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NEWSLETTER

Minnesota Geological Survey

Second Issue, June 1963

Minnesota Geological Survey

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CONTENTS

	Page
Responsibilities of the Survey.....	1
Activities.....	2
Fiscal statement.....	3
Natural Resources Bill.....	3
Staff notes.....	4
Current projects.....	5
Projects to start July 1.....	8
Noteworthy results of current projects.....	9
Publications.....	10
Papers presented during the year.....	11
Other publications on Minnesota geology.....	11
Notes.....	13
Topographic mapping in Minnesota.....	14
Other geologic activities in the State.....	15

RESPONSIBILITIES OF THE SURVEY

The Minnesota Geological Survey was established by an Act of the State Legislature in 1872, and its administration was entrusted to the Board of Regents of the University of Minnesota. The Survey has the responsibility for conducting investigations of the geology of Minnesota for the benefit of the citizens and industries of the State. This responsibility is carried out by geologic mapping of the rock strata, by research on the occurrence, quality and usefulness of geological mineral resources, and by publication of the results.

ACTIVITIES

The activities of the Geological Survey may be grouped into three main categories (1) geologic mapping and research on the State's mineral resources, (2) serving as a clearinghouse for geologic and mineral resource information, and (3) public education. Emphasis during the past year was placed on the first two functions.

Geologic mapping is the basic element in development of natural resources. Although the current mapping program is small with respect to the total needs of the State, two important projects are in progress: (1) An intensive investigation of the Precambrian rocks in Lake County, east of Ely. This is the first phase of a long range program to study the structure, stratigraphy, petrology, and mineral deposits of the Duluth Gabbro Complex and the adjacent older metamorphic and granitic rocks. The ultimate objective is to determine the economic potential of the mineral deposits of the region, with special emphasis on the copper-nickel mineralization in the gabbro and on the sulfide mineralization and iron ore deposits in the older rocks. The copper-nickel deposits in a part of the area have been explored by private mining companies and by the U. S. Bureau of Mines, and are of considerable economic interest. (2) A comprehensive study intended to develop basic geologic data needed for the solution of growing problems of urban development and industrial and highway construction in the Twin Cities metropolitan area. The surficial glacial deposits are being mapped at a scale of 1 inch equals 2,000 feet, and the deposits will be classified so as to be of maximum use for engineering purposes. A subsurface geologic map, which will be a revision of the earlier, extremely valuable map of G. M. Schwartz (Minnesota Geological Survey Bulletin 27, published in 1936), is being prepared at the same scale (1 in. = 2,000 ft.). These and other projects are discussed further in a subsequent section.

An increased number of requests were received from the public and the mineral industry concerning geologic and mineral resource information. A substantial proportion of these requests concerned the engineering geology and water resources of the Twin Cities area. Educational work was continued through correspondence, the distribution of pamphlets to students and the layman, and an exhibit at the State Fair. Many samples of geologic materials brought or sent to the Survey office were identified. Matters pertinent to the geologic and mineral resource development of the State were discussed by members of the staff before civic clubs, chambers of commerce, and other public organizations.

A field conference sponsored by the Survey was held in the Ely area on August 28 - 29, at the conclusion of the summer's field work in the Gabbro Lake quadrangle, Lake County. It was attended by 20 geologists from private industry and universities. Leaders for the conference were Dr. W. C. Phinney, in charge of mapping the Duluth Gabbro Complex, and Dr. J. C. Green, in charge of mapping the pre-Keweenawan rocks. Paul Weiblen, graduate student in the Department of Geology, led part of the trip into the gabbro. An informal evening meeting was held during the evening of August 27.

Tentative plans have been made with the Director of the Mines Experiment Station, Dr. J. M. Lawver, for cooperative studies of the nonmetallic minerals of the State. In broad terms, the Survey will be responsible for geologic and mineralogic studies and the Station will be responsible for technologic studies.

FISCAL STATEMENT

The Survey's activities are financed by money appropriated by the State Legislature to the University. During the fiscal year 1962-63, \$35,000 was appropriated directly to the Survey as a special item and \$24,490 was received from University support funds. An additional \$4,057 was received from sales and services.

Available funds, 1962-63

\$35,000 - Special appropriation
24,490 - University support funds
4,057 - Income from sales and services

\$63,547 - Total

The appropriation for fiscal year 1963-64 has been increased to \$82,932, as follows:

\$55,000 - Special appropriation
27,932 - University support funds

\$82,932 - Total

NATURAL RESOURCES BILL

The Natural Resources Bill passed by the 1963 State Legislature carries provisions for topographic mapping, geologic mapping, and mineral surveys. A \$5 million program for these items was approved for the 10-year period. Two hundred thousand dollars was appropriated for each of the next two years; allotments for the first fiscal year are as follows:

\$163,000 - Topographic mapping
| 30,000 - Aeromagnetic surveys
7,000 - Aerial photographs

The State Survey has the responsibility for interpreting the data obtained by the aeromagnetic surveys. During the next biennium we will cooperate with the U. S. Geological Survey in these studies.

It is anticipated that our role in the program will increase steadily in future years through participation in geologic mapping and mineral resources programs.

STAFF NOTES

Two new appointments to the staff, effective July 1, have been made.

Mr. Rudolph K. Hogberg has been appointed as Research Fellow and Assistant to the Director. He will carry on research on industrial minerals in the State. Hogberg has a Bachelor of Science degree (1952) in geology and a Master of Science degree (1957) in geology from Michigan State University. He was employed by the Carter Division of Humble Oil Company from 1952 to 1956 and was a geologist with the Northern Pacific Railway from 1957-1962. During the past year he has been an Instructor in the Department of Geology and Geophysics of the University of Minnesota.

Mr. Edward J. Cushing has been appointed half-time as a Research Fellow to conduct studies in glacial geology and palynology (pollen study). Half-time will be devoted to supervision of the pollen laboratory in the Department of Geology and Geophysics and the Limnological Research Center. Cushing has a Bachelor of Arts degree (1954) in geology from Washington University in St. Louis and is nearing completion of his ph.D. degree in geology at the University of Minnesota.

A position in clay mineralogy has been authorized for the next year (beginning July 1). A split appointment will be made with the Mines Experiment Station.

Mr. C. Marshall Payne will leave the staff on September 1. He will enter the Graduate School at the University of Arizona in the fall.

CURRENT PROJECTS

1. Duluth gabbro complex, Lake County

Project chief: Dr. W. C. Phinney

Geologic mapping of Gabbro Lake 15-minute quadrangle and adjacent Greenwood Lake 15-minute quadrangle in the central part of the complex; studies of petrology, structure, titaniferous magnetite deposits, and copper-nickel deposits. Geologic mapping was begun in 1961; it will be completed this year. Project is the first phase of a long-range study of the gabbro complex, which will be supported in part by National Science Foundation funds.

2. Granite Falls-Montevideo area, Minnesota River valley, Medicine and Chippewa counties

Project chief: Glen R. Himmelberg
Supervisor: Dr. W. C. Phinney

Geologic mapping, petrology, and structure of Precambrian rocks in a part of the Minnesota River valley. Mapping was begun in 1961; it will be completed this year. Project is supported in part by National Science Foundation funds. The project is the initial phase of a restudy of the rocks of southwestern Minnesota, needed to interpret the regional aspects of the geology of the Precambrian rocks. (See note on age of the Morton gneiss.) Project will be completed this year.

3. Brown iron ores, Fillmore County

Project chief: R. L. Bleifuss

A study of the occurrence, distribution, and origin of the iron ores. Study has been completed and the final manuscript is nearing completion.

4. Pre-Keweenawan rocks, Gabbro Lake quadrangle, Lake County

Project chief: Dr. J. C. Green

Geologic mapping of the metamorphic and igneous rocks in the quadrangle. Mapping was started in 1962; estimated completion date 1964. First phase of an intensive study of the pre-Keweenawan rocks of north-eastern Minnesota.

5. Conodont zonation, Upper Ordovician rocks, southeastern Minnesota

Project chief: G. F. Webers
Supervisor: Dr. R. E. Sloan

A paleontologic investigation to determine conodont zonation in Upper Ordovician rocks as an aid in subsurface correlation. Project will be completed this year.

6A. Engineering and glacial geology of the Minneapolis-St. Paul metropolitan area

Project chief: Dr. J. E. Stone

A long-range comprehensive restudy of the surficial deposits. Geologic mapping was started in 1962. The study is intended to result in a new geologic map of the area and a comprehensive summation of the engineering properties of its rocks and soils as related especially to urban development. A reconnaissance geomorphic map has been completed of fifteen 7½-minute quadrangles. Maps of the New Brighton, White Bear Lake West, and St. Paul East 7½-minute quadrangles will be completed this year.

6B. Subsurface geology of the Minneapolis-St. Paul metropolitan area

Project chief: C. Marshall Payne

A revision and up-dating of all available subsurface data in the metropolitan area. Well cuttings are being collected and studied and available well logs are being assembled. A revised subsurface geologic map of the metropolitan area is being prepared; first phase should be completed this fiscal year. The project is supported in part by the Division of Waters, State Department of Conservation.

7. Magnetometer survey of McLeod county and adjacent areas

Project chief: G. S. Austin

Ground magnetic investigations, to investigate anomalous positive airborne magnetometer anomalies. Project completed and report has been prepared.

8. Organic sediments of Minnesota lakes

Project chief: Dr. F. M. Swain

Continuing long-range studies of lakes in Minnesota, largely supported by funds from other sources. Two lakes in northern Minnesota were sampled in 1962.

9. South Lake quadrangle, Cook County

Project chief: G. B. Morey

Supervisor: Dr. F. M. Swain

Geologic mapping of Gunflint Iron-Formation, Rove Slate, and diabasic gabbro sills in the slate, with emphasis on the stratigraphy and structure of the Rove Slate. Mapping of slate completed in 1962. Stratigraphic studies of Rove Formation are to be continued to east in Cook County this field season.

10. Clay resources and stratigraphy of the Decorah Shale, southeastern Minnesota

Project chief: C. M. Gallick

Supervisor: Dr. F. M. Swain

Study has been completed and manuscript is in preparation.

11. Pre-Keweenawan rocks, Forest Center and Ensign Lake quadrangles, Lake County

Project has been recessed.

12. Paleontology of Decorah Shale, southeastern Minnesota

Project chief: Olgerts L. Karklins
Supervisor: Dr. F. M. Swain

A study of Ordovician cryptostome bifoliate Ectoprocta, as an aid in subsurface correlation. Field study has been completed and manuscript is nearing completion.

13. Reconnaissance glacial geology in parts of Pine and Kanabec counties

Project chief: E. J. Cushing
Supervisor: Dr. H. E. Wright

Geology and palynology of surficial deposits in Grantsburg sub-lobe (Valders) of Des Moines lobe. Part of current restudy of the glacial geology of the State, intended to provide a basis for reclassification of the Pleistocene materials and investigations of the resources and engineering properties of the surficial deposits.

14. Reconnaissance glacial geology, Pine county

Project chief: R. G. Baker
Supervisor: Dr. H. E. Wright

A study of Pleistocene surficial deposits adjacent to former Glacial Lake Upham. Purpose similar to 13, above. Study has been completed and manuscript is in preparation.

15. Geologic map of Paleozoic rocks, southeastern Minnesota

Project chief: Dr. R. E. Sloan
Assisted by: G. S. Austin

Compilation of all available geologic data in St. Paul, Mason City, La Crosse, and Eau Claire 1:250,000 AMS topographic sheets. All available outcrop data has been compiled; additional subsurface data will be collected this field season. Map will be published as part of a geologic atlas for Minnesota, a revision of the state geologic map. Field work should be completed this year.

16. Gravity investigations, southeastern Minnesota

Project chief: Dr. J. C. Craddock

An investigation of the positive gravity anomaly (Midcontinent gravity high) that extends through southeastern Minnesota into Iowa. During the past year additional closely-spaced gravity stations were established in the Twin Cities area. A report on the first phase has been completed and submitted for publication.

17. Clay resources, Goodhue and Wabasha counties
Project chief: G. S. Austin

A study of the occurrence and distribution of clay deposits in a broad area south of Red Wing. Study has been completed and manuscript has been prepared.

18. Aeromagnetic map of east-central Minnesota
(Cooperative project with U. S. Geological Survey; Isidore Zietz, U.S.G.S., P. K. Sims, M.G.S.)

Geophysical and geologic interpretation of anomalies above the Keweenaw basin of eastern Minnesota and adjacent pre-Keweenaw rocks. Report in preparation.

19. Reconnaissance of Knife Lake areas, northeastern Minnesota
Project chief: Dr. Tibor Zoltai

A geologic reconnaissance to locate porphyry bodies and sulfide mineralization. First phase completed.

PROJECTS TO START JULY 1

1. Geology and mineral resources, NE Babbitt 7 $\frac{1}{2}$ -minute quadrangle (Dunka River area) St. Louis County
Project chief: Bill Bonnicksen
Supervisors: Dr. P. K. Sims; Dr. H. L. James

Geologic mapping and mineralogic investigations of the taconite resources of the Biwabik Iron-Formation and the copper-nickel resources of the Duluth Gabbro Complex. The Biwabik Iron-Formation is metamorphosed and intruded by the Duluth Gabbro Complex in the Dunka River area. A new pit will be opened in the taconite during 1963 or 1964 to provide additional iron ore for the taconite plant of Erie Mining Company at Hoyt Lakes, Minnesota. The copper-nickel deposits within the gabbro are potentially important commercially. The project is expected to have a duration of 2 years.

2. Revision of State Surficial (Glacial) Map
Project chief: Dr. H. E. Wright, in
collaboration with Dr. J. E. Stone and
E. J. Cushing

A regional reconnaissance of at least two-year duration is planned as a first step toward revising the glacial map of the State. The objectives are (1) to prepare a glacial-geomorphic map of the State, possibly at a scale of 1:1,000,000, that will indicate the distribution of moraines, outwash plains, drumlin fields, washboard moraines, drainageways, eskers and other ice-contact features, glacial lakes, and other related geomorphic features, (2) acquire data on the stratigraphic as well as the geomorphic units, and, possibly, (3) prepare an atlas of annotated air photographs for publication.

3. Industrial mineral resources

Project chief: R. K. Hogberg

A long-range investigation of the State's known and potential industrial minerals and rocks. The study is intended to result in an inventory of the non-metallic mineral deposits and a comprehensive summation of the geologic factors controlling the locations of the deposits.

NOTEWORTHY RESULTS OF CURRENT PROJECTS

Duluth Gabbro Complex

Mapping and petrologic studies of the Duluth Gabbro Complex in the Gabbro Lake and Greenwood Lake quadrangles by W. C. Phinney and Paul Weiblen (project 1) have indicated a complex series of gabbroic intrusions associated with antiform and basin-like structures. Two major intrusive bodies have been recognized: (1) a cone-shaped body in the southeast quarter of the Gabbro Lake quadrangle and the north-central part of the Greenwood Lake quadrangle that intrudes anorthositic gabbro; it varies regularly from olivine-rich gabbro at the border to pyroxene-rich at the center, (2) a broad, shallow basin of olivine gabbro in the southwest quarter of the Gabbro Lake quadrangle; the gabbro apparently cuts anorthositic gabbro. The recognition for the first time that some of the rocks along or near the basal contact of the gabbro are younger intrusions is significant to an interpretation of the copper-nickel mineralization related to the Duluth Complex.

Glacial geology

It has been presumed that the glacial topography of the Twin Cities area resulted primarily from deposition by the Superior ice lobe, which deposited the St. Croix end moraine in this area, and that this topography was modified very little by the Grantsburg sublobe which subsequently crossed the area. This interpretation was logical because gray, silty Grantsburg-type till occurs as thin patchy deposits on top of red, sandy Superior-type till. Recent work, however, indicates that most of the till originally deposited by the Superior lobe in much of the Twin Cities area probably was picked up by the Grantsburg sublobe and redeposited without drastically modifying its composition or texture. Thus, the topography in much of the area actually was produced by the Grantsburg sublobe instead of by the Superior lobe. This new interpretation makes it possible to use the geomorphology of the area in conjunction with the recognition of previously unmapped lake deposits, outwash deposits, terraces, and drainage ways to reconstruct in detail the retreat of the Grantsburg sublobe from the area. Recent work also indicates that the Grantsburg sublobe was somewhat more extensive than was thought previously.

Reconnaissance for sulfide ore minerals

Geologic reconnaissance of areas in northeastern Minnesota underlain by the Precambrian Knife Lake Slate by Tibor Zoltai has disclosed sulfide mineralization associated spatially with quartz porphyries in three areas: (1) near Vermilion Lake in St. Louis County, (2) eastern part of the Knife Lake area, Lake County, mapped earlier by J. W. Gruner, and (3) the Virginia Horn area, St. Louis County. Chalcopyrite was identified in association with pyrite at two localities; gold was identified from two localities in the Virginia Horn area. The geology of these areas sufficiently resembles that of areas containing commercial copper-nickel-zinc deposits in the Eastern Townships, Quebec and the Bathurst area, New Brunswick, Canada to warrant further studies.

PUBLICATIONS

Publications issued by the Survey during the year

Bulletin 43. The geology of the East Mesabi District, Minnesota, by James Gundersen and G. M. Schwartz, 1962 (139 pages).

Manuscripts transmitted to University Press for publication

Geologic Map GML, Bedrock geology of Duluth and vicinity, St. Louis County, Minnesota, by R. B. Taylor (23 typed p., 1 colored geologic map).

Bulletin 37 (revised edition), Minnesota's rocks and waters, by G. M. Schwartz and G. A. Thiel. (The revised edition will be available by fall; more than 9,700 copies have been sold since publication in 1954.)

Manuscripts completed - but not yet transmitted

1. Taylor, R. B., The Duluth Gabbro Complex near Duluth, Minnesota (70 typed p., 18 text figs., 1 colored geologic map).
2. Sloan, R. E., The Cretaceous System of Minnesota (50 typed p., 10 illus.).
3. Austin, G. S., Geology of clay deposits of the Red Wing area, Goodhue and Wabasha counties, Minn. (28 typed p., 8 illus.).
4. Sims, P. K., and Austin G. S., Geologic interpretation of magnetic map of McLeod County, Minnesota.

Publications by staff members outside the Survey

1. Sims, P. K., 1963, Rock hunting in Minnesota: Earth Science, v. 16, no. 3, p. 107-110.

PAPERS PRESENTED DURING THE YEAR

The following papers were presented orally by Survey personnel at the 9th Annual Institute on Lake Superior Geology meetings in Duluth, May 2 - 3, 1963:

1. Buried extension of the Keweenaw basin in Minnesota - a geophysical study - Isidore Zietz and P. K. Sims
2. Geologic interpretation of aeromagnetic anomalies over Pre-Keweenaw rocks in central Minnesota - P. K. Sims and Isidore Zietz
3. Structure within the Duluth Gabbro Complex in the Gabbro Lake and Greenwood Lake quadrangles, Minnesota - W. C. Phinney
4. The thermal effect of the Duluth Gabbro upon the Snowbark granite - G. N. Hanson, W. C. Phinney, and P. W. Gast
5. The relationships between the Duluth Gabbro and the dikes and sills near Hovland, Minnesota - N. W. Jones
6. The stratigraphy and structure of the Rove Formation, Gunflint Lake area, Minnesota - G. B. Morey
7. Structures of concretions in the Thomson Formation, Carlton and Pine counties, Minnesota - Paul Weiblen
8. Clay mineralogy of the Decorah shale, Minnesota - C. M. Gallick
9. The subdivisions of the Biwabik Formation on the eastern Mesabi - G. M. Schwartz

OTHER PUBLICATIONS ON MINNESOTA GEOLOGY

1. Sloan, R. E., and Danes, Z. F., 1962, A geologic and gravity survey of the Belle Plaine area, Minnesota: *Minn. Acad. Sci. Proc.*, v. 30, no. 1, p. 49-52.
2. Bath, G. D., 1962, Magnetic anomalies and magnetizations of the Biwabik iron-formation, Mesabi area, Minnesota: *Geophysics*, vol. 27, no. 5 (Oct. 1962), p. 627-650.
3. Maclay, R. W., and Schiner, G. R., 1962, Aquifers in buried shore and glaciofluvial deposits along the Gladstone beach of Glacial Lake Agassiz near Stephen, Minnesota; in *Geological Survey Research 1962: U. S. Geol. Survey Prof. Paper 450-D*, p. D170-172.

4. Norvitch, R. F., 1962, Geology of the Vermilion end moraine, Nett Lake Indian Reservation, Minnesota; in Geological Survey Research 1962: U. S. Geol. Survey Prof. Paper 450-D, p. D130-132.
5. Anderson, L. A., Zandle, G. L., and others, 1962, Aeromagnetic map of Norman and part of Mahnomen counties, Minnesota: U. S. Geol. Survey Geophysical Investigations Map GP-325.
6. Anderson, L. A., Petrafeso, Frank, and others, 1962, Aeromagnetic map of parts of Clay, Wilkin, and Otter Tail counties, Minn.: U. S. Geol. Survey Geophysical Investigations Map GP-327.
7. Anderson, L. A., Zandle, G. L., and others, 1963, Aeromagnetic map of parts of Clay and Becker counties, Minnesota: U. S. Geol. Survey Geophysical Investigations Map GP-326.
8. Meuschke, J. L., Tyson, N. S., and others, 1963, Aeromagnetic map of the northern part of Lake County, Minnesota: U. S. Geol. Survey Geophysical Investigations Map GP-360.
9. Jelgersma, Saskia, 1962, A late-glacial pollen diagram from Madelia, South-central Minnesota: American Journal of Science, v. 260, p. 522-529.
10. Fries, Magnus, 1962, Pollen profiles of Late Pleistocene and Recent sediments from Weber Lake, Minnesota: Ecology, v. 43, p. 295-308.
11. Zablocki, C. J., 1961, Electrical properties of sulfide-mineralized gabbro, St. Louis County, Minn.: in Geological Survey Research 1961: U. S. Geol. Survey Prof. Paper 424-C, p. C256-258.
12. Goldich, S. S. and Hedge, C. E., 1962, Dating of the Precambrian of the Minnesota River valley, Minnesota (Abs.): Jour. Geophysical Research, v. 67, p. 3561-3562.
13. Catanzaro, E. J., 1963, Zircon ages in southwestern Minnesota: Jour. Geophysical Research, v. 68, p. 2045-2048.
14. Shields, W. R., Garner, E. L., Hedge, C. E., and Goldich, S. S., 1963, Survey of Rb⁸⁵/Rb⁸⁷ ratios in minerals: Jour. Geophysical Research, v. 68, p. 2331-2334.
15. Anderson, L. A., Hawkins, Daniel, and others, 1963, Aeromagnetic map of parts of Wilkin, Otter Tail, Grant, and Traverse counties, Minnesota: U. S. Geol. Survey Geophysical Investigations Map GP-378.
16. Anderson, L. A., Tyson, N. S., and others, 1963, Aeromagnetic map of the northwestern part of Cook County, Minnesota: Geophysical Investigations Map GP-361.

NOTES

Minnesota has oldest known rocks on the North American continent

Zircons contained in the Morton and Montevideo gneisses in the Minnesota River valley, southwestern Minnesota, have been found to have the oldest ages so far determined by the lead-uranium method for this continent. A minimum age of 3,300 million years was determined for these rocks. A discussion of the results are published in the April 1, 1963 issue of the Journal of Geophysical Review, by E. J. Catanzaro of the U. S. Geological Survey. The study is a continuation of the age studies by S. S. Goldich and colleagues on Minnesota rocks; the first phase of the study was described in Bulletin 41 of the Minnesota Geological Survey. Because of the importance of the Minnesota River valley area to an understanding of the Precambrian history of Minnesota, the State Survey is remapping a part of this area (Glen Himmelberg, project 2) to determine the detailed relations of the exposed rocks in the area between Morton and Montevideo.

Highest point in Minnesota

Topographic mapping recently completed in northeastern Minnesota by the U. S. Geological Survey indicates that Eagle Mountain in Cook County, 4 miles southeast of Brule Lake, is the highest point in Minnesota. Eagle Mountain is in the Eagle Mountain 7½-minute quadrangle, in T.63N., R.2W., and has an altitude of 2,301 feet above sea level.

The Survey's function as a clearing house

An important function of a State Geological Survey is to serve as a clearing house for all types of geologic and resource data. Information collected by or submitted to the Survey is maintained in permanent files, and is made available for the use of State agencies, industry, and the citizens of the State.

Efforts are being made to increase the size and scope of our files, to meet the increasing need in the State for all types of information regarding our mineral resources, geology, engineering properties of soils, and water. We urge industry to assist in this task, by providing us with resource information of lasting value, by depositing geologic and resource materials such as drill cores and water-well samples, and by informing us of activities that would furnish good exposures of bedrock or surficial materials. These data will contribute to a better understanding of the geology and resources of our State and will enable the Survey to provide industry and interested parties with up-to-date information.

Underground gas storage chamber, near Erskine, Polk County, Minnesota

An underground gas storage chamber that has a capacity of about 330,000 barrels was completed by Signal Oil and Gas Company in the northwestern part of the State in the past year. The excavation is mainly in an altered, highly variable calc-silicate rock, of Precambrian age, which is unlike any known exposed rocks in the State. The bedrock is covered by about 430 feet of unconsolidated materials, dominantly of Pleistocene age.

TOPOGRAPHIC MAPPING IN MINNESOTA

During the year ending June 30, 1963, 21 topographic maps in Minnesota were published by the U. S. Geological Survey. A total of \$85,993 in State funds, from the Division of Waters, Department of Conservation and from the Iron Range Resources and Rehabilitation Commission, was matched by Federal funds. An additional \$214,294 for topographic mapping in the State was supported entirely by Federal funds. The topographic maps are quadrangle maps that cover unit areas bounded by parallels and meridians, and are either 7½-minute (scale: 1:24,000) or 15-minute (scale: 1:62,500) maps.

Topographic mapping in Minnesota has progressed satisfactorily since 1949, when the State Legislature appropriated \$100,000 for the biennium for mapping to be done on a 50-50 matching basis with the U. S. Geological Survey. At this time it also created the State Mapping Advisory Board to advise the Commissioner of Conservation in the administration of the cooperative program. The board is composed of the Commissioners of Aeronautics, Agriculture, Business Development, Highways, Iron Range Resources and Rehabilitation, Taxation, and the Director of the Minnesota Geological Survey, together with one member appointed by the Governor to represent the public at large. It meets annually and presents its recommendations for areas to be mapped. It also serves to keep the progress and future needs of the mapping program before the public and the Legislature. Dr. G. M. Schwartz, emeritus Director of the Survey and member at large, currently is chairman of the Advisory Board.

The funds expended in Minnesota for topographic mapping during the period July 1, 1893 - June 30, 1962 are as follows:

<u>Period</u>	<u>Total State</u>	<u>Federal Matching</u>	<u>Total State and Federal Coop. Prog.</u>	<u>Federal non-Matching</u>	<u>Total Federal</u>	<u>Total Federal and State</u>
1893-1909				17,400	17,400	17,400
1910-1917	61,362	55,504	116,866		55,504	116,866
1930-1948	7,087	6,077	13,164	5,472	11,549	18,636
1949-1962	<u>1,120,054</u> *	<u>1,129,109</u>	<u>2,249,163</u>	<u>2,092,887</u>	<u>3,221,996</u>	<u>4,342,050</u>
GRAND TOTAL:	\$1,188,503	\$1,190,690	\$2,379,193	\$2,115,759	\$3,306,449	\$4,494,952

* / Includes \$539,598 from Iron Range Resources & Rehabilitation Commission Funds

The U. S. Geological Survey estimates that \$8,900,000 will be required to complete topographic mapping in Minnesota, or about \$220 per square mile at current costs. Maps at a scale of 1:62,500 that were issued before 1947 should be remapped at the current publication scale of 1:24,000. The cost of this work would amount to about \$1,200,000, making the total estimated cost about \$10 million.

OTHER GEOLOGIC ACTIVITIES IN THE STATE

State Division of Waters--The Division of Waters, Department of Conservation, issued 3 reports on water resources during the year:

- (1) Water resources of Minnesota, a study guide (Bull. 16)
- (2) Graphs of water levels in Minnesota 1957-61 (Bull. 18)
- (3) Power development in Minnesota (Bull. 20)

The following reports have been completed:

1. Basic geologic and ground water data for Kittson and parts of Marshall and Roseau counties, Minnesota, by G. R. Schiner, USGS (to be published as Bull. 19 of Division of Waters).
2. Quality of waters, Minnesota, a compilation 1955-62, by Marion L. Maderak, USGS (to be published as Bull. 21 of Division of Waters).
3. Water resources of the St. Louis River water shed unit (second of a series of reports on the 39 watershed units).

In order to provide the data needed for management of its water resources, the Nine Mile Creek Watershed District, Hennepin County, installed 18 ground water observation wells in 1962, and proposes to establish additional wells in the watershed this year. A stream gaging station has been established on Nine Mile Creek by the U. S. Geological Survey.

For fiscal year 1963, a total of \$224,242.00 was appropriated to the Division of Waters for its regular activities. Additional funds totalling \$150,500 were appropriated to the Division for specific projects.

Cooperative programs with U. S. Geological Survey--Cooperative programs for water resources investigations in the State by the U. S. Geological Survey were continued by the Department of Conservation, the Department of Iron Range Resources and Rehabilitation, the Department of Highways, and Hennepin County during the year ending June 30, 1963; \$105,014 of State funds were matched by Federal funds. Water resources reports are in press and were released to the open file at the St. Paul office of the U. S. Geological Survey for the following areas: Nett Lake Indian Reservation; Municipalities on the Mesabi and Vermilion Iron Ranges; Aurora, St. Louis County; and Stephen, Marshall County.

Current cooperative projects include: Surficial geology of the Mesabi and Vermilion Iron Ranges; Water resources in the Grand Rapids area, Itasca County; Geology of sinuous melt-water channels near Marshall, Lyon County; Depositional characteristics of Lake Agassiz shore line features; and Water levels and artesian pressures in observation wells in Minnesota.

Surface water cooperative studies include the operation and maintenance of 106 gaging stations, including 9 records furnished by other government agencies, of which 58 are operated under the cooperative program, and 125 crest stage gages for determination of peak flows at selected sites throughout the State.

The chemical quality of surface water was determined regularly for 13 sites on 11 streams in the State. Miscellaneous analyses of the chemical quality of water were made for 29 additional streamsites and for 12 lakes. Field studies were completed and a report was begun on the chemical quality of the ground water in the Minneapolis-St. Paul metropolitan areas.