

# THE GEOLOGICAL SURVEY OF WYOMING

Daniel N. Miller, Jr., State Geologist

## Thirty-Ninth Biennial Report of the State Geologist for 1979-1980



Laramie

December 1980

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**THE GEOLOGICAL SURVEY OF WYOMING**

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*Serving Wyoming Since 1933*

July 1, 1980

*Thirty-Ninth Biennial Report*

The Honorable Ed Herschler  
Governor of the State of Wyoming  
State Capitol Building  
Cheyenne, Wyoming 82002

Sir:

Submitted herewith is the Thirty-ninth Biennial Report of  
the State Geologist covering the calendar years 1979 and 1980,  
in compliance with Wyoming Statutes 9-3-1406, 1977.

Respectfully submitted,

*Daniel N. Miller, Jr.*  
Daniel N. Miller, Jr.  
State Geologist

DNM:sa

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TABLE OF CONTENTS

THE GEOLOGICAL SURVEY OF WYOMING

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T A B L E O F C O N T E N T S

	P a g e
INTRODUCTION . . . . .	1
ORGANIZATION AND ADMINISTRATION. . . . .	1
WYOMING'S MINERAL PRODUCTION AND RELATED GEOLOGICAL ACTIVITIES. . . . .	3
Services. . . . .	5
Continuing Services (1979-1980). . . . .	5
Other Cooperative Services . . . . .	5
Staff Activities. . . . .	5
Oil and Gas Section. . . . .	6
Minerals Section . . . . .	6
Coal Section . . . . .	6
Stratigraphy Section . . . . .	6
Environmental Section. . . . .	6
Publications. . . . .	7
Outside Funding and Cooperative Projects. . . . .	8
ACTIVITIES THAT WILL INFLUENCE WYOMING'S FUTURE. . . . .	8
ILLUSTRATIONS	
Organizational Chart - The Geological Survey of Wyoming (FY80). . . . .	2
Table I - Projected Staff Needs . . . . .	2
Annual Budget - Geological Survey of Wyoming. . . . .	3
Total Assessed Valuation of Wyoming's Mineral Production and Total Direct Income to Wyoming from Minerals Activity . . . . .	3
Natural Gas Production . . . . .	4
Oil Production. . . . .	4
Uranium Production. . . . .	4
Trona Production. . . . .	4
Subbituminous Coal Production . . . . .	5
Table II - Percentage of Staff Time Allocation by Section . . . . .	6
Content of Survey Publications (1911 to 1980) . . . . .	7
Number of Survey Projects Completed and Published per Decade. . . . .	7
Biennial Income from Survey Publications Deposited in General Fund. . . . .	7

# BIENNIAL REPORT OF THE STATE GEOLOGIST

FOR THE

GEOLOGICAL SURVEY OF WYOMING

1979 - 1980

## INTRODUCTION

The Wyoming Geological Survey is a State agency, established in 1933, located on the University of Wyoming campus in Laramie. The agency is authorized and operates under Wyoming Statutes 9-3-1420 to 9-3-1430 (1977). Functioning under an Advisory Board, the Survey attempts to supply the State with significant and timely reports and maps on all aspects of geology and mineral resources.

Overall operation of the Survey can be summarized into three general categories as:

Services -- Compilation and continuous updating and maintenance of public files and libraries of all new material, records, maps, and data relating to the surface and subsurface geology and mineral resources of the State; and distribution of this information upon request to city, county and state officials, state and federal agencies, the minerals industries, research organizations, and the general public.

Investigations -- Through field and laboratory studies that contribute new geological information to the State concerning mineral resources, and other matters or problems that have a practical bearing on Wyoming's communities and people, and by conducting cooperative investigations with other state and federal agencies on problems of mutual concern or interest.

Publications -- By publishing timely and significant reports, maps, books, tables, graphs and charts, in an effort to communicate the results of the investigations to other agencies, the minerals industry, and the public.

In addition, the Survey's professional staff also functions continuously in an advisory capacity for State officials and for all branches of State government on matters directly and indirectly related to minerals, mining, leasing, proposed legislation, and the impact of federal actions.

Activities within the Survey have been steadily increasing since 1970 in an effort to keep pace with exploration and development of the State's mineral and energy resources. A variety of projects and programs are constantly underway that result in new geologic information that is prepared, published and distributed. Every available means is used to expedite the Survey's investigations so that complete reports and maps are available when needed.

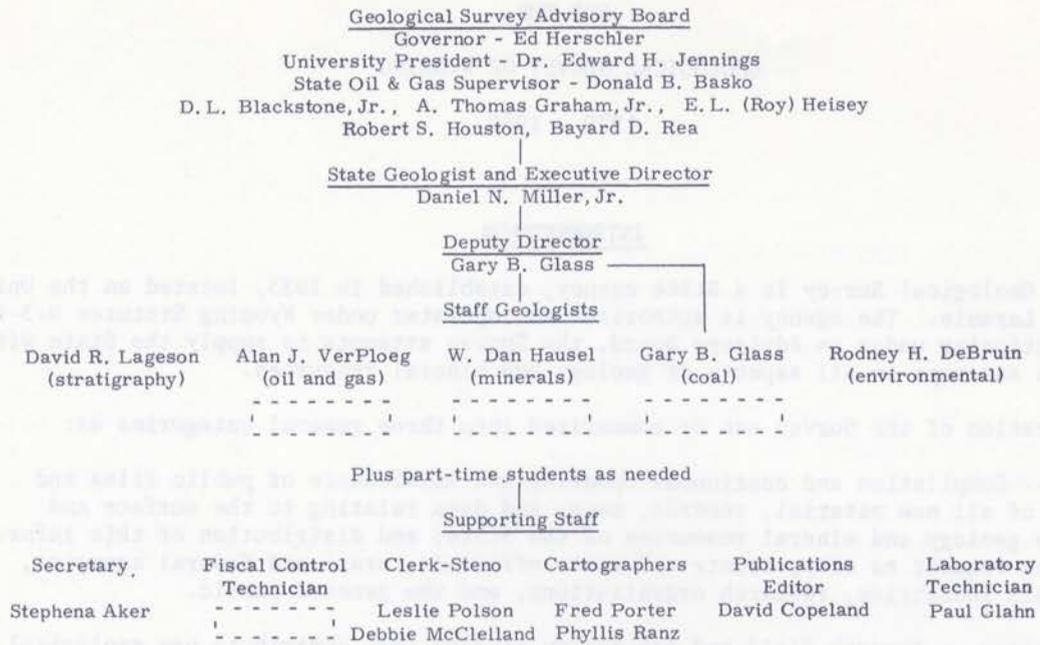
## ORGANIZATION AND ADMINISTRATION

The Survey's professional and supporting staff has now increased to 14 full-time employees: a director, five staff geologists (the Coal Specialist serves as Deputy Director), a technical publications editor, two draftsmen, one laboratory technician, one publication sales clerk, and three secretaries or clerk-stenos. In addition, the agency employed varying numbers of part-time student help to assist with investigations and routine office work as shown on the following Organizational Chart.

Activities center around the productivity of the Staff Geologists who are responsible for five specific areas of expertise - oil and gas, coal, minerals, general stratigraphy, and environmental geology. They maintain current files on all new geologic information for the State, attempt to keep abreast of state, federal, and industrial activity, and conduct appropriate field and laboratory investigations as required. The supporting staff assists with the preparation of the material and eventual printing, and the sale of publications. All Survey staff cooperate in responding to the many thousands of inquiries for geologic and mineral resource information received during the year.

Day-to-day operations of the Survey move at a rapid pace as the staff handles 30 to 50 telephone calls, and processes an average of 50 individual mail orders and inquiries about the availability of geological information. In addition, the staff assists about twenty visitors each day who have appointments with the staff to discuss activities in Wyoming, or to examine the files and records or purchase maps and publications.

ORGANIZATIONAL CHART - THE GEOLOGICAL SURVEY OF WYOMING (FY-80)



\* [-----] New positions requested in 1981-82 Biennium

Table I shows the personnel categories and the number of employees in each category during FY79 and FY80, as well as the projected needs anticipated during the coming years.

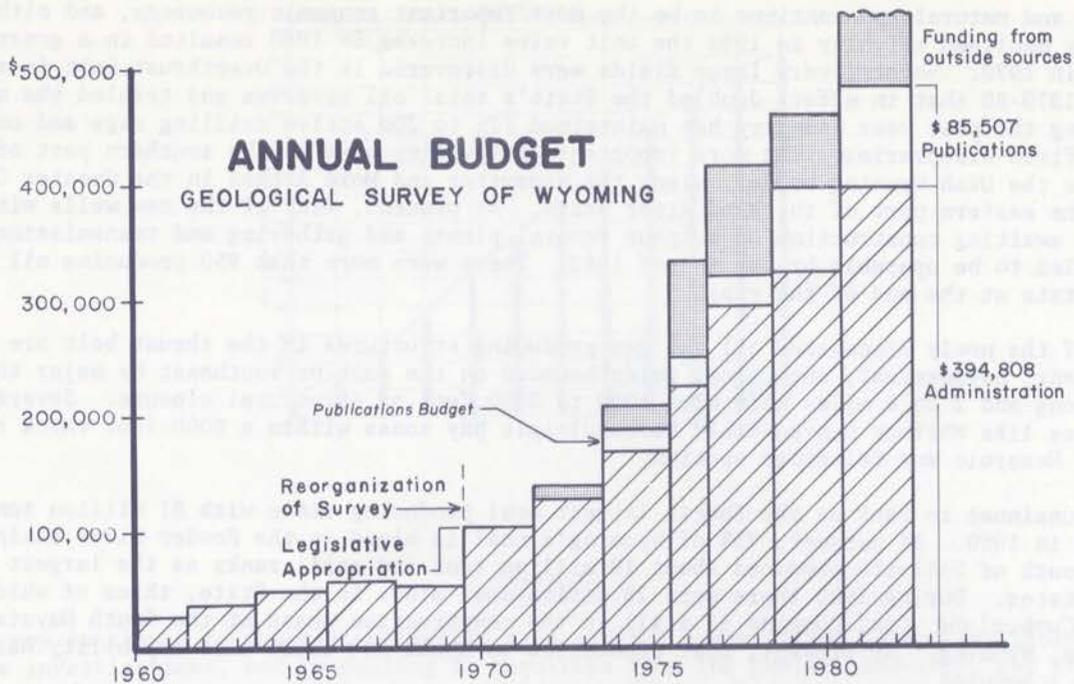
There is every likelihood that the responsibilities of the Survey will continue to increase just as they have for the past ten years, and that additional professional and clerical help will be needed in the future.

TABLE I

	<u>Projected Staff Needs</u>					
	FY 1977	1978	1979	1980	1981	1982
State Geologist and Director	1	1	1	1	1	1
Deputy Director	1	1	1	1	1	1
Staff Geologists	5	5	4	4	5	6
Publications Editor	1	1	1	1	1	1
Publication Sales Clerk	1	1	1	1	1	1
Draftsmen	2	2	2	2	3	3
Laboratory Technician	0	0	1	1	1	1
Secretaries	2	2	2	1	2	3
Clerk-Stenos	0	0	1	2	2	2
	<u>12</u>	<u>12</u>	<u>14</u>	<u>14</u>	<u>17</u>	<u>19</u>

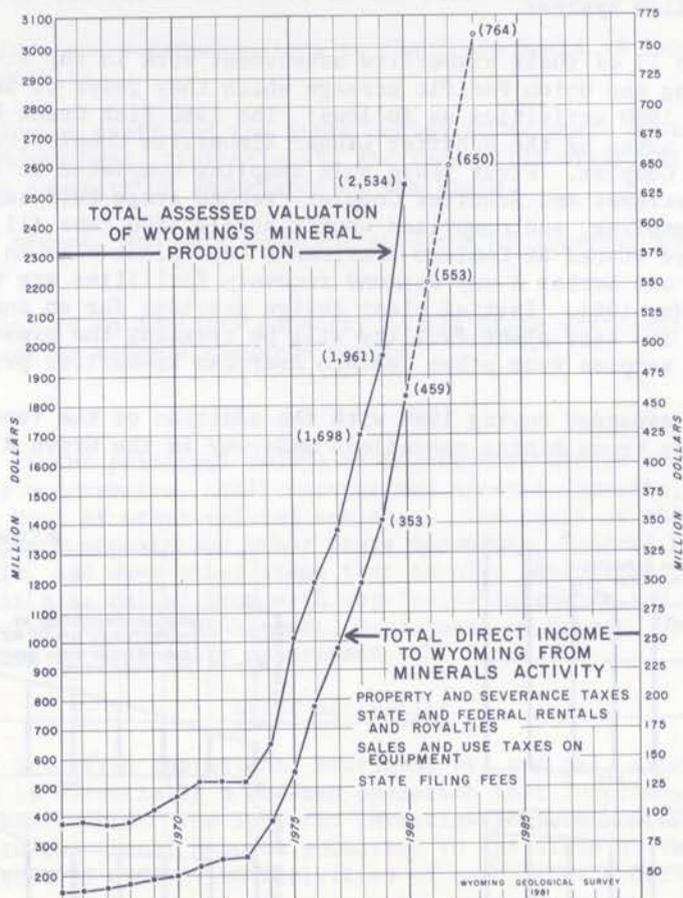
State approved funding for the Survey is administered on a biennial basis. The following graph illustrates the historical and current levels of funding on an annual basis.

Since 1973 the Survey has administered three separate budgets: Administration - that covers all of the routine office operations, field investigations, laboratory functions, and preparation of all materials for publication; Publications - that includes salaries and operational costs associated with manuscript preparation, publication and sales; and Funding from Outside Sources - that covers separate funding for special projects of a more specific nature.



#### WYOMING'S MINERAL PRODUCTION AND RELATED GEOLOGICAL ACTIVITIES

The total value of all raw mineral production in Wyoming is now estimated to be in excess of four billion dollars. As indicated on the following graph the total assessed valuation increased substantially in 1980 to an all-time high of \$2,534,000,000, and the direct income to the State rose to \$459,000,000. As of June 30, 1980, Wyoming's permanent mineral trust fund had reached \$155,731,003.



Petroleum and natural gas continue to be the most important economic resources, and although oil production actually declined slightly in 1980 the unit value increase in 1980 resulted in a greater income to the State than in 1979. Several very large fields were discovered in the Overthrust Belt in southwestern Wyoming during 1979-80 that in effect doubled the State's total oil reserves and tripled the natural gas reserves. During the past year industry has maintained 175 to 200 active drilling rigs and completed more than sixty new field discoveries. The more important discoveries were in the southern part of the Overthrust Belt near the Utah-Wyoming border, along the Wamsutter and Moxa Arches in the Greater Green River Basin, and in the eastern part of the Wind River Basin. At present, many of the new wells within the thrust belt are awaiting construction of sulphur removal plants and gathering and transmission pipelines that are scheduled to be operable by the end of 1982. There were more than 950 producing oil and/or gas fields in the State at the end of the year.

Several of the newly discovered oil and gas producing structures in the thrust belt are unique. All of them are linear, asymmetrical, anticlinal folds bounded on the east or southeast by major thrust faults, 3 to 15 miles long and 2 to 4 miles wide with 1000 to 3000 feet of structural closure. Several of the larger structures like Whitney Canyon field have multiple pay zones within a 5000-foot thick stratigraphic interval of the Mesozoic and Paleozoic section.

Wyoming continues to rank as the fourth largest coal producing state with 81 million tons produced and transported in 1980. At present, 73% of Wyoming's coal is mined in the Powder River Basin. The Amax Bel-Aire mine south of Gillette produced about 19 million tons and still ranks as the largest coal mine in the United States. During 1980 there were 28 active coal mines in the State, three of which are underground mines. Cumberland Coal Company is still in the construction phase at the South Haystack location east of Evanston, Wyoming. At present, coal production is about 20% below mine capability based on contracted tonnage schedules.

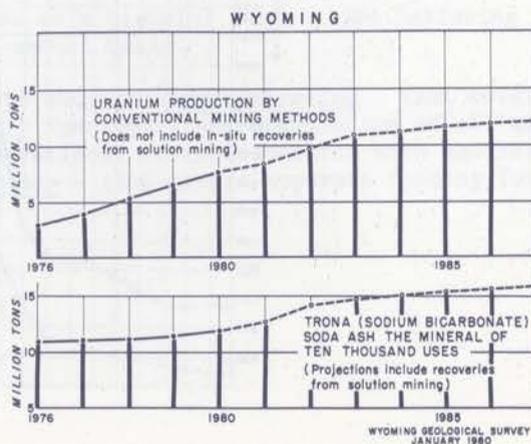
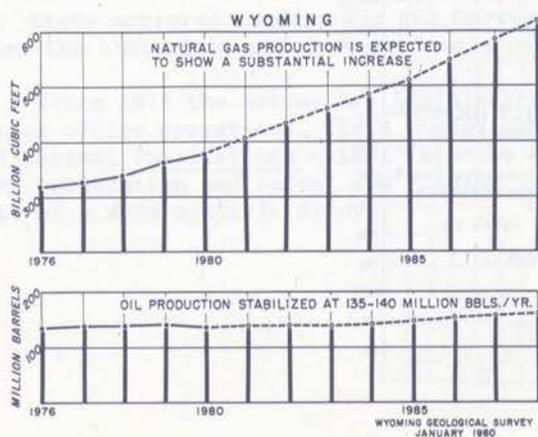
The uranium market was depressed during 1980 with an average price of \$28 per pound. Australian and Canadian suppliers are influencing the current market. Two new mines are under construction: Conoco's Pumpkin Butte surface mine and Cleveland Cliffs in-situ solution mining operation at North Butte, both of which are in the southern Powder River Basin.

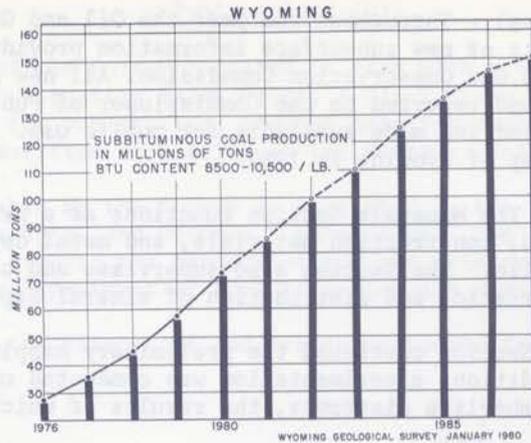
Exploration for base metals continues. Amax has been renewing their efforts in the Kirwin area west of Meeteetsee, and Timberline apparently has a significant Cu-Moly deposit defined 50 miles south of Cody.

Conoco and Superior, and others, continue to prospect for kimberlites throughout the State. There is also substantial interest in high calcium limestones at the present time for use in large scale industrial air and water purification systems.

COMINCO has begun Phase II of their kimberlite assessment work in the State-line area on the 2900 acre block of State of Wyoming and Union Pacific acreage which they refer to as the Fish Creek Project. COMINCO has summarized their 1980 activities as follows: The 1980 Fish Creek Project consisted of detailed geologic mapping in selected areas of the Schaffer Linear Kimberlite Complex, and bulk sampling at regular intervals along the Schaffer Complex. First stage bulk sampling completed in 1979 comprised 228 tons (25 samples) from the Aultman Diatremes and Schaffer Complex; second stage bulk sampling was completed in 1980 as followup to the initial sampling, and comprised approximately 4500 tons (11 samples) from the Schaffer Complex. The 1980 samples are stored at Cominco American's test plant site in Fort Collins, Colorado. The heavy media separation plant and Sortex X-ray diamond recovery facilities are under construction with plant commissioning scheduled for May 1981. Initial plant design provides for an annual capacity of 12,000 plus tons of kimberlite samples. The test plant facility will be treating the presently stored Fish Creek samples in 1981, as well as bulk samples from other Cominco American kimberlite projects.

The trona industry was expanded during 1980 with the addition of the Tenneco Mine near Green River. There are presently five major trona mining operations underway in the Green River Basin.





### Services

The Survey continues to function primarily as a service organization conducting geological and mineral resource investigations, and responding to inquiries from the public, industry, and state and federal officials and agencies. During 1980 the Survey handled more than 10,000 such inquiries, a part of which is reflected in the biennial income graph shown under the heading "Publications".

#### Continuing Services (1979-1980)

Monthly participation by the State Geologist as a Commissioner on the Wyoming Oil and Gas Conservation Commission.

Weekly tally by the staff of all drilling activity for oil and gas with regard to State mineral ownership for the State Land Commissioner.

Monthly participation by the State Geologist in the State Water Forum in Cheyenne.

Screening of applications and recommendations to the State Board of Land Commissioners for fossil removal permits.

Participation by the Survey staff and the State Geologist as guest speakers and lecturers to public, civic, educational, professional, and industrial organizations on geological and mineral resource subjects of importance to the State.

Timely publication of reports and maps covering subjects of interest to Wyoming's communities and people.

Continuous participation in an advisory capacity to all State officials and agencies on subjects of geological or mineral resource nature.

#### Other Cooperative Services

The Geological Survey is the principal source of information within the State on: surface and sub-surface geology, oil and gas occurrences, coal, uranium and mineral deposits, natural geologic hazards, geothermal resources, and a host of other related subjects. The staff of the Survey is therefore called upon frequently to review agency reports and other state documents, federal bills before the Congress, University research proposals, and many other items that involve geological interpretation in one form or another. The Survey staff is also called upon with regularity to review and advise on a variety of federal agency proposals from the Bureau of Land Management, Department of Energy, National Park Service, National Forest Service, and the Office of Technology Assessment.

#### Staff Activities

The Survey is divided into five operational sections; oil and gas, minerals, coal, environmental and stratigraphy. Each section is essentially a one-man operation that functions with the help of one or more part-time graduate student assistants. The specific investigations conducted by each section from 1979 through 1980 are described in the Annual Reports submitted to the State at the close of those fiscal years. The following report will serve to update the activities of each section during FY80.

Oil and Gas Section (Alan J. VerPloeg) - Throughout the year the Oil and Gas Section continued to receive, classify and file substantial amounts of new subsurface information provided by the petroleum industry and directed through the Wyoming Oil and Gas Conservation Commission. All new discoveries are evaluated with respect to State mineral ownership and reported to the Commissioner of Public Lands. All logs, maps, field reports, and production data are filed and made available for public use. The Section completed and published the new oil and gas fields map of Wyoming in 1980.

Minerals Section ( W. Dan Hausel) - The Minerals Section functions as a principal source of information on Wyoming uranium, industrial minerals, construction materials, and metal deposits for industry, other government bodies, and the general public. The Section also supervises and conducts independent and cooperative investigations on the characteristics and distribution of mineral deposits of all kinds.

During the year the Minerals Section continued the preliminary mapping of kimberlite occurrences in south-central Albany County. In addition, experimentation was conducted on the use of geophysical techniques to define the location of kimberlite diatremes, the results of which were published in 1980.

Coal Section (Gary B. Glass) - The Coal Section responds to all inquiries on coal geology, coal mining, and other coal related matters directed to the Survey. In carrying out its duties the Coal Section conducts field investigations and laboratory analyses, and interprets and publishes information of all kinds for a wide variety of users.

During the year the Section responded to more than 450 telephone and letter inquiries, and was interviewed by more than 100 individuals seeking advice or information related to coal in Wyoming.

Mr. Glass continues to present talks, lectures, and workshops on coal related activities to industry, professional and academic research groups, and educational and governmental organizations. Mr. Glass also serves as Deputy Director of the Survey on administrative and personnel matters.

Stratigraphy Section (David R. Lageson) - Mr. Lageson has been compiling and cross-indexing a master stratigraphy file and completing a variety of field investigations and reports. He resigned his position in September 1980 after he was awarded the Ph.D., and has accepted a teaching position on the faculty of the Department of Geology at Montana State University in Bozeman. Mr. Rodney H. DeBruin has transferred over from the Environmental Section to take over this position.

Environmental Section (Rodney H. DeBruin) - The Section devoted most of its time during 1980 to reviews of environmental impact statements and mining permits for the Department of Environmental Quality and to a statewide inventory of geologic hazards. Mr. DeBruin transferred over to the Stratigraphic Section in December of 1980, and will be replaced by James Case, previously of the Iowa Geological Survey, March 1, 1981.

The following Table II shows a breakdown of time allocated to different types of activity by each of the Sections during 1980.

TABLE II - Percentage of Staff Time Allocation by Section

	<u>Oil &amp; Gas</u>	<u>Minerals</u>	<u>Coal</u>	<u>Environ.</u>	<u>Stratigraphy</u>
Services					
Public	15%	40%	38%	25%	5%
State Agency	10%	7%	7%	10%	-
Federal Agency	5%	5%	5%	5%	10%
Field and Laboratory					
Project Investigations	25%	15%	2%	20%	50%
Data Organization	25%	10%	10%	20%	20%
Report Writing and					
Editorial Reviews	10%	18%	32%	10%	10%
Administration	5%	2%	3%	5%	5%
Other Activities	5%	3%	3%	5%	-

## Publications (02)

The Publications Section of the Survey operated in FY80 with a budget of \$83,388. The Section consists of a full-time Editor, a Publication Sales Clerk, a Clerk-Steno, and several part-time helpers who prepare all manuscript material for publication, arrange printing contracts, handle the sale of all materials, and deposit the income generated from sales in the General Fund.

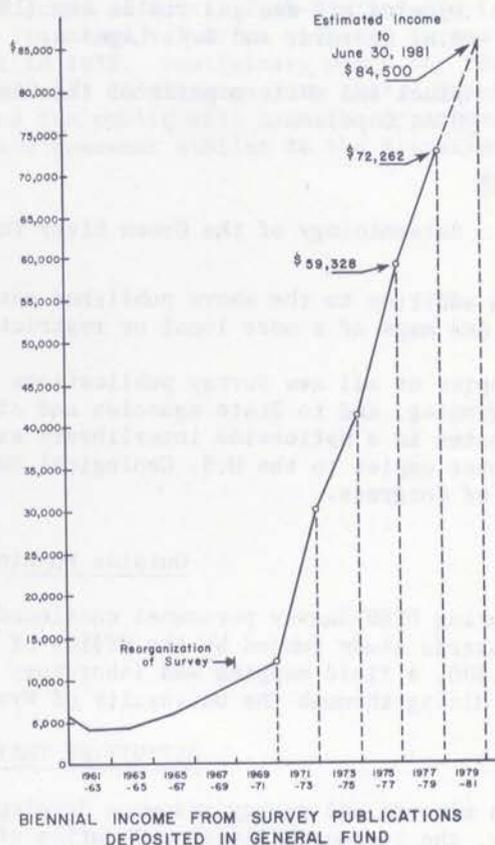
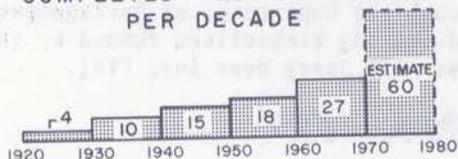
All of the material published by the Survey is initiated by the staff geologists who conduct investigations, compile data and photographs, and prepare a manuscript. The Publications staff take over at that point to supervise drafting and prepare the manuscript for the printer. All printing contracts are negotiated by the Editor through the Department of Administration and Fiscal Control.

The following graph shows the historical and projected income from publications sales on a biennial basis.

CONTENT OF SURVEY PUBLICATIONS  
(1911 TO 1980)



NUMBER OF SURVEY PROJECTS  
COMPLETED AND PUBLISHED  
PER DECADE



Over the years the Survey has become involved with investigations that cover a broad spectrum of subject matter. Many of the publications that result are in actuality spin-off from larger programs that provide useful information for a wider variety of users; hence, the designation Public Information Circulars. Current trends in geological work have shifted substantially during the past few years to public concerns for environmental impact and assessment studies where these Public Information Circulars are especially helpful.

During FY80 the Section prepared and published the following publications:

### Public Information Circulars

- No. 12 Wyoming coal production and summary of coal contracts, by G.B. Glass.
- No. 13 Rocky Mountain foreland basement tectonics, compiled by D.R. Lageson.

### Reports of Investigations

- No. 18 Geometry of the Prospect-Darby and LaBarge faults - Lincoln and Sublette counties, by D.L. Blackstone, Jr.
- No. 19 Exploration for diamond-bearing kimberlite in Colorado and Wyoming, by W.D. Hausel, et al.

## Reports of Investigations (cont.)

- No. 20 A stratigraphic evaluation of the Eocene rocks of southwestern Wyoming, by R. Sullivan.
- No. 22 Coals and coal-bearing rocks of the Hanna coal field, by G.B. Glass and J.T. Roberts.
- No. 23 Gold districts of Wyoming, by W.D. Hausel.

## County Resource Series

- No. 6 Natrona County, by the entire staff.

## Map Series

- No. 6 Wyoming oil and gas fields map (1980); Scale 1:500,000 (full color), by A.J. VerPloeg, R.H. DeBruin, and D.R. Lageson.
- No. 7 Black and white reprint of the Geologic Map of Wyoming, Scale 1:500,000, adapted by D.A. Copeland

## Bulletins

- No. 63 Paleontology of the Green River Formation, with a review of the fish fauna, by L. Grande.

In addition to the above published material, the Survey prepared and distributed a number of other reports and maps of a more local or restricted nature that are designated open-file reports.

Copies of all new Survey publications are distributed free of charge to all county and public libraries in Wyoming, and to State agencies and officials in State government who request them. The Survey also participates in a nationwide interlibrary exchange program with the other state geological surveys, and distributes copies to the U.S. Geological Survey, U.S. Bureau of Mines, Department of Energy, and the Library of Congress.

## Outside Funding and Cooperative Projects (03)

During FY80 Survey personnel continued with work on two cooperative projects: 03.12 (\$17,397), a geologic hazards study funded by the Office of Surface Mining through the Department of Environmental Quality; and \$20,800, a field mapping and laboratory analysis of diamond-bearing kimberlites funded by the Office of Surface Mining through the University of Wyoming. Both programs will carry over into FY81.

## ACTIVITIES THAT WILL INFLUENCE WYOMING'S FUTURE

As mineral and energy resource development extends into its eighth consecutive year of increasing activity, the responsibilities and duties of the Survey staff continue to expand proportionately. Although new equipment has been obtained to assist the drafting and stenographic operations in order to save time, the workload has expanded to the very limits of staff capability.

These are exciting times for Wyoming from the standpoint of historical discoveries and economic well-being. Geological concepts that form the framework of mineral and energy exploration philosophy are changing rapidly as new geophysical and other subsurface information becomes available. Listed below are just a few of the important events that took place in 1980 that will have a significant effect on Wyoming's future during the next decade.

1. Continuing refinement of seismic techniques by industry for application to overthrust structures has greatly reduced exploration risk for the drilling of both wildcat and development wells that cost between three and ten million dollars each. It will allow industry to explore with greater confidence millions of acres of overthrust structures that exist along the margins of many of the intermontane basins throughout the Rocky Mountain area. Significant new oil and gas discoveries will be made and a whole new conceptual philosophy of exploration will be brought into play during the next decade that will have a dramatic impact on the nation's oil and gas reserves.
2. Development of new in-situ techniques for mining of uranium and trona are underway that will allow industry to recover ore at less expense from greater depths and to develop lower grade ore bodies than would be practical by other methods. The level of success achieved by these experimental and pilot plant operations during the next few years will establish the methodology to be applied in the future.
3. Also in 1980 the State had its first request from industry to conduct an experiment utilizing microwave techniques in bore holes to recover kerogen from oil shale in the Green River Basin. The

operation will be field tested in 1981, but the results will not be known until the end of 1981 or 1982. If the technique can be made to be cost effective, it would revolutionize oil shale industry operations both here and elsewhere.

4. Although extensive high grade clinoptilite (zeolite) deposits have been recognized in Eocene deposits along the western margin of the Washakie Basin and along Beaver Rim farther north for quite some time, experimental work conducted during FY80 on market use will very likely prompt mining operations to begin in 1982 or shortly thereafter. These would be surface (strip mine) operations of relatively undisturbed strata.
5. As the concept of a long distance coal slurry pipeline moves closer to reality, concern over the use of Madison ground water for this purpose becomes more apparent to the public. Other similar slurry lines using surface water were under study during FY80.
6. During FY80 the State finally obtained clear title to 720 acres of fossil fish-bearing strata in Fossil Basin in southern Lincoln County. This was an in lieu land selection with the Bureau of Land Management that was initiated by the State Geologist in 1973. Preliminary plans for research and development of these unique outcrops began in FY80 and will continue on into 1981. Hopefully, these plans will reach fruition during the next decade and the public will have the opportunity to see these exceptional fossil beds in their natural state somewhat similar to the situation at Dinosaur National Park.