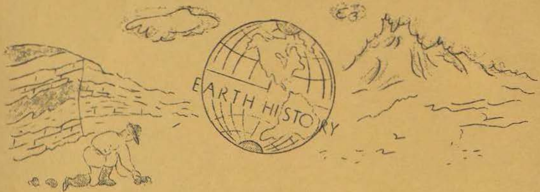

THE MINNESOTA GEOLOGIST

OFFICIAL BULLETIN

OF

THE GEOLOGICAL SOCIETY OF MINNESOTA

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One of the secrets of life is to keep
our intellectual curiosity acute.

W. L. Phelps.

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MEETINGS: October to May inclusive, 7:30 P.M. every 2nd and 4th Monday not a holiday, at Ford Hall, University of Minnesota, 17th Ave. S.E. and Washington Avenue. Visitors welcome.

FIELD TRIPS: May until October inclusive.

ANNUAL DUES: Residents in a 50 mile radius of the Twin Cities $ 3.00 plus $ 1.00 additional for husband, wife, or dependent family members. For students and non-residents, $ 1.00.

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and

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NOTES FROM THE PRESIDENT

E. L. KOPPEN.

Another successful and enjoyable field trip season has just closed and we are beginning our winter lecture season which promises to be equally successful and enjoyable. Beginning in May and ending in October the Society had four one-day trips, four two-day trips and one two-week trip together with our annual picnic at the Henry Sommers home on the banks of the St. Croix River. All were very well attended and we enjoyed much geology, beautiful scenery and good fellowship.

Below is a revised and corrected schedule of our winter lectures. The dates have been changed from the schedule given you earlier because Mr. McGannon, as you know, was unable to be with us on October 27th. Also one additional lecture is scheduled for December 1st. Mr. King has consented to popular demand and on that date will give a resume of the two-week trip he led to Wyoming and which the forty of us who accompanied him enjoyed so much. With maps, charts, diagrams and beautiful slides he will explain the geology of much of Wyoming in an easy to understand manner and it will be not only entertaining but very instructive as well. Make it a must to attend. Also invite your friends to attend the following lecture series.

BULLETIN BOARD

Nov. 10 - The Chemistry of Mineralogy - Mineral Genesis.

Nov. 24 - Important Sulfides.

Dec. 1 - Wyoming Field Trip - Mr. King.

Dec. 8 - Important Oxides and Carbonates.

Jan. 12 - Important Silicates.

Jan. 26 - Silicates and Miscellaneous Other Chemical Groups.

Feb. 9 - Introduction to Rock Study - Igneous Rocks, Plutonic.

Feb. 23 - Igneous Rocks, Effusive.

Mar. 9 - Clastic Sedimentary Rocks.

Mar. 23 - Nonclastic Sedimentary Rocks.

Mar. 30 - Metamorphic Rocks.

Apr. 13 - Metamorphic Rocks and General Compostion of the Earth.

Apr. 27 - Annual Banquet.

VOCABULARY FOR ROCK STUDY

ACIDIC rock - Igneous rock containing a high percentage of silica and (if crystalline) some free quartz. Contrasted with basic rock.
AEOLIAN deposit - Rock deposited by wind which has transported the particles from somewhere else; examples - sand dunes, loess.
AGGREGATE - Rock composed of mineral fragments cemented together.
ALLUVIAL rock - Rock deposited by a stream.
ALLUVIUM - Sedimentary deposit of rock made by a stream, such as in a delta, flood plain, and river bed.
ALTERATION - Physical or chemical change in a rock after its original formation, such as weathering.
ALUMINOUS - Containing a compound of aluminum, such as clay.
AMORPHOUS - Without internal crystalline structure, such as volcanic glass.
AMYGDULOID - Igneous volcanic rock containing small almond-shaped gas cavities lined or filled with secondary minerals, such as basaltic lava containing native copper (in northern Michigan).
AMYGDULE - Small almond-shaped cavity in an igneous volcanic rock, caused by gas expansion and filled with secondary minerals, such as calcite, quartz, and zeolites. (A similar cavity without the later minerals is called a vesicle).
ARENACEOUS - Sandy.
ARGILLACEOUS - Clayey.
BANDED - Structure of a rock having parallel layers of different minerals, colors, or textures.
BASALT - Compact basic volcanic rock of dark color.
BASIC rock - Igneous rock containing a low percentage of silica.
BRECCIA - Rock composed of angular fragments cemented together.
CELLULAR - Porous, containing cavities.
CEMENT - Materail that binds together the particles of fragmental rocks.
CHALK - Soft, fine-grained variety of limestone composed of the carbonate shells of small marine animals.
CLASTIC rock - Rock composed of fragments of minerals of a previous rock.
CLAY - Sediment consisting of very fine-grained hydrous aluminum silicate minerals, plastic when wet and hardening after being heated.
COLUMNAR structure - Parallel rod-like structure in rocks.
COMPACT - Closely packed.
CONCRETION - Rounded mass of mineral matter accumulated around a nucleus.
CONGLOMERATE - Rock composed of mineral or rock fragments cemented together.
DECOMPOSITION - Chemical decay or break-down of a rock.
DETRITAL - Consisting of mineral or rock fragments.
DETRITUS - Fragments of rock left over from the disintegration of older rocks.
DISINTEGRATION - Separation of a rock by mechanical means, such as by frost action.
DISSEMINATED mineral - Mineral that is scattered throughout a rock, such as diamond crystals in kimerlite.
DOLOMITE - Rock composed mostly of the mineral dolomite.
DRIFT - Uncemented alluvial deposit.
DRUSE - Cavity in rock lined with crystals.
DRUSY rock - Covered with tiny crystals.
EFFUSIVE rock - Rock that flowed onto the surface of the earth and solidfied there, such as lava. Same as extrusive.
ERUPTIVE rock - Igneous rock, usually an extrusive rock such as lava.

EXFOLIATION - Scaling-off of shells or scales from a rock surface, such as that due to frost action.
FISSILE rock - Rock capable of being split, such as slate.
FLUVIAL deposit - Sand, gravel, mud, or rock deposited by streams.
FOLIATION - Banding or layering in metamorphic rocks.
FRAGMENTAL rock - Rock consisting of pieces of minerals or former rocks cemented together.
GABBRO - Coarse-grained igneous rock consisting largely of basic plagioclase, feldspar and pyroxene.
GEODE - Hollow nodule lined with mineral crystals that project from the wall.
GLASS - Noncrystalline brittle rock that has cooled rapidly from a magma or lava.
GLASSY texture - Dense texture, like that of obsidian and other volcanic rocks.
GNEISS - Layered or banded metamorphic rock.
GOUGE - Clay-like crushed rock along the surface of a fault.
GRANITE - Coarse-grained igneous rock consisting essentially of feldspar, quartz, and one or more ferromagnesian minerals.
GRANULAR texture - Consisting of interlocking grains of similar size, such as granite.
GROUNDMASS - Background material (glassy or crystalline) for the larger crystals (phenocrysts) in a porphyritic rock.
IGNEOUS rock - Rock that has solidified from a molten state (magma). It may be an intrusive or extrusive rock.
INCLUSION - Foreign mineral, rock, or fossil enclosed within a rock.
INCRUSTATION - Coating or crust.
INDURATED rock - Rock that has been hardened by heat.
INJECTED rock - Igneous rock which forced its way while molten into another rock.
INTERBEDDED rock - Rock lying sandwich-like between two strata.
INTRUSION - Igneous rock which forced its way while molten into other rock.
INTRUSIVE rock - Igneous rock that crystallized below the surface of the earth, such as a batholith or dike.
LAVA - Surface flow of molten rock; lava may solidify into such rocks as basalt and rhyolite.
LIMESTONE - Sedimentary rock composed of calcium carbonate (calcite).
LITHOLOGY - Study of rocks, especially sedimentary rocks.
MARBLE - Recrystallized carbonate rock which before being metamorphosed was limestone or dolomite.
MASSIVE rock - Uniform rock, not bedded or layered.
MATRIX - Rock gangue in which the desired mineral or ore is embedded.
METAMORPHIC rock - Rock that has been extensively altered from a previous igneous or sedimentary rock by the effect of heat, pressure, or chemical action.
METEORITE - Rock that has fallen to earth from cosmic space. The light produced by a meteorite moving through the atmosphere is a meteor.
NODULE - Rounded lump of rock or mineral.
OBSIDIAN - Glassy volcanic rock.
PEGMATITE - Igneous rock consisting of very coarse mineral crystals.

Common pegmatite minerals include quartz, feldspar, mica, tourmaline, and beryl; many rare and gem minerals occur especially in pegmatites.

PERIDOTITE - Coarse-grained basic igneous rock composed largely of olivine and pyroxene.
PETROGRAPHY - Descriptive study of rocks.
PHENOCRYST - Conspicious crystal embedded in the finer-grained groundmass of a porphyritic rock.
PLUTONIC rock - Igneous rock that solidified from magma at depth.
POCKET - Cavity in rock, containing minerals.
POROSITY - Percentage of a porous rock that consists of space.
PORPHYRY - Rock consisting of conspicious crystals(phenocrysts) embedded in a finer-grained groundmass.
REPLACEMENT - Process by which a rock or ore takes the place of a previous one, often preserving the original structure.
ROCK flour - Finely pulverized rock.
SAND - Small broken fragments of a mineral or rock, quartz is the most common constituent.
SANDSTONE - Sedimentary rock consisting of consolidated sand.
SCHIST - Thinly layered metamorphic rock.
SEAM - Thin strata in bedded rock, such as coal.
SECONDARY rock - Rock derived from another rock by alteration or metamorphism.
SEDIMENTARY rock - Rock deposited from solution or suspension, or by organic activity, such as gypsum, sandstone, or limestone.
SEGREGATION - Mineral matter accumulated in conspicious aggregates.
SHALE - Thinly layered sedimentary rock composed of consolidated mud, clay, or silt.
SILT - Fine muddy sediment.
SLATE - Finely layered, compact metamorphic rock which splits easily into sheets.
STALACTITE - Mineral shaped like an icicle and deposited by the evaporation of solutions dripping from the roof of a cavern.
STALAGMITE - Mineral shaped like an icicle and deposited by the evaporation of solutions on the floor of a cavern.
STRATIFIED rock - Rock that has been deposited in layers.
STRIATED - Containing parallel grooves or scratches on the surface, such as glaciated rock.
STRUCTURE - Physical features of a rock, including porosity, jointing, stratification, parting, fracture, and banding.
TEXTURE - Pattern of minerals in a rock.
THIN section - Slice of rock that has been ground to transparency and mounted on glass for study under a microscope.
TILL - Unsorted glacial deposit consisting of sand, clay, and boulders.
VESCICULAR rock - Rock having numerous small cavities caused by gas expansion.
VOLCANIC glass - Noncrystalline rock formed by the rapid cooling of lava.
VOLCANIC rock - Igneous rock that has solidified from volcanic lava or explosive material
VUG - Small cavity in a rock.
WASH - Loose surface deposit of sand, gravel, or boulders laid down by running water
WEATHERING - Decomposition and alteration of rock under atmospheric conditions.

SOME NOTES ON FIELD TRIPS.

The field trip is an integral part of the Society and its program, because it gives reality to the lecture program and a better understanding of real geology, not to forget the pleasant fellowship that is enjoyed.

If we are to have an interesting and instructive field trip program it must become the responsibility of the Society as a whole, or else the few who have served as leaders will soon have exhausted their resources and the program will come to an end.

Any field trip to be successful must be scouted so that the leader knows intimately all the area that is to be visited, the time required, distances to be covered and places to stop. The scouting often takes more time than the trip itself, and can either be done specially for a new area or be based on information that has been gained on a previous trip, such as a vacation. We are not worried too much about leaders for short trips of a day or two from the Twin Cities area, but the possibilities for two week trips is near exhaustion unless some additional means are used to plan and formulate long trips.

Because it is very difficult and expensive to do special scouting for a two week trip, we must depend on information that has been obtained by individuals who have made past visits to interesting areas, or from someone who is planning a vacation and will arrange it so he can study the area as a plan for a future trip. There are about twenty members of the Society who regularly attend the two week trips and as many more who occasionally attend. If these people will get together and pool their information about various places that they have visited, a plan for a trip can possibly be arranged from that information. Then one or more of the group can look up additional information to formulate a trip. One or two can then be elected from the group to draw up an itinerary and make arrangements through Chambers of Commerce and organizations throughout the area for details of accomodations and stops.

The best time to start a long trip for 1959 is now and it is suggested that those interested get together as soon as possible and make plans.

The Board of Directors,
The Geological Society of Minnesota.

ALL ORES ARE NOT THE SAME.

by Robert Libby
Pickands Mather & Company.

Many kinds or varieties of iron ores are mined from the open pits and underground mines located in the State of Minnesota. They vary in appearance, structure and analysis. Some of the ores have high percentages of silica and phosphorus which depreciate the value of the ore. Others will have a high iron content but are very fine in structure. Some low grade ores will respond readily to treatment to better the quality and structure of the ore, while others stubbornly refuse to respond to an economical method of up-grading or beneficiation.

The most common iron ore is soft to medium-hard, yellowish brown to reddish or bluish-brown in color, and grades with increasing silica (sand) into ferruginous chert (rock). Ferruginous chert is an iron-bearing, fine crystalline silica. The term ferruginous means iron-bearing. Chert is a general term for a fine crystalline silica. The iron in the ore material may be in one of several different forms; the most common are hematite, an iron oxide, and limonite or goethite, which are iron hydroxides.

When the wall rock of a mine is a slate-type material, the iron ore in the mine is usually soft, dark red or bluish-red, clay like and laminated. If the wall rock is a cherty type, the ore in that mine is medium hard, somewhat sandy and generally breaks into small blocks.

The best type of ore from the Cuyuna and Mesabi ranges is a high quality, medium soft, reddish-blue hematite. Iron content has run as high as 68% (dry analysis) with a low phosphorus content. However, it must be remembered that this ore is exceptional and limited in quantity.

A second type is wash ore. This ore is disintegrated iron-bearing chert, a most of the silica is in the form of a fine sand which will wash out, leaving the iron oxide called the "concentrate".

A quite common third type is a finely laminated, brownish-yellow limonite, relatively low in silica and more claylike.

On the Cuyuna Range many of the ores are manganiferous, that is, containing varying percentages of manganese.

Each of the general ores mentioned will have wide variations in chemical analysis within its own group. During the mining of manganiferous iron ore the shovel is very apt to produce high manganese with low silica and medium phosphorus while another 20 feet along the same cut it is apt to run into a straight iron ore.

Moving along the same cut may produce a good grade of iron ore with low silica and little manganese, and proceed from there to iron ore that will run low in iron, low in manganese and with a silica that will be under 15%, with a 19 to 20% moisture. The latter material is commonly classed as a "low#combine-ore", that is, it will have a large percentage of volatile matter (carbonaceous material plus H_2O) that is lost in the blast furnace operation.

Mining records from one pit reveal one shift loading ore that analyzed 33% iron, 18% manganese, .032 phosphorus, and 11% silica. The next shift continuing along the same area produced ore running 42% iron, 6% manganese, .175 phosphorus and 14% silica.

High moisture content lowers the grade of ore because you will be paying freight on useless water. Yet ores vary greatly in the way they retain moisture. Years ago when a certain ore property was opened, the first cuts revealed a high moisture content, running 22 or 24% in moisture.

The high moisture content made this a "low-grade" ore and as such it was stockpiled and not touched for about six weeks. Then when it was possible to absorb some of this high moisture ore it was loaded into cars for shipment. The moisture content was down to 10 to 12%. Through aeration this ore had lost about half its moisture content. That type of ore gave up moisture readily. Other high moisture ores from the same property, stockpiled for the same length of time, retained their original percentages of moisture.

It seems that there is something favorable and also something unfavorable about practically every type of ore encountered in mining. Marketable ores are made or created by mixing the various types of ores together in the stockpiles or ore pockets to increase the favorable and decrease the unfavorable characteristics. The steel company buying or consuming ores will specify that the ores furnished must be of specified grade, that is, meet a definite analysis specifications.

In the building of a cargo of ore for one of the named vessels, pit foremen from various mines are notified when the vessel is due, how much tonnage they are to produce for it, and what analytical requirements they should attain and the number of empty ore cars they will be provided with to complete their portion of the vessel's cargo.

The vessel is required to carry on this particular trip a certain grade of ore. It is up to the ore grading department to see that the vessel receives this designated grade, with allowances for only slight alalytical variations from the guarantee that the ore seller sets up for the grade.

Bear in mind that the smallest analytical unit used by the chemist is a sample of the contents of five railroad cars. We assume the vessel will take a cargo of approximately 250 cars of ore, totaling between 10 and 11,000 tons.

Two hundred and fifty cars are loaded, and probably 50 cars of offgrade ore are left over from another vessel which did not fit in with the mix, or grade, of that vessel. That makes a total of 300 cars of ore or 60 five-car samples to manipulate until grade is reached. The taking out of certain five-car lots that upset the possible combinations of grade and mix and replacing them with other samples that will bring all the elements into line with the guarantee is sometimes a problem that experience alone can solve in a hurry. It must be done between the time the ore cars are loaded at the mine and the time when the cars are dumped into pockets at the dock. In other words, the possible combinations are spotted and then checked for the cargo average and the ore pocket mix.

The ore pocket mixing sheet is then marked as follows: 50 pockets are needed on one side of the dock to mix the 250 cars at five cars to a pocket. The 250 cars are divided into five groups of 50 cars each, so arranged that the ores in each group would have closely related analysis in the major elements such as iron, manganese, silica and phosphorus.

The ore pocket mixing, or disposition order, is wired or phoned to the Ore Dock Agent. Large switch engines then start switching out the 250 cars in the yards into the designated groups and then proceed to dump them into the ore pockets as requested.

Now each ore pocket has one car of each of the varieties available for the cargo, making 50 pockets of five cars each. The variations in analysis have been folded together from the inside track to the outside track over the top of each pocket. The fast running ore is at the bottom of the pocket to expedite the flow of ore from each pocket. The vessel comes alongside with hatches open and the chutes are lowered into the hatches. The face gate at the bottom of each pocket is opened and in three or four hours the vessel is loaded.

As the ore flows from each pocket into the vessel, one can see the blending of colors and structure of the different ores. Just another cargo - a result of coordinating the loading at the mines with the railroads and vessel schedules.

Geologists, mining engineers, pit foremen, plant foremen, chemists, trainmasters, dispatchers, ore graders and ore dock employees - all have contributed, working together to make and prepare this cargo for vessel shipment to the iron and steel making centers.

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