product more uniform in size. However, it is often possible also to improve the grade by this means. If the impurities, silica for example, are more abundant in the chunks, their elimination by screening increases the percentage of iron in the material passing through the screen. The "wash ores" on the western end of the range are low in iron and high in fine silica. A high grade concentrate can be made by removing a large part of the sand. This is accomplished in various types of machines in which water carries the sand grains but leaves the heavier iron particles. In many places material is found in which the silica is present in coarse pieces. This material did not make a satisfactory product as a result of simple washing. This is the material on which jigging and heavy medium separation are used. Roasting is for the purpose of changing the oxides of iron into magnetite so that magnetic methods of concentration may be used. Drying reduces the moisture content thus increasing the iron content in the dried product and effecting a saving in freight and shipping costs........

During the year 1946, 23.7% of the ore shipped from Minnesota had been beneficiated. Of this about 85% were washed concentrates; 8.7% heavy medium concentrates; 4.6% dried; and slightly less than 1% each for jigged concentrates and sintered material. Experimental work is being carried on in attempts to find methods of beneficiating other types of low grade material found in the formation. If this results in the development of processes which are commercially profitable much of this material will be added to the reserves and add to the life of the range........

EXPECT LIFE OF 60 YEARS. Geologists estimate that there is on the range 150 million tons of such ore. In addition there may be deposits on which no drilling has been done up to the present time, but which will be explored in due time. A second factor which will serve to add to the reserves is the successful solution of the problem of improving the grade of much intermediate material which is not now classified as ore. It has been estimated very conservatively that an additional 150 million tons will be added from this source. Changes in furnace practice may be affected which will make it possible to use material not now classified as ore. That this is a possibility is demonstrated in the case of high alumina ores which formerly were considered waste but now are quoted at the same base price as Mesabi Non-Bessemer ores. If the so-called law of averages has any merit it is safe to assume that the middle line will finally fall about half way between the two extremes and we can expect a life of some sixty years. Of course, as the end of production approaches there will be a gradual decrease in all of the factors affecting the life of the range and unless some new source of ore is developed the range will become finally a thing of the past, as least as far as a source of iron ore is concerned........

MESABI TACONITES. What of Mesabi taconites? Estimates differ as to the amount available, running from five billion tons. At the present time the taconite carrying iron particles in the form of magnetite gives the greatest promise of being commercially feasible. The figures given above are for this class of material and if it takes three tons of taconite to produce one ton of concentrates it would appear that there are possibilities for at least 1.7 billion tons if the first figure is correct and possibly 19 billion tons if the latter figure is not too enthusiastic. Even the first figure represents more ore than has been shipped from Minnesota over the years since the first boat load started on its trip to the Lower Lake ports.

To get a picture of taconite imagine a cupful of salt and two and one-half tablespoons of pepper mixed, not too uniformly. In some places layers of pepper should be left. This mixture should then be cemented into a hard, tough mass. The salt would then represent the sand grains in the chert while the pepper would represent the particles of iron bearing material. Laboratory experiments indicate that by crushing this material to minus 100 mesh, producing a product not quite as fine as flour, but considerably finer than the best grade of table salt, the particles containing iron would be freed and can be recovered by some method of concentration. The cherty layers give the most promise at the present time and only those carrying the iron bearing material in the form of magnetite. In the slaty layers the grain is so fine that it would be difficult to make a satisfactory product at a cost which would not be prohibitive. As the slaty layers overlie the cherty layers they would have to be removed in order to expose the chert.

On the eastern end of the Mesabi range are enormous beds of taconite carrying iron in the form of magnetite covered only with a relatively thin layer of glacial drift. The formation is hard and difficult to drill and crush. Some years ago a plant was erected at Babbitt in an attempt to utilize this material. It operated for three seasons. Though the product produced was of exceptional quality it could only be produced at a cost considerably above its selling price and the plant was finally shut down. The failure was due largely to the costs of mining and crushing together with that of sintering the concentrates. It is possible that with modern methods these costs can be cut to a point where a profit can be realized.

After concentration the magnetite particles will be so fine that shipment in cars would be impossible and they would not make a suitable feed for the blast furnace on account of the tendency to blow out through the top of the furnace. To overcome these difficulties they must be consolidated into chunks hard enough to resist abrasion in loading and unloading. This can be accomplished by sintering, nodulizing, agglomerating or pelletizing. Any of these operations will add to the cost of the product. However, there are compensating advantages as the iron content will be over 60% and the structure will make it a desirable feed for the furnace.

It is estimated that a plant to produce a million tons of ore per year will cost in the neighborhood of ten million dollars. Before the mining companies will be willing to spend this sum of money they must be assured that about the time the plant is ready to bring a return on the investment the taxes will not be raised so as to eat up possible profits........

GEOLOGICAL SOCIETY OF MINNESOTA
831 Second Avenue South
Minneapolis 2, Minnesota

APPLICATION FOR MEMBERSHIP

NAME: . . . .

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