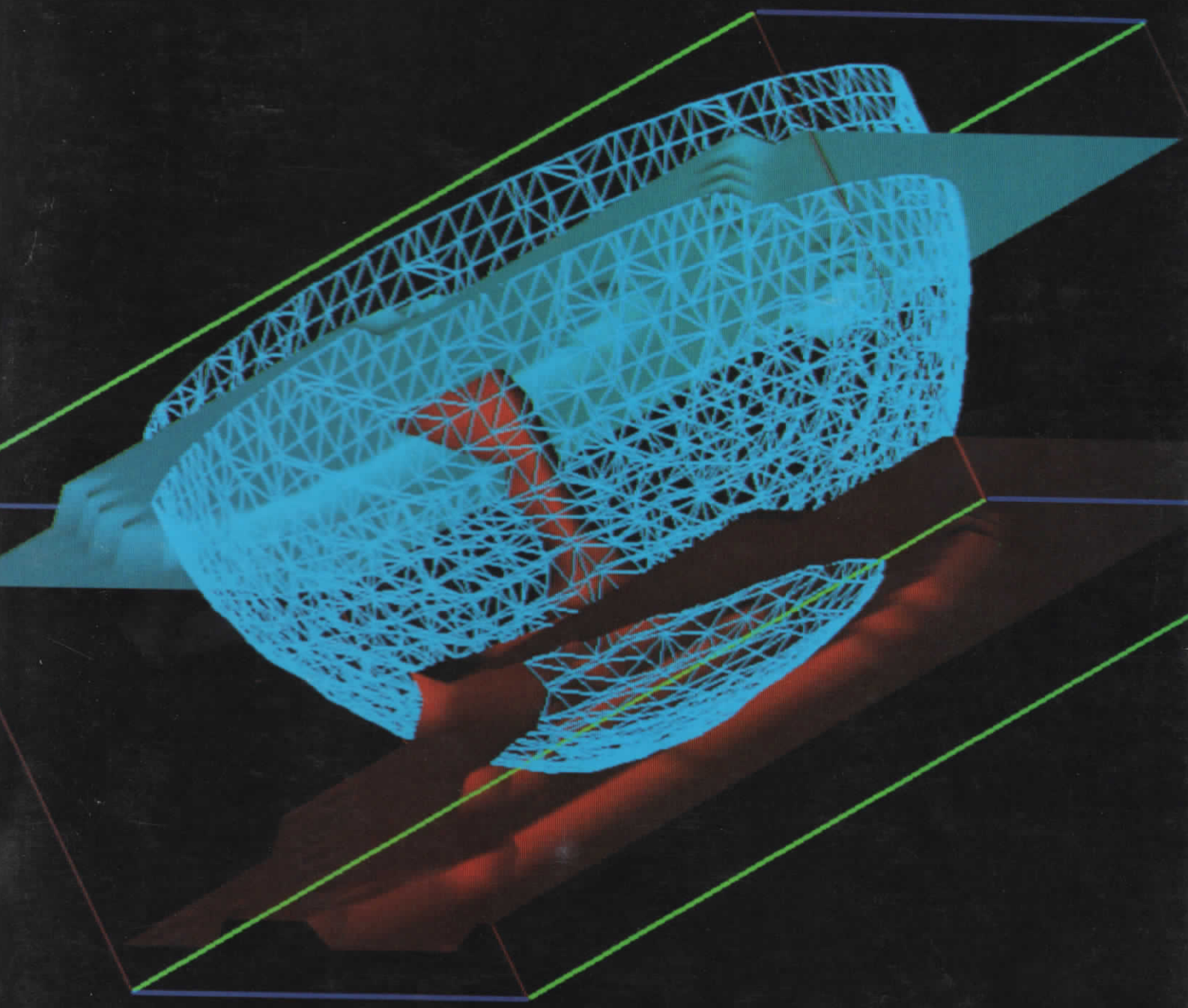
seventy six

Winter
1991



Exploration Research: Gaining a Competitive Edge

The history of the oil and gas business reveals a simple axiom: the companies which succeed are usually those that discover and develop the world's major petroleum deposits. But that's where the simplicity ends. With most of the easy-to-find oil fields already discovered, the contribution of Unocal's Exploration Research department—a branch of the Science & Technology Division—has become a crucial part of the team effort to achieve the company's ambitious goals for increasing its reserves.

Dr. Fred Aminzadeh, manager of the Seismic Acquisition & Imaging branch of the Exploration Research group, sums up the situation well. "We believe there may be several Prudhoe Bay-sized fields out there that remain undiscovered," he says. "If Unocal can find just one of these, the discovery will have an enormous, positive impact on the company's future."

"Major" hydrocarbon deposits are defined as fields containing more than 50 million barrels of oil or at least 300 billion cubic feet of natural gas. But the kind of discovery to which Aminzadeh refers is a mammoth field that contains anywhere from 200 million to 10 billion barrels of oil.

Geologists justifiably characterize such deposits as "elephants." But because the Earth holds a finite number of these huge petroleum caches, the chances of finding a new elephant-sized field become less likely with every Prudhoe Bay-scale discovery. As a result, the search for large undiscovered oil and gas fields has progressed toward frontier areas of the world which previously were closed to Western oil companies due to economic, political or technological obstacles.

Because little geological and geophysical data has yet been assembled to reliably describe potential oil and gas prospects in these formerly inaccessible areas, exploration of frontier territory is a costly endeavor fraught with significant risk. But by applying known geologic principles, computer simulation and other interpretive techniques to these data-poor areas, Unocal's Exploration Research group can help minimize uncertainty and improve the odds of hitting petroleum pay dirt.

In addition to Aminzadeh's seismic group, Exploration Research is comprised of four other technology-intensive teams: Petroleum Geochemistry, Basin Evolution, Reservoir Characterization and Stratigraphic Analysis. The department's primary mission, according to Dr. Robert Helander, vice president of Exploration Research, is "to enhance the assets and earnings of Unocal by promoting and supporting the use of technology in the search for, and production of, oil and gas," and "to transfer the use of new technologies to the operating divisions as soon as practical."

In his January letter to employees, Unocal's Chairman, President and Chief Executive Officer Richard J. Stegemeier affirmed the corporation's commitment to building a larger reserve base.

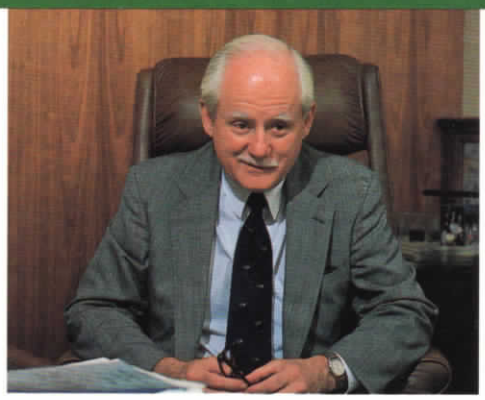
"We will move aggressively to find and develop energy resources in this country and abroad," Stegemier wrote. "To accomplish this objective, we have increased Unocal's planned exploration capital and expense for 1991 to more than $470 million."

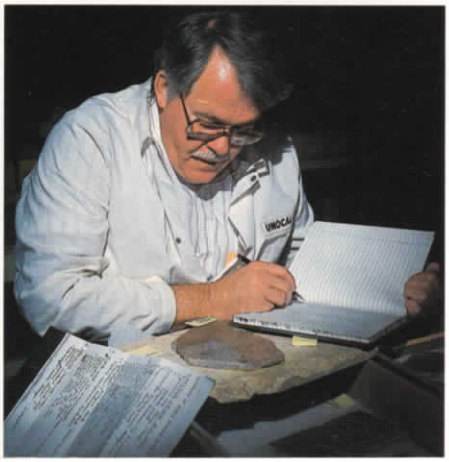
With such a large investment earmarked to find new reserves, the contribution of the Exploration Research department has become an essential ingredient in a strategy designed to help Unocal get the most from its exploration dollar. In order to compete effectively with the highly capitalized giants of the oil industry, a mid-sized company like Unocal must opt for a "quality over quantity" exploration strategy. Because Unocal cannot match the investment outlays of these oil giants, the company is banking on three strengths to successfully compete with them.

The first is the skill and efficiency of Unocal's explorationists in the field. The second is the expertise of Unocal's Exploration Research group, which can help identify the most promising frontier prospects in the most cost-effective ways. And the third is the ability to take quick action, made possible by a streamlined corporate decision-making process.

"Unocal has an advantage in the way we communicate," says Helander. "We encourage our scientists and researchers to pick up the phone and exchange information with each other and with the people in the operating divisions. In some of the larger companies, corporate bureaucracy can make this kind of communication unwieldy."

This ease of communication allows the operations groups to draw on the expertise of exploration researchers in developing an internal consensus and taking quick, decisive action. In the realm of frontier exploration, the company which hesitates is often the company that watches a competitor discover the next major oil or gas field.





Left, geologist Stan Frost of the Stratigraphic Analysis group examines a rock sample. Above, exploration drilling underway in the West Cameron field, offshore Louisiana. Top, Dr. Robert Helander, vice president, Exploration Research.

In fact, says Helander, the competition between companies to locate hydrocarbon deposits in frontier areas is not unlike a high-speed automobile race. "By pushing the edge of exploration's technological envelope, Unocal hopes to accelerate past its industry rivals just as the skillful driver outmaneuvers his opponents by pushing his race car to its limit," Helander explains. "We like to think that Exploration Research plays a big part in Unocal's effort to beat our competition to that next 'elephant.'"

From the window of Helander's office at the Fred L. Hartley Research Center in Brea, a work crew can be seen constructing a new laboratory at the south end of the facility. Dr. John Fox, manager of Unocal's Petroleum Geochemistry research group, watches quietly as workers hang doors and install fume hoods in this new building which will serve, for years to come, as the focal point for much of Unocal's advanced organic geochemical analysis.

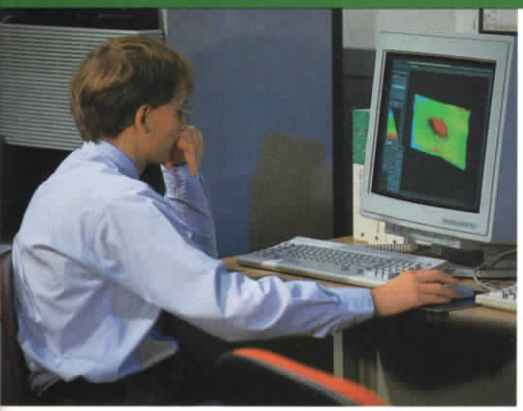
A mixed palette of cutting-edge technologies will be employed in the new lab—from a patented, infrared laser device designed to examine the microscopic particles which are sources of oil and gas, to advanced instrumentation that separates constituent elements of source rock and crude oil samples for geochemical analysis. These and other state-of-the-art research tools will allow Fox and his fellow geochemists—like the rest of their Exploration Research colleagues—to enhance their existing level of technical support for the field explorationists of Unocal's Energy Resources Division.

Traditionally, this support has involved geochemical, microscopic and computer analysis of a broad range of information including well-log data and rock, oil and gas samples supplied from the field.

"Our research shows that natural petroleum-producing processes can be detected and tracked on the basis of chemical clues," Fox explains. "By making systematic use of geochemistry during exploration, Unocal can evaluate oil and gas potential—and develop insight as to the size and type of possible hydrocarbon deposits—before acquiring new leases or participations."

But Unocal's petroleum geochemists do not work in a vacuum. All of the company's exploration researchers are encouraged to look beyond their own disciplines to obtain a better overall concept of where recoverable hydrocarbons are likely to be found. As a result of this integration, data compiled by one group may serve as the raw material for scientists specializing in other fields of exploration research. Primary emphasis has been placed on fostering a department-wide synthesis of geology, geochemistry and geophysics.

Unlike geology—which describes the overall history, composition and structure of the Earth—and geochemistry—which characterizes the properties, make-up and molecular structure of the materials found in its crust—geophysics involves study of the Earth through quantitative physical methods. Geophysical research techniques include interpretation of electrical, thermal, magnetic, gravitational and seismic measurements.



Left, Jean-Claude Dulac, a geophysicist with the Seismic Acquisition & Imaging group, uses a computer to "massage" raw seismic data. Below, Unocal workers drill an exploratory well offshore Indonesia.

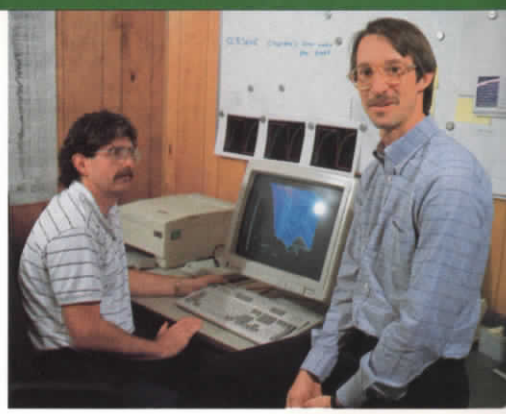
Seismic measurements, which detail the Earth's reflective response to sound waves, comprise roughly 95 percent of all geophysical exploration efforts, says Aminzadeh. Like geochemical and geologic data, seismic information is analyzed to some degree by nearly every group in Unocal's Exploration Research department.

"While geophysical measurements don't directly tell us where hydrocarbon deposits are, they do significantly enhance our understanding of the subsurface geology," Aminzadeh says.

In addition to employing advanced seismic acquisition techniques, Aminzadeh's troupe of scientists develops new methods of "massaging" basic seismic information into more detailed pictures of subsurface structure. Often, this is accomplished through computer data manipulation performed in cooperation with S&T's Scientific Computing Services department. Application of such enhancement techniques helps filter out the background patterns, or "noise," which often complicate scientific interpretation of seismic data.

"Every company in the industry uses seismic information to help locate oil-bearing formations," Aminzadeh explains. "Our objective is to use advanced seismic processing technology—including computer software which Unocal exclusively possesses—to see something in the seismic data that other companies may miss."

Near left, geochemists Rui Lin (seated) and Scott Stout of the Petroleum Geochemistry group use a state-of-the-art infrared laser device to analyze hydrocarbon source rock. Molecular compositions of mounted specimens, like the kerogen sample pictured at far left, are studied to determine their chemical make-up.



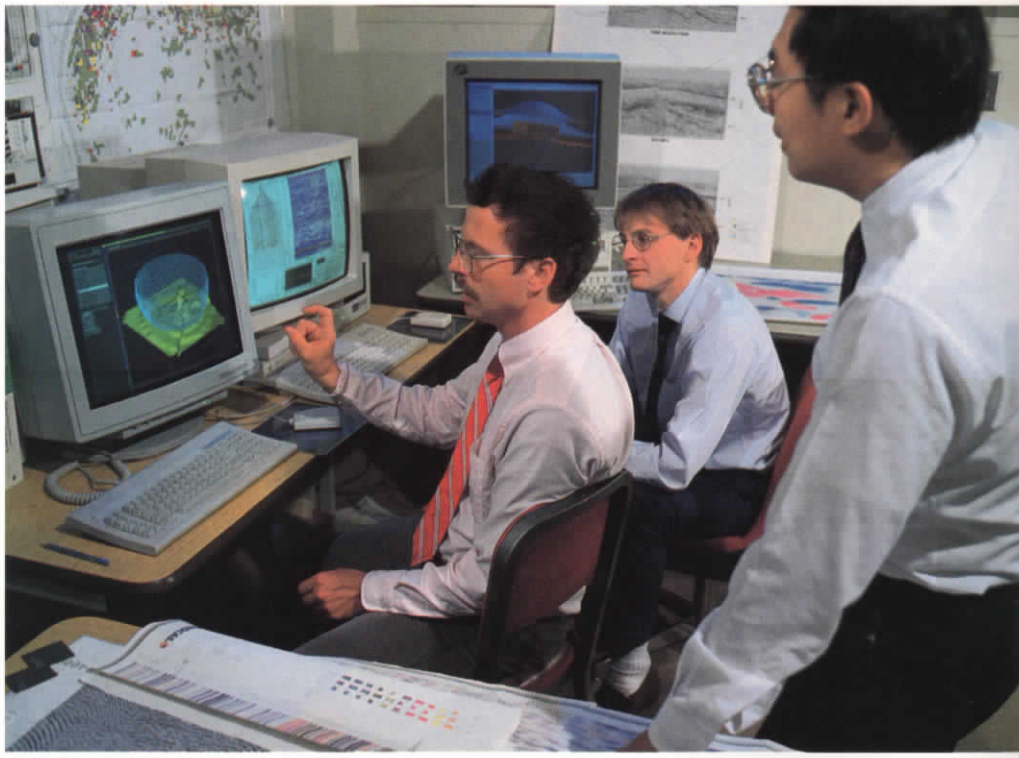
Among the current research priorities of Aminzadeh's group is an effort to develop new methods of collecting reliable seismic information from "difficult data areas." Due to complex or impenetrable subsurface conditions, such as the presence of fractured rock, these areas have historically yielded seismic data of extremely poor quality.

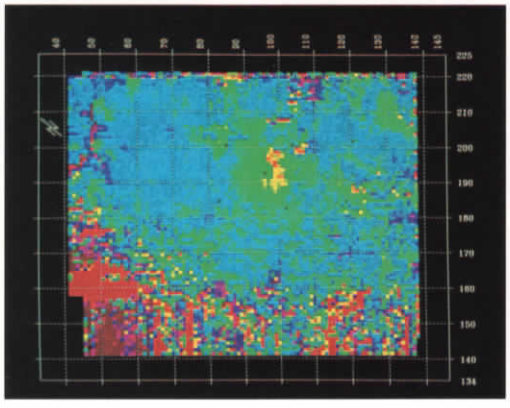
Other problem-solving research is geared to develop more-effective seismic imaging techniques for exploring around and under salt domes and complicated subsurface structures. New computer-driven methods of determining pay thickness—literally the physical dimensions of an oil producing zone—are also being studied. "Unocal stands at the leading edge of industry research in many of these areas," Aminzadeh says.

The three remaining groups which comprise Exploration Research—Stratigraphic Analysis, Basin Evolution and Reservoir Characterization—complement the work of the geochemical and seismic research groups. Other raw materials used for their studies and experimentation, such as well logs and core samples, come directly from the field.

The scientists of the Basin Evolution group take the information gleaned from field samples and interpret it through the use of specialized computer software. Simulation programs can be used to project reservoir quality by helping explorationists determine when and where hydrocarbon deposits were formed.

"We take the field data, plug it into a computer and do the best we can to reconstruct the history of a basin from its inception to the present day," says Jim Miller, manager of the Basin Evolution group. "The better you understand how a basin evolved, the better are your chances of assessing oil and gas exploration potential."





Right, geologists Franco Corona (left) and Bob Varga of the Basin Evolution group review a geologic map. Computer-generated displays like the one above help Exploration Research scientists examine the characteristics and behavior of oil and gas reservoirs.

Top left, Brett Mudford (at computer) and Paul Lundegard of the Basin Evolution group use specialized software to examine basin characteristics. Middle left, geophysicists (left to right) Rick Ottolini, Jean-Claude Dulac and Tai-Lin Hong of Seismic Acquisition & Imaging also employ computer-intensive techniques to study subsurface structures. Their findings help determine the best locations for exploration wells in the field.

Researchers in Miller's group focus their efforts on two main disciplines: basin modeling and structural geology. In basin modeling, a subject basin's temperature history, character of sedimentation and other key factors are manipulated by computer to ascertain the likelihood of hydrocarbon formation. If the computer simulations indicate favorable conditions for oil or gas, the research focus shifts to reservoir quality prediction. Here, the goal is to determine the porosity and permeability of petroleum-bearing rock formations.

"Explorationists have learned the hard way that one of the biggest causes of prospect failure is poor reservoir quality," says researcher Paul Lundegard. "Exploration Research began applying basin modeling technology for field use in 1986. Since then, these techniques have been used extensively in exploration decision-making."

Dr. Bob Varga, geological research associate with the Basin Evolution group, spearheads structural studies—a discipline that focuses on subsurface geologic structures such as salt domes, anticlines and faulted zones in the search for oil. Varga and his coworkers provide insight into the relationship between structural development and hydrocarbon migration by employing new analytical tools such as regional tectonic studies and balanced cross-section techniques.

While regional tectonic studies define how rocks within a basin have been deformed over time, balanced cross-section techniques unravel these time effects and allow researchers to "unfold" deformed rock units through computer simulation. This can provide an enhanced depiction of the original subsurface geology and thereby yield a more accurate idea of individual stratum dimensions.

"Because the vast majority of hydrocarbon accumulations are structurally controlled, we can significantly increase exploration potential by better defining known structural styles and by recognizing new structural play concepts," Varga explains. "These techniques can also breathe new life into mature basins where most of the obvious drilling targets have already been exploited."

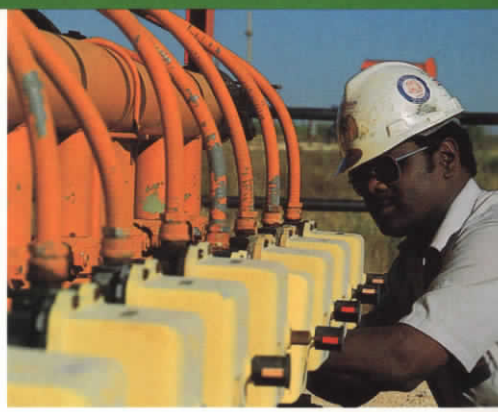
But even after hydrocarbon deposits have been discovered, explorationists still need to determine the best way to develop the fields for optimal oil recovery while minimizing drilling and other operating expenses. That's where Tim Anderson's Reservoir Characterization group makes one of its most important contributions.

The group develops and applies new technology for well-log interpretation, sedimentology, seismic interpretation and analysis of rock properties. By examining pore space, permeability, flow barriers and other reservoir properties, researchers can provide information to help operating staff maximize oil and gas recovery. Such information is critical for optimum oil field development and reservoir management.

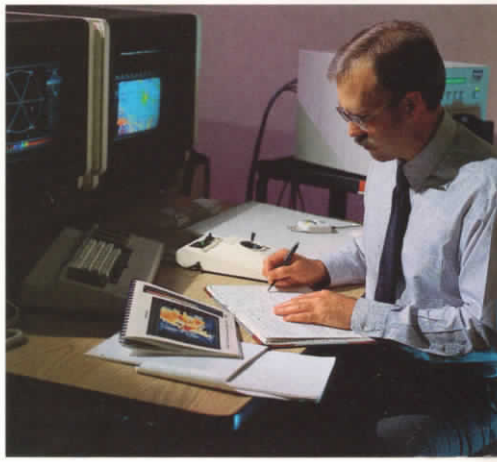
Describing the production potential of various prospects is just one application of reservoir characterization technology. Aggressive experimental research programs are also underway to demonstrate techniques for detection and characterization of fractured reservoirs, and for predicting reservoir quality in exploration programs.

Much of the work performed by Anderson's cadre of scientists—in direct support of Energy Resources' operating divisions—concerns enhanced development of existing fields to produce oil deposits previously considered unrecoverable. Accurate reservoir descriptions are critical to the success of such Enhanced Oil Recovery (EOR) projects.

Below, members of the Stratigraphic Analysis group interpret a variety of seismic, stratigraphic and geochemical information to describe an exploration prospect. Pictured (left to right) are geologists Eileen Williams, Tony Gary, Rich Armin, Gary Sjogren and Leonard Tjalsma. Right, a field operator monitors CO_2 injection at Unocal's Dollarhide field in West Texas. Accurate reservoir descriptions, provided by the Reservoir Characterization group, are critical to the success of such EOR projects.



Right, geologist Nuel Henderson examines well cores to predict rock character and porosity. Far right, geophysicist Frank Martens of the Reservoir Characterization group maps a portion of a reservoir.



Industry-wide, as much as 70 percent of the hydrocarbons present in a given field cannot be recovered by primary and secondary recovery methods alone. As a result, application of EOR techniques has become increasingly important to Unocal as the company steps up its search for additional reserves.

To date, Anderson says, approximately 140 billion barrels of oil have been produced in the United States. Another 100 billion barrels of domestic petroleum, formerly considered unrecoverable, could be produced through existing EOR technologies such as steam injection and horizontal drilling.

"There's still a lot of oil remaining here in the good old U.S.A.—right where we need it," Anderson says. "Finding ways to improve the efficiency and economics of EOR is a big theme in the business right now."

In addition to producing new oil through field extensions and EOR methods, advanced geophysical techniques are now allowing detection of hydrocarbon reservoirs previously hidden beneath developed petroleum finds. Recently, for example, Unocal made substantial gas discoveries below producing oil fields in Michigan and Canada.

Finally, a major research effort in Stratigraphic Analysis, the last of Unocal's five exploration research groups, could be the "big theme" of the future. Though several of the newer disciplines are in formative stages of development, Dr. Al Crawford, manager of the group, says stratigraphic analysis will likely become one of the most important exploration tools of the 1990s and beyond.

Researchers who work under the banner of Stratigraphic Analysis incorporate fossil, seismic and sedimentary information into a framework which can help explorationists determine if the rocks found within a particular area have the potential to produce commercial quantities of oil or gas. Unocal's decision to develop innovative stratigraphic concepts "can greatly improve our ability to locate the subtle, difficult-to-find reservoirs," Crawford explains. In the decades ahead, this ability will enable Unocal to explore successfully and aggressively in older, well-explored regions including most of the continental United States.

By analyzing seismic data, for example, stratigraphic researchers can directly infer whether or not a subsurface rock type is a sandstone or a shale—an understanding which is crucial to determining if an underground formation is a potential reservoir rock or a petroleum source bed. Stratigraphers also study the relationships of underground rock strata at varying depths, which helps them predict the presence of any high-quality reservoir rocks.

Finally, studies of ancient plant and animal fossils—found in rocks retrieved from varying well depths—help researchers determine the age and depositional environment of basin sediments. Such information can indicate whether or not a basin has the potential to contain both the reservoir and the seal needed to form and trap an underground store of petroleum.

"All of these integrated techniques are aimed at helping to predict, ahead of the drill bit, where to place that next exploratory well which might result in a major discovery for Unocal," Crawford says.

Regardless of the technological advances being made in their interrelated fields of study, it is highly unlikely that exploration scientists will ever devise a method for eliminating all risk from the business of locating petroleum deposits. But industry-wide, the synthesis of geophysical, geochemical and geological disciplines has helped improve the chances of finding oil from one exploration well in 10, during the 1960s and 1970s, to the current success ratio of one well in seven. "We have used our understanding to narrow the odds," Dr. John Fox explains. "Good, thorough science has paid off commercially."

Only the future can tell whether or not Unocal's commitment to exploration technology will pay off in a truly big way. But if the company does discover the world's next "elephant" oil or gas field, one can be sure that the Exploration Research department will have been an integral part of the team that found it. *M.B.* 76

TECHNOLOGY AND TEAMWORK PAY OFF

To produce oil and gas offshore The Netherlands, Unocal has had to contend with the unique conditions imposed by the North Sea and its underlying geology. The company's continued success in the region results from innovative technological solutions, efficient operations and a strong commitment to safety (see sidebar). Currently, Unocal Netherlands produces an average of about 18,000 barrels of oil per day from four fields in the Q/1 block of the North Sea's Dutch sector: Helder, Helm, Hoorn and Haven. The company also operates a gas production platform in the L/11 block, which produces 30 million cubic feet of gas per day.

Achieving this level of success—and expanding on it—has not been easy. The geology underlying the Dutch waters of the North Sea complicates production from conventional wells. Because much of the subsurface is composed of small complex structures offset at different geological horizons, hydrocarbon reservoirs are scattered, resulting in multi-platform locations. Additionally, the oil is somewhat viscous and overlies a prolific aquifer. This means that ever increasing amounts of water must be produced from the wells to maintain profitable oil production rates.

Unocal accounts for approximately 20 percent of The Netherlands' total oil production, which in 1990 was 25.1 million barrels. Below, the Helm platform, set in 1982, is located about 25 miles offshore in the Dutch sector of the North Sea.

"The structure of every field is unique," says Tony Stewart, district operations manager. "Some areas are more difficult to produce than others. Certain reserves that we found years ago have had to wait for production until better technology was available. But now we're succeeding in applying drilling and production technology to develop areas which used to be out of economic consideration."

Unocal began actively exploring offshore The Netherlands in 1968, and was the first company to find and develop commercial quantities of oil there. The Helm field was discovered in 1979, followed by Helder, Haven and Hoorn in 1980. Helm and Helder platforms were set in the summer of 1982 and began production that September. Hoorn came on stream in July 1983, and Haven in 1989. Unocal accounts for approximately 20 percent of The Netherlands' total oil production, which in 1990 was 25.1 million barrels.

The company has 38 producing wells, 22 of which were completed by horizontal drilling. A well drilled by this method deviates 90 degrees or more from the vertical, penetrating certain types of oil reservoirs for hundreds or even thousands of feet.

Since 1986, when the company pioneered the technique in the North Sea, horizontal drilling has proven to be a highly effective way to increase production offshore The Netherlands. That year, an existing Helder well scheduled for a workover instead became Unocal's first horizontally drilled well.

By early 1987, the well was returned to production with immediate positive results. Declining oil production rebounded, while both fluid volume and water cut were significantly reduced. As an added bonus, the well cost less to drill and complete than a new conventional well, which would have had to be drilled from the surface.

Several of the company's horizontal wells have been redrilled from existing conventional wells. In many cases, this method, called sidetracking, has resulted in substantial cost savings as well as increased production.

Another technological innovation that has aided Unocal Netherlands' quest for oil and gas is the tripod tower platform (TTP), first used in the Helder field in 1986 and later in Haven. Lighter in weight than a standard platform, the unmanned tripod tower accommodates two wellheads, an emergency shelter and a control room. The TTP proved to be a cost-effective method for producing an isolated well that had been drilled in 1980 and temporarily suspended.

Tripod tower platforms can be designed for relocation, and can cost approximately 25 to 30 percent less than conventional platforms. Much of the savings results from the TTP's light weight. Structural simplicity reduces the amount of steel required by about 40 percent, and an aluminum helideck further lightens the load.

"Horizontal drilling and the TTP have become trademarks of our operations here in The Netherlands," says Gary Carlson, resident manager. "The technology has enabled us to recover reserves from projects formerly thought to be uneconomic."

Innovative use of technology is not the only way the company has succeeded in boosting production and cutting costs. Sometimes a new approach to operating procedures is all that's needed. The company's Profit Improvement Task Force Program encourages employees to look for ways in which to improve operations by making them more efficient. Recently, two such improvements have streamlined operations and added up to substantial cost savings.

Operators in the North Sea routinely charter production supply vessels and maintain a supply base. After studying supply patterns, personnel in the purchasing and logistics department found that while most companies' operations required a production supply vessel on a routine basis, daily runs were often unnecessary. It made financial sense for Unocal Netherlands to share a boat with another company.

To locate a willing partner, the group first had to contend with the general industry practice of dedicating one supply vessel per operator. After several unsuccessful attempts to convince other companies to change supply patterns, Unocal struck a deal with Conoco. Under the agreement, each partner operates the vessel half of every week.

As the operations reached a mature state, the purchasing department reviewed the space needed at the supply base. Conoco was again approached, and after lengthy negotiations reached an agreement with Unocal to share the supply base facilities.

"Encouraging employees to review each operation and think of ways of cutting costs has proved effective," says Carlson."The supply sharing agreements alone have led to annual savings of $1.25 million."

But horizontal drilling remains the most important factor in Unocal Netherlands' ongoing success. When use of this method began in 1986, the company estimated that expanded use of the horizontal drilling technique would add at least 7 million barrels of recoverable reserves to Unocal's oil fields. In fact, horizontal drilling has added 12.7 million barrels of reserves to the books since its first use offshore The Netherlands.

New information about the Helder field's production performance, obtained from the 1987 series of horizontal wells, was entered into a computer simulation model. Reservoir engineers used the model to determine additional areas in which horizontal wells could be productive. Drilling engineers then designed wells to recover these reserves.

In January, Unocal completed five more horizontal wells in the Helder field, which have added a combined average production of 6,675 barrels per day. Total production from Helder has increased to 10,900 barrels per day.

"We've gotten progressively better at horizontal drilling," says Stewart. "Previously, we felt comfortable with building angle at only nine or 10 degrees per 100 feet without being concerned about causing downhole problems. Now we routinely design well courses of 14-degree build rate due to experience in recent wells. This means we can now drill to previously unattainable targets. Even with the increasingly difficult horizontal sidetracks, the most recent wells were finished in record time —averaging 10 days per well. As a result, costs are lower."

The success of the Helder horizontal drilling program spurred the company into taking a closer look at other discoveries previously written off as too marginal for development. One was the Haven field, discovered back in 1980. "The technology and options available at the time did not allow for economic development of Haven," says Carlson. "Horizontal drilling, tripod tower platform technology and new reservoir information combined to bring in Haven successfully."

The development proceeded in phases. First, the TTP had to be removed from its Helder location, modified with new equipment, and installed in its new location in the Haven field. To accomplish this, the TTP's only producing well was plugged. "Production from the well had declined to the point where it was no longer economic," says John Underhill, drilling manager."Moving the TTP to Haven was preferable to building another one."

Work commenced in June, 1989. Unocal contracted with Heeremac Engineering Service b.v. to remove the TTP from Helder, and transport it onshore to start modifications. By August, a contractor had laid a flowline and power/communication cable from the Helder A platform—where the produced oil would go for processing—to the proposed Haven location. One month later, the modified TTP was reassembled and placed at its new location.

"We're succeeding in applying drilling and production technology to develop areas which used to be out of economic consideration," says Tony Stewart, district operations manager. Right, development drilling in the Haven field. Below, a worker inspects a lifeboat on the Helm platform.

The next critical stage of the development plan began in October, when the first of two horizontal development wells was drilled across the top of the Haven reservoir structure. In November 1989, nine years and four months from the discovery date, the Haven field came on production. Currently, the field produces 3,200 barrels of oil per day, down from the initial rate of 4,847 bpd.

"The development went from concept to completion in just 10 months—no small accomplishment," says Carlson. "The project was completed on time and within budget. Now the field performs better than reservoir models predicted, and production has been stable for the last year."

The success of the Q/1 block horizontal drilling program encouraged Unocal Netherlands to look elsewhere for potential applications of the technique, including the possibility of developing the company's portion of the P/9 block into a commercial and viable project. Unocal Netherlands first acquired an 80 percent interest of a portion of the block in 1979, and purchased additional interests early this year.

Located approximately 25 miles offshore The Netherlands, the P/9 oil field was discovered by another company in 1982, and later appraised by four wells with less than encouraging results. The fractured, fine-grained nature of the block's sandstone reservoirs prevented them from yielding optimum production through conventional wells.

"Our experience with horizontal drilling led us to believe that P/9 could be developed by this method," says Carlson. "Based on future development requirements, we selected a location for the appraisal well, and drilled it in December 1987. The results looked promising, so we went ahead with development plans."

In 1988, work began on reservoir simulation to determine the P/9 field's reserves and production profile. The resulting model indicated that a phased approach would be the best way to proceed. First to be installed will be a wellhead platform, wells and a pipeline to transport the oil back to processing facilities on Helder A. This phase is scheduled to begin later this year.

The second phase will begin after sufficient production has occurred to provide data to efficiently design facilities for ultimate field development. At this point, another platform will be installed adjacent to the wellhead platform with facilities for oil, water and gas treating, power generation and living quarters.

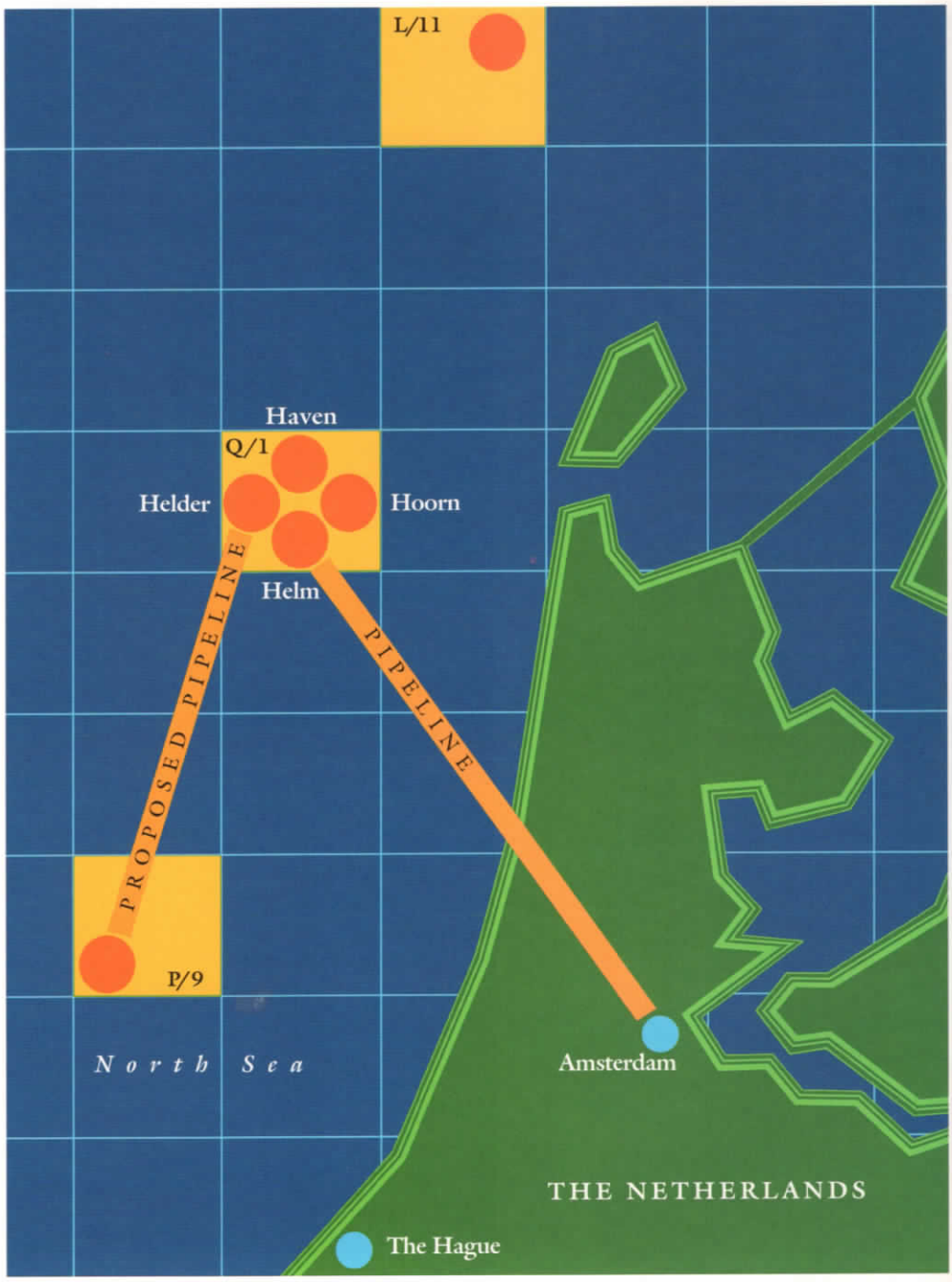
"We estimate that the P/9 oil development will cost $133 million and produce about 50 million barrels of oil over a 20-year period," says Carlson. "As an added bonus, the development schedule allows the company to make use of already-existing assets—the Q/1 block's processing facilities and pipeline."

Crude oil is not the only product produced from the North Sea by Unocal Netherlands. About 32 million cubic feet of gas per day come from the L/11 gas field, which started production in September 1986. Subsequent wells have been added to increase recovery from the field. Last year, an exploratory well was drilled to test the northeast fault block, a separate structure from the rest of the field. Additional reserves were found, and the well began producing in February of this year.

Gas was also found in the Q/1 block 17 years ago, but, like the Haven field, initial results did not support development. "Once again," says Carlson, "we're looking to horizontal drilling to provide the sustained production rates necessary to develop this structure. The well that will make or break this project will be drilled this coming May."

Unocal Netherland's track record in producing oil and gas from the North Sea despite the area's significant obstacles speaks for itself. Given the operation's success in applying innovative technology, the company has good reason to be optimistic. *V.A.* 76

The success of the Q/1 block horizontal drilling program encouraged Unocal Netherlands to look elsewhere for potential applications of the technique. One possibility is development of the company's portion of the P/9 block.



A FIVE STAR EFFORT

Unocal Netherlands has long maintained a firm commitment to safety. That effort has now received prestigious recognition. In January, the International Loss Control Institute (ILCI) awarded the company's offshore facilities its coveted, advanced-level Five Star safety rating.

The award represents the highest level of safety performance attainable under the Institute's International Safety Rating System (ISRS). In fact, of the thousands of facilities using the ISRS in 22 international jurisdictions, only 16 others have achieved Five Star status at the advanced level. The company is the only oil and gas operation to have received this award.

"The move to the Five Star rating was difficult and required extraordinary effort," says Gary Carlson, resident manager. "The award is an honor we all take pride in."

The ISRS is one of the most widely used systems for evaluating occupational safety, health and fire protection in the world, and serves as an international barometer of excellence in safety and loss control. Unlike other industrial safety audit systems which focus on hardware and symptoms of trouble, ISRS concentrates on the underlying management procedures which affect safe operations.

Above, Gary Carlson (left), Tony Stewart and Ian Carmichael display the International Loss Control Institute's top safety award, the coveted advanced-level Five Star rating. Left, a tripod tower platform undergoes preparations and inspection before being installed.

The system evaluates operating performance, and aims to eliminate problems before they occur by building safety measures into day-to-day management. Regular safety audits evaluate the condition of all safety and emergency equipment, and production crews conduct weekly meetings to review safety in operating procedures. All accidents are analyzed to determine their cause and what can be done to prevent a similar incident from happening again.

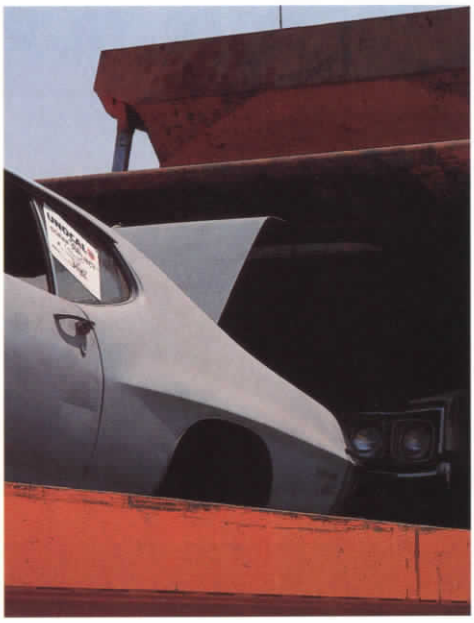
Unocal Netherlands began to incorporate ILCI concepts into its operating procedures in 1983. Since then, the company has steadily raised its ISRS rating by systematically improving its programs in areas such as management and employee training, planned inspections, analysis of procedures, and emergency preparedness. In all, the program evaluates 20 areas of operating procedure.

Attaining the advanced level Five Star rating required the commitment of all Unocal Netherlands employees. In 1983, its first year of participation in the ISRS, the company had 93 production-related injuries. By 1990, the number had been reduced to 20. "The essence of the program is getting everyone involved," says Carlson. "Key to our success has been the work of the safety committees."

Two committees constantly monitor Unocal Netherlands' safety performance: the Safety Program Committee, which integrates field operations with ILCI procedures; and the Management Safety Health and Environmental Committee, which oversees the progress of the Safety Program Committee and reviews suggestions solicited from employees and contractors.

Now that its operations have rated the top Five Star award, the challenge for Unocal Netherlands will be to maintain the intensity of its safety effort.

"We can't reach for a higher ILCI safety rating, because there is none," says Carlson. "But we can still strive to improve our safety performance." 76



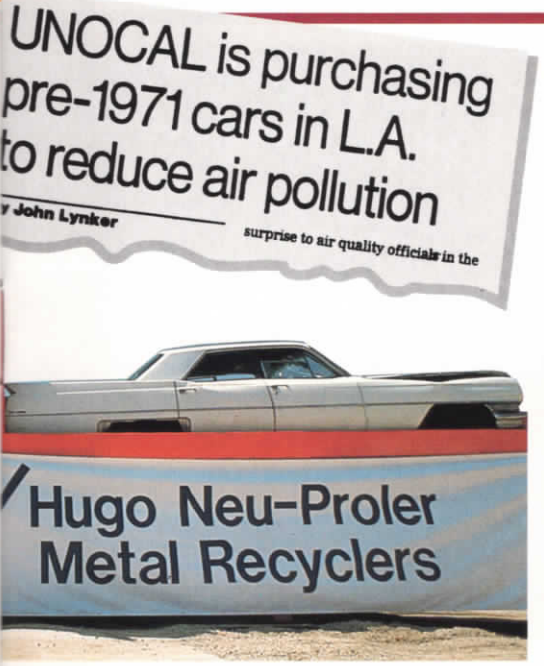
Unocal's SCRAP program removed 8,376 heavily polluting old cars from Los Angeles-area roads.

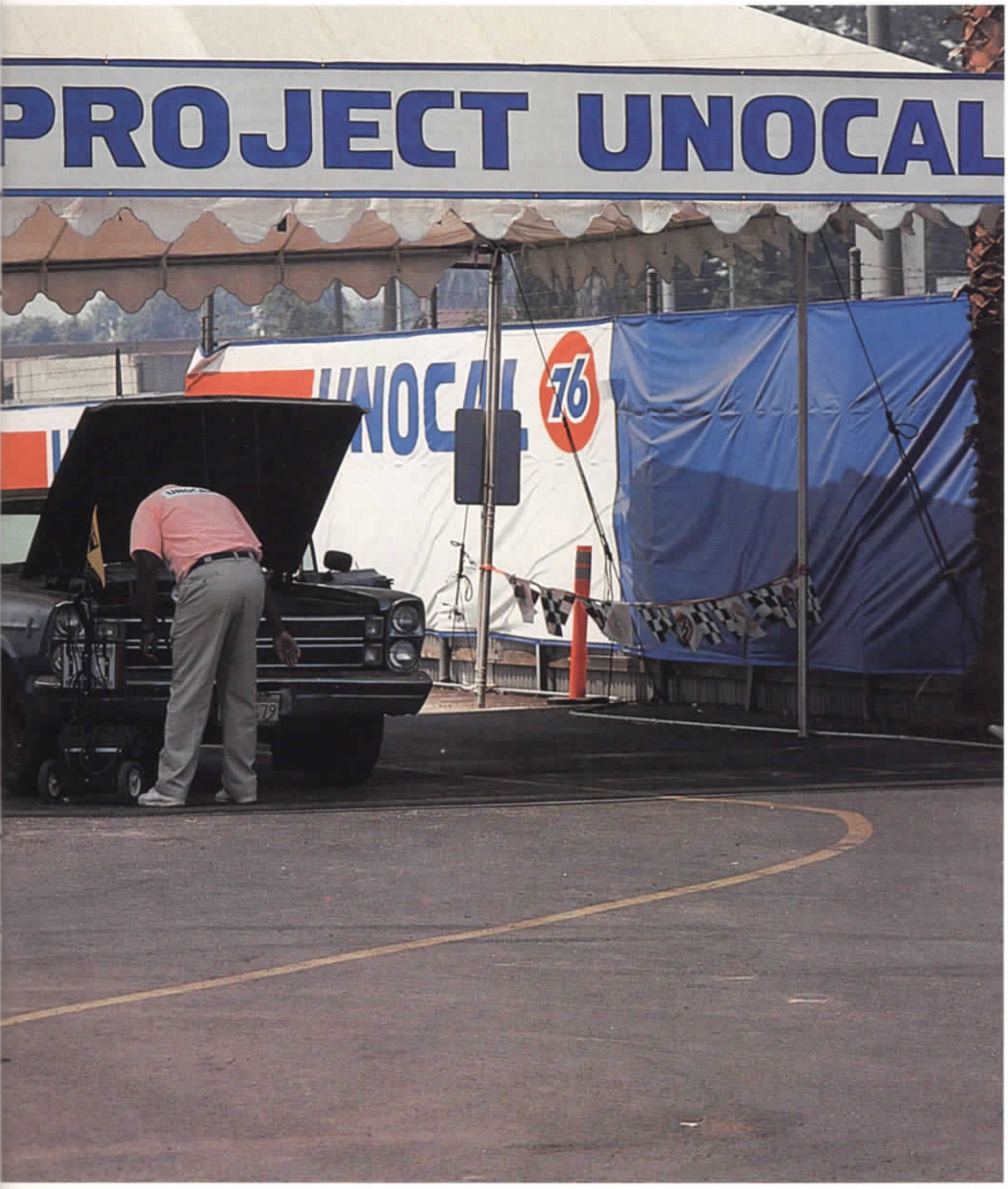
A SMASHING SUCCESS

On a sunny morning last June, an old white Cadillac sedan sputtered onto the grounds of a Los Angeles scrap yard. The driver emerged and walked over to a nearby registration table. As he filled out a form, an attendant drove the car to a tented area, where it was inspected and given an emissions test. Minutes later, a forklift hoisted the car — minus its wheels — onto the floor of an ominous-looking, bright orange metal-crushing machine.

"Here we go," announced Unocal Chairman, President and Chief Executive Officer Richard J. Stegemeier, pushing a button. The machine roared as its powerful vice-like jaws closed, engulfing the Cadillac. Moments later, a flattened mass of white metal emerged from the machine. Unocal had struck the first of 8,376 crushing blows on behalf of the environment.

Under an innovative environmental program it launched in 1990, the company paid $700 apiece to buy and junk 7,100 heavily polluting pre-1971 cars in the Los Angeles basin. Funds contributed by other sources allowed for the purchase of nearly 1,300 additional vehicles. The cars were turned over to a scrap yard, which crushed them and recycled the metal.



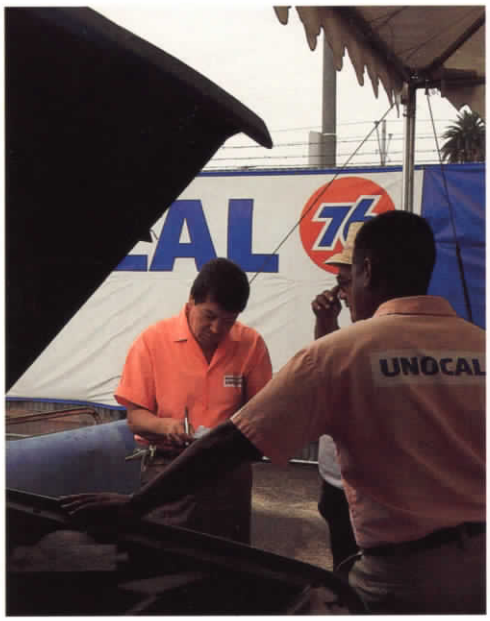


The purpose of the program, dubbed SCRAP (for South Coast Recycled Auto Program), was to demonstrate an innovative and cost-effective approach to solving the air pollution problem in the Los Angeles basin.

Tests conducted on the cars purchased under SCRAP revealed that they emitted 30 to 60 times more pollutants per mile driven than 1990 models. The old cars spewed out about twice the levels of hydrocarbons and carbon monoxide, and nearly three times as much particulate matter, as had been predicted.

According to company estimates, the SCRAP project removed 10.7 million pounds of pollution per year from the air of the Los Angeles basin, at a cost of about $6 million. Reducing unwanted air emissions from Unocal's Los Angeles refinery by the same amount would cost more than $150 million—about 25 times the cost of the SCRAP program—and would take years longer to achieve. In contrast, the environmental benefits of SCRAP were immediate.

The SCRAP campaign, which began in June and ended in October, was complemented by another Unocal-sponsored environmental initiative: the 76 Protech Patrol. Under this ongoing program, a joint effort between Unocal and participating 76 Protech dealers, special vehicles patrol the freeways during rush hours in five western cities.



Unocal offering free road ser

SAN FRANCISCO (AP) — A fleet of cars began free roadside service this week for stranded motorists on San Francisco Bay area freeways, officials from Unocal Corporation announced.

Six white Chevrolet Blazers — the Protech Patrol — will cruise freeways from 6 a.m. to 9 [illegible] to 6 p.m.,

plete with tools, gas, wat er cables and other supp

Unocal will foot the annual bill because air "increases dramaticall slow down due to free stalls," said Roger Be dent of Unocal's Re Marketing Division.

The service start ago on Sacram

"These programs are an excellent way for Unocal to gain the high ground with consumers, with regulatory officials and with our local communities," says Stegemeier. "We also hope to make a real contribution to the public's understanding of environmental issues."

Equipped to provide free emergency road service to stranded motorists, the Protech Patrol trucks help keep traffic moving by getting stalled cars off the freeways. This eases congestion, helping to reduce emissions from backed-up traffic. (See accompanying story.)

Unocal's environmental campaign began taking shape in late 1989. Senior executives of the company decided that new ideas, initiatives and leadership were needed from the private sector if the nation was to meet the environmental challenges of the 1990s. In particular, they believed Unocal should be a leader in environmental matters.

In addition to launching SCRAP and Protech Patrol, last year the company agreed to supply low-sulphur fuel for truck fleets participating in Navistar International's prototype smokeless diesel engine project. Unocal also announced plans (in partnership with San Diego Gas & Electric)to make compressed natural gas available as a vehicle fuel at one of its San Diego-area service stations.

"These programs are an excellent way for Unocal to gain the high ground with consumers, with regulatory officials and with our local communities," Stegemeier explains. "We also hope to make a real contribution to the public's understanding of environmental issues. Programs such as these represent an innovative attempt to reduce air pollution without having an adverse effect on Southern California's economy or lifestyle."

While both initiatives have attracted public attention, SCRAP made headlines around the world. The program also cultivated untold good will for Unocal. Newspaper editorials praised the program, as did public officials.

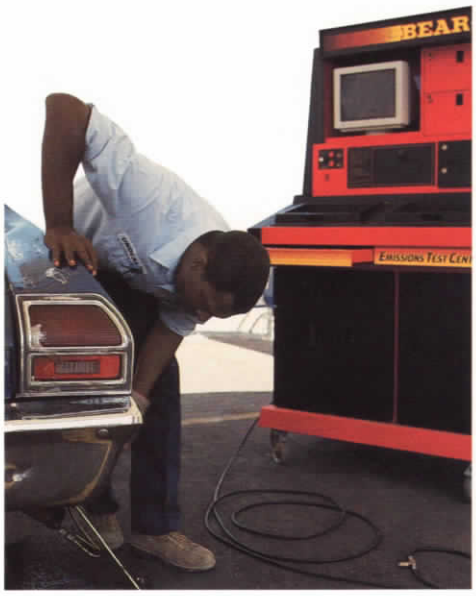
"This unprecedented program shows Unocal's commitment to clean air," Norton Younglove, chairman of the governing board of the South Coast Air Quality Management District (SCAQMD), wrote in a letter to Stegemeier. "The SCAQMD cannot carry the clean air banner alone, but must count on private-sector pioneers to step forward and share the duty. Unocal's contribution not only meets the challenge, but also illustrates the commitment and leadership we must all exert to make clean air a reality in Southern California."

The SCAQMD further enhanced the program's credibility by contributing $100,000 to help Unocal buy and junk nearly 150 additional cars. The company received support from other quarters too. First Interstate Bank of California offered special loan rates and terms to people who junked their old cars under SCRAP and wanted to buy newer, cleaner ones.

Ford Motor Company, along with Los Angeles-area Ford and Lincoln-Mercury dealers, contributed more than $700,000 to the program, enabling Unocal to scrap more than 1,000 additional cars. Stegemeier also received a check for $700 from the employees of Cypress Semiconductor to "buy and bury one for us, too."

Public response to the SCRAP program was equally enthusiastic. A toll-free telephone number was set up so reservations could be made for scrapping vehicles. The phone rang often enough to build a waiting list that at times numbered more than 3,000 would-be sellers.

Support from various state agencies ensured that the operation went as smoothly as possible. When autos are sold for scrap, they must be cleared by the Department of Motor Vehicles (DMV) to establish proof of ownership and to certify that the car will not be resold and returned to use. Typically, five to 10 days elapse between the time a scrap yard purchases a car and actually junks it. But at the volume the company expected—100 to 150 vehicles per day—storage space would be insufficient for such a delay.



Unocal representatives met with officials of the DMV, who recognized the value of the program and committed the agency to support it with personnel and computer hook-ups. This enabled Unocal to move sellers quickly through the paperwork process, give them preprinted checks, and crush their cars within just a few minutes time.

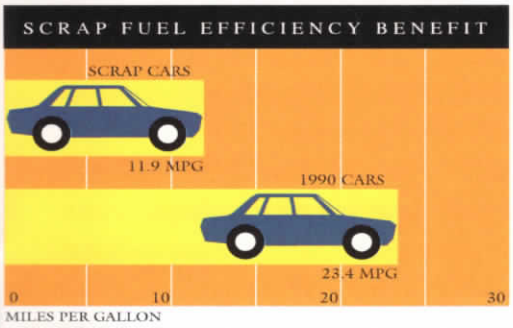
Restrictions were established to guard against importation of cars into the Los Angeles basin to be sold at a quick profit. Vehicles were eligible only if they had been registered for the previous six months within the area regulated by the SCAQMD, which includes portions of Los Angeles, Orange, San Bernardino and Riverside Counties. The cars had to be driven to the scrap yard under their own power, and offered for sale by the registered owners.

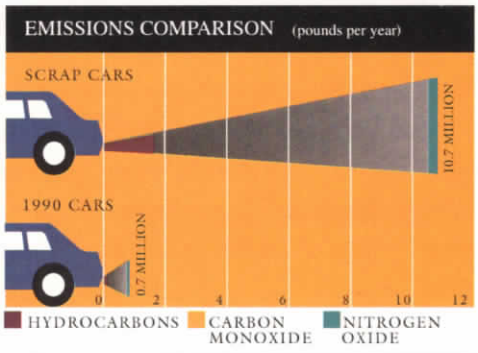
The $700 bounty was also carefully determined. Market research indicated that post-1975 vehicles — much cleaner cars with emission control equipment —were available for less than $700. SCRAP car sellers received month-long bus passes to provide public transportation while they looked for replacement vehicles.

Research also helped Unocal identify the target vehicles. Data from the California Air Resources Board showed that cars built before 1971 caused 15 percent of the air pollution in the Los Angeles basin, even though they accounted for only 7 percent of the vehicles on the road. (More than 400,000 pre-1971 automobiles are registered in the Los Angeles basin.) The data also indicated that pre-1971 cars, which have no emission control equipment, emit 15 to 30 times more pollutants (hydrocarbons, carbon monoxide and nitrogen oxides) into the air than new cars.

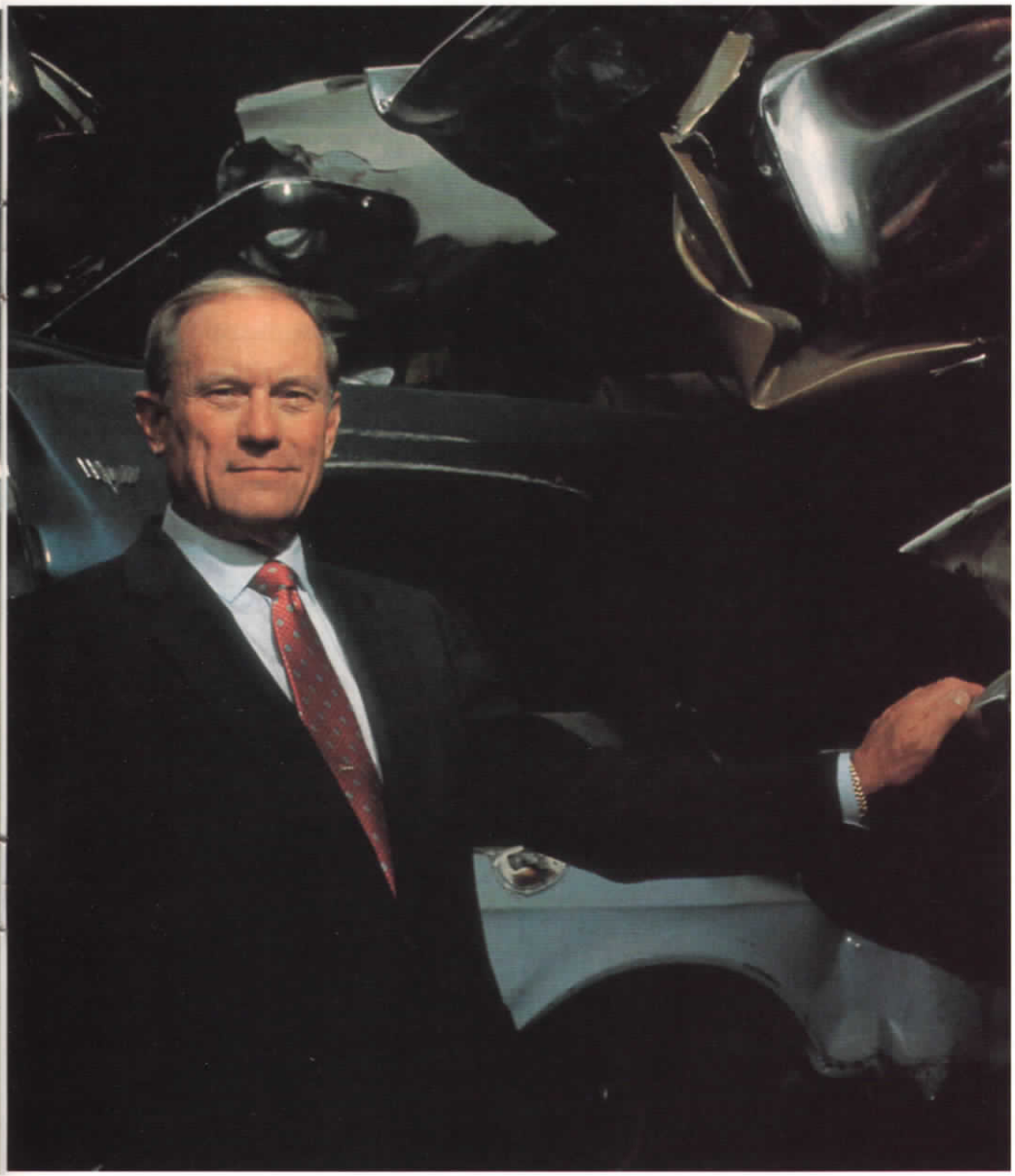
To gather scientific data on the SCRAP cars for comparison, Unocal tested the exhaust emissions of every vehicle purchased. Seventy-four of the cars underwent more intensive testing. These vehicles, chosen at random, were put on chassis dynamometers and run through the standard Federal Test Procedure, a regimen used by the U.S. government to monitor automobile emission-control performance. The results showed that pollution from the SCRAP cars was far more severe than had been anticipated.

On average, the SCRAP vehicles emitted more than 65 times the hydrocarbons and about 50 times the carbon monoxide of new 1990 models.





Unocal tested the exhaust emissions of every vehicle purchased under SCRAP. The results showed that pollution from the SCRAP cars was far more severe than had been anticipated.



The worst car tested emitted 87.3 grams of hydrocarbons per mile, or enough unburned gasoline to fuel an efficient 1990 car. Furthermore, the cars purchased under SCRAP averaged only 11.9 miles per gallon of gasoline in a test simulating urban driving conditions — about half the average gas mileage of 1990 cars.

The message of the SCRAP program apparently has not been lost on Washington. Some political observers expect the Department of Energy to propose a plan in 1991 calling for the federal government to buy old cars from their owners to help clean up the nation's air.

"It's important to stress that our environmental initiatives were never intended to solve Southern California's air quality problems by themselves," notes Roger Beach, senior vice president of Unocal and president of the company's Refining & Marketing Division. "The programs were designed to demonstrate what could be achieved if industry and government mobilized in a cooperative effort.

"They were also intended to make a strong contribution to the public's understanding of environmental issues. I believe both of those missions have been accomplished. Now we look for others to join us in further efforts." (76)

Story by Art Bentley

ON THE ROAD WITH PROTECH PATROL

It's 8 a.m. Monday on a busy stretch of the Ventura Freeway in Los Angeles. Michelle Jackson, the manager of a lingerie shop in Pasadena, is cruising to work amid the moderately heavy, eastbound flow of traffic. Without warning, her 1989 Nissan Sentra begins to veer sharply to the right. Employing a firm two-handed grasp, Jackson compensates for the strong, jerky pull of her steering wheel and safely maneuvers her car to the right-hand shoulder of the road. One of her front tires has just blown out.

One glance at the shredded rubber remains of the passenger-side tire instantly convinces Jackson that she needs help. After walking a quarter-mile along the roadside to the nearest freeway call box — only to find it out-of-order — she returns, frustrated, to her car. For Michelle Jackson, the workweek is off to a less-than-fantastic start.

But as if on cue, a remedy for her car trouble and rapidly deteriorating disposition suddenly arrives as an official-looking vehicle with a familiar blue and orange "76" logo on its hood pulls over. The driver, a stocky man clad in a blue uniform, gets out of the truck and approaches her. Jackson eyes him with mixed feelings. Though she's glad that help has arrived, she also knows that emergency road service can be expensive.

"Hello, Ma'am," the driver says. "I'm with Unocal 76 Protech Patrol. Would you like some free roadside service?"

The din of passing freeway traffic makes his words difficult to understand. "Did you say *free* road service?" Jackson asks.

The driver nods affirmatively. For the first time since her tire blew, Michelle Jackson manages a smile.

At 4:45 a.m., Driver Elliot Schnee maps out his route for the morning rush hour. In a single eight-hour shift, Schnee typically patrols as many as seven different Los Angeles-area freeways in search of stranded motorists.

Elliot Schnee, a Protech Patrol driver since the program began in the Los Angeles area last July, surveys the damage while Jackson watches over his shoulder. He points out that the tread of the flattened tire is worn smooth. "I knew that tire needed to be replaced," she says to him. "I guess I procrastinated just a little too long."

Within minutes, Schnee has mounted the Sentra's spare tire, added air and tightened the lug nuts. Jackson looks at her wristwatch. "This is great," she says, starting the car's engine. "I won't even be late for work."

Operated as a partnership between Unocal and participating 76 Protech dealers, Protech Patrol is a free service offered in five western cities to assist stalled motorists and thereby help keep traffic moving. Though they do not attempt to perform major repairs, Protech Patrol drivers are trained and outfitted to solve automotive problems of a minor nature.

Equipped with a five-gallon can of gasoline, a hydraulic jack, battery jumper cables, a portable air compressor, radiator coolant, flares, a fire extinguisher and a cellular mobile telephone, each Protech driver cruises hundreds of freeway miles during his eight-hour shift in search of stranded motorists.

On the surface, the Protech Patrol may appear to be little more than a time-saving convenience for stranded freeway commuters. But the program also has environmental benefits.

Mention Los Angeles and many people

think of smog. Indeed, some environmental authorities consider Southern California's air quality to be the worst in the United States. Motor vehicle emissions have long been identified as a major culprit behind the region's air pollution woes. Exacerbating the emissions problem are the enhanced levels of pollutants spewed by the scores of idling cars which—thanks to California's infamous traffic jams—are routinely relegated to moving along major thoroughfares at a snail's pace.

On Los Angeles freeways, a single stalled vehicle can precipitate a full-scale traffic jam. During rush hours, such a snarl typically results in wasted gasoline and a significant increase of tailpipe emissions as cars back up in bumper-to-bumper traffic. By offering timely roadside assistance to the stalled motorist, Protech Patrol helps keep traffic moving smoothly—which in turn helps reduce commuter vehicle emissions.

Unocal estimates that if one Protech Patrol vehicle reduces traffic delay on a typical four-lane freeway by even one minute, commuters would save nearly 5,000 hours and 1,400 pounds of pollutants would never reach the air.

The Protech Patrol program represents just one part of Unocal's effort to reduce Los Angeles-area automobile emissions. Complementing Protech Patrol in the company's battle against airborne pollution is the South Coast Recycled Auto Program (SCRAP), which last summer removed nearly 8,400 heavily polluting old cars from Los Angeles-area roads. (See accompanying story.)

Statistical data has yet to be compiled that might gauge the effectiveness of Protech Patrol in reducing auto emissions. But at least one air quality advocate believes the benefits are substantial—and that California could use more private-sector initiatives like it.

"Traffic congestion remains one of the biggest sources of air pollution in Southern California," says Norton Younglove, chairman of the South Coast Air Quality Management District (SCAQMD). Contrary to popular belief, Younglove adds, freeway congestion is often caused not by heavy traffic volume or auto accidents, "but by tie-ups resulting from individual vehicles which break down and impede the flow of traffic."

In addition to minimizing idle-speed auto emissions, a smooth flow of freeway traffic also helps decrease commuter stress, says Younglove. "The Protech Patrol is a Good Samaritan not only to those motorists whose cars have broken down, but also to those of us who would be stuck in the resulting traffic jams," he explains. "Unocal and its Protech dealers are making a very important contribution toward easing our freeway situation simply by assisting people whose cars break down at the wrong time and in the wrong place."

Other officials charged with the protection of public health and safety echo Younglove's praise for the Protech Patrol program. "I'm sure the Protech Patrol is having a very positive impact," says Sgt. Mike Brey, spokesman for the California Highway Patrol. "Certainly it's a benefit to the motorist. From that standpoint, we welcome what Unocal and its dealers are doing."

By tending to motorists who have been

"Did you say free road service?"

During particularly busy rush hours, Schnee might render roadside assistance to as many as 30 motorists.

waylaid by minor mechanical breakdowns, Protech drivers may also be boosting the effectiveness of the CHP. "I've heard several officers comment that often when they've come upon disabled vehicles, a Protech Patrol truck was already there to help," Brey explains. "That frees the patrolman to concentrate on more serious concerns."

The idea for the Protech Patrol program originated as part of a "grass-roots" initiative undertaken in 1988 by a group of Sacramento Unocal dealers, says Bob Mattes, supervisor of special projects for Unocal Western Marketing's Southern Division. Operating costs of the original patrol vehicle — initially dubbed the *Spirit* — were split between participating Unocal dealers, a local radio station and a cellular phone company.

Because the *Spirit* was so well received by area motorists, in 1989 the participating Sacramento Protech dealers approached Unocal for financial backing to expand the program. Impressed by the program's success, and mindful of its air-quality benefits, the company agreed to provide funds for the dealers to acquire additional patrol vehicles, along with advertising support.

Re-christened as the "Protech Patrol," the Sacramento initiative soon inspired Unocal 76 Protech dealers in other western cities to inaugurate their own emergency roadside service programs. Today there are more than a dozen Protech Patrol vehicles combing freeways in Sacramento, Fresno, San Diego, Los Angeles, and most recently, in Hawaii.

"I must emphasize that it was the dealers themselves who came up with the Protech Patrol concept," Mattes says. "It's still their program. They are the ones who underwrite the monthly expense of running the patrols, and they make it work."

"They just couldn't believe I was out there on a holiday."

Including the truck that Schnee drives each weekday morning, more than a dozen Protech Patrol vehicles comb freeways in metropolitan areas of California and Hawaii.

Depending upon who is asked, the Protech Patrol program represents a significant benefit to commuters, law enforcement officers and breathers of polluted air. But for Patrol drivers like Elliot Schnee, the success of the program is measured more incrementally— one stranded motorist at a time.

"Whenever I stop for someone on the side of the road, it's obvious that they really appreciate my help," Schnee says as he maneuvers his truck in merging lanes of freeway traffic. "A lot of people thank me several times before they drive away."

Motorists stranded by minor problems—including flat tires, overheated radiators, discharged car batteries and empty gas tanks—typically receive immediate hands-on attention from Schnee. "We just try to help them to the point where they can get their cars moving again," he explains. Although Schnee is not equipped to remedy more serious breakdowns, he still manages to aid these motorists by allowing them to use the truck's cellular phone to call for help from a friend, family member or towing service.

Currently, a total of six Protech Patrol trucks cruise the network of freeways that crisscross the Los Angeles metropolitan area. As the morning-shift patroller for the Pasadena area, Schnee's day begins at 5 a.m. and ends at 1 p.m., Monday through Friday. Another driver takes over his patrol route during the evening rush-hour shift. On aver-

age, Schnee makes 18 freeway stops before his workday concludes.

"On busy days, it's not uncommon for me to help as many as 30 motorists," he says. "Even on Thanksgiving Day — when the freeways were pretty empty — I helped people in 14 different vehicles. Most of them were families. They just couldn't believe I was out there on a holiday."

Each time Schnee stops to render assistance to the victim of a mechanical breakdown, he also gives the motorist a packet containing a blue and orange 76 antenna ball, a car litter bag, information about repair services offered through 76 Protech dealers, and a customer response card which solicits motorists' opinions of Protech Patrol.

"The public absolutely loves this program," says Mattes. "I receive six to eight customer response cards each day, and every one of them gives Protech Patrol an outstanding review."

"The public absolutely loves this program."

Often, a little water in the radiator or some air in a tire is all that's needed to get a stalled car back on the freeway. Here, Schnee provides a stranded motorist with a timely jump-start.

Protech Patrollers are given free rein to roam any freeway route within their respective geographical areas. Schnee himself typically patrols seven different freeways during his work shift.

"I try to hit each freeway on my route at least twice a day," he explains as he scans the road ahead for broken-down cars. "That means I drive roughly 200 to 250 miles per day. In fact, we've already put more than 49,000 miles on our patrol truck in just the last six months."

The sight of a stationary red Porsche at the side of the freeway interrupts Schnee's discourse. "Let's see what the problem is here," he says, flipping on the truck's rooftop bar lights.

Schnee pulls up behind the Porsche and announces himself over the truck's P.A. system as a member of the Unocal 76 Protech Patrol. A middle-aged man pulls his head out from underneath the car's opened hood and acknowledges Schnee.

"It just stopped running," the man says, gesturing toward the engine. Schnee takes a close look for any obvious signs of trouble.

"Try cranking the starter again," he suggests. The driver tries twice to restart the car, but the engine refuses to turn over. "The problem could be vapor lock," Schnee hypothesizes. "Why don't you give it one more try."

The man's third attempt proves to be the charm as the Porsche's engine rumbles back to life. Smiling, he gets out of the car and shakes hands with Schnee. "Maybe the engine was just flooded," Schnee offers.

Moments later, the Porsche is back on the road and Schnee retreats to the truck to continue his patrol. He pauses to take a sip of coffee, turns off the truck's bar lights and then merges back onto the freeway. "Some car problems are easier to fix than others," he says.

Obviously, with hundreds of freeway miles to cover during their shifts, Protech Patrol drivers cannot always be everywhere they are needed. But if you are a rush-hour commuter, it's comforting to know that when automotive technology sputters, Elliot Schnee and his fellow Protech Patrollers are combing the freeways to help you get back on the road again. *M.B.*

MR. CHEMICAL COMES TO CLASS

Judging by the plaintive and somewhat melancholy voices of the 290 elementary school students in his audience, Rudy Gonzales' schoolyard science demonstration has ended all too quickly.

"C'mon, Mr. Chemical!" a boy with a flattop haircut groans, "do one more!"

The boy's zeal for greater scientific knowledge is displaced by a different brand of enthusiasm when his teacher, who has spent the last hour monitoring the outdoor assembly, dismisses the class for the day. Most of the children stream from the schoolyard in typical breakneck fashion—yelping, teasing each other and jumping over cracks in the sidewalk. But two boys lag behind.

Leaning against a chain-link fence, they silently watch as Gonzales removes his white lab coat and begins packing a cardboard box with glass beakers, graduated cylinders and chemical-filled vials. Finally, the two boys muster the gumption to approach him.

"Mr. Gonzales," one of them asks tentatively, "can we have your autograph?"

While Rudy Gonzales' chemistry expertise has elevated him to quasi-celebrity status on the elementary school science circuit, it has also formed the backbone of a career spanning nearly two decades. February marked the beginning of his 19th year as a chemist with Unocal's Science & Technology Division. While on the job, Gonzales is designated as both a catalyst research technician and the School Science Coordinator. But in many elementary schools throughout Southern California he's known by more colorful sobriquets.

"The kids call me all kinds of things," Gonzales says with a broad smile. "Mr. Science, Mr. Chemical, Mr. Magic. It's always fun to hear what they come up with next."

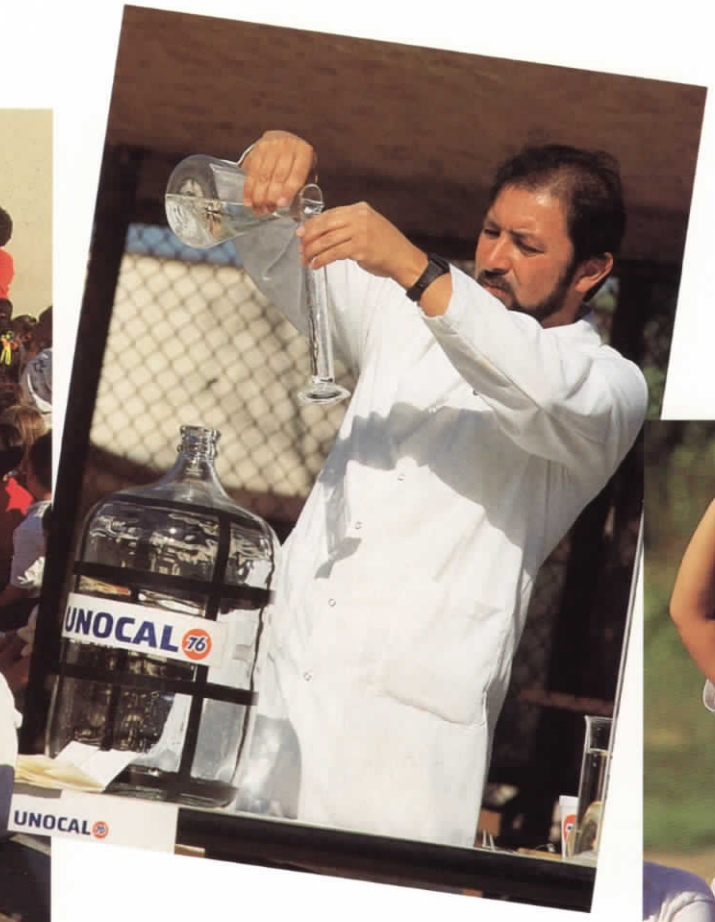
One might think that Gonzales has heard it all during the nine years he has been performing his science shows for elementary school students. Gonzales put on his first show for his daughter Rachel's second-grade class. The demonstration was well received, as were subsequent shows at other schools. Before long, elementary school teachers throughout Southern California began to approach Gonzales in hopes of scheduling science demonstrations for their own students. Currently, Gonzales performs his traveling science show at an average of two schools each month.

"I guess you could say the program has taken off like popcorn in a movie theater," he says.

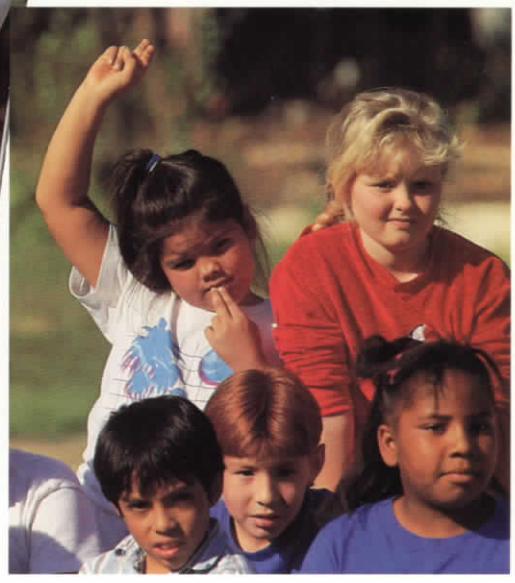
Though he originally performed the shows during his own free time, Gonzales eventually persuaded his Unocal supervisors to support his volunteer teaching efforts. Impressed by positive reviews from teachers and parents, the company initially allowed him to take off a few working hours each month to perform at nearby schools. During the past four years, Unocal has further supported Gonzales by reimbursing incidental expenses as well as furnishing a company car, laboratory equipment and assorted chemical compounds for use in his science shows.

"We view Rudy's science demonstrations as desirable for several reasons," says Dr. Ken Baron, manager of Catalyst Research and Gonzales' direct supervisor. "First of all, it's an excellent way of getting to know the schools and local communities. It also gives parents a very positive image of Unocal."

"The program has taken off like popcorn in a movie theater."



S&T chemist Rudy Gonzales has enthralled schoolchildren with his live science demonstrations for nearly a decade. "I want to show the kids that science is all around us in everyday life — and that it can be fun," he says.



"Yes, it does look like magic, but it's really science."

Looking down the road, the shows provide an opportunity to enhance student interest in science and to help groom scientists for the future, Baron adds. "Presently, there's a dearth of good science students in our high schools, and we need to think about the long term. Obviously, a corporation as technology-intensive as Unocal has an interest in seeing more students train to be scientists. Besides that, the kids get a kick out of the demonstrations. And I know that Rudy enjoys doing them."

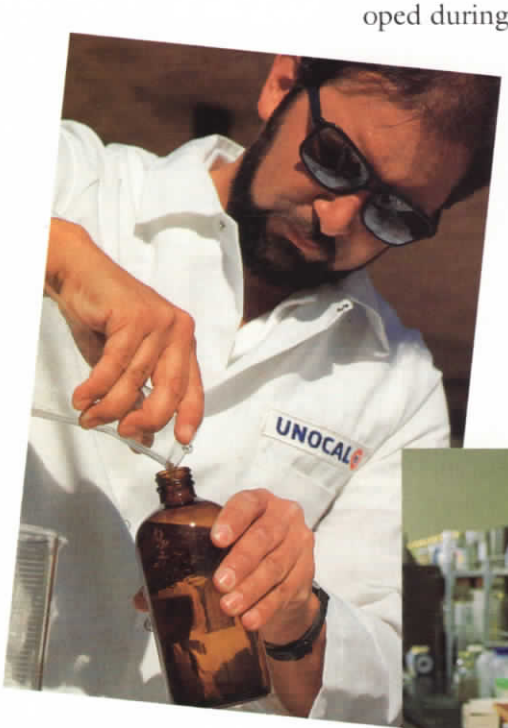
By constantly polishing his material, Gonzales has kept the science demonstrations from becoming routine. The content of his show has been reworked over the course of hundreds of on-site demonstrations, with student reaction serving as a guide for many of the modifications Gonzales decides to make. Though each presentation seems fairly spontaneous to the first-time observer, the material—from the choice of experiments to related science anecdotes and jokes—has been carefully developed during the past decade.

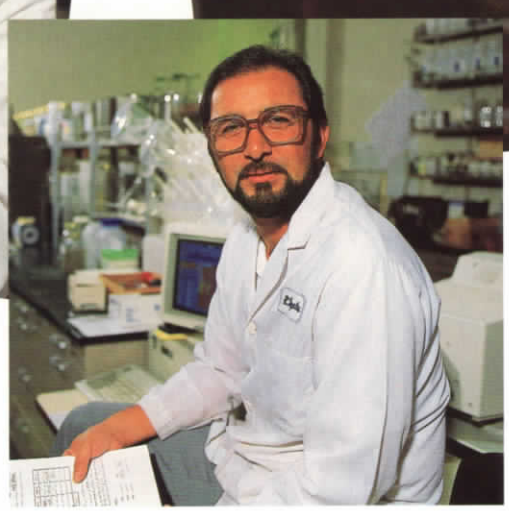
"Young kids are a tough audience —really tough," Gonzales explains. "They'll catch everything. I've tried out a lot of different approaches and experiments over the years, and I keep only the ones that work best."

Thanks to his trial-and-error method of improving the presentation, Gonzales' show has evolved into a sure-fire hit with pupils in the 8th-grade-and-younger age brackets. The material is informative and, above all, entertaining.

"It's hard for kids to sit still through a long talk, so I try to make the shows as entertaining as possible," Gonzales says. "Most of the experiments I show them are chemical reactions which result in some sort of color change. Some children think I'm performing magic tricks, so I tell them, 'Yes, it does look like magic, but it's really science.' "

During each show, Gonzales stresses several basic tenets of the scientific method. Chief among these is the importance of laboratory safety.





By constantly polishing his material, Gonzales has kept the science shows from becoming routine. "Kids are a tough audience — really tough," he says. "I've tried out a lot of different approaches and experiments over the years, and I keep only the ones that work best."

"I love children—I have five of my own—and that's why I really emphasize safety. I tell them it's very important for a scientist to know what he's doing," Gonzales says. "I also try to introduce the concept of hypothesis. I impress upon them that a scientist needs to have an idea of what's going to happen when he conducts an experiment."

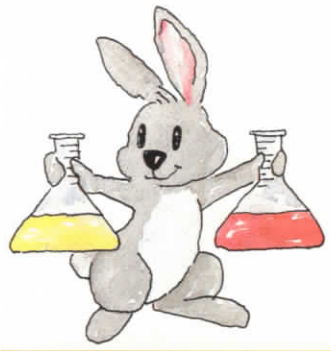
Other messages that Gonzales conveys are somewhat less didactic. "I try to explode the myth that you have to be a genius to like science," he explains. "I want to show the kids that science is all around us in everyday life—and that it can be fun."

The extent to which Gonzales successfully conveys his messages is apparent in the feedback he has received over the years. Opening a cabinet in his laboratory at the company's Brea research center, he withdraws a box filled with cards and letters. Though some of the correspondence consists of thank-you notes from teachers and parents, most of the letters have been written by schoolchildren. Often, they include the youngsters' crayon renderings of experiments that Gonzales has performed during visits to their schools.

"I've gotten tons of letters from kids who say, 'I want to be a scientist when I grow up,' " Gonzales explains while sorting through the pile of correspondence. "That always makes me feel pretty good."

The personal satisfaction that Gonzales reaps through his presentations is obvious to anyone who sees him in action. Welcomed as a visiting dignitary by the teachers of Lincoln Elementary School in Whittier, Gonzales is led out to the playground where he sets up a table for his experiments. With the anticipating eyes of several hundred schoolchildren watching his every move, Rudy Gonzales knows the moment has come for show time.

"Okay," Gonzales says, "let's start out with something simple." Using a pair of metal tongs, he removes several small chunks of an opaque, whitish material from a bowl and places them in a tall graduated cylinder.



"I try to explode the myth that you have to be a genius to like science."

"He's as good as Mr. Wizard!"

"This is dry ice," he continues, "which is really frozen carbon dioxide. Its temperature is about minus 110 degrees. Now when regular ice melts, it turns back into a liquid state —which, as you all know, is water. But dry ice is different. As it melts, it becomes a gas. Right now, you can't see the gas coming out the top of this cylinder. But if I pour in some liquid..."

Gonzales adds dyed water to the cylinder, which immediately causes the chunks of dry ice to bubble. As the gas breaks the water's surface, it fills the remainder of the cylinder with a dense white fog. Eventually the fog rises and spills out over the mouth of the cylinder, where it dissipates into the air.

"Cool!" cries one of the boys in the audience. "It's like a Frankenstein movie!" Other pupils "ooh" and "ahh" at the sight of the smoking glass tube. Comprised of students from ages five through 12, Gonzales' audience is remarkably well-behaved and attentive despite the occasional outbursts of exuberance.

"Chemistry can be fun. Sometimes it even seems like magic," Gonzales tells the children. "But you've got to remember that some of the chemicals we use can be dangerous. That's why, when I'm working in my lab, I always wear safety goggles and a lab coat."

For the next hour, Gonzales performs a variety of experiments. Many of the students are perched on the edges of their chairs as he demonstrates an oxidation reaction which causes a half-bottle of yellow liquid to turn red when it is shaken. Later in the presentation, Gonzales declares that he can get a peeled, hard-boiled egg through the narrow opening of a flask without even touching it. Several of the kids appear unconvinced by the claim.

Undaunted by their skepticism, Gonzales drops a burning piece of paper into the flask and covers the mouth of the bottle with his egg. Suddenly, and with a clearly audible "thwuck," the flask's internal combustion sucks the egg through the tiny opening. This phenomenon elicits a hearty round of applause.

"I've gotten tons of letters from kids telling me they want to be scientists when they grow up," Gonzales says. "That always makes me feel pretty good."

After about a dozen demonstrations, Gonzales is ready to deliver his finale. "For my last experiment, I'm going to pound a nail into a block of wood with this banana," he says.

"No way!" one boy yells. "You need a hammer!" shouts another.

Gonzales holds the nail between thumb and forefinger, places the point to the wood and, with a quick movement, brings the banana down on the nail's head. Feigning disappointment over the result, Gonzales lifts the banana to display it to the students. As they expected, the nail has easily penetrated the fruit and now protrudes through its skin.

"Oh, I forgot one thing," Gonzales says. From a large Thermos bottle he pours a smoking liquid into an insulated cup. "Remember how cold the dry ice was? Well, this stuff I'm pouring is called liquid nitrogen and its temperature is minus 340 degrees. I'll just dip the banana into the cup and see what happens."

After a minute or so, Gonzales removes the banana from its icy bath and again takes aim at the nail. Three sharp blows with the now frozen-solid banana are all he requires to drive the nail into the wooden block.

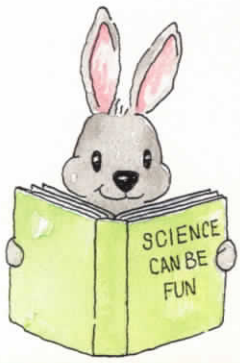
With the show now complete, there are few, if any, unbelievers remaining among the audience. If Gonzales says he can perform magic through science, by golly, they believe him.

"He's as good as Mr. Wizard," says sixth-grader Adam Cooney. "I'm not sure how all the experiments work, but I think it would be really neat to work with chemicals."

"This was just fantastic," says fourth-grade teacher Sharon Rehmyer. "As far as I'm concerned, the more science we can expose our students to, the better."

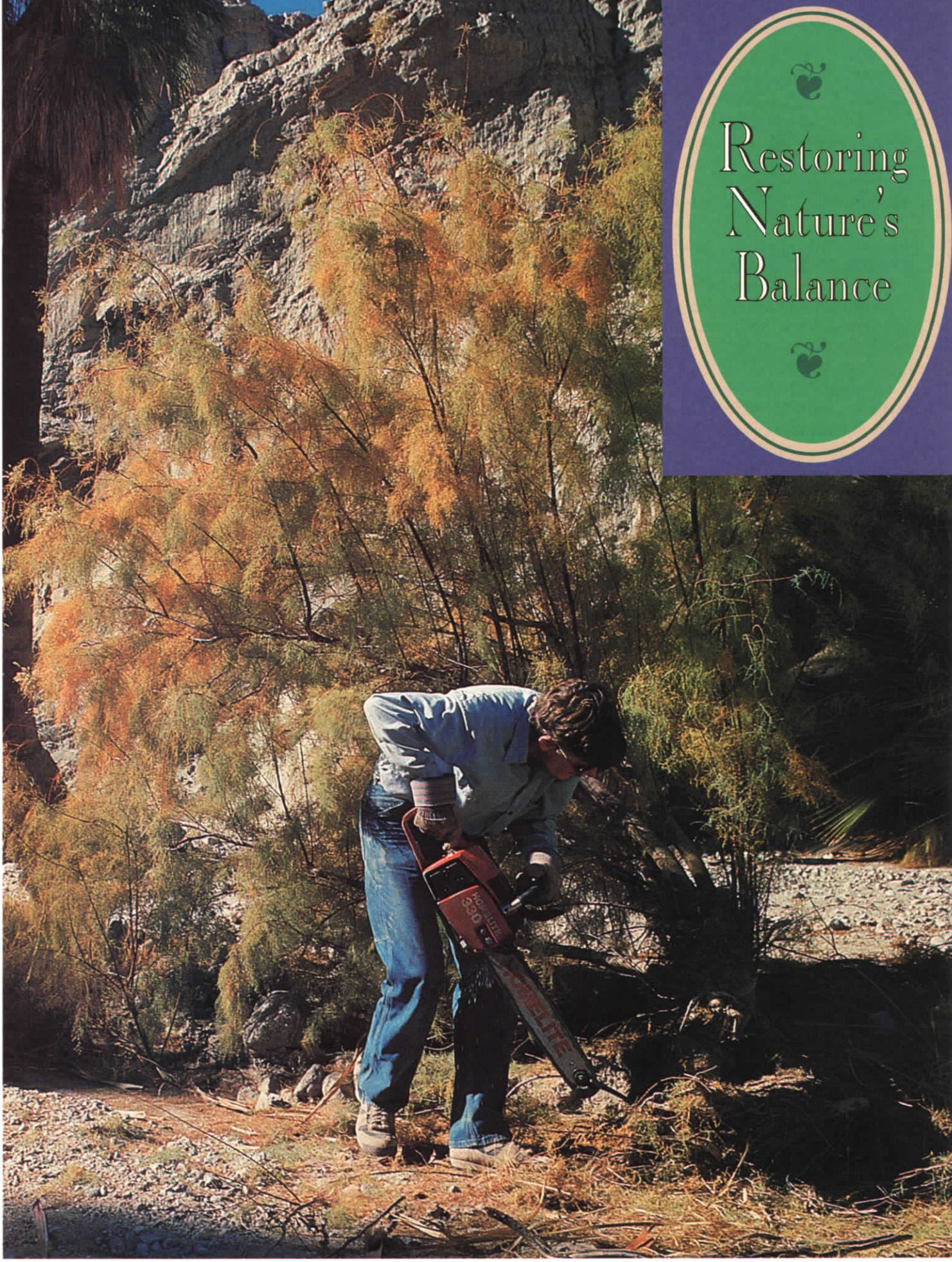
Despite such rave reviews, Gonzales downplays his effect on the children. "My show is only an introduction to chemistry," he explains. "I just try to spark that little flame of interest in the kids."

Perhaps that spark is all that is needed. There may be more than one future Unocal chemist or engineer who has embarked on his or her journey into the world of science during one of Rudy Gonzales' magical science shows. *M.B.* (76)



"I just try to spark that little flame of interest in the kids."

Restoring Nature's Balance



With a sharp tug on its pull cord, Bill Neill, a petroleum engineer with Unocal's Science & Technology Division, fires his chain saw to life. Its ear-splitting drone echoes off the steep, dried-mud walls of Pushwalla Canyon, a remote desert oasis hidden among the Indio Hills several miles northeast of Palm Springs, California. Putting the blade to the gnarled trunk of a tamarisk tree, Neill is quickly engulfed in a cloud of sawdust. Before long he has cut his way through a dense thicket of the tangled trees that choke the canyon floor.

"I guess it's kind of ironic for a desert conservationist to be cutting down trees instead of planting them," Neill says, taking a break from his labors as the buzz of a half-dozen other chain saws reverberates through the morning air. "Most people would probably consider this a rather unconventional idea of environmentalism."

Indeed, those unfamiliar with tamarisk might wonder why anyone would want to rid the sun-beaten desert of an entire species of tree. But to an avowed environmentalist like Neill, eliminating tamarisk from the desert is not unlike uprooting dandelions from his lawn.

Characterized by its ability to robustly survive periods of drought, tamarisk was imported to this country—for use as an ornamental windbreak shrub—from Eurasia nearly 140 years ago. But since then, the opportunistic plant species has proliferated widely throughout desert springs and river basins in areas west of the Rocky Mountains.

Disturbingly, tamarisk's prodigious spread has occurred at the expense of mesquite, willow, cottonwood and other native desert trees. Such indigenous plant species have been crowded out of their natural habitat in unsuccessful competition with the fast-growing tamarisk for sunlight and, most importantly, water. A single large tamarisk tree is reportedly capable of absorbing 200 gallons of water per day.

"Life is very fragile in the desert," Neill says. "When desert water sources are adversely affected or depleted, whole ecosystems can be threatened. And since its introduction in North America, tamarisk has had an increasingly negative impact on these water sources."

In California, that situation began to change nine years ago, when Bill Neill first learned of the problem and decided to devote himself to finding its solution. During the intervening years, he has spearheaded a battle to clear fragile Mojave Desert habitats of this harmful foreign tree species.

"To me, what is important in a natural environment is preserving the balance between native species," he explains. "Tamarisk has disrupted that balance."

It is the continuing effort to restore this balance that brings Neill to the California desert weekend after weekend. And Neill's commitment has inspired friends and other environmentally conscious people to take up saws and join him in defense of the desert environment. Though he refrains from actively recruiting the help of co-workers, Neill's roster of 90 volunteers includes several employees of the Science & Technology Division. One is Ray Whisenand, a programmer analyst at Unocal's Brea research center.

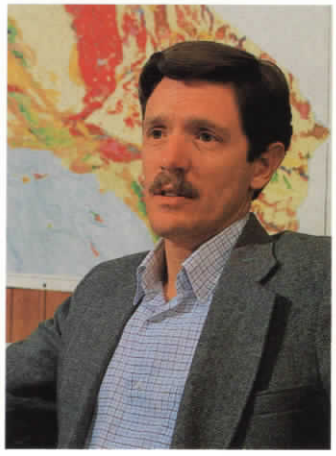
"Bill's enthusiasm has really rubbed off on me," Whisenand says. "Every outing is a course in nature, ecology and botany. You can't spend time with Bill and walk away without learning something new."

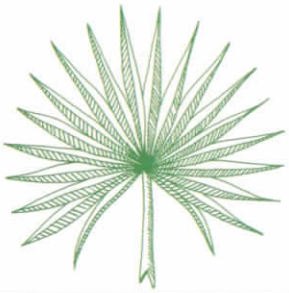
Mike Utt, manager of drilling, completions and offshore engineering, originally became involved with Neill's cause for less than lofty reasons. "I had an ulterior motive—firewood," he explains. "Once it's cured, tamarisk burns pretty well in the fireplace." But after he had satisfied his firewood needs, Utt continued making periodic forays into the desert with Neill's groups.

"I've come to feel that I need to do my part to protect the environment," he says, citing Neill's ability to galvanize volunteerism. "Bill's no drill sergeant, but he does know how to spur people into action."

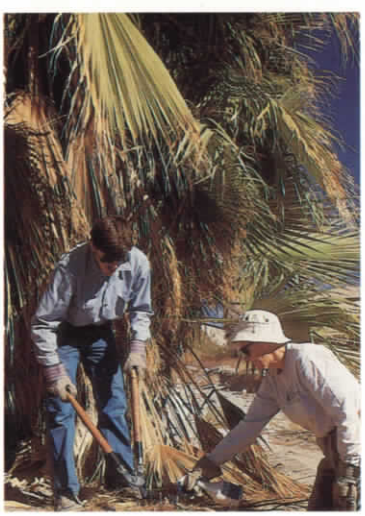
Neill's reputation extends well beyond the confines of Unocal's Science & Technology facility. The tireless efforts of Neill and his band of volunteers have elicited

Left, Unocal geological research engineer Bill Neill uses a chain saw to clear a thicket of non-native tamarisk trees from ecologically sensitive Pushwalla Canyon. "It's not that I'm obsessed with tamarisk removal," Neill says from the less-rustic confines of his office (below), "it's simply a chore that needs to be done."





Tamarisk eradication is back-breaking work. Below, Neill cuts tamarisk to ground level while Unocal research technician Gabrielle Rau applies herbicide to the remaining stumps. Opposite page (top), Neill weeds tamarisk from among a tangle of desert plants which are native to Pushwalla Canyon. Bottom left, retired Unocal chemical engineer Bob Love hauls away tamarisk limbs as Neill fells a stand of the trees. Bottom right, a large-scale tamarisk eradication effort at the nearby Coachella Valley Preserve contributed to the resurgence of this rare desert spring.



numerous accolades from local and national environmental organizations. As a former president of the Palm Springs-based Desert Protective Council, Neill is well known in environmental circles. His stature has helped him develop a cooperative rapport with policymakers at The Nature Conservancy, a privately funded environmental organization, and with officials of the United States Bureau of Land Management (BLM).

The majority of Neill's tamarisk field work has been performed—with official permission—on land under the jurisdiction of these two groups. His weekend warriors have attacked pockets of tamarisk infestation throughout Southern California, and have helped remove the harmful tree from more than a dozen ecologically sensitive desert sites.

"Bill learned of the tamarisk problem on his own and approached us with the idea for a growth management program," says Larry Foreman, wildlife biologist for the BLM's California Desert District. "His contribution was a critical element—he provided his expertise and took exceptional initiative both in recruiting and organizing volunteers."

"Thanks to Bill's leadership, we feel that we are winning the war against tamarisk," says John Humke, vice president of The Nature Conservancy. "His work has proven that the impossible is actually achievable. Without Bill's efforts, I doubt that anyone would be pursuing tamarisk control in a meaningful way."

To have a meaningful impact on the growing tamarisk population, Neill and his volunteers must employ intensive hand-to-branch warfare.

"The tree is very difficult to get rid of," Neill explains. "You can't kill tamarisk by burning it, by applying herbicide to its foliage or even by chopping it down at ground level. After I bought my first chain saw, I cut down a tamarisk to see what would happen. Within half a year, that tree had re-sprouted and grown back about six feet high."

Despite its tenacity, tamarisk can be exterminated by employing the proper combination of technology and elbow grease. By cutting it down to a stump, the tree can be made susceptible to herbicides—something Neill learned through extensive trial-and-error experimentation.

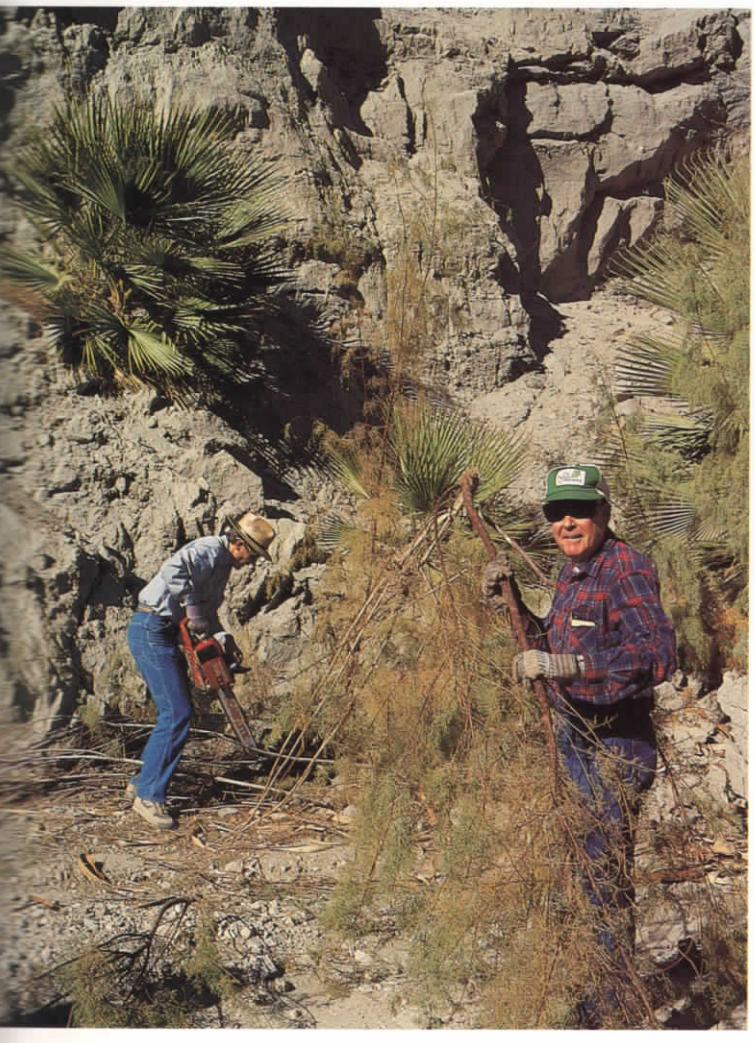
After consulting experts with the U.S. National Park Service, Neill began testing the application of herbicides as a means of preventing regrowth from tamarisk stumps. At the Coachella Valley Preserve near Palm Springs he initiated a five-year, large-scale tamarisk removal effort which included use of a bulldozer to knock down several acres of impenetrable tamarisk thickets. During this project, Neill and the preserve director successfully experimented with a variety of removal techniques.

"It was a scientific exercise," Neill explains. "I wanted to find out what worked best and most efficiently, then apply those techniques in areas beset by serious tamarisk intrusion."

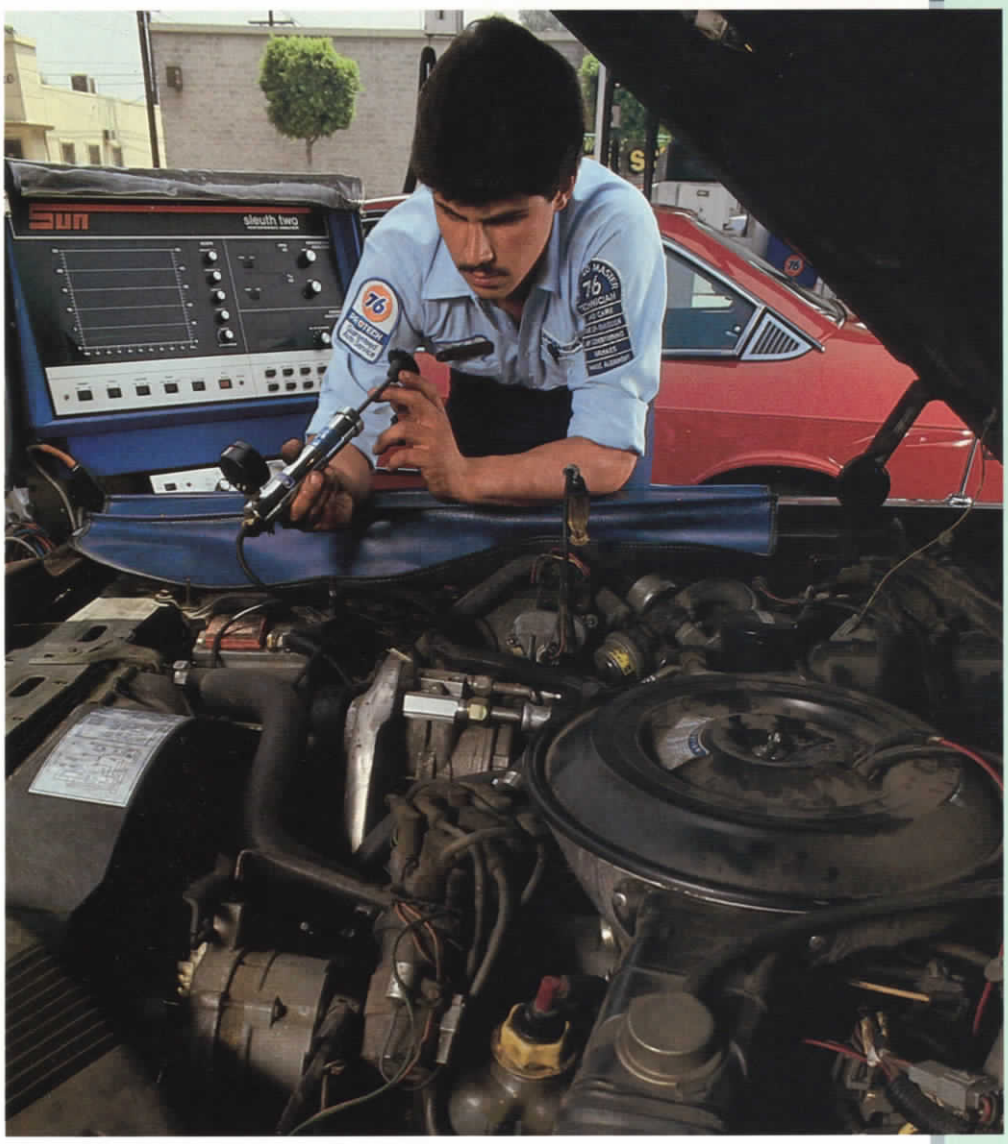
In Pushwalla Canyon, Neill and a group of nearly two dozen volunteers have divided up into parties of three for the day's assault on tamarisk. In each "cutting party," one person saws the trees into sections roughly four feet long, while his two partners haul away felled branches and spray the remaining stumps with an herbicide approved for use by the California Department of Food and Agriculture.

Wielding his chain saw, Neill spies a thicket of tamarisk—approximately 12-feet tall by 10-feet square—springing from a dry streambed. The fronds of a small, wilting palm tree protrude limply from the thicket as though trying, against all odds, to escape slow strangulation. Without a word, Neill jerks the cord on his saw. This stand of tamarisk will be the next to fall.

With tamarisk infesting more than 1 million acres in 15 states—including an estimated 16,000 acres of California's desert—the skeptic might view Bill Neill as a sort of environmental Don Quixote who tilts at trees rather than windmills. But as long as there are volunteers like him, who are willing to look beyond sheer numbers and fight tamarisk one tree at a time, the battle will never be lost. *M.B.* ⑯



CAR CARE MADE EASY



"If it's not one thing, it's another," mutters the befuddled professor, pounding his fist on the steering wheel in frustration. He's stuck in rush-hour traffic, and a vaporous cloud engulfs the hood of his car. The ill-fated professor is a victim of every motorist's nightmare — an overheated engine.

This is the opening scene in *Caring for the Life of Your Car,* a Unocal-produced video now used by school districts throughout California, Hawaii, Oregon, Nevada and Arizona. Since 1986, driver training teachers have found the video a valuable tool in the instruction of basic car maintenance. As a public service, Unocal provides the tape to schools free of charge.

The story line of this 15-minute video illustrates how neglect of auto maintenance can eventually lead to costly repair work — and how easily this can be avoided. After pulling into a Unocal 76 service station, the professor learns that his car's problems are attributable to his own lack of attention. He can't even recall the last time he had the car serviced.

Station operator Chuck, a certified 76 Protech mechanic, advises his other customers not to make the same mistake. Chuck and one of his attendants explain the fundamentals of car maintenance to Debbie, a teenager preparing to leave home for college. Debbie receives tips on how to change a tire, check the oil, check tire pressure, and read temperature and voltage gauges.

Chuck goes on to explain how to recognize early warning signals that indicate brakes need replacement or adjustment. He also lists the seven fluid levels that drivers should always monitor—fuel, coolant, brake fluid, transmission fluid, power steering fluid, water for conventional batteries, and windshield washer solution.

Unocal produced the video in 1986, in response to inquiries made during company-sponsored public forums. "We kept hearing the same question: 'Is there anything you can do to help us care for our cars?'" explains Barbara Payne, a consumer affairs consultant who helped organize the forums.

From late 1984 through 1987, a traveling Unocal entourage—usually including Payne, then-Coordinator of Corporate Identification and Programs Ed Spielman, and recently retired Vice President of Western Marketing Clay Warnock—visited 23 western cities. At each location, the invitation-only meetings attracted an average of two dozen local community leaders.

"We felt it would be helpful to communicate directly with a cross-section of Unocal customers about oil industry issues," Payne recalls. "We purposefully invited people with diverse interests and points of view—including government officials, environmentalists, business and labor leaders, and educators. The discussions were lively and productive."

The concerns expressed about car care prompted the company to consider developing an instructional package about the subject. "The video was the direct result," says Payne, who co-wrote the script.

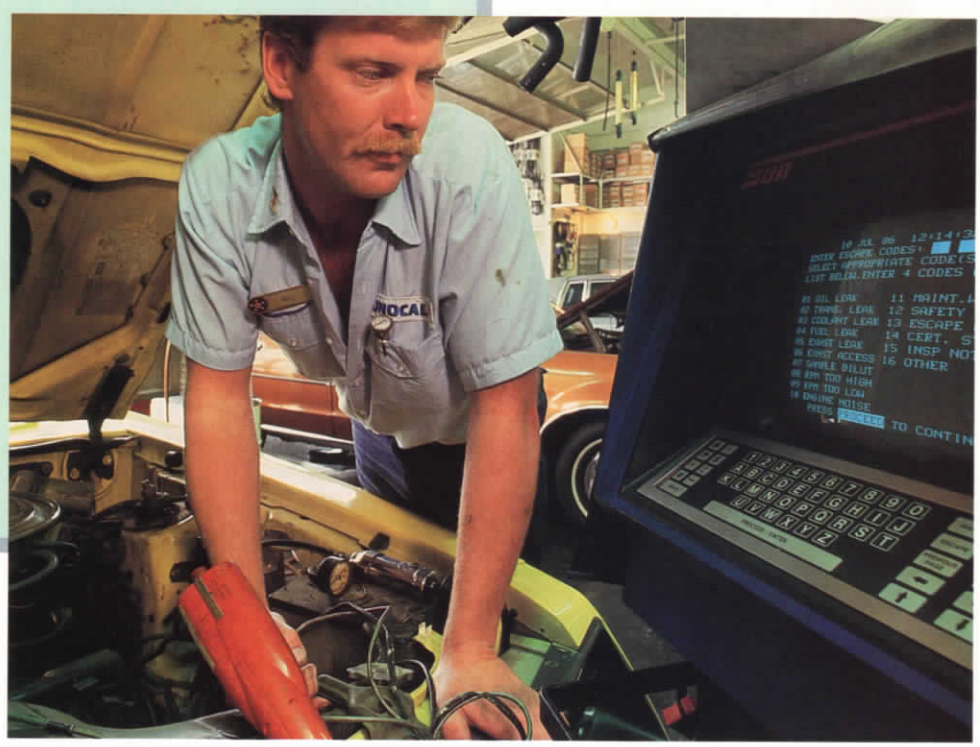
The tapes are made available to civic groups and schools, which are encouraged to make duplicates as needed. An instructor's guide and a quiz accompany each issued video.

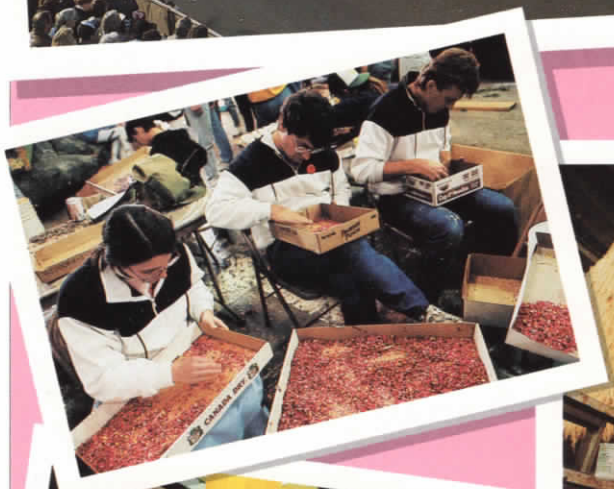
Not only does the video provide a public service, it also serves as a marketing tool to attract young customers. "The video really stresses the importance of going to a qualified auto mechanic for car care," says Ted Seden, Unocal advertising manager. "Because 'Chuck' is clearly identified as a 76 Protech mechanic, Unocal is reaching a large audience of new motorists."

Heightening the public's awareness of the need for good car maintenance also has environmental and energy conservation benefits. "Well-maintained cars have lower emissions levels and consume less gasoline," Payne points out.

In addition to contacting schools throughout the west, Unocal has promoted the car care video at driving instructor conventions in California and Arizona. "The instructors were delighted to have a new, meaningful teaching aid," Seden says. "We're offering educators a complete package in car care instruction at no cost to them." 76

A Unocal-produced video teaches driver education students the essentials of automobile maintenance.





A FLORAL CELEBRATION

Unocal celebrated "Fun 'N' Games," the theme of the 102nd Tournament of Roses Parade, with its float *Kabuki*. The float featured a depiction of the medicine vendor, a character that has become a regular player in the Japanese Kabuki theatrical repertoire. *Kabuki* was Unocal's 49th entry in the annual New Year's Day event, which is held in Pasadena, California.

The float, which was designed and built by C.E. Bent & Sons, was decorated by a volunteer workforce consisting of nearly 400 Unocal employees, retirees and their families. Working in shifts, the Unocal team spent more than 3,000 man-hours decorating the float.

A huge representation of the medicine vendor appeared on each side of Unocal's float. His robes were adorned with roses, orchids, carnations, chrysanthemums and straw flowers. The animated fans he waved were edged in orchid petals, with the designs worked out in ti leaves and carnation petals.

The medicine vendor's face was covered with crushed sweet rice, carnation petals and silver leaf, and the hair was made of pampas grass. A 22-foot-high torii, or gateway, on the float was decorated in carnations, seaweed, statice, ti leaves and seeds. Curtains hanging from the torii were made of orchid petals and spider mums, with roses, orchids and gerbers filling the garden around the float's base.

An estimated 1 million people lined Colorado Boulevard in Pasadena to view the parade, which was seen by a worldwide television audience of more than 300 million.

SERVICE AWARDS

UNOCAL 76

CORPORATE

35 YEARS **Ronald R. Runge,** Unocal Center

20 YEARS **Ernest L. Brown,** Santa Rosa, Ca.
Michael A. DeRuyter, San Francisco, Ca.
Wallace T. Skok, Unocal Center

15 YEARS **Byron S. Flynt,** Unocal Center
Steven W. Thomas, Bakersfield, Ca.

10 YEARS **Michael P. Anderson,** Unocal Center
John F. Chisum, Orcutt, Ca.
Liliana I. Cranmer, Unocal Center
Cristeta L. Cruz, Unocal Center
Noel E. Galbraith, Unocal Center
Barbara J. Haugh, Washington, D.C.
Joseph V. Heisler, Schaumburg, Il.
Allan A. Hirata, Unocal Center
Norma R. Kobayashi, Unocal Center
Alvin B. Perry, Unocal Center
Leonard Romo, Unocal Center
Carolyn J. Steinhart, Unocal Center
Frank A. Valdez, Santa Rosa, Ca.
Jeaneette C. Vasquez, Unocal Center
Jacqueline K. Williamson, Brea, Ca.

REAL ESTATE

35 YEARS **David V. Rozas, Jr.,** Unocal Center

20 YEARS **Michael Roybal,** Unocal Center

ENERGY MINING

25 YEARS **Milton R. Cisneros,** Parachute, Co.

15 YEARS **Robert E. Van Nostrand,** Parachute, Co.

10 YEARS **Daniel G. Baum,** Parachute, Co.
Michael S. Lawson, Parachute, Co.
Peter D. Nichols, Parachute, Co.
Robert W. Parrish, Parachute, Co.

SCIENCE & TECHNOLOGY

25 YEARS **Hayden T. Bowles,** Brea, Ca.
Samuel C. Hanson, Brea, Ca.
Roy M. Matsuo, Brea, Ca.
Helen F. Roberts, Brea, Ca.

15 YEARS **George W. Poutney,** Brea, Ca.
Steven D. Rice, Brea, Ca.
Lavon Staub, Brea, Ca.
William P. Torok, Brea, Ca.

10 YEARS **Robert H. Bennett,** Brea, Ca.
Melvin Dixon, Brea, Ca.
Richard C. Geske, Brea, Ca.
Karl Gunther, Brea, Ca.
Wook B. Lee, Brea, Ca.
Kenneth L. McNutt, Brea, Ca.
Shamseddin S. Mohammadi, Brea, Ca.
Steven R. Molinari, Brea, Ca.
Nellie V. Nacua, Brea, Ca.
Jon D. Probst, Brea, Ca.
Richard Salampessy, Brea, Ca.
Arnold L. Shugarman, Brea, Ca.
Oong K. Youn, Brea, Ca.
Miguel A. Yracheta, Brea, Ca.

ENERGY RESOURCES

NORTH AMERICAN OIL & GAS

45 YEARS **Georgianne J. Barthelme,** Midland, Tx.

35 YEARS **Dwayne E. Beard,** Van, Tx.
Wiley E. Campbell, Brea, Ca.
Randall L. Poulin, Orcutt, Ca.

25 YEARS **Robert D. Avery,** Houston, Tx.
Sandra M. Dake, Ventura, Ca.
Lyle R. Davis, Sr., Orcutt, Ca.
Gerry A. Graham, Los Angeles, Ca.
Frank R. Gularte, Ventura, Ca.
Robert E. Huguenard, Orcutt, Ca.
Frank R. Knor, Orcutt, Ca.
Ravis J. Landry, Lafayette, La.
Harris P. Leboeuf, Lafayette, La.
David A. Minor, Houston, Tx.
William D. Powers, Santa Fe Springs, Ca.

20 YEARS **Russell D. Adams,** Van, Tx.
Benjamin C. Bell, Jr., Houston, Tx.
Elmer J. Bolin, Jr., Van, Tx.
Alfred D. Broussard, Lafayette, La.
Lonnie L. Brummett, Taft, Ca.
Brian K. David, Moab, Ut.
Arlene A. Definis, Bakersfield, Ca.
Novis L. Eady, Kenai, Ak.
Larry E. Florence, Van, Tx.
John B. Gillespie, Amilea, La.
William K. Gingrich, Casper, Wy.
M. C. Griffin, Jr., Ganado, Tx.
Russell C. Hanscom, Jr., Farmington, N.M.
Larry W. Harvey, Kenai, Ak.
Sylvester T. Hinton, Jr., Compton, Ca.
Rudolph Lopez, Ventura, Ca.
Brian W. G. Marcotte, Bakersfield, Ca.
John C. Merritt, Jr., Houston, Tx.
Dorothy M. Mitchell, Houston, Tx.
Tiew K. Ong, Santa Fe Springs, Ca.
Dustin J. Rhodes, Kenai, Ak.
Clark A. Robichaux, Theriot, La.
Roberta M. Wheeler, Houston, Tx.

15 YEARS **William T. Ames,** Coalinga, Ca.
Robert R. Broyles, Huntington Beach, Ca.
David A. Cole, Orcutt, Ca.
Leroy H. Fabricius, Worland, Wy.
Patrick Foster, Placentia, Ca.
Gregory L. Gluth, Cut Bank, Mt.
Vincent Gonzalez, Kenai, Ak.
Daryl D. Graff, Kenai, Ak.
Steve E. Hulin, Kaplan, La.
Rodney C. Montz, Abbeville, La.
Edward J. O'Donnell, Anchorage, Ak.
Barney B. Prejean, Abbeville, La.
Felipe M. Subia, Jal, N.M.
Merle W. Tozer, Worland, Wy.
John D. Traylor, Healdton, Ok.
Carl E. Waller, Ventura, Ca.

10 YEARS **Lee E. Bailey,** Bakersfield, Ca.
Leonard W. Barfield, Chunchula, Al.
Robert W. Barker, Houston, Tx.
Michael G. Bezilla, Kenai, Ak.
Yvonne B. Biliardi, Bakersfield, Ca.
David R. Birchfield, Kenai, Ak.
William T. Bondurant III, Houston, Tx.
Edward J. Bonvillain, Dulac, La.
Carl L. Bradshaw, Freeport, Tx.
James P. Brady, Anchorage, Ak.
Harold D. Brown, Jr., Oklahoma City, Ok.
James D. Burress, Santa Paula, Ca.
Donald A. Chudanov, Anchorage, Ak.
Glenn T. Clifford, Kenai, Ak.
John R. Cowell, Orcutt, Ca.
Blake A. Crochet, Dulac, La.
Terry L. Dickerson, Van, Tx.
William D. Dugan, Ventura, Ca.
Darrell R. Falke, Gueydan, La.

Charles A. Field, Jr., Orcutt, Ca.
Laurence D. Fisk, Ventura, Ca.
Larry B. Gable, Chunchula, Al.
Ashok K. Ghosh, Houston, Tx.
Estle E. Giles, Jr., Houma, La.
Stephen P. Glenn, Orcutt, Ca.
Jeff M. Glossa, Midland, Tx.
Dale E. Golike, Orcutt, Ca.
Ronald D. Harmon, Ventura, Ca.
Evan K. Harness, Anchorage, Ak.
Richard V. Harrington, Abbeville, La.
George E. Hixon, Kenai, Ak.
James S. Hollimon, Kenai, Ak.
Catherine L. Huska, Anchorage, Ak.
Rodney A. Hutchings, Coalinga, Ca.
Steven H. Jimenez, Orcutt, Ca.
Veronica P. Johnson, Houston, Tx.
Wayne E. Johnson, Kenai, Ak.
Bobby R. Kennedy, Kenai, Ak.
Lynda M. Kline, Santa Fe Springs, Ca.
Helen R. Ladson, Liberty, Il.
Keith O. Larson, Cut Bank, Mt.
Daniel C. Lennep, Houma, La.
Curtis L. Locklar, Seminole, Tx.
Wayne S. Marshall, Orcutt, Ca.
Joseph H. Martin, Lafayette, La.
David B. McCaleb, Houston, Tx.
Ted Joe Medley, Kenai, Ak.
Sharon L. Miller, Midland, Tx.
Donna M. Mills, Van, Tx.
Jesse T. Noah, Oklahoma City
J. Faye Norton, Midland, Tx.
Jeffrey R. Oleson, Kenai, Ak.
Allan T. Olson, Orcutt, Ca.
Jackie D. Parnell, Midland, Tx.
Randy J. Ponder, Bakersfield, Ca.
Edward S. Poole, Andrews, Tx.
Robert C. Regnier, Orcutt, Ca.
Johnny L. Reynolds, Orcutt, Ca.
Gilbert R. Salois, Cut Bank, Mt.
Sherryl A. Schussler, Bakersfield, Ca.
Carol Jean Shults, Andrews, Tx.
Vern W. Slayton, Kenai, Ak.
Davis Stewart, Jr., Dulac, La.
Frank D. Stillwell, Midland, Tx.
John L. Sweezy, Lafayette, La.
Victor L. Tenney, Clay City, Il.
Edward E. Thompson, Kenai, Ak.
Nancy E. Tinnin, Bakersfield, Ca.
Jimmie Toloudis, Jr., Houma, La.
Diane V. Vandeventer, Midland, Tx.
Clyde Verdin, Dulac, La.
Barry G. Wallace, Houston, Tx.
David S. Whitacre, Midland, Tx.
Chris E. Williams, Orcutt, Ca.
Tony K. Williams, Bloomfield, N.M.
Henderson Young, Van, Tx.

Unocal Canada, Ltd.

20 YEARS **Robert G. Goodwin,** Slave Lake, Alberta
Lawrence W. Sadler, Calgary, Alberta

10 YEARS **C. Lex Herron,** Calgary, Alberta

SERVICE AWARDS

INTERNATIONAL OIL & GAS

20 YEARS **Judith M. Howick,** Unocal Center
Donald A. Olisar, Indonesia

15 YEARS **Angela M. Egremont,** Unocal Center
Herbert H. Light, Thailand
Betty N. Tham, Unocal Center
Chung H. Yu, Unocal Center

10 YEARS **Lorna G. Curtis,** Unocal Center
Peter M. Longerich, Myanmar
Michael H. Majer, Ecuador
Lyndon F. Pittinger, Aberdeen, Scotland
Teddy R. Story, Thailand

Unocal Thailand, Ltd.

10 YEARS **Pinit Atha-Tamsuntorn**
Chart-Cho Charaswong
Niwat Chatsuthi
Suvakon Chavech
Pornchai Chitsawart
Pramote Choowong
Nipon Chutipanich
Ruengsak Im-Suwan
Prapote Jareonsuk
Sorabul Klommitr
Noy Kotcharuck
Manoch Malagool
Cha-Um Nittayo
Suchin Pengsree
Chakrit Petchram
Jarusnat Plabkrasong
Somkid Pojanasiri
Pichai Prapatsak
Suwat Prisarajub
Klin Saisopha
Parnupol Saitantong
Kessanun Samhuey
Yutadanai Sangduen
Sirithorn Sophon
Sittichai Supaperm
Niphon Thammachart
Apirom Thanajarupong
Kovit Tospitakul
Wirat Traitangwong
Revat Vattanonta
Vichai Visutisang
Chatchai Wichiencharoen
Chaiwat Yawwapapong
Sakchada Yimsong
Sasima Youngjaroen

Unocal Indonesia, Ltd.

20 YEARS **Sublie A.S.**

15 YEARS **Arbainsjah**
Multazan
Priyonggo
Rusadi
Ruwadji
Sanatu
Slamet
Sudiyono
Sugitrisno
Sutarno
Zulhamdy
Zulfius Abbas
Achmad Alsiwan
Machud Amir
M. Babuki
Hans E. J. Gasper
Sidik H. Guntoro
Daud Hamid
Dev Hamsjah
F. X. Harsono
Mathias Yusran Inung
Muchamad Jusup H.
Wasmana K
Widya Latief
Muchtar Lompo
Jose Marcus
Harjono Much
Eddy I. Muhayano
Bambang Murdiyarso
Robert Raintung
Andy Rifai
Pither Ruru
Salim Vincent Saragi
Budi Setyo
Hengki Sie
Lahud Simanungkalit
Parlin S. Sinambela
Farel Sitorus
M. Amir Sjarifuddin
Hary Soetarto
Bambang Sudiwasono
Alfried Tumang
St. Widyanto
Anang Winardi
Vence A. Wongkar

10 YEARS **Hawir Aboe**
Helwanurrachman Djumiril
Antonius Sudaryanto

Unocal U.K., Ltd.

10 YEARS **Brian Fraser,** Sunbury, England
Robert Gordon, Aberdeen, Scotland
Reidar Hustoft, Aberdeen, Scotland
Doris Shepherd, Sunbury, England
Mary Wilson, Aberdeen, Scotland

Unocal Singapore, Ltd.

10 YEARS **Roselind Huang Eng Neo**

Unocal Netherlands, B.V.

10 YEARS **Rene Kamphuis**
Bert Timmer

GEOTHERMAL

10 YEARS **John M. Bodell,** Philippines
Robert B. Dickerson, Santa Rosa, Ca.
Florence M. Gaa, Unocal Center
Bradley W. Martin, Santa Rosa, Ca.
Sandra Neilsen-Chacon, Unocal Center
Albino Z. Perez, Santa Rosa, Ca.
David E. Schultz, Santa Rosa, Ca.
Felipe R. Valdivia, Imperial Valley, Ca.
William P. Warren, Santa Rosa, Ca.

Philippine Geothermal, Inc.

15 YEARS **Ernesto C. Alimboyogen,** Makati
Emilna M. Fernando, Makati
Metodio L. France, Makati
Rolando G. Ibarra, Makati
Marilou C. Lopez, Makati
Alfonso D. Lorenzana, Makati
Bienvenido C. Roaquin, Jr., Makati

10 YEARS **Andres V. Amante,** Bulalo
Wilfredo P. Amante, Bulalo
Alphonso P. Belsondo, Bulalo
Noel S. Bonot, Bulalo
Ladislao M. Brozas, Bulalo
Elsie B. Capili, Tiwi
Marcelo M. Carpio, Bulalo
Oscar B. Carpio, Bulalo
Luis Y. Cielo, Bulalo
Magin C. Dacir, Bulalo
Regino R. De Jesus, Bulalo
Jose G. De Los Reyes, Bulalo
Cesar C. Diego, Bulalo
Leon V. Ernesto, Bulalo
Cynthia S. Florentino, Makati
Sotero C. Flores, Bulalo
Edilberto F. Forte, Tiwi
Quirico P. Gido, Bulalo
Norberto S. Gimenez, Tiwi
Ma. Theresa R. Grageda, Makati
Jaime M. Guevarra, Bulalo
Rodolfo T. Guillermo, Bulalo
Deomides C. Lat, Bulalo
Efren M. Lopez, Bulalo
Carlos D. Lucillo, Bulalo
Luis M. Mabilangan, Bulalo
Tereso C. Magampon, Bulalo
Pedro C. Malbataan, Bulalo
Celso C. Maligalig, Makati
Manuel R. Maligalig, Bulalo
Andres P. Malijan, Bulalo
Gerardo S. Malilay, Bulalo
Ciriaco M. Malipol, Bulalo
Felix M. Maloles, Bulalo

SERVICE AWARDS

Rodrigo M. Maloles, Bulalo
Rodrigo S. Maloles, Bulalo
Roldofo D. Mantupar, Bulalo
Delfin O. Matibag, Bulalo
Gabriel N. Mercado, Bulalo
Nazario C. Monteroso, Bulalo
Angel R. Monterozo, Bulalo
David R. Monterozo, Bulalo
Donato G. Navarette, Bulalo
Fe M. Navarette, Bulalo
Leonardo V. Pareja, Bulalo
Benjamin M. Perez, Bulalo
Mario M. Piamonte, Bulalo
Angelo M. Pucyutan, Bulalo
Maria P. Puntanar, Bulalo
Leandro M. Punzalan, Bulalo
Juanito A. Reyes, Bulalo
Bernardino P. Sabarias, Bulalo
Roberto V. Sanchez, Bulalo
Moises C. Siriban, Bulalo
Cresenciano G. Torres, Bulalo
Prospero A. Victoria, Bulalo
Virgilio E. Villanueva, Bulalo

REFINING & MARKETING

40 YEARS **Billy R. Mosley,** Frankston, Tx.

35 YEARS **Carroll A. Scogin,** Birmingham, Al.

30 YEARS **William R. Baldwin,** Portland, Or.
Shirley T. Gilyeat, San Francisco, Ca.
Carl A. Hakansson, Schaumburg, Il.
Dennis D. Hartman, San Francisco, Ca.
Ronald E. Ness, Bakersfield, Ca.
Gary C. Piatanesi, San Francisco, Ca.
Myron S. Podgurski, Schaumburg, Il.
George R. Quigley, Richmond, Ca.
Robert C. Schoettler, Los Angeles Refinery
Paul J. Schroeder, Schaumburg, Il.
Ronald G. Simpson, Los Angeles, Ca.
Lewis E. Smith, Pensacola, Fl.
Shirley M. Zoellick, Schaumburg, Il.

25 YEARS **Elfriede Ella Adams,** San Ramon, Ca.
Joan A. Van Auken, San Francisco, Ca.
Robert P. Frank, San Francisco, Ca.
Donald F. Glass, Hendersonville, Tn.
Jack H. Green, San Francisco Refinery
Thomas W. Hail, McKittrick, Ca.
Donald M. Hall, San Francisco Refinery
William H. Hodges, Savannah, Ga.
Douglas O. Johnson, Los Angeles, Ca.
Gary E. Lee, San Francisco Refinery
Horace G. Lutz, Los Angeles Refinery
Douglas O. Olave, San Luis Obispo, Ca.
Dean C. Schuster, Atlanta, Ga.
Paul H. Thomaszeck, Los Angeles, Ca.

20 YEARS **Floyd J. Apodaca,** San Francisco Refinery
Karen E. Bruton, Los Angeles, Ca.
Terry E. Cavanaugh, Santa Maria Refinery
David K. Chan, San Francisco Refinery
Ronald F. Ciciarelli, Los Angeles, Ca.
Bernard M. Coleman, Schaumburg, Il.
Allan M. Dailey, San Francisco Refinery
Virginia B. David, San Francisco, Ca.
Janet I. Domingo, Los Angeles, Ca.
Lorna O. Frantilla, San Francisco, Ca.
Michael H. Geigle, Tacoma, Wa.
William W. Hawk, San Francisco Refinery
Theodore L. Koehn, Fort Morgan, Co.
Kenneth A. Larson, Santa Maria Refinery
Sanford K. Machado, Honolulu, Hi.
Charles C. Magnus, San Francisco, Ca.
Henry E. Miller, San Francisco Refinery
Jerry A. Miracle, Portland, Or.
David M. Murai, Sacramento, Ca.
Paul G. Nauert, Los Angeles, Ca.
Johnny R. Peacock, Macon, Ga.
Jeral D. Pope, Montgomery, Al.
Gwynn S. Scott, Savannah, Ga.
Edwin H. Smith, Los Angeles Refinery
Angelina C. Songco, San Francisco, Ca.
Howard I. Spencer, San Francisco Refinery
Sharon L. Vallejo, San Francisco, Ca.
Pamela K. Whittington, Los Angeles, Ca.
John A. Woodcock, Savannah, Ga.

15 YEARS **June E. Allen,** Schaumburg, Il.
Milton Ballentine, Jr., San Diego, Ca.
Deborah K. Beath, Nederland, Tx.
John M. Bedlion, Santa Maria Refinery
Steffan E. Blaser, San Francisco Refinery
Steve P. Cantu, Los Angeles Refinery
Steven E. Conroy, Los Angeles, Ca.
James J. Dean, Columbus, Oh.
Barry D. Ebright, Los Angeles Refinery
John Fedjur, Schaumburg, Il.
Hector S. Garza, Nederland, Tx.
David M. Gibson, Unocal Center
Robert Hanson, Brisbane, Ca.
Mauricio R. Hernandez, Portland, Or.
George S. Hollander, Birmingham, Al.
Frank C. Kruger, Richmond, Ca.
John F. Magnante, Los Angeles Refinery
Howard L. Muto, San Francisco Refinery
Daniel J. Ogden, San Francisco Refinery
Robert L. Owens, Sacramento, Ca.
Lanny E. Partain, San Francisco Refinery
Charles W. Phillips, San Francisco Refinery
Russell J. Prokuski, Schaumburg, Il.
Thomas J. Prusa, Orange, Ca.
Larry W. Roberts, Portland, Or.
Maybelle J. Sechrest, Schaumburg, Il.
William A. Stratton, Santa Maria Refinery
Lina S. Szott, Schaumburg, Il.
Rebekah J. Taba, San Francisco Refinery
Donna L. Tate, San Francisco Refinery
Samuel W. Taylor, Los Angeles Refinery
Wilfred B. Turner, Seattle, Wa.
Sam S. Uong, Los Angeles, Ca.

SERVICE AWARDS

10 YEARS **Teresita L. Agustin,** San Francisco, Ca.
Joseph F. Austin, Savannah, Ga.
Tommy D. Baumgardner, S.F. Refinery
Darryl B. Binder, Nederland, Tx.
Dean G. Bowlus, San Francisco Refinery
George E. Bradbury, San Francisco Refinery
Jonathon A. Brown, Los Angeles Refinery
William C. Brown, San Ramon, Ca.
Debra L. Casas, Los Angeles Refinery
Jaime N. Castillo, Santa Maria Refinery
Joe E. Comstock, San Ramon, Ca.
Paul B. Davis, Los Angeles Refinery
Walter K. Demoray, Los Angeles Refinery
Frank R. Digiovanni, San Francisco Refinery
Randy W. Dunn, Los Angeles Refinery
Chris W. Elder, Los Angeles, Ca.
Michael P. Farrell, Tallmadge, Oh.
Donald W. Fox, Los Angeles Refinery
Robert J. Franklin, San Francisco Refinery
Charles S. Frazier, Los Angeles Refinery
Ruben Gonzales, Portland, Or.
Julie M. Jacques, Schaumburg, Il.
Rhonda M. Jefferson, San Francisco, Ca.
Michael R. Jenkins, Avila Beach, Ca.
Vernon J. P. Kim, Hilo, Hi.
David H. MacFarland, Memphis, Tn.
Patricia A. McFarlin, Van, Tx.
Cathy L. Meredith, Seattle, Wa.
Marco A. Mota, Schaumburg, Il.
Arthur L. Murdock, Los Angeles, Ca.
Mark E. Niccum, San Francisco Refinery
Wallace S. Pape, Ft. Lauderdale, Fl.
Robert L. Prophete, Los Angeles, Ca.
Philip R. Rosenthal, Los Angeles Refinery
Caryn L. Roty, Schaumburg, Il.
Harold C. Scott, Los Angeles Refinery
Eric Shultz, San Francisco, Ca.
Michael A. Skehen, Santa Maria Refinery
Myles S. Stevens, San Francisco Refinery
Michael N. Stone, Los Angeles Refinery
Karen J. Tajbl, Schaumburg, Il.
Rhonda L. Taylor, San Francisco Refinery
Richard L. Thorne, San Francisco, Ca.
Nancy E. Tinnin, Bakersfield, Ca.
Marshall G. Waller, Los Angeles Refinery
Glenn Williams, Los Angeles Refinery
Brian L. Woo, San Ramon, Ca.

MARKETERS & DISTRIBUTORS

55 YEARS **Citizens Oil Co.,** Gaffney, S.C.

45 YEARS **Woco Pep Oil Co.,** Covington, Ga.

30 YEARS **Fuel Service, Inc.,** Chippewa Falls, Wi.
Parnell Oil Co., Parkton, N.C.

25 YEARS **Adams Oil Co., Inc.,** Avon Park, Fl.

20 YEARS **Brandon Oil Co.,** Johnson City, Tn.
Security Oil Co., Inc., Concord, N.C.
Union 76 Service Center Co., Waseca, Mn.

15 YEARS **G&G Oil Co. of Indiana, Inc.,** Muncie, In.

CHEMICALS & MINERALS

40 YEARS **Joseph B. Blanchard,** Brea, Ca.

35 YEARS **Leon E. Hinkle,** La Mirada, Ca.
Lloyd A. Osborne, Brea, Ca.

30 YEARS **Ronald A. Lee,** Lemont, Il.
Georgine H. Smith, Conshohocken, Pa.
F. Ullersberger, Carteret, N.J.

25 YEARS **Samuel C. Cook,** Charlotte, N.C.
Harold D. Kithcart, Arroyo Grande, Ca.
Donald L. Smith, Kankakee, Il.
Harry S. Sparrow, Charlotte, N.C.
Walter M. Tarpley, Atlanta, Ga.

20 YEARS **John M. Giba,** Lemont, Il.
Charles R. Sheehan, Charlotte, N.C.
Michael W. Thomasson, Charlotte, N.C.

15 YEARS **Harold W. Carter,** Kenai, Ak.
David A. Fay, Kenai, Ak.
James D. Ferguson, Brea, Ca.
David W. Isaac, Charlotte, N.C.
Edward D. Kaona, Kenai, Ak.
Leslie M. Kosydar, Kenai, Ak.
Henry B. Madretzke, Clark, N.J.
Marilyn A. Newell, La Mirada, Ca.
Anthony J. Scott, Conshohocken, Pa.
Timothy J. Wilkes, Charlotte, N.C.

10 YEARS **Robert P. Alexander,** Kenai, Ak.
Brenda T. Fenker, Schaumburg, Il.
Lucia E. Goins, Brea, Ca.
Michael J. Graham, Schaumburg, Il.
Thomas J. Klein, Brea, Ca.
Richard W. Main, Kenai, Ak.
Larry N. Odell, Fresno, Ca.
Richard A. Roth, Twinsburg, Oh.
Dale W. Rush, West Sacramento, Ca.
John E. Torrence, Charlotte, N.C.
Vincent B. Way, Kenai, Ak.
Randall K. Wilson, Dallas, Tx.

MOLYCORP, INC.

30 YEARS **Keith H. Steever,** Mountain Pass, Ca.

25 YEARS **Arthur Coca,** Questa, N.M.
Edward F. Garcia, Mountain Pass, Ca.

20 YEARS **Robert L. Martinez,** Questa, N.M.
David H. Osborne, Louviers, Co.
Paul Prado, Questa, N.M.

15 YEARS **Richard W. Frizzell,** Mountain Pass, Ca.

10 YEARS **Marie M. Bigardi,** Mountain Pass, Ca.
Kenneth G. Costello, Mountain Pass, Ca.
John C. Daniels, Washington, Pa.
Philip W. Evans, Paris, France
David B. McBride, Mountain Pass, Ca.
Gerald N. Radford, Mountain Pass, Ca.
Stephen Rowe, Mountain Pass, Ca.
James K. White, Mountain Pass, Ca.

POCO GRAPHITE, INC.

15 YEARS **John F. Beasley,** Decatur, Tx.
Royal P. Nix, Decatur, Tx.

RETIREMENTS

Corporate

Herb G. Baumgaertner, September 2, 1954
Elisabeth L. Comploi, November 8, 1971
Bernard W. Dorin, March 1, 1964
Russel Groesbeck, December 1, 1954
Robert O. Hedley, July 17, 1950
Donald L. Huebsch, November 18, 1971
Hans E. Menter, February 9, 1954

Oil & Gas

Carol De Zotell, June 8, 1973
Kenneth J. Robertson, March 18, 1957
Dale Shawcroft, July 25, 1966
Donald J. Suhoza, August 26, 1970
Jack D. Young, September 3, 1959

Refining & Marketing

Signe E. A. Andersen, July 13, 1951
Franklin S. Boccia, July 25, 1952
John E. Brown, April 7, 1952
Clarence Cheetham, December 7, 1949
Roscoe E. Colclasure, November 30, 1953
James E. Culpepper, January 10, 1947
Gordon H. Ellings, September 8, 1964
Robert C. Fraser, August 23, 1973
David Gross, November 13, 1967
William E. Herchline, December 26, 1950
Raymond D. Iverson, August 3, 1971
Raymond J. Jerge, June 22, 1964
Frank G. LaVieri, August 16, 1961
Thomas Matthews, March 3, 1958
Calvin J. Maurer, November 20, 1956
Gordon A. McLean, November 20, 1967
Donald P. Morris, April 18, 1960
Roy G. Perry, September 30, 1947
William M. Redding, January 1, 1963
Harold M. Runyon, August 17, 1950
Clay R. Warnock, February 25, 1956

Science & Technology

Vance Lynch, September 1, 1963

SERVICE AWARDS

Energy Mining

Dennis A. Murray, July 8, 1980

Chemicals & Minerals

Mildred Axe, October 19, 1966
Darline R. Christensen, January 8, 1968
Byron L. Coker, August 16, 1959
John W. Detlefsen, December 5, 1961
Frank P. Dougherty, October 1, 1980
Gerald E. Hendrixson, February 7, 1955
Edwin E. Johnson, February, 1, 1954
James Keim, June 13, 1966
Burt Charles Mack, September 21, 1959
Paul D. Morrison, July 18, 1968
Bland T. Moser, February 7, 1969

Poco Graphite, Inc.

Edwin J. Brajer, August 11, 1975
Harold R. Robinson, August 31, 1970

IN MEMORIAM

EMPLOYEES

Oil & Gas

Ronald W. Hillis, November 1, 1990
John Raymond Mobley, October 1, 1990
James B. Skaggs, December 9, 1990

Refining & Marketing

Allen C. Archambault, December 8, 1990
Tommy Casey, December 31, 1990
Eric Spendlove, December 1, 1990
James A. Velasco, October 28, 1990

Chemicals & Minerals

Gordon A. Barlow, October 29, 1990

RETIREES

Corporate

Albert Dee Cluster, November 26, 1990
Lela T. Green, August 20, 1990

Oil & Gas

Robert E. Anderson, November 26, 1990
Adolf J. Bezdek, November 13, 1990
Edwin P. Fitzgerald, October 27, 1990
Benjamin F. Hanly, Jr., October 10, 1990
Mavis W. Jones, December 1, 1990
Samuel T. Lough, December 2, 1990
Roy W. Martin, October 21, 1990
Lorne D. McCluskey, January 12, 1991
Anne E. Pellant, December 24, 1990
Clay Stafford, December 21, 1990
Stanley G. Wissler, October 26, 1990

Refining & Marketing

Leo Anderson, November 19, 1990
Luther M. Barrow, December 28, 1990
Walter H. Black, December 29, 1990
Byron L. Boutin, December 9, 1990
Joseph B. Brockett, November 9, 1990
Walter F. Brodbeck, November 19, 1990
Jack Burgess, October 25, 1990
John J. Cardamon, December 16, 1990
Doyle E. Carter, November 11, 1990
Robert W. Colville, October 4, 1990
Cyril Thomas Cordial, November 23, 1990
Donald F. Davies, December 20, 1990
Clifford Davis, November 4, 1990
Arthur D. Dawson, April 27, 1990
Robert Cecil Duncan, December 23, 1990
Jack H. Durden, November 15, 1990
Lawrence E. Eberle, November 28, 1990
Eugene G. Garman, December 16, 1990
George C. Gills, October 12, 1990
Karl F. Giloth, October 15, 1990
William H. Graham, August 8, 1990
Mary C. Gray, October 11, 1990
William S. Hamilton, November 11, 1990
Harold S. Hammett, November 29, 1990
Joseph R. Hancock, November 26, 1990
William M. Harris, January 1, 1991
Arthur S. Haugen, October 8, 1990
Gordon M. Henderson, October 26, 1990
Edward F. Horn, November 29, 1990
Eugene H. Irwin, December 2, 1990
Shirley Lynn Jackson, December 10, 1990
Howard M. Jungles, December 31, 1990
Clement P. Lombardi, August 20, 1990
Robert W. Mach, November 3, 1990
George C. Majors, December 19, 1990
Dennis L. McCormick, November 12, 1990
Hubert L. Miller, December 9, 1990
Allen Frederick Millikan, November 17, 1990
John A. Morrison, November 28, 1990
John H. Moulton, October 31, 1990
Grace Myers, December 21, 1990
John A. Ryan, November 5, 1990
Paul Schmidbauer, December 25, 1990
James Y. Smith, October 18, 1990
Waymon H. Smith, November 4, 1990
William Snider, November 4, 1990
Milton E. Spear, December 15, 1990
Cornelius J. Tamson, October 21, 1990
George W. Tyll, October 7, 1990
Ross Waymon, November 1, 1990
Michael Winisky, October 21, 1990
Louis Witt, September 24, 1990

Science & Technology

Hillis O. Folkins, October 27, 1990
Clarence J. Moderow, December 26, 1990

Chemicals & Minerals

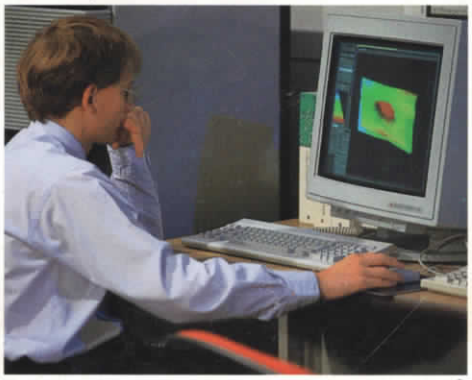
Eugene M. Deane, January 7, 1991
William H. Wright, November 16, 1990

Molycorp, Inc.

Curwin W. Knaub, December 24, 1990

UNOCAL 76
Unocal Corporation
P.O. Box 7600
Los Angeles, California 90051

CONTENTS



1

8

24

Cover: Computer modeling reveals how seismic waves, shown as a blue grid pattern, propagate around and through a subsurface salt dome. Computer interpretation of seismic data is just one of the advanced techniques employed by Unocal's Exploration Research specialists in support of the company's effort to increase its oil and gas reserves. Story on Page 1. *Photo by Chuck Schoenfeld.*

Seventy Six is published by the Corporate Communications Department, Unocal Corporation, Box 7600, Los Angeles, California 90051. **Karen Sikkema**, Vice President,Corporate Communications; **Tim Smight**, Editor; **Mike Broadhurst**, Assistant Editor; **Valerian Anderson**, Editorial Assistant; **Ray Engle and Associates**, Art Directors.

Seventy Six
VOL. LXX
NUMBER 1
WINTER 1991

Use of the name "Unocal" in Seventy Six *may refer to either "Unocal Corporation" (a Delaware corporation) or "Union Oil Company of California" (its wholly owned subsidiary) or, at times, to subsidiaries of either of these companies.*