UTAH GEOLOGICAL & MINERALOGICAL SURVEY

QUARTERLY REVIEW

Vol. 7, No. 1 Service to the State of Utah February 1973

UGMS FOREWARNS

Earth Failures Menace I-80

Last August along Interstate Highway 80 between Coalville and Echo in Summit County, a portion of the road cut failed—the second such occurrence along that stretch since the road was first opened to traffic.

At least two years prior, Utah Geological and Mineralogical Survey staff had photographed the lanes, before and after being opened to traffic, and had predicted landsliding (see top picture taken from UGMS' Earth Science Education Series No. 2, published February 1971).

A third massive earth failure in December 1972 covered the westbound lane of traffic and required snowplows to clear the area. The slide was entirely in fill embankment material. Drill rig equipment is being used to explore subsurface conditions to provide data for a solution to the problem.

Above: View along newly opened traffic lanes; notch cut in slope is the result of a failure onto the road. Landsliding was predicted. (All photos by B. N. Kaliser, UGMS.)

Below: The second slide between Coalville and Echo in Summit County, August 1972. *Left center*: Farther north along the same highway, *en echelon* tension cracks portend future problems. *Right center*: Excavation of the slide foot revealed this scarplet with a clearly deformed (differentially shored) claystone horizon; the cone-in-cone structure (arrow) is believed penecontemporaneous with most of the deformation. Splintering, which already is destroying the structure, follows the fluting and slickensides in orientation.

More than 3 million gallons of water are pumped daily at Bountiful City's new well.

Kaliser checks Peterson Brothers' truck-mounted pump equipment.

CITY INSTALLS PUMP

Bountiful Well Boosts Water Supply

The City of Bountiful has a new water well, gauged at flowing 2,225 gallons per minute—maximum pump capacity. The rate of 3,204,000 gallons of water per day provides a terrific boost to Bountiful's supply of water to serve the community.

Bruce N. Kaliser, UGMS engineering geologist, recommended siting the well at the mouth of Barton Canyon at the east end of 6th South, an elevation considerably above the greater urban area, to avoid filtration, evaporation and pressure loss problems; he also supervised the drilling operation.

Peterson Brothers Drilling Co. of Bountiful drilled the well to 550 feet and installed a pump. Water will be drawn into the city water reservoir for dispersal.

Oil Shale–Possible Energy Source

"Oil shale and oil-impregnated rocks," presented by H. R. Ritzma, UGMS petroleum geologist, at the 1972 annual meeting of the American Association of Petroleum Geologists, will be published in the proceedings of the Mineral Economics Symposium (AAPG) by the Mineral Economics Institute, Colorado School of Mines.

The paper describes the oil shale and oil-impregnated rock resources of the U. S. and, in particular, the oil shale of Colorado, Utah and Wyoming and Utah's oil-impregnated rock.

The magnitude of these resources and their possible exploitation as energy sources is discussed. Both oil shale and oil-impregnated rocks (tar sands) are predicted to contribute to the nation's supply of synthetic petroleum by 1975 and in significant amounts by 1985.

In addition to the paper by Ritzma, the volume will contain articles on mining and mineral policies, petroleum, natural gas, coal and uranium by authorities in each field.

Copies are to be sold by: Publications Department, Colorado School of Mines, Golden, Colorado 80401. Price is $3.00 per copy payable by check or money order.

Utahns Mourn Armand J. Eardley

Dr. Armand J. Eardley, professor emeritus, Department of Geological and Geophysical Sciences, University of Utah, died November 7, 1972 at his home of a heart ailment.

Dr. Eardley, former dean of the College of Mines and Mineral Industries at the University for 11 years, was also head of the Department of Geology. He was president of the Rocky Mountain Section of the American Association of Petroleum Geologists and a member of the Utah Geological Society and other professional organizations.

He was the recipient of several awards honoring him as a scientist, scholar and teacher, i.e., the James E. Talmage Scientific Achievement Award in 1963 from Brigham Young University and meritorious service award in 1956 from the Utah Academy of Sciences.

Although he had exceptionally wide interests and published papers of global scope, he maintained especiai interest in the geology of the Salt Lake area. His studies of the waters, sediments and environ of Great Salt Lake are world famous.

At the time of his death, he was actively engaged in a joint study, financed by the National Science Foundation, of a deep core from the Great Salt Lake.

In eulogizing Dr. Eardley, one colleague said if ever there was a man to emulate, it was Dr. Eardley, because he was, in the true sense, a gentleman and a scholar.

The Utah Geological Survey joins with his friends and associates in mourning the loss of a great man.

UGMS RELEASES NEW SERIES

The first studies in a new Oil and Gas Field series were released this month by UGMS. Nos. 1 and 2, Pariette Bench Field and Agate Field Area, are in Uintah and Grand counties; No. 3, Grassy Trail Creek Field, straddles the Carbon-Emery county line.

A map depicting the structure of the field, stratigraphic data where significant to production, and a type log—usually electric or gammaray-neutron—cover each field, with one or more cross sections for larger fields.

Accompanying text details the field's discovery, development, reservoir data and production statistics and describes its geology.

The series begins with fields discovered and developed since 1961, but ultimately will update and supplement older data (i.e., the Intermountain Association of Petroleum Geologists' Guidebook, *Oil and Gas Fields of Utah—A Symposium).*

Work on fifteen fields is underway or has been completed by P. R. Peterson, consulting geologist, under contract to the Survey.

Maps, charts and text are folded into an envelope for convenience in filing or binding in a looseleaf. The first three studies are $1.00 each over-the-counter, $1.10 by mail (Utah Survey, 103 UGMS Bldg., University of Utah, Salt Lake City, Utah 84112).

Utah's Sen. Frank E. Moss, chairman of the Subcommittee on Minerals, Materials and Fuels, was appointed chairman of the Committee on Aeronautical and Space Sciences and will no longer serve on the Interior Committee. A new subcommittee chairman has not been chosen.

Hollis Dole Resigns Federal Post

President Nixon has accepted the resignation of Hollis M. Dole, Assistant Secretary of the Interior (Mineral Resources). A professional geologist, Dole joined the Nixon Administration on March 21, 1969.

Dole held major responsibilities for federal policies and programs related to energy and mineral resource development; he was among the first administration officials to call attention to the nation's deteriorating energy situation. He was instrumental in securing the passage of the Mining and Minerals Policy Act and the Geothermal Steam Act, and in carrying out significant portions of President Nixon's Clean Energy program.

As stated by the American Mining Congress, Dole's record as both a state and federal official reflects a philosophy of making public resources available for development by private enterprise.

He has consistently sought to increase the number of mining engineers being graduated and to upgrade the capabilities of mineral science colleges through programs of federal assistance.

Dole is a graduate of the College of Mines, University of Utah, and an honorary member of the Association of American State Geologists. From June 1955 until March 1969 he was Oregon's state geologist and acted in that position from January 1954 to June 1955. The UGMS salutes him for his accomplishments.

"Trickle-Root" System Implemented in U. S.

An agreement between S. Blass, originator of trickle-root irrigation in Israel, and H. Klein, Washington, D. C., to market the trickle-root system in the U. S. may be a crucial development in water management.

Present estimates of withdrawals for irrigation in 1980 run as high as 136,000 million gallons daily, with consumptive use projected at 82,000 million gallons daily (*Water Newsletter,* v. 14, no. 8, 1972). Amounts for 1965 were 111,000 and 65,000 million respectively. In a nation which uses the equivalent of about 1,800 gallons of water per person each day to serve its homes, farms and factories, cutting back irrigation demands is a major shift in the direction of sensible water budgeting.

Although some areas in the U. S. presently use the drip watering method, the agreement paves the way for large-scale implementation with "tens of thousands of acres of various row crops and orchards exploiting this system throughout the United States"—using 30 percent less water to grow crops twice as large as those now grown with conventional irrigation techniques.

The Blass method reportedly helps stem pollution by eliminating the irrigation flooding of land with its consequent dumping of sediment-laden water and chemicals from fertilizers in nearby streams.

A fixed plastic network incorporating a fertilizer control head, main filters, mainpipes and dripping lines is placed on the soil to feed sufficient water and nutrients to "grow fruit not roots." Crop watering is planned at predetermined rates sufficient to

(continued on page 7)

Mineral Production in Utah, 1971-1972

by Carlton H. Stowe, UGMS Staff Specialist

During 1972, Utah's mineral industry accounted for more than *20 percent* of the assessed valuation for the entire state, or $403,196,468, an increase over 1971's $402,538,800.

Utah collected more than $35 million in taxes from mineral producers: +$2.9 million in state royalties, +$28.6 million in property tax (17.07 percent of total), +$3.8 million in occupation tax, and corporation and sales taxes.

In 1972, the Bureau of Land Management administered 22,722,316 acres (43.12 percent) of Utah's 52,696,960 acres. Largest contributor of receipts from BLM-administered lands and resources during fiscal 1972 came from the Mineral Leasing Act of 1920: $10,035,591 (89.25 percent) of the total $11,244,294; although total receipts were larger in 1972 than 1971, mineral leasing provided 90.7 percent of the total in 1971.

Income from mineral leases and permits consistently accounts for the greatest percentage of receipts; it reached a peak in 1962 when nearly 96 percent was from receipts. Cash receipts for all minerals in fiscal 1972 were $10,035,591 compared to 1971 $9,264,164. Payments to the State of Utah from public land revenues for mineral leases in 1972 were $3,828,370, highest since 1965.

The Division of State Lands reports a gross receipt of $730,527 royalty and a gross interest receipt of $2,183,642 on mineral-lease rental as of June 30, 1972. Royalty receipts increased $5,940 and mineral-lease rental increased $586,634 over the previous fiscal year ending June 30, 1971. The State has a total of 2,337,381 acres under lease with the largest amount, 1,419,154 acres, being oil and gas leases. Oil shale includes 238,066 acres; salt 262,003; metallic minerals 171,636; nonmetallics 68,915; bituminous sands 68,258; and coal 109,349 acres. Acreage under lease increased by 236,614 acres over the 1971 figures.

Royalty payments for the 1972 fiscal year were highest in Uintah County where $230,961 are recorded. San Juan County, second, recorded $194,542; Carbon County's royalty amounted to $64,180.

A total of 459,806 acres are under State land lease in Uintah County, 231,230 acres in San Juan County and Grand County has 364,198 acres under lease, although it records a relatively low royalty payment receipt.

From a downward trend in 1971 Utah's mineral production valuation rose 2 percent in 1972 to $536.8 million from $525.7 million in 1971.

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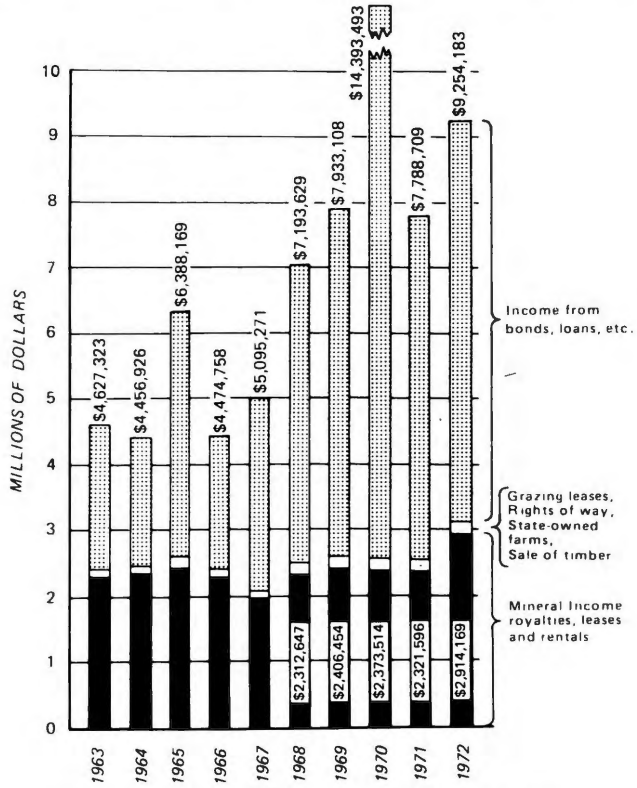
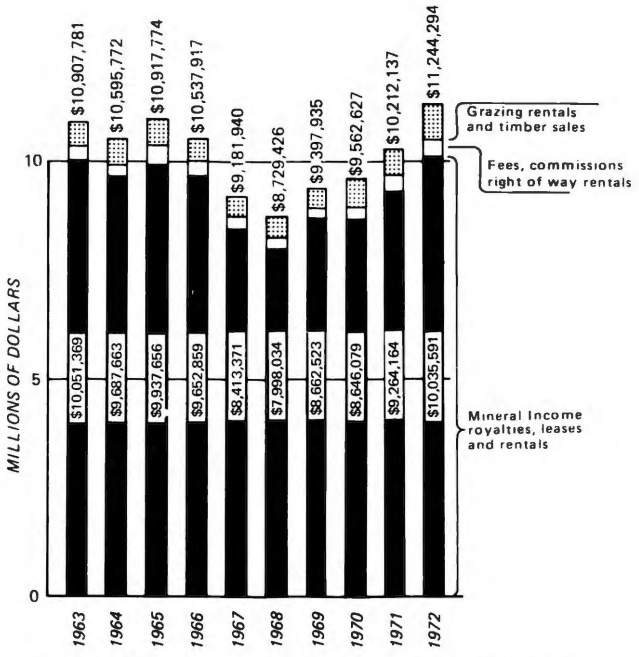


Annual Income From State-Owned Lands, 1963-1972
(from Division of State Land)



Rentals and Fees from Federal Lands in Utah, 1963-1972
(from U. S. Bureau of Land Management)

(continued from page 4)

In preliminary data the U. S. Bureau of Mines reports that production in the metals group remained about the same in 1972 as in 1971 and accounted for 65 percent of the total value. Production of mineral fuels increased 5.6 percent and accounted for 25 percent of the value, while nonmetals increased 8.2 percent to about 10 percent of the value.

Largest increase noted is in gold which rose to $21,391,000 in 1972 compared to 1971's $15,221,000. Production in 1972 was less than 1971 (367,155 compared to 368,996 troy ounces). Copper rose to $274,299,000 over $273,989,000. Because of the tremendous increase in oil exploration, primarily in the Uinta Basin area, petroleum climbed to $79,648,000, highest since 1963 when the mark was set at $90.9 million. Marketed natural gas, however, fell from $7,084,000 in 1971 to $7,020,000 in 1972.

At the end of 1972, oil and gas operating companies and independent operators had drilled 159 wells in Utah compared to 90 wells drilled in 1971—86 were exploratory whereas 56 were exploratory in 1971.

Utah's 1972 well completions include:

New field wildcats: 10 oil, 2 gas, 56 dry for a total of 68 wells. Footage drilled, 458,863 feet. *Other exploratory wells*: 12 oil, 6 dry for a total of 18 and 195,715 feet drilled. Includes new pool, deeper pool, shallower pool, outpost and extension tests. *All wells drilled for oil and gas*: 75 oil, 13 gas, 71 dry for a total of 159 wells. A grand total of 1,292,374 feet of hole was drilled for the year.

Note: Federal and state mineral statistics related to leasing and royalties are maintained on a fiscal year basis; data apply to the fiscal year July 1, 1971 to June 30, 1972. U. S. Bureau of Mines reports, however, are on a calendar year basis. Mineral production and values by county for 1972 will be included in May's *Quarterly Review*.

Information for this report was derived from the following sources: U. S. Bureau of Mines 1971 annual yearbook data, 1972 preliminary data and additional information released to UGMS by the USBM; Public Land Statistics, 1971, Bureau of Land Management; BLM Facts and Figures for Utah, 1972, and Utah Division of State Lands fiscal report, July 1, 1971 to June 30, 1972.

Utah lands fees, royalties, rentals, fiscal year data 1967-1972.

	1967	1968	1969	1970	1971	1972
FEDERAL						
Minerals	8,413,371	7,998,034	8,662,523	8,022,666	9,246,164	10,035,591
Grazing	445,606	416,165	450,874	570,172	660,371	731,342
Others	322,963	315,227	284,538	55,292	287,602	477,361
Total	9,181,940	8,729,426	9,397,935	8,648,130	10,212,137	11,244,294
STATE						
Minerals	1,979,388	2,312,647	2,406,454	2,373,514	2,321,596	2,914,169
Grazing	151,130	156,898	172,386	183,291	193,396	208,031
Others	2,964,753	4,724,084	5,354,268	11,836,688	5,273,717	6,131,983
Total	5,095,271	7,193,629	7,933,108	14,393,493	7,788,709	9,254,183

Minerals activity on federal lands in Utah,
July 1, 1971, to June 30, 1972 (U. S. Bureau of Land Management)

	Mineral permits and Licenses		Mineral Leases			Receipts	
Commodity	No.	Acres	No.	Acres	Production	Leases, Permits	Royalties
Petroleum	1,383	1,329,521	13,412	9,686,581	10,561,959	$8,575,974	$4,722,553
Natural gas					26,623,751		
Oil and gas liquids					51,976,219		
Coal	0	0	241	405,355	2,281,418	593,731	507,955
Other						25,436	22,335
Potash	38	75,772	74	133,547		55,651	44,392
Phosphate	1	322	18	25,940		13,371	12,979
Gilsonite and bituminous sands	0	0	15	3,546			
Carbon dioxide					63,087		
Silica sand					13,829		
Totals	1,422	1,405,615	13,760	10,254,969		9,264,163	5,310,214
(7-1-70 to 6-30-71)	1,626	2,153,464	15,184	9,487,982		8,646,079	4,926,712

Total receipts from leases and permits on public lands in fiscal year 1972 include royalties on Federal leases collected by U. S. Geological Survey: $10,035,591.

Allocation of Bureau of Land Management receipts to State of Utah for mineral leases and permits: $3,828,370.

Source: Bureau of Land Management Facts and Figures for Utah, 1972.

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San Arroyo Field–StudyOn Open File

A study by O. A. Monsalve, *Geology of the San Arroyo gas field, Grand County, Utah,* is on open file at Utah Geological Survey.

The study covers the stratigraphy, structure and accumulation of natural gas in the San Arroyo field, one of Utah's largest gas producers. A series of maps depicts the anticlinal structure of the field of several levels and the areal extent and thickness of each major sandstone body. Large-scale faulting on the north flank of San Arroyo anticline was revealed by detailed structural mapping. Differences in the gas produced in the field are discussed.

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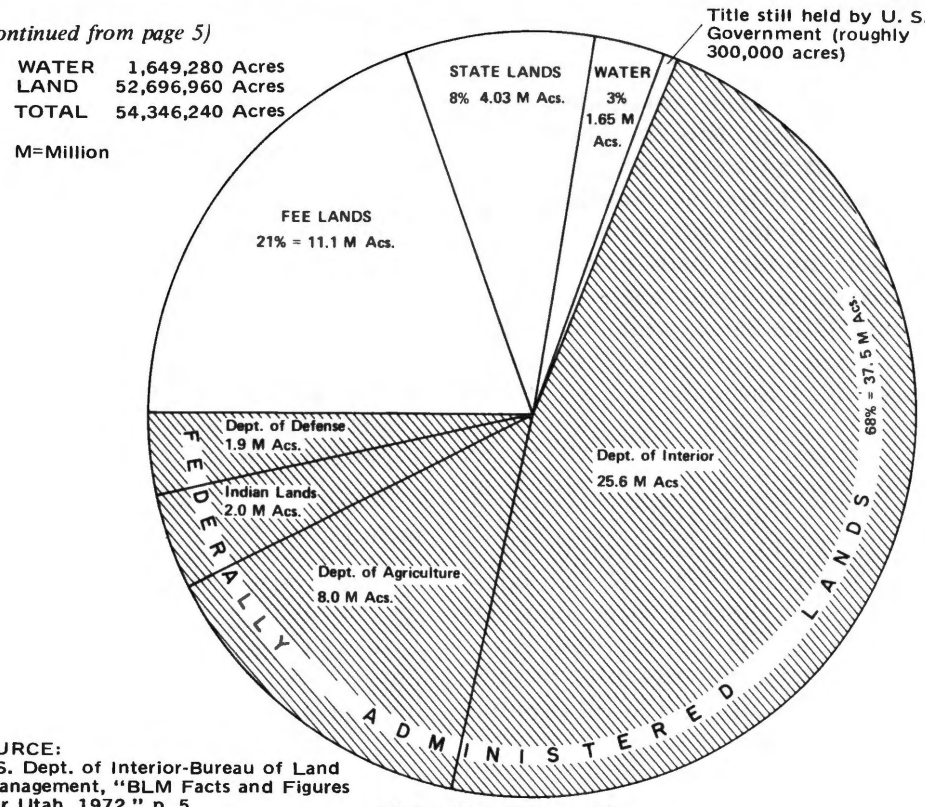

SOURCE:
U. S. Dept. of Interior-Bureau of Land Management, "BLM Facts and Figures for Utah, 1972," p. 5
Utah State Div. of State Lands Fiscal Report 7/1/71 to 6/30/72

Utah land ownership, 1972.

Mineral production in Utah in 1971 and 1972.

Mineral		1971[1] Quantity	1971[1] $ Value (thousands)	1972[2] Quantity	1972[2] $ Value (thousands)
Carbon dioxide (natural)	thousand cubic feet	55,178	$ 4	55,000	$ 4
Clays	thousand short tons	198	1,064	324	1,477
Coal (bituminous)	do	4,626	34,082	4,300	32,800
Copper (recoverable content of ores, etc.)	short tons	263,451	273,989	267,870	274,299
Fluorspar	do	10,947	341	1,604	48
Gem stones		NA	90	NA	95
Gold (recoverable content of ores, etc.)	troy ounces	368,996	15,221	367,155	21,391
Iron ore (usable)	thousand long tons, gross weight	1,681	11,886	1,850	13,149
Lead (recoverable content of ores, etc.)	short tons	38,270	10,562	21,608	6,504
Lime	thousand short tons	172	3,569	165	3,420
Manganiferous ore (5 to 35 percent Mn)	short tons	112	W	—	—
Natural gas (marketed)	million cubic feet	42,418	7,084	39,000	7,020
Natural gas liquids:					
Natural gasoline and cycle products	thousand 42-gallon barrels	W	W	460	1,450
LP gases	do	W	W	1,800	3,260
Petroleum (crude)	thousand 42-gallon barrels	23,630	71,886	26,200	79,648
Pumice	thousand short tons	6	10	5	10
Salt	do	619	5,213	587	5,123
Sand and gravel	do	10,505	10,190	11,240	11,005
Silver (recoverable content of ores, etc.)	thousand troy ounces	5,294	8,185	4,449	7,430
Stone	thousand short tons	2,556	5,335	2,797	4,240
Uranium (recoverable content U_3O_8)	thousand pounds	1,445	8,959	1,440	8,928
Vanadium	short tons	226	W	W	W
Zinc (recoverable content of ores, etc.)	do	25,701	8,276	23,850	8,491
Value of items that cannot be disclosed: Asphalt and related bitumens, beryllium (bertrandite ore), cement, gypsum, magnesium chloride, molybdenum, natural gas liquids, perlite, phosphate rock, potassium salts, sodium sulfate, tungsten concentrate, and value indicated by symbol W		XX	49,754	XX	47,003
TOTAL		XX	$525,700[3]	XX	$536,795

[1] Production as measured by mine shipments, sales or marketable production (including consumption by producers). Final U. S. Bureau of Mines tabulations.

[2] USBM Mineral Industry Surveys 1972 Preliminary Report.

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

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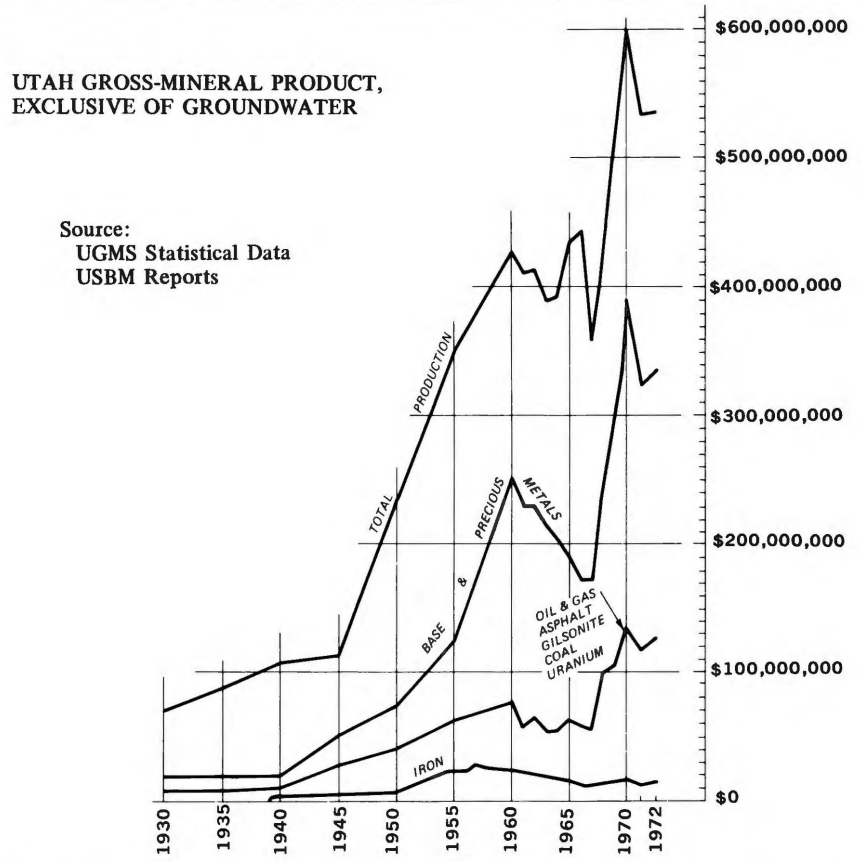
(continued from page 6)

	1968	1969	1970	1971	1972
Iron	$ 11,281,000	$ 12,552,000	$ 13,837,000	$ 11,468,000	$ 13,149,000
Energy minerals	87,609,000	83,998,000	116,558,000	118,266,000	126,086,000
Base and precious metals: copper, lead, zinc, gold, silver	236,034,000	333,221,000	391,611,000	324,223,000	318,115,000
Other	89,027,000	94,882,000	79,991,000	78,510,000	79,445,000
Total Production	$423,951,000	$524,653,000	$601,997,000	$532,467,000	$536,795,000



Agricultural Waste

Problem Mounts Up

According to environmentalist Gary Soucie in the September issue of *Audubon,* "... American agriculture each year generates nearly 10 times as much solid waste as all our cities, towns, suburbs, and communities combined ... some of the feedlots supplying us with steaks and hamburgers have sewage problems the equivalent of one million people living on 320 acres, a population density 26 times that of Calcutta ... (and) disposal of logging debris by prescribed burning produces more particulate air pollution than all our motor vehicles, industries, powerplants, space heating, and burning dumps combined."

The author states that agricultural activities generate 2.5 billion tons of solid wastes annually, more than half of all solid wastes from all sources.

Animal wastes constitute the biggest share and the biggest problem: 1.1 billion tons of fecal waste, 435 million tons of commingled liquid waste, and another 200 to 400 million tons of used bedding, paunch manure from slaughtered cattle and carcasses.

Waste production by domestic animals in the United States is equivalent to a human population of 1.9 billion.

(continued from page 3)

prevent "moisture stress" which causes roots to seek more water than is required for maximum growth of the useful parts of the plant. The method is also said to prevent damage to crop leaves typical of sprinkle systems.

The Israeli benefits include 20 tons of winter cucumbers per acre instead of eight under sprinkle irrigation and a 12 percent increase over eight years in oranges grown with 17 percent less water. Recent refinements of equipment, hoses, pipes and nozzles have resulted in a cost for the system competitive with conventional sprinkler irrigation networks.

Old As The Hills

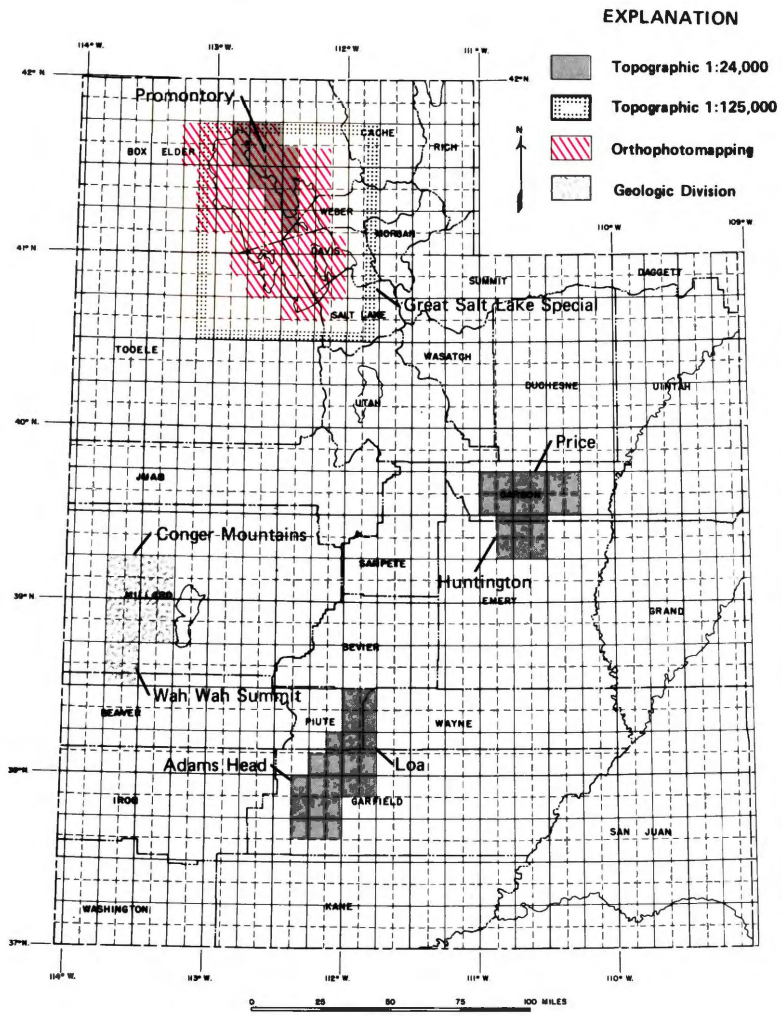
Quakes Then, Too...

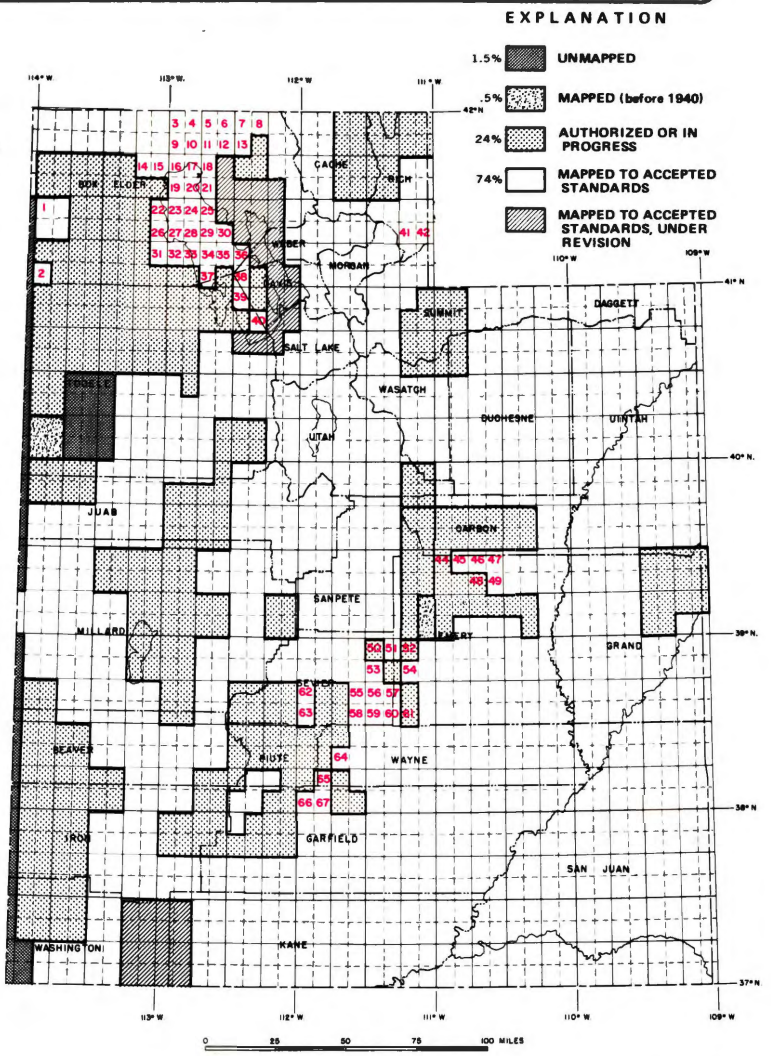
In perusing the archives of the Church of Jesus Christ of Latter-day Saints, Bruce Kaliser, UGMS, has turned up some most interesting facts and anecdotes concerning seismic events in Utah's earlier years. The following is one such passage (from a private letter written in Camp Yuba (Zuba?), December 5, 1853; an account of an earthquake in Gila):

Event occurred in a.m. of Nov. 29, 1853 at 12:00; lasted ~½ min ... Stopped clock and threw some books down from shelf ... Clouds of dust rose from ground where banks of river fell. Cliffs and rocks also fell from the mountains ... A few moments after the first shock I was looking toward the south, when I saw a large column of steam rise, and at a great height spread out into a cloud. It was followed at short intervals by two smaller jets. The exact direction was S47° west of the post and 25 or 30 miles distant. The motion appeared to be from the NE to SW. All the ground around us is full of fissures and in many places mud, sand and sulphur. Water gushed to the height of several feet. The river rose in a wave nearly a foot, and did not subside under several hours. The velocity of the current was increased and its bed appears to be permanently lowered. During the day and night there were more than a dozen shocks, most of them slight.

(from *Ogden Herald,* November 10, 1884):

... animals stampeded and people awakened ... The event is significant of the mighty parturition which is now agitating the political world, the finis of which is to be the birth of a new era of reform with Grover Cleveland at the helm.





U. S.' Water Demands Met

Industry uses more than six times as much water now as in 1900—about 940 gallons per person per day; an individual withdraws an average of only 60 or 70 gallons per day for drinking, washing, lawn-watering and other household purposes.

Yet, the United States is water rich. Our streams carry an average of 1.2 billion gallons of water daily to the oceans; lakes in North America contain about 7,800 cubic miles of water (8.6 quadrillion gallons) and the upper half mile of the nation's groundwater reservoir holds about 50,000 cubic miles of water (55 quadrillion gallons).

These vast stores of water dwarf industry's need for 177 billion gallons per day.

Only 6 percent of the water withdrawn is actually consumed (that is, evaporated or incorporated in a finished product and no longer available for use). Water that is not consumed is returned to bodies of water where it may be used again if its quality is preserved.

1. Lucin NW
2. Crater Island SW
3. Monument Peak NW
4. Monument Peak NE
5. Snowville
6. Rattlesnake Pass
7. Ridgedale Pass
8. Limekiln Knoll
9. Monument Peak SW
10. Monument Peak SE
11. Salt Wells
12. Bulls Pass
13. Howell
14. Peplin Flats
15. Crocodile Mountain NE
16. Locomotive Springs
17. Monument Point
18. Lake Ridge
19. Spring Bay SW
20. Coyote Point
21. Rozel
22. Dolphin Island West
23. Dolphin Island East
24. Gunnison Island NE
25. Rozel Point
26. Hogup Ridge North
27. Gunnison Island SW
28. Gunnison Island
29. Rozel Point SW
30. Indian Cove
31. Hogup Ridge South
32. Strong Knob
33. Lakeside
34. Carrington Island NW
35. Carrington Island NE
36. Promontory Point
37. Carrington Island SW
38. Fremont Island SW
39. Plug Peak NW
40. Plug Peak SE
41. Neponset Reservoir NW
42. Neponset Reservoir NE
43. Flat Ridge
44. Poison Spring Bench
45. Elmo
46. Olsen Reservoir
47. Mounds
48. Cow Flats
49. Flat Top Mountain
50. Acord Lakes
51. Emery West
52. Emery East
53. Old Woman Plateau
54. Mesa Butte
55. Hilgard Mountain
56. John's Peak
57. Willow Springs
58. Forsyth Reservoir
59. Geyser Peak
60. Solomons Temple
61. Salvation Creek
62. Silver Falls
63. Koosharem
64. Moroni Peak
65. Flossie Knoll
66. Antimony
67. Pollywog Lake

USGS STUDIES

Quadrangle Map Releases

Recent topographic quadrangle releases by the U. S. Geological Survey and unmapped and mapping-in-progress areas are shown above (right); cooperative studies between the USGS and the Utah Geological Survey are also located (left; not shown is a cooperative project on the Great Salt Lake with USGS' Water Resources Division).

Gentlemen:

This is our yearly request for help from you. Inquiries regarding Utah geology often involve areas where there is no published geologic coverage, but on which there has been geologic field work. Therefore, the Utah Geological and Mineralogical Survey hereby solicits your cooperation for our open file listing of those areas being studied by professors and students or agencies. The Survey requests that you circulate this form among your staff and graduate students so it may be filled in and returned. Information supplied by respondents will be published in the *Quarterly Review* and should be submitted not later than March 31.

Your general knowledge of studies being conducted by other organizations or universities is also requested.

Some of the information solicited may be contingent on future decisions. Please do not withhold that which is available pending more definite plans. Our compilation must be timely if it is to be meaningful.

Where possible, please indicate on the map on the other side of this page the areas covered or to be covered.

Yours truly,

W. P. Hewitt

William P. Hewitt, Director
Utah Geological and Mineralogical Survey

Organization _____

Name of chief investigator _____

Address _____

Subject of thesis _____ or study _____

Geographic area _____

Location by township _____ Range _____

Latitude _____ Longitude _____

(Please also note location on reverse side on map)

Scope and class: (i.e., detail, reconnaissance, photo interpretation with or without field checking, etc.)

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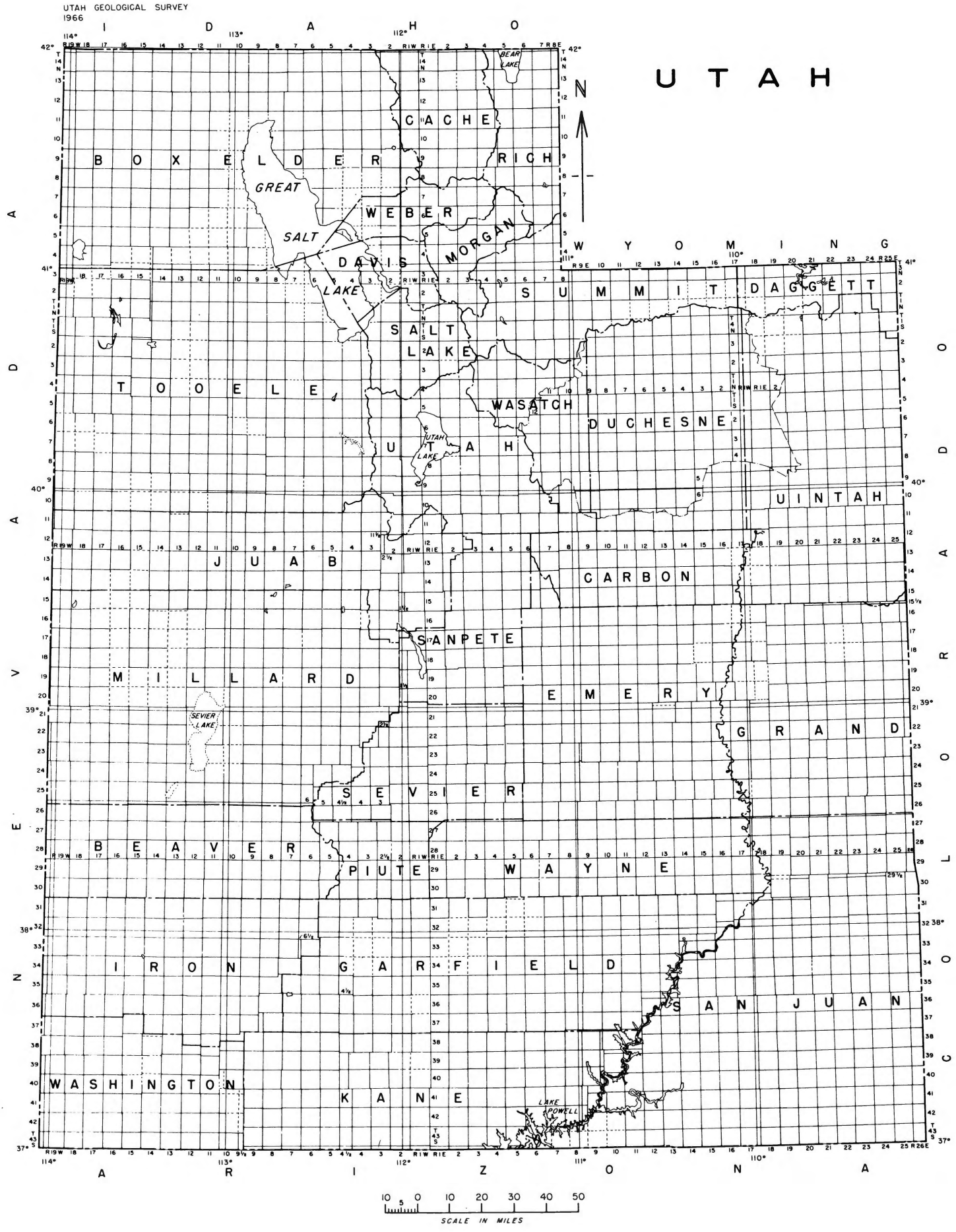
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LAKE POWELL
SCALE IN MILES

At Home With Geology

Excavation Costs *Can* Be Cut

by B. N. Kaliser
UGMS Engineering Geologist

Constructing a home requires grading a lot and preparing a foundation; basements and buried power and telephone lines and sewers require even greater excavation.

To excavate soil or unconsolidated earth costs about $.40 per cubic yard[1], increasing to $3.00 per cubic yard if ripping equipment for bedrock is necessary and $10.00 or more per cubic yard if blasting is required.

Rock removed by excavation not incorporated into fill and hauled to a disposal site will increase costs, as will soil imported for landscaping.

Careful selection of homesites can minimize excavation costs by avoiding underground bedrock knobs, shallow profiles and land-modifying expenses.

Rock outcrops and differing soil textures on prospective and neighboring lots can be observed. Test holes can be dug, preferably with a backhoe, to examine depth to bedrock and the extent to which the rock mass is fractured, weathered and cemented.

A more sophisticated approach involves the refraction seismograph, a geophysical instrument that has been greatly simplified in recent years for shallow engineering work. Seismic velocities are determined and correlated to soil and rock classification; type of material, its hardness or density, and removal or rippability characteristics of the soil and rock also can be determined.

Igneous rocks, being crystalline and lacking stratification and cleavage planes, are the most difficult to rip; sedimentary rocks with inherent planes of stratification and lamination are generally the most easily ripped and metamorphic rocks with their varying degrees of foliation, schistocity or cleavage fluctuate considerably in rippability.

[1] Haulage costs not reflected.

Rock drilled for water line placement in subdivision; outcrops are absent, but soil cover is negligible.

Hardness and physical and chemical weathering characteristics of rocks also affect excavation difficulties.

In Salt Lake Valley, some well cemented sedimentary horizons are buried at shallow depth. For example, (1) caliche, a soil in arid environments, cemented with calcium carbonate, and (2) Lake Bonneville tufa, calcium carbonate cement precipitated by algae along the shoreline of the ancient lake. Both materials should be rippable, however.

U of U Librarian Passes Away

Geologists and students lost a true friend with the death of Cecil W. Warren, assistant in the Science and Engineering Library, University of Utah, since 1960, who passed away November 13, 1972, following an illness.

Recently Warren, a miner in his early life with a keen interest in geology and maps, indexed material which pertained to mines in the *Salt Lake Mining Review*. He worked on the project at home in his spare time for two years and the UGMS published it in 1971 as Bulletin 91. The index is invaluable to librarians, geologists and prospectors.

Warren also hand-set and hand-printed a volume of his own poetry, *Figs Not Gathered in Tusculum,* which he published in 1963; the edition was sold out.

Graduate students, faculty of the College of Mines and Mineral Industries, staff of the Utah Geological and Mineralogical Survey, professional geologists and miners pay tribute to Cecil Warren for his dependability, his dedicated and willing work, and most important, for his excellent library service to all people, especially those unfamiliar with library procedures.

Earthquake Epicenters

General earthquake epicenters in or near Utah for June through October 1972, with dates of occurrence and approximate magnitudes, are listed below. Unless otherwise indicated, localities are in Utah.

		Magnitude
June		
1	South of Sunnyside	2.3
2	Near Monroe (slight damage)	4.0
2	Near Monroe	3.3
2	Near Monroe	2.7
2	Near Monroe	3.1
3	Near Monroe	2.7
3	Near Mt. Pleasant	2.5
3	Near Mt. Pleasant	2.5
12	Near Hyrum	3.0
12	Five aftershocks from the Hyrum area	1.2 to 2.0
15	Near Bonanza	<2.0
15	Near Bonanza	<2.0
16	Nine earthquakes near Ouray	1.3 to 2.6

(continued on page 10)

(continued from page 9)

17 Near Bonanza 1.6
19 South of Sunnyside . . . . . <2.0
20 Near Bonanza . . . . . <2.0
21 Near Bonanza 2.1
24 Near Bonanza 2.0
24 Near Bonanza 2.0
29 Near Coalville 1.9
30 South of Vernon 2.2

July
1 Near Antimony 2.4
1 San Rafael Swell 2.4
2 East central Nevada 2.5
2 East central Nevada 3.0
2 South of Hatch 3.0
3 South of Hatch 2.5
4 South of Sunnyside 2.6
6 South of Bonanza 1.7
7 Near Fairview 2.7
13 Near Marysvale 3.0
14 Promontory Point 2.3
18 East of Bear Lake 3.5
19 Near Fayette . . . . . <2.0
20 South end of Great Salt Lake . . . . . <2.0
20 Near Lehi 2.6
21 South of Ephraim 2.6
22 North of Preston, Idaho 2.5
22 North of Oak City 2.2
26 East of Sigurd . . . . . <2.0
26 South Wyoming 2.1
27 South of Levan . . . . . <2.0
31 Near Manti 2.2
31 East of Richfield 2.5

August
1 Near Morgan 1.6
5 Near Junction 2.6
6 North of Randolph 3.6
8 Near Spanish Fork 2.1
16 Near Redmond 2.1
16 Promontory Point . . . . . <2.0
16 North of Vernal . . . . . <2.0
17 Near Bear Lake 2.5
17 Central Utah-Arizona border 2.5
22 South of Coalville 1.7
26 Near Cedar City . . . . . <2.0
26 Near Salina 2.1
27 Near Big Piney, Colorado 2.9
28 Near Coalville 2.3
28 Near Cedar City . . . . . <2.0
28 Near Scipio 2.0

September
1 South of Moore 2.0
2 South of Cedar City 3.5
7 Near Castle Dale . . . . . <2.0
13 Near Helper . . . . . <2.0
13 South of Sunnyside . . . . . <2.0
14 South of Bonanza . . . . . <2.0
15 South of Sunnyside 2.2
15 Near Richmond 2.9
15 Near Castle Gate 1.9
16 South of Sunnyside . . . . . <2.0
19 North of Scipio 2.2
21 Near Farmington Bay 1.5
21 Near Farmington Bay 2.2
22 Near Farmington Bay 1.5
23 San Rafael Swell . . . . . <2.0
27 Near Strawberry Reservoir 2.3
27 South of Fillmore 2.5
28 Near Castle Dale 2.2

October
1 Near Richfield 2.6
1 Near Heber City (slight damage in Heber City and Midway (approx. location 40°51′ N. lat. 111°35′ W. long.) 4.1
1 Near Heber City 3.8
1 Near Heber City 2.8
1 Near Heber City 3.1
2 Near Heber City 3.2
1-13 Ninety small aftershocks near Heber City . . . . . <2.5
8 Near Price . . . . . <2.0
13 South of Sunnyside . . . . . <2.0
14 Near Strawberry Reservoir . . . . . <2.0
15 Near Heber City 1.4
16 Near Hanna (approx. location 40°41′ N. lat. 111°01′ W. long.) 3.0
17 Near Hanna 2.4
17 Kaiparowits Plateau 3.2
19 Utah-Nevada border west of Palute, Utah 2.9
21 South of Kamas 2.1
29 South of Sunnyside . . . . . <2.0
29 Utah-Arizona border south of St. George 3.2
29 Utah-Arizona border south of St. George 3.0
30 Near Cedar City . . . . . <2.0
30 Fifteen miles northwest of Strawberry Reservoir 1.9
30 Fifteen miles northwest of Strawberry Reservoir 1.4
31 Near Heber City 1.6

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; the final determinations will be printed in the University of Utah Seismological Bulletin, issued quarterly.

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