THE MINNESOTA GEOLOGIST

OFFICIAL BULLETIN
OF
THE GEOLOGICAL SOCIETY OF MINNESOTA

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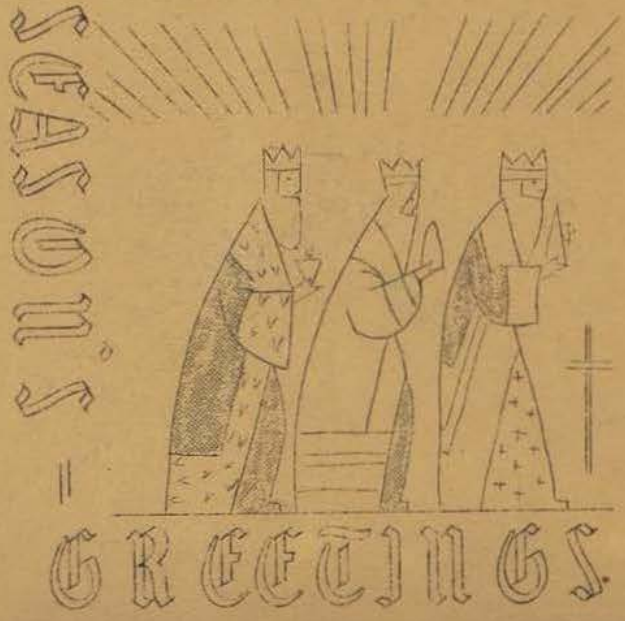

GEOLOGICAL SOCIETY OF MINNESOTA

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

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MEETINGS : October to May inclusive, 7:30 P.M. every Tuesday not a holiday, auditorium, Minnesota Museum of Natural Hisotory University of Minnesota, 17th Ave., S. E. and University Avenue.

Visitors welcome.

FIELD TRIPS: May until October 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 MINERALOGICAL AND GEOLOGICAL SOCIETIES
and
THE AMERICAN FEDERATION OF MINERALOGICAL SOCIETIES

* Deceased

Bulletin Board

1952 LECTURE PROGRAM

During the second half of our lecture season we have a continuation of the series on Regional Geology of the United States by Dr. F. M. Swain on the second and fourth Tuesdays of each month (except Feb. 5). On alternate Tuesdays are lectures on various topics of geologic interest. These lectures are held in the Auditorium of the Museum of Natural History, University of Minnesota, University & 17th Ave. S.E. Minneapolis (except as noted below for January 15).

Jan.	8	The Rocky Mountains	Dr. F. M. Swain
* Jan.	15	Ice Age Mammals	Dr. Louis H. Powell
Jan.	22	Regional Geology of the U. S.	Dr. F. M. Swain
Jan.	29	Surface Water Supplies and the Growth of Cities	Dr. John R. Borchert
Feb.	5	Regional Geology of the U. S.	Dr. F. M. Swain
Feb.	19	Geological and Archeological Reconnaisance in Iraq	Dr. H. E. Wright
Feb.	26	Regional Geology of the U. S.	Dr. F. M. Swain
Mar.	4	A Trip to the Center of the Earth	Dr. Harold M. Mooney
Mar.	11	Regional Geology of the U. S.	Dr. F. M. Swain
Mar.	18	Sand in Time and Space	Dr. G. A. Thiel
Mar.	25	University Holiday	
Apr.	1	The World Down Under	Mr. Henry S. Sommers
Apr.	8	Regional Geology of the U. S.	Dr. F. M. Swain
Apr.	15	Trilobite Distribution in the Franconia Formation	Dr. W. C. Bell
Apr.	22	Regional Geology of the U. S.	Dr. F. M. Swain
Apr.	29	Banquet	

* This lecture will be held in the Science Museum in St. Paul. It is located just across the street (University Ave.) north of the State Capitol Bldg. It is a block and a half east of the point where the Como-Harriet and St. Paul cars from Minneapolis turn off University Ave. on Wabasha. TIME 7:30 P.M.

EDITORIAL - MEMO

The adoption of "pin on" name cards (introduced by Mr. Harris) has done away with the "I remember your face but your name escapes me" look, and has done much to make the members attending the meetings feel that we all "belong". Mr. Charles Havill has been getting there early and arranging the cards for easy selection.

Those attending the Park Board "Mum" show were treated to an extensive exhibit of rocks and fossils in one of the long greenhouses. The placards naming the specimens gave a brief explanation of the history and growth of each, rather than the chemical composition. Many of the larger more interesting specimens were loaned by Mr. George Luxton.

George Rickert has been burdening himself with boxes of rock fragments for members to pick over and select from. He has also picked out choice specimens, or rather collections which he has offered as door prizes.

Dr. F. M. Swain's lectures are illuminating interpretations of above and below ground geography.

The E. J. Longyear Co. brought to us interesting and revealing information regarding exploration and drilling in the search for much needed minerals in all parts of the world.

Feeling that the exhibit booth at the State Fair in 1951 was successful in interesting visitors in the study of Geology, plans are under way to repeat and enlarge this project.

Mrs. Helene Becker is now correlating suggestions made during the Fair and improvements planned by Dr. Thiel and Mr. Harris. Further ideas will be welcome and will be given consideration by her committee.

The sudden passing of our staff member, Benjamin A. Pratt, came as a shock to us all. We extend to his family our deepest sympathy.

The annual convention of the Midwest Federation of Mineralogical and Geological Societies will be held at Macalester College on July 1, 2 and 3. Hosts - The Minnesota Mineral Club, assisted by the Geological Society of Minnesota. Convention chairman, Wm. J. Bingham, St. Paul, Minn. President, H. T. Perry, Minneapolis, Minn.

In remitting your dues by mail, send them to Mr. J. Orval Engen, Treasurer, 5317 Chowen Avenue South, Minneapolis 10, Minn.

Any other Society correspondence should be sent to Mr. Wesley Bender, 1828 Chicago Avenue, Minneapolis 4, Minn. or Mr. J. Merle Harris, President, 3509 Stinson Blvd., Minneapolis 18, Minn.

All Bulletin correspondence should be sent to the Editors, 3376 Brunswick Ave., Minneapolis 16, Minn.

GEOLOGICAL SOCIETY OF MINNESOTA

Comparative Operating Statement
Fiscal years ending June 30 1950 and July 1951

	Year Ending 6-30-50	Year Ending 6-30-51
Cash on hand at beginning of year	507.15	398.52
Receipts		
Membership Dues	444.00	400.50
Field Trips (net)	18.53	47.38
Annual Dinner		5.90
Miscellaneous Receipts	1.65	2.35
Total Receipts	464.18	456.13
Total	971.33	854.65
Disbursements		
Lectures	333.80	235.93
Bulletin and Notices	212.81	190.39
Annual Dinner	5.85	5.75
Mid-West Dues	11.60	9.40
Miscellaneous	8.75	28.67
New Typewriter		75.00
Total Disbursements	572.81	545.14
Balance on hand in bank June 30	398.52	309.51

Statement of Trust Fund

Fiscal Year Ending June 30-1951

Balance on hand in bank July 1, 1950		1464.44
Receipts		
Interest on balance	27.46	
Memorial to O. C. Cole	64.00	
Memorial to Ruth L. Preston	5.00	
Total Receipts		96.46
Total		1560.90
Disbursements		
Robert Berg Cambrian Research	165.20	
Flour City Iron Co. for markers	450.10	
Total disbursements		615.30
Balance in bank June 30, 1951		945.60

IN APPRECIATION by MAURITZ V. WESTMARK

A number of years ago a marker was placed on the west shore of Lake Pepin describing the early history of the lake. It was situated on an overlook along trunk highway 61 between Lake City and Wabasha, near the southern limits of the lake. For reasons unknown to the writer, this marker disappeared, and was never found. The State Highway Department, who have cooperated with the Geological Society of Minnesota in the erection of our previous plaques, recognized the value of geological and historical markers and asked our Society to write a geological inscription for a new plaque which they would furnish and install. The text for this marker was written by one of our members, Mr. Lawrence W. King and approved by the Department of Geology of the University of Minnesota.

This plaque differs somewhat from our design, - it is made of aluminum, is of greater size, the letters are larger and are not capitalized. The new marker was installed during the summer of 1951 and is located 1.6 miles north of Reads Landing (north of Wabasha), opposite the mouth of the Chippewa River. The inscription reads as follows:

L A K E P E P I N

Lake Pepin occupies the Mississippi Valley above this point for a distance of 22 miles. The lake is formed by the delta of the Chippewa River which enters the Mississippi directly east of this site.

The Chippewa, a relatively small river, has a much steeper gradient than that of the Mississippi. It was therefore able to transport more sand and coarser gravel than the master stream could remove. In consequence the Mississippi was dammed back in the gorge to form Lake Pepin.

The surface of the lake is 664 feet above sea level and 450 feet below the top of the bluffs which line its shores.

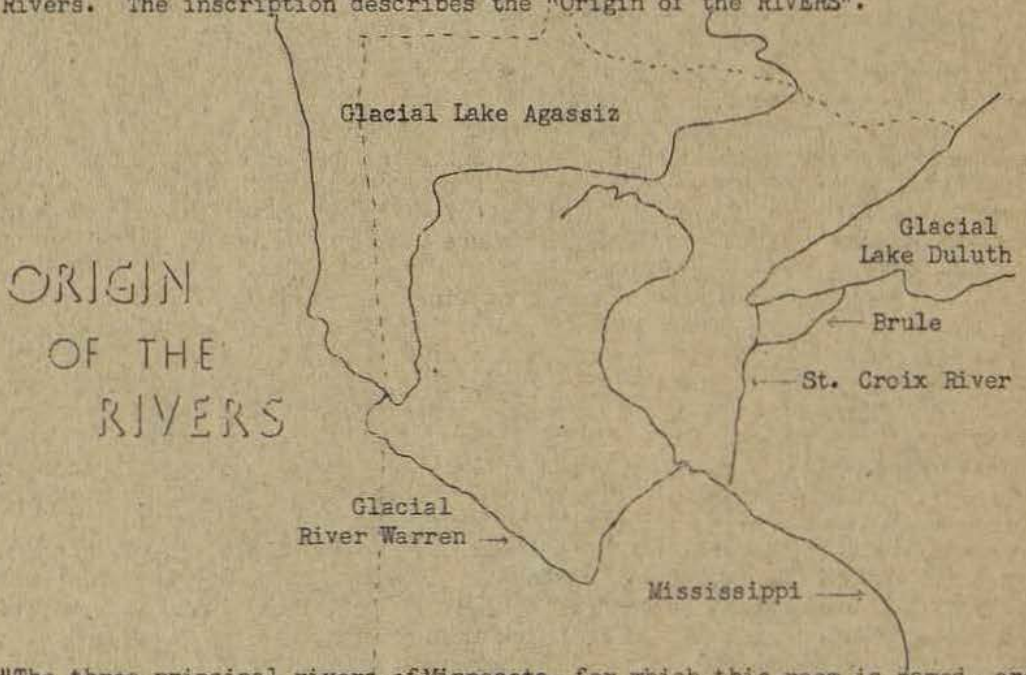
The snad and limestone walls of the gorge are composed of material deposited in Cambrian and Ordovician seas when the continent was submerged some 400 million years ago. The bottom of the gorge is 150 feet below the lake surface having been filled to its present elevation as the carrying power of the river decreased.

Lake Pepin also ha s a very interesting historical background. The present name first appeared on a French map of 1703, and about its shores centered many French military and trading activities of the late 17th and early 18th centuries. Augustine Rocque built a fur post at the foot of Lake Pepin in the early part of the 19th century. The settlement of Reads Landing, named for Charles Read, a settler of 1847, became an important steamboat and outfitting point for the Chippewa River lumber trade. Railraod building in the seventies ruined the river traffic, and with it, the towns. This lake, always dangerous, was dreaded by boatmen, and in 1890 the capsizing of the steamboat "Sea Wing" during a storm, cost about 100 lives.

ANOTHER PLAQUE

by ELSIE B. WESTMARK

In addition to the four bronze tablets which the Geological Society of Minnesota has erected at Taylors Falls, Gooseberry Park, Stillwater and Mankato, and the tablet placed at Reads Landing by the State Highway Department, there is a sixth plaque located on the wall of Schuneman's River Room Restaurant in St. Paul. This was dedicated by our Society during a dinner meeting in the restaurant on February 28th, 1950. The walls of the River Room are decorated with lovely handpainted murals of Minnesota rivers, and on one wall the artist has painted a large map of Minnesota, showing Glacial Lake Agassiz, Glacial Lake Duluth, Glacial River Warren, and the Mississippi, St.Croix and Brule Rivers. The inscription describes the "Origin of the RIVERS".



"The three principal rivers of Minnesota, for which this room is named, are important geological features of the state. Their valleys have been formed by water from melting glaciers which covered the region thousands of years ago.

The ice at its center in Canada attained a thickness of 10,000 feet and stored in its frozen mass hundreds of thousands of cubic miles of water. When the ice melted, the vast quantity of water scoured the valleys through which these rivers flow.

The main stream below St. Paul was the ancestral Mississippi which drained this area. A once mighty river, larger than the Mississippi at its mouth today, filled the present valley.

The ice blockade at the eastern outlet of the Great Lakes impounded water which filled them to overflowing. The water of Lake Superior, then Glacial Lake Duluth, was discharged to the south into the St. Croix. It was during that period, while the river was at flood stage, that the Dalles of the St. Croix, shown on these walls, were cut through the lava rock at Taylors Falls.

After the ice front retreated across the Continental Divide, the melt water was impounded in the northwestern part of the state to form Glacial Lake Agassiz, a magnificent body of water, which at its maximum was larger than the combined areas of the five great lakes today. The outlet of the lake was at Browns Valley, where Glacial River Warren had its source. For 10,000 years that great river carried the overflow from this lake and formed the wide and beautiful valley in which the Minnesota River now flows."

SUMMARY

The Franconia Formation of Minnesota and Wisconsin

by

Robert R. Berg

June, 1951

The Upper Cambrian Franconia formation was studied in its outcrop area of Southeastern Minnesota and West-Central Wisconsin in order to determine the nature and distribution of lithic units within the formation. The "Conference Classification" of Twenhofel, Raasch, and Thwaites (1935) proposed a faunal zonation of the Franconia formation and applied geographic member names to the zones. The "members" were established on faunal criteria and are not rock units, and these names have become established by usage as biostratigraphic terms. The present study has resulted in the discrimination of units of uniform lithic character, properly called members, and this procedure requires the rejection of previously proposed names.

The Franconia formation consists of fine- to coarse-grained, quartzose sandstones that range from 165 to 195 feet in thickness. Five distinct lithic units are recognized largely on the basis of glauconite content and to a lesser extent on such features as grain size, bedding, and the presence of carbonate or shale. The members are, in ascending order, the Woodhill coarse-grained sandstone, the Birkmose glauconitic sandstone, the Tomah sandstone and shale, and the Reno glauconitic sandstone. A fifth member, the Mazomanie sandstone, represents a non-glauconitic facies that interfingers with and replaces the glauconitic sandstones to the north and east.

The Woodhill member is the basal unit of the Franconia formation and at the type locality in Juneau County, Wisconsin, consists of a lower coarse-grained and poorly sorted sandstone that is 13 feet thick overlain by a medium-grained and well sorted sandstone 17 feet thick that carries the Elvinia fauna at the top. The base of the member in all outcrops is characterized by coarse-grained sandstone that overlies the uniformly medium-grained and well-sorted Galesville sandstone of the Dresbach formation. Garnet first appears in the heavy accessory mineral suite of the lower Woodhill and is lacking in the Galesville member. The maximum Woodhill thickness of 44 feet occurs at La Crescent, Houston County, Minnesota, where the member consists of a basal coarse-grained and poorly sorted portion, a middle coarse-grained but well-sorted portion, and an upper medium-grained portion that carries the Elvinia fauna. Here there is no change in the heavy minerals comparable to that at the Woodhill type section, for garnet is common in both the Galesville and Woodhill sandstones.

The Birkmose member consists of 27 feet of find-grained, glauconitic sandstones at the type section near Birkmose Park, Hudson, Wisconsin, and two rock types are present: greensand, a cross-bedded, highly glauconitic sandstone that may contain up to 50 percent of glauconite grains, and wormstone, a massive, buff to orange, glauconitic sandstone that contains abundant linear masses of gray silt that represent the filled borings of benthonic animals. At the top of the member is a two-foot bed of glauconitic, dolomitic, flat-pebble conglomerate, and this bed is interpreted as a terminal conglomerate formed at the end of the period of deposition characterized by the accumulation of sand and glauconite in current-agitated water. Along the Mississippi River in Houston County, Minnesota, the member ranges from 10 to 18 feet in thickness and consists of greensand and lenticular dolomite conglomerate beds. Eastward in Wisconsin the member thins to about 4 feet of greensand and dolomite conglomerate and in Central Wisconsin consists of 1 foot of interbedded greensand and shale.

The Tomah member consists of thinly-interbedded sandstone and shale that is 28 feet thick at the type locality near Tomah, Monroe County, Wisconsin. The sandstone is yellow to gray, very fine-grained to silty, and laminated, and is unique in its high content of authigenic orthoclase that occurs as overgrowths on detrital grains and as intersatitial cement. The compostion as determined from chemical analysis and petrographic data is as follows: orthoclase ($Or_{98}Ab_2$) 48.5 percent, quartz 43.7 percent, glauconite 4.9 percent, muscovite 2.2 percent, and minor amounts of collophane, leucoxene, garnet, tourmaline, and zircon. The Tomah is called a feldspathized sandstone in order to emphasize the petrologic character of the rock because the terms feldspathic sandstone and arkose are defined only on the basis of detrital feldspar content. The interbedded shale consists of equal amounts of silt and illite clay. The Tomah member is uniform in character but in the Lake Pepin - Lower Chippewa Valley area the member contains thin beds of wormstone. The Tomah is the most fossiliferous rock of the Franconia formation, and well-preserved molds represent species of the Conaspis or Ptychaspis faunas.

The Reno member consists of wormstone and greensand that have a total thickness of about 116 feet in the type section near Reno, Houston County, Minnesota. Beds of wormstone, similar to Birkmose wormstone except for a higher glauconite content are separated by thinner beds of cross-bedded greensand. Beds of laminated, glauconitic sandstone 1 to 3 feet thick also are present and often contain fossils of the Ptychaspis-Prosaukia or Dikelocephalus postrectus zones. Thin beds of greensand conglomerate are common, and the top of the Reno member is marked by a 1- to 6-foot bed of dolomitic, flat-pebble conglomerate.

The term Mazomanie formation was introduced by Ulrich (1920) for non-glauconitic, dolomitic sandstone in Central Wisconsin that contains the Prosaukia fauna, and he believed that the Mazomanie was younger than the Franconia formation. This sandstone actually represents a facies to the north and east of the more highly glauconitic Franconia sandstone, and the name Mazomanie member is applied here to this non-glauconitic facies. The Mazomanie member consists of two types of quartzose sandstone, a dolomitic, fine- to medium-grained, cross-bedded sandstone that is common in Central Wisconsin, and fine-grained, thin-bedded sandstone that is dominant in the St. Croix River Valley. The stratigraphic distribution of these two distinct types, called the cross-bedded and thin-bedded Mazomanie, cannot be determined in detail because of incomplete exposure in most areas.

The distribution of faunal zones of the Franconian Stage is largely independent of the lithic units of the Franconia formation. The Elvinia zone, characterized by Camaraspis convexa (Whitfield), is present at the top of the Woodhill member and in the Birkmose greensand. The Irvingella major ("Ptychopleurites") zone occurs in the lower Tomah member at only three localities in Central Wisconsin. Species of the Conaspis zone occur in the conglomeratic portion of the upper Birkmose member, in the Tomah member, and in the Mazomanie member. Several subdivisions of the Conaspis zone are recognized, the Eoorthis subzone below and the Taenicephalus subzone above, and the Taenicephalus subzone is divided into three teilzones that are characterized by common trilobite species that are, in ascending order, Parabolinoides palatus Berg n. sp., Maustonia nasuta (Hall), and Taenicephalus altus Nelson MS. The species of the teilzones have restricted and, in some cases overlapping ranges.

The Conaspis fauna, as well as higher Franconia faunas, is found to occupy successively higher stratigraphic positions when traced from the area in which the glauconitic sandstones are dominant into the areas in which the Mazomanie facies is prominent. Because the distribution of the teilzones is not controlled by sedimentary facies, they may be accepted as planes of essentially contemporaneous deposition. Therefore, the greensand and conglomerates of the Birkmose

member were formed in the West during the deposition of Tomah sandstone and shale in the East, and, similarly, the Tomah was deposited in the West while Mazomanie sandstone was formed in the East with an intermediate area of Reno sandstone deposition.

The Ptychaspis subzone is most common in the Reno greensand in outcrops along the Mississippi River but also occurs in the Tomah and Mazomanie members. The Prosaukia subzone is present in the Reno and Mazomanie members but shows an areal segregation of species according to rock type. An assemblage named the Prosaukia misa biofacies is present in the Reno member and in the thin-bedded Mazomanie sandstone, and an assemblage characterized by several different species of Prosaukia and named the Prosaukia longicornis biofacies, occurs only in the cross-bedded Mazomanie sandstone. The Dikelocephalus postrectus zone is found near the top of the Reno member in several sections.

The deposition of the Franconia formation began with the transgression of the sea from the southwest in the area of maximum Woodhill thickness and progressed northward and eastward to the Taylors Falls and Baraboo islands where conglomerates were formed by intensive wave action. After the period of relatively rapid transgression, deposition was characterized by an oscillating sea level with a near balance maintained between sedimentation and depression of the area. Glauconite was formed off shore in fine-grained sediments that were built up to wave base, agitated by currents, and washed of finer material to form the cross-bedded greensand of the Birkmose member. Deposition of the Tomah member took place nearer shore in quieter water in an environment of deposition that was areally restricted and existed in several places at different times. The sites of Tomah sedimentation migrated southward and westward and finally were replaced by deposition of the Mazomanie in the near shore environment and by greensands and wormstones of the Reno member in the off shore area. Intertonguing of the Reno and Mazomanie sandstones indicates a fluctuating depth of water. In most areas Mazomanie deposition began earlier than greensand deposition and the rate of sedimentation was more rapid as shown by the expansion of the Conaspia zone both northward and eastward. The final phase of Franconia sedimentation was marked by the spread of greensand over nearly the entire area and by the formation of terminal conglomerates, and no regressional sedimentation is indicated.

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EDITORS NOTE - For new members of our Society the above article deserves a word of explanation. It is a brief summary of the research work done by Dr. Robert R. Berg and submitted to the graduate school of the University of Minnesota in partial fulfillment of the requirements for the P. H. D. degree which was granted him in June 1951. The field work was done during the summers of 1949 and 1950, sponsored by our Society. The article serves to show the high quality of the work and the high caliber of the man whom our Society was privileged to sponsor. Dr. Berg now has an excellent position with the California (oil) Co. with offices in Denver. Before leaving Minneapolis he presented the Society with a copy of his entire thesis. This may be borrowed by any member of the Society upon request.

The following article was submitted by Mr. Ara P. Rickmire, one of our charter members, a local attorney who has devoted many years of study and research on the theory of "The Precession of the Equinox". He recently put into book form the findings and results of this research.

The Precession of the Equinox Movement.

Writers in geology and astronomy (those in the know) for nearly 21 centuries have agreed that the movement consists of a revolution of the earth on a vertical axis (westerly) one in every 25765 years. No position given except that the ends would be on the Arctic and AntArctic circles. (The north end is about on the bounday between Norway and Sweden).

The said writers have not been engineers and have overlooked two very important points of natural law.

1. To perpetuate the earth, nature devised the movement to keep centrifugal force from expanding the earth at the equator indefinitely, until the earth would have been nothing but a flat disc.
2. That the terrific momentum of a swift moving body turning in space will absorb a slow motion in the opposite direction without changing the poles as to the stars, of the fast moving body. Hence the slow movement of 6 feet per day westerly does not affect the position of the axis poles.

When these two points of natural law are admitted, there will be no trouble in establishing the cause of all earthquakes, recurring ice ages, volcanoes and the changing climate from time to time.

Contrasts of Climate.

To those who heard the lecture on and saw the views of Spitzbergen at the University, November 13, 1951, were shown the snow covered islands, and, as we term today, perpetually frozen ground. At the same time the audience heard and were shown evidence of ten billion tons of coal laid down in different periods of earth history which contradicts the perpetually frozen surface. The ten billion tons of coal means a tremendous amount of vegetation, mostly timber, grown on said islands in different periods of the past. This further, means little, if any, frost for long periods of time. The following is the explanation for the phenomena.

By reason of the precession of the Equinoxes, the islands today are in latitude about 80 degrees - 10 degrees from the axis pole. In 6000 years from now, the said islands will be in practically the same latitude as Scotland is today and will be in that same latitude for over 12000 years. This means that the said islands, with the help of the Gulf Stream, are, almost, frost free for one half of the time in every cycle of 25765 years. This is the reason for the vegetation that now shows up in the coal.

There will be no evidence of palm trees as there is in the vicinity of Fairbanks, Alaska nor of any coral as the climate of Spitzbergen never gets warm enough for that. The said islands are too close to the North Ecliptic Pole to have the variation of climate that Alaska shows today.

A. P. Rickmire.

GEOLOGIC HISTORY OF NORTH AMERICA
(After Fletcher—Pages 262-5)

ERA	PERIOD	CRUSTAL MOVEMENTS	DEVELOPMENT OF PLANTS AND ANIMALS	ROCKS
	CASCADIAN REVOLUTION. Mountains of the west elevated again, beginning in the Miocene and continuing to present time.			
CENOZOIC ERA Age of Mammals and Modern Seed Plants	RECENT (25000 yr.)	Elevation of marginal lands (coastal plains) Uplift continues in the west.	Man dominates the scene. Civilization begins.	Loose deposits only
	PLEISTOCENE (2 million yr.)	Glacial periods alternating with warmer intervals Grand Canyon being cut by rejuvenated Colorado River	Man appears in interglacial periods and develops from manlike ape to apelike man, to Heidelberg man, to Neanderthal man, to Cro-Magnon, to modern man.	Loose deposits of glacial origin
	PLIOCENE (10 million yr)	Elevation of the continent continues, particularly in the west. (Himalayas uplifted) Erosion in Grand Canyon begins. Climate cool	Appearance of manlike ape in Africa In England, eoliths (flints) made by man Primitive cats and dogs	Marls and continental deposits; sands, gravels, etc.
	MIOCENE (15 million yr)	Crustal disturbance in the west with extensive surface flows (igneous) Climate cool	Horses and elephants show development. (Tailless apes in Europe and Asia) Birds and trees modern	Sediments of all kinds including phosphate deposits
	OLIGOCENE (10 million yr)	Marginal seas only Equable climate A time of erosion	Elephants appear. Mammals dominate the lands and seas. Primates have disappeared in N. America.	Consolidated and unconsolidated sediments

ERA	PERIOD	CRUSTAL MOVEMENTS	DEVELOPMENT OF PLANTS AND ANIMALS	ROCKS
CENOZOIC ERA (Cont.)	EOCENE (20 million yr)	Only about 6% of continent covered and only on margins Climate mild	Rise of modern mammals, and birds First primates appear. Dominance of modern flowering plants (seed bearing)	All kinds of sediments, many of them unconsolidated
	LARAMIDE REVOLUTION. Rocky Mts. formed. Great igneous activity from Mexico to Alaska. Appalachians elevated again.			
MESOZOIC ERA Age of Reptiles and Medieval Seed Floras	CRETACEOUS (60 million yr)	Widespread submergence of the continent for the last time	Extinction of dinosaurs at end of period Birds and mammals begin. Modern flowering plants appear with great increase of modern insects.	All kinds of sediments, but very often they are unconsolidated Chalk present
	JURASSIC (30 million yr)	Nevadian Revolution at end of period, forming Sierra Nevada, Coast Range, and other mountains Appalachians peneplaned Pacific waters encroached on land. Climate arid	Giant reptiles (dinosaurs) Toothed birds Primitive mammals Modern insects appear. Cycads and conifers dominant Conifers become modern	Sandstone, shale, and limestone with gypsum
	TRIASSIC (30 million yr)	Palisade disturbance ends period, accompanied by volcanic activity Continent emergent Submerged only on margins Arid climate	Dominance of reptiles First mammals Cycads and conifers the most common plants	Sediments, but no limestones Igneous intrusions and surface flows

The events of geologic history outlined in this table correspond to the rocks as we find them. The rocks on top give us the history of most recent times. To read geologic history, like human history, beginning with the earliest times, this table must be read from the bottom up, starting on page 4.

ERA	PERIOD	CRUSTAL MOVEMENTS	DEVEL'T OF PLANTS AND ANIMALS	ROCKS
	APPALACHIAN REVOLUTION. Upflift of Applachian region. Prounounced mountain-making epoch, the world over.			
PALEOZOIC ERA Age of Invertebrates and Marine Floras	PERMIAN (40 million yr)	Continent emergent Climate cold Widespread aridity	Extinction of trilobites and many other invertebrates Development of reptiles Disappearance of many old types of plants. Rise of seed floras	Sediments, including much salt
	PENNSYLVANIAN (40 million yr)	Repeated rise and fall of land Warm and moist climate Much swampland, resulting in great coal deposits	Great forests of scale trees and ferns (spore-bearing) First reptiles Insects numerous and large	Chiefly shales with much coal
	MISSISSIPPIAN (30 million yr)	Toward end of period, mountains raised in S. E. Canada and southern Appalachians During most of period, land submerged and warm	Crionoids numerous Fishes well developed Amphibians numerous Forests of ferns and conifers	Sandstones, shales, and many limestones
	DEVONIAN (40 million yr)	Acadian disturbance ends period. Mountains raised in N. Hampshire, Vermont, Maine, and near-by Canada. Volcanic activity	Marine fishes numerous First amphibians Brachiopods prominent First forest (tree ferns)	Chiefly limestones; but other sediments found
	SILURIAN (30 million yr)	Widespread submergence in the central continent No mountain making, but local volcanic activity	First land animals (scorpions) appear. Abundance of reef corals First land plants	Conglomerates, sandstones, and shales with many limestones
	ORDOVICIAN (60 million yr)	Taconic and Green Mts. raised at end of period 60 % of continent submerged	Invertebrates still dominant, but first vertebrates appear. Beginning of corals and fresh-water fishes	Widespread limestones Slate in Vermont
	CAMBRIAN (100 million yr)	30% of N. America submerged Climate mild	fossils very numerous All kinds of marine animals except vertebrates appear. Trilobites dominant	Chiefly sedimentary, some metamorphosed, very little igneous

In Memoriam

Effie Burch McWethy was born in Menomonie, Wisconsin, in October 1884. She was educated at Milwaukee Downer and at the Chicago Art Institute and she taught art in the State Teachers College in Duluth. She was married to Hal McWethy in 1915 and they leave one son, David B. of Minneapolis. She died on November 2nd, 1951.

Mrs. McWethy's interest in the Geological Society precedes that of its founder, her brother, Edward Burch. Before there was any organization she was proud of Edwards study of geology and his determination to share his acticities with people of all ages. She herself gave more time to the study of birds and through a program of year around feeding she filled her garden at all seasons with birds rarely seen in the city.

Mrs. McWethy contributed of her talents to the work of her church and to the St. Anthony Park Public Library. The tribute paid at her memorial service for that unselfish effort was a very beautiful thing. Her own scientific achievements are quite unknown to most of her friends. Her brother, Dr. Frank Burch persuaded her to learn to use the ophthatmoscope, and at Miller Hospital she made water color paintings of the retina of the eye. No one without great ability and infinite patience could have done this exacting work. Some of her paintings have been published and some are still on exhibition at the University of Minnesota in the collection for teaching purposes established by Dr. Burch. However, no accomplishment of Mrs. McWethy's compare with her own friendliness and personal warmth. The members of the Geological Society will agree with her rector who said, "She was able to bring to all she touched a health and vitality, for she radiated the fruits of the spirit." The Society has lost one of its most beloved members.

Mrs. L. W. King.

It is with regret we announce the passing of Paul Denkowitz on Friday, November 30, 1951. Services were held at Gill Brothers Chapel.

Mr. Denkowitz was of a retiring disposition never seeking the limelight, thus perhaps was not too well known to most of our members. It was apparent to all of us however, that he was intensely interested in the natural sciences. A real student, one who was tireless in his pursuit of knowlege. Mr. Denkowitz was a member of the Geological Society since 1940 and an ardent member of the Astronomy and Audubon Clubs. He will be missed by his many friends.

Loretta E. Koppen.

In Memoriam

Benjamin A. Pratt was born on November 11, 1883, at Madison Wisconsin. His people moved to Minneapolis in 1892. When he was in High School his family operated a small dairy. In addition to his full share of dairy work he kept up his High School studies and played on the football team. After the dairy was sold he worked in a grocery store. Here one day the first grapefruit came in. A customer asked how much they were. Ben said 10 cents apiece or 2 for a quarter. The man said he'd take a quarters worth and Ben sold them to him.

After High School he attended the University of Minnesota and graduated in civil engineering. As a civil engineer he laid out the Kings Highway. He also designed the curves in the 3rd Avenue bridge. He taught at South High School from 1919 to 1940 when he retired to care for his wife who was ill.

Mr. Pratt was an active church worker and choir singer. Before the Y.M.C.A built its many facilities here he managed a gymnasium in connection with his church work.

On Sunday evening, December 23, 1951, he died suddenly of a heart attack while driving home in his car.

His son Perry H. is a Captain in the Air Force stationed in Germany and was unable to come home for the funeral.

The funeral services were held in St. Lukes Episcopal Church. The text used "He was moved with compassion toward them, and He began to teach them many things". Mark 6th Chapter, 34th Verse.

He will be buried at Sunset Memorial Park when his son returns. Mr. Pratt was a member of the S.A.E. Fraternity and a member of the Geological Society of Minnesota. He took a great interest in the Society and was a member of the Bulletin staff. His willingness to give his time and effort whenever needed and his kindly unselfish disposition won many friends everywhere.

Mrs. Helen Howard.

The following poem by Mr. Pratt was submitted to us several months ago and we feel it is not only appropriate but fitting to his memory to publish it at this time.

A Philosophical New Year
by Benj. A. Pratt.

The New Year has been welcomed
And held to high appeal
The Old Year started out the same
But turned out to be real

Let's remember our successes
Our failures, let's forget
Some things we planned on doing
We just haven't reached as yet

Still, of course, we start again
It can't be otherwise
With hope and faith and sturdiness
Our fears will minimize

Mr. Hal E. McWethy
2174 Dawson Ave.
St. Paul