

STATE OF MICHIGAN

**THE DEPARTMENT OF
CONSERVATION**



**TWENTY-FOURTH BIENNIAL REPORT
1967-1968**



LETTER OF TRANSMITTAL

To the Governor and Members of the Seventy-Fifth Legislature:

Sir and Gentlemen:

In accordance with provisions of section four, Act No. 17, Public Acts of 1921, I am transmitting herewith the Twenty-Fourth Biennial Report, Department of Conservation, for the years, 1967 and 1968.

I am pleased to submit this summary of the activities and progress of this Department.

Respectfully,

DR. RALPH A. MacMULLAN, *Director*

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Region I

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Region III

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REPORT OF THE DIRECTOR

During the period covered by this Report, conservation in Michigan came face to face with one of the most urgent challenges in its history—the challenge of environmental pollution.

During final months of the biennium, battle lines were drawn by the Conservation Commission and the Department against the threat of destructive pesticides on the land and the threat of pollutants in air and water. These lines were a part of a state-wide front already taking shape within a concerned public and Legislature.

The biennium closed with firm conviction that control of environmental pollution would be a dominant consideration in Department action from now on.

Among highlights of the biennium was encouraging progress in management of the fishery of the Great Lakes. Initial success of the introduction of coho salmon, mentioned in the twenty-third Biennial Report, was followed in 1967 by a dramatic sport fishery unprecedented in Great Lakes history.

Also significant in the fish management program was authority the Director of the Department received from the Legislature to regulate commercial fishing on the Great Lakes. This was considered essential to rehabilitation of the fishery.

In Game management, more liberal legislation permitted a lengthened archery season and earlier seasons on woodcock and grouse. The State's first spring turkey gobbler season was held in 1968 and was met with enthusiasm among sportsmen.

An administrative change resulted in a shift of the water access site program from the Fish to the Waterways Division.

The tourist industry surpassed the billion-dollar-a-year spending level during the period, thus attaining a five-year goal established in the early 1960's.

Worthy of mention in a review of biennium highlights is a record in forest fire control established in 1967 when only 2,884 acres were burned by 868 fires. Reflected in this is the Forest Fire Division's progressive development of fire fighting techniques and equipment.

Recreational use of state forests continued to demand increasing attention of the Forestry Division. Sudden popularity of snowmobiling resulted in development of 22 snowmobile trails throughout the state forest system. There was also increased development of campgrounds, forest drives and foot trails; all attesting to the expanding use of woodlands for recreation.

Details of all activities of the Department appear on following pages of this Report. They represent an exceedingly busy biennium in all divisions, and one of encouraging promise for the years ahead.

Ralph A. MacMullan, *Director*

GEOLOGICAL SURVEY DIVISION

GERALD E. EDDY, *State Geologist*

The Division continued to carry out its responsibilities in providing service to mineral industries, state and federal agencies, other divisions of the Department and to individual citizens.

Problems involving the underground disposal of industrial wastes continued to increase in number and complexity. The continued urging on the part of state and federal pollution control agencies contributed to this growth. A report published by the Interstate Oil Compact Commission, to which this Division made a significant contribution, points up many of the complexities and ramifications which are involved in this type of waste disposal. The State Geologist continued to represent the Governor as his official representative on the Interstate Oil Compact Commission.

The State Geologist continued to serve on the Water Resources Commission. Establishment of Interstate Water Quality Standards and deliberations on the creation of intrastate standards demanded services of not only the Division Chief, but many of his staff. Some 150 municipalities have been cited for violations of the Water Resources Act.

Since the last biennium the Air Pollution Control Commission has been created by statute. The Director designated the State Geologist to represent him on that Commission.

In line with national statistics, total petroleum activities have declined a small percentage. This is due both to a less favorable percentage of discovery wells and to an unfavorable price situation with respect to crude oil.

A section on Glacial and Environmental Geology was created. Responsibility of this section is to bring up to date surface geology maps upon which no organized work has been done for many years. An allied responsibility will be to provide information on mineral resources in the glacial drift for municipal and regional planning groups to avoid loss of minerals in preparing long-range plans for sections of the State.

While mining activities are detailed in another section of this report, the trend forecast two years ago continued. Underground mines in the iron ranges have found it increasingly difficult to compete with open pit, beneficiated, and imported high-grade foreign ores. This resulted in the closing of all but large producers with attendant low cost. Beneficiated ore production has increased as is reported in the detailed figures included in the section on Mining.

The topographic mapping program started in 1964-66 continued at a modest level. At the present rate of expenditures it will take 10 to 12 years to completely cover the State. This will, of course, necessitate map revision at intervals during the closing years of the program.

Detailed reports covering the activities of the various sections in the Division follow.

OIL AND GAS

This Section directs the development and production of oil and gas in Michigan through statutory authority vested in the Supervisor of Wells.

The combined supervision of oil and gas activities promotes the maximum efficient recovery of oil and gas by the industry.

The supervisor of this Section also serves as secretary to the Oil and Gas Advisory Board, schedules hearings on oil and gas matters, and reports on findings and determinations. Fifty-nine hearings were held to consider 116 separate cases. These involved adoption of orders for the issuance of 46 permits to drill off-pattern locations. There were 45 cases involving adoption, amending or abrogating well-spacing and proration orders. Additional cases involved determinations on pooling to form drilling units, unitization of pools, determining status of reservoirs, directional drilling of wells and other regulatory determinations.

Oil production declined from 29,658,983 barrels to 27,324,751 barrels, a decline of approximately 8 percent. This was due to minimum development of new reserves. Exploratory wells declined from 416 to 340. New discoveries remained at the same rate as in the previous biennium.

An encouraging note at the end of the biennium was the encountering of a good oil show in the Silurian at a well in Presque Isle County. This was followed by a very extensive program of geophysical prospecting in many of the counties of the northern Lower Peninsula. As a result of these activities and interest on the part of the industry, the Department had scheduled a lease sale at the close of the biennium and was offering 580,000 acres of state-owned lands for lease. It was reported that some 750,000 acres of privately-owned lands had been leased in this area.

Regulatory Control

This Unit issues drilling permits and conducts field inspections to assure compliance with the statutes, terms of the permits, and regulations controlling well locations, casing and cementing programs, brine disposal, site maintenance, and plugging and abandoning procedures. Drilling permits issued totaled 807. Drilling records and production statistics were collected.

These activities are carried out by geologists and inspectors operating out of oil and gas field offices in Mt. Pleasant, Cadillac, Plainwell, Imlay City, and from the main office in Lansing.

Pollution and Fire Control

This Unit investigates and implements corrective measures for oil and gas fields, refineries, truck transports, and pipelines wherever pollution and fire hazards constitute a menace to life and property.

During the biennium, 527 oil and refined product losses were investigated. Fifty-five percent of oil and product losses involved lakes and streams. Costs of clean-up operations, in several instances, exceeded \$100,000 due to procedures necessary to eliminate fire hazards and prevent contamination of water resources. Nearly 1,600 burning permits were issued.

One oil loss of approximately 7,000 barrels entered a stream which is the source of the water supply for the City of Ironwood. That contamination of the city's water supply did not result was due entirely to the prompt cooperation of the pipeline company in closely following procedures set by the Division.

A number of laboratory evaluations were made of six chemical additives used for removal of oil slicks on water. All were found toxic to fish and wildlife in various degrees, depending on the amount of oil and dispersant used in the tests.

During the summer of 1968, plans were drafted with the U.S. Coast Guard for controlling and eliminating possible oil losses in harbors along the Great Lakes. Meetings were arranged at Muskegon and Detroit which were attended by representatives of police and fire departments, harbor personnel, boat owners, and other concerned persons, including officials of chemical companies.

Production and Proration

Primary objective of this Unit is a program directed toward maximum ultimate recovery of Michigan's natural hydrocarbons.

This constitutes a long-range program of testing and evaluation over the life of major oil reservoirs and the compiling of detailed production and engineering histories. These duties plus the regulatory functions associated with them dominate the general day-to-day operations.

During the biennium, despite a relatively active exploratory program, Michigan's crude production declined from 39,600 to 34,900 barrels per day or about 6 percent. Proration orders were abrogated in three fields, modified in two others, while three new fields were placed under proration control. Thus eight fields consisting of 657 wells producing 62 percent of Michigan's crude petroleum are currently under proration control. Two additional fields of 55 wells are under modified proration orders which restrict only their gas production.

Petitions were received, reviewed and orders approved for the unitization of three Michigan fields to initiate secondary recovery programs. The State of Michigan is participating as a major owner of mineral interests in these secondary projects.

Nine refineries in the State continue to process an average of 150,000 barrels of crude petroleum daily of which 23 percent or 35,000 barrels are produced in Michigan. While total imports remain close to 115,000 barrels per day, Canadian-produced crude has increased its share of this figure from 15,000 barrels daily in mid-1966 to nearly 45,000 barrels daily in mid-1968. Domestic crude imports have declined in like quantity.

Two refineries were abandoned during the biennium presumably becoming non-economic. They were Marathon Oil Company's Muskegon Refinery and the Delta Terminal Company at Rapid River.

Through a cooperative industry-state study utilizing revised data, Michigan's estimated petroleum reserves have been substantially increased. Pegged at 52.7 million barrels at end of calendar year 1966 and subsequent production of 13.6 million barrels in 1967, revised reserves were estimated to be 62.5 million barrels as of January 1, 1968.

Petroleum Geology

Functions of this Unit are collecting geological and engineering data on drilling and completing oil and gas tests in Michigan; processing and distributing this information in the form of well logs, technical reports and maps; maintaining a library of well sample cuttings; and, serving

as a geological consultant to the Supervisor of Wells, government agencies, universities and the public.

The file of mechanical well logs increased substantially, especially the gamma ray-neutron logs needed for geological and engineering studies supporting both regulatory duties and our geological research program.

Many new well sample sets were added to the sample library. Also, many valuable sample sets and drill cores necessary in research programs had to be rejected for lack of storage space and supporting funds. The effort to acquire more adequate storage facilities and a laboratory will continue. These sample sets are studied by students and exploration geologists from all over the country in addition to Survey personnel.

The Unit continued to support Michigan State University and University of Michigan in storage and retrieval computer programs involving a wide range of geological information.

Routine basic services are covered in the following table:

Oil and Gas Well Logs			
New logs received	794	Total logs available	33,098
Deepenings and reworks	227	Logs sold by subscription	29,372
New logs published	889	Logs sold by special order	13,723
Mechanical Logs			
New logs received	561	Total logs on file	4,053
Well Sample Library			
New sets received	1,543		
Total sets on hand	9,112		
Sets loaned:*			
Companies	365		
Consultants	23		
Universities	550		
Maps			
New maps available	11	Miscellaneous maps sold	58
Oil and gas maps available	255	Maps sold	2,022
Receipt of Sales			
Logs (estimated)	\$4,519.00		
Maps	1,646.02		
Total	\$6,165.02		

*(A large number of sample sets were examined at the Record Center and in the basement of the Mason Building. Inasmuch as they were not checked out of the respective buildings no records as to the numbers were kept.)

Again information and advice were given to approximately 2,000 visitors to the office, including promoters, developers, landholders, geologists, and many others concerned with general geology and the development of petroleum resources. Also much geological and engineering consulting was performed for other divisions on matters such as disposal of industrial wastes, land transactions, and general geology. Geological operations and engineering studies were performed for the Corporation and Securities Commission, Public Service Commission, and Department of State Highways.

Reports were prepared for the American Association of Petroleum Geologists, Michigan Basin Geological Society, Interstate Oil Compact

Commission, and Water Well Drillers' Association as well as other trade journals and interested groups.

MINING AND ECONOMIC GEOLOGY

Mines Appraisal and Precambrian Geology

Annual appraisal of all iron ore and copper mines and mineral properties for general property tax purposes continued to be a major activity. Valuations are determined after a review of drill hole records, maps, cross-sections, ore estimates and operating records, as well as surface and underground examination. The valuations are reported to the State Tax Commission which assesses the mines and mineral properties in conformance with other property in the assessing district. Total value of the approximate 100 mining properties appraised was:

	1967	1968
Iron ore properties	\$23,829,500	\$21,932,000
Copper properties	27,914,000	27,973,000
	<hr/>	<hr/>
	\$51,743,500	\$49,905,000

Iron ore operations which beneficiate low-grade iron formation or which agglomerate underground ore are subject to a specific tax in lieu of general property taxes. Determination of this tax and its allocation to those assessing districts involved in each of the operations has become an increasingly important activity. Total specific taxes calculated by Survey appraisers for these operations were:

Type operation	1967	1968
Low grade	\$1,119,681.18	\$1,228,456.62
Underground (agglomerated)	452,868.87	404,598.18
	<hr/>	<hr/>
	\$1,572,550.05	\$1,633,054.80

Geologic mapping of the Precambrian rocks of western Upper Peninsula in cooperation with the U.S. Geological Survey continued. This work is coordinated by the Section and is designed to provide basic geologic data for determination of the mineral potential of the area. Field mapping was carried on in five quadrangles in Marquette County, six in western and central Gogebic County and one in Ontonagon County. Supplemental to the field mapping, the aeromagnetic survey program was extended eastward to include Menominee, Delta and southern Marquette counties where the Precambrian is covered by Paleozoic rocks. All of the Upper Peninsula west of 86° 30' longitude has been flown in this survey and the data obtained published for all the area except the eastern portion flown during the biennium.

Study of Precambrian geology continued in those areas outside presently active mineral districts and not included in the U.S. Geological Survey cooperative program. Emphasis on field mapping was in northwestern Menominee County, whereas office research was concerned with the compilation of old Survey notes, manuscript data and air photo interpretation.

A resurgence of interest on the part of mineral producers in the base metal potential of western Upper Peninsula resulted in requests for geo-

logic information and advice. Published and preliminary open-file data resulting from the cooperative geologic mapping program have been of value in this regard. Answering these queries, as well as those from land owners and general public on matters involving economic geology, continued to be the most significant daily activity. Members of the Section served as geologic consultants to the Lands Division in determining the value of minerals on state lands being sold or exchanged. A revision of Department policy on the sale of state-owned mineral rights resulted in a substantial increase in the number of parcels appraised. Annual reports of exploratory work done on state lands held under copper, iron ore and limestone leases were reviewed and the leased lands inspected for conformance with lease requirements.

Mineral Statistics and Nonmetallic Minerals

Collection of yearly mineral statistics authorized by Sec. 319.202 of Michigan Compiled Laws of 1948 was made in cooperation with the U.S. Bureau of Mines. Some 430 metallic and industrial mineral operators responded by questionnaires on production and value of mineral raw material produced. With this and oil and gas production data provided by the Oil & Gas Section, two annual statistical summaries for 1965 and 1966, supplemented by directories of producers, were compiled and published. A report covering the 1967 mineral output for the State is in preparation. Preliminary data shows a 2.2 percent decline over that of 1966 due largely to less production of copper, stone, gypsum, and petroleum.

In conjunction with the annual mineral statistics, collection questionnaires were prepared and sent to the State's 83 county road commissions for 1967 data on brine and salt used for road dust and ice control. Results show that all but seven counties used rock salt; 17 counties in the Lower Peninsula operated some 51 brine wells for road brine; nine counties used oil well brines, and some 35 counties obtained all or part of the brine used from commercial suppliers.

QUANTITY AND VALUE OF SALT AND BRINE
USED BY COUNTIES FOR DUST AND ICE CONTROL IN 1967

	Quantity		Value
	Short tons	Gallons	
Southern Peninsula			
Rock salt	264,375	—	\$ 491,240
Natural brine ¹	—	56,431,093	289,013
Oil field brine	—	9,134,800	55,598
Commercial brine	—	34,872,296	1,445,212
Total	264,375	100,438,189	\$2,281,063
Northern Peninsula			
Rock salt	15,970	—	\$ 241,513
Commercial brine	—	40,214	\$ 4,557
Total	15,970	40,214	\$ 246,070
State total	280,345	100,478,403	\$2,527,133

¹Produced by counties for county-owned or based wells.

In connection with field investigation of potential mineral areas, rocks, minerals and fossils were collected to make 4,000 rock and mineral sets. The sets, containing 18 common rocks and minerals and one fossil with a booklet on specimen identities, are sold through the Department's Publications Room for 50¢.

Evaluation of gravel, clay, peat, and underlying bedrock strata, for their commercial potentials was made for properties in which the surface owners made applications to the Lands Division to purchase mineral rights long owned by the State.

Other than collecting, recording, maintaining inventories and providing basic information on the mineral resources of the State the nonmetallic unit worked on individual mineral commodity reports involving gypsum, brine, stone, etc. Work scheduled included recording of surface and bedrock geology along a water pipeline under construction in Iosco and Arenac counties; the investigation of sand dune migration in Berrien County; sampling shale formations for bloating test for light-weight aggregate characteristics; assisting in geological studies of the Engadine Dolomite in Chippewa and Mackinac counties; and giving assistance in glacial mapping in western Upper Peninsula and southern part of the Lower Peninsula. In addition, the Unit identified numerous rock and mineral specimens sent in by the public for identification, provided specimens and photos for displays and various other purposes, and answered correspondence and inquiries on all phases of geology largely concerning the industrial minerals of the state.

WATER

The Water Resources Section is consultant to other divisions and other state agencies on matters of occurrence, availability, quantity and quality of both ground and surface water. It is the source of geologic information on water supply and water resource data for the public.

Ground Water

During the first year of the biennium, 8,300 water well logs were received and nearly 13,000 the second year. They provide a significant contribution to the knowledge and understanding of the ground water resources of the State, and are a basis for comprehensive evaluation of the occurrence, quality, and quantity on a local, regional or state-wide basis.

Technical assistance to other divisions and other agencies continued as a major function with special emphasis on location and construction of water supplies, and investigation of pollution of ground waters through disposal of waste products. As the state repository for ground water data, the Section daily responds to inquiries from the general public, consultants, municipalities, institutions and contractors for water supply information.

Surface Water

Projects dealing with lake rehabilitation through dredging, level control through control structures and by means of water pumped from wells, upland dredging, diversion of water from streams and reservoir impoundments was a coordinated effort with the Engineering and Lands Divisions.

Geological and ground water interpretations were prepared for Water Resources Commission river basin reports.

U.S. Geological Survey Cooperative

Matching fund support by the Geological Survey Division with the Water Resources Division of the U.S. Geological Survey maintained programs of stream gaging, lake gaging, ground water level and water quality monitoring, and detailed investigation of local and regional water resources.

Reports were completed and published for the Marquette Iron Range area, and Branch, Iron and Dickinson counties and the Battle Creek area. Published reports also include surface water records for 1965 and 1966, and annual summaries of ground water conditions. Work was in progress for studies in Oakland, Kalamazoo, Houghton, Keweenaw, Gogebic and Ontonagon counties, and the Tri-County area of Ingham, Eaton and Clinton counties.

Geographic Names

The Section acts as clearinghouse for information and procedures for selecting and revision of geographic names. It reviews and processes new and proposed name changes pending before the U.S. Board of Geographic Names.

GENERAL GEOLOGY

Producing and disseminating a variety of general data on the geology and mineral resources of Michigan continued to be the principal activity of this Section. It also served as a clearinghouse for general information on the earth sciences and mineral resources. The recipients of this service are many and varied: consultants, planners, developers, teachers, students, hobbyists and legislators, as well as the public at large.

Information

Reference files were maintained on a number of topics within the fields of geology, earth science, and mineral resources, with particular emphasis on Michigan. These files are source material for responding to inquiries, both written and oral. Telephone conferences were far too numerous to record, but office consultations totaled about 500 persons.

Education Service

Lectures, talks, and field trips were conducted for a total of about 900 persons (averaging 45 per group). The trend in this activity has continued downward in recent years. Participants were mostly teachers enrolled in programs sponsored by the Department of Conservation and by state universities.

Geological exhibits were sponsored at 12 conventions, fairs and shows in Region III. The total number of people viewing these exhibits is estimated between 60,000 and 65,000. Most of this activity took place after May, 1967 when a new exhibit designed and fabricated by a private studio was put to use.

Several movies were previewed as instructional aids.

Training

A two-day orientation conference for all members of the Division was organized and held at Higgins Lake in September 1966. The accent of this meeting was on providing better service and clarifying the Division's role

and objectives. Speakers were drawn from industry, the universities, the Department, and Division staff. A similar meeting was set up for September, 1967 but had to be cancelled for lack of funds.

Members of this Section attended several scientific conferences to keep abreast current activities and developments within our field of interest.

The Section head participated in several meetings of the Training Representatives Committee instituted by the Education and Training Section of the Information and Education Division.

Library

Most of the geological literature received by the Division continued to be passed on to the Geology Department of Michigan State University. Priorities for topographic work in the State.

The Section continued to manage the Division periodical display and clipping services.

Mapping

All work on the Chicago and Fort Wayne sheets in the interstate geological mapping program with Indiana was completed.

A cooperative project for preparing geological maps of Wayne County, with an accompanying report for planners, was established with the Geology Department at Wayne State University. Manuscripts were received and are to be published.

The Section head served as secretary to the State Mapping Advisory Committee established by Act 289 of 1966 to accelerate and to establish priorities for topographic work in Michigan.

State Boundaries

Consulting services to the Legislature, the Attorney General's Office, and the Division Chief, on interstate water boundary problems in Lake Erie and Southern Lake Michigan were continued.

Publications

In addition to preparing several booklets and reports, this Section also managed the publication and distribution of all Division maps and reports.

With the assistance of the Methods Management Section of the Administrative Services Division, addressing procedures were standardized and codified for converting to a fully automated mailing system during the next biennium.

A manuscript on meteorites of Michigan was edited and submitted for publication, and will become available late in 1968.

Requests for publications continued to expand, totalling 1,763 for the biennium. Another 911 were processed and returned to the Department Publications Room for handling.

DIVISION REPORTS PUBLISHED

- Bulletin 4*—The Glacial Lakes around Michigan
- Circular 3*—Mineral Resources—Depletion or Deterioration?
- Circular 4*—Outline of Procedures for Determining Gas-Oil Ratios and Subsurface Pressures
- Circular 5*—Sources of Geological Information in Michigan
- Circular 6*—Role of Geology in State Government
- Circular 7*—Index to Michigan Geologic Theses
- Report of Investigation 2*—Michigan's Silurian Oil and Gas pools
- Report of Investigation 4*—Geologic and Magnetic Data for Northern Iron River Area, Michigan (U.S.G.S. cooperative)

- Water Investigation 5*—Ground-water Resources of Dickinson County, Michigan (released March 1966) (U.S.G.S. cooperative)
Water Investigation 6—Ground-water Resources of Branch County, Michigan (U.S.G.S. cooperative)
Water Investigation 7—Ground-water Resources of Iron County, Michigan (U.S.G.S. cooperative)
Annual Statistical Summary 4—Michigan's Oil and Gas Fields, 1965
Annual Statistical Summary 5—Mineral Industry of Michigan, 1965
Annual Statistical Summary 6—Michigan's Oil and Gas Fields, 1966
Annual Statistical Summary 7—Mineral Industry of Michigan, 1966
Annual Directory 1—Michigan Mineral Producers, 1965
Annual Directory 2—Michigan Mineral Producers, 1966
List 7-9—Available publications of the Geological Survey
Small Scale Map 1—Morainic Systems of Michigan
Small Scale Map 2—Bedrock of Michigan
Intra-Division File 3—Periodical Acquisition Program (released August 1965)
Intra-Division File 4—Policies and Procedures on Publishing Reports
Intra-Division File 5—Classification of Reports of the Geological Survey

U. S. GEOLOGICAL SURVEY COOPERATIVE REPORTS

Publications:

- Professional Paper 513—Geology of the Menominee Iron-bearing District, Dickinson County, Michigan, and Florence County, Wisconsin
 Professional Paper 550-D (part of)—Preliminary Results of Geochemical Prospecting in Northern Michigan
 Bulletin 1226—Geology of the Kelso Quadrangle, Iron County, Michigan
 Water-Supply Paper 1842—Water Resources of the Marquette Iron Range Area, Michigan
 Water Resources Data for Michigan, 1965—Part 1, Surface Water Records
 Water Resources Data for Michigan, 1965—Part 2, Water Quality Records
 Water Resources Data for Michigan, 1966—Part 1, Surface Water Records
 Water Resources Data for Michigan, 1966—Part 2, Water Quality Records
 Map I-466—Map Showing Precambrian Geology of the Menominee Iron-bearing District and Vicinity, Michigan and Wisconsin
 Map I-497—Pre-Quaternary Geologic and Magnetic Map and Section of Part of the Eastern Gogebic Iron Range
 GP-578—Aeromagnetic Map of Parts of Ironwood and Wakefield Quadrangle, Gogebic County
 GP-579—Aeromagnetic Map of Parts of Thomaston, Carp River, North Ironwood, and Little Girls Point Quadrangles, Gogebic and Ontonagon Counties
 GP-599—Aeromagnetic Map of Pelkie Quadrangle, Baraga and Houghton Counties
 GP-600—Aeromagnetic Map of Perch Lake Quadrangle, Houghton, Baraga and Iron Counties
 GP-601—Aeromagnetic Map of Sidnaw Quadrangle, Houghton and Baraga Counties
 GP-602—Aeromagnetic Map of Part of Winona Quadrangle, Ontonagon and Houghton Counties
 GP-603—Aeromagnetic Map of Part of Beechwood Quadrangle, Iron County
 GP-604—Aeromagnetic Map of Kenton Quadrangle, Gogebic, Ontonagon, Iron and Houghton Counties
 GP-605—Aeromagnetic Map of Iron River and Vicinity, Iron County
 GP-606—Aeromagnetic Map of Rousseau Quadrangle, Ontonagon and Houghton Counties
 GP-607—Aeromagnetic Map of Crystal Falls Quadrangle, Iron County
 GP-608—Aeromagnetic Map of Keweenaw Bay Area
 GP-609—Aeromagnetic Map of Ned Lake Quadrangle and Part of Witch Lake Quadrangle, Iron, Baraga and Marquette Counties
 GP-610—Aeromagnetic Map of Parts of Ralph and Norway Quadrangles, Dickinson County
 GP-611—Aeromagnetic Map of Sagola Quadrangle and Part of Iron Mountain Quadrangle, Dickinson, Iron and Marquette Counties

Open File Materials:

- Summary of Ground-Water Conditions in Michigan in 1965
 Summary of Ground-Water Conditions in Michigan in 1966

INFORMATION AND EDUCATION DIVISION

WILLIAM J. MULLENDORE, *Chief*

The Information and Education Division continued to carry out programs and supporting services in mass communications, conservation education, and inservice training during the biennium. No major new programs were launched during the period; rather, it was a time of meeting new challenges and demands with existing tools and techniques.

As the Department's "mirror" the Division was called upon to reflect to the public such developments as the Great Lakes salmon fishery, the pesticides controversy and the growing concern for total environmental protection. These and other events frequently taxed the Division's personnel and budgetary resources to the limit.

A summary of activities follows:

INFORMATION AND PUBLICATIONS

Publications. Several informational folders were added to the Department's list of publications, notably those covering the mushrooming Great Lakes fish programs. Included are "Fishing Lake St. Clair," "Great Lakes Fishing in Michigan's Upper Peninsula," "Coho, Chinook, and Steelhead in Michigan," and a full-scale revision of an old standby, "Michigan Fish and How To Catch Them." In addition, several reprints of articles carried in the Department magazine were distributed. All these publications and the reprints were produced in quantities from 25,000 to 500,000, and distribution was free. In addition, the Division provided technical and consultant services to other divisions in preparation of reports and brochures.

Photographs. Requests for both black and white photographs and color slides continued to increase. There has been a steady growth in the use, nationwide, of Department pictures, with the Great Lakes fish program again being a major factor. Nine national magazines used Department photos on their covers during 1967-1968.

Of special significance is a marked increase in requests from other divisions for color slides. As a result, more emphasis than ever is being placed on pictures in color. Duplicates of originals from the Division's files are made on special equipment to provide this "new" service economically and efficiently.

Magazine. The price of Michigan Conservation magazine was raised in this biennium from a basic yearly subscription rate of \$1 to \$2. Circulation of the magazine held up after this rate increase took effect, but began to slump during 1968. Budget restrictions prevented both promotion of new readers and follow-up of expired subscriptions. At the end of the biennium, circulation was down from 65,000 to about 53,000, but had stabilized at this level.

News Service. The weekly bulletin continued to serve as the backbone of the Department's news service, being mailed to about 1500 individual addresses, including 300 newspapers, radio stations, television stations, Department field stations, and individual employes on field assignments. It is also mailed nationwide to a large and growing number of outdoor editors, newspapers, other state agencies, and key individuals in natural