

Survey Releases Latest Studies

The Utah Geological and Mineral Survey has released the following publications for sale through the UGMS Publications Office, 103 Utah Geological Survey Building, University of Utah, Salt Lake City, Utah 84112. When ordering by mail, add 10% for handling and mailing charges.

Bulletin 101, "Utah Mineral Industry Operator Directory," by Carlton H. Stowe (\$3.00). The report lists names and addresses of mineral producers in Utah and locations of their mineral operations during 1972-1973. It includes oil and gas industry operators, sand and gravel companies and all others engaged in mining activities in Utah.

Water-Resources Bulletin 18, "The Effects of Restricted Circulation on the Salt Balance of Great Salt Lake, Utah," by K. M. Waddell and E. L. Bolke (\$3.00). The study was prepared by the U. S. Geological Survey in cooperation with the Utah Geological and Mineral Survey. The report includes sections on the hydrology of the lake since 1969, movement of dissolved-solids load and water discharge through the causeway during the 1970-1972 water years, salt precipitation and re-solution, a causeway model with predicted movements, the effects of debris on the discharge in the west culvert, recommendations for

(continued on page 17)



Dr. William P. Hewitt (left), retiring Director of UGMS, discusses issues which will affect Mr. Donald T. McMillan (right), who became Director February 11, 1974.

CHANGES IN LEADERSHIP

New Staff Appointments at UGMS

Dr. William P. Hewitt, Director of the Utah Geological and Mineral Survey since 1961, retired as of February 8. Dr. Hewitt guided the Survey through a steady growth period, was directly responsible for the Survey's enlarged staff and its service to the State of Utah, and is credited with UGMS' growth in influence and prestige throughout the nation. Through Dr. Hewitt's supervision and guidance, the Utah Geological and Mineral Survey has implemented many excellent programs, including geologic investigations conducted by the Solid Fuels and Industrial Minerals section, the Petroleum section, Mining Districts and Geologic Resources section, Urban and Engineering Geology section, the Great Salt Lake section, and the Mineral Information section. Several cooperative geo-

logic studies have been established and conducted through Dr. Hewitt's efforts with the U. S. Bureau of Mines, the U. S. Geological Survey, and numerous State agencies. His accomplishments are many but some of the most outstanding are: his service on the Liaison Committee of the Association of American State Geologists; hosting the AASG annual meeting in May, 1972 in Moab, Utah; and service on the Western Governors' Mining Advisory Council, the Governor's Advisory Committee on Geologic Hazards, the Utah State Mapping Advisory Committee, the Utah Legislative Council Mined-Land Reclamation Subcommittee, and the Natural Resources Subcommittee on Strip Mining. Dr. Hewitt is also a Professor of Geology, Department of

(continued on page 2)

NEW ORLEANS

IOCC Representative Attends Meeting

Howard Ritzma, Assistant Director and Chief of the Petroleum Section of the Survey, attended the annual winter meeting of the Interstate Oil Compact Commission held December 2-5, 1973, in New Orleans, Louisiana. Mr. Ritzma represented the State of Utah on the Secondary Recovery and Pressure Maintenance Committee and the Tar Sands Subcommittee, and delivered an address to the joint session of the Commission on, "Commercial Aspects of Utah's Tar Sand Deposits."

The IOCC is an organization of 35 oil- and gas-producing states to promote conservation of energy resources and uniformity of regulatory practices among the member

states. Utah's place on the Compact Commission was filled by Mr. Guy Cardon, Chairman of the Utah Oil and Gas Conservation Board, representing Governor Rampton.

The Tar Sands Subcommittee passed a resolution urging definition of a leasing policy for tar sand deposits located on federal lands. Utah contains 90-95% of the nation's mapped resources of oil in oil-impregnated sandstones, an estimated total of about 25.1 billion barrels. The resolution was incorporated into the Statement of Policy adopted by the IOCC, and members of Utah's congressional delegation have since pressed the U. S. Department of the Interior for action in the matter.

(continued from page 1)

Geological and Geophysical Sciences, College of Mines and Mineral Industries, University of Utah.

Dr. and Mrs. Hewitt plan to spend a part of their retirement in Oaxaca, old Mexico. Buenas Suertes.

The position opened by the retirement of Dr. William P. Hewitt has been accepted by Mr. Donald T. McMillan, a consulting geologist in Tucson, Arizona. He was formerly Vice-President of Exploration with Strauss Exploration, Inc., also in Tucson. Mr. McMillan, a native of Scarsdale, New York, holds a M. Sc. degree from Montana School of Mines and has had over 30 years' field experience in mining and exploration geology throughout the western United States, Canada, Mexico, Peru, and the Philippines. He has been associated with such industries as American Metal Co., Phelps-Dodge Co., Anaconda Copper Co., and the Guggenheim Exploration Co., investigating many types of economic deposits including base

and precious metals, fluorite, copper, molybdenum, iron and boron.

Mr. McMillan's grandfather, Duncan J. McMillan, was the founder of Wasatch Academy at Mt. Pleasant, Utah, and an uncle and great-uncle were lifelong residents of Salt Lake who were active in local mining affairs of earlier days. Mr. McMillan and his wife arrived in Salt Lake January 15 and he assumed his formal duties at the Survey February 11. Everyone at UGMS is very pleased to have Mr. McMillan with us and feels he is an excellent choice as Director.

In addition to Mr. McMillan's appointment, Mr. Howard K. Ritzma, formerly the petroleum geologist at the Survey, was named Assistant Director.

A native of Illinois, Mr. Ritzma received his master's degree from the University of Wyoming. For some 17 years prior to joining the Survey in 1967, he pursued his profession as a consulting petroleum geologist in Den-

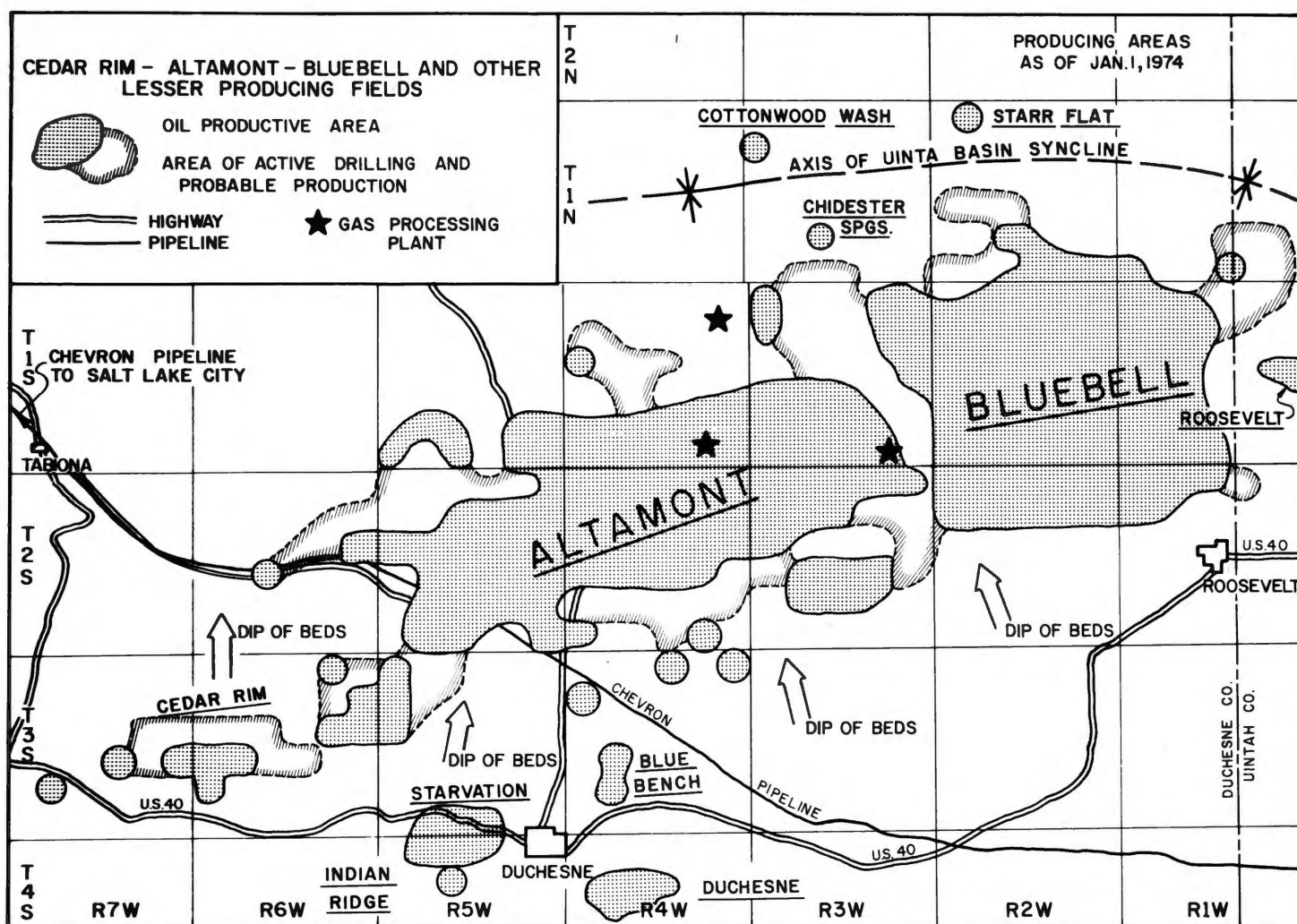
ver, Colorado where he was associated with several consulting groups and independent and major oil companies.

During 1954-55 he was employed by General Petroleum Corp. (Mobil Oil) in Salt Lake City as a district geologist for the Great Basin region. He is a specialist in the geology of northeastern Utah, adjoining Colorado and Wyoming, and he has authored several papers on the geology of the region surrounding the Uinta Mountains as well as numerous statewide reports, investigations, and studies. He was Chairman of the Committee on Environmental Problems of Oil Shale for the State of Utah and has presented many papers on oil shale and tar sands to various industry organizations.

In addition to his duties with the Survey, during 1970-71 Mr. Ritzma also served as President of the Utah Geological Association and is currently the Editor of the Association's newsletter. In addition, he has served the Association for several years as guidebook author and field trip chairman, and has been active on various committees.

Mrs. Gloria Kerns has been appointed Editor of the UGMS to fill the position vacated by the resignation of Mrs. Ann Fadel. Mrs. Kerns received a B. A. in Geology from Utah State University in 1971. From the time she graduated until July, 1973, she worked for the Department of Physics at USU as Departmental Secretary. Her editorial experience includes a year as the Editorial Assistant of BIOS, a national biological society journal, and she has helped prepare many manuscripts for publication in geology and physics, as well as working on the manuscript of an optical mineralogy text.

Mrs. Kerns is originally from Oklahoma, but she has lived in Utah for the past 6½ years.



FASTEST GROWING INDUSTRY

Initial Report on Uinta Basin Petroleum Development

by Howard R. Ritzma, UGMS Petroleum Geologist

Three fields, Bluebell, Altamont and Cedar Rim, named from northeast to southwest, seem destined to grow and finally coalesce into one field trending east-northeast to west-southwest at least 40 miles long and from 4 to 12 miles wide, eventually covering 350 to 400 square miles, not including small separate areas of production around the field's periphery. If precedent is followed, the main producing area will probably come to be known as Greater Altamont after the central field. There is also the possibility that the growing giant may ultimately merge with the old Roosevelt field to the east.

STRUCTURE

The structure of the area is very simple. At the surface formations dip gently at $1\frac{1}{2}^{\circ}$ to 3° to the north and northwest toward the axis of the Uinta Basin. Because of thickening of formations from south to north as the basin is approached, dip increases gradually with depth but probably does not exceed 6° to 8° at depths of 15,000 to 18,000 feet. A conservative estimate of the total sedimentary section (Tertiary, Mesozoic and Paleozoic) in the deepest part of the basin is 30,000 to 32,000 feet. Only in the Bluebell portion of the area is

there a small variation in the structure, a gentle northwest plunging nose with less than 100 feet of reversal, slight structural flattening and no closure to the east or southeast. It appears to have little effect on production and becomes less prominent with depth.

STRATIGRAPHY

Deep drilling in the area has revealed unsuspected thicknesses of Eocene and Paleocene sediments filling the "deep" of the Uinta Basin. Shell Oil Company's #1-11-B4 Brotherson well, $S\frac{1}{2}$ NE

(continued on next page)

(continued from page 3)

Sec. 11, T. 2 S., R. 4 W., total depth 17,766 feet, is one of the deepest stratigraphic penetrations in the field. From a ground elevation of 6,179 feet (6,198' KB) in the late Eocene Duchesne River Formation, the well penetrated the following section:

Formation	Top (feet)	Thickness (feet)
Duchesne River	surface	2,100 ±
Uinta	2,100 ?	2,700 (approx.)
Green River (upper)	4,800	1,560
Upper Green River- Wasatch "transition"	6,360 ±	2,940
Middle Green River (datum marker)	9,300	1,390
Lower Wasatch-Green River "transition"	10,690	4,510
North Horn	15,200 ±	1,890
Cretaceous	17,090	676 +
TOTAL DEPTH	17,766 in Cretaceous	

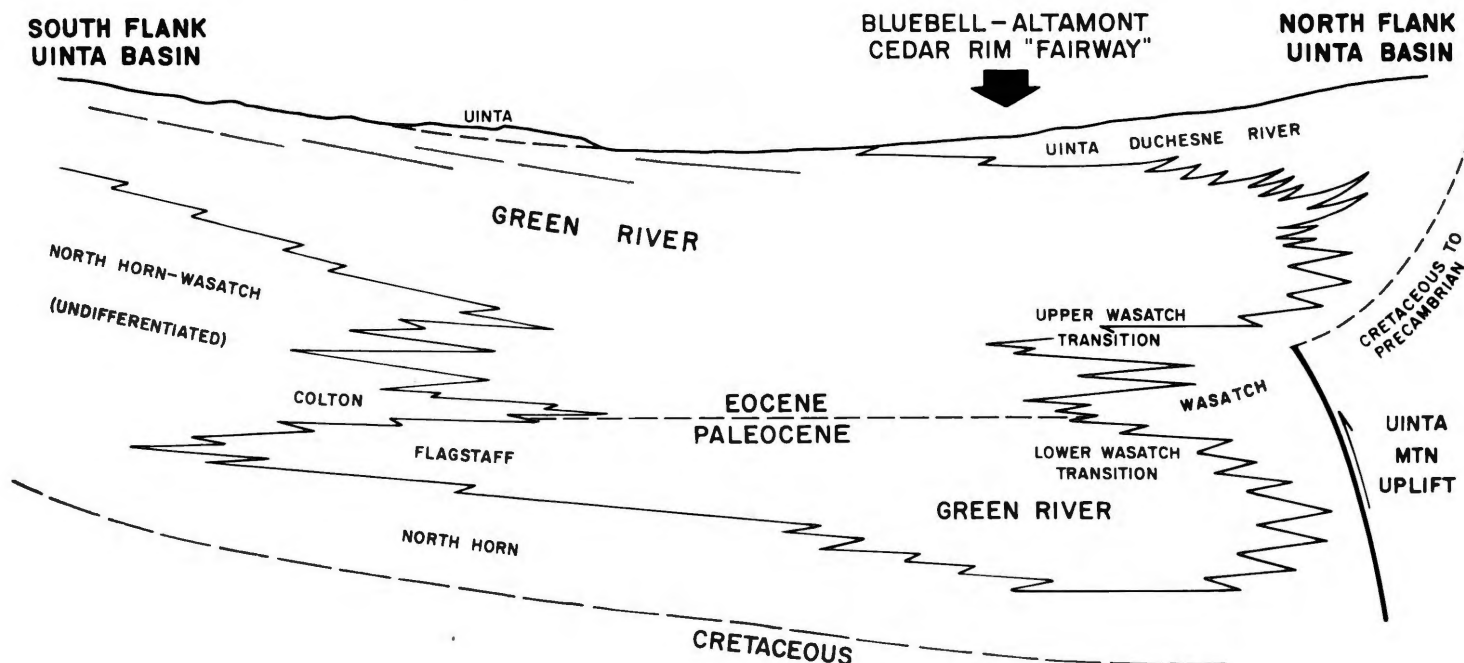
Production from this well is from perforations from 11,609 to 14,532 (gross). The well initially flowed 1,710 barrels of oil with 2.4 million cubic feet of gas per

day. No significant shows were found in the Cretaceous rocks penetrated.

Bluebell, Altamont and Cedar Rim fields are a series of compound stratigraphic traps formed by gradual lateral change of very fine- to fine-grained clastics (siltstones and sandstones) in the Wasatch-Green River "transition" to dense calcareous mudstones, shales and limestones of the thick lacustrine Green River Formation of the central basin (see generalized south to north cross section). This change in lithology takes place from north to south updip from the axis of the basin and forms a permeability barrier which has stopped oil migrating out of the basin toward the margin to the south. Entrapment takes place irregularly in areal extent through 5,000 to 5,500 feet of vertical section with a maximum of about 3,000 feet of potential "pay" zone at any one location.

Apparently lacustrine conditions persisted almost continuously from Paleocene through middle Eocene time in the central part of the basin. The tongues of Wasatch-Green River "transition" clastics represent an outpouring of coarse material from the rapidly rising Uinta Mountains to the north in early and middle Eocene time. When traced to the north, these fine-grained siltstones and sandstones rapidly change to coarse sandstones and pebbles, followed by cobble and massive boulder conglomerates. The sharp pulse of the Uinta uplift apparently terminated in an episode of reverse or thrust faulting now completely concealed by the nearly horizontal, overlapping, late Eocene Duchesne River Formation, the uplift apparently having stopped by that time (see cross section of north flank of Uinta Basin). The existence of this faulting was first postulated by Robert Garvin in UGMS Special Studies 29 (1969).

(continued on next page)



The Tertiary rocks of the Uinta Basin were deposited in and around Eocene Lake Uinta and its Paleocene predecessor Lake Flagstaff. These rocks cannot easily be subdivided into conventional formations and members. Actually the different lithologies are facies—lacustrine, paludal, shoreline, fluvial, upland, etc.—which transgress time lines and really only mark shifting depositional environments existing at a particular time and place in the basin.

The above diagrammatic section shows the position of the Bluebell-Altamont-Cedar Rim "fairway" in the overall facies of basin deposits.

Generalized south to north section across western Uinta Basin (after Baker and Lucas, World Oil, April, 1972).

(continued from page 4)

RESERVOIR AND OIL

The reservoir rocks at Bluebell, Altamont and Cedar Rim have low native porosity and permeability and would probably be almost unproductive if it were not for an extensive set of fractures found throughout the oil-saturated section, from which it is thought a very large percentage of production comes. The all-pervasive nature of the system has led to the very wide 640-acre spacing for oil wells in the field. The cause of the fractures is not known, but they are thought to be associated with a deep-seated fracture or lineament in the earth's crust which strikes across this area and

most of northern Utah at a N. 65° to 70° E. angle. The facies change that traps the oil seems to follow this trend, as do areas of most prolific production. The northernmost fracture line of the set, which is the one with the most prominent surface expression, also controls location of several oil-impregnated sandstone deposits.

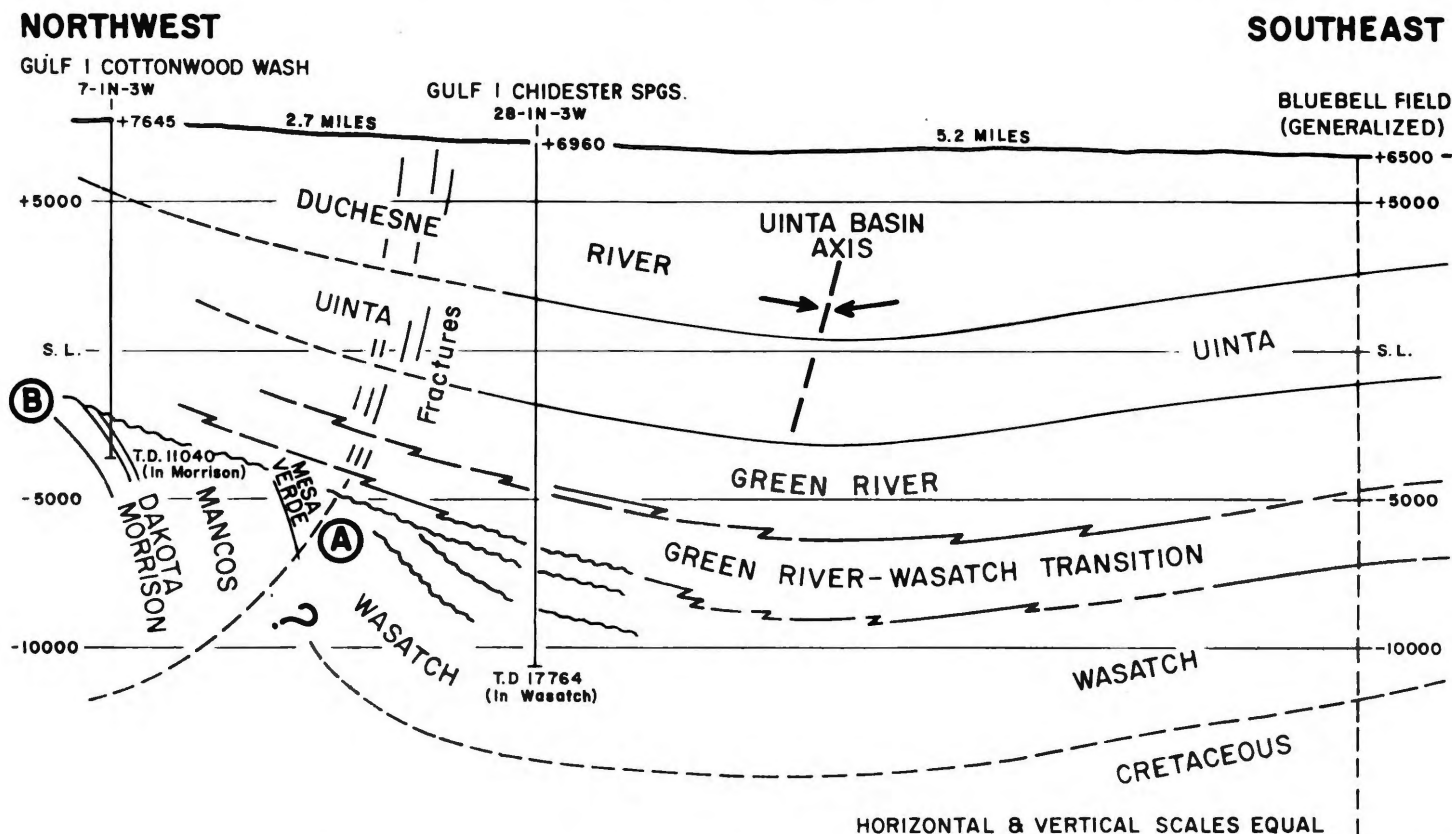
The oil in the area is paraffin base (90-135° pour-point) and varies widely in color from black through shades of olive green, brown, red, orange, yellow and pale ivory, the lighter colored oils generally from greater depths. The depth of production ranges from 8,000 feet to more than 15,000 feet insuring that oil flows to the

surface at high enough temperatures to remain liquid until reaching heated storage and transport.

RESERVES

The fracture reservoir in this field makes calculation or estimation of reserves very uncertain. One widely quoted estimate puts the field in the billion barrel class. More conservative estimates place probable recovery at between 500 and 650 million barrels. The area is, without doubt, Utah's largest and one of the nation's giant fields, but until it has been completely drilled, its limits defined, and several years of sustained production history assembled and carefully evaluated, the true

(continued on page 18)



This cross section depicts the structure of the north flank of the Uinta Basin northwest from Bluebell Field through two wells drilled by Gulf Oil, #1 Chidester Springs and #1 Cottonwood Wash. The section depicts the structure for eight miles to the northwest and shows the concealed overthrust (A) which marks the boundary between the Uinta Mountain Uplift on the north and the Uinta Basin.

The age of this faulting is Paleocene through Middle Eocene. The fault and overthrust block is presumably overlapped by post-fault Wasatch and Green River. The Uinta Basin continued to be strongly downwarped after the major fault episodes and more than 12,000 feet of Middle and Late Eocene rocks bury the fault.

The unconformity (B) continues to the northwest. Five miles northwest of the Cottonwood Wash well, Duchesne River beds rest on Paleozoic and eventually come to rest on Precambrian.

Cottonwood Wash and Chidester Springs are small oil producers from Wasatch, Cottonwood Wash at 9,894-9,904 feet and Chidester Springs at 17,027-17,226 feet.

North flank of Uinta Basin, structure and stratigraphy.

VITAL STATISTICS

Phenomenal Growth of Altamont-Bluebell District

by Carlton H. Stowe, UGMS Minerals Information Specialist

PHENOMENAL PRODUCTION GROWTH

Shell Oil, discoverer of the Altamont field in 1970, Chevron Oil and Gas Producing Enterprises, Inc., both discovery well operators at the Bluebell field in 1967 and 1971 respectively, were pace setters in 1973. At the beginning of 1973, 90 wells in the Altamont-Bluebell area were producing nearly 9,000 barrels of oil daily; now more than 135 wells in the area produce better than 1,372,920 barrels of oil each month.

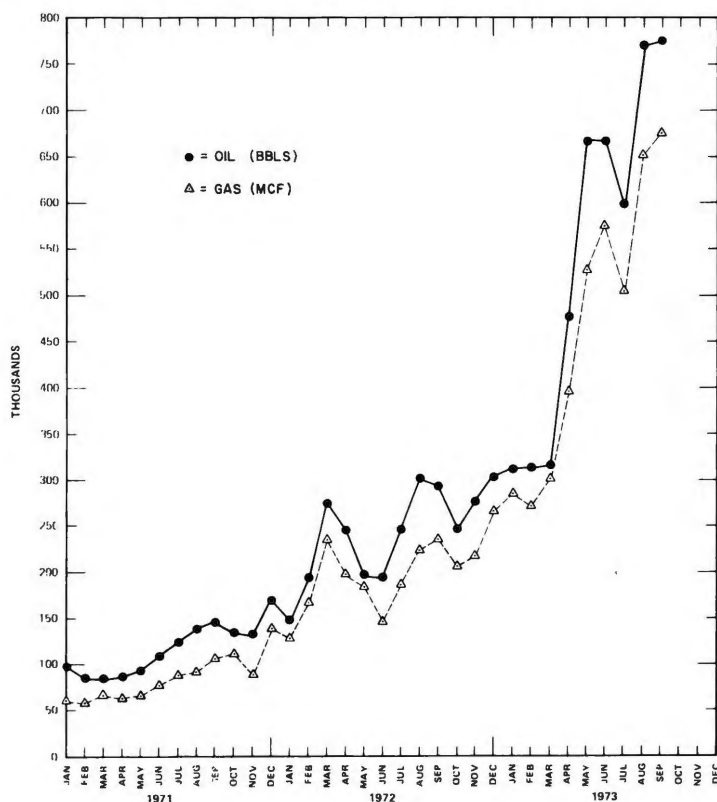
Before the Altamont-Bluebell area, San Juan County's Greater Aneth field had produced more crude oil than any other field in the history of the State's oil industry, but by May, 1973, production at Altamont field passed Aneth and has held its lead since.

In September, Aneth, McElmo Creek, Ratherford, White Mesa and Cahone Mesa fields combined produced 648,531 barrels of oil; September's production at Altamont-Bluebell was slightly more than 1,372,900 barrels; September's production from the Wasatch Formation at Bluebell field alone was 761,085 barrels. By the end of September, 1973, the Altamont-Bluebell area produced an all time cumulative total of 21,983,313 barrels of oil and 10,157,092,000 cubic feet of gas, five percent of the total production of Utah.

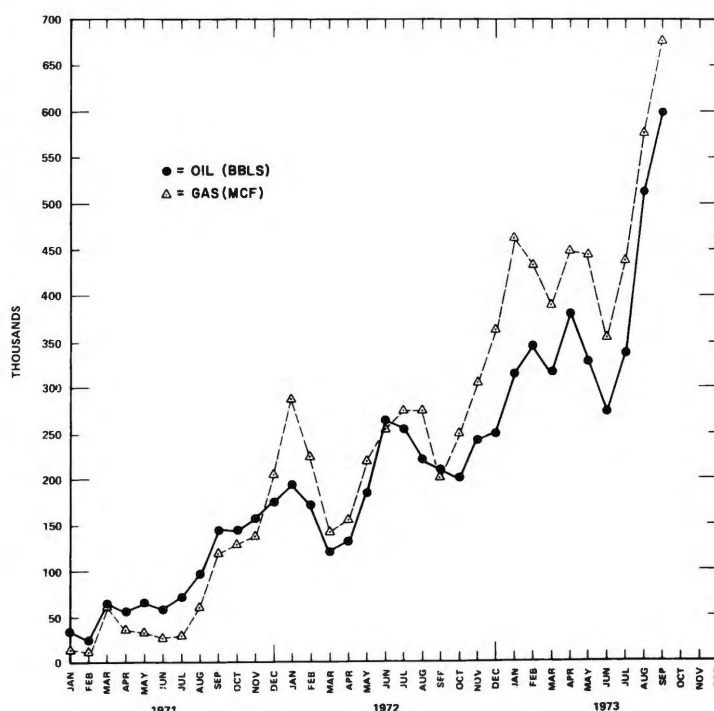
Bluebell field, originally discovered in 1955, passed the 100,000 barrel per month mark in June, 1971. At that point, production continued to increase steadily from 31 wells to its current 60 wells. At the close of 1971, Bluebell produced 4,667,280 barrels of

oil and 2,611,975,000 cubic feet of gas; however, only 1,390,503 barrels of oil were sold valued at \$4,006,485. At the end of 1972, Bluebell field production totaled 7,590,991 barrels of oil and 5,053,792,000 cubic feet of gas. During that year, operators sold 2,901,353 barrels of oil valued at \$7,725,462 and 257,182,000 cubic feet of gas valued at \$52,568. In 1972, monthly production at Bluebell passed the 200,000 barrel mark and by August, 1973, it exceeded 300,000 barrels. Although complete 1973 figures are not yet compiled, by the end of September Bluebell's monthly production had risen from the 300,000 barrels to a new high of 775,413 barrels, and gas production was 677,035,000 cubic feet. Since discovery in 1955, Bluebell has produced a total of 12,796,871

(continued on next page)



Production from Bluebell field, Duchesne County, Utah.



Production from Altamont field, Duchesne County, Utah.

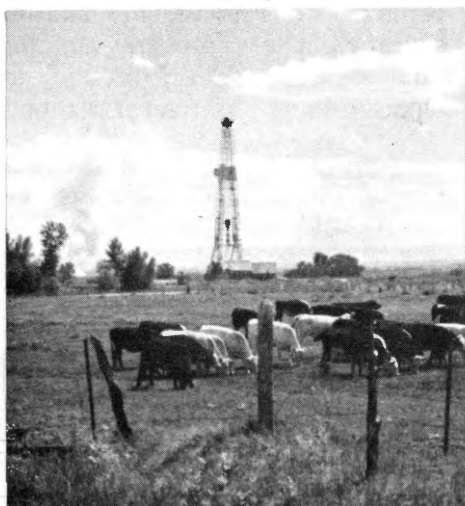
(continued from page 6)

barrels of oil and 9,502,606,000 cubic feet of gas.

Altamont field passed its 100,000 barrel monthly production in September, 1971, and has consistently produced above that level for the past two years. During 1971, 1,370,632 barrels of oil were produced at Altamont and operators sold 1,278,734 barrels valued at \$3,726,699. At the close of 1972, cumulative oil production climbed to 3,958,760 barrels and gas production was 4,481,306,000 cubic feet; 2,461,538 barrels of oil were sold, valued at \$5,838,113. In January, 1973, production over 300,000 barrels per month was reached. By September, production reached 597,506 barrels of oil and 687,342,000 cubic feet of gas. At this time, cumulative oil production at Altamont is 7,803,581 barrels of oil and 9,186,442,000 cubic feet of gas.

DEVELOPMENT WORK

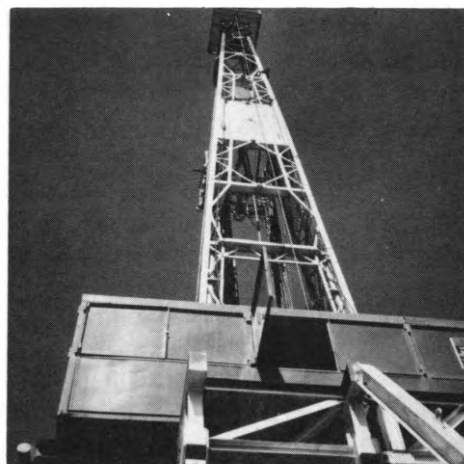
The Altamont-Bluebell field is the site of the most substantial development work in the Intermountain Region. The Bluebell field discovery was completed in 1967 by Uqueahgut Inc., at #1 Victor Brown, SW NW Sec. 3, T. 1 S., R. 2 W., pumping 122 barrels of oil and 247 barrels of water per day from the upper Green River Formation at 9,042-9,099 feet; total depth is 9,728 feet. Follow-



Typical oil rigs in an agricultural landscape dot the Altamont-Bluebell area.



New, modern and well equipped electric drilling rig. The rig has a 26-foot substructure (left), and measures roughly 142 feet from floor to crown (right).



ing completion of the Uqueahgut well, Chevron Oil and Gas Producing Enterprises, Inc., brought in several wells ranging from 600 to 1,900 barrels of oil and 1,770,000 cubic feet of gas per day. Production was from the lower Green River and Wasatch Formations and ranged in depth from 9,650 to 12,470 feet. In 1970 Shell Oil discovered Altamont field in Sec. 35, T. 1 S., R. 4 W. nine miles southwest of nearest production in Bluebell field, by completing the #1 Miles well flowing 1,100 barrels of oil and 596,000 cubic feet of gas per day from a lower Wasatch Formation transition zone perforated at 12,910-12,942 feet.

Other fields in the same general vicinity include Cedar Rim field, 18 miles SW of Shell's #1 Miles well, discovered by Mountain Fuel Supply, Indian Ridge and Cottonwood Wash fields discovered by Gulf Oil, Roosevelt field by Humble Oil and Refining (EXXON), Starvation and Blue Bench fields discovered by Brinkerhoff Drilling Company, and the Starr Flat field. Some of these discoveries are several years older than the Altamont-Bluebell area; the earliest was Roosevelt field in 1949. Blue Bench field, discovered in 1972, is the most recent.

1972-1973 DRILLING HIGHLIGHTS

Successful well completions highlight both 1972 and 1973 in

the Altamont-Bluebell fields. Weekly drilling reports spelled out success of wells throughout 1973 at Altamont and nationwide attention was focused on the area. Many drilling companies, including Parker, Brinkerhoff, R. L. Manning, Noble, and Vierson-Cochran, moved in modern and specialized equipment to handle problems of high pressures, lost circulation, high pour-point oil, and deep drilling. Never before in the history of the Rocky Mountain Region oil drilling experience has so much new and highly sophisticated drilling equipment been assembled for a single area at one time.

NEW FOR UTAH—GAS PROCESSING PLANTS

As field development work progressed and demand for petroleum products increased, it became apparent that gas processing plants would have to be constructed. First of these to go on stream was the Bluebell gas plant by Gary Operating Co., nine miles northwest of the town of Roosevelt in the Bluebell field. The plant has a capacity of 20 million cubic feet of gas per day and recovers propane, butane and natural gasoline in processing casinghead gas produced with oil at wells in the field. A second gas plant is in process of construction by Shell Oil Company at its Altamont facility with a designed capacity of 40

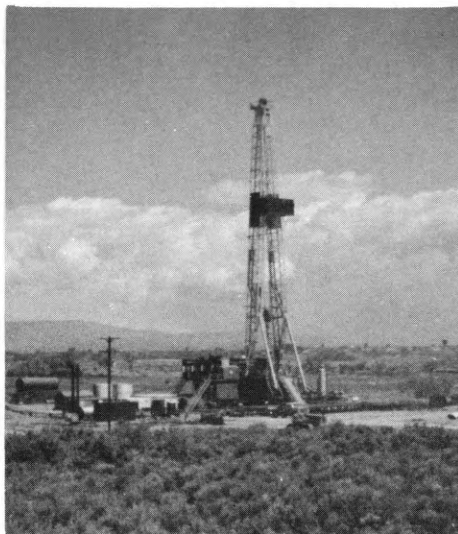
(continued on next page)

(continued from page 7)

million cubic feet per day and, when it reaches that level of operation, is expected to recover 3,000 barrels of liquids per day. A third gas plant, the Altonah, was announced in late August, 1973, by Gary Operating Company to gather, compress and recover propane, butane and gasoline from natural gas produced in the Altonah area of Altamont-Bluebell. It will process 20 million cubic feet of gas per day. Residual gas from the operation will be supplied to eastern Utah residential and commercial customers by the Utah Gas Service Company which is constructing about 50 miles of pipeline facilities to bring the gas from the plant to the Vernal area.

MARKETING—TRANSPORTATION—PIPELINES

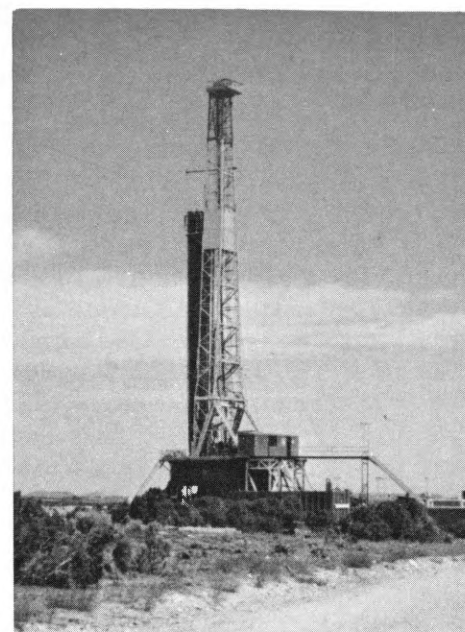
Crude oil produced from the area has a high wax content and a pour-point of over 100 degrees. Existing pipelines and refineries can handle only a limited amount of the crude in a mix with more conventional low pour-point types. Crude being marketed from the area is pumped into the Chevron Oil pipeline which runs westward from Rangely field in Colorado to the Salt Lake City Chevron refinery, a subsidiary of Standard Oil of California, where modifications have been made. Chevron has also constructed approximately 100 miles of new pipeline with heating stations from the Altamont-Bluebell area to Salt Lake City. In late December, 1973, Chevron made its first transmission through the new line to the refinery. In addition, Chevron is laying plans for a unit-train to carry crude oil to its Richmond, California facilities. Marathon Pipeline Company and the Bureau of Land Management are presently investigating the best possible route for a pipeline to be constructed from Altamont to Guernsey, Wyoming. Husky Oil Company is conducting a \$5.5 million modernization plan



Typical drilling rigs in the Altamont-Bluebell area.

for its North Salt Lake refinery which will more than double the processing capacity at that plant.

Gary Operating purchased the American Gilsonite refinery at Fruita, Colorado, late in 1973 and will increase crude oil transmission through the existing pipeline from the Bonanza area to the Colorado plant, and a number of other refiners in Utah are taking some crude. Phillips Petroleum and American Oil plan to enlarge their processing capacity for crude from the area. Arizona Fuels Inc. has reactivated the Major Oil Company refinery facility west of Roosevelt and is processing more than 2,000 barrels daily. Meanwhile, more than 100 truck tanker units haul crude oil to Salt Lake City, Craig, Grand Junction, Cheyenne and Denver.



BUILDING CONSTRUCTION—NEW SERVICE AND SUPPLY FIRMS

As a result of the large scale development of the area scores of new buildings and offices are being constructed by the oil field service and supply firms moving into the area. Baroid, a drilling mud supplier, has constructed a 200 barrel/day liquid mud mixing plant which includes a 3,000 barrel storage capacity for liquid mud, a dry mud warehouse, and storage space for a million pounds of bulk barite. Construction is taking place throughout Duchesne and Uintah Counties, particularly in and around Vernal and Roosevelt. The companies new to the area and the services they provide are too numerous to mention but they include drilling contractors, supply

(continued on next page)

Table 1. Projected costs for future typical development well (average depth, 11,700-13,500 feet).

	Altamont ¹ Main field area	Bluebell ²	
		Main field area	West end
Drill and complete	\$800,000	\$380,000	\$517.827
Production and pump facilities	68,000	80,000	106.000
Dry hole burden	98,000	n. i. ³	n. i. ³
Total/well	\$966,000	\$460,000	\$623.827

¹ 1973 analysis.

² 1970 analysis.

³ Does not include information on dry holes, land acquisition, exploratory costs or salt water disposal.

(continued from page 8)

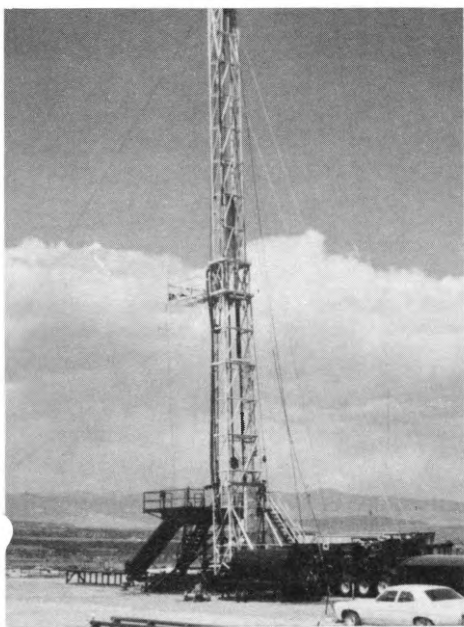
Table 2. Tax assessments on State lands in Duchesne and Uintah Counties.

	Royalty	Percent of Utah	Rental	Percent of Utah	Acres	Percent of Utah	Oil and gas acres	Percent of Utah	Oil shale acres	Percent of Utah
Duchesne County	\$ 75,833.97	10	\$ 79,788.50	3	83,374.59	3	43,379.49	2	37,003.33	17
Uintah County	219,799.04	27	434,169.89	17	445,340.62	16	240,950.18	13	150,801.35	70
Total	\$295,633.01	37	\$ 513,958.39	20	528,715.21	19	284,329.67	15	187,804.68	87
Utah total	\$795,747.15		\$2,518,432.60		2,762,469.77		1,846,119.46		216,474.63	

stores, tool specialists, pipe, well logging, hole treatment firms and many others.

DRILLING AND COSTS

Table 1 is a chart analysis of economic factors in the Altamont-Bluebell field drilling prepared for oil and gas hearings. The Bluebell information is by Chevron Oil Company, and the Altamont analysis by Shell Oil Company. Shell estimates 5,752,000 barrels of oil per each 640 acre drilling lease with a recovery rate of 20.9% for its Altamont holdings. Chevron estimates 4,080,000 barrels of oil with a 13.7% recovery factor for each 640 acre lease in the main zone of the Bluebell field and 4,568,000 barrels in the main zone plus the lower Green River Transition Zone.



A completion rig prepares to place the well into the final stages of production.

Drilling costs, however, have spiraled over the past few years making expenses incurred by the drilling contractor increase considerably and even greater increases are expected during the coming years. Labor alone has increased over 50% since 1968 and the cost of drilling mud has risen about 35%. Actual staking of a well costs over 75% more now than it did five years ago and fuel costs have also skyrocketed.

ECONOMIC GROWTH

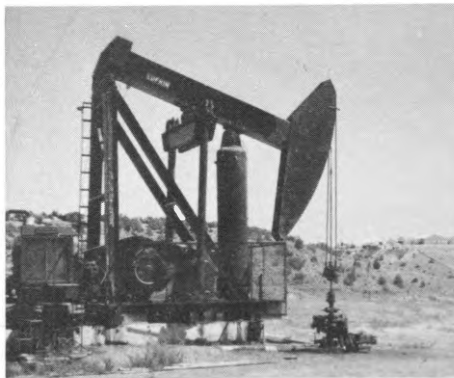
The economic impact of 1973's drilling activity in the Uinta Basin, of course, has been dramatic. Planning on a long-term basis is expected to achieve levels of economic stability and to avoid a cycle of boom and bust. The Division of State Lands' report for 1973 (table 2) shows assessments for Duchesne and Uintah Counties and the totals for the State.

Economic growth is expected to bring hundreds of thousands of dollars into Duchesne and Uintah Counties stimulating growth and development in all areas of business and government. Population growth is also expected to proceed rapidly as more and more companies expand their facilities or move into the area bringing men and equipment. Employment prospects are excellent and increased payrolls will produce much new revenue in the forms of taxes and a greater volume of commerce.

FUTURE PLANS

Generally speaking, development work in the Uinta Basin dur-

ing 1974 is expected to proceed at a steady pace and activity in the Altamont-Bluebell vicinity should be reliable. Several operators intend to increase exploratory and "step-out" drilling efforts and also plan to maintain their current levels of development work. Shell Oil, for example, will continue contracts with Brinkerhoff, Loffland and Parker Drilling companies and maintain a working program of some 12 rigs underway bringing their total number of wells up to about 100 in the field. Gulf Oil has contracts with Manning, Noble and Signal Drilling and plans to keep about eight rigs running. Chevron Oil Company's program calls for three rigs run by Loffland and Noble Drilling companies, to keep 1974 production at a steady level. Sun Oil tentatively plans to keep four rigs busy, Gas Producing Enterprises expects to continue development work, Mapco has moved in additional Vierson-Cochran rigs for at least a six-well program, and several others expect to keep operations busy during the year.



A pump control unit and tank battery at Bluebell field.

Mineral Production in Utah, 1972-1973

by Carlton H. Stowe, UGMS Minerals Information Specialist

Utah's mineral value in 1973 set a record high, \$644,325,000, a 19% increase over 1972 which was \$542,809,000. Increases were noted in all three commodity groups, mineral fuels, metals, and nonmetals, but mineral fuels registered the largest gain, 21% in total value. All commodities in the group recorded increased value except asphalt, related bitumens and carbon dioxide. Petroleum value rose to \$101,632,000 from the 1972 total of \$80,773,000 and production totaled 31,080,000 barrels. Natural gas increased to \$8,812,000 from last year's total of \$6,711,000 and in production from 39.5 billion cubic feet to 45.2 billion cubic feet. Natural

gasoline and cycle products rose from \$1,406,000 to \$1,530,000 for the same period.

Total value of the metals group was 19% greater than in 1972, boosted by gains in copper, gold, iron ore, molybdenum, and silver. Copper, for example, accounted for 76% of the metals value, \$312,351,000, and 48% of the total mineral production in Utah. Its production climbed from 259,507 tons in 1972 to 262,480 tons. Gold value rose to \$30,694,000 from the 1972 figure of \$21,237,000; silver value in 1973 was \$9,438,000.

In the nonmetals group, increased values for clays, fluorspar,

salt, stone, phosphate rock, and potassium salts more than offset decreases in sand and gravel, cement, gypsum, sodium sulfate, and lime. Total value for the group rose 12%. Coal production increased from 4,802 tons in 1972 to 5,140 tons valued at \$48,830,000.

As reported by the Utah Tax Commission, assessed valuation of mineral industries in the State decreased somewhat during 1973, largely because of cutbacks felt within the copper industry. The 1973 figure, \$362,806,709, dropped from \$403,196,468 during 1972. The largest assessment for 1973 was \$262,934,909 in the nonferrous-metal mines group (except for iron and uranium). Industrial minerals were assessed \$15,319,344; iron mines, \$10,544,408; coal mines, \$9,988,340; and uranium,

(continued on next page)

Mineral production in Utah, 1972 and 1973.¹

Mineral	1972		1973 ²		
	Quantity	\$ Value (thousands)	Quantity	\$ Value (thousands)	
Carbon dioxide (natural)	thousand cubic feet	61,103	\$ 4	60,000	\$ 4
Clays ³	thousand short tons	266	790	262	824
Coal (bituminous)	thousand short tons	4,802	42,868	5,140	48,830
Copper (recoverable content of ores, etc.)	short tons	259,507	265,735	262,480	312,351
Fluorspar	short tons	2,977	84	7,701	272
Gem stones	NA	95	NA	95	95
Gold (recoverable content of ores, etc.)	troy ounces	362,413	21,237	319,160	30,694
Iron ore (usable)	thousand long tons	1,788	W	1,935	W
Lead (recoverable content of ores, etc.)	short tons	20,706	6,224	13,495	4,399
Lime	thousand short tons	171	4,216	181	3,760
Natural gas	million cubic feet	39,474	6,711	45,192	8,812
Natural gas liquids:					
Natural gasoline and cycle products	thousand 42-gallon barrels	458	1,406	450	1,530
LP gases	thousand 42-gallon barrels	1,742	2,787	1,700	3,230
Petroleum (crude)	thousand 42-gallon barrels	26,570	80,773	31,080	101,632
Pumice	thousand short tons	14	29	14	29
Salt	thousand short tons	660	4,955	680	5,534
Sand and gravel	thousand short tons	14,619	17,071	14,911	16,402
Silver (recoverable content of ores, etc.)	thousand troy ounces	4,300	7,245	3,739	9,438
Stone	thousand short tons	3,384	6,005	3,631	6,680
Uranium (recoverable content U ₃ O ₈)	thousand pounds	1,496	9,425	W	W
Vanadium	short tons	188	W	W	W
Zinc (recoverable content of ores, etc.)	short tons	21,853	7,758	16,710	6,704
Value of items that cannot be disclosed: Asphalt, beryllium, cement, clay (kaolin), gypsum, magnesium chloride, magnesium compounds, molybdenum, phosphate rock, potassium salts, sodium sulfate, tungsten concentrate, vanadium and values indicated by symbol W					
		XX	57,391	XX	83,105
TOTAL		XX	\$542,809	XX	\$644,325

¹ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

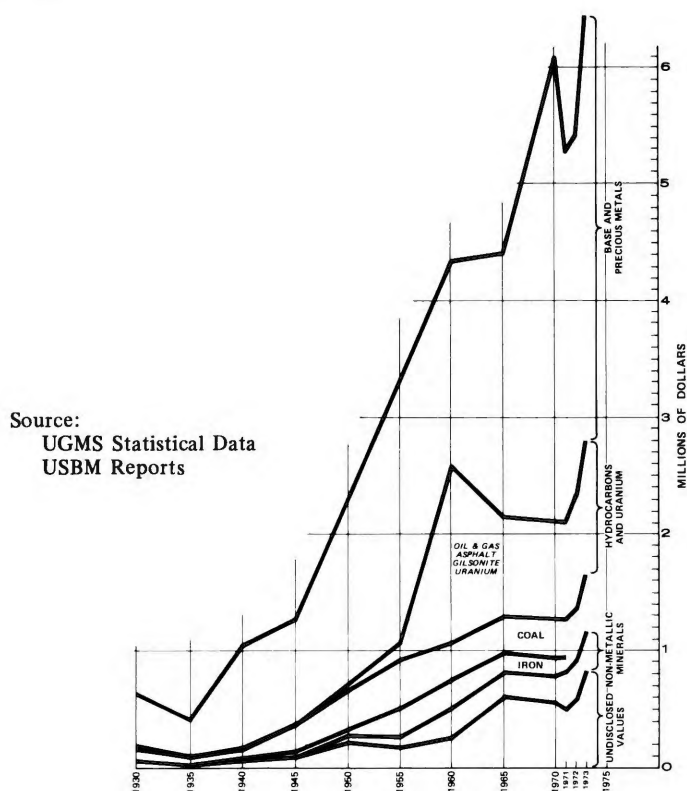
² Preliminary.

³ Excludes kaolin, included with "Value of items that cannot be disclosed."

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

(continued from page 10)

	1970	1971	1972	1973 ¹
Undisclosed values	\$ 55,899,000	\$ 49,754,000	\$57,391,000	\$ 83,105,000
Non-metallic minerals	24,092,000	32,896,000	33,249,000	33,600,000
Iron	13,837,000	11,886,000	NA	NA
Coal	34,472,000	34,082,000	42,868,000	48,830,000
Hydrocarbons and uranium	82,086,000	80,845,000	101,102,000	115,204,000
Base and precious metals	391,611,000	316,233,000	308,199,000	363,586,000
Total Production	\$601,997,000	\$525,696,000	\$542,809,000	\$644,325,000

¹ Preliminary.

Gross mineral production, 1930-1973.

\$3,154,183. Oil and gas assessments were \$60,887,399. Occupation tax was paid on 52 separate mining locations in Utah, 32 of which are located in San Juan County. State-wide, uranium properties lead the list in mining with a total of 35 properties. Oil and gas occupation tax was paid on 63 properties. Assessed valuation on pipelines was \$12,839,435 for 13 companies.

The Bureau of Land Management administered 42.96% or 22,639,230 acres of the 52,696,960 acres comprising Utah

lands in 1973. During 1972, BLM controlled 43.12% or 22,722,316 acres of Utah land. Largest percentage of receipts from BLM-administered lands and resources during 1973 resulted from the mineral leasing act of 1920: \$11,390,247 (90.6%) of the total \$12,606,017. A slight increase is noted in these receipts from the \$10,035,591 (89.25%) of 1972's total \$11,244,294. Although 1971's mineral leasing receipts were lower than either 1972's or 1973's the percentage (90.7%) of the total was slightly higher in 1971. Payments to the State of

Utah from public land revenues for mineral leases in 1973 were \$4,338,077 and in 1972, \$3,828,370. Income from mineral leases and permits consistently accounts for the greatest percentage of receipts followed by the Taylor Grazing Act receipts (6.1%); sale of lands and materials (0.5%); and fees, services and miscellaneous (2.8%). The Division of State Lands reports mineral lease revenue for 1973 was \$2,518,432.60 compared to \$2,183,624.49 during 1972, or an increase of \$334,790.11. Royalty payments increased \$65,719.92, from \$730,527.25 in 1972 to a total of \$796,247.17 in 1973.

Utah State ownership shows a total of 2,762,470 acres under lease with the largest amount, 1,846,119 acres, being oil and gas leases. Oil shale leases include 216,475 acres; salt, 244,252; metallic minerals, 218,321; non-metallic minerals, 55,065; bituminous sands, 55,382; and coal, 126,856 acres. Acreage under lease increased by 425,089 acres over the 1972 figure. Royalty payments for the 1973 year were highest in Uintah County (445,341 acres) where \$219,799 is recorded and San Juan County (290,493 acres) was second with a recorded total of \$175,987. Carbon County's royalty amounted to \$68,261 for a third place position. Grand County has the most (340,314) acres under lease although it shows a relatively low royalty payment.

Oil and gas operators drilled more wells (195) in Utah during 1973 than in any year of the past decade (214 in 1963). Interest was particularly stimulated because of the increased success ratio experienced in drilling efforts throughout the Altamont-Bluebell fields in Duchesne County. Further, 1973 drilling efforts increased because of the overall rise in demand for petroleum products. It is interesting to note that total footage in

(continued on next page)

(continued from page 11)

Utah lands: fees, royalties, rentals, fiscal year data 1968-1973.

	1968	1969	1970	1971	1972	1973
FEDERAL						
Minerals	\$7,998,034	\$8,662,523	\$ 8,022,666	\$ 9,264,164	\$10,035,591	\$11,390,247
Grazing	416,165	450,874	570,172	660,371	731,342	767,098
Others	315,227	284,538	55,292	287,602	477,361	448,672
Total	\$8,729,426	\$9,397,935	\$ 8,648,130	\$10,212,137	\$11,244,294	\$12,606,017
STATE						
Minerals	\$2,312,647	\$2,406,454	\$ 2,373,514	\$ 2,321,596	\$ 2,914,169	\$ 3,314,680
Grazing	156,898	172,386	183,291	193,396	208,031	247,035
Others	4,724,084	5,354,268	11,836,688	5,273,717	6,131,983	6,117,450
Total	\$7,193,629	\$7,933,108	\$14,393,493	\$ 7,788,709	\$ 9,254,183	\$ 9,679,165

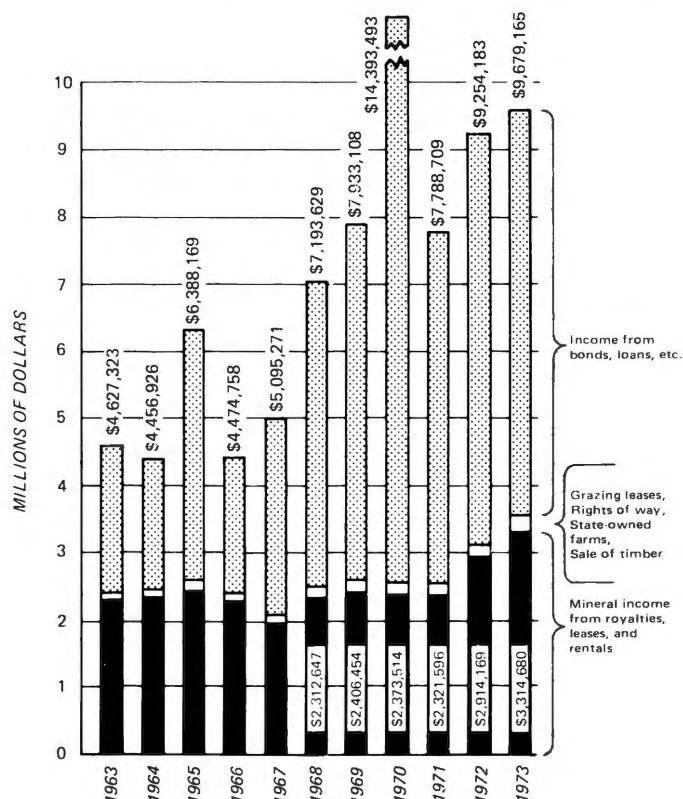
1973 was higher than the 1963 figure. In 1973, 1,678,359 feet of hole was drilled averaging a per well depth of 8,607 feet. In 1963, 1,096,620 feet of hole was drilled for an average depth of 5,124 feet. These figures essentially show that oil and gas operators are drilling deeper in the search for new reserves. Many wells in Utah exceed the 8,607 foot average, especially in the Uinta Basin region where Tertiary production is found at depths of 12,000 feet and deeper.

1973 drilling statistics show that of the 195 holes drilled, 106 oil wells were completed successfully, 25 wells produced gas and 64 were dry holes. Only three wells, one oil and two gas wells, are classified as actual new-field discovery wells. Of the exploratory holes drilled there were 42 failures. In comparison, 1963's drilling resulted in 68 oil wells, 28 gas wells and 118 dry holes.

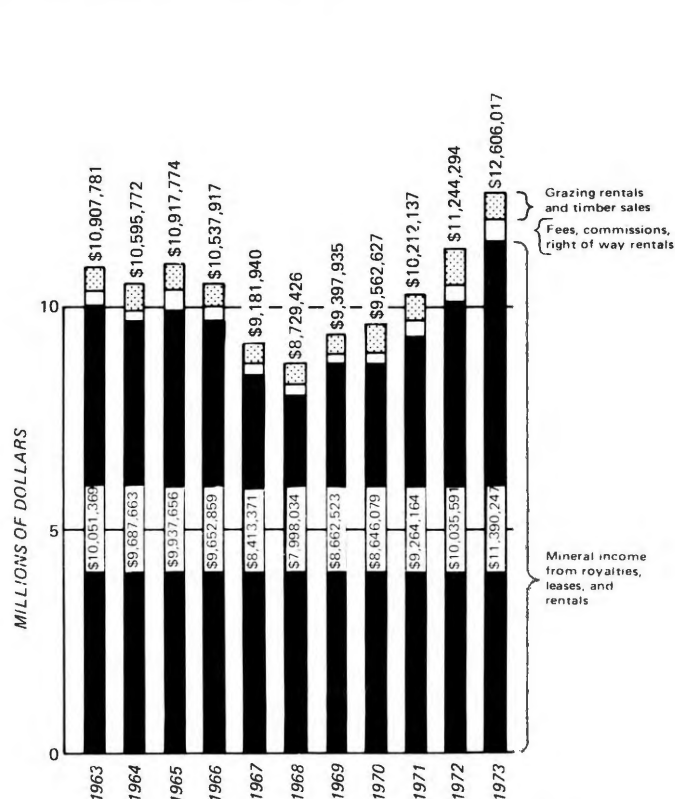
Note: Federal and state mineral statistics related to leasing and royalties are maintained

on a fiscal year basis; data apply to the fiscal year July 1, 1972 to June 30, 1973. U.S. Bureau of Mines reports, however, are on a calendar year basis. Mineral production figures for 1972 are the latest compiled by USBM.

Information for this report was derived from the following sources: U.S. Bureau of Mines preliminary data for 1973 and additional information released to UGMS by the USBM; Public Land Statistics, 1972, Bureau of Land Management; BLM Facts and Figures for Utah, 1973, and Utah Division of State Lands fiscal report, July 1, 1972 to June 30, 1973. Additional information was made available through the Division of Oil and Gas Conservation.



Annual income from State-owned lands, 1963-1973
(from Division of State Lands).

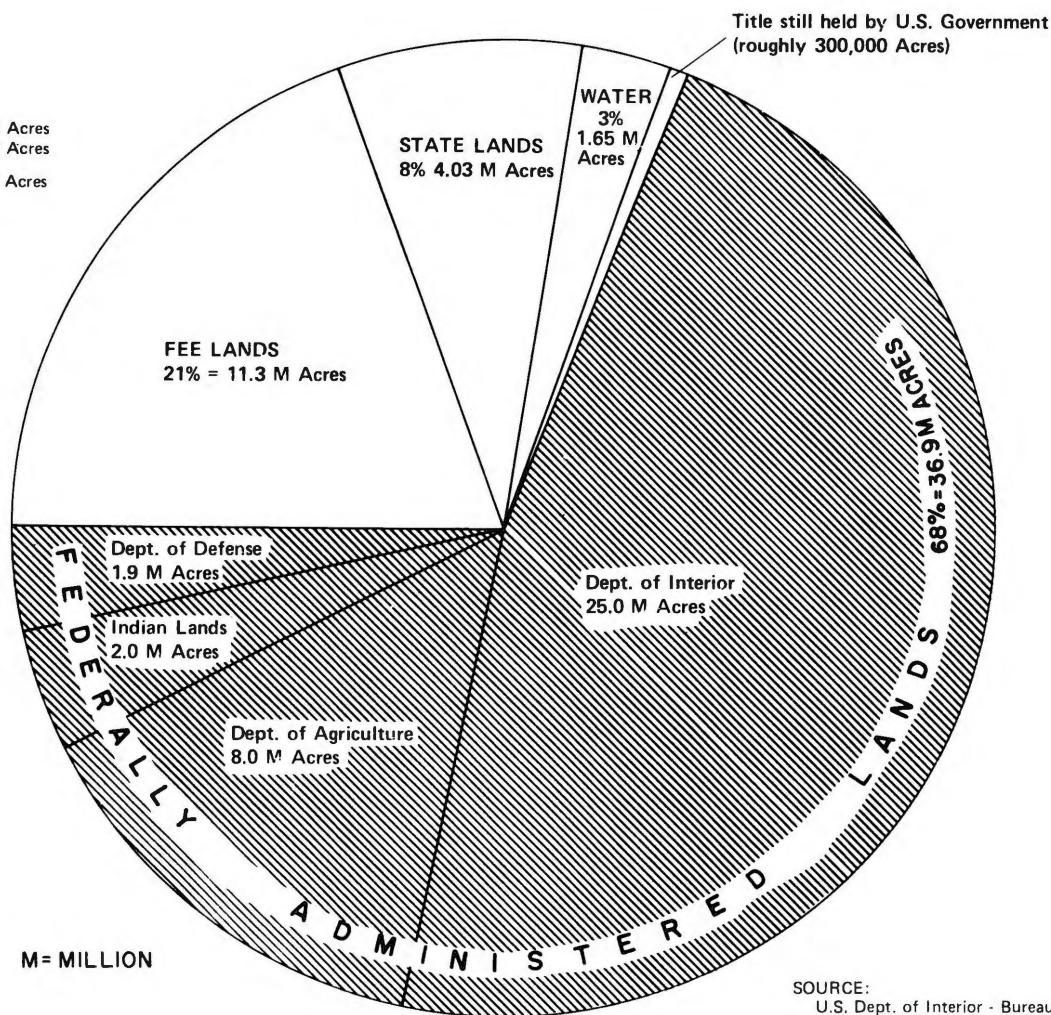


Rentals and fees from federal lands in Utah, 1963-1973
(from U. S. Bureau of Land Management).

(continued on next page)

(continued from page 12)

WATER - 1,649,280 Acres
 LAND - 52,696,960 Acres
 TOTAL - 54,346,240 Acres



Utah land ownership, 1973.

SOURCE:
 U.S. Dept. of Interior - Bureau of Land Management
 "BLM Facts and Figures for Utah, 1973" p. 12
 Utah State Div. of State Lands
 Fiscal Report 7/1/72 to 6/30/73

Minerals activity on federal lands in Utah, July 1, 1972 to June 30, 1973 (U. S. Bureau of Land Management).

Commodity	Mineral permits and licenses		Cumulative mineral leases outstanding		Production	Receipts	
	Number	Acres	Number	Acres		Leases, permits	Royalties
Petroleum	2,535	4,047,308	13,889	11,937,132	21,595,501 bbls	\$ 9,371,280	\$4,771,831
Natural gas					24,498,377 CF		
Oil and gas liquids					71,894,760 gals		
Coal	0	0	239	402,098	1,979,975 s. t.		527,870
Other						21,577	26,577
Potash	0	0	46	71,913		64,749	39,806
Phosphate	1	133	15	22,999		9,180	8,781
Gilsonite and bituminous sands	0	0	15	3,546			
Carbon dioxide					55,837 TCF		
Silica sand					10,485 s. t.		
Totals	2,536	4,047,441	14,204	12,437,688		\$10,035,591	\$5,374,865
(7-1-71 to 6-31-72)	1,422	1,405,615	13,760	10,254,969		\$ 9,264,163	\$5,310,214

Total receipts from leases and permits on public lands in fiscal year 1973 include royalties on federal leases collected by U. S. Geological Survey: \$12,606,017.

Allocation of BLM receipts to State of Utah for mineral leases and permits: \$4,338,077.

Source: BLM Facts and Figures for Utah, 1973.

New Leasing Regulations

Oil and Gas Activity to Come to a Screeching Halt?

by Carlton H. Stowe, UGMS Minerals Information Specialist

In the February, 1969, issue of the *Quarterly Review*, an article dramatically displayed the effects of land withdrawal from control by the State of Utah. The figure accompanying that article (figure 1, A, B, and C) is reproduced here. To figure 1B and C a new bar-graph construction has been added showing additional restrictions of land since 1969, as well as the total land area disturbed by commercial mining activities to date.

The State is now faced with the loss of additional economic mineral potential under the new terms and conditions for leasing as set forth on November 2, 1973, in a "Public Notice" by the Utah State Office of the Bureau of Land Management. This new policy was announced in the December, 1973, "Newsletter of the Utah Environment Center" which stated, "the BLM State Director has announced a new approach for the orderly processing of oil and gas leasing of national resource lands..." In this "new approach," BLM has established leasing designation of lands into one of four categories: (1) Open lease areas, (2) Restricted lease areas, (3) No surface occupancy areas, and (4) No leasing areas, for all national resource lands in its control.

Governor Rampton, Senator Moss, and representatives from Senator Bennett's and Congressman McKay's offices met with various Directors and representatives of the BLM, Forest Service, and Utah's Department of Natural Resources January 11, 1974 in the Governor's office to explore BLM and Forest Service planning programs. These proposed programs now include 45% of all BLM lands

defined as "open for oil and gas leases." Of the remaining 55% of lands controlled by BLM, 43% is also listed as "open," but with the following restrictions: subject to "special stipulations" (33%), and subject to "no-surface occupancy stipulation" (10%). The final 12% is a "suspended or no lease category," which boils down to the fact that this 55% is either closed or severely restricted for oil and gas leasing. It also appears that these categories, unless altered, along with National Parks, Forest Service lands, Military installations, various projects for reclamation, Fish and Wildlife areas, etc., have removed at least two-thirds of the State from oil and gas activity!

Retiring Director, W. P. Hewitt, UGMS, points out, "these plans are theoretically subject to revision but many times they display the unfortunate characteristic of becoming set in administrative concrete which has the effect of abrogating both the Mining Law of 1872 and the Mineral Leasing Act of 1920." Additionally, Governor Rampton made a point concerning land-use policies of federal agencies quite clear, "We don't want to be a witness. We want to be on the jury."

Each oil and gas plat located in the BLM office, eighth floor, Federal Building, Salt Lake City, has been carefully noted with the new categories. Roughly two hundred folders, each containing anywhere from 40 to 50 plats, are on file. These include detailed quarter-quarter, section, township and range, and the leasing category designated. Also in the BLM "public room" is a large wall map covered with a plastic overlay showing general land areas covered by the leasing categories. This

map, produced by BLM, is a single copy, but it is "available for anyone" to inspect. No detailed maps which show location of Utah's lands in each of the four categories are available, outside the actual oil and gas plats, which are retained in the BLM office.

Several attempts were made to obtain maps from both the BLM and the Forest Service. At each request for such, UGMS was strictly denied access. The estimates listed on the figure are based on information available to UGMS at this time.

Vast areas are included in the "no leasing, restricted, and no-surface occupancy" categories. The BLM land office wall map shows all of Grand and San Juan Counties and eastern sectors of Wayne, Garfield, and Kane counties covered. The huge Aneth oil field is completely surrounded. The San Rafael province, the south-central hingeline area of Sevier and Sanpete Counties, the Deep Creek Range in western Utah, Great Salt Lake boundaries, Utah Lake and its surrounding region, the Uinta Basin (where current oil development work is being done), and scattered lands throughout Morgan, Daggett, Weber, and other counties are included... all where oil and gas activity is vitally important to the State (see Utah production summary, also this *Quarterly Review* edition).

Exactly how judgements were made in the way in which the land was divided and categorized into the "restricted," "no surface occupancy," or "no leasing" areas is mysterious. It is known that this was done almost totally by BLM district personnel whose work

(continued on page 16)

Figure A

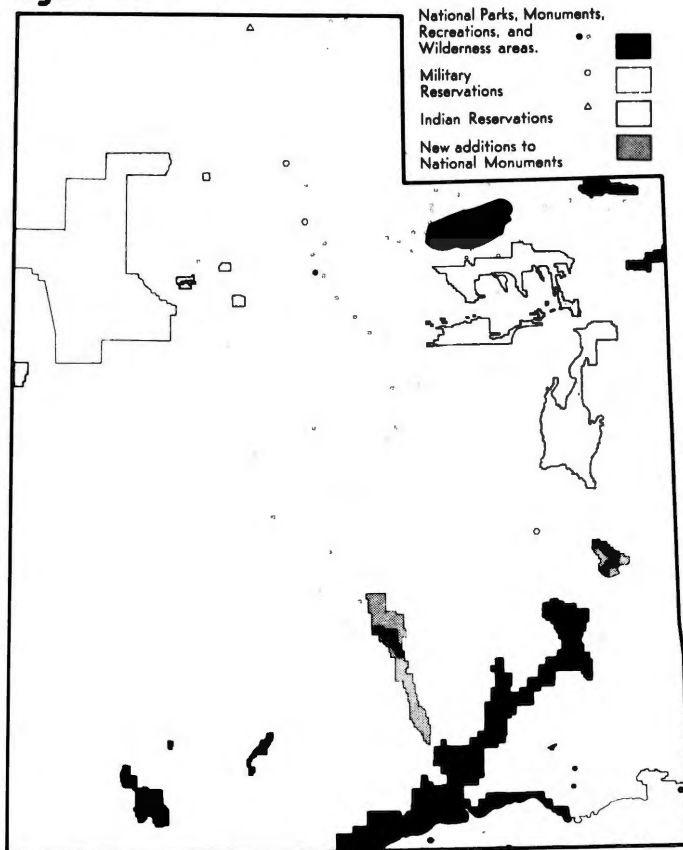


Figure B

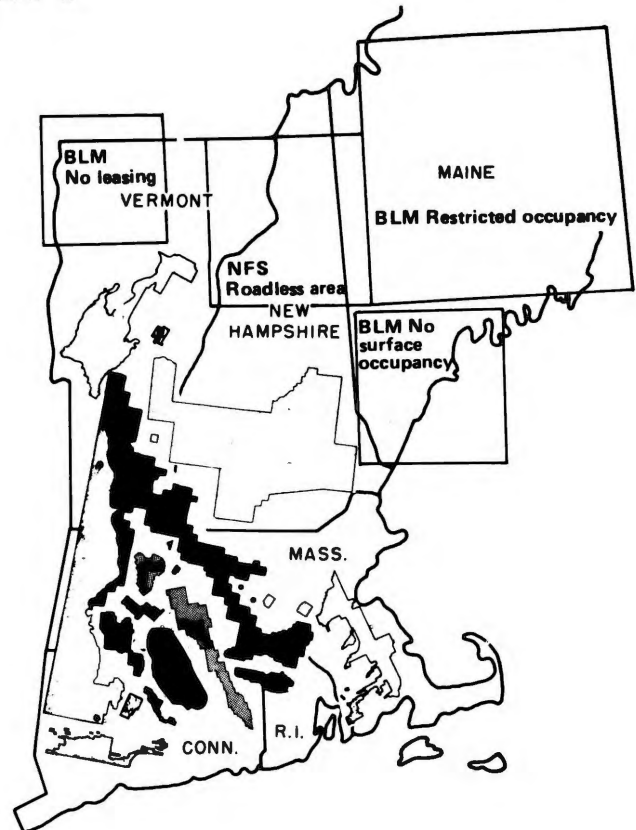
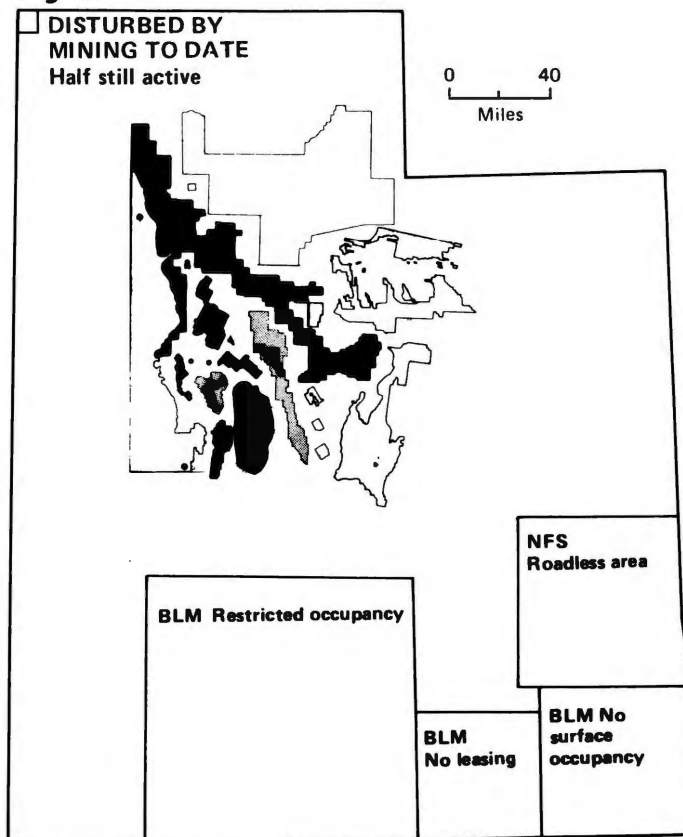


Figure C



ADDITIONAL FEDERAL LANDS INVOLVED IN CATEGORIES*

	Percent
Military	5.7
National Parks, Primitive and Recreation Areas	6.9
BLM: No Leasing (excluding National Park Service Recreation Areas)	4.8
BLM: No Surface Occupancy	6.6
BLM: Restricted Occupancy	22.3
NFS: Roadless Areas	8.6
Percent of Federal Land	54.9

*UGMS ESTIMATES

(continued from page 14)

experience and educational background tend to be surface oriented. It is also evident that very little mineral evaluation had been made of the areas administratively restricted. In fact, the Utah Geological and Mineral Survey received no notices pertaining to proposed management reorganization for these lands and no input was requested. Although several UGMS studies throughout the State cover a vast amount of mineral potential investigations, they were apparently not considered.

Standards of use applied to oil and gas operators are apparent in the stipulation list. These standards are quite different from those applied to other users of the land. The stipulations are somewhat involved as one reads through and studies each leasing designation category. For example, oil and gas use will be allowed only if it will not interfere with other uses (Surface Disturbance Stipulations, paragraph 4, "The lease area will be available for any other public use, unless restricted in writing by the authorized officer."), if it can be hidden (paragraph 10), and if the operators will finance improvements for other users as well as studies which have little or no bearing on their use of the land (paragraph 11). Other stipulations call for submittal of maps and wordy explanations of anticipated activity to at least two federal agencies involved in the area. An environmental analysis then has to be made by the two federal agencies, followed by compliance with half-a-dozen other regulations. These stringent requirements will discourage many oil, gas, and mineral exploration companies considering exploration of provinces of Utah!

In addition to the new policy by BLM, and occurring at about the same time, the Forest Service has set forth several new National

Forest areas within the State (see Circular Report 11, Forest Service, USDA, October, 1973, 21 p.) and has initiated a policy of "Supplemental Stipulations for Lands Under Jurisdiction of the Department of Agriculture." Report 11, "New Wilderness Study Areas," includes additional acreage of State lands scattered throughout the vicinity of Ashley, Dixie, Fishlake, Manti-La Sal, Uinta, and Wasatch National Forest regions. The new mining regulations covered by the "Supplementary Stipulations" are due to go into effect on May 1, 1974. UGMS was belatedly advised that these new regulations have already been published in the Federal Register (December 19, 1973).

It is interesting to note just how State control of land has been diminishing. Since the original publication of figure 1, A, B and C in 1969, all the areas indicated by the blocks in figures 1B and C have been placed into one of the categories, and development of other large areas has been restricted by the imposition of stipulations and conditions.

At a time when more and more shortages of energy minerals are felt and problems of energy supply are real, it now becomes plain that large parts of Utah's federal domain, formerly open to prospecting, are being chopped at and nibbled away, both piecemeal and by large chunks. Now, in the midst of crisis, this leasing structure seems intent upon discouragement of initiative and capital investment with the consequent strangling of the capability of dominant energy people to proceed responsibly. Under the leasing categories now manifested, the best Utah will see is severe reduction of drilling activity, development work, and oil and gas exploration, and at worst, termination. Oil and gas leasing, of course,

cannot help but decrease. The effect will be that many petroleum landmen, lease brokers and title workers will be out of jobs; not only will there be employment lost but income generated back to the State of Utah will diminish. Oil and gas companies looking for provinces for initial exploration work leading up to the actual drilling effort will be stopped at the land acquisition level.

Considering the economic impact made by the oil and gas industry in our rural areas, we can see where the livelihood of many towns is involved. The 195 wells drilled in Utah during 1973 reflect the most wells drilled since 1963. Correspondingly, royalty increased to the State and towns and communities experienced favorable economic increases, in all areas of economic growth. New building construction, for example, is done to handle additional drilling contractor warehouse-office-shop complexes, service and supply firms, and the many people involved who make up the work force of the industry.

In 1973, 1.7 million feet of hole was drilled averaging a per well depth of 8,600 feet; ten years ago, total drilling was 1.1 million feet of hole, average depth of 5,100 feet, costing \$290,000 per hole. Today the cost of drilling an average 8,600 foot hole is \$400,000. If only ten wells are lost to the State of Utah we will have a 4 million dollar loss in revenue!

In a State Tax Commission study I did for the Legislative Council, assessed valuation of oil and gas in 1973 was \$60,887,399.00, up from \$56,948,124.00 in 1972. Occupation taxes paid by the oil industry in 1973 were \$1,397,399.00, and oil and gas pipeline companies paid \$12,839,435.00. I'm sure we would hate to see the oil and gas industry move elsewhere!

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,



Donald T. McMillan, Director
Utah Geological and Mineral 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.)

Pertinent information: (i.e., special techniques, methods, map scales, cooperating agencies, commodities, etc.)

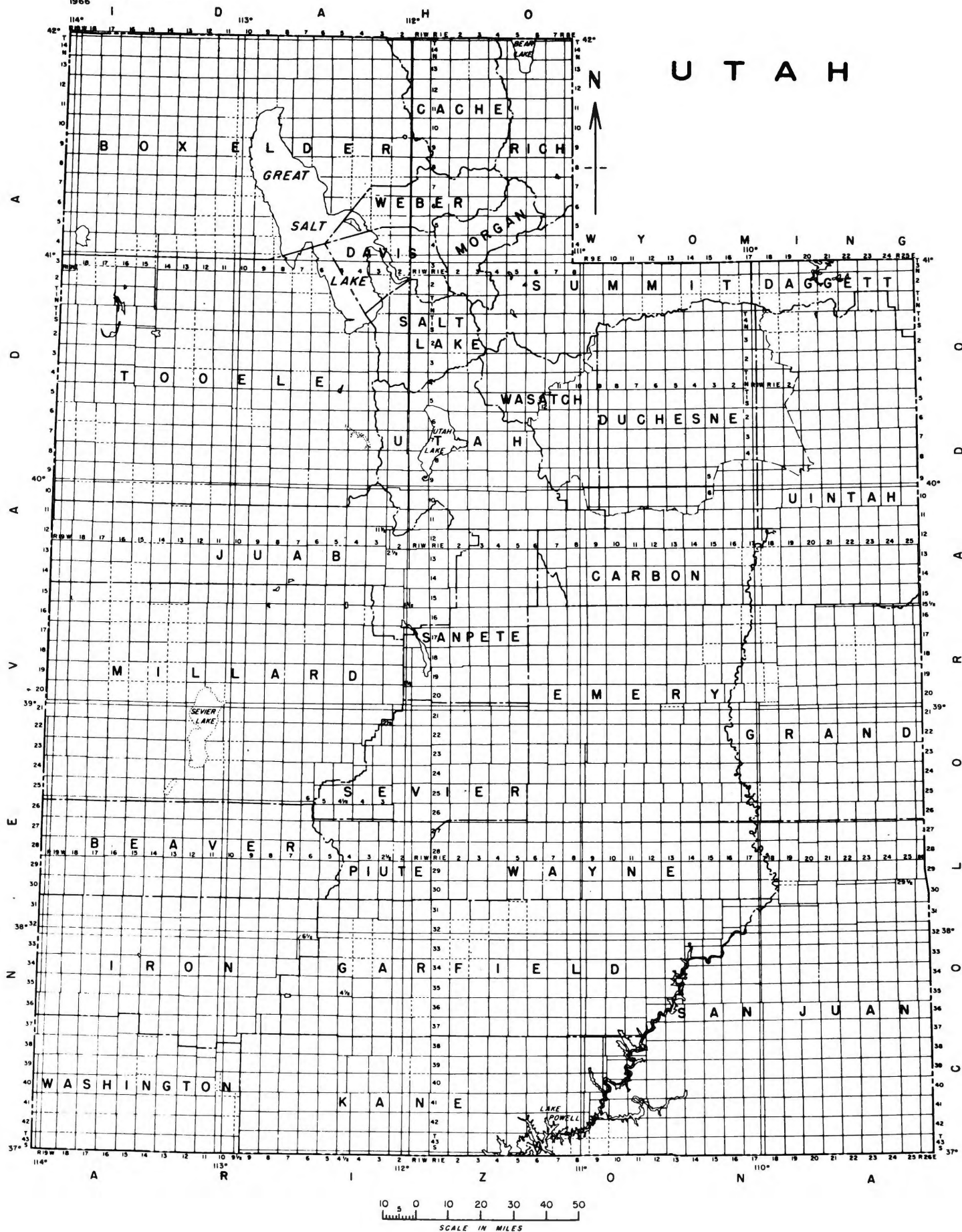
Dates: Inception _____

Projected completion _____

Probable location of information: (i.e., thesis file only, where, publication agency, etc.)

Probable status on completion: (i.e., University thesis; open file—where; state agency—where; publication—where; company confidential—release date and provision, where)

Please return this form to: Utah Geological and Mineral Survey, 103 UGS Building, University of Utah, Salt Lake City, Utah 84112, Attn: Editorial Department.



Generous Donation to UGMS Sample Library

Contribution of samples gives the library its first major acquisition from the Altamont-Bluebell area. Samples donated by McCulloch Oil Corporation are from the following wells:

Jessen 1-17, Sec. 17, T. 1 S., R. 1 W. Total depth — 17,072'.
 Warren 1-32, Sec. 32, T. 1 S., R. 4 W. Total depth — 15,510'.
 Birch 1-26, Sec. 26, T. 1 S., R. 5 W. Total depth — 16,510'.
 Jensen 1-29, Sec. 29, T. 1 S., R. 5 W. Total depth — 16,264'.
 Jensen 1-31, Sec. 31, T. 1 S., R. 4 W. Total depth — 16,243'.
 Brotherson 1-27, Sec. 27, T. 2 S., R. 4 W. Total depth — 12,625'.
 Chrisman-Bland 1-31, Sec. 31, T. 2 S., R. 4 W. Total depth — 12,025'.
 Erwin 1-35, Sec. 35, T. 2 S., R. 4 W. Total depth — 13,114'.

These samples, together with others previously contributed, now comprise a representative group for the Sample Library from the deeper wells of the area.

Earthquake Epicenters

General earthquake epicenters in or near Utah for January through April, 1973, with dates of occurrence and approximate magnitudes, are listed below. Unless otherwise indicated, localities are in Utah.

	Magnitude
January	
2 South of Deer Creek Reservoir	2.4
2 Northeast of Heber City	1.6
5 Near Bingham Canyon	1.7
7 East of Heber City	2.5
10 East of Boulder	2.0
11 South of Green River	2.3
11 Near Cedar City	2.0
11 Near Cedar City	2.0
15 South of Sunnyside	2.0
17 Near Payson	2.4
18 Near Kamas	1.5
18 Near Castle Dale	2.2
19 South of Sunnyside	2.1
20 Near Cedar City	2.2
21 Near Logan	2.2

(continued on page 18)

BOX SCORE ON WELLS AND DRILLING RIGS, JANUARY 1, 1974 — ALTAMONT-BLUEBELL AREA

Field	Completed wells	Drilling wells and announced locations	Dry holes
Bluebell	61 ¹	15	2 ²
Altamont	96 ¹	53	1 ³
Cedar Rim and others	16 ¹	9	7 ⁴
Total	173	77	10

¹ All oil wells with associated gas except one gas well at west end of Cedar Rim field.

² Within field.

³ Edge of field.

⁴ Scattered in vicinity.

ESTIMATED INVESTMENT — ALTAMONT-BLUEBELL AREA

Exploration, 1965-1970	\$ 10,000,000
Productive wells, 1967-1973	200,000,000
Dry holes, 1967-1973	10,000,000
Drilling wells, to end of 1973	60,000,000
Probable costs of completing these and other programmed wells	50,000,000
Services and supplies, 1967-1973	180,000,000 ¹
	\$510,000,000

¹ Includes pipelines, gas processing plants, storage facilities, etc.

This expenditure has developed about 0.5% of daily U. S. oil production as of November-December 1973.

(continued from page 1)

future study, and selected references. An appendix is furnished including culvert equations, test wells, well logs, lake altitude, salt-balance equations, density, specific gravity and temperatures. Fifteen illustrations and nine tables accompany the text. The report should be most useful to those who are concerned with data as an ample base for determining economic and sociologic changes.

Water-Resources Bulletin 19, "Hydrogeology of the Bonneville Salt Flats, Utah," by L. J. Turk (\$4.00). The study evaluates the immediate and long-term potential of potash production at the Bonneville Salt Flats. It includes a description of the hydrologic system of the Salt Flats, theories on its possible origin, and predictions concerning its future.

Special Studies 45, "Micro-paleontology and Paleoecology of the Tununk Member of the Mancos Shale," by R. H. Lessard (\$2.00). The study is an in-depth

investigation of the lowermost member of the Mancos Shale, the Tununk Shale member. The study was partially supported by a grant from the Geological Society of America. It describes stratigraphic relations, age, paleogeography and paleoecology, the Tununk fauna and systematic paleontology.

Special Studies 46, "Geology and Mineralogy of the Milford Flat Quadrangle, Star District, Beaver County, Utah," by S. Abou-Zied and J. A. Whelan (\$3.00). The report covers the Star District where complex geologic relationships exist. Intermittent exploration in the area since 1872 has resulted in the establishment of several mines to produce lead, zinc, silver, gold and copper. The authors cover a wide range of subjects dealing with the stratigraphy of the area, structure, hydrothermal alteration, economic geology, a complete description of the area's mines, and conclusions concerning the future of the area. The report includes eight figures, three plates and 14 tables.

(continued from page 17)

22 Near Cedar City	3.5
22 Near Alton	2.0
23 Near Woodland	2.5
23 Near Alton	3.1
23 Near Woodland	2.3
23 Near Woodland	1.8
26 Near Cedar City	2.0
27 Near Kamas	2.1
30 Southern Utah-Nevada border	2.7
31 Near Salt Lake City	2.6

February

2 North of Vernal	2.0
4 Near Levan	2.1
5 Near Rio Blanco, Colorado	3.6
6 Near Levan	2.2
6 Near Woodland	2.1
9 Near Levan	<2.0
9 Near the Goosenecks of the San Juan	2.5
10 North of Lund	3.2
10 North of Lund	2.6
10 North of Lund	2.5
10 North of Beaver	2.5
10 North of Beaver	<2.0
11 South of Sunnyside	<2.0
12 North of Beaver	2.6
13 North of Beaver	2.5
14 North of Beaver	2.5
14 North of Beaver	3.0
16 South of Avon	2.3
17 Near Price	2.1
18 Near Beaver	3.3
18 Near Beaver	2.0
20 Near Beaver	2.0
25 Parleys Canyon	2.0
26 Near Cedar City	<2.0
27 Near Randolph	2.4
28 Near Coalville	1.5
28 Near Huntsville	1.7
28 Near Huntsville	1.6

March

1 Near Sage Creek Junction	2.5
2 South of Sunnyside	<2.0
6 Near Wanship	2.5
6 Near Goshen	1.5

6 South of Sunnyside	<2.0
7 Near Goshen	2.3
7 Near Wanship	2.6
8 Hansel Valley	3.1
8 Near Heber	2.8
10 Near Beaver	3.1
18 South of Sunnyside	<2.0
21 North of Hanksville	2.1
23 North of Morgan	2.3
23 North of Morgan	2.3
24 Near Antimony	2.4
25 South of Castle Rock	2.2
25 Near Echo Reservoir	2.2
28 Yellowstone National Park, Montana	4.5

April

4 East of Alta	1.5
5 Rangely, Colorado oil field	1.7
5 Rangely, Colorado oil field	1.6
5 Rangely, Colorado oil field	1.7
5 Near San Rafael Reef	1.7
7 100 miles north of Logan	2.5
9 Near Levan	2.2
13 South of Malad City, Idaho	3.2
14 South of Malad City, Idaho	4.1
14 South of Malad City, Idaho	2.5
14 Near Castle Rock	2.0
16 Northwest of Rock Springs, Wyoming	2.7
19 West of Moroni	2.3
21 Near Promontory	2.3
21 Northwest of Elsinore	2.8
23 North of Neola	1.6
24 Near Layton	2.0
24 Near Layton	2.4
30 West of Springville	2.3

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.

UINTA BASIN DEVELOPMENT

(continued from page 5)

potential of Utah's growing giant will remain the subject of much guesswork.

The Utah Geological Survey has available maps and data on the Bluebell and Cedar Rim parts of the field as Oil and Gas Field Studies 10 (Cedar Rim) and 12 (Bluebell). These studies by Parley R. Peterson, consulting geologist, sell for \$1.50 and \$2.00 respectively (add 10% postage and handling when ordering by mail). The Altamont portion of the field has developed very rapidly and information has not been released freely. However, the Utah Geological Survey expects to publish another of its oil and gas field studies on the area in 1974.

QUARTERLY REVIEW

State of Utah Calvin L. Rampton
Governor

Department of Natural
Resources Gordon E. Harmston
Executive Director

Utah Geological and
Mineral Survey Donald T. McMillan
Director

UTAH GEOLOGICAL AND
MINERAL SURVEY

103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah 84112

State of Utah—Department of Natural Resources

UTAH GEOLOGICAL AND MINERAL SURVEY

103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah 84112

Address Correction Requested

Nonprofit Org.
U. S. Postage Paid
Permit No. 1529
Salt Lake City, Utah