

THE GEOLOGICAL SURVEY OF WYOMING

D. N. Miller, Jr., State Geologist

Thirty-fifth Biennial Report of the State Geologist for 1969-1971



Geology Building, University of Wyoming

Laramie

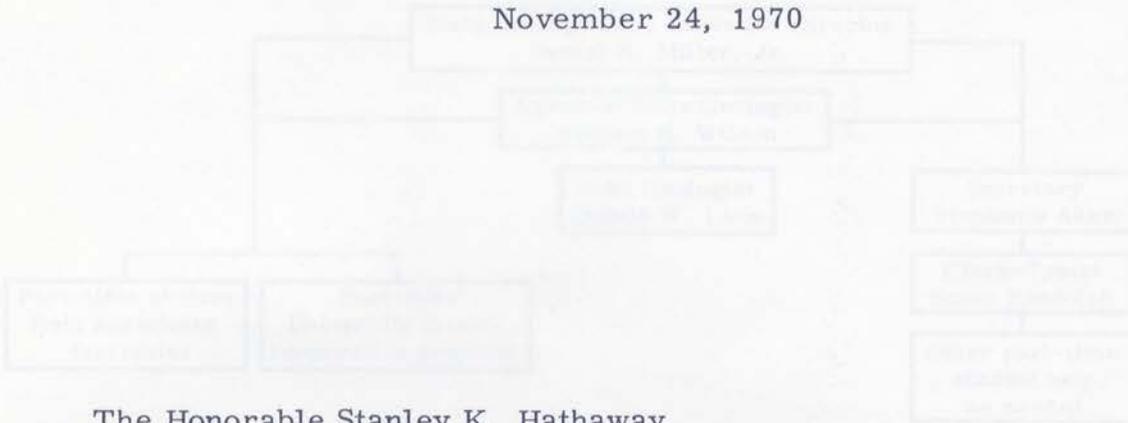
November, 1970



THE GEOLOGICAL SURVEY OF WYOMING
UNIVERSITY OF WYOMING
BOX 3008 UNIVERSITY STATION
LARAMIE, WYOMING 82070

Serving Wyoming Since 1933

November 24, 1970



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

Sir:

Submitted herewith is the Thirty-fifth Biennial Report of the State Geologist covering the period from July 1, 1969 to June 30, 1971, as required by Article 11, Section 9-252, Wyoming Compiled Statutes, 1957.

Respectfully submitted,

D. N. Miller, Jr.
State Geologist

DNM:sa

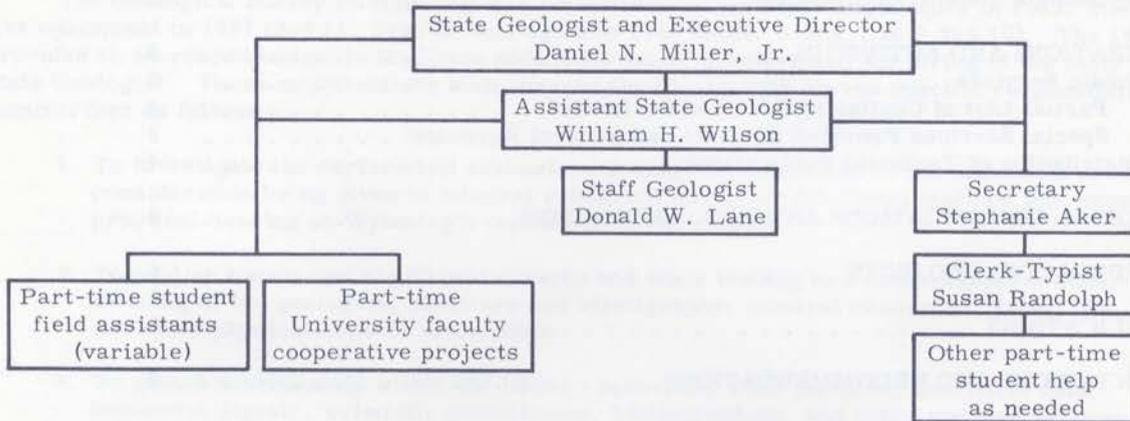
THE GEOLOGICAL SURVEY OF WYOMING

LARAMIE

1969 - 1971

CHART NO. 1

ADMINISTRATIVE RELATIONSHIPS



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

1969-1971

INTRODUCTION

The Geological Survey of Wyoming was established by the State Legislature in 1933, modified by legislative enactment in 1957 (Art 11, Div. II), and again in 1969 (Secs. 9-264.1 to 9-264.10). The 1969 modification provided an increased budget to facilitate additional public services and the hiring of the State's first full-time State Geologist. These modifications also charged the Survey with eleven specific responsibilities which are summarized as follows:

1. To investigate the surface and subsurface geological formations of the State with special consideration being given to mineral resources and other functional matters that have a practical bearing on Wyoming's communities and people.
2. To publish timely and significant reports and maps leading to a comprehensive understanding of the geological structure and stratigraphy, mineral resources, fossil life, and other physical aspects of the State.
3. To gather continuously within the library such other rock samples, analytical data, industrial digests, scientific publications, bibliographies, and maps that are pertinent to an understanding of the geology and mineral resources of Wyoming.
4. To furnish geological advice, consulting services, and cooperative arrangements to all State agencies and departments and to make available upon request, copies of all the above described materials for beneficial use.

The Survey consists of offices and other physical facilities on the University campus in Laramie, which are staffed by three full-time professional geologists, one secretary, one clerk-typist, and part-time student help.

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. Most requests for geological information are answered the same day they are received. Communications from and to industry receive first priority. Project assignments requiring field or laboratory investigations are handled as quickly as possible and depend upon the amount of information available, the scope of the project, and the degree of detail required. Part-time student help under the supervision of the Survey personnel help to expedite the work.

Chart No. 1 shows the administrative relationship of the staff during 1969-1970. Dr. Dan Miller was appointed to the position of State Geologist in August 1969, to succeed Dr. D. L. Blackstone, Jr., who has returned to full-time teaching in the University. Dr. William H. Wilson has held the position of Assistant State Geologist since 1951. Dr. Donald W. Lane replaced Richard W. Monckton as Staff Geologist in October, 1970.

The Survey's location in the Geology Building 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 Resource Research Institute, and ready access to the overall University facilities. Cooperative arrangements with these organizations help to keep project costs and operational expenditures minimal.

Comparison With Other State Geological Surveys

All but two states maintain active Geological Surveys. Table No. 1 shows the broad range in pertinent statistics for 1969 and Wyoming's relative position at that time in each category. As previously mentioned, the 1969 Legislature increased the overall operational budget of the Wyoming Survey from \$50,100/year to \$100,000/year.

TABLE 1

Comparison Chart - State Geological Surveys - 1969

State	Total Available Survey Income	Total Professional Staff	Funds Allocated to Research, Services, and Administration	Value of Total Mineral Production
Alabama	\$2,156,287	43	\$ 819,356	\$ 284,736,000
Alaska	430,000	13	425,000	257,776,000
Arizona	143,500	8	143,500	859,303,000
Arkansas	427,000	13	246,000	208,126,000
California	1,391,920	40	1,387,420	1,850,517,000
Colorado	46,000	1	46,000	368,494,000
Connecticut	145,107	17	69,117	27,767,000
Delaware	105,750	5	64,800	2,086,000
Florida	753,434	12	247,739	295,377,000
Georgia	626,475	21	445,900	190,902,000
Hawaii	398,736	25	191,736	29,539,000
Idaho	243,490	14	243,490	118,309,000
Illinois	2,034,865	119	1,984,865	659,815,000
Indiana	530,120	33	530,120	241,871,000
Iowa	442,413	11	294,813	119,930,000
Kansas	1,057,700	55	759,144	577,815,000
Kentucky	1,039,074	13	218,374	591,048,000
Louisiana	336,410	11	155,484	4,685,326,000
Maine	86,000	20	86,000	20,188,000
Maryland	386,293	11	169,963	83,483,000
Massachusetts		No Geological Survey		49,843,000
Michigan	1,133,636	34	183,817	668,247,000
Minnesota	224,543	21	224,543	635,636,000
Mississippi	120,450	5	120,450	243,184,000
Missouri	741,722	35	477,222	367,232,000
Montana	390,295	23	297,110	282,631,000
Nebraska	272,914	14	198,914	78,030,000
Nevada	379,605	12	- - - -	168,295,000
New Hampshire	23,850	2	9,850	8,120,000
New Jersey	199,014	11	149,594	83,107,000
New Mexico	553,500	40	533,500	935,746,000
New York	245,826	11	- - - -	302,339,000
North Carolina	140,625	10	117,845	90,455,000
North Dakota	270,402	21	163,002	91,048,000
Ohio	433,890	15	417,359	580,667,000
Oklahoma	308,858	18	283,858	1,090,809,000
Oregon	334,574	12	314,074	60,164,000
Pennsylvania	1,168,800	32	564,300	976,367,000
Puerto Rico	105,750	5	30,000	- - - -
Rhode Island		No Geological Survey		4,433,000
South Carolina	45,678	11	- - - -	55,864,000
South Dakota	405,271	16	332,771	54,921,000
Tennessee	375,093	26	337,093	205,451,000
Texas	461,670	32	412,685	5,769,970,000
Utah	342,895	19	226,359	543,282,000
Vermont	22,759	4	22,538	27,759,000
Virginia	1,022,920	29	420,420	317,527,000
Washington	258,886	7	206,886	88,626,000
West Virginia	398,918	15	273,298	948,430,000
Wisconsin	338,293	20	169,593	79,792,000
WYOMING	50,100*	2*	48,600*	647,442,000

* Increased by 1969 Legislature to a total Survey income of \$100,000 with 3 staff

It should be noted from this data that most states maintain their Survey in relative proportion to the total value of the taxable mineral production in order to employ professional geologists, engineers and others who have had considerable experience in the minerals industry. These men play an important role in state government because of the close relationship between the state and the extractive mineral industries. They are also capable of handling a wide variety of other geological and environmental problems that arise.

Wyoming's Mineral Development

Wyoming is experiencing broad scale mineral development that is unprecedented in its historical past. The total value of this production has increased steadily and now ranks eleventh within the nation. In terms of oil and natural gas, our most valuable resource, Wyoming ranks fifth among all the states and new discoveries during 1969-1970 continue to enhance the overall reserves. Uranium exploration has reached a point where industry is now drilling 10 - 12 million feet a year, having proved up our country's greatest reserves. Wyoming coal, which has recently attracted considerable nationwide attention, is now undergoing many new forms of development. The other mineral industries; trona, iron ore, bentonite, phosphates, etc., are all experiencing or planning significant expansion.

The total value of mineral production in Wyoming for 1970 is expected to exceed \$720 million, an 11% increase over 1969 and a 45% increase since 1965. Appendix "A" shows the 1969 breakdown by county and commodity.

It is important that Wyoming maintain constant surveillance of these developments in terms of exploration, exploitation and reclamation and realize a maximum income from these irreplaceable resources.

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. At the present time inquiries from the public, and services to industry, require 75 to 80% of total Survey effort.

Public Services

During the past twelve month period, the Survey has replied to more than 2900 inquiries regarding the geology of the State. Of these about 65% are from industry, 10% are from state and federal agencies, 15% are from teachers and students, and 10% are miscellaneous. Most of these inquiries require only a few minutes of Survey time; others require days, weeks, or even months of investigation before answers can be provided.

In addition to the above requests, the Survey also performs other routine services on a continuing basis and undertook special cooperative, service projects when requested as described below.

Partial List of Continuing Services Performed (1969-70)

- (a) Monthly participation in State Oil and Gas Conservation Commission hearings.
- (b) Weekly tally of drilling activity for oil with respect to state mineral ownership for the State Land Commission.
- (c) Quarterly participation in Interstate Oil Compact Commission meetings.
- (d) Participation in the State Interdepartmental Water Conference.
- (e) Screening of applications for fossil collecting permits for the State Board of Land Commissioners.
- (f) Formal talks, lectures and seminars for the Wyoming Mining Association, Wyoming Geological Association, Rocky Mountain Oil and Gas Association, American Association of Petroleum Geologists, Wyoming Bankers Credit Conference, various Chambers of Commerce and other civic groups, National Science Foundation - Teacher Education projects, and the Environmental Action Group of Laramie.

Special Services Provided for State and Federal Agencies (1969-70)

- (a) Investigations of potential commercial grade ore deposits.
- (b) Preparation of geological reports on three oil shale prototype locations for the Department of the Interior, Washington.

- (c) Preparation of recommendations to Department of the Interior for the EROS Spaceflight - Earth Resource Technology Satellite program.
- (d) Preparation of a new legislative bill regarding exploratory mine drill hole plugging in cooperation with the Wyoming Geological Association and State Engineer's Office.
- (e) Preparation of new directives governing the issuance of fossil collecting permits.
- (f) Recommendations regarding specific community ground water development programs and potential pollution hazards.
- (g) Recommendations to the State Highway Department regarding signing of special geological and archeological sites.
- (h) Preparation of new materials in cooperation with the U. S. Geological Survey for publication of a new state geologic map.

Because of the great number of inquiries on certain subjects, the Survey publishes mimeographed copies of information about important or interesting aspects of Wyoming's geology from time to time. These are distributed on request. The following material was prepared during the past year.

- (a) "Sources of Groundwater Information in Wyoming".
- (b) "1970 Reference List and Directory of Geological Consultants for Wyoming".
- (c) "Bibliography of Graduate Theses and Dissertations on the Geology of Wyoming - through 1966 (exclusive of the University of Wyoming)."

Work was also completed on an illustrated information type bulletin entitled "Fossils of Wyoming" by Michael Hager. The manuscript is in press and will be ready for distribution by January 1971. Another subject of many requests concerns economic mineral deposits in the State. A special colored edition of a "Mines and Minerals Map of Wyoming - 1970" has reached completion and will be published and available early in 1971. This work was done in cooperation with the Department of Economic Planning and Development.

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 at large for a small fee that covers printing and handling costs. Copies are also distributed to academic and scientific organizations throughout the country. All Survey publications are exchanged with other state geological surveys and the U.S. Geological Survey, as a routine matter. The total library exchange program amounts to 330 recipients of Survey publications.

Many hundreds of topographic maps of Wyoming and other selected publications of the U. S. Geological Survey are also kept in stock and sold on an over-the-counter basis at cost.

ORIGINAL INVESTIGATIONS AND FIELD ACTIVITIES

During a part of each year the Survey attempts to devote at least some of its total effort to new investigations that will be beneficial to the State. During the past biennium the Survey was involved in the following projects which are also outlined on the State Index Map.

- (a) Completion and publication of the Medicine Bow Precambrian mapping report on southeastern Wyoming under the supervision of Dr. R.S. Houston. (See Memoir No. 1, Report)
- (b) Completion of the geologic mapping of the Soapy Dale Quadrangle, Park County, by Dr. W. H. Wilson. This is a part of an ongoing study of the Absaroka Mountains project under Dr. Wilson's supervision that includes:
 1. Completion of field mapping of the Irish Rock and part of the Kirwin Quadrangles.
 2. Compilation of mineral resource material for Park County.
 3. Continuation of work on the Geologic Guide to Shoshone National Forest.
 4. Completion of research and mapping on the Eagle Creek mineralized area by Graduate Student John T. Galey.

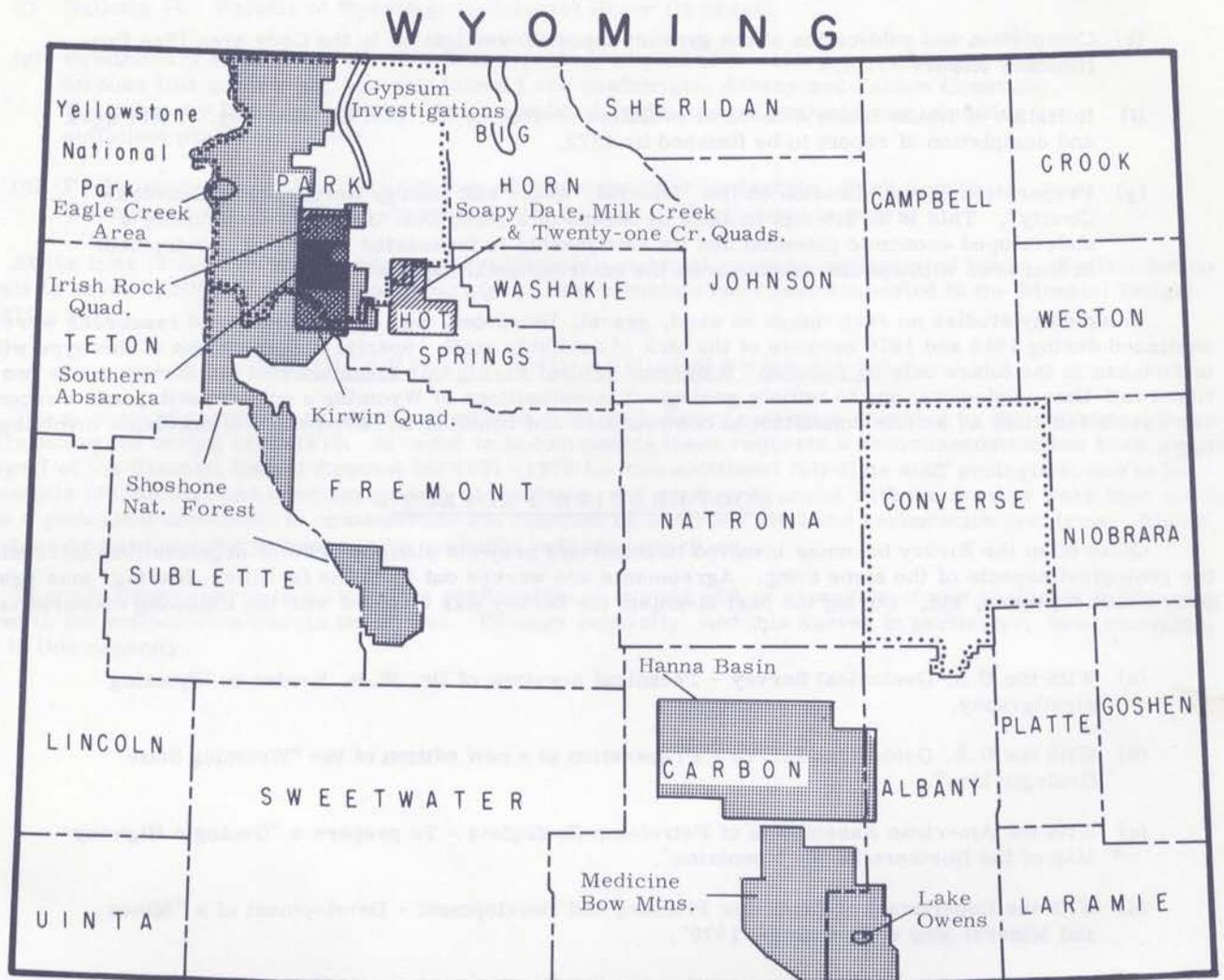


Fig. 2 INDEX MAP TO GEOLOGICAL SURVEY INVESTIGATIONS (1969-71)

5. Initiation of the geomorphic and glacial studies in the southern Absaroka Range by Graduate Student Roy M. Breckenridge.
 6. Initiation of paleomagnetic and petrologic studies on early basalt flows in northwestern Wyoming by Graduate Student Edward F. Pruss.
- (c) Completion of a Big Horn County gypsum deposits report, now being finalized for publication.
 - (d) Completion of geophysical field studies of the Lake Owens area by Graduate Student Robert L. Raforth, with supervision from Dr. W. H. Wilson.
 - (e) Completion and publication of the gypsum deposit investigation in the Cody area (See Preliminary Report No. 9).
 - (f) Initiation of Hanna Basin structural evolution studies by Dr. Don L. Sawatzky. Field work and completion of report to be finished by 1972.
 - (g) Preparation of a publication on the "Mineral, Water and Energy Resources of Converse County". This is an attempt to show by means of a geological inventory each county's undeveloped economic potential and its relationship to forecasted industrial development in that area with special emphasis on the environmental aspects.

Commodity studies on such things as sand, gravel, limestone, and other widespread resources were discontinued during 1969 and 1970 because of the lack of available staff. Special investigations of this type will be undertaken in the future only on request. It became evident during this biennium that the Survey needs two additional full-time geologists: one to initiate geological investigations of Wyoming's coal deposits, and a second who can devote full time as a state consultant to communities and counties on environmental problems involving geology.

COOPERATIVE PROJECTS

Quite often the Survey becomes involved in important projects along with other organizations interested in the geological aspects of the same thing. Agreements are worked out as to the facilities, funding, man power, publication expenses, etc. During the past biennium the Survey was involved with the following cooperative projects:

- (a) With the U. S. Geological Survey - Technical services of Dr. W. R. Keefer on Wyoming stratigraphy.
- (b) With the U. S. Geological Survey - Preparation of a new edition of the "Wyoming State Geologic Map".
- (c) With the American Association of Petroleum Geologists - To prepare a "Geologic Highway Map of the Northern Rocky Mountains".
- (d) With the Department of Economic Planning and Development - Development of a "Mines and Mineral Map of Wyoming - 1970".
- (e) With the Department of Economic Planning and Development for the Department of Interior - "Special Environmental Report on Development of Three Prototype Oil Shale Sites in Wyoming".

PUBLICATIONS

Each year the Survey, as authorized in 9-264.2, publishes a number of technical reports, maps, charts, tables, etc., to whatever extent the budget allows. These items are sold at a small profit to recover printing costs and overhead with all funds returned into the Geological Survey Publications Fund. The following material was completed or published during the past biennium:

- (a) Memoir No. 1 - Report on a regional study of rocks of Precambrian age in that part of the Medicine Bow Mountains lying in southeastern Wyoming, by R. S. Houston and others, - 167 pages, 35 plates, 53 text figures, and 67 tables.
- (b) Reprinting of Bulletin 17 - Bibliography and index of Wyoming geology 1823-1916, by G. G. Bovee, - 126 pages.

- (c) Bulletin 53 - Bibliography of Wyoming Geology 1917-1945, by Max L. Troyer, - 73 pages.
- (d) Preliminary Report No. 9 - Gypsum deposits in the Cody area, Park County, Wyoming, by James M. Bullock and William H. Wilson, - 12 pages, 1 plate, 5 text figures, and 2 tables.
- (e) Preliminary Report No. 11, - Structural geology of the Rex Lake quadrangle, Laramie Basin, Wyoming, by D. L. Blackstone, Jr., - 17 pages, 1 plate (colored geologic map of Rex Lake quadrangle), 3 text figures, and 3 tables.
- (f) Bulletin 54 - Fossils of Wyoming, by Michael Hager (in press).
- (g) Preliminary Report No. 12 - Structural geology of part of the Morgan quadrangle, the Strouss Hill quadrangle, and the James Lake quadrangle, Albany and Carbon Counties, Wyoming, by D. L. Blackstone, Jr., completed, with colored geologic map; awaiting sufficient publication funds.
- (h) Preliminary Report No. 13 - Geology of the Soapy Dale quadrangle, Park County, Wyoming, by W. H. Wilson; completed, with colored geologic map; in press.

At the time of this writing the backlog of publishable material exceeds our budgeted funds. Redistribution of funds to cover additional printing costs during the next biennium have been requested in the Biennial Budget for 1971 - 1973.

CONCLUSIONS AND RECOMMENDATIONS

The number of requested services and related mineral industry activities provided by the Geological Survey greatly increased during 1969-1970. In order to accommodate these requests a recommendation has been placed on page 7 of the Biennial Budget Request for 1971 - 1973 for two additional full-time staff geologists: one to be responsible for the coal and uranium geology of the State, and another to assist with the service work load and to act as a geological consultant to communities and counties on environmental and reclamation problems. There is a pressing need now for someone to be available in these capacities.

There is every reason to anticipate a continuation of our old and an expansion of new problems in Wyoming related to the extractive minerals industries. Geology generally, and this Survey in particular, have much to offer in this capacity.

APPENDIX "A"

VALUE OF MINERAL PRODUCTION BY COUNTY (1969)*

<u>County</u>	<u>Total Value</u>	<u>Minerals Produced in Order of Value</u>
Albany	\$ 6,737,000	Cement, petroleum, iron ore, stone, sand and gravel, gypsum
Big Horn	27,409,000	Petroleum, clays, natural gas, gypsum, stone, lime, sand and gravel
Campbell	99,738,000	Petroleum, natural gas, coal, sand and gravel, LP gases, stone
Carbon	21,402,000	Uranium, petroleum, natural gas, coal, LP gases, sand and gravel, natural gasoline, copper, stone, gold, silver
Converse	15,435,000	Petroleum, coal, natural gas, sand and gravel, LP gases
Crook	24,097,000	Petroleum, clays, natural gasoline, LP gases, natural gas, stone, sand and gravel
Fremont	86,803,000	Uranium, petroleum, iron ore, natural gas, natural gasoline, sand and gravel, LP gases, stone
Goshen	withheld	Sand and gravel, lime, petroleum, stone
Hot Springs	44,207,000	Petroleum, natural gas, coal, natural gasoline, sand and gravel
Johnson	17,395,000	Petroleum, clays, sand and gravel, natural gas, LP gases, natural gasoline, stone
Laramie	3,023,000	Stone, petroleum, sand and gravel, natural gas
Lincoln	10,518,000	Coal, natural gasoline, LP gases, phosphate rock, sand and gravel, stone
Natrona	53,143,000	Petroleum, natural gas, LP gases, uranium, sand and gravel, natural gasoline, clays, sodium sulfate, stone
Niobrara	1,820,000	Petroleum, natural gas, sand and gravel, LP gases
Park	103,242,000	Petroleum, natural gas, LP gases, gypsum, sand and gravel, natural gasoline, stone
Platte	4,445,000	Iron ore, stone, sand and gravel
Sheridan	3,379,000	Coal, petroleum, sand and gravel, stone, natural gas
Sublette	24,565,000	Petroleum, natural gas, sand and gravel, LP gases, stone
Sweetwater	79,226,000	Sodium carbonate, petroleum, natural gas, sand and gravel, coal, LP gases, natural gasoline, stone, pumice
Teton	withheld	Stone, sand and gravel
Uinta	1,267,000	Natural gas, natural gasoline, petroleum, clays, sand and gravel, stone
Washakie	9,914,000	Petroleum, natural gas, LP gases, lime, sand and gravel, stone
Weston	8,697,000	Petroleum, clays, sand and gravel, natural gas, LP gases, stone
Yellowstone National Park	151,000	Sand and gravel
Undistributed	828,000	
TOTAL	\$647,442,000	

* Compiled from U. S. Bur. Mines Report