

# THE GEOLOGICAL SURVEY OF WYOMING

D. N. Miller, Jr., State Geologist

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## Thirty-sixth Biennial Report of the State Geologist for 1971-1973



Geology Building, University of Wyoming

Laramie

September, 1972

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**THE GEOLOGICAL SURVEY OF WYOMING**  
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September 12, 1972

The Honorable Stanley K. Hathaway  
Governor of the State of Wyoming  
State Capitol Building  
Cheyenne, Wyoming 82001

Sir:

Submitted herewith is the Thirty-sixth Biennial Report of the State Geologist covering the period from July 1, 1971 to June 30, 1973, as required by Article 11, Section 9-252, Wyoming Compiled Statutes, 1957.

Respectfully submitted

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

DNM:sa

BIENNIAL REPORT OF THE STATE GEOLOGIST  
 FOR THE  
 GEOLOGICAL SURVEY OF WYOMING

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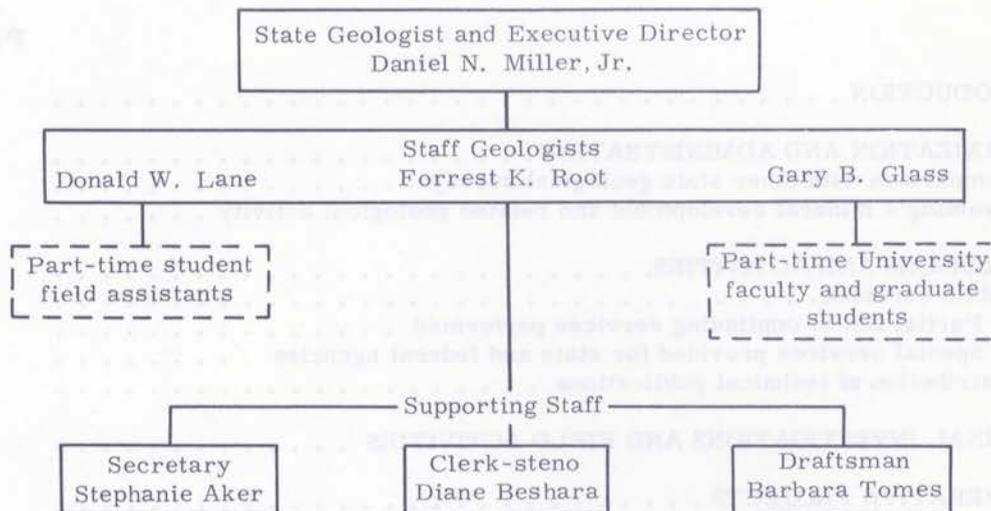
ORGANIZATION AND ADMINISTRATION

The staff of the Geological Survey is available as a medium of information and service to the people of the State, industry, and to other agencies. All activities are considered administrative for budgetary purposes. Related activities include interagency programs that consist of field and laboratory investigations and publications. Publications describing the geology of the State. All printing and publication expenses are paid through a revolving Publications Fund, a separate account independent of the administrative budget.

New additions to the staff during this biennium are Dr. Forrest E. Kohl, who replaced Dr. William R. Wilson, and Mr. Gary B. Glass, a civil geologist previously employed by the Pennsylvania Geological Survey. Miss Barbara Turner, of Torrington, is responsible for all cartographic drafting and geological illustrations. Mr. Glenn Weathers has replaced Miss Susan Handlino as a Clerk-steno.

ORGANIZATIONAL CHART - THE GEOLOGICAL SURVEY OF WYOMING

1 9 7 2



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# BIENNIAL REPORT OF THE STATE GEOLOGIST

FOR THE

## GEOLOGICAL SURVEY OF WYOMING

1971 - 1973

### INTRODUCTION

The Geological Survey of Wyoming was established by the State Legislature in 1933, modified by legislative enactment in 1957 (Wyoming Compiled Statutes, Art. 11), and further modified in 1969 (Art. 11, Geological Survey Div. II, Secs. 9-264.1 to 9-264.10).

The Survey is charged with eleven specific objectives which have been summarized as follows:

- A. To compile and maintain libraries and files of all published material, records, maps, and data, relating to the surface and subsurface geology of Wyoming and to make such information available upon request to other State agencies, the mineral industries, and the public at large.
- B. To conduct field investigations that contribute new geological information to the State especially as it relates to mineral resources but also as it relates to other practical matters that have a bearing on Wyoming's communities and people.
- C. To publish timely and significant reports and maps that lead to a comprehensive understanding of the overall geology of the State and its resources.
- D. To offer geological advice, consulting services, and cooperative working arrangements to all State agencies and departments and to enter into practical agreements for the purpose of conducting investigations of mutual concern.
- E. The State Geologist serves on the Wyoming Oil and Gas Conservation Commission, as a member of the Interdepartmental Water Planning Conference, on the Interstate Oil and Gas Compact Commission, and on other committees where geological information is needed.

The State Geologist and Geological Survey are especially concerned with the distribution and potential of Wyoming's mineral resources and evaluation of State lands. They assist the State Board of Land Commissioners, the Department of Economic Planning and Development and advise other State agencies on the geology of such matters.

Offices and other facilities of the Survey are located on the University of Wyoming campus in Laramie, and are staffed as illustrated on the Organizational Chart.

### ORGANIZATION AND ADMINISTRATION

The staff of the Geological Survey is organized to provide a maximum of information and service to the people of the State, industry, and to other State and Federal agencies. All activities are considered administrative for budgetary purposes; they include both in-house and cooperative interagency programs that consist of field and laboratory investigations and the preparation of reports, maps and other publications describing the geology of the State. All printing and publication expenses are paid through a revolving Publications Fund, a separate account independent of the administrative budget.

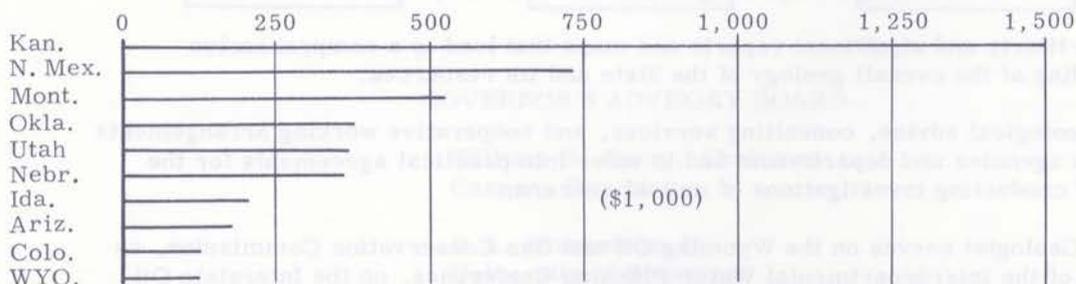
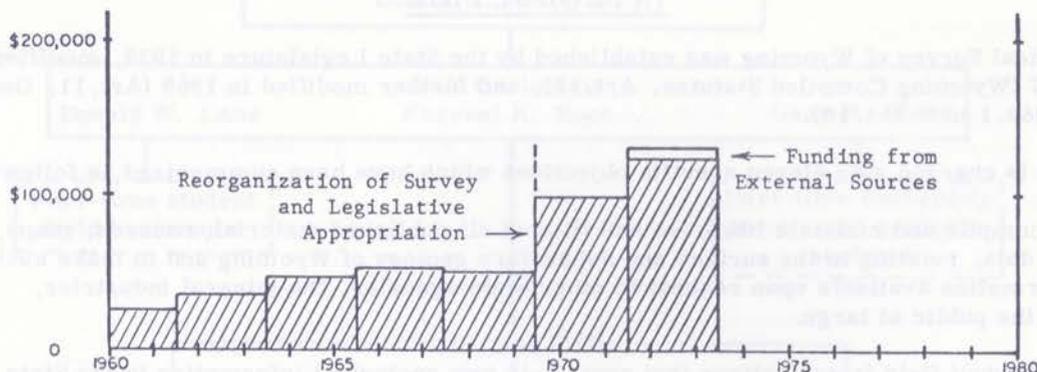
New additions to the staff during this biennium are Dr. Forrest K. Root, who replaced Dr. William H. Wilson, and Mr. Gary B. Glass, a coal geologist previously employed by the Pennsylvania Geological Survey. Miss Barbara Tomes, of Thermopolis, is responsible for all cartographic drafting and geological illustrations. Mrs. Diane Beshara has replaced Mrs. Susan Randolph as a Clerk-steno.

The location of the Survey on the University campus affords numerous advantages because of the close proximity of the Department of Geology, the U.S. Geological Survey, the U.S. Bureau of Mines, the Natural Resources Research Institute and ready access to other university facilities. Cooperative working arrangements with these organizations help to keep project costs and overhead expenses minimal.

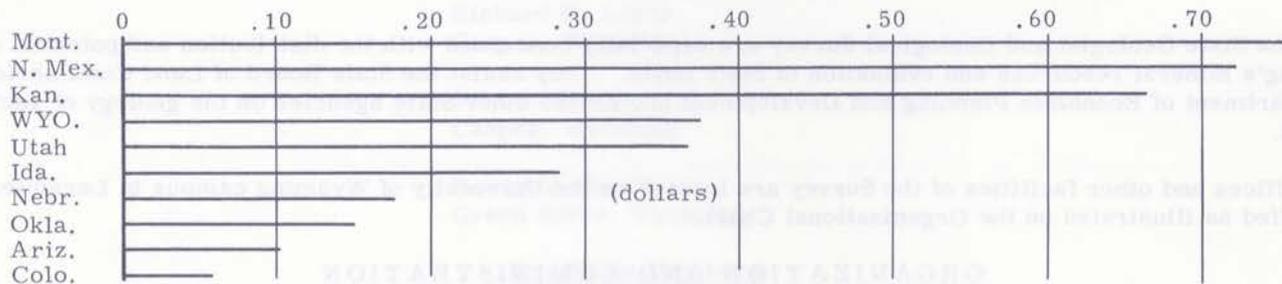
Comparison With Other State Geological Surveys

All but two states in the United States maintain active Geological Surveys. The following tables show Wyoming's relative budgetary position as of 1971 with respect to a few adjacent states and from different aspects of State activity.

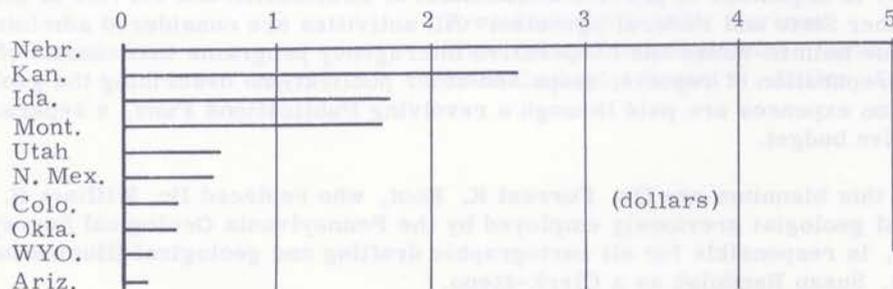
ANNUAL BUDGET, GEOLOGICAL SURVEY OF WYOMING



1971-72 State appropriations for Geological Surveys in 10 Rocky Mountain and adjacent states.



1971-72 State appropriations per capita.

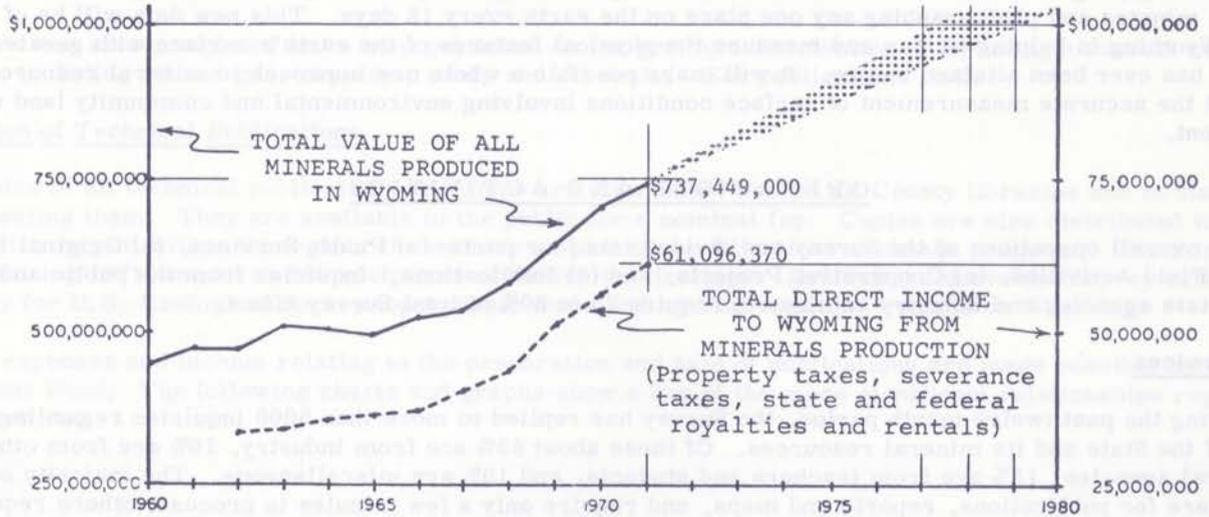


1971-72 State appropriations per \$1000 value of mineral production.

Most states maintain their Geological Survey in proportion to the total value of taxable mineral production in order to employ professional geologists, engineers, and other specialists who have had considerable experience in industry. These men play an important role in Survey investigations because of the close relationship between state activities and the extractive minerals industry. As professionals they are also capable of dealing with a wide variety of other kinds of geological and environmental problems.

Wyoming's Mineral Development and Related Geological Activities

Wyoming's overall mineral production including oil and gas continues to increase and was conservatively estimated by the U. S. Bureau of Mines to have reached \$737, 449, 000 in 1971. The total direct income to Wyoming from this production was approximately \$61, 096, 370 as compiled by the Department of Economic Planning and Development from State records. As illustrated on the graphs the total value of minerals produced can be expected to reach one billion dollars between 1977 and 1979 barring unforeseen delays due to federal interference with industry operations and work stoppages. Appendix "A" shows the 1971 values of minerals produced by county.



Total Value of Minerals Produced in Wyoming  
During 1971 - \$737, 449, 000\*

Percentage Values of Minerals Produced	17%	Other Minerals - \$126, 338, 000 (trona, bentonite, phosphate rock, cement, iron, feldspar, gypsum, sand and gravel, etc.)
	4%	Coal - \$27, 300, 000
	6%	Uranium (value of recoverable U <sub>3</sub> O <sub>8</sub> ) - \$44, 793, 000
	7%	Natural Gas (marketed) - \$52, 500, 000
	66%	Petroleum (crude) - \$486, 518, 000

\* Report of the U. S. Bureau of Mines, 1972

Coal production during 1972 is expected to show the most substantial single increase; it will have an estimated total value of more than \$34,000,000. Petroleum and natural gas production is expected to decline slightly. The pace of new exploration in the Powder River and Green River Basins is expected to increase during the next two years which should result in new reserves that will help offset declining production in the older fields.

Mineral exploration companies continue to be optimistic about markets and are developing momentum both in exploration and development to meet the demand. New services to industry and improvements in exploration technology have helped to speed up the time necessary to evaluate mineral prospects.

Announcement of plans by Reynolds Aluminum for a 2.2 billion dollar gaseous-diffusion, uranium enrichment plant near Buffalo, Wyoming, and Alcoa's leasing of more than 8000 acres of anorthosite in the Laramie Range have aroused interest in the possibility of new industries for the State.

It is also noteworthy that the ERTS (Earth Resources Technology Satellite) high altitude photography and remote sensing program will monitor the northern Rocky Mountain states during 1972 rotating about the earth every 103 minutes and photographing any one place on the earth every 18 days. This new data will be of great value to Wyoming in helping to map and measure the physical features of the earth's surface with greater accuracy than has ever been attained before. It will make possible a whole new approach to mineral resource exploration and the accurate measurement of surface conditions involving environmental and community land use development.

### OPERATIONS AND ACTIVITIES

The overall operations of the Survey are divided into four parts: (a) Public Services, (b) Original Investigations and Field Activities, (c) Cooperative Projects, and (d) Publications. Inquiries from the public and services to other State agencies and industry continue to require 75 to 80% of total Survey effort.

#### Public Services

During the past twelve month period, the Survey has replied to more than 5000 inquiries regarding the geology of the State and its mineral resources. Of these about 65% are from industry, 10% are from other State and Federal agencies, 15% are from teachers and students, and 10% are miscellaneous. The majority of these inquiries are for publications, reports and maps, and require only a few minutes to process; others require days or even weeks of investigation before answers can be provided.

In addition to the above requests, the Survey also provides other routine services on a continuing basis and undertakes special cooperative projects when requested by other State agencies.

#### Partial List of Continuing Services Performed (1971-72)

- (a) Monthly participation in State Oil and Gas Conservation Commission hearings.
- (b) Weekly tally of drilling activity for oil and gas with respect to State mineral ownership for the State Board of Land Commissioners.
- (c) Quarterly participation in Interstate Oil Compact Commission meetings.
- (d) Participation in the State Interdepartmental Water Conference.
- (e) Screening of applications for fossil removal permits for the State Board of Land Commissioners.
- (f) Formal talks, lectures and seminars for Wyoming's professional and civic groups.

#### Special Services Provided for State and Federal Agencies (1971-72)

- (a) Investigation of Wyoming's coal and commercial grade ore deposits.
- (b) Guided field trips and reports on the Hanna Basin coal field.
- (c) Recommendations to Department of Interior on the ERTS Spaceflight Earth Resources Technology Satellite program and on other projects relating to the "County Resource Series" investigation and underground waste water disposal.

- (d) Recommendations on ground water occurrences and indexing of ground water chemical analyses.
- (e) Preparation of new materials and drafting for the State Geologic Map in cooperation with the U.S. Geological Survey.

Because of the sustained interest in the general aspects of Wyoming's geology, the Survey publishes mimeographed material on minerals, rocks, fossils, etc., for free distribution on request to the schools and general public.

The following material was also prepared during the past year:

- (a) "1972 Reference List and Directory of Geological Consultants for Wyoming".
- (b) "1971 and 1972 Reviews of Wyoming's Coal Fields".

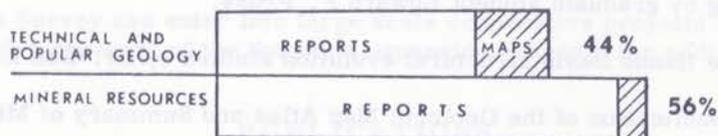
Work was also completed and a map published on the geologic distribution of Wyoming's overall energy resources including oil and gas, uranium, coal, and oil shale. (See publications list).

Distribution of Technical Publications

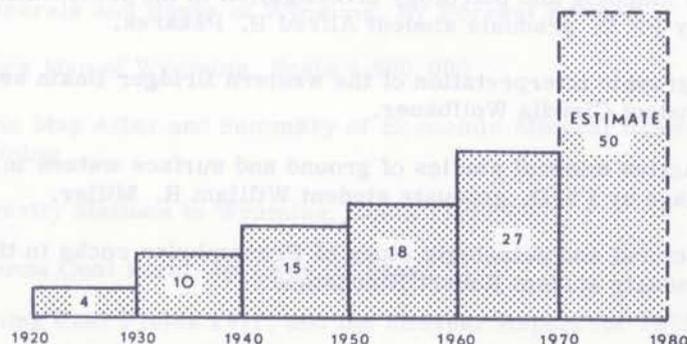
Copies of all technical publications and maps are distributed free to all County libraries and to State agencies requesting them. They are available to the public for a nominal fee. Copies are also distributed to academic and scientific organizations throughout the country as part of a publications exchange program. The total exchange program during 1971 amount to 246 recipients of Survey publications. Besides the above the Survey acts as a sales repository for U.S. Geological Survey topographic maps and special technical reports on Wyoming.

All expenses and income relating to the preparation and sale of publications are made possible through the Publications Fund. The following charts and graphs show a few of the more significant relationships regarding these activities.

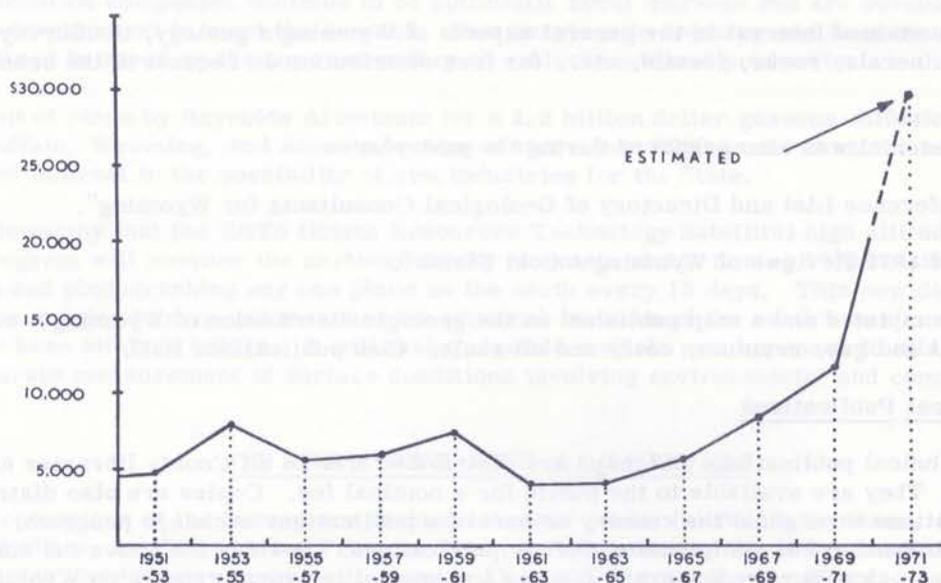
**CONTENT OF SURVEY PUBLICATIONS  
(1911 TO 1972)**



**NUMBER OF SURVEY PROJECTS COMPLETED  
AND PUBLISHED PER DECADE**



**BIENNIAL INCOME  
FROM SURVEY PUBLICATIONS**



ORIGINAL INVESTIGATIONS AND FIELD ACTIVITIES

During a part of each year the Survey attempts to devote some of its effort to new investigations and research that will benefit the State. The following projects were undertaken during 1971 and 1972 by the staff, or represent cooperative University of Wyoming graduate student research, partly subsidized by the Survey.

- (a) Completion of the geomorphic and glacial studies in the southern Absaroka Range by Ph. D. graduate student Roy M. Breckenridge.
- (b) Termination of paleomagnetic and petrologic studies on early basalt flows in north-western Wyoming by graduate student Edward F. Pruss.
- (c) Completion of the Hanna Basin structural evolution studies by Dr. Don L. Sawatzky.
- (d) Completion and publication of the Geologic Map Atlas and Summary of Mineral Resources, Converse County, Wyoming.
- (e) Initiation of two laboratory research projects; on jade, and the mineralogy of uranium ores under the supervision of Professor John Howatson, Department of Chemistry, University of Wyoming.
- (f) Initiation of a ground water, geophysical field research investigation with Professor Edward Quincy, Department of Electrical Engineering, University of Wyoming.
- (g) Initiation of a field mapping and petrology investigation in the Rattlesnake Hills, Natrona County, by Ph. D. graduate student Alfred H. Pekarek.
- (h) Initiation of stratigraphic interpretation of the western Bridger Basin sediments by Ph. D. graduate student Claudia Wolfbauer.
- (i) Initiation of radioactive mineral studies of ground and surface waters in the North Platte River drainage by Ph. D. graduate student William R. Miller.
- (j) Initiation of a structural and petrologic study of Precambrian rocks in the Laramie Range by M. S. graduate student Robert Blackstone.

- (k) Preliminary geologic field mapping on the western slope of the Teton Mountains by Professor Roger Hoggan, Department of Geology, Ricks College, Idaho.
- (l) Inventory of Wyoming's operating coal mine areas, their geologic setting, production and compilation of geologic maps, by Gary B. Glass.
- (m) Inventory of Wyoming's caves by undergraduate students, Department of Geology, University of Wyoming.
- (n) Regional stratigraphic studies of the Phosphoria Formation by Donald W. Lane.
- (o) Synthesis of Wyoming's Precambrian rocks and evolution of potential resources by Forrest K. Root.

#### COOPERATIVE PROJECTS

Each year the complexity of projects related to geology increases. The Survey along with other State and Federal agencies work together on these projects to minimize any duplication of effort and maximize the overall productivity. Cooperative working agreements have been made that will continue to be profitable for Wyoming. The following list describes a few of the programs in which the Survey was involved with other organizations during 1971 and 1972.

- (a) The U.S. Geological Survey - Technical services of Dr. J. David Love on the "Wyoming State Geologic Map".
- (b) The American Association of Petroleum Geologists - Distinguished Lecture Program for universities and professional organizations.
- (c) The Department of Economic Planning and Development on publication of the "Energy Resources Map of Wyoming".
- (d) The Department of Geology, University of Wyoming, on the ERTS satellite resource data interpretation project.

New cooperative opportunities continue to become practical as the staff of the Survey expands and as new equipment and facilities improve the Survey's overall technical capability. During 1972 the Survey found it necessary to reject a \$285,000 offer from the U.S. Geological Survey because of the lack of staff, equipment and work space. A similar \$4000 grant related to the above was approved and is presently in effect.

The extent to which the Survey can enter into large scale cooperative projects during 1973 and 1974 will depend largely upon Legislative approval of the Survey's expansion requests for additional staff and planning funds for a building.

#### PUBLICATIONS

The Survey as authorized under amended section 9-264.2, publishes a number of technical reports, maps, and booklets to whatever extent the budget allows. The items are sold at a small profit with all proceeds returned into the Publications Fund. The following material was published during 1971 and 1972:

- (a) Bulletin 54 - Fossils of Wyoming, by Michael W. Hager
- (b) Bulletin 55 - Traveler's Guide to the Geology of Wyoming, by D. L. Blackstone, Jr.
- (c) Bulletin 56 - Minerals and Rocks of Wyoming, by Forrest K. Root
- (d) Energy Resources Map of Wyoming, Scale 1:500,000
- (e) CRS-1 - Geologic Map Atlas and Summary of Economic Mineral Resources of Converse County, Wyoming
- (f) Index Map to Gravity Stations in Wyoming, Scale 1:500,000
- (g) Mining in the Hanna Coal Field, by Gary B. Glass
- (h) Review of Wyoming Coal Fields 1971; and the Midyear Report for 1972, by Gary B. Glass
- (i) 1972 Reference List and Directory of Geological Consultants for Wyoming

The backlog of material to be published continues to increase and is limited by the availability of publication funds. The 1973-75 Biennial Budget Request for the Publications Fund will be \$34,000, a 30% increase over the past biennium.

### CONCLUSIONS AND RECOMMENDATIONS

All areas of Survey activity continue to expand at a rapid rate to such an extent that three additional staff are needed and have been requested in the 1973-75 budget as follows:

- (a) An Assistant Director for the Survey, replacing the position of Assistant State Geologist, who would assume responsibility for administration of all interagency cooperative programs which will result in a substantial increase in external funding covering a broader spectrum of projects than is presently possible.
- (b) A Staff Geologist capable of utilizing newly acquired earth-satellite and high altitude remote-sensing data and aerial photographs that will assist with geological exploration-mapping programs, community and land reclamation inventories, and related environmental problems.
- (c) A Technical Publications Writer-Editor who will assume full responsibility for the preparation by the staff of all manuscripts and their publication, and for all contractual arrangements with the printers.

It is also evident that the extractive mineral industries will continue to expand their exploration and development in Wyoming. Appendix "A" shows the 1971 value of the mineral commodities produced in each of the counties as compiled by the U.S. Bureau of Mines. The above mentioned personnel will also be called upon to assist with many of the services accompanying these expanded exploration programs.

The Survey is presently limited in its capability because of the lack of adequate office, laboratory, drafting, library, and other work space. There is an urgent need now to begin planning the design of a building to house this agency on the University campus by 1976. A request for \$50,000 is included in the 1973-75 Legislative Budget Request that would pay architectural, engineering and legal fees for preliminary planning that should be done in 1973 and 1974.

APPENDIX "A"

VALUE OF MINERAL PRODUCTION BY COUNTY (1971)\*

<u>County</u>	<u>Total Value</u>	<u>Minerals Produced in Order of Value</u>
Albany**	\$ 12,913,000	Cement, petroleum, iron ore, stone, sand and gravel, gypsum
Big Horn	21,754,000	Petroleum, clays, natural gas, gypsum, stone, lime, sand and gravel
Campbell**	128,441,000	Petroleum, natural gas, coal, sand and gravel, LP gases, stone
Carbon**	35,601,000	Uranium, petroleum, natural gas, coal, LP gases, sand and gravel, natural gasoline, copper, stone, gold, silver
Converse**	22,293,000	Petroleum, coal, natural gas, sand and gravel, LP gases
Crook	21,693,000	Petroleum, clays, natural gasoline, LP gases, natural gas, stone, sand and gravel
Fremont	83,175,000	Uranium, petroleum, iron ore, natural gas, natural gasoline, sand and gravel, LP gases, stone
Goshen	458,000	Sand and gravel, lime, petroleum, stone
Hot Springs	33,811,000	Petroleum, natural gas, coal, natural gasoline, sand and gravel
Johnson	16,870,000	Petroleum, clays, sand and gravel, natural gas, LP gases, natural gasoline, stone
Laramie	2,739,000	Stone, petroleum, sand and gravel, natural gas
Lincoln**	14,135,000	Coal, natural gasoline, LP gases, phosphate rock, sand and gravel, stone
Natrona	51,014,000	Petroleum, natural gas, LP gases, uranium, sand and gravel, natural gasoline, clays, sodium sulfate, stone
Niobrara**	1,916,000	Petroleum, natural gas, sand and gravel, LP gases
Park**	109,934,000	Petroleum, natural gas, LP gases, gypsum, sand and gravel, natural gasoline, stone
Platte**	4,727,000	Iron ore, stone, sand and gravel
Sheridan**	8,026,000	Coal, petroleum, sand and gravel, stone, natural gas
Sublette	24,581,000	Petroleum, natural gas, sand and gravel, LP gases, stone
Sweetwater**	97,076,000	Sodium carbonate, petroleum, natural gas, sand and gravel, coal, LP gases, natural gasoline, stone, pumice
Teton	209,000	Stone, sand and gravel
Uinta**	1,674,000	Natural gas, natural gasoline, petroleum, clays, sand and gravel, stone
Washakie**	11,020,000	Petroleum, natural gas, LP gases, lime, sand and gravel, stone
Weston**	12,452,000	Petroleum, clays, sand and gravel, natural gas, LP gases, stone
Yellowstone National Park	W	Sand and gravel
Undistributed	1,351,000	
TOTAL	\$ 717,863,000	

\* Compiled from U.S. Bur. Mines Report

\*\* Counties that have substantial increases

W Withheld to avoid disclosing individual company confidential data; included with "undistributed"