UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

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Oil In Escalante

by Howard R. Ritzma
Petroleum Geologist, UGMS

There's a new bustle along the streets of Escalante. Hard hats are almost as common as the broad-brimmed variety, and conversations at cafe counters may not be so much of cows and tourists as of drilling problems, well locations and the movement of oil tank trucks. And some of the accents may be more typical of south Texas than south Utah.

The difference is two or three years and the Upper Valley Oil Field discovered by Tenneco Oil Company in 1964 and now in its fifth and busiest year of development. Production in October 1969 was 142,263 barrels from 16 wells, an average of 4,590 barrels per day for the field and 287 barrels per day per well. The oil produced from the Kaibab and Timpoweap limestones of Permian age is 27° gravity (API), brownish black, asphaltic base crude with 1.75 percent sulphur content. This field is the only source of this type of crude oil in Utah.

Production of Upper Valley* is summed up as follows:

Year	No. of Wells at Year's End	Annual Production (bbls.)	Cumulative Production (bbls.)
1964	1	57,867	57,867
1965	2	126,611	184,478
1966	4	223,504	407,982
1967	5	431,592	839,574
1968	11	890,943	1,730,517
1969 (6 mo.)	13	748,002	2,478,519

Production in October 1969 from 16 wells raised the total to 2,973,979 barrels, and projections indicate that the 3¼ million barrel mark may be reached by year's end.

Almost all oil from Upper Valley moves by truck tankers to Salt Lake City, an operation employing scores of drivers, maintenance men and personnel at loading facilities. Payrolls of oil field employees and of the companies engaged in drilling and servicing the wells have pumped a welcome surge of new dollars into the economies of Escalante and surrounding towns. Garfield County records show that the oil field's first tax bill in 1965 of $2,985 has grown to $33,717 in 1968, about ten dollars annually for every person in the county. Equally impressive is the distribution of royalties, 100 percent payable to Uncle Sam since the field is wholly on Federal land.

In 1968 alone, Upper Valley returned $214,777, 12½ percent of its gross income, in royalties to the Federal government. Following a complicated formula, 37½ percent of this found its way back to the county and state of origin. Ten percent of this, a little more than $8,000, was returned to Garfield County to finance county road work. The remaining 90 percent was distributed through the State Uniform School Fund to Utah's state-supported institutions of higher learning, elementary and secondary schools, and several educational and scientific agencies. Upper Valley's surging oil production in 1968 generated about $15,000 for the University of Utah and $1,300 for Southern Utah State College, to cite two examples.

Escalante's oil activity is far from boom proportions but the scent of big oil has had its effect. Seismic crews have fanned out far and wide across southern Utah as other companies eagerly but cautiously probe for a new big find in the relatively undrilled Kaiparowits Basin. There is talk of connecting Upper Valley to the pipeline 150 miles south in Arizona. Oil would then flow to the hungry California market.

Significant exploratory tests have been drilled and abandoned. More are drilling now and many more will spud in the months ahead. Any one of these could hit, set off the "big play," and give Utah another oil-rich basin to rival the Uinta and Paradox.

*Data from Division of Oil and Gas Conservation, State of Utah.

URBAN AIR POLLUTION

The problems and perils of urban air pollution have finally reached the acute stage where manifestation of public awareness is about to progress from talk to action. New advances in transportation technology direct this action toward experimental use of the external combustion engine and electrically driven vehicles.

California, using a grant of federal money to its state legislature, has contracted for a fume-free bus to be put on a regular run in a metropolitan area in 1970. The power source will be an external combustion steam engine. The California Assembly has passed legislation offering to pay twice the going price of conventional vehicles for fumeless cars up to one-fourth of the total number of its state-owned fleet.

Parallel to the steambus experiment is a freon vapor bus experiment at Dallas, Texas, announced by the U.S. Department of Transportation. And if a federal law sponsored by influential members of both houses of Congress becomes reality, the General Services Administration will pay a premium of 25 percent above the normal price for automobiles free of fumes.

New York Transit Authority is planning a test of electrically powered buses on cross-town runs in Manhattan.

Local service fleets of gas and electric companies are using a natural gas fuel system initiated by a company in southern California.

Further incentive to replace the internal combustion engine is provided by

(Continued on page 6)

UGMS *Quarterly Review* publishes information annually in its May issue about geologic field work planned for the ensuing summer. If you contemplate field work in Utah in the summer of 1970, please provide the information requested on the enclosed questionnaire. The map on the back should be marked to show the area of the field work.

The questionnaire should be mailed to Editorial Office, Utah Geological Survey Building, University of Utah, Salt Lake City, Utah 84112, by March 31, 1970.

REMINDER FOR FIELD CREWS

As the coming field season draws near, UGMS reminds all field geologists to take precautions to ensure a safe and productive field season this year. We give this reminder in the form of a story.

Last summer J. Wallace Gwynn and Edward Dalton, as part of UGMS field work, were mapping the oil-impregnated sandstones in the Hill Creek area, southeast Uinta Basin. It is a desolate and seldom frequented area 35 to 40 miles south of Ouray, in the Uintah and Ouray Indian Reservation.

The two geologists were near the last of their ten-day field stay working in the Tabyago Canyon area. The weather had been occasionally rainy, but the roads and creek bottoms appeared dry and seemed solid enough to drive on. Towards the end of the day they found themselves some distance to the north in the lower portion of Tabyago Canyon. Rather than backtrack, they followed the creekbed south and then east to its junction with Cat Canyon where a road was shown on their map, leading up out of the canyon and joining the main road at Dog Knoll. Feeling that this route would hasten their return to camp and enable them to further check for northward oil, they proceeded, avoiding the remaining soft sand and wet areas in the drainage.

They soon lost their position on the map owing to the sinuous nature of the drainage. As they rounded an abrupt turn, the front wheels of their four-wheel drive vehicle dropped suddenly out of sight.

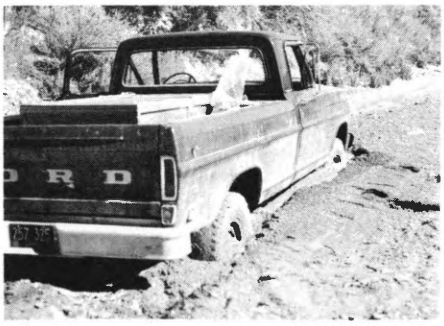
They found themselves in deep, water-filled sand which was dry and undetectable on the surface. They put the vehicle into four-wheel drive and attempted to work themselves out, but in seconds, the back tires too had broken through, and the truck sank nearly to the hubs.

It was late in the day, the canyon air was humid and hot and they were tired from the day's work. They had plenty of cold canned pop and water, a few cookies, and a shovel, a handiman jack and a few pieces of two-by-four.

Realizing that help, if any, was a long way away, they began to dig the truck out. The mud was heavy in the hot afternoon sun, the weight of the truck seemed to increase as they jacked it up, and the rocks they put under the tires were hard to find. After about an hour and a half they had a road built of rock and brush. They were by this time tired, hungry, and nearly sick from heat and exhaustion, and still were not sure where they were. After they eased the truck back onto solid ground, they climbed up out of the canyon to get a better look at their surroundings. The small canyon they were trying to pass, at the mouth of which they had been stuck, was the very canyon they were looking for.

Arriving back at their Hill Creek camp well after dark, exhausted and hungry, the men reflected on the events of the day and realized how fortunate they were. They had carried a shovel, a dependable jack and a small amount of food. They had a dependable vehicle. It could have been worse.

The next day they returned to Salt Lake City on schedule. If the two had not shown up by that evening, someone would have come looking for them. But what would have happened if something had gone wrong at the first of the ten days, and where specifically would someone look? What if they had encountered mechanical difficulty, or had not had the proper equipment to dig the truck out with, or if there had been only one person, or no food and water? These are problems which every field worker must be prepared to face. Many of these problems can be minimized by driving a dependable vehicle, having a partner at all times, carrying proper equipment, food and water, and always telling someone your destination and date of return. Groundlings can file a flight plan too. Such precautions as these may pay rich dividends if the unexpected should happen.



BEFORE AND AFTER: A little foresight insures a happy ending to an event that can happen anywhere off the beaten path in Utah.

Great Basin Bulletin

A University of Utah Bulletin, vol. 10, No. 7 in the Biological Series, entitled "The Great Basin, with emphasis on glacial and post-glacial times," is a remarkably useful tool in the study of the geology, the zoology, climatic changes and prehistoric man who inhabited the Great Basin. Section I, The Geologic Background, was written by Eliot Blackwelder, Section II, The Zoological Evidence, by Carl L. Hubbs and Robert R. Miller, and Section III, Climatic Changes and Pre-White Man, by Ernst Antevs.

Published in 1948, this publication gives authoritative information in the specialties of the authors still valid after 20 years. Numerous photographs illustrate the geologic changes and the endemism of living fishes in bodies of water that are remnants of the many pluvial lakes of the Pleistocene.

Archeological sites provide information on climatic conditions and the corresponding lake levels throughout the Great Basin.

"The Great Basin" may be ordered for $1.00 from 103 Utah Geological Survey Bldg., University of Utah, Salt Lake City 84112.

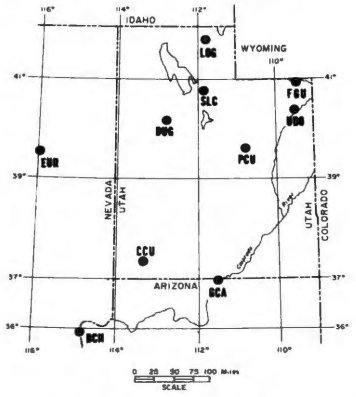
Fossils Found in Dry Hole

Deepening of Mountain Fuel Supply No. 11 Clay Basin Unit, SE NW 22-3N-24E., Daggett County, Utah has provided geologists with new information on Cambrian stratigraphy in the region. The well, an unsuccessful attempt to find deeper production in Utah's oldest commercial gas field, topped Cambrian sediments at 11,175 feet and was still penetrating Cambrian carbonates when drilling halted at 11,762 feet.

In the nearest basal Paleozoic exposures along the north flank of the Uintas, Cambrian rocks are absent. At Sheep Creek, 25 miles west, and on Cold Spring Mountain, Colorado, 20 miles east, Mississippian limestone rests on the Precambrian Uinta Mountain Group. So the 587 feet or more of Cambrian sediment in the well came as a surprise.

Even more unexpected was discovery of abundant definite Middle Cambrian trilobites in cores recovered from 11,160 to 11,650 feet in the well. The fossils were identified by Richard A. Robison of the University of Utah. Thin Cambrian sediments on the south flank of the Uintas are late Cambrian in age, and this corner of Utah has been heretofore considered to lie considerably east of areas of middle Cambrian deposition.

The fossil information, an unexpected scientific bonus from an expensive dry hole, is expected to stimulate new regional concepts of Cambrian sedimentation and paleogeography.



This map shows location of seismograph stations in Utah and adjacent areas. Locality symbols represent stations at Logan (LOG), Salt Lake City (SLC), Dugway (DUG), Flaming Gorge (FGU), Price (PCU), Vernal (UBO), Glen Canyon, Ariz. (GCA), Boulder City, Nev. (BCN), and Eureka, Nev. (EUR). After Cook and Smith, Seismicity in Utah, 1850 through June 1965, Bulletin of the Seismological Society of America, vol. 57, 1967.

UGMS Maps

"Mining Districts and Mineral Deposits of Utah" is available at the UGMS office. This map, compiled and published in 1966 by Charles A. Mardirosian, consulting geologist in Salt Lake City, shows the districts and deposits in color on a USGS base map of the state, scale 1:750,000. Production and gross value of the larger mining districts and descriptions of the districts and mineral deposits are given.

"Index to Geologic Thesis Mapping in Utah," map No. 7 in the UGMS series, is available in a limited number. This map, published in 1958, supplements the USGS Geologic Map Index of Utah, 1954, and can be used as an overlay.

Copies of the maps may be ordered at the UGMS office, 103 Utah Geological Survey Bldg., University of Utah, Salt Lake City 84112. "Mining Districts and Mineral Deposits of Utah" costs $1.50, and "Index to Geologic Thesis Mapping in Utah," 35¢. If the latter map is ordered alone, the price should be included with the order.

Please add 10 percent to the amount in payment for your order for packaging and postage.

Magnificent Moab

The area in Utah around Moab, in Grand County, contains magnificent country and opportunities for widely varied recreation. Arches National Monument and Canyonlands National Park provide opportunities for rugged activity, on foot, cycle or in four-wheel drive vehicles. Jet boat trips traverse the Colorado River and dune buggies crisscross the hills and ravines.

The La Sal Mountains National Forest, with 30 peaks up to 13,000 feet elevation, and Dead Horse Point and Indian Creek state parks, all provide recreational opportunities.

The spectacular recreation areas in the vicinity of Moab in southeast Utah in Grand County are brought to public attention by the Moab *Times-Independent,* in its publication of brochures and maps advertising the area. The *Times-Independent* is to be complimented in its effort to make the possibilities of this part of Utah known to the public.

EARTHQUAKE EPICENTERS

General earthquake epicenters in or near Utah in September, October and November 1969, with dates of occurrence and approximate magnitude, are listed below:

SEPTEMBER		Magnitude
1	South of Sunnyside	1.8
4	Near Fruita	2.0
8	Utah, Wyoming Border	2.0
10	Rulison Blast — Rifle, Colo.	4.8
12	South of Sunnyside	1.8
12	South of Sunnyside	2.0
12	South of Sunnyside	1.5
12	Near Sugarville	2.4
17	South of Sunnyside	1.5
17	South of Sunnyside	1.8
19	South of Salina	1.5
19	South of Salina	2.8
20	South of Sunnyside	2.0
21	South of Sunnyside	1.8
22	North of Randolph	2.2
22	North of Randolph	2.8
25	San Rafael Swell	2.2
26	Promontory Mt.	2.4

(14 rockbursts in September)

OCTOBER		Magnitude
3	South of Sunnyside	2.0 - 2.5
3	South of Sunnyside	2.0 - 2.5
3	South of Sunnyside	2.0 - 2.5
5	South of Sunnyside	2.0 - 2.5
6	Southern Utah - Nevada Border	2.0
7	North of Fillmore	1.5
8	South of Sunnyside	2.0 - 2.5
8	South of Sunnyside	2.0 - 2.5
8	*Blast at Three Peaks, west of Cedar City	no Mag.
10	Southern Utah - Nevada Border	3.5
12	South of Sunnyside	2.0 - 2.5
14	South of Sunnyside	2.5
19	South of Sunnyside	2.0 - 2.5
19	Northeast of Fillmore	2.6
21	Promontory Mountains	1.5
23	North of Salina	2.0
23	North of Salina	1.8
24	South of Sunnyside	1.5
25	Promontory Mountains	1.5
31	Southwest Wyoming	3.5
31	East of Springdale	2.5

(6 rockbursts in October)

*100 Kiloton blast detonated by the Weapons Laboratory of the United States Air Force.

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UGMS Staff Changes

UGMS will have a new staff member in March. He is Walter M. Katzenberger, who will be chief of operations, in charge of the Survey vessels and other equipment used in exploration of Great Salt Lake. The vessels are the 42-foot G. K. Gilbert, the Clyman, a 22-foot motor dory, three DUKWs (amphibious trucks), and the Oolite, a 12-foot lifeboat. Two jeeps, two trucks, and the exploratory equipment also will be in his charge.

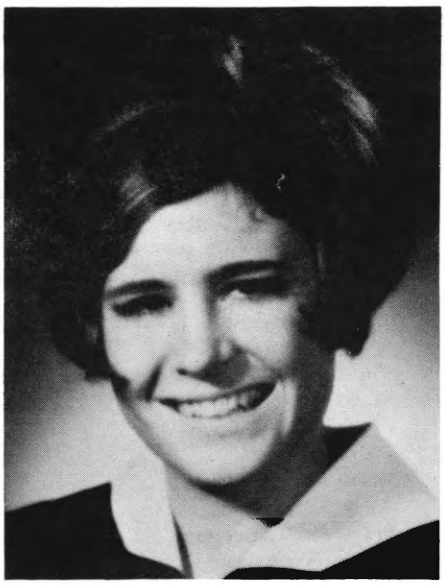
Mr. Katzenberger recently retired from active duty in the U.S. Navy as chief petty officer, QMC. He has had wide practical experience in operation and maintenance of small craft under all conditions — except Great Salt Lake!

The new chief of operations plans to move his family from Virginia Beach, Virginia, to Salt Lake City.

UGMS loses staff members occasionally too. Ann Allen, editorial office manager, has been teaching English in a junior high school since her resignation on December 31.

Miss Allen has been employed in the editorial office for four years, her entire undergraduate career.

Sue Francis, a manuscript typist since March 1969, will fill the office manager vacancy.



Ann Allen

PETROLEUM PERCENTAGES INCREASE

Estimates indicate that more than 75 percent of U.S. energy will be supplied by petroleum in 1970. Percentages of U.S. energy consumption for selected years depict a drastic shift in national energy sources from coal to oil and gas.

	Coal	*Petroleum*	*Hydropower*	*Nuclear*
1920	78.4	17.7	3.9	0.0
1930	61.2	35.3	3.5	0.0
1940	52.4	43.8	3.8	0.0
1945	50.7	44.6	4.7	0.0
1950	37.8	57.5	4.7	0.0
1955	29.3	66.9	3.8	0.0
1960	23.2	73.2	3.6	0.0
1965	22.9	73.2	3.8	0.1
1968 (preliminary)	21.4	74.8	3.7	0.1
1970 (estimate)*	20.1	75.9	3.4	0.6
1975 (estimate)*	17.1	76.0	3.1	3.8

*Projections by Oil and Gas Journal. All other data from publications of American Petroleum Institute.

Petroleum (including crude oil, natural gas and natural gas liquids) began to exceed coal in 1946. Hydropower reached a peak of 5.0 percent in 1949 and has declined since. Nuclear power first entered the tabulation in 1961. Fuel wood (not included in tabulation) is estimated to have provided 7.5 percent of energy total in 1920, 2.6 percent in 1955 and some unknown small percentage today. As late as 1940 wood was a greater source of energy in the national total than hydropower.

Breakdown of the petroleum total shows the growth of natural gas as an energy source.

	Crude Oil	*Natural Gas*	*Natural Gas Liquids*	*Petrol'm Products (Net)***
1940	32.1	11.4	1.0	—0.7
1950	36.0	18.0	2.3	+1.2
1960	38.4	28.4	3.2	+3.2
1968	35.3	31.1	3.6	+4.8

**Minus figures represent exports. Since 1949 U. S. has been a net importer of products represented by plus figures.

Interstate Oil Meet

UGMS occupied a prominent place in the activities of the Interstate Oil Compact Commission which met on December 7-10, 1969. The commission met for the first time in Salt Lake City, at Hotel Utah.

A Survey exhibit described current activities in oil shale and oil-impregnated sandstone (tar sand) studies in Utah. About 300 samples of high-grade "Mahogany" oil shale in plastic bags were given to out-of-state registrants at the meeting.

Howard Ritzma, Survey petroleum geologist, addressed a combined committee session on "Utah's Tar Sand Resources." William P. Hewitt and Mr. Ritzma also attended a meeting of the Compact's Tar Sands subcommittee; and Mr. Ritzma, committee member for Utah, presented an informal report on the Survey's progress in mapping and analysis of tar sand deposits.

Delegates to the meeting were welcomed to Utah by Governor Rampton. Hosts for the meeting were the commissioners and staff of the Division of Oil and Gas Conservation, Department of Natural Resources.

Marsell Honorary Member

The Association of Engineering Geologists awarded its first honorary membership at its annual meeting held October 24, 1969, in San Francisco. The recipient was Ray E. Marsell, geologist with Utah's Water Resources Division in Salt Lake City and professor emeritus of geology, University of Utah.

Marsell was co-author of a paper "The Lower Jordan Valley water distribution system's reliance upon geology," presented by Bruce N. Kaliser, UGMS engineering geologist.

Predict Earthquakes

Scientists of USGS National Center for Earthquake Research. Menlo Park, California, say that "it seems reasonable to hope that short-range prediction of earthquakes (on the order of hours or days) may be achieved through continuous monitoring of ground tilt, strain, seismic activity, and possibly fluctuations in the earth's magnetic field."

This observation was quoted in the December 19 issue of *Science*.

Salt Forms Crust in Great Salt Lake

by
Leonard Hedberg

Staff Specialist, Great Salt Lake Project

The salt crust in the bottom of the south arm of Great Salt Lake was successfully cored by the UGMS Great Salt Lake crew during the summer of 1969. Measurements indicate a total volume in the order of magnitude of .045 Km^3 or 100 million short tons of salt precipitate in the south arm. Analysis of a representative sample of the salt by the UGMS laboratory, subject to correct, shows the following percentages:

Mg	.084
Ca	.32
K	.13
Na	37.4
Cl	60.9
S	.26
Si	.093
B	.001
Li	.014
Cu	.0001
Fe	.001

A layer of material 3 to 6 cm thick lies between the salt crust and the underlying lake clays. Analysis of this layer shows the following percentages:

MgO	2.9
CaO	12.1
K_2O	.66
Na_20	22.6
Cl	25.6
SO_4	23.4
$SiO_2 + Al_2O_3$	11.4
Li	.009
CuO	.040
FeO	.10

Preliminary measurements of the thickness of salt crust in the north arm show the deposit is wedge-shaped in section, increasing in thickness east to west, from 10 cm on the east shoreline to 35 cm on the west. The estimated volume of salt crust in the north arm is on the order of magnitude of .24 Km_3 or 600 million short tons of salt precipitate.

Analysis of representative samples of the north arm salt shows the following percentages in their composition:

Na	38.6
Cl	60.4
K	.004
Mg	.0015
Ca	.002
Br	.005
SO_4	.0016
Fe	$<.002$
Cu	$<.001$
Insolubles	.10

AAPG Maps

The American Association of Petroleum Geologists has published the third of a series of 11 geological highway maps which will portray the entire continental United States.

Each map is a combination of a geological map showing location and surface distribution of rocks of various geological ages, and a base map that locates highways, rivers, counties, cities and towns. Color and standard symbol show the age and outcrop pattern of the surface forks.

Cross sections illustrate the subsurface geology, the tectonic map presents the principal structural features, and the physiographic map shows the principal landforms. The generalized chart of time and rock units illustrates the kinds of rocks that comprise the map units and their relative and radiometric ages.

Map No. 2, Southern Rocky Mountain Region (Utah, Colorado, Arizona and New Mexico) and map No. 3, Pacific Southwest Region (California and Nevada) are available in the UGMS office and at the AAPG office, P.O. Box 979, Tulsa, Okla. 74101, for $1.50 each.

Plastic Mine Support Possible

Safer and more economical permanent support for underground mine workings is possible through use of high-strength plastic polymers, according to the U.S. Bureau of Mines. But further research is needed before such polymers can be tested under actual mining conditions, according to the Dec. 29, 1969, News Bulletin of the American Mining Congress.

The bureau said preliminary tests at its Spokane (Wash.) Mining Research Laboratory have been encouraging. Plastic treatment has been shown to add substantially to the strength of rocks, even to the point of "healing" fractures and making the rock stronger than before it was fractured. After treatment with plastic, one type of extremely porous rock (volcanic tuff) was 3.5 times as strong, the report said.

The treatment described by the Bureau of Mines involves impregnating rock specimens with a highly fluid form of plastic which can be forced into cracks, joints and pores. Heat is then applied in the presence of catalysts to link individual molecules of plastic, called monomers, into larger and more complex molecules, the polymers. The polymerized plastic imparts great strength to the rock, healing cracks and fissures, the bureau said. The treated rock has a visible coating that can resist deteriorating effects of water and heat.

The Bureau of Reclamation (Interior Department) and the Bureau of Public Roads (Department of Transportation) also are testing the treatment method for application in strengthening concrete for dam and road construction. The Atomic Energy Commission's Brookhaven National Laboratory is conducting research on plastic polymerization with cobalt-60 radiation.

UGMS Board Changes

The advisory board of UGMS has undergone changes in the last six months.

Col. William J. Lewis of the Magnesium Division of National Lead is a newly appointed member. L. W. Folsom resigned June 1 and is a consulting geologist in Grove City, Pennsylvania. Alvin J. Thuli, Jr., resigned December 31 and is manager of construction for Bougainville Pty. Ltd., at Pangura, Bougainville, in the Territory of Papua, New Guinea. The mine, in a large copper porphyry deposit, should be ready for operation by January 1, 1972.

Kurt O. Lynn of Texas Gulf Sulfur resigned January 31. He will be working with a subsidiary of Texas Gulf, Australian Inland Exploration Co., with headquarters in Perth, in western Australia.

POLLUTION

(Continued from page 1)

public hearings held in early December 1969 by the California Assembly Transportation Committee on the dangers of poisoning by lead burned in gasoline and spreading through the atmosphere.

With these and other incentives, private industry is ready to invest money, time and talent in alleviation of the air pollution problem. Whoever comes up with the first economical smogless car will have a guaranteed market.

A biochemist named Arie Jan Haagen-Smit of the California Institute of Technology was one of the first to recognize smog for what it is. Many of the toxic ingredients of smog react with hydrocarbon particles in the air to form ozone and poisonous compounds of nitrogen, sulfur and carbon. In urban areas, 85 percent of air pollution emanates from auto exhaust.

Haagen-Smit sees a basic weakness in adding devices to reduce the gasoline engines' exhaust discharge by more complete burning of the gasoline. As more oxygen is introduced to complete the destruction of hydrocarbons, the oxygen combines not only with the hydrocarbons but with nitrogen in the air, creating oxides of nitrogen that are among the most noxious elements in smog.

Those working on the smog problem, whether scientists or associated with government or industry, recognize that the fight against smog is a war for survival and should be conducted as such.

UGMS List Out

UGMS is distributing a new List of Publications, available free for the asking at 103 Utah Geological Survey Bldg., University of Utah, Salt Lake City 84112.

Increased demand for UGMS publications requires that we make a 10 percent charge for packaging and postage, with a 10¢ minimum charge on all orders.

Quantity discounts are available on UGMS Bulletins, Special Studies and Water-Resources Bulletins, and Utah Geological Society publications. See the List of Publications for details.

Those who wish to receive a copy of the new List of Publications should fill in the enclosed coupon.

(Continued from page 3)

NOVEMBER		Magnitude
1	Bloom	<2.5
3	South of Sunnyside	<2.0
3	South of Sunnyside	<2.0
4	South of Sunnyside	<2.0
5	South of Sunnyside	<2.0
6	South of Sunnyside	<2.0
8	Southern Nevada - Utah Border	3.0
9	Idaho - Utah Border	2.5
11	South of Sunnyside	1.5
11	East of Logan	3.0
12	South of Sunnyside	<2.0
13	South of Sunnyside	<3.0
15	North of Huntsville	3.3
16	Northern part of Great Salt Lake Desert	3.2
17	East of Kamas	2.5
18	North of Green River	3.0
19	Southwest of Teasdale	2.7
20	North of Lund	2.5
22	Mt. Pennell	3.5
26	South of Sunnyside	2.0
28	South of Sunnyside	1.8
30	South of Sunnyside	2.3

(10 rockbursts in November)

These earthquakes were recorded by the University of Utah seismograph stations under the direction of Kenneth L. Cook. All locations and magnitudes are preliminary determinations; final determinations will be printed in the University of Utah Seismological Bulletin, issued quarterly.

New Department Head

The new Department of Geological and Geophysical Sciences, University of Utah, is embarked upon a program of reorientation and expansion. The first step in this program was the formation of the new department by merger of the former departments of Geology, Mineralogy and Geophysics. The second step was the appointment of Dr. Stanley H. Ward, formerly with the University of California, Berkeley, to the chairmanship of the new department, effective July 1, 1970. Dr. Ward has indicated that his objectives include the attainment of teaching excellence and an expanded program in research. Fundamentals and a quantitative approach in both teaching and research will be stressed.

The department will be housed in a new $3,200,000 Minerals Building, under construction at present, and slated for completion in January 1971.

Faculty positions are available, and interested individuals are invited to contact Dr. Ward.

Dr. Stanley H. Ward

UGMS Gifts

UGMS acknowledges with thanks gifts of $500 from Great Salt Lake Minerals and Chemicals Corporation, Ogden, and $150 from Vanguard Exploration Company, Spokane, toward purchase of a radar instrument, used in exploration in Great Salt Lake.

Mineral Production in Utah by County, 1967-1968

1968 mineral production value in Utah was $424 million. In order of value, the leading commodities were (released values only) copper, crude petroleum, bituminous coal, gold and uranium (U.S. Bureau of Mines).

The largest segment of the mineral industry was the metals. Labor strikes that carried over from 1967 and ended in March 1968 lowered metal values for the year, but even so they showed a good increase over the 1967 figure. Copper, gold, lead, silver and zinc values amounted to $236 million compared to $171 million in 1967.

Petroleum and natural gas values stood at $70.1 million compared to $69.7 million for the previous year. An increase in wellhead value for natural gas marked a 12.8 percent increase in the produced value. There was a very small decrease (2.3 percent) in crude oil production. One hundred and forty-eight wells were completed during the year, 90 development and 58 wildcat, with a total footage of 748,792 feet. Of the development wells, 53 were successful and 37 were dry, a success ratio of 58.9 percent. Three of the 58 wildcats were successful, one in Washington County (Anderson Junction Field) and two in San Juan County (Cowboy Field and Wilson Canyon Field). The depth record for oil wells drilled in Utah was broken twice during the year, first by Chevron's Stone Cabin Unit No. 1 well in Carbon County ,17,261 ft) and by Phillips's No. 10 Bridger Lake well in Summit County (17,910 ft).

Coal production increased 3.2 percent and uranium 24.8 percent over the previous year. At the end of the year a unit train between the Fontana plant of Kaiser Steel and Sunnyside went into operation, handling 8,400 tons of coal per trip at 6 mills per ton-mile. Rio Algom Mines, Ltd., revealed plans to build a uranium mill south of Moab to produce 1.2 million pounds of U_3O_8 annually.

Work on Great Salt Lake Minerals and Chemicals solar ponds and other facilities near Ogden was completed. Potassium sulfate, sodium sulfate and magnesium chloride will be produced by Great Salt Lake Minerals and Chemicals.

Federal and state mineral statistics related to leasing and royalties are maintained on a fiscal year basis. The following information is therefore dated to show the time period involved. Monies collected by federal and state agencies for leases, rentals and royalties on minerals produced in Utah for the fiscal year ending June 30, 1968, amounted to $14.9 million. The total received by the state, including the federal allocation to the state, was $5.3 million. Mineral production and values by county for the year 1968 are listed below. For a comparison with 1967 figures, the reader is invited to check the Utah Geological and Mineralogical Survey *Quarterly Review* for February 1969, v. 3, No. 1, p. 6. Information for this report was derived mainly from the U.S. Bureau of Mines report, "Mineral industry surveys: the mineral industry of Utah, 1968"; additional information released to UGMS by the U.S. Bureau of Mines; Public Land statistics, 1968; U.S. Department of the Interior Bureau of Land Management; Utah Division of State Lands fiscal report, July 1, 1968, to June 30, 1969.

Commodity	*Value*	*Quantity*
BEAVER COUNTY		
Gold	W[1]	W
Silver	W	W
Copper	W	W
Lead	W	W
Zinc	W	W
Pumice	W	W
Sand and gravel	$ 31,000	22,000 s.t.[2]
Total	$ 1,564,977	
BOX ELDER COUNTY		
Lime	W	W
Salt	W	W
Sand and gravel	$ 842,000	873,000 s.t.
Stone	92,356	3,544 s.t.
Total	$ 1,420,852	
CACHE COUNTY		
Lime	W	4,582 s.t.
Sand and gravel	$ 483,000	385,000 s.t.
Stone	293,798	111,882 s.t.
Total	$ W	
CARBON COUNTY		
Carbon dioxide	$ 4,042	57,747 t.c.f.[3]
Coal	18,362,948	3,061,922 s.t.
Natural gas	162,000	1,026 m.c.f.[4]
Sand and gravel	92,000	95,000 s.t.
Total	$ 18,620,990	
DAGGETT COUNTY		
Natural gas	$ 118,000	746 m.c.f.
Petroleum	8,000	3 t.b.[5]
Sand and gravel	6,000	6,000 s.t.
Total	$ 132,000	
DAVIS COUNTY		
Sand and gravel	$ 642,000	795,000 s.t.
Stone	9,231	4,026 s.t.
Total	0 651,231	
DUCHESNE COUNTY		
Natural gas	$ 44,000	281 m.c.f.
Petroleum	1,938,000	725 t.b.
Sand and gravel	376,000	455,000 s.t.
Total	$ 2,358,000	
EMERY COUNTY		
Coal	$ 6,038,709	1,167,240 s.t.
Natural gas	68,000	429 m.c.f.
Petroleum	24,000	9 t.b.
Sand and gravel	262,000	250,000 s.t.
Uranium, U_3O_8	W	W
Vanadium	W	W
Total	$ 6,692,640	

(Continued on page 8)

Officials Cite Serious Salt Loss

Utah's salt company officials asked Gov. Rampton to assist in alleviating a serious lowering of salt concentration in the southern part of Great Salt Lake, where most salt gathering and processing facilities are located. They asserted that the Southern Pacific Railroad causeway which crosses the lake at Willard Bay has resulted in an imbalance of salt content — the northern part of the lake having 26 percent and the southern part only 16 percent. The causeway is a permeable landfill with two 20-foot culverts. Some 95 percent of the lake's fresh water comes in south of the causeway.

(Continued from page 7)

Commodity	Value	Quantity
GARFIELD COUNTY		
Petroleum	$ 2,398,000	897 t.b.
Sand and gravel	354,000	350,000 s.t.
Uranium, U_3O_8	92,010	11,521 lb.
Vanadium	W	W
Total	$ 2,844,010	
GRAND COUNTY		
Natural Gas	$ 881,000	5,574 m.c.f.
Petroleum	361,000	135 t.b.
Potassium salts	W	W
Sand and gravel	43,000	36,000 s.t.
Uranium, U_3O_8	514,302	68,333 lb.
Vanadium	W	W
Total	$ 7,876,415	
IRON COUNTY		
Coal	W	W
Iron ore	$ 11,280,697	1,763,511 l.t.[6]
Pumice	12,650	5,050 s.t.
Sand and gravel	369,000	361,000 s.t.
Stone	W	W
Total	$ 11,679,422	
JUAB COUNTY		
Gold	$ 26,186	667 troy oz.
Silver	106,479	49,650 troy oz.
Copper	17,241	20 s.t.
Lead	2,220	8 s.t.
Zinc	608	2 s.t.
Clays	W	W
Fluorspar	213,111	8,762 s.t.
Sand and gravel	160	320 s.t.
Stone	W	W
Total	$ 1,531,931	
KANE COUNTY		
Coal	$ 9,650	1,618 s.t.
Sand and gravel	94,000	116,000 s.t.
Total	$ 103,650	
MILLARD COUNTY		
Sand and gravel	$ 30,000	30,000 s.t.
Total	$ 30,000	
MORGAN COUNTY		
Cement, masonry and portland	W	W
Sand and gravel	W	W
Stone	W	W
Total	$ W	
PIUTE COUNTY		
Gold	W	W
Silver	W	W
Copper	W	W
Lead	W	W
Zinc	W	W
Clays	W	W
Sand and Gravel	$ 37,000	39,000 s.t.
Uranium, U_3O_8	W	W
Total	$ 424,959	
RICH COUNTY		
Phosphate rock	W	W
Sand and gravel	W	W
Total	W	
SALT LAKE COUNTY		
Gold	$ 10,694,031	272,390 troy oz.
Silver	6,962,309	3,246,437 troy oz.
Copper	187,619,685	224,173 troy oz.
Lead	6,170,955	23,354 s.t.
Zinc	3,311,982	12,267 s.t.
Cement, portland	W	W
Lime	W	W
Clays	W	W
Molybdenum	W	W
Salt	W	W
Sand and gravel	2,809,000	3,034,000
Stone	W	W
Tungsten, 60 percent WO_3	W	W
Total	$238,830,818	

Commodity	Value	Quantity
SAN JUAN COUNTY		
Silver	$ 21,388	9,973 troy oz.
Copper	857,110	1,024 s.t.
LP gases	W	W
Natural gas	3,179,000	20,122 m.c.f.
Natural gasoline	W	W
Petroleum	$ 36,363,000	13,604 t.b.
Sand and gravel	53,000	53,000 s.t.
Stone	57,044	28,522 s.t.
Uranium, U_3O_8	12,284,252	1,595,332 lb.
Vanadium	W	W
Total	$ 58,464,458	
SANPETE COUNTY		
Clays	W	1,080 s.t.
Natural gas	W	35 m.c.f.
Salt	W	W
Sand and gravel	$ 63,000	62,000 s.t.
	$ 130,230	
SEVIER COUNTY		
Silver	$ 36	17 troy oz.
Lead	66	([7]) s.t.
Zinc	1,107	4 s.t.
Clays	153,776	33,985 s.t.
Coal	W	W
Gypsum	W	W
Salt	7,500	2,500 s.t.
Sand and gravel	118,000	119,000 s.t.
Total	$ 1,585,009	
SUMMIT COUNTY		
Gold	$ 70,943	1,807 troy oz.
Silver	724,023	337,603 troy oz.
Copper	84,531	101 s.t.
Lead	1,263,226	4,781 s.t.
Zinc	1,481,463	5,487 s.t.
Clays	W	W
Coal	64,818	12,730 s.t.
Natural gas	79,000	503 m.c.f.
Petroleum	3,477,000	1,301 t.b.
Pyrites	W	W
Sand and gravel	394,000	397,000 s.t.
Stone	177,628	82,714 s.t.
Total	$ 8,095,540	
TOOELE COUNTY		
Gold	$ 6,555	167 troy oz.
Silver	360,840	168,255 troy oz.
Copper	109,430	131 s.t.
Lead	686,733	2,599 s.t.
Zinc	463,131	1,715 s.t.
Clays	W	W
Lime	W	W
Magnesium chloride	W	W
Pyrites	W	W
Salt	1,418,715	208,017 s.t.
Sand and gravel	521,000	1,008,000 s.t.
Stone	748,415	312,992 s.t.
Total	$ 6,980,377	
UINTAH COUNTY		
Gilsonite	W	W
LP gases	W	W
Natural gas	$ 2,755,000	17,435 m.c.f.
Natural gasoline	W	W
Petroleum	18,257,000	6,830 t.b.
Phosphate rock	W	W
Sand and gravel	146,000	135,000 s.t.
Total	$ 26,615,342	
UTAH COUNTY		
Gold	W	W
Silver	W	W
Copper	W	W
Lead	W	W
Zinc	W	W
Clays	W	W
Lime	W	W
Sand and gravel	$ 536,000	538,000 s.t.
Stone	W	W
Total	$ 8,971,348	

(Continued on page 9)

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Commodity	Value	Quantity
WASATCH COUNTY		
Gold	$ 2,317,439	59,028 troy oz.
Silver	1,165,805	543,600 troy oz.
Copper	806,517	964 s.t.
Lead	1,236,855	4,681 s.t.
Zinc	952,006	3,526 s.t.
Sand and gravel	120,000	132,000 s.t.
Stone	8,000	346 s.t.
Total	$ 6,606,622	
WASHINGTON COUNTY		
Gold	$ 39	1 troy oz.
Silver	20,054	9,351 troy oz.
Copper	1,548	2 s.t.
Petroleum	W	W
Sand and gravel	99,000	76,000 s.t.
Stone	W	W
Total	$ 121,894	
WAYNE COUNTY		
Sand and gravel	$ 3,000	7,000 s.t.
Uranium, U_3O_8	W	W
Total	$ W	
WEBER COUNTY		
Sand and gravel	$ 774,000	865,000 s.t.
Total	$ 774,000	
Undistributed[8]		
Cache, Morgan, Rich and Wayne counties, plus gem stones	$ 10,843,369	
GRAND TOTAL	$423,951,000	

1. W = Withheld to avoid disclosing individual company confidential data; values are included in county totals. County totals that have been withheld to avoid disclosing individual company confidential data are included with "Undistributed."
2. s.t. = short tons.
3. t.c.f. = thousand cubic feet.
4. m.c.f. = million cubic feet.
5. t.b. = thousand barrels.
6. l.t. = long tons.
7. Less than ½ unit.
8. Includes county values indicated by symbol W and gem stones that cannot be assigned to specific counties.

Mineral Production in Utah[1]
(U.S. Bureau of Mines)

Mineral		1968 Quantity	1968 Value in thousands	1969 Quantity	1969 Value in thousands
Carbon dioxide (natural)	thousand cubic feet	57,747	$4	57,000	$4
Clays[2]	thousand short tons	160	476	154	471
Coal (bituminous)	do.	4,316	24,893	4,000[3]	25,100[4]
Copper (recoverable content of ores, etc.)	short tons	228,245	191,027	299,200	283,923
Fluorspar	do.	8,762	213	6,700	195
Gem stones		NA	83	NA	80
Gold (recoverable content of ores, etc.)	troy ounces	344,419	13,129[5]	444,600	18,758
Iron ore (usable)	thousand long tons, gross weight	1,764	11,281	1,917	12,202
Lead (recoverable content of ores, etc.)	short tons	45,205	11,945	39,500	11,724
Lime	thousand short tons	174	3,439	193	3,732
Natural gas (marketed)	million cubic feet	46,151	7,292	53,540	8,459
Petroleum (crude)	thousand 42-gallon barrels	23,504	62,826	23,900	69,071
Pumice	thousand short tons	8	19	W	W
Salt	do.	405	3,756	421	3,941
Sand and gravel	do.	10,293	9,364	10,850	9,950
Silver (recoverable content of ores, etc.)	thousand troy ounces	5,121	10,982	5,996	10,732
Stone	thousand short tons	1,953	4,312	2,084	4,569
Tungsten concentrate (60 percent WO_3 basis)	short tons	W	W	2	6
Uranium[6] (recoverable content U_3O_8)	thousand pounds	1,712	13,175	1,233	7,688
Vanadium	short tons	563	2,010	564	2,416
Zinc (recoverable content of ores, etc.)	do.	33,153	8,951	33,000	9,636
Value of items that cannot be disclosed: Asphalt and related bitumens, cement, clays (halloysite), gypsum, magnesium chloride, molybdenum, natural gas liquids, phosphate rock, potassium salts, pumice, pyrites (1968), and values indicated by symbol W		XX	44,774	XX	56,447
TOTAL		XX	$423,951	XX	$539,104

NA: Not available.
W: Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
XX: Not applicable.

1. Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
2. Excludes halloysite; included with "Value of items that cannot be disclosed."
3. Based primarily on railroad carloadings.
4. Based on final 1968 Bureau of Mines State figures for value per ton f.o.b. mine adjusted to a 1969 level by use of Bureau of Labor Statistics price indexes. The latter indexes were for bituminous coal at the United States level for the first 10 months of 1968 and 1969.
5. Based on average U.S. Treasury price ($35.00) Jan. 1, 1968, through Mar. 14, 1968, and the New York selling price for the remainder of the year.
6. Value estimated based on $8.00 (1968) and $5.88 (1969) per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 (1968) and $6.35 (1969) per pound for commercial sales; includes value of U_3O_8 obtained from Utah ores processed at out-of-State mills.

(Continued on page 10)

Geologist for UNESCO

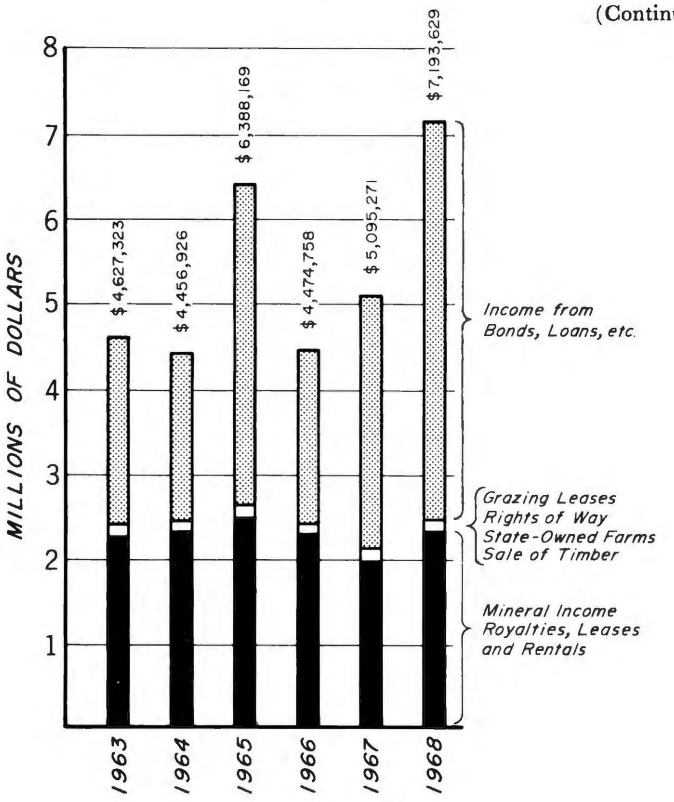
Dr. Matthew P. Nackowski, professor of mining and geological engineering at the University of Utah, has returned to the university after spending two years in Turkey as an expert in applied geology for UNESCO.

Dr. Nackowski served on the faculty of the Middle East Technical University at Ankara during 1967-68 and 1968-69. He taught undergraduate courses, directed graduate research, and served as advisor on curricula, course sequence and content, and acquisition of equipment.

The Middle East Technical University, founded about 10 years ago, is a forerunner of the international university, according to Dr. Nackowski. Even though it is now a national institution, it functions as a regional one, with students from neighboring Iran, Pakistan, Lebanon and Egypt. English is the language of the university; students study that language for a year at preparatory level.

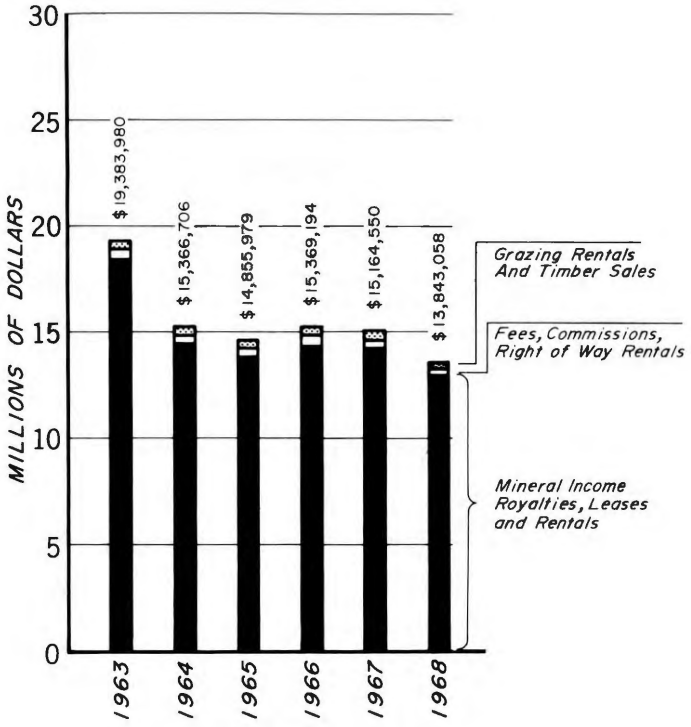
Dr. Nackowski's original intention was to stay in Turkey one year, but when the opportunity to remain a second year arose, he elected to do so. He travelled the length and width of the country, both with his family and in his capacity as advisor, accompanying students and helping them set up their research. The copper deposits in the Black Sea area, the chrome mines, and geologic mapping in central Turkey were subjects of primary interest, both to students and professor.

(Continued from page 9)



ANNUAL INCOME FROM STATE-OWNED LANDS, 1963-1968

FROM DIVISION OF STATE LANDS



RENTALS AND FEES FROM FEDERAL LANDS IN UTAH, 1963-1968

FROM U.S. BUREAU OF MINES

Minerals activity on federal lands in Utah, July 1, 1967, to June 30, 1968 (U.S. Bureau of Land Management).

Commodity	Mineral Permits, Licenses		Mineral Leases		Production	Receipts	
	Number	Acres	Number	Acres		Leases, permits	Royalties
Petroleum					11,753,542 bbls		
Natural gas			13,672	7,245,965	27,212,461 Mcf	$7,425,197	$4,275,816
Oil and gas liquids					12,229,536 gals		
Coal	27	48,816	183	258,467	1,723,752 s.t.	427,773	295,904
Other			78	95,070		28,428	25,677
Potash	53	123,716				95,695	4,825
Phosphate	19	30,521				20,800	3,952
Sodium	1	563				141	
Totals	100	203,616	13,933	7,599,502		$7,998,034	$4,606,174

Allocation of BLM receipts to state of Utah for mineral leases and permits: $3,003,394.

QUARTERLY REVIEW

State of Utah ..... *Calvin L. Rampton, Governor*
University of Utah ..... *James C. Fletcher, President*
College of Mines & Mineral Industries ..... *George R. Hill, Dean*
Utah Geological & Mineralogical Survey ..... *William P. Hewitt, Director*

UTAH GEOLOGICAL AND MINERALOGICAL SURVEY
103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah
84112