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# SHALE COUNTRY

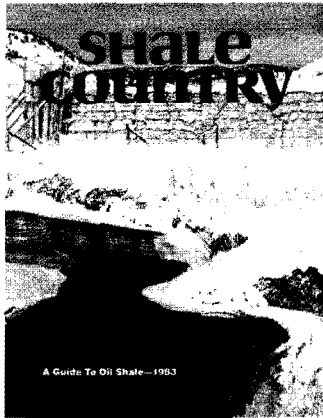
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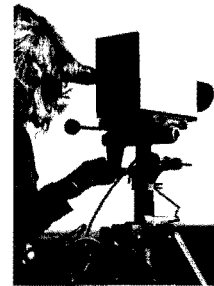
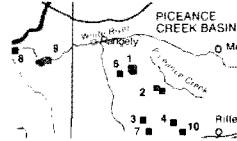
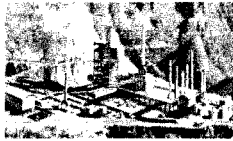
Winter 1983

# THIS ISSUE



**On the cover:** Sunny skies in shale country hint of spring days soon to come.

SHALE COUNTRY updates industry's shale activities (p. 2-5), reviews oil shale basics (p. 6-9), checks up on environmental questions (p. 15-17), and stops by several shale area communities (p. 18-20).



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# SHALE COUNTRY

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## Glancing at the Shale Montage

"The more things change, the more they remain the same." In 1983, this adage seems especially apt in relation to oil shale development. For more than 100 years shale has gone through an on-again, off-again cycle, primarily because of money—it's expensive to remove the oil from that rock.

In 1981, when SHALE COUNTRY was reactivated (the magazine was first published in 1975 and 1976 until shale activities slowed down), the climate for development seemed on target—technology had improved and Presidential and Congressional support for synfuels had spurred activities on several projects. In fact, while some people were hoping shale's time had finally come, others were fearing a rush to development.

Just one year later, the mood was much less optimistic. The political administration had changed along with budgets and policies. Not only were politics changing, but economics were also once again coming to the forefront as the nation marched toward recession. Near the end of 1981 and the beginning of 1982, several projects—such as Cathedral Bluffs and Multi Mineral—were slowing activities, citing high costs as the reason. Last May, Exxon announced it would phase down the Colony Shale Oil Project, also citing economics.

But this time around, despite the same cyclical pattern, there's a new twist to the shale story. Although shale development may be temporarily ailing, the prognosis is promising. Perhaps because shale's history is now so long, the small steps taken forward in the past are slowly beginning to catch up to the steps taken backward. For while many companies are re-evaluating

## Looking Ahead

development approaches, rescheduling timetables and intensifying research, few are dropping out of the game altogether.

Also, shale development cannot be stereotyped. Each project and its problems are as unique and complex as the site-specific characteristics of its own land. For instance, in March 1982 a court injunction, involving ownership questions on Utah federal tracts U-a/U-b was lifted, and White River is now proceeding with mine development.

In Colorado, Rio Blanco (tract C-a), went into suspension last August because it needed Congressional legislation allowing it to lease off-tract land for waste disposal. But in December, an amendment allowing the additional lease was passed. While the legislation does not mean construction will start tomorrow (Rio Blanco first needs to acquire the land and then re-examine project economics), it does remove at least one hurdle that has been blocking C-a's development. Also in Colorado, another chapter in shale history promises to unfold as Union Oil Company proceeds with plans to be in commercial production by the second half of this year.

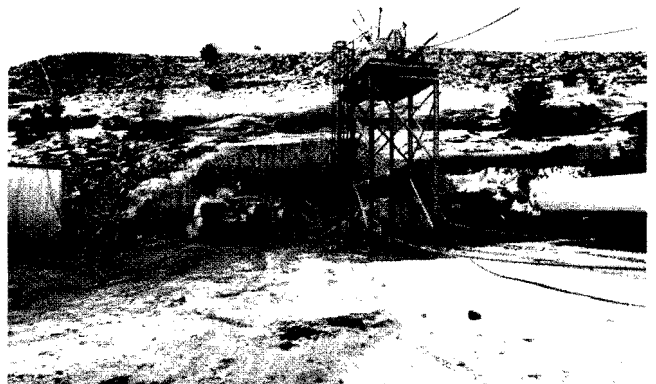
An indication of industry's commitment to shale development is the continuation of SHALE COUNTRY. To reflect the decrease in activity, in 1983, the magazine will be published less frequently—four times a year rather than seven. Nevertheless, the Oil Shale Committee of the Rocky Mountain Oil and Gas Assn. is continuing to sponsor the magazine as a public information ser-

vice because despite the slowdown, it recognizes that area residents are still being affected by shale and still have a need to know about industry activities.

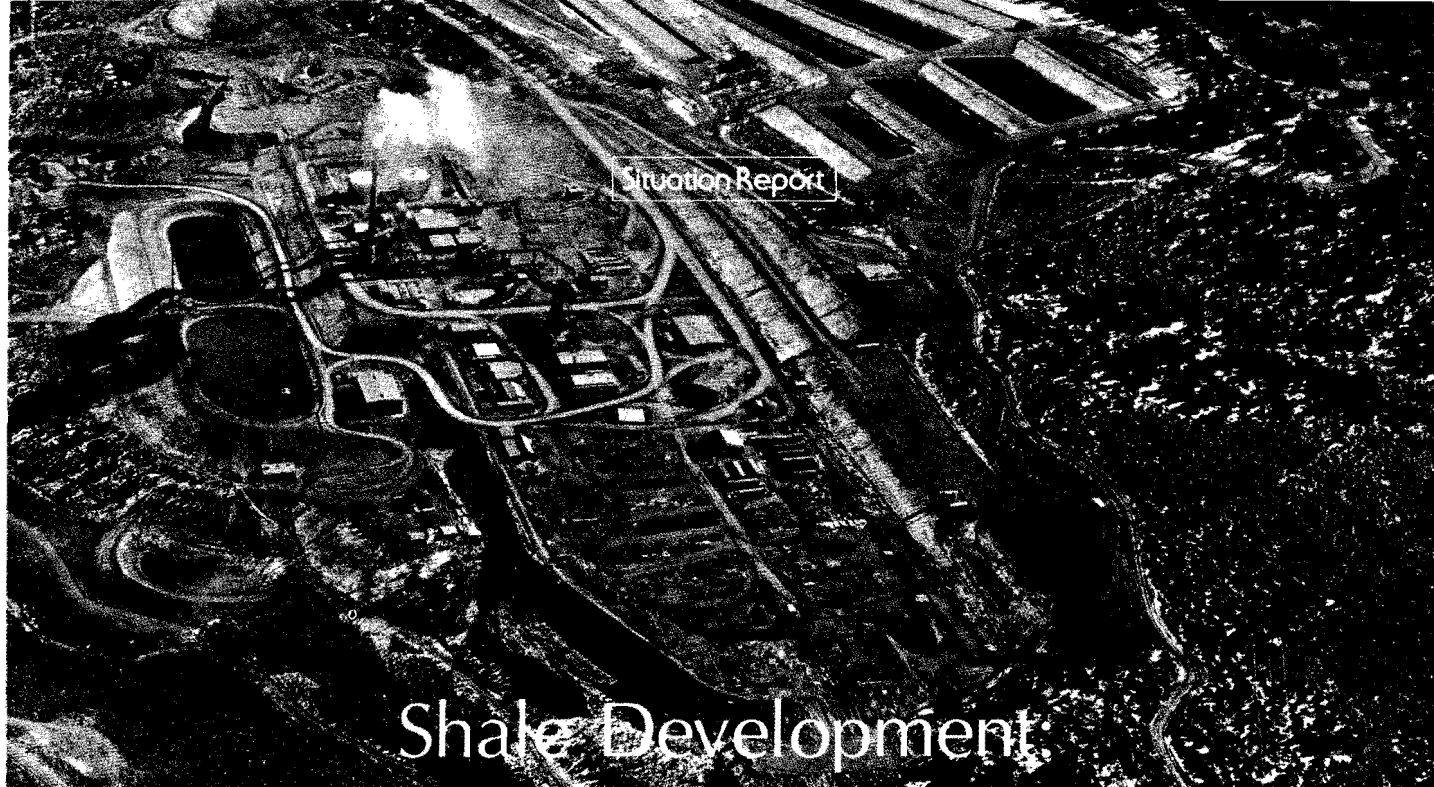
What will the shale story be in 1983? For starters, SHALE COUNTRY intends to cover which projects are moving ahead, what research is being done, which projects are on hold.... There's still a maze of documents, persons and programs that need to be translated into an easily understandable picture... environmental concerns have not disappeared and neither have technological problems. But possibly the most important story of all is how shale area residents are dealing with the changes taking place.

The first issue of 1983 is our annual review issue, and it updates topics we've covered during the past year, including the oil shale directory. It also provides an overview of shale history, environment and technology. In addition, it examines the status of various projects, as well as some communities—how have the towns in shale country fared through the ups and downs of 1982?

With this issue, people who are new to shale can brush up on basics, and those who are familiar with the subject can take a quick refresher course. In other issues we'll go back to covering these topics in more depth. In the meantime, please let us hear from you. We want to be sure we're covering topics you want to know about, talking to people you want to hear from—and for that we need your help. KC □



**Mine portal decline** (slanted shaft tunnel) currently under construction at the White River Shale Project in Utah.



## Yet More Revisions in the Script

By Kathy Callahan

One of the first things a student of shale development's history learns is that the plot is rife with starts and stops. For more than 100 years, every time the fledgling industry is ready to get up and get going, events, usually in the form of economics, push it back down.

By the early 1970s, for example, it appeared that oil shale development truly was about to become a reality. The oil embargo and OPEC price increases underscored the risk of relying on foreign imports. Technology had improved and in 1974, the U.S. Interior Dept.'s (DOI) Federal Prototype Oil Shale Leasing Program gathered momentum. But by 1976 the scene had changed. The energy crisis abated, oil prices were rising at a slower pace than they had been, inflation was rampant... and shale development went into hibernation.

Then came the 1980s. The Carter Administration was supporting synfuels, the U.S. Dept. of Energy (DOE) was supplying research funding and DOI intended to lease more lands under the prototype program. But by the end of 1981 the country's economy was seriously ailing, the Reagan Administration was altering budget allocations and policies, and several shale proj-

ects, such as Cathedral Bluffs and Rio Blanco, began slowing activities. In May 1982, Exxon announced it was phasing down the Colony Shale Oil Project near Parachute, CO, and many thought oil shale would once again be relegated to the back burner.

But as 1983 rolls in, although many projects are slowing down or being reassessed, others are moving ahead and yet others are temporarily concentrating efforts on research. And this time around an entirely new scene has been written into the shale script—Union Oil Company of California expects to produce shale oil commercially during the latter part of the year.

### The federal tracts inch forward

Last year some technological decisions were made and some legal questions were resolved that seem to be removing barriers to development on the federal tracts.

**Colorado tract C-a:** When the federal leasing program got underway in 1974, the first least issued was for this 5,100-acre tract southeast of Rangely, CO. Acquired by Gulf Oil Corp. and Standard Oil Co. (Indiana), the joint venture is now known as the Rio Blanco Oil Shale Co. Rio Blanco spent the next 2 years putting together its Detailed

Development Plan (DDP)—a document that outlines how shale oil will be developed and how the environment will be protected—and, in March 1976, submitted the DDP to Interior.

Later the same year, though, Rio Blanco asked for and was granted a 1-year suspension of its lease. The company had planned to use open-pit mining and surface retorting (an above-ground method of heating shale to extract the oil), which requires an off-tract site for waste disposal. Interior found, however, that it did not have clear-cut authority to lease additional land. Also, although there was no on-site development taking place, natural background levels for air-quality standards did not meet federal requirements.

Air standards were later clarified, and the following year Rio Blanco submitted a revised DDP to Interior, which called for a modified in-situ (MIS) demonstration program. (In-situ is an in-place underground retorting method.) In October 1980, the company ignited its first MIS retort and a second was ignited in June 1981, for a combined yield of 26,320 barrels of shale oil. Although the demonstration was deemed technically successful, feasibility studies still indicated that open-pit mining

**Rio Blanco's modified in-situ demonstration program produced more than 26,000 barrels of shale oil.**

and surface retorting would offer greater economic and resource-recovery advantages than MIS.

Thus, in August 1982, Rio Blanco was granted another temporary lease suspension to allow time for legislative consideration of off-tract disposal. Last December Congress adopted an amendment, signed into law by President Reagan, giving the Interior the authority to lease 6,400 off-tract acres to Rio Blanco.

Estimates are that it will be at least 1-2 years before Rio Blanco actually obtains the additional land, at which time tract C-a's lease suspension will automatically end. In the meantime, during suspension, Rio Blanco will maintain the facilities on the tract, continue environmental monitoring and proceed with an internal research and development program at Standard's Naper-ville, IL, and Gulf's Harmarville, PA, facilities. Construction of a 1- to 5-ton-per-day Lurgi pilot retort at Harmarville is almost completed and operations are expected to begin this year.

Although the recently passed legislation removes a huge stumbling block in the road to C-a's development, a commercial decision will still depend on economic considerations and information obtained from Rio Blanco's pilot-plant test runs and research and development program.

**Colorado tract C-b:** When C-b, a 5,094-acre tract southwest of Piceance Creek in Colorado was leased in 1974, it was awarded to a group composed of Ashland Oil, Atlantic Richfield, Shell Oil and Tosco Corp. Tract ownership changed several times until 1979, when Occidental Oil Shale, Inc., and Tenneco Shale Oil Co. became equal partners in the venture and renamed it Cathedral Bluffs Shale Oil Co.

C-b also requested a 1-year suspension of its lease in 1976 because of air-quality questions and because it found that the tract's shale characteristics made the originally proposed mining methods unworkable. In 1977, a revised DDP was submitted to Interior, which called for use of Oxy's modified in-situ retorting process. Shaft-

sinking began in 1979 and three shafts were completed by the end of 1982. In December 1981, however, Cathedral Bluffs announced a delay in development while it re-evaluated the project's design.

Almost exactly 1 year later, in December 1982, Cathedral Bluffs announced it had decided to take a modular approach to development, which would now include above-ground retorting combined with modified in-situ. Then, in January, Cathedral Bluffs submitted a request for funding to the U.S. Synthetic Fuels Corp. (a quasi-governmental agency designed to spur private synfuels development). Whether or not the project proceeds will depend on the response Cathedral Bluffs receives from the Synfuels Corp. Should the response be favorable, production would begin in 1988 for an estimated 13,500 barrels of shale oil per day.

**Utah tracts U-a/bU-b:** The White River Shale Oil Corp., which consists of Phillips Petroleum Co., Sohio Shale Oil Co. and Sunoco Energy Development Co., is developing these two tracts jointly. Located southeast of Vernal, UT, the combined tracts total 10,240 acres. Like its Colorado prototype counterparts, White River also asked for lease suspensions in 1976. Just as in Colorado, White River discovered that air-quality requirements were not being met although no on-site development was underway.

Unlike Colorado, however, legal questions regarding ownership of U-a/U-b arose, which left the tracts in suspension for almost 6 years. These questions have now been largely resolved, and in March 1982 a court injunction was lifted and White River began to move ahead.

Plans for the project include staged development in three phases. Phase I is expected to produce 15,000 barrels of oil a day by the end of 1989, Phase II will bring production to 57,000 barrels by 1993, and full commercial production of approximately 106,000 barrels of oil per day is expected by 1996. The construction work force will peak at approximately 4,037 employees in 1991, and the permanent work force will be about 3,353.

Site construction began last year. Tract access roads were completed, and a mine service building, which includes a mine

change room and office facilities is almost finished. Initial development work on the room-and-pillar mine was also started in 1982, and should be completed in late 1984. For the present, the bulk of the work on-site is expected to take place underground, and the work force will peak at about 150 during 1983. Presently, White River is considering using Union Oil Co.'s retorting technology.

### **Private projects exercise caution**

Despite slowdowns, most private ventures stayed on the shale scene during the past year—in one way or another. The following is a review of some key projects:

**Chevron Shale Oil Co.:** A subsidiary of Standard Oil Co. of California, Chevron, during a 10-year period starting in 1944, began acquiring shale properties in Garfield County, CO. Two properties totaling 43,000 acres make Chevron the largest private shale landholder in Colorado. During the early 1970s, Chevron conducted various lab studies on shale, and in 1979, began preplanning and environmental baseline studies for its Clear Creek property near De Beque. In December 1981, Conoco Shale Oil, Inc. joined Chevron as a 30-percent joint-venture owner in the project.

Current plans for the Clear Creek Shale Oil Project (CCSOP) include a combination of underground and open-pit mining, and adjacent surface-retorting and upgrading facilities. Presently, Chevron is constructing a 350-ton-per-day semiworks (large-scale research and development) Staged Turbulent Bed (STB) retort plant adjacent to its refinery near Salt Lake City, UT. Completion of the plant is expected by the end of 1983.

CCSOP will produce 100,000 barrels of oil per day, and will be built in phases, starting with a 10,000-barrel-per-day/25,000-ton-per-day retort. Construction of the first phase is expected to begin in 1985, after the semiworks plant has been successfully operated for 12-18 months. Full-scale commercial production is planned for the mid-1990s.

**Colony Shale Oil Project:** The Colony Project, located on private property 15 miles north of Parachute, CO, was formed in 1964 by Standard Oil of Ohio, Cleveland-Cliffs Iron Co. and the Tosco Corp. A semiworks retort and demonstration mine

were in operation on the site between 1965 and 1972, producing more than 180,000 barrels of shale oil. However, in 1974 Colony suspended operations because of rising costs.

By 1980 the project's ownership had changed hands several times, and that August it changed once again. Exxon Corporation purchased Atlantic Richfield's 60-percent share of the project, and formed a joint operation with Tosco's subsidiary, The Oil Shale Corp.

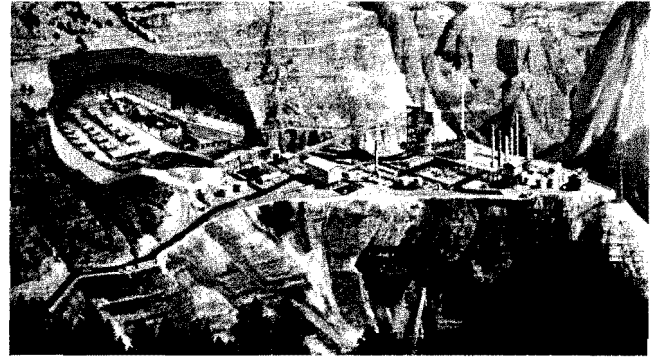
Preparations began immediately for the commercial facility, which would use the TOSCO II retorting technology. Major contracts were awarded for engineering design and construction of the mine, plant and upgrading facilities. The plan was to produce about 45,000 barrels of upgraded shale oil per day by the mid-1980s. In May 1982, Exxon announced it would phase down Colony, and Tosco exercised its option requiring Exxon to purchase Tosco's interest in the project. At the time, the mine bench, access roads and site preparation were nearly completed and foundations for two dams were in the early construction phase; however, construction of above-ground facilities had not yet begun.

Exxon is retaining a work force on the Western Slope that is responsible for certain construction, maintenance and reclamation activities. Exxon will maintain and develop Battlement Mesa—a new community that was being built to accommodate growth—on a reduced scale. Activities will include completing certain community buildings and housing units that were under construction at the time of the announcement, and providing roads, utilities and other essential services.

**Equity Oil Co.:** Equity, which has a 1,000-acre private tract in Colorado's Piceance Creek Basin, is involved in a research program known as the BX In-Situ Oil Shale Project. Testing is being done through a cooperative agreement between Equity and the Dept. of Energy.

The project, in continuous operation from September 1979 through January 1982, was designed to test the feasibility of injecting super-heated steam into shale to extract the oil. By using this method, no mining is necessary because the steam heats the rock while it is still in place. From

**This drawing depicts** Union Oil Company's oil shale mine and retorting complex; the cutaway view on the left shows the interior of the room-and-pillar mine, including underground shops, warehouse and shale crushers.



January through the fall of 1982, hot-water-injection testing was continued in an attempt to maximize shale oil recovery. Project operations are now suspended while the process is being evaluated.

**Geokinetics, Inc.:** Formed in 1969, Geokinetics holds shale leases on 30,000 acres of land 70 miles south of Vernal, UT. The company has been testing its horizontal in-situ retorting techniques since May 1975. Three new retorts were blasted underground last year, bringing the total of test retorts to 28.

Geokinetics research and development program was completed at the end of 1982, and this year the company expects to secure a Synthetic Fuels Corp. support contract and move into commercial production at a rate of 1,000-barrels-per-day, at the same location as the test site.

In 1982 the company also completed a feasibility study for two other projects, a 4,000-barrel-per-day in-situ project, and a 16,000-barrel-per-day project using mining and surface retorting. In addition, last November Geokinetics was awarded a contract from the Dept. of Defense (DOD) to refine 82,000 barrels of crude shale oil into military jet fuel.

**Getty Oil Co.:** Owner of 21,000 acres of lands above Clear Creek Valley in Garfield County, CO, Getty has not yet decided whether or not to proceed with a shale-related project. Currently Getty is conducting market analyses, studying technologies and generalized mining plans, and obtaining environmental and permitting information.

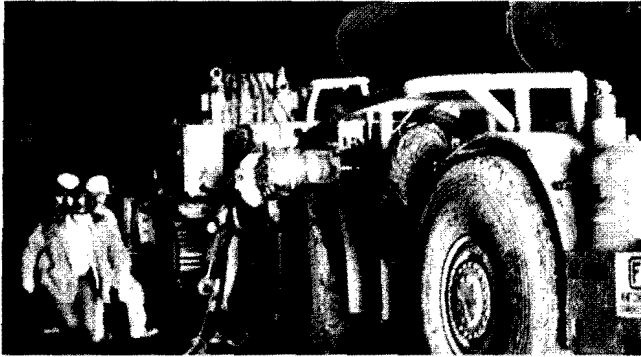
**Mobil Oil Corp.:** Mobil's work in shale dates back to World War II, when it built and operated a pilot retort at one of its

research laboratories. Mobil's shale activities near Parachute, CO, began in 1963, as it started acquiring 10,000 acres of private land in the Piceance Creek Basin. Mobil began planning for the Parachute Shale Oil Project in 1980, and by 1981 it had initiated environmental and socioeconomic baseline studies. Groundwater wells were drilled and tested and air- and water-monitoring stations were put into operation. Although final schedules for a commercial operation have not yet been determined, a production level of 100,000 barrels of shale oil per day is being considered for the late 1990s.

**Multi Mineral Corp.:** Formed in 1978, Multi Mineral was mining shale, not just for oil production, but also for nahcolite—a baking-soda-like substance used to remove sulfur from coal in electrical generating plants. Through a cooperative agreement with the U.S. Bureau of Mines and the U.S. Bureau of Land Management (BLM), Multi Mineral operated an experimental mine at Horse Draw in Colorado's Piceance Creek Basin until the beginning of 1982.

In 1981 it started construction of a research facility in Grand Junction, CO, which is now 85-percent completed. At the beginning of 1982, because of economic conditions, construction on the research facility was halted. The project is now on hold while the company investigates the possibility of finding investment partners.

**Occidental Oil Shale Co.:** Besides participating in the shale project on federal tract C-b, Oxy has also been conducting retort tests at Logan Wash near De Beque, CO. Logan Wash has been used as a research facility for Oxy's modified in-situ retort, and in January and February of 1982,



**A continuous mining machine at work deep inside the decline tunnel at White River. (The shale will be removed from this tunnel by conveyors.)**

retorts 7 and 8 were ignited. The two commercial-sized retorts operated simultaneously, producing approximately 196,000 barrels of oil during the test period. Research is now winding down, and activities at Logan Wash include retort monitoring and reclamation work.

**Paraho Development Corp.:** Paraho has been involved in shale research since the early 1970s, and it is working toward the commercial development of its process in both foreign and domestic arenas at facilities near Rifle, CO. Last year Paraho also completed detailed design and feasibility studies for the commercial-scale Paraho-Ute Shale Oil Facility near Vernal, UT; the studies were funded by DOE and 14 industry participants. In January 1983, Paraho reapplied to the Syntana Corp. for loan and price guarantees for the first phase of the project, which is expected to produce approximately 11,300 barrels of hydrotreated oil per day. Construction of the first phase is proposed to begin this year. Upon completion of the second phase in 1990, the project is expected to produce 39,500 barrels of hydrotreated oil per day.

**Phillips Petroleum Co.:** Besides its participation on the Utah federal tracts, Phillips also has leased oil shale land in Colorado's Piceance Creek Basin, known as the Mahogany Shale Project. Site exploration and off-site engineering studies are being conducted; however, specifics on plans for development have not yet been determined and commercial production will probably not take place before the early 1990s.

**Sohio Shale Oil Co.:** Sohio, a subsidiary of Standard Oil (Ohio), besides being involved with federal tracts in Utah, is also part of a joint venture called the Pacific

Shale Project. The project, which consists of approximately 12,800 acres of private land, is located in Garfield County, CO, 45 miles northeast of Grand Junction. The Cleveland-Cliffs Iron Co. and Superior Oil Co. are the other members of the venture.

Currently a feasibility study is being conducted to develop preliminary plans and to determine estimates and economics for a 50,000-barrel-a-day facility. The results of this study will be completed in the first quarter of 1983.

**Syntana-Utah:** Syntana is a joint-venture partnership of Quintana Minerals Corp. (operator), Synthetic Oils Corp. of Oklahoma City and Magic Circle Energy Corp. The project is located on 8,000 acres in Utah near the Colorado border.

The initial phase of the project would be a 16,500-barrel-a-day shale facility to be completed in the late 1980s, with plans to expand to 50,000 barrels a day later. To achieve the larger capacity, however, its leases on state lands at Bonanza must be consolidated into a continuous, mineable block; thus, Syntana has asked the state of Utah and the Dept. of Interior to consider a proposal involving the exchange of state for federal lands. Syntana has also applied for PSD (air-quality) and mining permits.

**Texaco, Inc.:** Texaco, in conjunction with Raytheon Co., and Raytheon's subsidiary, The Badger Co., Inc., is testing a true in-situ retorting process, using radio-frequency electric fields to heat the shale. The process involves lowering a heating and pumping unit into a vertical drill hole to heat the shale, and the same bore hole is used to pump the oil to the surface. Field tests have been conducted on Texaco's property, south of Vernal, UT.

#### **Union Oil Company of California:**

Union is forging ahead with the finishing touches of Phase I of its Parachute Creek Shale Oil Program; mining equipment is arriving at the site and mine-supervisors' training is being conducted. This August, the project will be mechanically completed, and Union will be producing 10,000 barrels of shale oil per day in late 1983—the first commercial shale oil project in the United States.

Considered one of the shale industry's pioneers, Union began acquiring property north of the town of Parachute, CO, back in the 1920s. Currently, the company has a 30,000-acre block of property that contains 20,000 acres of shale lands and 10,000 acres of valley lands, portions of which will be used for plant facilities and pipelines.

Since the early 1940s, Union has been conducting a wide variety of oil shale research and at that time it began developing its own retorting process in a lab at its Los Angeles refinery. From 1955-1958, Union constructed and operated a semi-works retorting facility on its Colorado property, which produced 800 barrels of oil per day. The low price of crude oil forced Union to suspend actual development, but research efforts on its own retorting process continued.

Permitting for Phase I of the project began in March 1978 and all federal, state and local permits were in hand about 3 years later. Road work started in fall 1980 and predevelopment operations on a room-and-pillar mine began in January 1981. The peak construction work force was more than 2,500 and approximately 550 workers will operate the facility.

For the first phase of its project, Union has a 10-year contract with the Dept. of Energy to supply 3,000 barrels per day of jet fuel and 7,000 barrels a day of diesel to the Dept. of Defense. The price at time of delivery to DOD will be either the market price or the contract floor price. If the market price is below \$42.50 a barrel indexed to inflation, Union will receive a payment from DOE to equal the difference. After Phase I of the project is completed and in successful operation, Union will assess the economics of Phase II, which will bring production to 90,000 barrels of oil per day by 1994. □

# Shale Country— Past to Present

By Nancy L. Sullivan

Millions of years ago as the earth cooled, buckled and mountain ranges and oceans emerged from the cosmic gloom, vast deposits of energy-rich minerals formed in the earth's crust. Just as enormous pools of oil were brewing beneath the African deserts and the East Texas range lands, so rich bodies of oil shale were being created in the Green River geologic formation under the Rocky Mountains of Colorado, Utah and Wyoming.

Western oil shale is not actually oil in the sense that most of us think of—rather it is the rock marlstone, which contains a thick, rubbery substance called kerogen. When heated, kerogen breaks down to form shale oil. But like other fossil fuels, such as a coal and crude petroleum, kerogen began life as microscopic plants and animals that became trapped in shallow waters, layer upon layer, over millions of years. The incubators for this process in the Rockies were two prehistoric fresh-water lakes—Lake Gosiute, which covered Southern Wyoming, and Lake Uinta, covering Colorado and Utah. As the Rocky Mountains emerged these lakes were cut off from fresh sources of water and became stagnant, mixing the plant and animal life settling on the lake bottoms with sand, clay, volcanic ash and rock. As this ooze was pressed and heated, it became marlstone and kerogen.

Today, the Green River Formation underlies about 17,000 sq. mi. (11 million acres) of Colorado, Utah and Wyoming. It is estimated that the Formation contains about 2-trillion barrels of oil—an amount that far overshadows the Middle East oil fields. If one-third of the resource is recoverable, an estimated 610 billion barrels of shale oil

might be produced (from shale that yields 15 gallons per ton of rock). Currently, the richer mineable shales hold about 139 billion barrels of oil (with a ton of oil shale yielding 30 gallons of oil or more). About 80 percent of this reserve is located in the Piceance Creek Basin, a 1380-sq.-mi. area in Garfield and Rio Blanco counties in Colorado.

## From the Ohio River to Teapot Dome

Although the Western United States holds the world's largest oil shale deposits, the mineral is not unique to this continent. In 1350 Austria produced medicinal oil from oil shale, and in 1694 the English government patented a process to distill shale oil. Before 1900, Australia, Brazil, Canada, France, New Zealand and Scotland all had produced oil from oil shale. Today, the Soviet Union and China both have oil shale operations.

American experiments with oil shale began with the Ute Indians who called it "the rock that burns." In the early 1800s Appalachian shale was converted to lamp oils and medicine, and at mid-century an oil shale plant on the Ohio River actually went into operation. The shale oil business might have taken off at that point if Col. E.L. Drake hadn't struck oil at Titusville, PA, in 1859.

This pattern of inexpensive crude oil thwarting oil shale development was to repeat itself as the 20th century got underway. In 1915 it looked as if oil shale might again take off when the U.S. Geological Survey reported that 20-million barrels of oil were sitting under the Rocky Mountains. The oil shale land rush was on, and more

than 30,000 oil shale claims and nearly 200 corporations were formed before 1920. The boom ended when wildcatters hit the enormously profitable East Texas and Oklahoma oil fields.

The oil shale picture also altered drastically in 1920 as the result of a change in the law. Up until that time, individuals could file oil shale claims on the mineral rights under the Mining Act of 1872. Many did so, and these mining claims make up most of today's private shale holdings. But in 1920 Congress passed the Mineral Leasing Act and restricted ownership of oil shale lands to the federal government. The public, however, could lease federal land for the purpose of mining and processing oil shale. This change was an important one, because about 72 percent of the land overlying 80 percent of the shale in the Green River Formation is controlled by the U.S. Dept. of the Interior (DOI). Since this area of federally owned land also contains most of the thickest and richest deposits of oil shale, development of the industry has always been dependent on the hand of the federal government.

Leasing was permitted at the discretion of the Secretary of the Interior and under the Harding Administration Secretary Albert Fall was accused of taking bribes in return for noncompetitive leasing of Naval Petroleum Reserve No. 3—the Teapot Dome field in Wyoming. The backlash to what became known as the Teapot Dome Scandal was an Executive Order in 1930 under President Hoover that temporarily removed oil shale lands from the leasing process. It wasn't until 1952 that President Truman authorized the Secretary of the

Interior to accept leasing bids on oil shale lands once again.

Leasing was hampered, however, by a reluctance on the part of the Interior Dept. to take advantage of a situation that had once ended in scandal and also by uncertainty over the validity of mining claims on the land filed before 1920. But probably the most important factor holding back oil shale production was once again economic—foreign supplies of crude were plentiful and cheap during the 1950s and 1960s.

### Leasing comes out of limbo

During the 1960s, however, Congressional delegates from the states of Colorado, Wyoming and Utah continued to push for an active oil shale policy on the part of the federal government, claiming development of indigenous energy sources was in the national interest and would provide economic benefits to state and federal governments in the form of taxes.

The result was the 1968 lease offering program under Interior Secretary Stewart Udall. Three Colorado lease tracts were offered to private industry; however, no acceptable bids were received and the program ended. Private industry backed off because the lease requirements restricted activities to research and development (R&D) on small areas of the tracts, and because there was no commitment by the federal government to allow subsequent commercial operations on a tract, once the R&D stage was completed. Again, cheap foreign crude was also a critical factor in discouraging the development of synthetic fuels, as much as the drawbacks in the leasing program itself.

The 1968 leasing attempt did set the stage, however, for Federal Prototype Oil Shale Leasing Program in 1974. Under Interior Secretaries Walter Hickel and Rogers Morton, this second program was established with four objectives: to provide the nation with a new source of energy; to ensure the environmental integrity of affected areas; to permit an equitable return to all parties involved in commercial development of shale oil; and to develop government expertise in leasing and supervising oil shale activities.

The program was helped tremendously at this time by the sudden, rapid increase in

the cost of foreign crude supplies, and in 1974 six tracts were offered for bid in Wyoming, Utah and Colorado with the goal of encouraging development on each tract of significantly different mining and processing technologies. It was projected that commercial-scale production of about 250,000 barrels per day would be achieved by 1980. Private industry committed capital to four of the tracts—two in Colorado and two in Utah. (The Wyoming tracts were passed up primarily because their low-grade shale promised little economic return.)

### Mixed tract record

Although the leasing part of the program was successful, the overall reviews for the program's ability to meet its objectives have been mixed. Despite the tripling of world oil prices in the mid-1970s, which seemed to guarantee shale oil would be able to compete economically, rapidly rising plant construction costs, environmental concerns, legal issues, and technological difficulties have since presented unexpected delays.

On Colorado's tract C-a, for example, problems with the original plans for open-pit mining have halted development. Rio

Blanco Oil Shale Co., the operating company on the tract, initially intended to use open-pit mining, a process that would yield more than two times the shale oil recovery as a modified in-situ process (in-situ is in-place extraction of oil from shale). To be effective, though, open-pit mining depended on off-tract disposal of processed shale and temporary storage of overburden (soil and rock that overlie the shale). Assured by Interior Dept. officials that DOI had the authority to grant the necessary off-tract disposal sites, the company planned its operations for this method.

But when the Secretary of the Interior sought Congressional legislation to clarify DOI's authority to grant the sites, the issue met considerable opposition in Congress and DOI denied Rio Blanco's application in 1975. In addition, efforts to resolve possible conflicts with federal air-quality standards also slowed down C-a's operation, and in 1976 Rio Blanco asked for a 1-year suspension of its lease terms.

Since then, the company has tested a modified in-situ (MIS) process on the tract. However, technical and economic analyses still indicate that open-pit mining provides greater resource recovery. Thus, in August 1982, tract C-a asked for temporary suspen-

### Shale Glossary

**Backfill**—The process of refilling an excavation. This term can also refer to the material that is used to refill the excavation.

**In-situ**—In the natural or original position; in-situ retorting refers to retorting processes used in place or below the surface.

**Modified in-situ**—A process that uses a combination of underground mining and below-surface retorting.

**Oil shale (Western)**—Sedimentary rock (marlstone) containing insoluble organic matter (kerogen), which can be converted into liquid fuels by heating.

**Open-pit mining**—A mining method designed to extract minerals that occur relatively near the earth's surface from an open excavation. Waste materials overlying the resource must be removed before the mineral can be mined.

**Overburden**—Rock and soil overlying a geologic deposit that must be removed before the resource can be mined.

**Patent**—A term used to describe the official

document that conveys land rights from the federal government to an individual.

**Processed shale**—Shale residue that remains after shale oil has been removed. Sometimes called spent shale.

**Reserves**—Resources with known location quantity and quality, which are economically recoverable through present technology.

**Resources**—The total quantity of minerals in the ground, as defined within specified limits.

**Retorting**—The process of heating shale to remove the oil contained in the rock.

**Room-and-pillar mining**—An underground mining technology whereby shale removal creates a series of rooms with pillars of rock left standing between to support the ceiling.

**Spent shale**—See processed shale.

**Synthetic fuel**—Any liquid or gaseous hydrocarbon fuel that can be used or substituted for petroleum or natural gas or their products, which is produced by the chemical or physical transformation of coal, shale, tar sands or plant matter.

sion of lease terms pending further legislative consideration of off-tract disposal sites. Last December, Congress adopted an amendment to the 1920 Mineral Leasing Act that allows Rio Blanco to acquire an off-tract lease. Although President Reagan signed the bill into law at the end of the year, the process of obtaining the land is expected to take another 1-2 years.

On tract C-b, operating companies ran into early technological problems with the proposed room-and-pillar mining method, as well as with the same possible violation of federal air-quality standards faced by Rio Blanco. Suspension of the lease terms was also requested on tract C-b in 1976. A revised development plan calling for modified in-situ technology was approved by Interior in 1977, and shaft sinking began 2 years later. However, tract activity again halted in late 1981, while Cathedral Bluffs Shale Oil Co., the current developer, began reassessing project feasibility. At the end of 1982, Cathedral Bluffs announced plans to proceed with development in 1984, using a combination of technologies.

In Utah, air-quality standards were also a complicating issue in the development of

tracts U-a and U-b (the White River Shale Project). But a more crippling problem was a series of legal questions about who really owned the federally leased land—the Ute Indians, the federal government, the state of Utah or individuals who had staked claims prior to 1920. As a result, the operating companies requested a suspension of lease terms in 1977. A subsequent court order prohibited development of the tracts until the various legal questions could be resolved.

Last March, however, field activities beyond environmental monitoring began at the tracts when the court injunction was lifted. Presently, the White River Corp. is going ahead with the initial stages of development.

### **New plans and programs for federal lands**

Currently, the Interior Dept. has directed the Bureau of Land Management (BLM) to consider offering additional tracts in Colorado for leasing under the prototype program. An Environmental Impact Statement (EIS) is being prepared to supplement the original EIS filed in 1973. Interior officials

anticipate two tracts could be offered for leasing in the first part of 1983 should the Secretary of the Interior decide the information in the EIS warrants opening new leases.

In addition, BLM is also planning a separate program for the overall development of federal oil shale reserves, which involves a new leasing and management program as well as federal oil shale leasing regulations. As part of the process, BLM is preparing an EIS that will provide information to the Secretary of the Interior and the public on possible environmental impacts; on the role of federal leasing in oil shale development; on alternative programs and on the possible impacts of permanent federal oil shale regulations. At this time, BLM estimates the final EIS (with public comments) will be completed by spring of 1983. Oil shale regulations could be effective by mid-1983, depending on the decision of the Secretary of the Interior.

So although oil shale development is currently in one of its frequent holding patterns, both the government and private industry are preparing for the future—a future they anticipate will one day see the commercial production of shale oil. □

## **Shale Processing Techniques**

Once the oil shale is mined, it must be crushed into smaller fragments, then heated to a very high temperature—or retorted—to separate the oil from the rock. Retorting can be done on the surface in metal vessels or in underground chambers. Although there are more than 3,000 patents related to oil shale recovery and processing, only a few are considered applicable to Western U.S. shales. Some of the best-known technologies are:

—**Bureau of Mines Retort:** Authorized in 1944, this retort, later built at Anvil Points near Rifle, CO, set precedents for technological developments up to that date. Crushed shale moves down the vertical, kiln-like vessel by gravity, and hot, recycled gases move up from the bottom. The combustion of gases and some carbon from the processed shale results in rising hot gases that heat the raw shale to retorting temperature. The oil vapor and gases rise to the top of the retort and are removed.

—**Circular Grate method:** This method can process oil shale containing dawsonite, and when extracting the oil produces a

soluble form of aluminum. The circular grate rotates inside a retort shaped like a giant doughnut and carries shale through several processing zones in the retort.

—**Paraho retort:** This is a vertical, steel vessel, in which lumps of shale, 3 inches and smaller in size, enter at the top of the kiln and descend by gravity against hot rising gases. The shale vapors rise to the top of the retort for removal, and the processed shale cools and leaves through a moving grate in the bottom.

—**Lurgi-Ruhrgas process:** With this method, the spent shale is the heat-transfer medium. A circulating stream of hot spent shale ash is mixed with unretorted shale in a horizontal screw mixer.

—**TOSCO II retort:** This retort is not a gas-combustion process but rather a rotary-type retort that uses hot ceramic balls to transfer heat to the shale. The balls are separated from the spent shale, reheated and recycled.

—**Union Oil retort:** The Union upflow retort features a rock pump with a 10-foot-diameter piston. It moves crushed oil shale upward

into the retort where crude shale oil is produced in both gaseous and liquid form. Heated gases enter at the top of the retort and flow down. Shale oil is taken from the bottom of the retort.

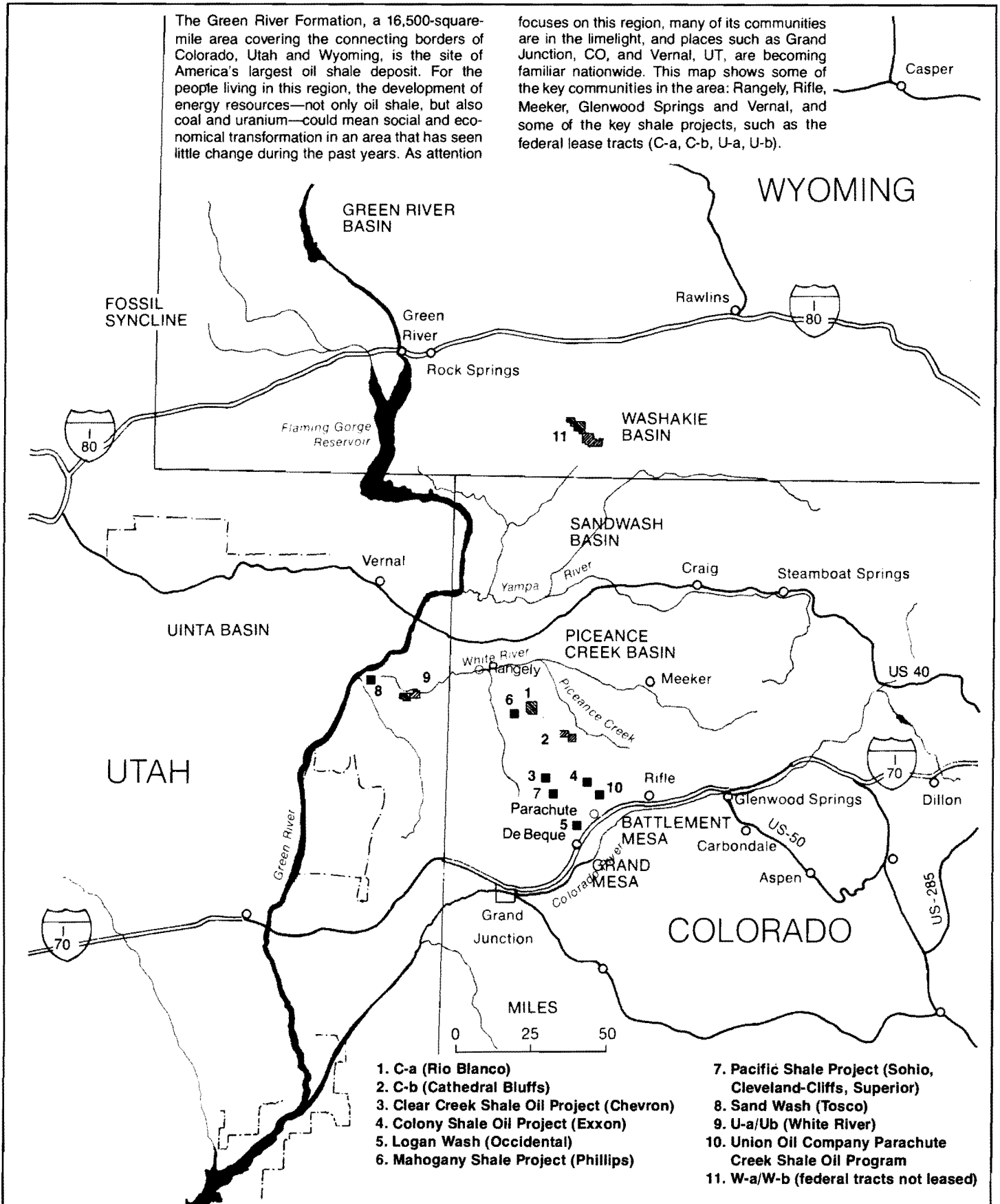
—**In-situ processes:** True in-situ, or in-place retorting, is conducted totally underground and requires no mining. Boreholes are drilled into the deposits, so the shale can be fractured into small fragments underground. The oil and gas are produced by various means depending on the retorting technique. In some processes, combustion takes place, in others, super-heated steam or microwaves heat the structure to retorting temperature. Oil and gas then flow through fractures in the deposit.

—**Modified in-situ (MIS) processes:** Modified in-situ combines mining and true in-situ processing. One technique is to create voids by removing a portion of the shale and hauling it to the surface for above-ground retorting. When an adequate void has been created, explosives are used to fracture the remaining oil shale, which is retorted (underground).

# Shale Country

The Green River Formation, a 16,500-square-mile area covering the connecting borders of Colorado, Utah and Wyoming, is the site of America's largest oil shale deposit. For the people living in this region, the development of energy resources—not only oil shale, but also coal and uranium—could mean social and economical transformation in an area that has seen little change during the past years. As attention

focuses on this region, many of its communities are in the limelight, and places such as Grand Junction, CO, and Vernal, UT, are becoming familiar nationwide. This map shows some of the key communities in the area: Rangely, Rifle, Meeker, Glenwood Springs and Vernal, and some of the key shale projects, such as the federal lease tracts (C-a, C-b, U-a, U-b).



- 1. C-a (Rio Blanco)
- 2. C-b (Cathedral Bluffs)
- 3. Clear Creek Shale Oil Project (Chevron)
- 4. Colony Shale Oil Project (Exxon)
- 5. Logan Wash (Occidental)
- 6. Mahogany Shale Project (Phillips)
- 7. Pacific Shale Project (Sohio, Cleveland-Cliffs, Superior)
- 8. Sand Wash (Tosco)
- 9. U-a/U-b (White River)
- 10. Union Oil Company Parachute Creek Shale Oil Program
- 11. W-a/W-b (federal tracts not leased)

# Who's Who in Shale

These are some key companies and governmental agencies involved with developing oil shale. There are, of course, other groups making important contributions to this development, but the organizations noted are the names heard most often.

**Atlantic Richfield (ARCO)**—Owner of extensive oil shale lands in Western Colorado; formerly one of two participants in the Colony Shale Oil Project and a former lessee of federal tract C-b in Colorado. Public Information Office, 555 17th St., Denver, CO 80202, (303) 575-7000.

**Battlement Mesa, Inc. (BMI)**—A wholly owned subsidiary of Exxon Corporation. BMI is the developer of the new community, Battlement Mesa, near the town of Parachute, CO. Lars Larsen, Operations Manager, P.O. Box 308, Grand Junction, CO 81502 (303) 244-3900.

**C-a**—One of two federally leased oil shale tracts in Colorado. (See Rio Blanco Oil Shale Co.)

**C-b**—One of two federally leased oil shale tracts in Colorado. (See Cathedral Bluffs Shale Oil Co.)

**Cameron Engineers, Inc.**—See The Pace Co.

**Cathedral Bluffs Shale Oil Co.**—Project title for development of Colorado tract C-b. Lessees: Occidental Oil Shale, Inc. (Partner), Tenneco Shale Oil Co. (Partner). J.B. Phillips, President, Cathedral Bluffs, P.O. Box 2687, Grand Junction, CO 81502, (303) 244-3000.

**Chevron Shale Oil Co.**—A subsidiary of Standard Oil of California, Chevron is the largest owner of private oil shale lands in Colorado. Currently it is investigating the feasibility of building a commercial project on these lands. D.E. Hurst, General Manager, 1625 Broadway, Suite 2150, Denver, CO 80202, (303) 623-8282.

**Cleveland-Cliffs Iron Co.**—A company involved in the mining aspects of oil shale development. It acts as an engineering consultant to other companies and is part owner of private shale lands in Colorado. It also has a long-term lease with Sohio on

property in Utah. A commercial feasibility study is currently underway for the Pacific property near De Beque, CO, which Cliffs owns jointly with Sohio and Superior. The company has formed three subsidiaries, headquartered in Rifle, to take care of shale activities. R.M. DeGabriele, General Manager, Western Operations; Gary Aho, Oil Shale Manager, P.O. Box 1211, Rifle, CO 81650, (303) 625-2445.

**Cliffs Engineering, Inc.**—See Cleveland-Cliffs Iron Co.

**Cliffs Oil Shale Corp.**—See Cleveland-Cliffs Iron Co.

**Cliffs Synfuels Corp.**—See Cleveland-Cliffs Iron Co.

**Club 20**—A Western Colorado association of communities and businesses dedicated to economic stability and orderly economic development through education, promotion and political action. Bill Cleary, President, P.O. Box 550, Grand Junction, CO 81502, (303) 242-3264.

**Colony Shale Oil Project**—Formerly a joint development of Exxon Corporation and The Oil Shale Corp., a Tosco subsidiary; now owned solely by Exxon. Project activities are being phased down, with land reclamation and some construction activity continuing. G.D. Ortloff, Resident Manager, Colony Shale Oil Project, P.O. Box 308, Grand Junction, CO 81502, (303) 244-3900.

**Colorado Mining Assn.**—Trade association composed of companies and individuals engaged in various phases of the mineral industry. David R. Cole, President, 410 Denver Hilton Office Bldg., 1515 Cleveland Pl., Denver, CO 80202, (303) 534-1181.

**Colorado School of Mines Research Institute (CSMRI)**—An independent, not-for-profit corporation affiliated with the Colorado School of Mines; CSMRI has been conducting shale research for government and industry since 1949. Tom Sladek, Vice President, Energy Div., P.O. Box 112, Golden, CO 80402, (303) 279-2581.

**Conoco Shale Oil, Inc.**—A 30-percent

joint-venture owner with Chevron Shale Oil Co. in efforts to develop shale on the Clear Creek Project near De Beque, CO. Milford Lee, President, 555 17th St., Denver, CO 80202, (303) 575-6150.

**Denver Research Institute**—Branch of the University of Denver, consisting of scientists and engineers engaged in contract research for government and industry. DRI has been involved in oil shale research for more than 30 years. Kishor Galla, Research Chemist, 2390 S. York St., Denver, CO 80208, (303) 753-2911.

**Development Engineers, Inc. (DEI)**—A subsidiary of Paraho. Larry Lukens, President and Chief Executive Officer. (See Paraho Development Corp.)

**Equity Oil Co.**—Company currently involved in oil shale research and development in Colorado's Piceance Creek Basin. Paul M. Dougan, Secretary, 10 W. 3rd St., Salt Lake City, UT 84101, (801) 521-3515.

**Exxon Company, U.S.A.**—Operator of the Colony Shale Oil Project near Parachute, CO. A. Plante, Public Affairs Coordinator, Southwest Rocky Mountain Area, Exxon Company, U.S.A., P.O. Box 120, Denver, CO 80201, (303) 789-7550.

**Gary Energy Corp.**—Company with a refining facility in Fruita, CO. Gary will be processing 7,000 barrels per day of syn-crude from Union's Parachute Creek shale oil project when Union begins production later this year. Sally V. Allen, Vice President of Personnel and Administration, 115 Inverness Dr. E., Englewood, CO 80110, (303) 770-4710.

**Geokinetics, Inc.**—Recipient of a Program Opportunity Notice from the U.S. Dept. of Energy, for in-situ (in-place) research. It is currently testing its horizontal in-situ retorting process at its field test site 70 miles south of Vernal, UT. Mike Lekas, President, 391 Chepita Way, Suite D-2, Salt Lake City, UT 84108, (801) 583-0511.

**Getty Oil Co.**—Company that owns oil shale land in Colorado's Piceance Creek Basin. Currently conducting shale lab research. Mike Franco, Environmental Coordinator, 1670 Broadway, Suite 3100, Denver, CO 80202, (303) 861-7800.

**Gulf Oil Corp.**—One of two lessees of federal oil shale tract C-a in Colorado (Rio Blanco Oil Shale Co.). John F. Muirhead, Vice President/Project Manager, Rio Blanco Oil Shale Co., 2851 S. Parker Rd., Suite 500, Aurora, CO 80014, (303) 695-2400.

**Magic Circle Energy Corp.**—See Quintana Minerals Corp.

**Mobil Oil Corp.**—Company owning

land near Parachute, CO. Intends to begin construction on an oil shale facility in the late 1980s. R.H. Fischer, Oil Shale Engineering Manager, Mining and Coal Div., P.O. Box 17772, Denver, CO 80217, (303) 628-6388.

**Occidental Oil Shale, Inc.**—The oil shale division of Occidental Petroleum Corp., involved in a private oil shale venture called Logan Wash Operations near De Beque, CO, where it recently concluded investigation of its modified in-situ (in-place) retorting process, which has been ongoing since 1972. Also one of two lessees of federal tract C-b. Dr. Raymond L. Zahradnik, President and Chief Executive Officer; Marney Talbert, Vice President, Marketing/Public Relations, P.O. Box 2687, Grand Junction, CO 81502, (303) 244-3300.

**Paraho Development Corp.**—Company involved in testing its retorting technology on foreign and domestic shales at its facilities on private leased land west of Rifle, CO. Last year, Paraho completed a 30,000-barrel-a-day feasibility study for the Paraho-Ute Shale Oil Facility near Vernal, UT. Larry Lukens, President and Chief Executive Officer; Clint Engstrand, Chairman of the Board; Charles F. Metzger, Vice President for Marketing and Governmental Affairs, 183 Inverness Dr. W., Suite 300-A, Englewood, CO 80112, (303) 694-4949.

**Phillips Petroleum Co.**—One of the developers of federal tracts U-a and U-b in Utah, together known as the White River Shale Oil Project. Also has the Mahogany Shale Project in the northwest part of the Piceance Creek Basin. Fred Terry, Manager of Oil Shale/Tar Sands, 8055 E. Tufts Ave. Pkwy., Denver, CO 80237, (303) 850-3000.

**Quintana Minerals Corp.**—Operator of a joint-venture partnership shale project with Magic Circle Energy Corp. and Synthetic Oil Corp. of Oklahoma City. This venture is known as the Syntana-Utah Shale Oil Project, and it plans a 16,500-barrel-a-day plant east of Bonanza, UT. Project Director: R.E. Lee, Vice President, Synthetics, 601 Jefferson St., 40th Floor, Houston, TX 77002, (713) 651-8878.

**Rio Blanco Oil Shale Co.**—Project title for the development of federal tract C-a in Colorado. Lessees are Gulf Oil Corp. and Standard Oil (Indiana). Richard M. Lieber, President; John Muirhead, Vice President/Project Manager, 2851 S. Parker Rd., Suite 500, Aurora, CO 80014, (303) 695-2400.

**Rocky Mountain Oil and Gas Assn.**

**(RMOGA)**—Trade association with oil shale committee active in environmental, informational and planning efforts. Pam Oldham, Director, Committee on Oil Shale, 340 Petroleum Bldg., Denver, CO 80202, (303) 623-5988.

**Sandia National Laboratories**—Wholly owned subsidiary of Western Electric Corp. with funding from the U.S. Dept. of Energy for shale research. Works with private industry to research different processing techniques for oil shale extraction. Paul J. Hommert, Division Supervisor, In-Situ Processes Div., P.O. Box 5800, Albuquerque, NM 87185, (505) 844-6759.

**Skyline Oil Co.**—Major oil shale landowner in Utah, which leases land adjoining tracts U-a and U-b to Sohio Shale Oil Co. and Cleveland-Cliffs Iron Co. It is a wholly owned subsidiary of Texas Eastern Corp. Max. D. Eliason, Executive Vice President, 2000 University Club Bldg., Salt Lake City, UT 84111, (801) 521-3500.

**Sohio Shale Oil Co.**—Part of Standard Oil Co. (Ohio). One of the developers of Utah federal tracts U-a and U-b, together known as the White River Shale Oil Project. Also has various patented lands for oil shale development in Utah and Colorado, including 60-percent ownership of the Pacific Shale Project. T.F. LaMore, Manager of Shale Oil and Tar Sands, Crossroads Plaza Tower, 50 S. Main St., Suite 930, Salt Lake City, UT 84144, (801) 328-3700.

**Standard Oil (Indiana)**—Partner with Gulf Oil Corp. in Rio Blanco Oil Shale Co., the company that is developing Colorado federal tract C-a. Richard M. Lieber, President, Rio Blanco Oil Shale Co., 2851 S. Parker Rd., Suite 500, Aurora, CO 80014, (303) 695-2400.

**Sunoco Energy Development Co. (SUNEDCO)**—Subsidiary of Sun Co. One of the developers of federal tracts U-a and U-b in Utah, together known as the White River Shale Oil Project, Clyde V. Hornback, President, 12700 Park Central Pl., Suite 1500, Dallas, TX 75251, (214) 385-5000.

**Syntana-Utah Shale Oil Project**—See Quintana Minerals Corp.

**Synthetic Oil Corp. of Oklahoma City**—See Quintana Minerals Corp.

**Tenneco Shale Oil Co.**—Division of Tenneco Oil Co. and one of two lessees of Colorado federal tract C-b. N.H. McLaurin, Vice President; B.E. Dinger, Regulatory Affairs Manager, P.O. Box 2511, Houston, TX 77001, (713) 757-2131.

**Texaco, Inc.**—A company with land holdings in both Colorado and Utah. It has

completed in-situ retorting field tests in Uintah County, UT. John A. Masson, Jr., Public Affairs Coordinator, Rocky Mountain Area, 4601 S. Tamarac Pkwy., Denver, CO 80237, (303) 740-0900.

**The Oil Shale Corp.**—See Tosco Corp.

**The Pace Co. (Consultants & Engineers, Inc., Rocky Mountain Div.)**—Formerly Cameron Engineers, Inc., an engineering consulting firm specializing in synthetic fuels' enhanced oil and heavy oil recovery. Consultant for government and industry. F. Culberson, President; J.E. Sinor, Manager Engineering Services, 650 S. Cherry St., Suite 400, Denver, CO 80222, (303) 321-3919.

**The Superior Oil Co.**—Company engaged in testing retorting and mineral recovery processes on private shale lands in Colorado near Meeker. Also a 20-percent participant in the Pacific Project near De Beque, which is now undergoing a commercial feasibility study. John H. Knight, Manager, Oil Shale Div., 2750 S. Shoshone, Englewood, CO 80110, (303) 761-5853.

**Tosco Corp.**—Formerly a lessee of federal tract C-b in Colorado and a former participant in the Colony Shale Oil Project. Also a lessee of shale lands at the Sand Wash Project in Utah, which are being planned for development. Walt Klein, Vice President for Public Affairs, Tosco Corp., 1877 Broadway, Boulder, CO 80302, (303) 447-0550.

**U-a**—One of two federally leased shale tracts in Utah. (See White River Shale Oil Corp.).

**U-b**—One of two federally leased oil shale tracts in Utah. (See White River Shale Oil Corp.).

**Union Oil Company of California**—Company now constructing 10,000 barrel-per-day facility on property in Parachute Creek Basin, north of Parachute, CO. Union owns in fee 20,000 acres of oil shale properties and 10,000 acres of bottom lands. Construction underway on mine, commercial-sized Unishale B upflow retort and shale oil upgrading facility. Will begin producing 10,000 barrels per day of shale oil under an agreement with the Dept. of Energy in 1983. Permitting process underway to increase production to 90,000 barrels. John Hopkins, President, Union Energy Mining Div., Union Oil Center, Los Angeles, CA 90017, (213) 977-6437; Allen C. Randle, Vice President, Oil Shale Operations; J.S. Cloninger, Manager, Administrative Services, 2777 Crossroads Blvd., Suite 100, Grand Junction, CO 81501, (303) 243-0112.

**Utah Mining Assn.**—Trade association composed of companies and individuals engaged in various phases of the mineral industry. Jack E. Christensen, President, 825 Kearns Bldg., 136 S. Main, Salt Lake City, UT 84101, (801) 364-1874.

**White River Shale Oil Corp.**—Operator of federal tracts U-a and U-b in Utah, which are being developed on a cooperative basis as the White River Shale Project. Rees C. Madsen, Vice President of Administration; Jack R. Lyman, Director of External Affairs, Prudential Bldg., 115 S. Main St., Suite 500, Salt Lake City, UT 84111, (801) 363-1170.

**Wyoming Mining Assn.**—Trade association of individuals and companies engaged in various phases of the mineral industry. William H. Budd, Jr., Executive Vice President, Hitching Post Inn, P.O. Box 866, Cheyenne, WY 82003, (307) 635-0331.

## Key Governmental Agencies

**Associated Governments of Northwest Colorado**—Formerly the Colorado West Area Council of Governments (COG). Legal grouping of local governments on Colorado's Western Slope, it includes city and county representatives from Garfield, Mesa, Moffat and Rio Blanco counties. Associated Governments monitors socio-economic impacts of energy development and helps local governments formulate policy positions on state and federal legislation. Jim Evans, Director, P.O. Box 351, Rifle, CO 81650, (303) 625-1723.

**Bureau of Land Management (U.S.)**—Division of U.S. Dept. of the Interior. Manages 60 percent of the country's federal lands and administers the federal law pertaining to these lands, including those relating to resources such as oil shale. Robert Leopold, Oil Shale Program Manager, 1037 20th St., Denver, CO 80202, (303) 837-4481.

**Bureau of Mines (U.S.)**—Agency in the U.S. Dept. of the Interior. The bureau performs research and provides information concerning the extraction, processing, use and disposal of minerals. Stephen Utter, Senior Staff Engineer, Denver Research Center, Denver Federal Center, Bldg. 20, Denver, CO 80225, (303) 234-3754.

**Bureau of Reclamation (U.S.)**—An agency within the U.S. Dept. of the Interior. Oversees the development of water and related land resources throughout 17 West-

ern states, including irrigation, hydro-electric power generation, municipal and industrial water supply, outdoor recreation, fish and wildlife enhancement and flood control. Glade Barney, Chief, Economics and Land Resources, P.O. Box 11568, Salt Lake City, UT 84147, (801) 524-5522.

**Colorado Dept. of Health**—State agency that deals with health and environmental health regulations related to oil shale; in particular, air quality, solid waste and water quality. John M. Clouse, Chief of Stationary Sources Control, Air Pollution Div., (303) 320-4180, Mary Cervera, Industrial Hygienist, Waste-Management Div., (303) 320-8333, 4210 E. 11th Ave., Denver, CO 80220. John Blair, District Engineer, 125 N. 8th, Suite 10, Grand Junction, CO 81501, (303) 245-2400.

**Colorado Dept. of Natural Resources**—State agency consisting of 11 divisions; many divisions have either regulatory or advisory roles related to oil shale development. Monte Pascoe, Executive Director; Office of the Executive Director, 1313 Sherman St., Room 718, Denver, CO 80203, (303) 866-3311.

**Colorado Energy Research Institute**—State agency, established by state statute through the Colorado School of Mines to coordinate research on Colorado's energy studies. Robert Case, Director, 3000 Youngfield, Suite 153, Lakewood, CO 80215, (303) 232-1906.

**Colorado Geological Survey**—Division of Colorado Dept. of Natural Resources; involved in many oil shale planning studies and also publishes reports on oil shale. John W. Rold, Director and State Geologist, 715 State Centennial Bldg., 1313 Sherman St., Denver, CO 80203, (303) 866-2611.

**Colorado Mined Land Reclamation Board and Division (Dept. of Natural Resources)**—This board is responsible for all decisions made under the Colorado Mined Land Reclamation Act of 1976; such decisions include rule-making, issuing permits, determining violations, setting and releasing bonds. The division acts as the board's staff by performing research, analysis and investigations, and makes recommendations to the board. Mined Land Reclamation, 1313 Sherman St., Room 423, Denver, CO 80203, (303) 866-3567.

**Colorado School of Mines**—State supported institution; sponsors annual shale

symposium and other seminars on shale. The school presently offers a special engineering program in shale oil: "Shale Oil: Its function, properties and utilization." John Welles, Vice President; Chuck Morris, Director, Public Relations, Golden CO 80401, (303) 273-3000.

**Colorado State University**—State institution involved in oil shale research, particularly in the area of revegetation. Edward F. Redente, Dept. of Range Science, Fort Collins, CO 80523, (303) 491-6677.

**Colorado Water Conservation Board**—Division of Dept. of Natural Resources. Studies problems concerning water supply, water use, water rights and water quality, including those related to oil shale development. J. William McDonald, Director, 823 State Centennial Bldg., 1313 Sherman St., Denver, CO 80203, (303) 866-3441.

**Colorado West Area Council of Governments (COG)**—See Associated Governments of Northwest Colorado.

**Cumulative Impacts Task Force (CITF)**—A non-profit corporation consisting of elected representatives and local jurisdictions in six Northwest Colorado counties, representatives of utilities, oil shale and coal companies, and shale government officials. Its purpose is to develop and maintain a set of computer models to evaluate economic/energy activities, demographics, expenditures and revenues, facility needs and fiscal balances of the jurisdictions in the area, as well as provide a forum for discussing energy and economic-development mitigation issues. President, Flaven Cerise, Garfield County Commissioner, P.O. Box 640, Glenwood Springs, CO 81602, (303) 945-9158; 1st Vice President, Allen C. Randle, Vice President, Oil Shale Operations, Energy Mining Div., Union Oil Company, 2777 Crossroads Blvd., Grand Junction, CO 81501, (303) 243-0112; 2nd Vice President, Secretary/Treasurer, Morgan Smith, Executive Director, Colorado Dept. of Local Affairs, (303) 866-2771, Assistant Secretary/Treasurer & Operating Committee Chairman, Ronald W. Cattany, Assistant Director, Colorado Dept. of Natural Resources, (303) 866-3311, 1313 Sherman St., Denver, CO 80203.

**Dept. of Energy, Laramie Energy Technology Center**—Formerly Laramie Energy Research Center. A leader in the field of oil shale research, especially in-situ (in-place)

processes. James Watson, Director, P.O. Box 3395, University Station, Laramie, WY 82071, (307) 721-2011.

**Dept. of Energy (U.S.)**—Responsible for major federal energy programs, policies, research and development; works with industry, universities and other government agencies. The Dept. of Energy office of oil shale and gas focuses on generic research and development of high-risk, long-term novel concepts, as well as methods of mitigating the environmental impacts of oil shale technology. Keith N. Frye, Deputy Assistant Secretary for Oil, Gas, Shale and Coal Liquids; Paul A. Petzrick, Deputy for Technology, U.S. Dept. of Energy, Germantown, MD 20545, (301) 353-2703.

**Dept. of the Interior (U.S.)**—Responsible for the administration of more than 533 million acres of federal land. Formulates and administers programs for the management, conservation and development of natural resources. Darrell P. Thompson, Special Assistant to the Secretary of the Interior, Bldg. 67, Room 688, Denver Federal Center, Denver, CO 80225, (303) 234-3275.

**Environmental Protection Agency (U.S.)**—Responsible for researching, monitoring and regulating pollution control. Also coordinates research and anti-pollution activities of state and local governments, educational institutions and individuals. Robert A. Simmons, Director of the Office of Management Systems and Analysis, EPA, Region VIII, 1860 Lincoln St., Denver, CO 80295, (303) 837-2351.

**Governor, State of Colorado**—Richard Lamm, Office of the Governor, State Capitol, Denver, CO 80203, (303) 366-2471.

**Governor, State of Utah**—Scott Matheson, Office of the Governor, State Capitol, Salt Lake City, UT 84114, (801) 533-5231.

**Governor, State of Wyoming**—Ed Herschler, Office of the Governor, State Capitol, Cheyenne, WY 82002, (307) 777-7434.

**Laramie Energy Research Center**—See Dept. of Energy, Laramie Energy Technology Center.

**Lawrence Livermore National Laboratories (LLNL)**—Laboratory managed by the University of California; it receives funding from the U.S. Dept. of Energy for oil shale research. Studies the basic chemistry of retorting to provide data for private industry.

Art Lewis, Project Leader for Oil Shale Research, L-207, P.O. Box 808, Livermore, CA 94550, (415) 422-1100.

**Los Alamos National Laboratory**—A U.S. Dept. of Energy laboratory operated by the University of California. Currently working with a consortium of private companies to conduct a series of experiments on fracturing oil shale through the use of explosives. Wayne Morris, Oil Shale Project Manager, Los Alamos, NM 87545, (505) 667-7590.

**Mountain Plains Federal Regional Council**—Works with presidential initiatives, state and local governments and Indian tribes; it assists shale country communities in finding the proper entity for federal assistance. Frank Dunkel, Staff Director, Bldg. 67, Room 690, Denver Federal Center, Denver, CO 80225, (303) 234-6066.

**Northwest Colorado Consortium for Training and Education**—A consortium of Colorado Mountain College (CMC), Mesa College and Colorado Northwestern Community College (CNCC) formed to jointly meet the needs of the oil shale and other energy-related industries for locally trained, skilled workers. A.D. Anderson, Dean of the School of Industry and Technology, Mesa College, Grand Junction, CO 81502, (303) 248-1514; Harvey Telinde, Dean of Occupational Education, CMC, 401 W. 1st Ave., Glenwood Springs, CO 81601, (303) 945-9196; William J. Nelson, Vice President of Instruction, CNCC, Rangely, CO 81648, (303) 675-2261.

**Oil Shale Environmental Advisory Panel (OSEAP)**—Assists Interior Dept. in enforcement of provisions of the prototype oil shale leases for the protection of the environment. Basically an advisory body

### The Federal Oil Shale Prototype Leasing Program

In 1973, the Interior Dept. announced the opening of several oil shale tracts for lease. To date, four 5,000-acre oil shale tracts have been leased to private companies; two of the tracts are in Colorado and two in Utah.

#### Colorado tract C-a

Location: 5,089 acres on the western flank of the Piceance Creek Basin, about 15 miles from Cathedral Bluffs, 13 miles off Piceance Creek Rd. in Rio Blanco County, 51 miles from Meeker, 58 miles from Rifle, 68 miles from Rangely by existing roads.

Expected yield: 2 billion barrels of oil (using modified in-situ technology and surface retorting), or 5 billion barrels using open-pit mining and surface retorting.

Project title: Rio Blanco Oil Shale Co.

Project headquarters: Aurora, CO

Lessees: Gulf Oil Corp. and Standard Oil Co. (Indiana) (Amoco)

Bid price: \$210 million

Effective date of lease: March 1974

Current status: Modified in-situ demonstration phase completed. On-tract development currently in suspension.

#### Colorado tract C-b

Location: 5,094 acres in Rio Blanco County, 1 mile off Piceance Creek Rd., 40 miles from Meeker and Rifle, 65 miles from Rangely by existing road.

Expected yield: An estimated 1 billion barrels of oil using a combination of modified in-situ technology and surface retorting (figure may be revised after initial

operations).

Project title: Cathedral Bluffs Shale Oil Co.

Project headquarters: Grand Junction, CO

Original lessees: Ashland Oil, Atlantic Richfield, Shell Oil and Tosco Corp.

Current lessees: Occidental Oil Shale, Inc. and Tenneco Shale Oil Co.

Bid price: \$117 million

Effective date of lease: March 1974

Current status: Shaft-sinking phase completed. Expecting modular production by the late 1980s.

#### Utah tracts U-a/U-b

Location: 10,240 acres in Uintah County, about 50 miles southeast of Vernal.

Expected yield: About 700 million barrels of oil from both tracts.

Project title: White River Shale Project\*

Project headquarters: Salt Lake City, UT

Lessees: Phillips Petroleum Co., Sohio Shale Oil Co. and Sunoco Energy Development Co.

Operator: White River Shale Oil Corp.

Bid Price: U-a—\$75 million, U-b—\$45 million

Effective date of lease: U-a—May 1974, U-b—June 1974

Current status: Final engineering, permit processing and mine-development work underway.

\*U-a and U-b planning is being done on a cooperative basis. One development is planned for both tracts.

that evaluates development plans and makes recommendations to Interior Dept. field officials. Panel is composed of federal, state, local governments and public members representing the industry and environmental sectors. Henry O. Ash, Chairman, Room 1010, Bldg. 67, Denver Federal Center, Denver, CO 80225, (303) 234-3275.

**Oil Shale Office (OSO)**—Responsible for administering the Interior Dept.'s Federal Prototype Oil Shale Leasing Program, as well as for reviewing and approving all development and environmental monitoring programs on the leased tracts. Eric Hoffman, Acting Deputy Minerals Manager for Oil Shale (Oil Shale Mining Supervisor), Mesa Federal Bldg., 131 N. 6th, Suite 300, Grand Junction, CO 81501, (303) 245-6700.

**Socio-Economic Impact Coordinator (Colorado)**—Formerly called Oil Shale Coordinator. Part of Colorado Dept. of Local Affairs, Div. of Impact Assistance. Responsibilities include coordinating state oil shale planning efforts. Steve Schmitz, Director, 523 State Centennial Bldg., 1313 Sherman St., Denver, CO 80203, (303) 866-2674.

**Soil Conservation Service (U.S.)**—Division of the Dept. of Agriculture. Works in cooperation with local soil conservation districts to provide seeds and plant materials for testing in oil shale reclamation programs. Also helped establish the Upper Colorado Environmental Plant Center near Meeker. Don Gillaspie, State Resource Conservationist, U.S. Dept. of Agriculture, U.S. Soil Conservation Service, 2490 W. 26th Ave., 3rd Floor, Denver, CO 80217, (303) 837-5651.

**Synthetic Fuels Corp. (U.S.)**—A quasi-governmental organization formed to administer up to \$88 billion worth of federal financial assistance for synfuel development. William Rhatican, Vice President of External Relations, 2121 K St. NW, Washington, DC 20586, (202) 822-6600.

**Uintah Basin Assn. of Governments**—Blanket planning agency for two Utah counties: Daggett and Duchesne. Works for intergovernmental cooperation. George Roth, Director, P.O. Box 1449, Roosevelt, UT 84066, (801) 722-4518.

**Uintah County Community Impact Council**—Represents the county, five water

districts, three cities and the local school district. Monitors population growth, determines needs for facilities and services and secures financing for the county from the state's Permanent Community Impact Fund. It also negotiates with industry for impact assistance and acts as a forum for discussing impacts with industry. Bob Nicholson, Staff Coordinator, City/County Planning Office, Room 103, Uintah County Courthouse, Vernal, UT 84078, (801) 789-2300.

**United States Navy**—The Dept. of Energy now has jurisdiction over the Naval Oil Shale Reserves on lands in Colorado and Utah. Cooperates with other government agencies and industry in shale oil research. Dr. C.M. Wong, Program Manager; Michael Yanock, Legal Council, U.S. Naval Petroleum and Oil Shale Reserves, Dept. of Energy, Room 6454, 12th and Pennsylvania Ave. NW, Washington, DC 20461, (202) 633-8641.

**University of Colorado**—State institution that conducts research on oil shale development and impacts; also has continuing education center in Grand Junction. Ron Lemon, Director, Office of University-Industry Relations. (This office serves as interface between industry and the university.) Campus Box 433, Boulder, CO 80309, (303) 492-8211.

**University of Utah**—State institution; the university is energy research center for the state, particularly fuels, engineering and mining research. Dr. Lamont Tyler, Chairman, Chemical Engineering Dept.; H.R. Jacobs, Assistant Dean of College of Engineering, Professor of Mechanical Engineering; H.Y. Sohn, Professor of Metallurgical Engineering, Salt Lake City, UT 84111, (801) 581-6915.

**Upper Colorado Environmental Plant Center**—Established in cooperation with various federal agencies and private industry to test seeds and plants for oil shale and other reclamation programs. Samuel Stranathan, Center Manager, P.O. Box 448, Meeker, CO 81641, (303) 878-5131.

**Utah Dept. of Community and Economic Development**—State agency that coordinates socioeconomic issues related to synthetic fuels development. Gary R. Tomsic, Deputy Director, 6290 State Office Bldg., Salt Lake City, UT 84111, (801) 533-5396.

**Utah Dept. of Health**—State agency

that deals with health and environmental-health regulations regarding oil shale and energy-impacted communities, specifically air and water quality, solid and hazardous waste, health planning and other related activities. James O. Mason, Executive Director, P.O. Box 2500, Salt Lake City, UT 84110, (801) 533-6111.

**Utah Dept. of Natural Resources and Energy**—State agency that regulates and leases state lands. The department has eight divisions. Temple A. Reynolds, Executive Director, 1636 W.N. Temple, Salt Lake City, UT 84116, (801) 533-5356.

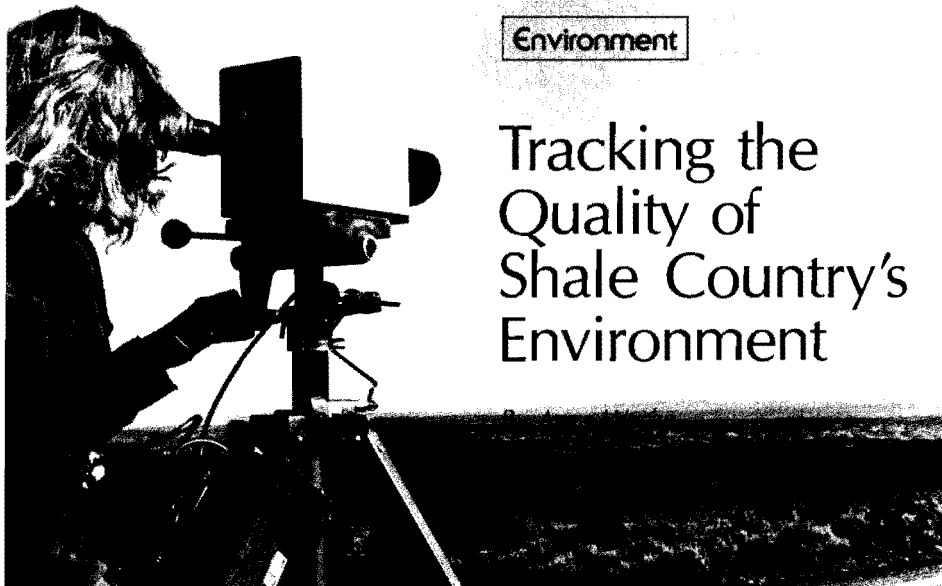
**Utah State University**—State institution; the university is looking into water problems involved in energy development. Dr. Thad Box, Dean, College of Natural Resources, Logan, UT 84322, (801) 750-2445.

**Western Energy Land Use Team**—Part of the Office of Biological Services, U.S. Fish and Wildlife Services, U.S. Dept. of the Interior. Determines research needs relating to energy development and its effects on wildlife; does research; evaluates and disseminates information. Joseph E. Townsend, Team Leader, 2625 Redwing Rd., Drake Creekside, Bldg. 1, Fort Collins, CO 80526, (303) 226-9398.

**Western Governors Policy Office (WESTPO)**—Independent organization of governors of 13 states, designed to strengthen the policy-making and management capacity of the member states and their roles in the federal system. It spearheads efforts to identify and deal with such energy-related issues as synfuels development, impact mitigation and energy transportation and export. James D. Maddy, Executive Director, 3333 Quebec, Denver, CO 80207, (303) 399-9957.

**Western Interstate Energy Board/WINB**—State government agency representing 16 Western states on energy, natural resources and environmental law issues. Serves in an advisory capacity to the Western states' governors and legislators. Douglas Larson, Executive Director, Suite 3500, Stapleton Plaza, 3333 Quebec, Denver, CO 80207, (303) 837-5851.

**Wyoming Geological Survey**—Involved in surveying and studying oil shale lands. Gary B. Glass, State Geologist, P.O. Box 3008, University Station, Laramie, WY 82071, (307) 742-2054.



Visibility monitoring being conducted on tract C-a.

## Tracking the Quality of Shale Country's Environment

Where rainfall is scarce, ecosystems are delicate because lack of moisture limits the types of plants and animals that can survive. So, in shale country's semiarid climate, any disturbance of natural conditions must be watched to see how it will affect the environment as a whole.

In fact, federal and state laws require industrial developers to study and control the effects their activities might have on the environment. As a result, shale companies have comprehensive programs designed to monitor their projects' environmental baseline conditions—conditions that exist prior to development. These programs are intended to provide data so that after on-site activity begins, the developer can detect any changes and then identify the source of impact. SHALE COUNTRY talked to representatives of several shale projects to find out what their environmental efforts were in 1982 and what activities will take place in 1983.

### C-a: recording results

Last summer the lessees of Colorado federal tract C-a were granted a suspension of lease terms for up to 5 years, and tract activity is minimal. Says Jack Clark, tract environmental coordinator for C-a's developer, the Rio Blanco Oil Shale Co., monitoring has focused on refining baseline

conditions for meteorology (weather conditions), air quality, terrestrial and aquatic vegetation and wildlife, hydrology (surface and groundwater), and on identifying impacts from experimental modified in-situ (in-place extraction of oil from shale) operations on tract C-a.

According to Clark, "Our program has been refined and leaned out over the last year. We've trimmed it as we learned where to expect changes, and now we can concentrate on those areas. Basically, we expect that our monitoring program is likely to continue in its present form in 1983."

The company also carried out some special studies in 1982. "Rio Blanco participated in the South Piceance Creek Basin study conducted with the National Oceanic and Atmospheric Admin.," says Clark, "which is aimed at determining the nature of upper air flows in the Basin and examining small-scale meteorology and terrain interactions. This information will help us identify which way any emissions created by activity will go. In 1983 we will be reviewing the data from this study and trying to project how air quality might be affected. We'd also like to look at information about the whole Basin to see how all the industries expected here will affect the air quality.

Another study undertaken in 1982 and

scheduled to continue in 1983 is concerned with the suspended particulates (solid particles) in the air around the site. "Research has been done to determine the size of the particulates, which may have health implications," says Clark. "We've installed some monitoring devices to measure the amount of these particulates in the air.

"In the area of terrestrial (land-based) studies, we're developing approaches for reclaiming disturbed land for livestock range and wildlife use. In addition to the restoration program, we're conducting several studies to see if we can enhance wildlife habitat. For example, by fertilizing or altering existing habitat we may be able to increase its carrying capacity. By this we mean that the land can now support 40 deer per square mile, and we'd like to improve it so that 50 deer can live on that same piece of ground. This would mitigate the impact of removing certain lands, such as plant sites, from wildlife use."

### C-b: study, study

Late in 1981, Cathedral Bluffs (Colorado federal tract C-b) announced it was delaying development to reassess the project's feasibility, and since then tract activities have been minimal. Ed Baker, environmental services manager, Cathedral Bluffs Shale Oil Co. (C-b's developer) notes that for Cathedral Bluffs, 1982 has been a year of continued studies.

"The monitoring programs for air, water and biology, which were started more than 8 years ago, are continuing and we expect them to go on through 1983," states Baker. "And if we stay on schedule, and project activity begins again in the spring of 1984, we'll have to begin our developmental monitoring program in the fall of 1983—6 months prior to start-up. Right now," he continues, "we are just observing the natural ecosystem. When we begin construction, we'll have to monitor more intensely to pick up any changes that may result."

In addition to monitoring, Cathedral Bluffs—as did various other projects—provided information for a study sponsored by the Northwest Colorado Wildlife Consortium; the study focused on the expected impacts to wildlife because of the population increase in the Rifle-Meeker area. (The Northwest Colorado Wildlife Consortium is

an organization consisting of members from the Colorado Div. of Wildlife and several state universities, which coordinates public and private efforts for wildlife protection.) Baker notes that C-b will continue supplying the consortium with data in 1983.

"In past years," he adds, "we've implemented vegetation-modification projects, which included fertilizing 320 acres of land so that it can absorb the grazing pressure created when 180 acres of land were disturbed. Also, 100 acres of sagebrush was beat (eradicated) and seeded with more desirable species. These programs are designed to provide needed forage for wildlife and domestic stock by making undisturbed areas more productive." (These areas have been 'undisturbed' by industry; however they have been modified by other land-use practices such as grazing.)

"In 1983," Baker reports, "we hope to evaluate reclamation technology on a plot of raw shale that was built in 1981, and on a processed (retorted) shale plot that we plan to build this year. We intend to do this on a small scale, using the techniques for revegetating processed shale that we've discovered during previous work. We will use what we consider the ideal amount of topsoil—12 inches in depth—the best mix of plant species and a minimum amount of irrigation. Although the plot isn't large enough to test alternatives, we will have an opportunity to demonstrate reclamation methods that we feel are best for this site."

### **White River: by the book**

Mine development is currently underway at the White River Shale Project (Utah federal tracts U-a/U-b). Jim Godlove, director of environmental affairs, White River Shale Oil Corp. reports, "Last year, one of the major goals of our environmental program was to complete a description of baseline conditions to provide background information prior to more extensive construction on tract.

"In 1982, we examined five areas: air quality, water quality, and terrestrial and aquatic biology and vegetation," he continues. "Using an environmental monitoring manual completed by White River earlier this year, we plan to take a systems approach to monitoring impacts. This means we'll look at how environmental

**This golden-mantled ground squirrel was part of a C-b wildlife sampling program.**



factors work together rather than examining an individual event in a vacuum.

"The information in the manual will help us identify where impacts might occur," notes Godlove. The manual also details how impacts can be measured; the location of monitoring sites; the amount of data necessary to detect changes in the environment; the intervals of data collections; and how the data will be analyzed. "We used the manual in 1982," he reports, "and it's going to guide our monitoring throughout the life of our project."

The systems approach is particularly evident in terrestrial monitoring—observing wildlife. "Our studies focus on reptiles, birds and rodents, and their relationship to other physical and biological parameters," says Godlove. "We also include studies of soil, foliage and invertebrates, such as insects, because that's where the first impacts of project's development can be seen. Invertebrates have a short lifespan and limited mobility, and they are a food source for larger animals. If you get a disruption at the bottom of the food chain—where the invertebrates are—it indicates that changes could occur in other areas."

Also on tap for 1983 is continued reclamation research. Since 1975, scientists contracted to White River have been studying ways to reclaim disturbed land and revegetate processed shale. "We've never generated enough processed shale to do research on a large scale at White River," Godlove reports, "but we do have access to retorted shale at the Anvil Points research facility in Colorado.

"We're studying a self-sustaining revegetation technology that requires little moisture or topsoil and that is salt tolerant. (Processed shale can contain large amounts of water-soluble salts.) We've been very encouraged by the successful results of many of our test plots, some placed directly on processed oil shale. However, the final proof is many years down the road. Our goal," concludes Godlove, "is to develop an environmental technology that is specific to Eastern Utah."

### **Chevron: working on the EIS**

Chevron is still in the planning stages for its Clear Creek Project near De Beque, CO. Al Verstuyft, senior environmental engineer, Chevron Shale Oil Co., notes that most of Chevron's environmental work at the Clear Creek Project in 1982 was a continuation of monitoring programs started in 1981. "The work included an extension of baseline monitoring to analyze the water quantity and quality in Clear Creek, and this will continue until mid-1983," says Verstuyft. "We continued surface and groundwater monitoring at the site.

"Chevron participated with Getty Oil Co. and Cities Service in some special work to examine the plant communities in the Roan Creek Valley for threatened and endangered species. We also did some cultural resources work to record any archeological data—prehistoric and historic—in the area," he adds.

"Chevron, the Bureau of Land Management (BLM) and Camp, Dresser, and

McKee, a private consulting firm, worked on the Environmental Impact Statement (EIS) for the Clear Creek Project, and this activity will continue into 1983. The BLM schedule calls for the final statement in late spring," says Verstuyft. Later in the year, Chevron will begin a developmental monitoring program to prepare for expected construction of the semiworks (large-scale research and development) plant in 1984.

### **Colony: environmental activity moves forward**

On May 2, last year, Exxon announced it was phasing down the Colony Shale Oil Project and the company stopped most field construction activity. Gerald Ortloff, resident manager, Colony Shale Oil Project, explains: "Currently we're planning for the next 2 to 3 years. In September we submitted an application to amend our current reclamation plan to the Mined Land Reclamation Board (which was accepted). We examined every acre that we disrupted, and are replanting grass on all land that won't be disturbed again."

Ortloff reports that "We started immediate reclamation work in June, performing permanent reclamation in areas where we had completed construction, such as along the sides of roadbeds." Other plans include temporary reclamation for land that would be redisturbed if the project becomes active again. Dust suppression programs, using a glue-like material, are being conducted on roads and large areas where there are currently no plans for reseeding, such as areas above the 8,100-foot elevation on the plateau.

Colony also proposes to build a dam on the Middle Fork. "We need the dam to prevent flooding the mine bench, but it will be a smaller dam than originally planned because we won't need it to store water for shale processing right now," notes Ortloff.

And in accordance with its discharge permit issued by the Water Pollution Control Div. of the Colorado Dept. of Health, Colony is maintaining silt-collection ponds to treat all water discharged from the property. Any overflow from the ponds is monitored for silt content.

Colony also has its own extensive hydrological and meteorological monitoring pro-

grams. Although the frequency of data gathering will be reduced in 1983, Ortloff says, "We want to keep a record of baseline conditions so we'll have a continuous record of conditions on the site."

Other programs slated to continue into 1983 are studies of revegetation plots and a comparison of mule deer population during the periods of high and low activity. "We do expect to see mule deer in our revegetation plots, because, after all, it's probably the best grass on the mesa," he says.

### **Union: gearing up for the production**

In 1982 construction of Union Oil's Parachute Creek Shale Oil Program's Phase I (10,000-barrel-per-day) project was in full swing, and permit activities on the Phase II expansion to 90,000 barrels per day have been initiated. Terrence Larson, environmental administrator for the project says, "For Phase I the environmental group spent considerable time monitoring construction activities to ensure permit compliance. Several design and construction changes required permit revisions. In addition, ongoing monitoring programs for water and air quality continued through 1982.

"Since start-up of the 10,000-barrel-per-day Phase I mine, retort and upgrade facilities is scheduled for late summer, 1983, operational monitoring plans have been developed with the Environmental Protection Agency and the Colorado Dept. of Health. Equipment for the extensive monitoring system has been ordered and the system is scheduled to be installed shortly. A groundwater monitoring program in the East Fork area where most of the activity will take place has been approved by the Colorado Mined Land Reclamation Div. The wells for the system have been drilled and the sampling program is underway.

"We are all looking forward to start-up," he continues, "since this will be the first commercial shale oil project in the country. But considerable preparation is necessary, and the environmental group will be deeply involved in start-up monitoring activities to insure permit compliance. Two major areas of emphasis will be air-quality sampling and retorted shale disposal."

For the Phase II expansion, emphasis has been on engineering and permit activities

according to Larson. "During early 1982", he explains, "we held a series of public-information meetings through the Colorado Joint Review Process to describe our expansion. (The Joint Review is a process that helps coordinate permitting at all levels of government.) The U.S. Army Corps of Engineers is the lead federal agency for the Environmental Impact Statement, and that agency held a series of public scoping meetings to provide input into the EIS. We have selected a contractor and have begun preparing an Environmental Report to submit to the Corps of Engineers, which will serve as the basis for the EIS. The EIS is scheduled to be published in draft form by the end of 1983. The EIS review will be assisted by the Colorado Joint Review Process."

In addition to developing project descriptions based on engineering studies, Larson reports, time has been spent collecting environmental baseline data for the EIS and other permit applications. Most of the work, including soils, cultural resources, wildlife and aquatics-collection work, was completed in 1982. Water-quality data collection from surface-water and groundwater monitoring systems has begun. The wildlife and aquatics programs have been refined, and certain follow-up activities will continue in 1983. □

### **Glossary**

**Baseline data:** Information gathered prior to the disturbance of land for the purpose of outlining conditions existing on the undisturbed site.

**Biota:** Plants and animals found in a particular environment.

**Groundwater:** Water within the earth that supplies wells and springs.

**Hydrology:** The study of the distribution of water above, on and under the earth's surface.

**Meteorology:** The study of the atmosphere, especially weather conditions.

**Surface water:** Water on or above the earth's surface.

**Terrestrial:** Pertaining to land.

## Community Profile

# Holding Steady on Main Street

By Heather H. McHugh

1982 wasn't quite what anyone in shale country expected. The rosy growth projections of 1981 largely failed to materialize, but despite a lagging national economy and slackening energy demand, communities in Eastern Utah and Western Colorado posted modest gains for the year. Residents are tightening their belts and counting their blessings. As Lawrence Yack, mayor of Roosevelt, UT, put it: "We've been fortunate in comparison to other places, and we're growing little by little, which is better than all at once."

To find out just how some of these communities weathered 1982, and what they can expect in 1983, SHALE COUNTRY spoke with community representatives in several Colorado and Utah towns. Their thoughts:

### **Grand Junction—diversifying and doing fine**

The largest city in shale country and a regional service center for agriculture as well as the energy industry, Grand Junction saw its economy bolstered in 1982 by a number of major construction projects. "Overall, things don't look too bad for us," says Mayor Louis Brach, although he estimates that the city experienced a population decline during the year because of the slowdown in energy activities.

Still, Brach points to continuing construction in the area and predicts that Grand Junction will get through the next few years just fine. Many of the current projects are capital improvements financed by the city, county and state governments. "We're cur-

rently finishing construction and site improvements at the municipal airport at a total cost of \$6.5 million. And the city and county spent millions of dollars during 1982 to improve streets, roads and bridges," Brach says.

A senior-citizen housing complex is being built now and work will begin this spring on an annex to the U.S. Post Office and a new Public Service Co. building. And on top of this activity, Brach estimates that millions will also be spent in the next 3-5 years to complete the construction of Interstate 70 through the area.

"Of course the economy has leveled off some," Brach admits, "but I think the next 3 years are going to be pretty active, and hopefully after that, oil shale and coal development will pick up again. I think we're diversified enough that we'll get through this leveling off period and will begin gaining economically once again in the next couple of years."

### **De Beque—anticipating steady growth**

Located near Interstate 70 between Parachute and Grand Junction, De Beque has long been home to people who commute to work elsewhere. This was particularly true during the latter months of 1982. When Exxon phased down the Colony Shale Oil Project last May, "We lost 50 people out of a population of approximately 300," says Mayor Wood Smith. "And the school district population has dropped considerably, down to 130 students from 171 last spring. But since then there has been a steady trickle of people moving back into town.

Still," he notes, "housing growth here slowed during 1982 with only three or four new homes built."

Other than the abrupt population loss, Mayor Smith insists that "De Beque hasn't changed a bit. We are progressing with a master plan for De Beque's housing and commercial growth, and we hope to bid soon on a system that includes street paving and underground irrigation. We anticipate growth," Smith says, "just a nice, slow, steady growth, which we appreciate very much."

### **Parachute—staying in business**

1982 ended at a decidedly less hectic pace than it began in Parachute. But the town is alive and kicking despite the phase-down of the nearby Colony Shale Oil Project.

"We have more students in school now than at any time this year," points out Mayor Floyd McDaniel. "There's been quite a turnover but a steady increase in enrollment overall. We have more than 700 students in school currently, and next winter a new middle school will open."

Other signs of life abound in Parachute. "We completed water and sewer improvements during 1982, and we're now in the process of paving streets and building sidewalks and underground irrigation," McDaniel says. In addition, "A new county library opened here in the fall and, although the town had to cut back a bit on its police force, we were able to continue our emergency dispatch center. The fire district has a new fire truck and a new ball park should be completed in time for the summer ball season."

Concluding his list of Parachute's accomplishments for 1982, McDaniel notes that "Most of the businesses here are still doing pretty well and we even have a new pizza restaurant in town. Also, a full-time doctor has moved to town and opened a practice."

The mayor admits that the coming year will be difficult for Parachute. "We will have a tight budget and we foresee a tight year overall. The budget will be around \$600,000 next year compared to several million in 1982. All in all though," he says, "I agree with the bumper sticker the new doctor put on his car which says, 'Parachute—alive and well.'"

## **Battlement Mesa—slowing down but stable**

Like neighboring Parachute, the new community of Battlement Mesa was directly affected by Colony Shale Oil Project's phase down last spring. And like its neighbor, Battlement Mesa completed the year in far better condition than anyone expected.

According to Lars Larsen, operations manager for Battlement Mesa, Inc., the community's population of 1,700 now equals year-ago levels. "We are very pleased," he says, "that the population has stabilized."

And like McDaniel, Larsen is quick to note the community's signs of health. "Although 45 single-family houses and more than 150 apartments are currently unoccupied, the mobile homes at Battlement Mesa are nearly all rented," Larsen explains. "Water, sewer and road systems are in full operation, a new middle school under construction will open this spring, and a new elementary school that officially opened in October is already filled to capacity. A recreation center including weight rooms, an indoor track and a gymnasium will be completed in April along with retail facilities, which are expected to draw commercial establishments.

"We expect that next year, with the opening of recreation and commercial establishments, we'll start to grow again," Larsen concludes. "Our main objective is to attract tenants to the retail space. Those establishments will in turn attract more residents and Battlement Mesa will slowly but steadily grow from there."



**New construction in Rangely, CO,** promises to ease the town's housing shortage.

**The Bea Underwood elementary school at Battlement Mesa, CO,** was dedicated in October 1982.



## **Rifle—looking to the future**

George Mitchell, mayor of Rifle, estimates that the city's population has dropped to 4,500 people from a high of 5,600 last spring. Sales-tax revenues are down and "For Sale" signs are scattered through Rifle's residential areas. However, the city has adjusted its budget for the next year, and Mitchell is confident that existing municipal services will continue to be provided.

For example, the city made several capital improvements during 1982, including expanding water and sewer systems to handle 10,000-12,000 people and a \$1-million street-improvement program. Rifle has more projects planned for 1983. "We're presently seeking a site for a new city hall, which hopefully will include a public library," Mitchell reports. And he notes that "We're taking preliminary steps to see if we

can build a recreation center."

The mayor would also like to see construction begin on a proposed "Ski Rifle" resort area during 1983, which will provide the city with much needed employment opportunities and perhaps fill up a few rooms in the three new motels built in Rifle in 1982. Mitchell foresees a difficult time for Rifle in the near future. "But," he adds, "I'm sure we have the kind of character to survive."

## **Meeker—seeking new opportunities**

"We're still in pretty good shape around here," says Meeker's Mayor Darold Hedenskog. The town's population has stabilized at about 2,200 people, down from 2,500 at the beginning of 1982. And although one police officer's position was deleted and several planned capital-improvement projects have been postponed, Meeker will be able to preserve and even modestly improve city services during the coming year.

"We are going forward with a road-surfacing project next year and some of our water and sewer lines will be replaced," the mayor explains. "The school district just received an energy-conservation grant to improve its heating system and make windows and lighting more energy efficient."

As the pace of oil shale and coal development slackens, Meeker residents are seeking to bring new business to the community. A 14-member economic development committee was formed last fall to work with the local chamber of commerce in an effort to help existing businesses, as well as to attract

new businesses to the Meeker area. "Although we don't expect any noticeable results right away," Hedenskog says, "we are looking forward to seeing how the program will work out."

In the meantime, residents will be enjoying expanded recreational facilities, thanks to the creation of a new parks and recreational district in the area. A new ice-skating rink is being planned, and land has been acquired for softball fields and perhaps other facilities. "I personally feel that the townspeople are looking to the future with a positive attitude," reports Hedenskog.

### **Rangely—meeting challenges of 'boom' times**

An influx of activities associated with the nearby Western-Fuels Deserado Coal Mine and the Bonanza Power Plant, now under construction across the border in Utah, shielded Rangely from the effects of the general energy-industry slowdown during 1982. All efforts in this Northwestern Colorado town last year were directed at keeping up rather than scaling down.

"This is an exciting and very challenging time for Rangely," says Mayor Peggy Rector. "We're in a boom situation. We've been planning for this activity for years, and now we are finally into the implementation stage. We believe we will respond well."

Projects implemented during 1982 include the construction of a senior-citizen housing complex and \$800,000 in street improvements and utility-line changes. Current plans include the expansion of municipal and county buildings, which will more than triple the size of the existing town hall.

And perhaps most importantly, the town now has room for badly needed new housing, thanks to a land purchase of 106 acres from the U.S. Bureau of Land Management. Utility lines will be extended to that land next spring, and new housing should begin appearing in the summer of 1983.

In addition, "Funding has just been acquired for a new recreation center that will include a 9-hole golf course," Rector says. "We're trying to beef up all of our town services and recreational facilities for the new people who are moving into town." She warns, though, that "Newcomers should be sure they have a job and housing before they come here," because

job opportunities and housing are not unlimited.

### **Vernal—preparing for a bright future**

The population of Vernal, UT, increased slightly during 1982, despite a decline in oil and gas drilling and the fact that "We didn't get the influx of activity from oil shale that we expected," according to Sam Snyder, the city's mayor. Vernal's population neared 9,000 by the end of the year, with another 23,000 people living in the valley outside the city.

"In fact," Snyder says, "a new city named Naples incorporated just a mile-and-a-half south of Vernal during 1982 and it already has a population of 2,800. We've also had substantial business move in recently, especially fast-food places. And a new KMart store is due to come in next spring. There has been a lot of building going on in the valley all year," he continues. "Actually, housing has probably been overbuilt, but we will have absorbed the excess by next summer or the summer after that."

In the meantime, Vernal is preparing for still more people. "We plan to get a new water-treatment plant underway during 1983. By the fall of 1984 we should have water-treatment facilities in place to serve a population of 50,000 to 100,000."

As for the future, Snyder hopes to see "increased activity in the oil and gas industry this year. In 1984 we may benefit from the construction of a dam on the White River, and by then we'll also have a better idea of how much oil shale activity there will be."

### **Roosevelt—getting spillover growth from Vernal**

"We're kind of at a standstill right now, like everywhere else," observes Lawrence Yack, mayor of Roosevelt. "Before the economy slowed down we annexed a lot of new territory, some 1,500 acres, so that we would be prepared for growth. We also expanded our water and sewer systems. But we haven't needed it."

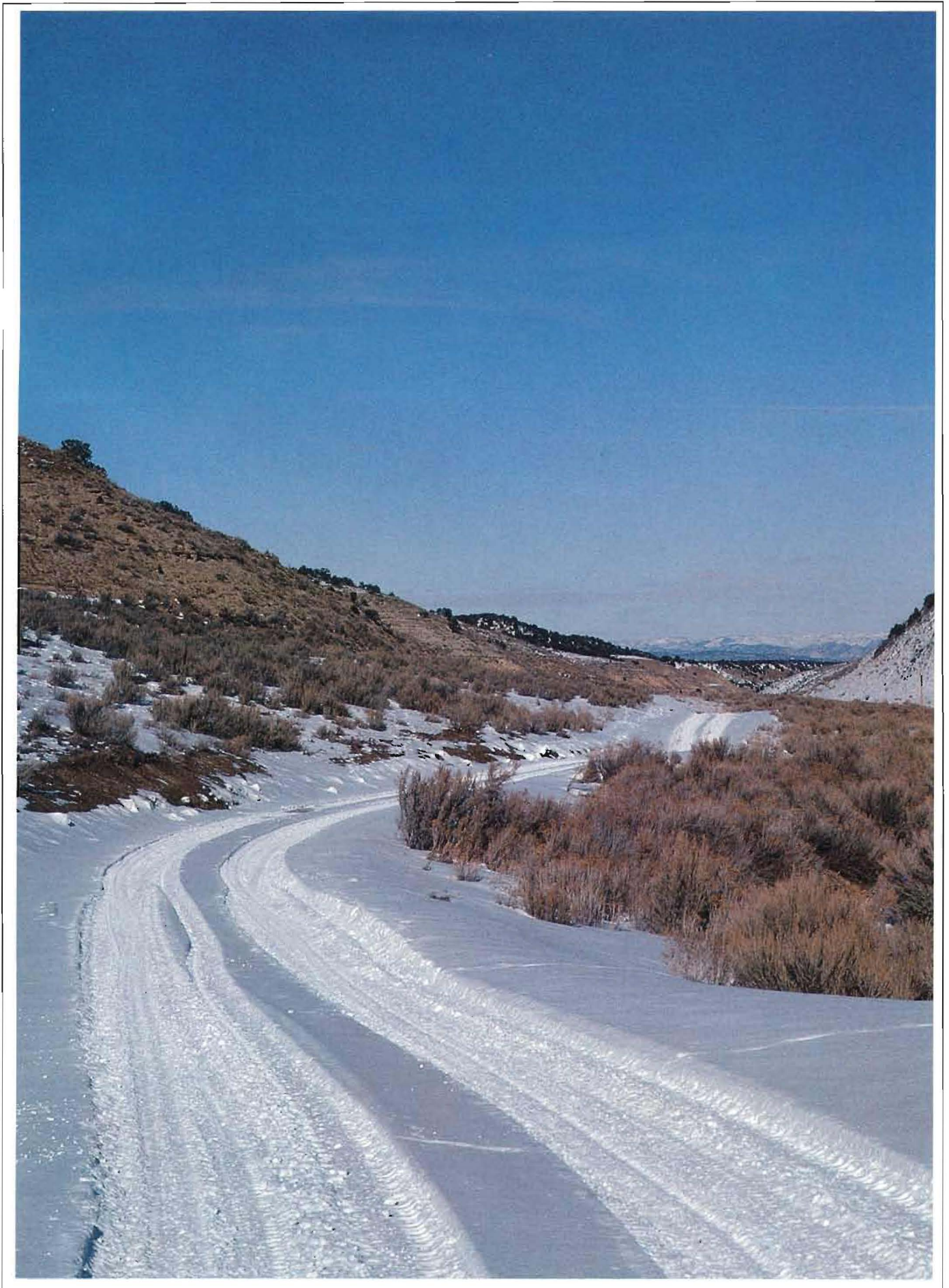
In spite of the lagging economy, Roosevelt experienced moderate growth in 1982. "We're getting new housing all the time, including apartments, which we need badly," says Yack, "and new people keep moving in, so that we now have a population of 5,000, an increase of about 1,500 during the past 2 or 3 years. Most of our growth right now is spillover from Vernal, with people living here and driving there to work."

Roosevelt's schools are packed, especially at the elementary level. "We have many more students this year," the mayor reports. "We even had to bring in three mobile-housing units to serve as temporary classrooms." Other city facilities seem to be adequate to handle the increased population. "We have been hurting for water," says the mayor, "but a new well now under construction will be completed this May, so we shouldn't have water problems for the next year or two."

And although a shopping mall project was "killed due to high interest rates," Yack concludes that "We had no drastic problems in 1982. Oil shale helped us this year—every little bit helps." □



**Roosevelt, UT, experienced moderate growth during 1982, but most city facilities seem adequate to handle the population increase.**



**Winter brings** a special aura to Colorado's Piceance Creek Basin.

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