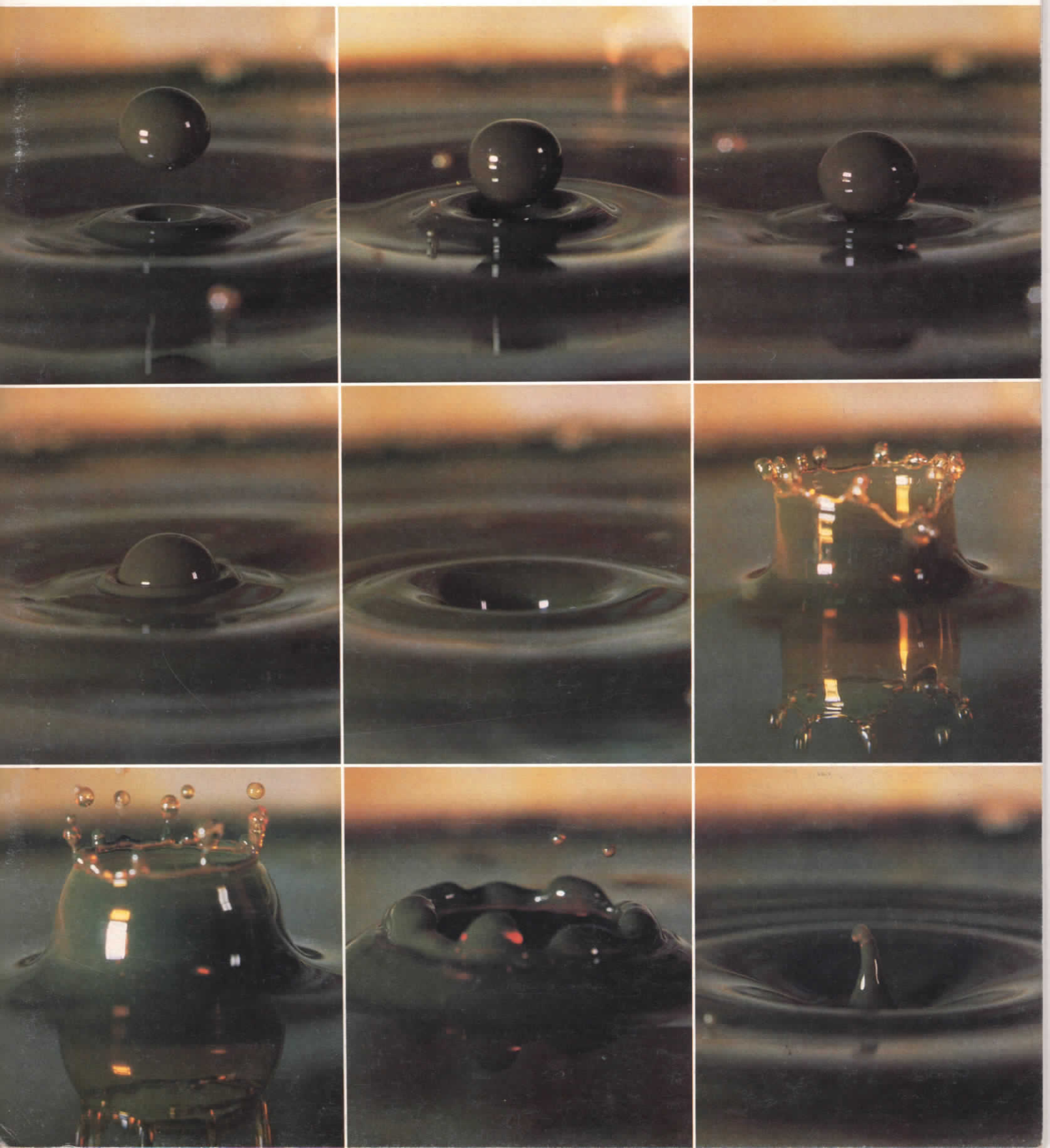
Seventy Six

March
April 1983



THE SAGA OF A DROP OF OIL

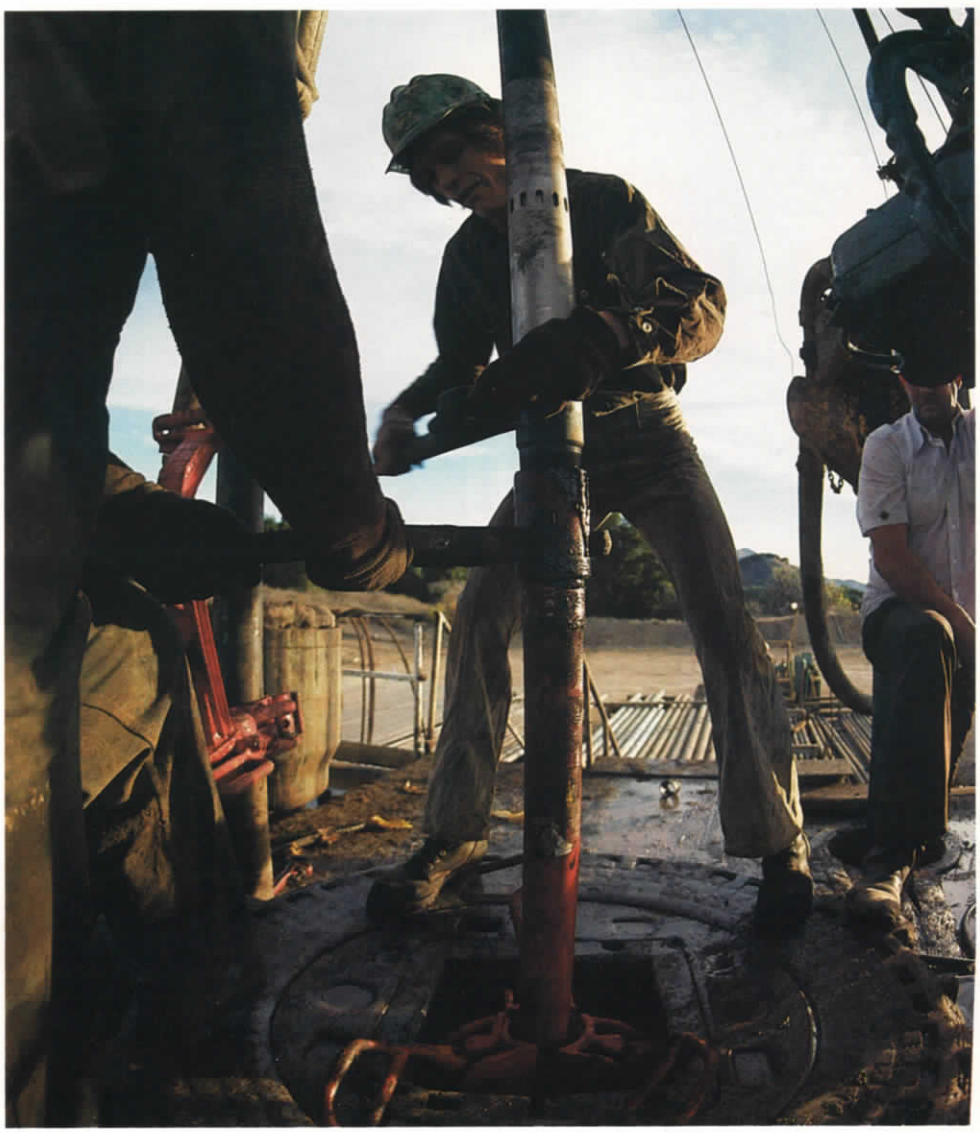
by Sergio Ortiz

I would like to open my story by paraphrasing that ubiquitous American Express commercial, "You don't know me, but my name is familiar all over the world." Of course, it isn't the usual kind of name because I'm not the usual kind of celebrity. So who am I? Just a small, insignificant drop of crude oil.

Or, at least, to the uninitiated that's all I'd be. But what a misguided impression. I may be small, but by no means am I insignificant.

For I am the true backbone of industry. Just think of what is made from me: gasoline, kerosine, naphtha, cup grease, lubricants, waxes, paraffin, laundry wax, jellies, ointments, nasal sprays, medicine products, ethers and anesthetics, bug sprays and insecticides, dyes and commercial solvents, oil for making candies and cosmetics and for packing fruit and preserving eggs, gases and oils for accelerating plant growth, flotation oils and reducing agents for metallurgical uses, rubber and plastics, roofing materials, paving and road oils, fuel for steamships and boilers and diesel engines and household furnaces, fuel for

A drop of oil forms a coronal effect as it falls into a petri dish of crude (Left). *Workers* (Below) *engage in drilling operations in man's search for energy. Drilling is but one of the many steps in the production of crude oil or natural gas.*



power plants, coke and a multitude of other necessary things that make the world turn.

And that isn't all. You see, I am as distinctive and varied as a person's fingerprints and sometimes far, far more difficult to analyze.

But, "How is that"? you ask. Isn't crude oil still crude oil, no matter how you cut it?

But, ah, if you only knew my endless complexities. You see, I, that "measly" drop of crude, am a complex assemblage of organic molecules derived from once living organisms. I have been "brewed" so to speak, over millions and millions of years.

But I am getting ahead of my own story. Let's begin again.

Every substance on earth belongs to one of two great classes. If it is, or has at one time been, part of living organisms, whether animal or vegetable, it is organic. Everything else is classed as inorganic.

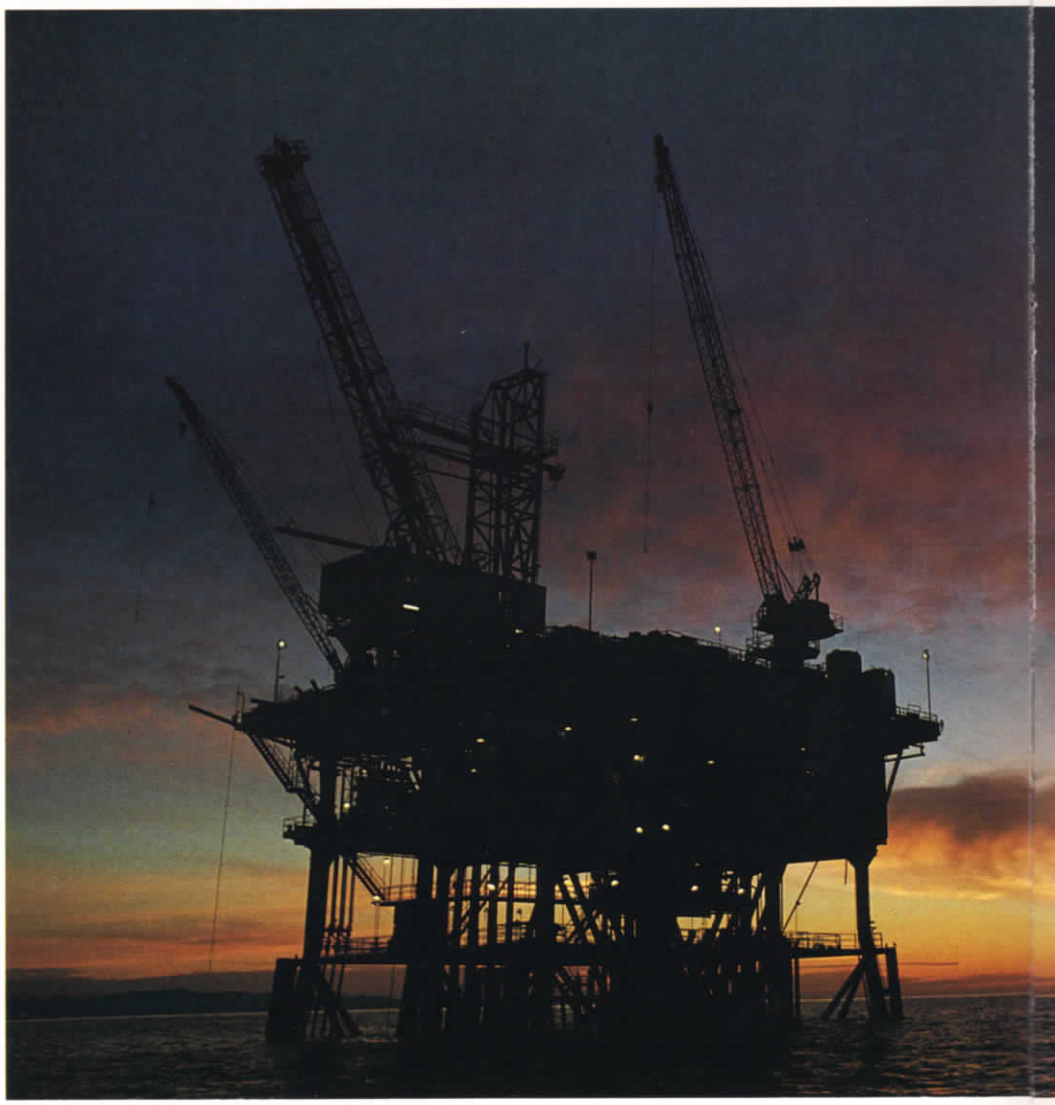
Although I am organic in substance, because I have derived from living organisms, I am also a mineral. Like coal and other organic mineral substances I am composed mainly of hydrogen and carbon. That's why we are called "hydrocarbons."

In its natural state, hydrogen is a light gas. In its purest form, carbon is a solid, adopting different properties such as graphite, charcoal and even diamonds.

But, I am not just a simple hydrocarbon either. *Au contraire*, I am an extremely complex compound with an endless variety of formulas and characteristics. Natural gas is nearly always associated with me, by the way. In fact, we are both part of a family of hydrocarbons, some of whom contain small

Pumping units extract oil from the earth before it goes through many other processes making it into refined products.

Although it was known that oil and gas were to be found beneath the sea for a long time, offshore drilling is a relatively new application. Union Oil's platform "C" produces oil from offshore California.



amounts of oxygen, sulfur or nitrogen.

On one side of my family, I have a very light, odorless, heavy flammable gas cousin called methane, or "marsh gas." At the other end, I am akin to solids such as paraffin, from which candles are made and the asphalt you see in pavements. Between those two are an endless variety of liquids, gases and even some semi-solids. They range from butane to gasoline, from jet fuel to fuel oil. Each one is a little heavier than the other.

So please, don't think that all oils—my cousins and I—are alike. We are as diverse as people in a stadium crowd. Some of us may have a high volume of gasoline, a low sulfur content, and be rich in lubricants. Others may have a base that is rich in asphalts or paraffin.

Gertrude Stein would probably say that an oil is an oil is an oil. Just like she said a rose is a rose is a rose. But there are a million more variations in oils than in roses.

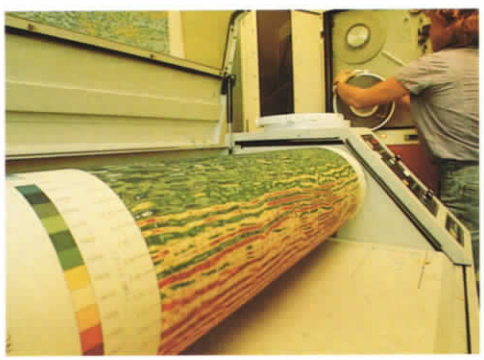
Yes, we oils are very, very different. We have even been cursed by that abominable misnomer—"Black gold." Yet only the heavy, asphalt-rich oils are black. Some of the lighter ones are actually green if you look directly at them and dark red if you look through them. A few oils are even yellow.

And color is the least of it. As a rule, lighter oils require simpler refining processes, and more gasoline can be extracted from them. This tends to make a difference in prices.

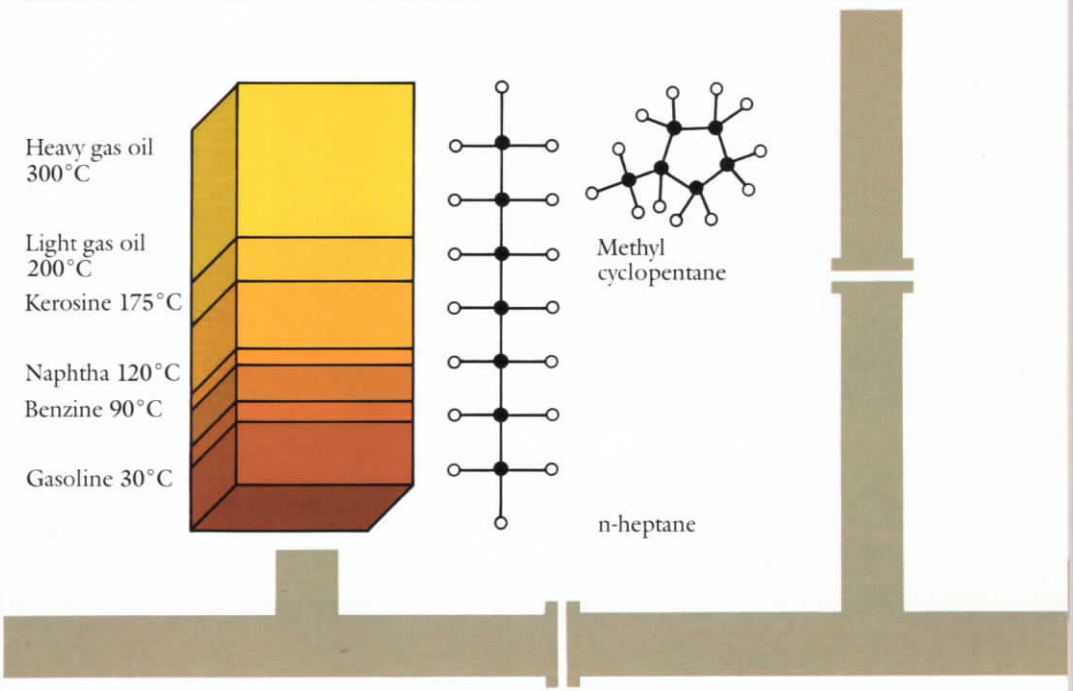
But, I ramble. Please bear with me. Because now that you understand these differences, I can explain how I awakened from my millennia-long slumber and was wrested from the ground.

As you know, I am the result of a

Research is ongoing in the search for and the production of energy resources. Below, a scientist at the Union Oil Fred L. Hartley Research Center in Brea, Ca., plots a seismic profile.



A Union Oil refining engineer examines product samples at the company's Los Angeles Refinery. Although visual inspection is routinely conducted, far more elaborate tests take place in the refinery's labs.



long, long distillation of organic materials lodged in source rocks that were once deposited as sediment usually on the bottom of prehistoric oceans and lakes. It was a geologist who first suspected my existence in a deep, tomb-like reservoir.

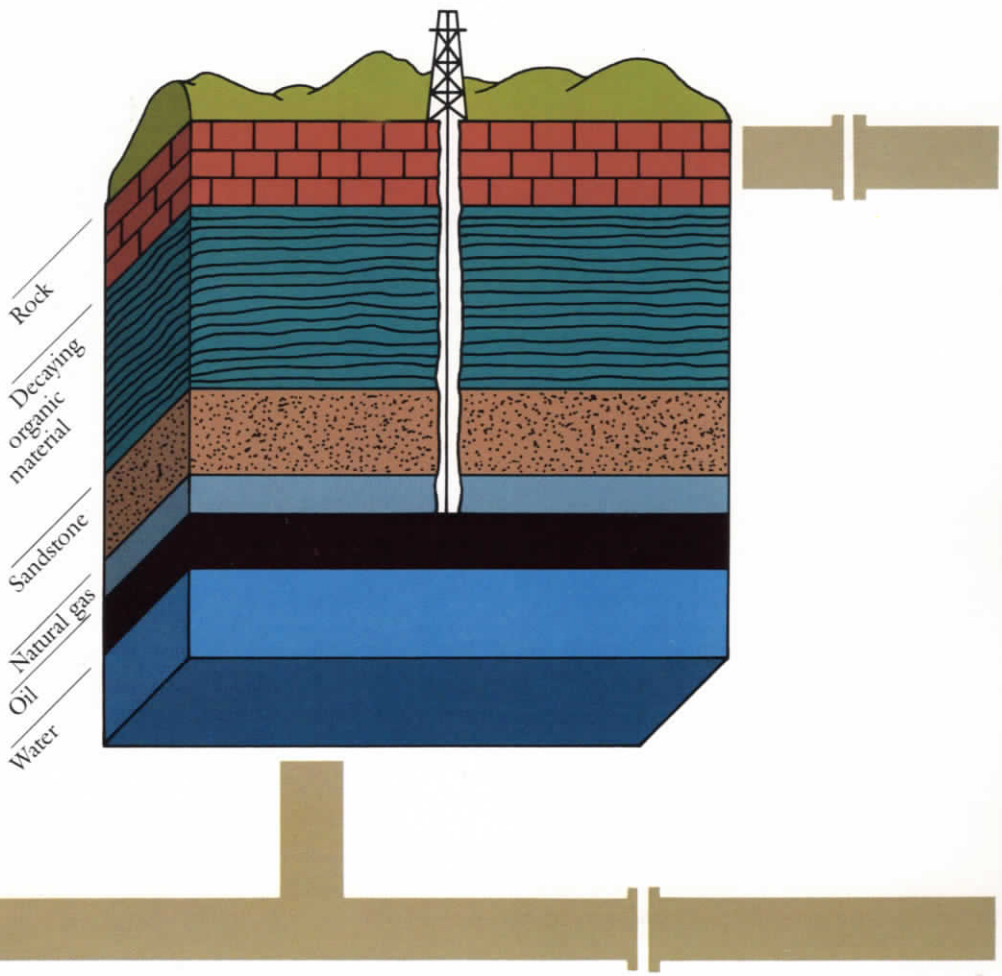
After long and arduous study of the area, he recommended that what is known as "exploratory drilling" be conducted over the site where I had been trapped.

Geology is the genesis of oil production. But a geologist by no means finds the oil. He merely *recommends* where to drill. In a true sense of the word, he is an explorer, his mind searching out the secrets of the earth in an attempt to "guess" what lies thousands of feet below. But he is only one member of the team of experts involved in the complex process of discovering producing reservoirs. Other team members may include: a paleontologist, who determines the age of certain beds after studying the fossils within those strata; a geochemist, who studies the organic material in samples from outcrop found deep below the surface; and usually a geophysicist using complex gizmos called gravity meters, seismographs, magnetometers and other devices that aid in understanding the sub-surface.

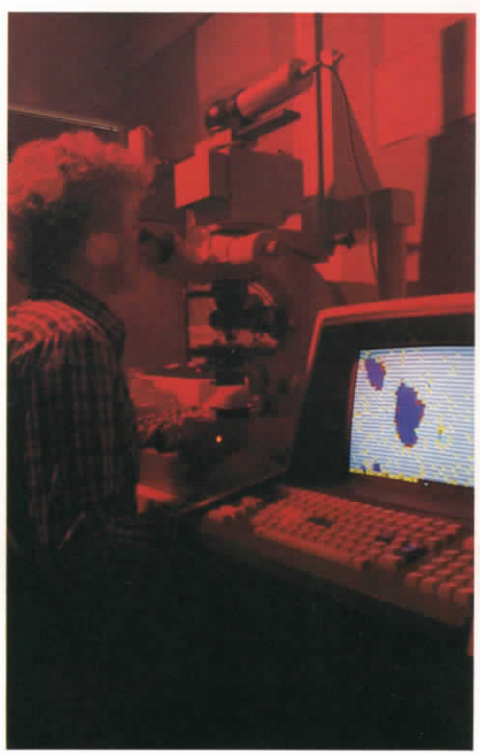
And that's not all. Not by a long shot.

A subsurface geologist will study the different characteristics of the rocks by analyzing the logs of many wells. A photogeologist pores over aerial pictures that outline the structure in between rocks and sediments. A minerologist may use a microscope to correlate strata from their mineral makeup.

Cross section of earth strata



After the oil leaves the well, it is transported via pipelines (Below) that require constant inspections and upkeep. Again, while the oil is being processed, research continues to discover better ways to produce, refine and market energy.



I hope I haven't lost you but in these early innings—if we can refer to the serious business of energy exploration as a "game"—I hadn't even been found yet. Suspected, yes. Confirmed, no.

After the scientists have made endless studies and findings, a landman appeared on the property directly above my reservoir. His mission was to acquire the rights to drill on the land, sometimes a complicated legal step involving long negotiations and discussions.

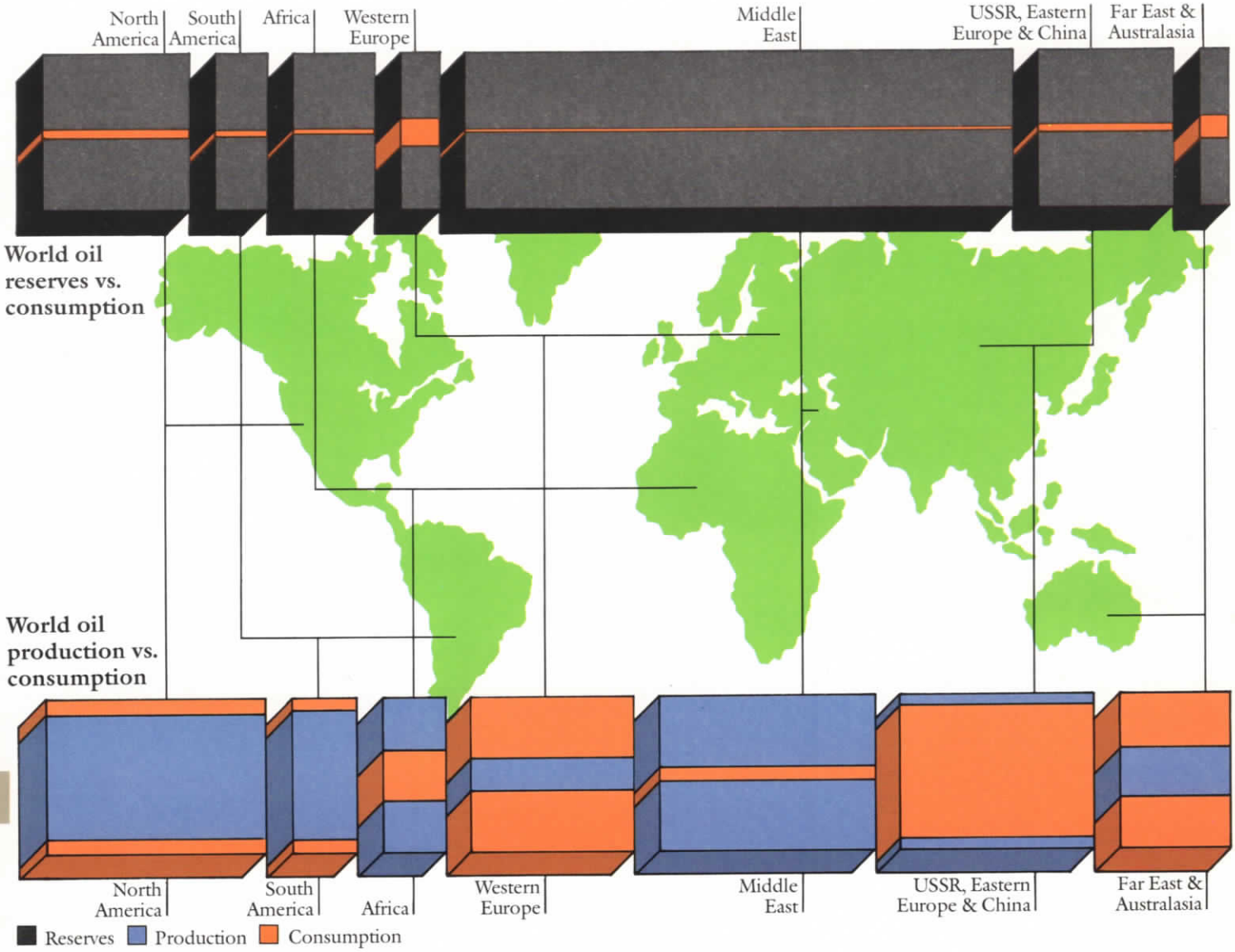
Oh my. I'm digressing again. Back to my origins and the theories that determine my existence.

Contrary to popular conception, I am not found lying in huge subterranean caverns or flowing in vast underground rivers. Instead, I took form millions of years ago in the tiny voids of such reservoir rocks as sandstones and—in some cases—limestones. My fellow drops and I gathered in those pores, pushed up by water. Source beds, reservoir rocks and traps—these are the things a geologist looks for as he seeks crude oil accumulations.

In the source beds, he looks for clues indicating the presence of sufficient organic material to have formed some oil. He then determines if reservoir rocks are present. Eventually he hopes to find a rock formation porous enough to hold fluids but pervious enough to allow those fluids to flow through the rock.

The source beds are almost always shales or limestones which once contained a plethora of organic remains when they were deposited as mud or ooze on the sea floor or lake bottom in times long gone by.

Another word or two about my cou-



sin natural gas. As a rule, where oil is found, gas is also present. There are many gas fields with no oil. But the oil field that lacks gas is very rare. Since natural gas is lighter than I am, it will be at the top of my reservoir. Water, the heaviest of all, is always found at the bottom.

Now, let's get back above ground. A great deal has happened. The lease on the prospective land has been acquired for drilling, roads have been built and an adequate water supply has been secured. The well that will tap my reservoir is ready to be drilled.

But first, it must be christened. We have all heard some of the names given to wells. A few are industry legends. But my well was named according to a long established oil practice. Since it was drilled by Union Oil Company, on a lease from the Santo Domingo Land Company, the well was known as the Union Oil/Santo Domingo Number One. That is its legal name and all official papers refer to it as such.

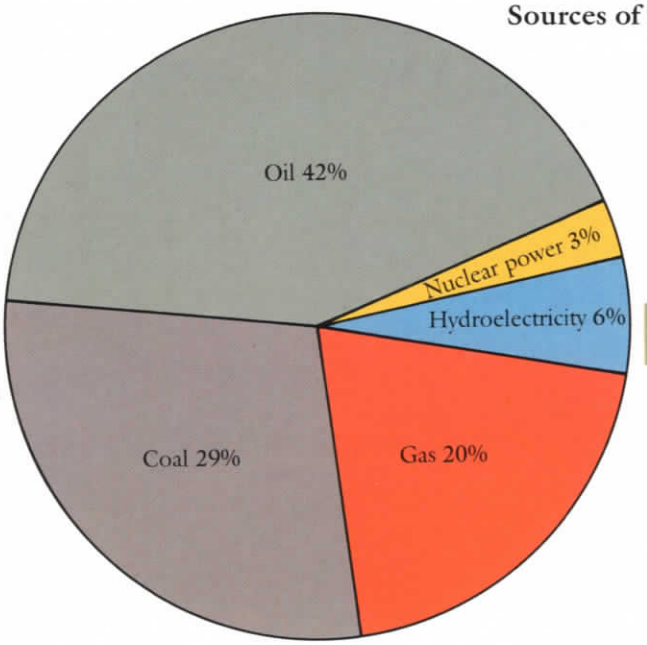
After the christening, it is time to drill the well. This is a technique in which the hole is drilled by rotating a cutting tool, or drill bit, on the end of a long pipe.

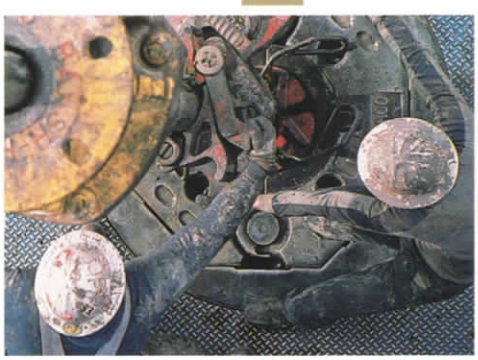
Following a complicated construction stage, the completed rig stood over my reservoir like the Eiffel Tower. Then the well was "spudded in," meaning that the bit had entered the ground.

The well is drilled using drilling fluid called "mud" to cool the rapidly rotating bit, carry out the drilled up material (cuttings) and keep back pressure on the formation so the hole does not collapse or the well blow out.

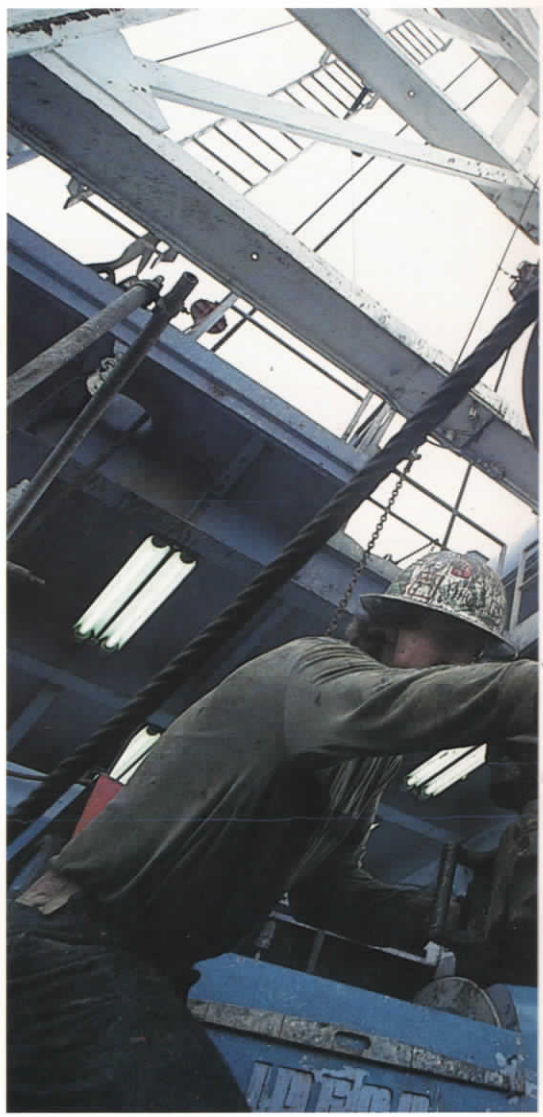
After weeks, months or even years

Sources of energy used worldwide





Drilling, an essential part of the energy world, is conducted both onshore and offshore and even in remote places such as the Arctic and far-off tropical jungles.



of work, considerable expense—and often some unexpected delays—the driller of my well will reach the predetermined depth. Electric logs will then be run to determine if I and my other oil droplet buddies are really present.

If I am present, the oil company may wish to run a test to see how well I come out of those little pores in the reservoir. If so, a carefully devised and controlled test is performed. My reservoir filled a 100-barrel tank in 20 minutes. This would lead drilling experts to estimate my reservoir had the potential of producing almost 7,000 barrels of crude oil per day.

Guess who was in the first barrel. Me. The crew was behaving nonchalantly, but even veteran oil hands will tell you that nothing can compare to the exhilaration of having successfully drilled a producing well.

Crude oil in a storage tank is of no use to anyone. It must be transported to a place where it can be refined for its thousand and one uses and eventually marketed.

Transportation to a refinery is usually accomplished via a pipeline or ocean-going tanker. If neither is available, tank trucks, barges or even rail cars are used to take the oil to a refining complex.

In my case, I was injected into a pipeline system shortly after I was produced. Earlier, the company's land man had negotiated permission for the rights-of-way to lay a new pipeline leading from my well to an existing carrier. It wasn't an easy feat, what with all the red tape that must be unraveled these days.

It was only after a long pipeline trip that brought me hundreds of miles to a refining center that the most impor-

tant chapter in my story—the one that tells of the way I benefited mankind—finally began.

You must realize that up to this point, I have been nothing but an expense for everyone involved in my production. It is estimated that the average well costs over 1 million dollars to drill. There are huge overhead expenses involved in the transportation, refining and special treatment that crude oil undergoes before its derivatives can be marketed.

Once at the refinery, a study of my composition is made. It was no easy task. Scientists conducted a very complicated study of the products that I might provide. These were then compared with market studies to choose the products that would yield the most saleable products at the lowest cost. After all, I had almost reached the point where I could begin to carry my weight and justify the salaries of all the people who have brought me this far.

An engineer charted an "index" to my character and weight. He knew, of course, that my makeup included gases, liquids and solids, each heavier than the last. He also knew that the lighter my weight, the more gasoline he was apt to produce from me. Not necessarily, however. This is not an absolute rule because all oils are not alike and one of the biggest differences is our weight, or "gravity."

At the risk of belaboring the point, I will provide a brief explanation of how my weight is determined. At the turn of the century, a Frenchman named Baumé invented the universal method for determining the gravity of an oil sample. In pure water, he found, a hydrometer—a tool for measuring water—sinks to a measurement of 10.

Transportation is a very important facet in the world of energy; here, a large ocean-going tanker docks.

In heavy oil, perhaps from the Texas fields, it will dip to about 40. In good grade gasoline, its measurement will sink to about 60 or even as low as 66.

The early oil refiners used this as their guide. In modern times, however, the Baumé scale has been revised and oils are graded in terms of their density, or "degrees API" (American Petroleum Institute). For example, a Texas crude might be referred to as 40 API, a California offshore crude—such as from Union Oil's platforms in the Santa Barbara Channel—as a California 20. And so on.

End of lesson and back to the refinery where it was my fate to be sampled by a laboratory technician. He submitted me to an insufferable number of tests to determine my boiling range, pour point, viscosity and other characteristics.

Well, if I can take it so can you. Because, like it or not, I'm about to give you a very basic lecture on refining.

Don't tell this to an engineer, but despite all the high-falluting terms he uses, the fundamental principle in refining is as simple as this: When heat is applied to any substance, be it oil or water, the lightest constituents boil first. And boiling is nothing more than changing a liquid into a vapor.

Let's assume that you put me into a tea kettle at 300 degrees below Fahrenheit and turn on some heat. At about 260 degrees below, my methane would dissipate and fly through the spout. By the time you have brought me to the melting point of ice, the other dry gases would also begin to vaporize. Upon reaching body temperature, all the gases would be gone. And this is when natural gasoline

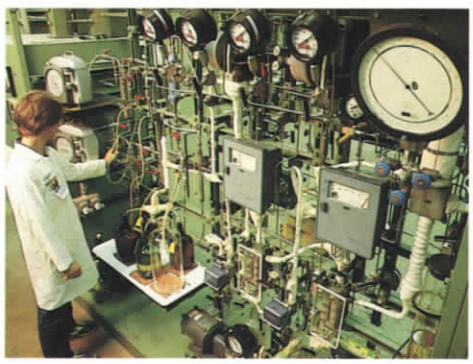
The construction of pipelines is a long and complicated process that involves high technology.

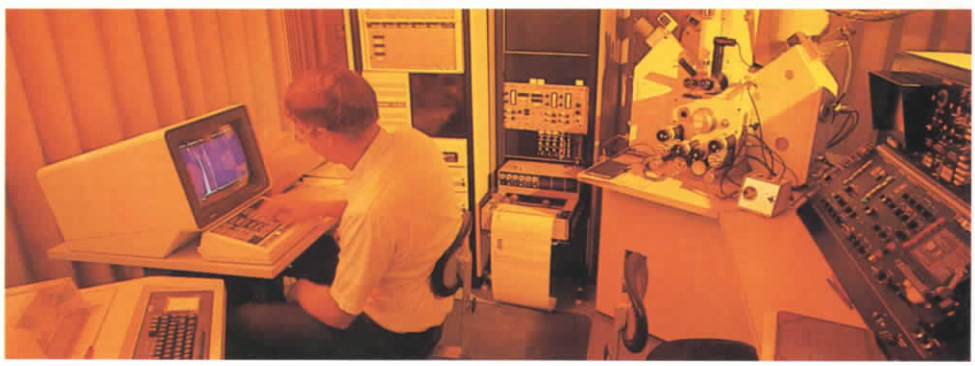
Eventually all oil must be processed at modern refining centers such as the Union Oil Los Angeles Refinery.

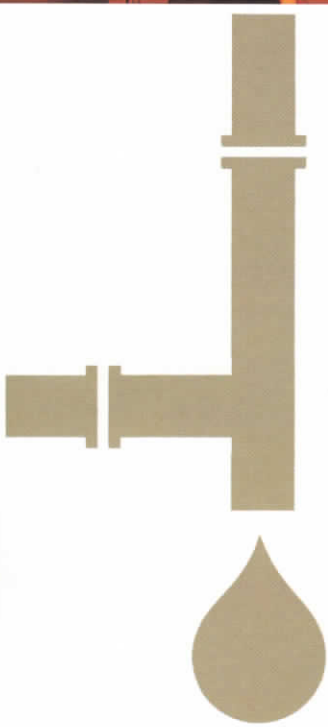
would begin to boil. By the time you've subjected me to about 450 degrees, all my gasoline would have evaporated. The jet fuel and diesel fractions would boil next, followed by the gas oil, lubricants, wax oils and paraffin. Cooking me at about 1,000 degrees, my asphalt would have decomposed into lighter products that would evaporate as well. Anything left? Just some coke.

I've reached the end of my tale, such as it is for a "simple" drop of oil. But the story of your involvement with oil is still "to be continued." After all, mankind has been using the likes of me in one form or other for at least 7,000 years. And, even though the world's limited oil supplies are inexorably dwindling, there are still quite a few more drops around. (76)

Refining and research go hand-in-hand in the world of energy where new concepts and ideas are constantly being tried and developed to benefit the modern world.







Five thousand, three hundred and seventy-six fluid ounces make-up a barrel of oil. To some, a barrel of crude may look like a gooey liquid whose only redeeming virtue is to be eventually refined into gasoline. The products that can be derived from those 42 gallons of petroleum in one barrel, however, begin to resemble an industrial horn of plenty.

Union Oil researchers broke down a typical barrel of domestic crude oil into what may be produced from it. (By the way, the average domestic crude oil has a gravity of 32 degrees and weighs 7.21 pounds per gallon.)

Here's what just one barrel of crude oil can produce:

Enough gasoline to drive a medium-sized car (17 miles per gallon) over 280 miles.

Enough distillate fuel to drive a large truck (five miles per gallon) for almost 40 miles. If jet fuel fraction is included, that same truck can run nearly 50 miles.

Enough liquefied gases (such as propane) to fill 12 small (14.1 ounce) cylinders for home, camping or workshop use.

Nearly 70-kilowatt hours of electricity at a power plant generated by residual fuel.

Asphalt to make about one gallon of tar for patching roofs or streets.

About four pounds of charcoal briquets.

Wax for 170 small birthday candles or 27 wax crayons.

Lubricants to make about a quart of motor oil.

There are enough petrochemicals left in that same barrel to provide the base for one of the following:

39 polyester shirts
750 pocket combs
540 toothbrushes

65 plastic dustpans
23 hula hoops
65 plastic drinking glasses

195 one-cup measuring cups
11 plastic telephone housings
135 four-inch rubber balls

The special naphthas in a barrel are used mainly for paint thinners and dry-cleaning solvents and they could make nearly a quart of one of these products.

The miscellaneous fraction of what is left still contains enough by-products to be used in medicinal oils, absorption oils, fractionating oils, still gas, road oil, and plant condensates.

And that's a real industrial horn of plenty. (76)

SHALE

MOUNTAINS OF OIL

"There are no textbooks on costs of mining, retorting or refining, nor in fact, any assurance that a suitable oil could be obtained from the (Colorado) shales at anything like a reasonable cost. The mere fact that the work was so new made it all the more interesting and kept everyone on his toes, for each man felt like a pioneer expecting something new around every turn or over the next hill."
—R. Burnham
The Union Oil *Bulletin*, 1922

Today, the mountains that Burnham once prospected, are teeming with activity. There, Union Oil is currently undertaking an ambitious plan to wrest hydrocarbons imbedded into marlstones millions of years ago when the Rockies were at the bottom of a sea.

Up to 85 percent of the richest and most accessible shale oil reserves lie in the Piceance Creek Basin in western Colorado—where Union is on the threshhold of converting this resource into energy.

Sixty one years after Burnham conducted his tests on the Long Ridge, workers are currently finishing the shale retort unit *(Bottom Left and Right)*. The upgrading facilities *(Left)*, eight miles south of the retort, where the impurities will be removed, will begin operations after retort start-up this fall.

While work continues on the retort, (Left), *the upgrading facility is nearly complete* (Below). *The three cylindrical reactors are associated with Unionfining, and dewaxing—all Union patented refining processes.*

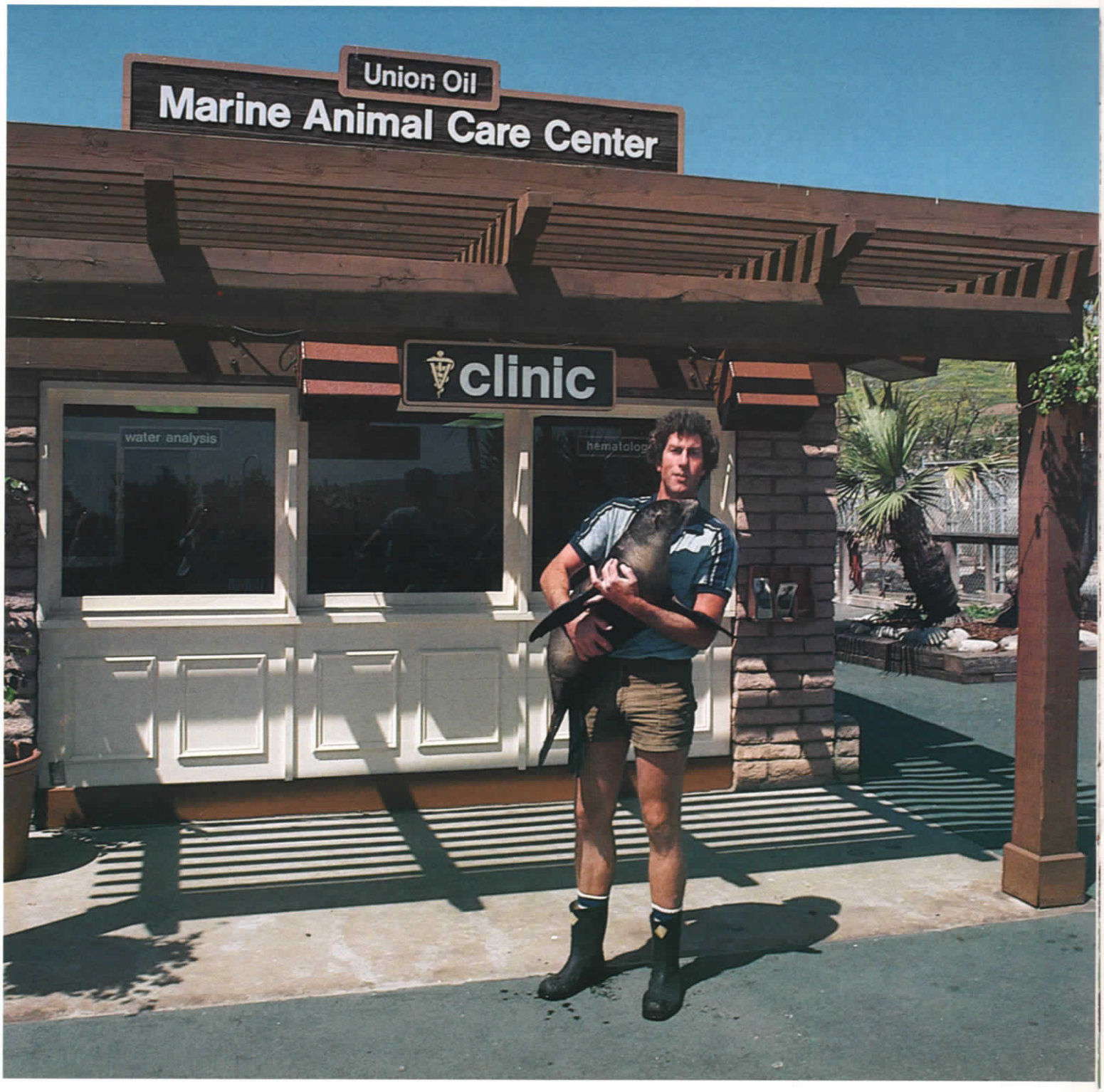
The retort unit can be seen from inside the mine high on the side of Long Ridge. This is the first commercial shale project in the country.

An overall view of the upgrading facility shows the progress that has been made since Union started operations in Colorado more than two years ago, (Right). *Below, the conveyor belt that will carry the spent shale to a wetter, where it will be moisturized and later compacted, stands like a rollercoaster against the mountainside.*

The retort, shown here, and recycle gas heater are two of the units that will help make the shale operation fully functional by the latter part of this year.

Union's aim after starting the retorting facility is for the operation, after a "break-in" period, to reach its full design production of 10,000 barrels of syncrude per day, (Left). *The conveyor belts that will carry the shale from the mine to the retort* (Right) *are but one of the many steps that will eventually see the oil reach the upgrading facilities near Parachute* (Below) *before the oil is shipped to the refineries.*

Brad Andrews holds Lolita, a California sea lion recuperating at the center.



CARE CENTER FOR OCEANIC ORPHANS

Story and photos by Linda Gleason

Only a few hours earlier, when brought to the Union Oil Marine Animal Care Center at Marineland, the starving and convulsing young California sea lion was on the verge of death. But after careful treatment, the skinny creature is now strong enough to nip at Brad Andrews, head curator of the southern California park, who is attempting to draw a blood sample.

For the time being, at the busy care center, the eight-month-old sea lion is simply referred to as "Number 1468."

Like many of the other 110 pups already patients at the center, "Number 1468" was a victim of the series of relentless storms that battered the California coast this winter. The infant sea lions were separated from their mothers, orphaned before learning to feed themselves.

Thanks to care at the Union Oil sponsored infirmary, many of these young animals will regain their health and return to their natural habitat.

"Number 1468" was washed ashore on Redondo Beach in early April. Ribs distinctly outline the sea lion's underweight frame. He ought to be round and fat, at least three times his current size.

"Because of the storms, we had already handled nearly 300 animals by the end of March," says Andrews. "Normally, we handle half as many throughout the entire year."

The major stranding season is in May and June when California sea lions are newly weaned. "It takes nine or 10 months for sea lions to wean," says Andrews. "If they haven't been successfully weaned they often end up on a beach somewhere helpless, hungry and sick when they are about a year old."

As a result, most of the center's patients are yearling California sea lions. But other species occasionally require attention, such as the half-dozen elephant seals noisily "laughing" as a keeper tosses fish to them in their sunny cages, or the month-old harbor seal that arrived the same morning as "Number 1468." The center also cares for about 30 marine birds, mostly pelicans, each year.

Before arrival at Marineland, the stranded pups were living off their own body fat and quickly losing weight. Some had contracted parasites, such as lung worms—the number one cause of death for the animals—carried by fish they had eaten. Once sick, sea lions can't swim or catch fish and often get pneumonia as well.

Pelicans and other marine birds are regular patients at the center. Andrews examines a blood sample for parasites in the laboratory (Right). *Two pups happily take a bottle formula* (Lower right).

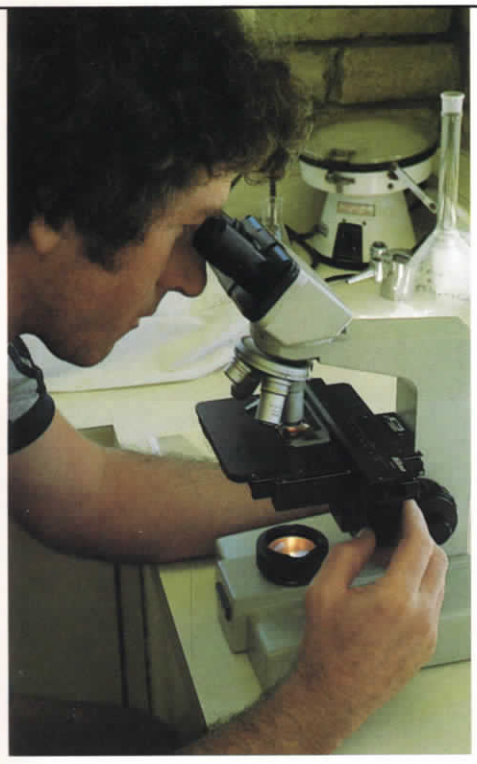
When an ill or injured animal is found on a southern California beach, animal control officers, specially trained by Marineland personnel, pick them up and deliver them into the waiting and capable hands of care center employees.

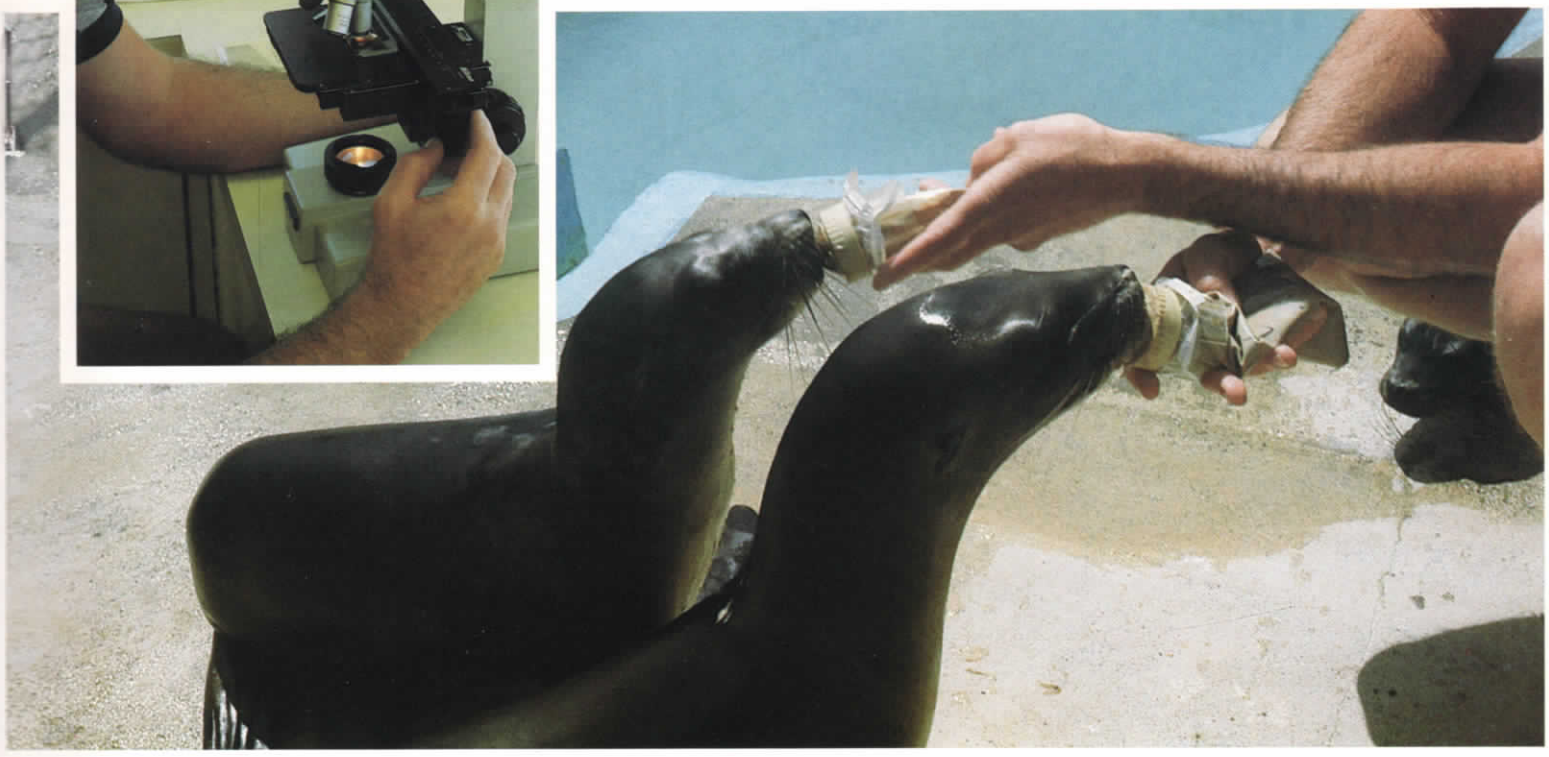
The first stop for the newcomers is the fully equipped laboratory where Andrews is now testing for parasites with the blood sample taken from this morning's new charge. Here, diagnostic samples are taken and the animals are given immediate medical attention, even surgery if necessary. A consulting veterinarian makes regular rounds.

"We conduct treatment in three stages," says Andrews. "During the first stage we feed the animals, administer antibiotics and try to stabilize their condition. This is a critical period—the normal survival rate is about 55 percent. If we can keep them alive their first 48 hours here, they will probably make it."

Because they are only eight months old, however, the orphans of the 1983 storms have had a 66 percent survival rate. They don't have the secondary parasitic and respiratory problems of the year-old pups because they haven't begun to eat fish yet.

"In the second stage we try to fatten them up and, at the same time, treat them for parasites," Andrews explains.





Pups who won't eat are forcefed a mixture of ground fish, antibiotics and nutrients. Others are bottlefed a formula of whipping cream, oils and a soybean derivative. "Marine mammal mother's milk is about 45 to 55 percent fat—three times that of human milk," says Andrews as two eager pups clamor for the bottles he offers. "These pups need to get fat fast in order to keep warm in their marine environment."

The animals eating solid food are given the same kind of fish they would eat in the wild.

During the third stage the seals live in community pools where they learn anew how to compete for food. "Sometimes we even introduce live fish so they can re-learn to hunt," says Andrews, as he hold up 'Lolita,' one of his healthier patients, for visitors to pet.

About 25 percent of the animals are returned to the sea once they maintain their weight and regain their health. Those too dependent on man are relocated to zoos. Probably 90 percent of this year's storm orphans will go back to their oceanic homes.

Most of the yearlings are released on local beaches. Others are taken in the Marineland boat to be set free on Catalina or the other Channel Islands. All of them are tagged and numbered so their movement can be studied.

"Animals that require treatment for a long time, or very young animals, usually become too tame to be released to their natural habitat," observes Andrews. "We have a very successful relocation program for them."

Some of California's beached marine animals now entertain crowds in Hong Kong's Ocean Park, Tel Aviv's Zoological Gardens, the Barcelona Zoo, Amsterdam's Zoological Gardens and zoos all over the United States.

"The relocation program serves a twofold purpose: The zoos get healthy animals, suitable for public display, and they don't have to go to the wild to find them. It also relieves us of the responsibility of feeding them. Our food bill is tremendous—the 110 animals we're treating now eat 700 pounds of fish a day," says Andrews who began his 11-year career doling out the smelly meals in the park's "fish room."

Tim Desmond, assistant curator, tosses fish to hungry orphans. Desmond tucks medication into fish gills before feeding time.

Georgie Girl, a 400-pound baby walrus, gets a little extra attention from Andrews. Dozens of orphaned sea lions, like this one, were washed ashore by winter storms in California (Right).

Two stranded pups, "Tody" and "Seymour," have gone on to become stars at Marineland, performing their stunts and antics in one of the daily shows.

Another pair of California sea lions who were patients at the Union Oil Care Center now happily sun themselves and play in the water in one of the park's display ponds. This happy couple has even produced offspring. "They have really come a long way. When they came to us they were literally dying," says Andrews.

"Georgie Girl," a 400-pound, one-and-a-half-year-old orphaned walrus, will also remain in the park. Found stranded on an Alaskan beach, she was flown to Marineland. When older, she will share an aquarium with the offspring of the only two pair of walruses to successfully mate in captivity.

The listless, emaciated animals in the care center's row of open-air kennels are in sharp contrast to the healthy, frolicking marine life seen throughout the rest of the park. It is obvious they are not here to entertain.

When Union Oil began sponsoring the center, in 1980, its "behind the scenes" operations were opened up. The glass enclosed laboratory was specially equipped with two-way microphones so visitors may ask questions about the treatment. Care center personnel explain their work to over 150,000 school children each year.

As one of the few marine animal clinics in the world, the center is also a good place for veterinary students to get hands-on experience with oceanic animals. The knowledge and expertise gained here is shared with student "externs," who visit in two-week increments during a year-round program.

After Andrews has checked on all the animals, making sure they have had their first feeding for the day, he returns for one more look at "Number 1468." The little sea lion is resting quietly in his cage. It looks as though he may pull through after all. (76)

The headquarters of Poco Graphite—a wholly owned subsidiary of Union Oil Company—are located in the quaint town of Decatur, one of the stops in Texas on the legendary Chisholm Trail. Today, however, the tramping thunder of thousands of cattle herds that made the trek to the north is but a memory, relived only in films or Western novels.

Decatur has seen Poco Graphite grow into a sophisticated company that produces materials for an astonishing variety of high-tech products.

Since 1965, when Poco Graphite was acquired by Union Oil with the merger of Pure Oil Company, Poco has seen its product reach literally into the vastness of outer space.

Graphite is a form of carbon, a basic element found in almost every substance on earth. Of the million or so compounds known to man, 90 percent of them contain carbon. The public may consider carbon as something found in lead pencils, flashlight batteries or in lubricants needed to loosen sticky doors. More rarely—in its hardest form—we know it as diamonds.

The type of carbon compound produced by the Poco experts, however, is neither mundane nor precious. It is a special substance with myriad applications in electrical discharge machining, medicine, semiconductor and fiber optics manufacturing, nuclear fusion machines and harnessing solar energy. Other applications include heat-resistant materials needed by the aerospace industry, turbine engines, crucibles and space vehicles.

The uses of Poco graphite are, in fact, expanding rapidly. Although synthetic graphite has been made in crude fashion since the early part of this century, its first large-scale use in a highly specialized application began during World War II. Scientists developing the atomic bomb utilized graphite as a key substance needed to build the world's first atomic reactor pile.

"In those days a nearly pure graphite was produced," explains R. K. "Bob" Carlson, president of Poco Graphite. "Compared to the purity and property of our present product, however, that stuff wouldn't even be competitive."

Of all the highly sophisticated applications for Poco graphite, perhaps the most fascinating are in medical science. Ironically enough, when the dehydrated human body is reduced to its most basic form, one finds that 90 percent of it is carbon. However, it is carbon's inertness that makes graphite an extremely compatible material to supplement or even replace many organs.

The properties of Poco graphite

The Medical Value of Graphite

Rx

This patella resurfacing device, used to replace the back side of a kneecap, and finger and big toe knuckle implants made of Poco graphite are in some ways superior to natural joints.

Poco Graphite produces high-tech products at its headquarters in Decatur, Texas.

A special grinding technique, where nothing touches the piece being machined, is used to produce electrical discharge machining (EDM) electrode rods.

make it ideal—in strength and durability—for making artificial implants for the human body that are in some ways superior to the natural organ and can last a lifetime.

That is the main reason why Poco Graphite has more interaction with medical science than any other company of its type in the world. Since 1969, more than 400,000 artificial heart valves, using carbon, have been implanted into patients worldwide. In addition, many people have received artificial tooth roots, joints and other medical implants that use graphite as a base. The type of graphite used is almost always Poco.

What makes this substance so ideal for medical implants?

According to Dr. Jack Bokros, president of CarboMedics, Inc., an Austin, Texas, firm that produces many of the carbon implants in use today, Poco graphite is the most desired product to make the implants.

"Our patented process basically involves taking Poco graphite as a substrate. First we apply extreme heat to it, then deposit another type of carbon, Pyrolite carbon, on its surface. When we cool it down—over 1,000 degrees (C.)—it shrinks tremendously. For this process to work correctly, the thermal expansion of the substrate must be appropriate. We find Poco graphite is ideal because it shrinks faster than other carbons and, consequently, puts the surface in compression." (CarboMedics' Pyrolite goes in compression because Poco graphite will—under those circumstances—shrink about 20 percent faster.)

Dr. Bokros explains that once this part of the process is completed, the elasticity of Pyrolite carbon and the Poco graphite match.

But Poco graphite has other advantages as well. Because it is isotropic, i.e. its properties are equal along all axes, and fine grained, it is machinable to extremely close tolerances.

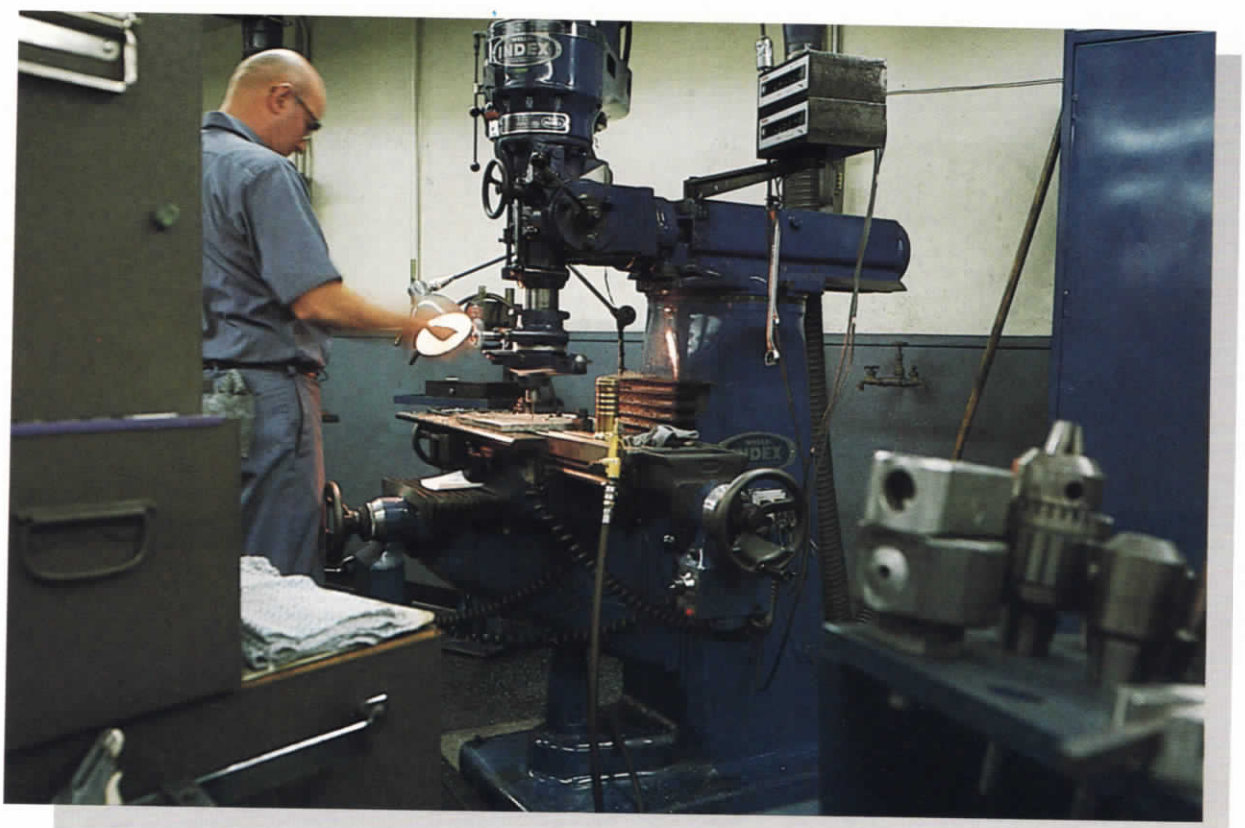
"Most graphites are very coarse-grained and have pores, so it's difficult to get a good finish on them. But Poco is not like other graphites," Dr. Bokros notes.

The most commonly used carbon implant is a heart valve, a life-saving modern miracle usually named after the physician who developed it.

Dr. Michael DeBakey, the world-renowned Houston heart surgeon, began using his carbon-based DeBakey-Surgitool Aortic Valve in 1969—coincidentally, the year Poco graphite also went to the moon in some of the components of the landing module "Eagle." Before that time, most heart valves were made from silicone rubber or Teflon, both of which

Poco graphite is used in the production of many machine parts.

Many old buildings, like the Wise County Court House erected in 1898, grace the historical town of Decatur.



Some tooling is done manually in Poco's precision machine shop.

lacked the needed durability and compatibility with the human body.

Today's heart valves using Poco graphite and Pyrolite carbon are completely impermeable with a surface that is smooth and strong. These factors make the valves resistant to wear and fatigue and not susceptible to blood clots. Such properties are a must for a heart valve that must open and shut more than 40 million times a year while allowing full blood flow.

Dr. Bokros and others developed Pyrolite carbon while searching for a material that could withstand the extreme heat found in the cores of nuclear reactors. Its value for medicine was only recognized later.

Today's heart valves—made of Pyrolite-coated Poco graphite—have been tested to take 60 times the normal load of a heart. They have a lifespan of more than 100 years. According to Dr. Bokros, wear, as a probable cause of failure, has been virtually eliminated.

But it's not all heart valves and space trips for Poco graphite.

Medical advances in the field of implants have been revolutionized by the development of artificial carbon joints, a godsend for victims of severe rheumatoid or osteoarthritis. Here the material is used as a bone replacement to repair the ravages inflicted by these two painful diseases.

Ron Yapp, a bioengineer and a designer of artificial joints and other implants manufactured by Carbo-Medics, explains why the implants that use Poco graphite are superior to others used in prostheses, or artificial body parts. "Often, when a person is afflicted with arthritis, the diseased part of the body is very knarled, almost like the root of a tree, because a lot of the soft tissue has been destroyed," he observes. "A canal is made through the center of the damaged bone and that is where the artificial joint is placed. Once the bone grows around the area that has been corrected, it holds the implant in place naturally."

Not only do carbon-based prostheses not get rejected by the body, but the bone will grow much closer around them than around replacements made from other materials.

Partial joint implants, called endoprostheses, are currently being developed.

Another area benefiting from innovations made possible by Poco graphite is dentistry. In fact, some experts feel this may be the most important application of carbon implants. Tests have determined that a carbon tooth root implant allows a more natural distribution of force on the jaw bone

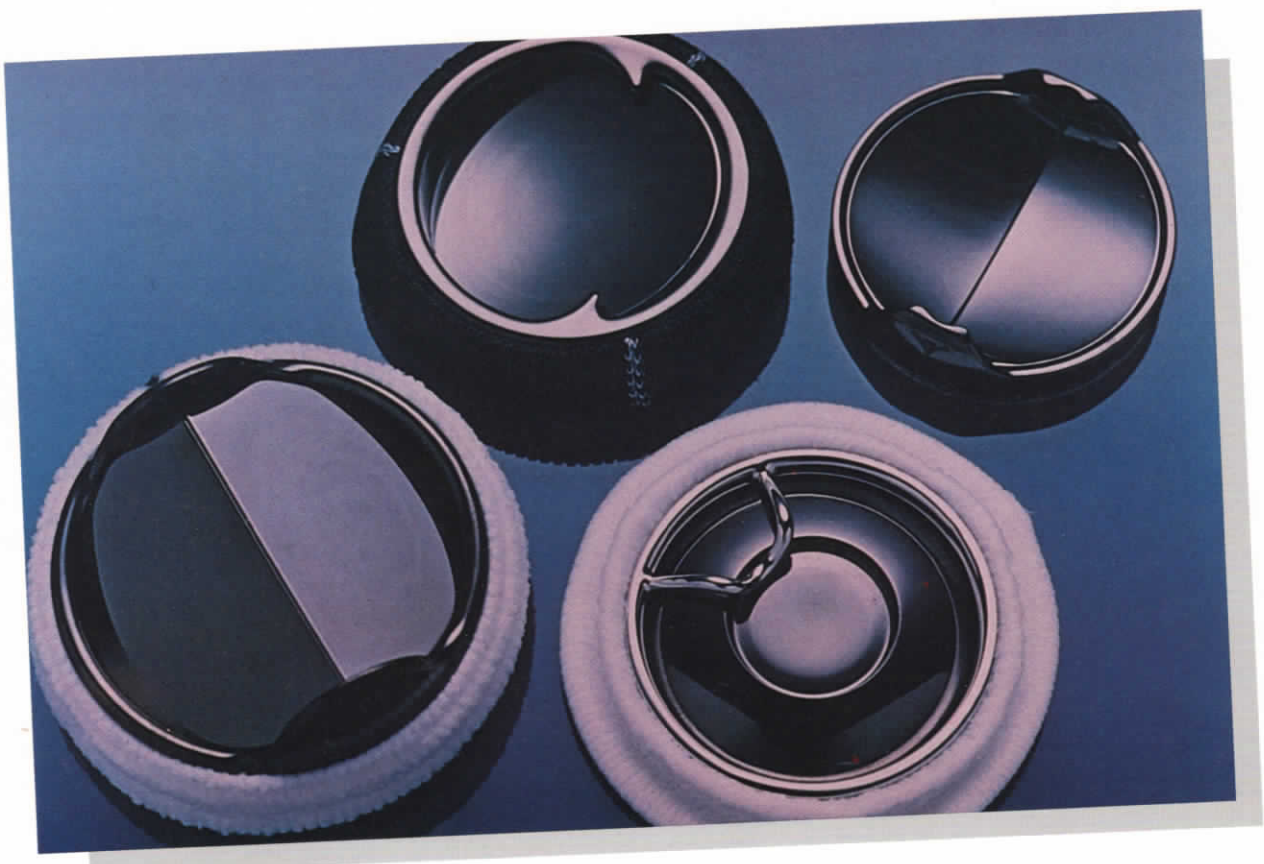
The measuring machine is used for inspecting surface tolerances of finished graphite products.

than dentures. In addition, graphite implants do not wiggle around like other oral replacements.

Indeed, the applications of Poco in medicine seem endless. Already under development are: permanently emplaced blood-access systems that eliminate the skin-puncturing pain of kidney dialysis; skeletal attachment of prosthetic limbs, and even artificial forms of hearing and sight made possible by the fact that graphite conducts electrical impulses to and from the brain.

Since Poco Graphite is involved in specialty products, its sales force is also composed of highly specialized scientists and engineers. The fast expanding territory they cover—in aerospace, energy resources, electronics, and medicine—indicates that the company is on the threshold of a very exciting future. (76)

Dr. Hillis Folkins, a former Pure Oil employee, was one of the first recipients of a heart valve made of Poco graphite in 1973.



CarboMedics uses Poco graphite to make various types of heart valves.

DOMINGUEZ: A LOCAL FIELD MAKES GOOD

...it is possible that a person living next door to an oil well will fill up at the neighborhood Union 76 service station with gasoline refined from crude produced by the very same well.

The sight of pumping units rhythmically coaxing oil out of parking lots or even residential backyards is nothing out of the ordinary in southern California. Monotonously performing their round-the-clock job while activity flourishes around them, the pumping units seem oblivious to their urban surroundings.

In many cases, this city oil is taken many miles to the nearest refining complex then transported even farther before it's of use to anyone.

But our story concerns a rare exception.

The residents of Carson, a Los Angeles suburb named after the famous American frontiersman Kit Carson, may think no more of the oil wells in their midst than the telephone poles lining their streets.

But this oil-rich, highly industrialized city, where Union Oil jointly operates an historic oil patch known as the Dominguez field, holds a unique distinction. Here, it is possible that a person living next door to an oil well will fill up at the neighborhood Union 76 service station with gasoline refined from crude produced by the very same well.

As Jim Buckingham, area production superintendent at Santa Fe Springs, California, observes: "This may be the only place within the company where production from a field is processed with other crude feedstocks and eventually distributed and marketed in the same area."

It hasn't always been that way.

When Union first began operations in the Dominguez field, today one of its oldest, there were no company service stations in the then undeveloped area.

In fact, nothing but wide open spaces and some small farms witnessed the spudding, in 1923, of "Calendar 1-A," the field's first successful well.

But, the next 60 years saw the development of a thriving community and the drilling of 126 wells. Today, 55 of those wells are still tapping crude from the three producing zones that lie roughly one mile beneath residences, shopping centers and factories.

Pumps draw almost 900 barrels of crude oil and more than 600 thousand cubic feet of natural gas each day thanks to the added kick of 13 water-injection wells.

Production from the Dominguez field is refined at Union Oil's Los Angeles Refinery and distributed from the company's Los Angeles Terminal (Top). *Pumping units quietly do their work in busy Carson neighborhoods.*

When the Dominguez field was first discovered in 1923, nothing but wide open spaces surrounded it.

Pumps draw almost 900 barrels of crude oil and more than 600 thousand cubic feet of natural gas each day...

Union's patented Unicracker process uses hydrogen and catalysts under high pressure to crack lighter gas oils and FCC-produced light cycle oil to produce high-quality gasoline.

"Union began secondary recovery techniques in the Dominguez field in 1947," Buckingham explains. "It was one of the first water injection sites in California. As production dropped, water was pumped down into some of the existing wells, forcing more oil out of the others."

Buckingham adds: "Now the reservoir is reaching its limits, becoming very mature and we produce 10,000 barrels of water a day along with the oil and gas. Over 90 percent of what's coming out of the ground is water. The water and oil are separated in wash tanks in the field and we inject that same water back into the wells."

The crude collects in six storage tanks and the natural gas is processed in a small compression plant nearby. After measuring and sampling, the Union Oil pipeline department sends the oil back underground via the company-owned pipeline system. There the thick, black Dominguez crude travels to Union's Los Angeles Refinery, in Wilmington, at a speed of two to four miles per hour.

During the 12-mile journey, Dominguez crude joins other crudes produced throughout the Los Angeles Basin.

The refinery's Tank 227 receives the L.A. Basin mixture. From there, it feeds directly into one of the refinery's two crude distillation units for boiling and separation into fractions.

"It takes a couple of distillation steps to purify the fractions enough to blend or convert them," explains Russ Wermers, operations planning engineer at the Los Angeles Refinery.

"L.A. Basin crudes are high in sulfur and relatively heavy. At one point or another in the refining process the sulfur and other impurities must be removed," he notes. "They also require more conversion than, for example, an Indonesian crude which may initially be 30 to 40 percent gasoline, to turn them into refined gasoline products."

Industrial fuel gas comes from the lightest fraction streamed off the distillation units. The refinery produces gasoline from the next fraction after raising the octane level. The refinery blends the mid-barrel distillates, after further processing, into Diesel Number 2, for sale at the pumps, Jet-A, a commercial jet fuel and JP-4, Navy jet fuel. Next are gas oils which are converted into gasoline.

The refinery uses several processes to convert these fractions into blending stock. Heavier gas oils are treated in the Fluid Catalytic Converter.

"Here the gas oils react with hot catalysts that crack them into lighter fractions that can be blended into gasoline," explains Wermers. "Cracking is the chemical breakdown of heavier molecules into lighter ones," he adds.

Union's patented Unicracker process uses hydrogen and catalysts under high pressure to crack lighter gas oils and FCC-produced light cycle oil to produce high-quality gasoline. Because it adds hydrogen, it yields 1.25 barrels for every barrel processed.

After cracking, light, high-octane feedstocks are processed in an alkylation unit to lower the vapor pressure which permits them to be blended into gasoline.

Catalytic reforming also produces high-octane gasoline from low-octane feedstocks. In fixed-bed radial reactors the octane level is raised by changing the molecular structure without using lead additives. "We added another reforming unit process in the mid 70's when stricter environmental laws began requiring cars to have catalytic converters and use unleaded gasoline," Wermers explains.

Union Oil crews regularly service the wells to keep them in good operating condition.

...Dominguez crude is processed into: 48 percent gasoline, 16 percent jet fuel, 17 percent diesel, 15 percent residuals and 4 percent fuel gas.

After separation and conversion, what was once Dominguez crude, is now several different feedstocks, ready for blending into refined products.

From a control room in the refinery, blending operators route the different feedstocks into automatic blending units. The result: precisely mixed products of consistent high quality.

Roughly speaking, Dominguez crude is processed into: 48 percent gasoline, 16 percent jet fuel, 17 percent diesel, 15 percent residuals and 4 percent fuel gas.

From the refinery, Union 76 Super, Unleaded Regular and Diesel, partially processed from crude wrested from beneath the city of Carson, travel through pipelines to Union Oil's Torrance Tank Farm. From there, the products flow to terminals in southern California, Phoenix and Las Vegas. One line from the tank farm feeds the Los Angeles Terminal. It is from here that the fuel is distributed to Union's service stations in metropolitan Los Angeles and Orange County.

Spinning meters indicate that 1,500 barrels of product enter the terminal's tanks each hour. They are sent out almost as quickly as they are received.

"If the pipeline shut down, our nine 10,000-barrel tanks would be empty in less than two days," says Dick Stewart, area operations manager. "We receive and deliver gasoline and diesel 24 hours a day, every day—the cycle never stops."

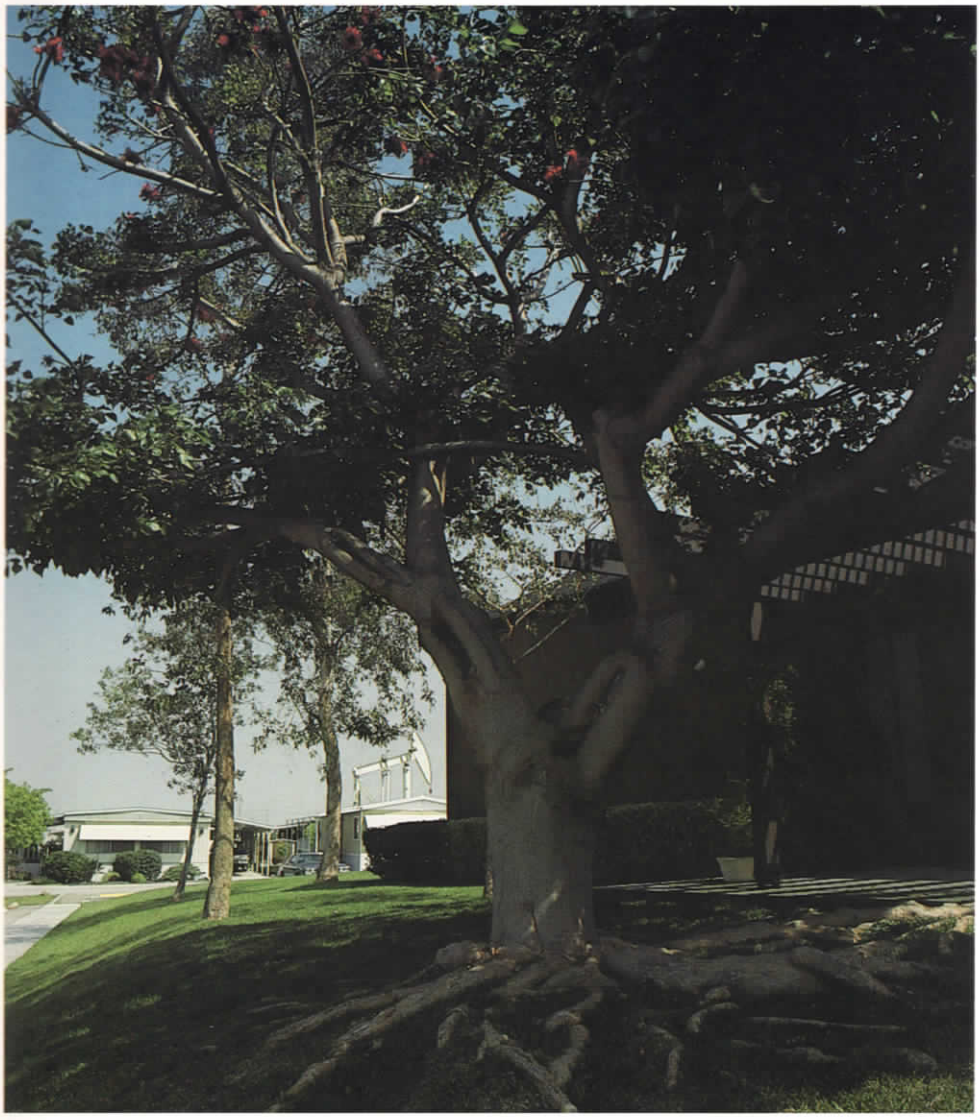
The terminal maintains a fleet of 20 tank-trucks and trailers, each capable of transporting 8,500 gallons of refined products. Working in shifts, 60 drivers make from 200 to 280 deliveries a day.

When a Union Oil service station owner in Carson sees his gasoline supply running low, he places his order at the terminal. The order goes into a computer and a company dispatcher schedules a truck to make the delivery.

Within 48 hours, the service station's supply will be replenished and residents of Carson may be filling their tanks with gasoline that, in part, is a product of their own neighborhood.

"If the pipeline shut down, our nine 10,000-barrel tanks would be empty in less than two days."

Tank-trucks fill up at the Los Angeles Terminal round-the-clock to make more than 200 deliveries each day (Top). *Some of the oil produced in Carson neighborhoods finds its way back as refined product to be sold at local Union Oil service stations.*



Currently, 55 producing wells operate in parking lots, trailer parks and back yards that sit above the Dominguez field's oil reserves.

...residents of Carson may be filling their tanks with gasoline that, in part, is a product of their own neighborhood.

Service Awards

UNION 76

CORPORATE

January 1983

25 YEARS **L. Errol Anderson,** Houston, Tx.

5 YEARS **Coy S. Ritter,** Union Oil Center

February 1983

5 YEARS **Nancy A. Wheelington,** Houston, Houston, Tx.

March 1983

30 YEARS **Bert Adams,** San Luis Obispo, Ca.

25 YEARS **Russell J. Hermann,** Union Oil Center

20 YEARS **Robert W. Fest,** Union Oil Center
Annemarie Vlack, Union Oil Center
Daniel M. Waldorf, Union Oil Center

10 YEARS **Olive W. Arnott,** Union Oil Center
Richard G. Hokanson, Schaumburg, Il.

5 YEARS **David A. Monroe,** Union Oil Center
William H. Whichard, Jr., Washington, D.C.

April 1983

25 YEARS **Ruth A. Bradford,** Union Oil Center

15 YEARS **Marion J. Courtney,** Schaumburg, Il.
James R. Donovan, Union Oil Center
Donald Grelyak, Schaumburg, Il.

10 YEARS **Rosalina T. Cueva,** Union Oil Center
Thomas W. Lindsay, Union Oil Center
John H. Robinson, Jr., Union Oil Center

5 YEARS **Astrid S. Gunn,** Union Oil Center
Donald F. Nesci, Schaumburg, Il.
Sara E. Pfiester, Union Oil Center

UNION SCIENCE AND TECHNOLOGY DIVISION

March 1983

35 YEARS **Dean A. Young,** Brea, Ca.

15 YEARS **Roger L. Hughes,** Brea, Ca.
Jerry W. Steinhardt, Brea, Ca.
Gerald A. Wessler, Brea, Ca.

10 YEARS **Patrick L. Burke,** Brea, Ca.
Jerry L. Marmolejo, Brea, Ca.

5 YEARS **Richard A. Anthony,** Brea, Ca.
Kenneth Baron, Brea, Ca.
Ronnie Lee Freeman, Brea, Ca.
Alicia M. Gonzales, Brea, Ca.
Eric L. Moorehead, Brea, Ca.
David L. Shaffer, Brea, Ca.

April 1983

45 YEARS **Vernon C. Herron,** Brea, Ca.

35 YEARS **John E. Hines, Jr.,** Brea, Ca.
Cloyd P. Reeg, Brea, Ca.

30 YEARS **Raymond J. Bodini,** Brea, Ca.
Kenneth L. Collins, Brea, Ca.

15 YEARS **Danford E. Clark,** Brea, Ca.
Dale L. Pickering, Brea, Ca.

10 YEARS **Charles B. Anderson,** Brea, Ca.
Danilo M. Capampangan, Brea, Ca.
Romeo S. Jaojoco, Brea, Ca.
Stanley G. Shatford, Brea, Ca.
Michael S. Sheets, Brea, Ca.

5 YEARS **John B. Dunham,** Brea, Ca.
James F. Landry, Brea, Ca.
David W. Matthews, Brea, Ca.
Gary D. Rush, Brea, Ca.

UNION REAL ESTATE DIVISION

March 1983

30 YEARS **Frank J. Rickman,** Union Oil Center

15 YEARS **Robert F. Woehrmann,** Union Oil Center

April 1983

30 YEARS **William C. Huston,** Union Oil Center

15 YEARS **Eldon R. Jackson,** Union Oil Center

UNION 76 DIVISION

March 1983

40 YEARS **Betty L. Nieman,** Schaumburg, Il.
Donald E. Scully, Chicago Refinery

35 YEARS **Elliott B. Bartlett,** Santa Maria, Ca.
Jordon R. Bledsoe, Los Angeles Refinery
Dorothy H. Groff, Beaumont Refinery
Roy Hall, Spartanburg, S.C.
Donald R. Laughlin, Beaumont Refinery
Stanley J. Pinta, Los Angeles, Ca.
William H. Saunders, Beaumont Refinery
Kenneth J. Schassberger, Beaumont Refinery
Robert C. Walker, Beaumont Refinery

30 YEARS **Lloyd M. Abbott,** San Luis Obispo, Ca.
Marilyn L. Arsint, Chicago Refinery
Ulysses F. Baird, Richmond, Va.
Gerald L. Baldwin, San Francisco, Ca.
Thomas A. Buckle, Los Angeles Refinery
Chester R. Burkhalter, Beaumont Refinery
Robert D. Burnham, San Francisco, Ca.
Francis N. Castleberry, Schaumburg, Il.
Alice E. Dykhuizen, San Francisco, Ca.
Fred H. Griffin, Jr., Los Angeles Refinery
Clayo M. Martin, Bakersfield, Ca.
Vernon A. Miller, San Francisco Refinery
Merrell T. Mitchell, Jr., Beaumont Refinery
Donald N. Parker, San Francisco Refinery
Ruth M. Schultz, Los Angeles Refinery
Louis F. Searles, Los Angeles Refinery
Jimmy G. Simmons, Beaumont Refinery
Yvonne J. Turner, San Francisco, Ca.
Clarence B. White, San Francisco Refinery
Richard A. Wilkison, Schaumburg, Il.
James A. Williams, Memphis, In.

25 YEARS **Clyde K. Carrier,** Hayward, Ca.
Kenneth G. Elder, Pasadena, Ca.
Sherer B. Guin, Charlotte, N.C.
Thomas W. Matthews, Schaumburg, Il.

20 YEARS **John E. Berwick,** Beaumont Refinery
Michael B. Brashers, Beaumont Refinery
David J. Cahoon, Los Angeles Refinery
Bernice S. Fio Rito, Schaumburg, Il.
Raymond F. Fisher, Chicago Refinery
Carl E. Hjort, Renton, Wa.
Robert A. Kielma, Chicago Refinery
Raymond J. Koerner, Chicago Refinery
D. G. Kollmansberger, Los Angeles, Ca.
James W. Nash, Beaumont Refinery
Robert J. Petzold, Schaumburg, Il.
Dixie D. Tuck, Avenal, Ca.

15 YEARS
Gary W. Broussard, Beaumont Refinery
Ross D. Brown, San Francisco Refinery
Raymond C. Crotty, Chicago Refinery
Wallace M. Dawson, Santa Maria Refinery
Marc R. Duncan, San Francisco Refinery
Joe D. Epps, Beaumont Refinery
Edwin W. Forbes, San Francisco Refinery
Richard J. Fuhrman, Chicago Refinery
Chester F. Gosciej, South Holland, Il.
Alton B. Heck, Atlanta, Ga.
Marvin E. Lash, Houston, Tx.
Donald A. McCreery, Beaumont Refinery
Richard E. Oehlerts, Schaumburg, Il.
Timothy G. O'Neil, Schaumburg, Il.
Mary Pribela, San Francisco, Ca.
Herbert J. Schweitzer, South Holland, Il.
Robert E. Turrietta, Orange, Ca.
William W. Weder, San Francisco Refinery
Marilyn B. Womack, Beaumont Refinery

10 YEARS
James T. Bates, Tacoma, Wa.
Michael A. Biggi, Los Angeles, Ca.
Vito J. Debellis, Portland, Or.
Jerry D. Eastridge, Phoenix, Az.
Kay Foster, San Francisco, Ca.
Edward R. Frost, Los Angeles Refinery
Harry E. Frost, Chicago Refinery
Jerald J. Hall, Beaumont Refinery
Kenneth E. Henning, Portland, Or.
Patty K. Jeffries, Seattle, Wa.
Virginia O. Lawson, Schaumburg, Il.
Rhonda D. Ornelas, San Francisco, Ca.
David A. Peterson, Colton, Ca.
Thomas W. Ragsdale, Los Angeles Refinery
Thomas Ramirez, Beaumont Refinery
Norman Ephriam Simon, Jr., Richmond, Ca.
Thomas Washington, Jr., Beaumont Refinery
Arthur L. Wells, Beaumont Refinery
Frank J. Wilson, Los Angeles, Ca.
Hector Yescas, Jr., Los Angeles Refinery

5 YEARS
Paul J. Bauer, Brea, Ca.
Gwyn M. Blake, Orlando, Fl.
Robert S. Boucher, San Jose, Ca.
William F. Busse, Chicago Refinery
Keith Chapman, Indio, Ca.
Betty M. Clifford, Anchorage, Ak.
Edward M. Dorner, Chicago Refinery
Illa J. Edwards, Chicago Refinery
Carl J. Guardia, Chicago Refinery
Richard G. Hindman, Los Angeles Refinery
Danny L. Hopkins, Beaumont Refinery
Kenneth J. Ivaska, Chicago Refinery
Charles O. Johnson, Chicago Refinery
Guy R. Jones, Chicago Refinery
Cheri D. Long, Beaumont Refinery
Carlo C. Lorquet, Los Angeles, Ca.
Terrance D. Lyman, Pasadena, Ca.
Arvin M. Maldonado, Chicago Refinery
David L. Mastrud, Los Angeles Refinery
Tony L. Meredith, Los Angeles Refinery
Becky L. Mitchell, Beaumont Refinery
Glenn H. Morris, Beaumont Refinery
Norman Naylor, Los Angeles Refinery
David L. Pepper, Chicago Refinery
David M. Phelps, Cincinnati, Oh.
Richard J. Picha, Chicago Refinery
Rodney W. Pilz, Chicago Refinery
James H. Rapinac, Chicago Refinery
Theodore A. Sams III, Beaumont Refinery
William J. Seward, Chicago Refinery
Thelisme M. Thibodeaux, Beaumont Refinery
Viola L. Valsin, Beaumont Refinery
Anita R. West, Beaumont Refinery
Paula L. Weston, Schaumburg, Il.
Larry S. Whitman, Schaumburg, Il.
Joseph L. Zuech, Beaumont Refinery

April 1983

40 YEARS
Laura N. Abbott, Los Angeles, Ca.
Thomas M. Wills, Beaumont Refinery

35 YEARS
James W. Eddington, Gurly, N.E.
Clara B. Filip, Schaumburg, Il.
Clifford C. Fruitger, Edmonds, Ca.
Charles R. Fyfe, Schaumburg, Il.
Blanche A. Gaylord, Miami, Fl.
Godfrey Heidecker, Jr., Beaumont Refinery
Norman Laird Lay, Los Angeles Refinery
Joseph A. Manuel, Beaumont Refinery
Martin R. Walton, Beaumont Refinery
Arthur D. Weaver, Toledo, Oh.

30 YEARS
James E. Bohac, Gurly, N.E.
Mark E. Broussard, Lafayette, La.
Helen G. Galanis, San Francisco, Ca.
Harold E. Granquist, San Francisco Refinery
Howard Jordan, Cleveland, Oh.
Arthur K. Mayfield, Schaumburg, Il.
Bobby A. Payne, Pittsburgh, Pa.
Frank H. Pinnell, San Francisco, Ca.
Francis J. Simons, Los Angeles, Ca.
Jack T. Spaulding, San Luis Obispo, Ca.
Dwan W. Warner, Beaumont Refinery
William F. Young, Jr., Charlotte, N.C.

25 YEARS
Mary J. Shewchuk, Los Angeles, Ca.

20 YEARS
Wayne L. Gerdon, Tampa, Fl.
William R. Harvey, Schaumburg, Il.
Lorraine R. Kamin, Schaumburg, Il.
Carl S. Miller, Taft, Ca.
Thomas M. Rowley, Los Angeles Refinery

15 YEARS
David Cave, Chicago Refinery
Raymond R. Collins, Chicago Refinery
Rickey L. Flanigan, Taft, Ca.
Marvin E. Gifford, Brisbane, Ca.
Robbie D. Hamilton, Portland, Or.
Robert B. Hattendorf, Chicago Refinery
Davis M. Hess, San Francisco Refinery
Bobby G. Hill, Schaumburg, Il.
John E. James, San Francisco Refinery
Carolyn S. Leedy, South Holland, Il.
Noel C. Mayder, Los Angeles, Ca.
David W. McCrary, San Francisco Refinery
Ronald M. Morofsky, San Francisco Refinery
Duane M. Musgrave, Houma, La.
Louis M. Nunes, Santa Maria Refinery
Melvin S. Pomeroy, Merino, Co.
Robert H. Pruitt, Columbus, Oh.
Consuelo Stoklosa, Schaumburg, Il.
Fumiye Takano, San Francisco, Ca.
Virginia B. Youngblood, Beaumont Refinery

10 YEARS
Gerald J. Allison, Chicago Refinery
Jose E. Aragon, Los Angeles Refinery
Duane R. Bernard, Los Angeles, Ca.
Robert E. Blalock, Chicago Refinery
Jerriel D. Broussard, Lafayette, La.
Billy R. Coston, Schaumburg, Il.
Timothy K. Davis, Van, Tx.
Richard L. Fallacaro, Brisbane, Ca.
Dale L. Fitzgerald, Chicago Refinery
Robert B. Glover, Chicago Refinery
Manuel V. Gonzalez, Los Angeles Refinery
Louis C. Guillory, Beaumont Refinery
Debra L. Gunia, Schaumburg, Il.
Lawrence E. Jackson, Beaumont Refinery
Susan M. Jerome, Schaumburg, Il.
Ruth M. Liatos, San Francisco, Ca.
Randy L. McFarlane, Hollywood, Ca.
William A. McNeil, Los Angeles, Ca.
Richard W. Peterson, Chicago Refinery
Manuel D. Ramos, Jr., Beaumont Refinery
Alvaro Rivas, Brisbane, Ca.
Donald R. Rood, Brisbane, Ca.
Robert Ryan, Chicago Refinery
Domingo Sanchez, Chicago Refinery
Edward E. Schultz, Jr., Chicago Refinery
Rizalina C. Torres, San Francisco, Ca.
Wanda J. Waller, Schaumburg, Il.

5 YEARS	**Judith A. Blum,** San Francisco, Ca.
	Victoria F. Burns, Schaumburg, Il.
	Janete I. Craig, San Jose, Ca.
	Robert L. Dalton, Los Angeles, Ca.
	Steve A. Donnelly, Richmond, Ca.
	Timothy P. Eggleston, Torrance, Ca.
	Dolores A. Felix, Union Oil Center
	Elizabeth A. Flores, Phoenix, Az.
	Bettie L. Gong, Schaumburg, Il.
	Connie R. Harris, Los Angeles Refinery
	Bruce E. Irion, Santa Maria Refinery
	Sherry S. Lockett, Beaumont Refinery
	Anne S. McClelland, Beaumont Refinery
	Orestes O. Morales, Los Angeles Refinery
	Patricia A. Piccolo, Schaumburg, Il.
	Darryl J. Powell, South Holland, Il.
	Richard J. Mraz, Torrance, Ca.
	Marc L. Newell, Las Vegas, Nv.
	Gary A. Olpinski, Los Angeles, Ca.
	Roger E. Reimer, Los Angeles Refinery
	Manuel Rodriguez, Los Angeles Refinery
	Francis R. Romano, Los Angeles Refinery
	Charles M. Spade, Los Angeles Refinery
	William C. Stone, Los Angeles Refinery
	Terri M. Tarsia, Portland, Or.
	Stephen T. Webb, Sacramento, Ca.
	John J. Wilson, Los Angeles, Ca.
	Deborah A. Wright, Richmond, Ca.

UNION OIL AND GAS DIVISION

March 1983

40 YEARS	**Lorraine Cosner,** Bakersfield, Ca.
35 YEARS	**Dorothy M. Osborne,** Union Oil Center
	James P. Murphy, Houston, Tx.
30 YEARS	**Donald C. Bates,** Orcutt, Ca.
	Malcolm C. Hardesty, Coalinga, Ca.
	John R. Kimble, Andrews, Tx.
	V. B. McCutcheon, Ventura, Ca.
25 YEARS	**Ernie Guidry,** Lafayette, La.
15 YEARS	**Michael J. Boquet,** Houma, La.
	Ben M. Burns, Houston, Tx.
	Ken S. Ogata, Pasadena, Ca.
	Rodney D. Pratt, Coalinga, Ca.
	Ronald E. Thompson, Breckenridge, Il.
	Larry E. Waterman, Orcutt, Ca.
10 YEARS	**Monte R. Bemount,** W. Liberty, Il.
	Johnny E. Broussard, Lafayette, La.
	Louis J. Brown, Lafayette, La.
	Oscar Chavez, Ventura, Ca.
	Johnny D. Nichols, Orcutt, Ca.
5 YEARS	**Brian A. Authement,** Houma, La.
	Carl J. Boyd, Van, Tx.
	James A. Johnson, Hominy, Ok.
	Max R. Kilcrease, Hominy, Ok.
	Carroll M. Murphy, Anchorage, Ak.
	Robert W. Norris, W. Liberty, Il.
	Colleen P. Stodghill, Houston, Tx.
	Joseph B. Sylvester, Lafayette, La.
	Gary W. Uhland, Oklahoma City, Ok
	Randal A. Vincent, Lafayette, La.
	Craig H. Williams, Olney, Il.
	Elvin R. Williams, Lafayette, La.

April 1983

40 YEARS	**Stockton M. Quirey,** Ganado, Tx.
35 YEARS	**James S. Brown,** Union Oil Center
	Kenneth L. Kohal, Coalinga, Ca.
30 YEARS	**D. R. Fitzgerald,** Orcutt, Ca.
	Corman E. Glenn, Orcutt, Ca.
	Bobby J. Hays, Orcutt, Ca.
	Archer S. Pratt, Ventura, Ca.
	Raymond H. Walker, Orcutt, Ca.
20 YEARS	**Tommy N. Crouch,** Ardmore, Ok.
	Edward D. Hannah, Worland, Wy.
	Thomas W. Miller, Clay City, Il.
	Bill D. Sharp, Oklahoma City, Ok.
	James H. Stevens, Ardmore, Ok.
15 YEARS	**Jim L. Altman,** Lafayette, La.
	Duffy J. Duplantis, Houma, La.
	Jessica M. Lower, Union Oil Center
	Bob R. Nelson, Moab, Ut.
	Richard Y. Salisbury, Santa Fe Springs, Ca.
10 YEARS	**Mark C. Atkins,** Orcutt, Ca.
	Edwin R. Ditto, Andrews, Tx.
	Lyle L. Goodrich, Breckenridge, Mi.
	Wayne E. Jones, Orcutt, Ca.
	Harold L. Province, Orcutt, Ca.
	Lloyd G. Shipley, Worland, Wy.
	Wayne L. Stockton, Grayling, Mi.
5 YEARS	**Clarence R. Baxley,** Clay City, Il.
	Donald E. Bean, Ventura, Ca.
	Larry Dace, Sr., Houma, La.
	Kenneth G. Davis, Lafayette, La.
	Steven W. Gregory, Moab, Ut.
	Hildegard Gross-Shigenaka, Orcutt, Ca.
	Elizabeth A. E. Johnson, Union Oil Center
	Rhonda E. Kemp, Midland, Tx.
	Rodney A. Monighetti, Taft, Ca.
	Carol A. Moudy, Ventura, Ca.
	Kay Ellen O'Connell, Anchorage, Ak.

UNION GEOTHERMAL

March 1983

5 YEARS	**Alina M. Fernandez,** Union Oil Center
	Tim F. Garrison, Big Geysers, Ca.

April 1983

35 YEARS	**Richard W. Dodds,** Manila, Philippines
10 YEARS	**Gilbert T. Jojola,** Santa Rosa, Ca.
5 YEARS	**Richard G. Hoke,** Big Geysers, Ca.

UNION CHEMICALS DIVISION

March 1983

30 YEARS	**Willie J. Williams,** Bridgeview, Il.
25 YEARS	**Wilbur H. Frey,** Denver, Co.
	Margaret Wood, Union Oil Center
20 YEARS	**Peter Ambrunn,** Newark, Ca.
	David Barth, Union Oil Center
	Vincent T. Cox, E. Providence, R.I.
	Richard Reed, Arroyo Grande, Ca.
	Margaret Wood, Union Oil Center
15 YEARS	**Joanne M. Berggren,** Schaumburg, Il.
	Gilbert Holloway, Wilmington, Ca.
	Evord F. Knights, Schaumburg, Il.
	Robert Lillevick, Union Oil Center
	Kenneth Potts, Rodeo, Ca.
	Donald Wright, Brea, Ca.
10 YEARS	**Sheryl A. Anderson,** St. Paul, Mn.
	Austin D. Byers, Schaumburg, Il.
	James C. Crisafi, La Mirada, Ca.
	Betty J. Franks, Atlanta, Ga.
	Gary D. Richards, La Mirada, Ca.
	Carl C. Sarvis, Charlotte, N.C.
	Linda B. Stow, La Mirada, Ca.
5 YEARS	**Albert Davis,** Charlotte, N.C.
	Lupe Diaz, Bridgeview, Il.
	Ruth A. Farrell, Clark, N.J.
	Jeffery Hallamore, Conshohocken, Pa.
	Dale Keith, Kenai, Ak.
	Kenneth Laing, Kenai, Ak.
	Alicia Lopez, Union Oil Center
	Richard Losier, Wilmington, Ca.
	Charles Smith, Brea, Ca.

April 1983

20 YEARS	**Daniel Mullins,** Brea, Ca.
15 YEARS	**Robert M. Healy,** Schaumburg, Il.
	Lonnie R. King, Charlotte, N.C.
	Robert C. Krimminger, Charlotte, N.C.
	Helyn A. Moore, Schaumburg, Il.
10 YEARS	**Horace R. Jones,** Providence, R.I.
	Robert Moeller, Chicago, Il.
	David Shullaw, Chicago, Il.
5 YEARS	**Alan R. Adamson,** La Mirada, Ca.
	Douglas Anderson, Kenai, Ak.
	Charles Black, Kenai, Ak.
	Lawrence F. Harper, La Mirada, Ca.
	Jay Kidd, Kenai, Ak.
	Marian Luka, Lemont, Il.
	Thomas Manson, Kenai, Ak.
	Stanley M. Smolarczyk, Bridgeview, Il.

UNION OIL INTERNATIONAL DIVISION

April 1983

30 YEARS	**Raymond T. Burns,** Los Angeles, Ca.

UNION OIL CO. OF CANADA, LTD.

March 1983

15 YEARS **Nora Arnold,** Calgary, Alberta
Nelson Barber, St. John, Alberta

10 YEARS **Louis Fraser,** Calgary, Alberta
Bill Houston, Calgary, Alberta

5 YEARS **Sheryl Lidfors,** Calgary, Alberta
Barry Smith, St. John, Alberta

April 1983

15 YEARS **Theodore Dageford,** St. John, Alberta

5 YEARS **Alfredo Rico,** Calgary, Alberta

UNION OIL CO. OF GREAT BRITAIN

March 1983

10 YEARS **L. Alexander**

5 YEARS **G. Blair**

UNION OIL COMPANY OF INDONESIA

March 1983

10 YEARS **Anung Nindita**
Awang Sjamsudin
Bambang Djati Poernomo
Bistok Nainggolan
Chairil Tabanaera
Desire Kowsolea
Efraim Naslawi Inung
Etrelias Labuha Medelu
Hadi Siswanto
Idjab Dangas
Marzuki
Ngadianto
Salewe
Simon Becy
Sujinto A.
Syakur Makkasau
Tentu Sitepu
Thomas Tato
Unding Noor

April 1983

10 YEARS **Johannes Picaulima**
Washingan

UNION OIL CO. OF SINGAPORE

March 1983

10 YEARS **Ahmad bin Ariffin**

UNION ENERGY AND MINING DIVISION

April 1983

25 YEARS **Elaine E. Murphy,** Union Oil Center

MOLYCORP, INC.

March 1983

35 YEARS **Ernest Fowler,** Washington, Pa.

15 YEARS **Damain Duran,** Questa, N.M.
Carlos Herrera, Questa, N.M.
E. J. Pacheco, Questa, N.M.

10 YEARS **Clair Doll, Jr.,** York, Pa.
Robert Nelson, Denver, Co.

5 YEARS **Steven Atkins,** Questa, N.M.
Terry Brasdshaw, Mountain Pass, Ca.
Gordon Gumble, Denver, Co.
Joseph Rekai, Washington, Pa.
Dean Soderstrom, Mountain Pass, Ca.

April 1983

25 YEARS **Modesto Cisneros,** Questa, N.M.

15 YEARS **Louie Bailon,** Questa, N.M.
Eliseo Rael, Questa, N.M.

10 YEARS **Richard Berkheimer,** York, Pa.
Walter Edwards, White Plains, N.Y.
Gilbert Montano, Questa, N.M.
Gopalakrishnan Nair, York, Pa.
Jose Salazar, Questa, N.M.

5 YEARS **Dennis Axe,** Mountain Pass, Ca.
Mary Jane Brenneman, York, Pa.
Michael Lis, Spokane, Wa.

JOBBERS AND DISTRIBUTORS

February 1983

30 YEARS **Darrow Russell,** Ontario, Ca.

March 1983

20 YEARS **Georgetown Oil Co.,** Georgetown, Oh.

15 YEARS **Tasker Oil Co.,** Piqua, Oh.

April 1983

50 YEARS **Spurrier Oil Co.,** Charlotte, N.C.

30 YEARS **Jamestown Oil Co.,** Jamestown, Oh.
James C. Nolan, Fall River Mills, Ca.

20 YEARS **Consolidated Oil Co.,** St. Cloud, Mn.
Goldfinch Oil Co., Conway, S.C.

RETIREMENTS

November 1982

John B. Anderson, Union 76 Division, Eastern Region, Lockport, Il. October 16, 1937

Edward N. Rimola, Union 76 Division, Western Region, San Rafael, Ca. January 1, 1963

December 1982

Russell L. Heck, Molycorp, York, Pa. January 3, 1940

Nathan J. King, Union 76 Division, Western Region, Fullerton, Ca. August 12, 1941

January 1983

Aladino L. Archuleta, Molycorp, Cenno, N.M. March 3, 1967

Edward C. Attane, Jr., Science and Technology, Anaheim, Ca. March 7, 1944

Arlo Baty, Union 76 Division, Western Region, Torrance, Ca. October 2, 1948

Estaney Cisneros, Molycorp, Taos, N.M. December 23, 1968

Walter D. Conklin, Union 76 Division, Western Region, Sacramento, Ca. July 23, 1947

John A. Creswell, Union 76 Division, Eastern Region, Nederland, Tx. December 5, 1947

Frank D. Dietz, Union 76 Division, Eastern Region, Wilmette, Il. March 15, 1948

William H. Fitzgerald, Union 76 Division, Western Region, Seattle, Wa. April 24, 1945

John C. Gibbs, Jr., Union 76 Division, Western Region, Fairfield, Ca. October 5, 1947

Duane B. Haugan, Union 76 Division, Western Region, Long Beach, Ca. September 7, 1952

Robert G. Hayes, Union 76 Division, Eastern Region, Port Neches, Tx. March 1, 1948

Walter C. Isaacs, Union 76 Division, Eastern Region, Nederland, Tx. January 8, 1948

Albert B. Kaufman, Union 76 Division, Western Region, Portland, Or. June 11, 1955

Harold F. Norman, Union 76 Division, Eastern Region, Brooklyn Center, Mn. September 18, 1950

John H. Pedersen, Union 76 Division, Western Region, Long Beach, Ca. May 8, 1950

Joseph N. Platter, Corporate, Tempe, Az. September 4, 1979

George C. Reid, Union 76 Division, Eastern Region, Downers Grove, Il. July 1, 1949

Reed Riding, Union 76 Division, Western Region, Long Beach, Ca. March 14, 1956

Edward D. Smith, Union 76 Division, Eastern Region, Pittsburgh, Pa. May 4, 1953

Keith O. Summers, Union 76 Division, Western Region, Lakewood, Ca. November 11, 1948

Rupert Vittinghoff, Union Geothermal, Palm Desert, Ca. October 6, 1938

February 1983

Florence B. Atkinson, Molycorp, Santa Fe, N.M. September 26, 1966

Donna M. Beard, Union 76 Division, Eastern Region, Wonder Lake, Il. October 1, 1960

John L. Board, Union 76 Division, Western Region, Glendale, Ca. June 27, 1956

Alden V. Donatoni, Union 76 Division, Western Region, Edmonds, Wa. September 10, 1947

Merritt E. Edwards, Union 76 Division, Eastern Region, Palatine, Il. June 30, 1952

Marmion C. Freiberg, Union 76 Division, Eastern Region, Elgin, Il. November 1, 1966

Steve S. Lucas, Union 76 Division, Eastern Region, Carteret, N.J. January 21, 1959

Victor T. Mavity, Jr., Science and Technology, Fullerton, Ca. February 8, 1960

Calvin Miles, Oil and Gas, Montecito, Ca. November 23, 1954

Martin B. Nelson, Jr., Union 76 Division, Eastern Region, Beaumont, Tx. June 1, 1949

Burton L. Schreiber, Union 76 Division, Eastern Region, Lockport, Il. August 25, 1952

Don K. Shay, Union 76 Division, Eastern Region, Kettering, Oh. September 23, 1939
Ruth M. Smith, Corporate, Los Angeles, Ca. November 11, 1969
Bonnie C. Tunnell, Oil and Gas, Van, Tx. August 8, 1940
Russell J. Winnen, Molycorp, Questa, N.M. March 16, 1966

March 1983

Francis L. Bump, Union 76 Division, Eastern Region, Bement, Il. February 10, 1943
Thomas A. Dembowski, Union 76 Division, Western Region, Carson, Ca. October 25, 1945
Sherman Elder, Molycorp, Washington, Pa. February 9, 1962
Murraye D. Joyce, Pure Transportation, Andrews, Tx. June 11, 1940
Verne D. Keenan, Molycorp, Washington, Pa. December 12, 1939
Stanley W. Knowlton, Union 76 Division, Eastern Region, Virginia Beach, Va. February 16, 1949
Alice Loskutoff, Union 76 Division, Western Region, San Francisco, Ca. December 30, 1951
Patrick W. McGinnis, Science and Technology, Whittier, Ca. January 5, 1953
James W. McKisic, Union 76 Division, Eastern Region, Elk Grove, Il. January 9, 1961
Robert T. Pierce, Union 76 Division, Eastern Region, Mt. Prospect, Il. February 20, 1953
Francis E. Ries, Corporate, Scribner, N.E. May 23, 1946
Charles O. Stetson, Molycorp, Washington, Pa. October 29, 1939
Louise E. Strack, Corporate, Alhambra, Ca. July 13, 1944
James E. Tierheimer, Oil and Gas, Pico Rivera, Ca. November 19, 1951
Frank Van Acker, Jr., Corporate, Palos Verdes, Ca. January 5, 1942
Wells L. Wescott, Union 76 Division, Eastern Region, Edina, Mn. August 27, 1945
Floyd D. Williams, Union 76 Division, Western Region, El Cerrito, Ca. February 23, 1951

IN MEMORIAM

Employees

Virginia O. Clemons, Union 76 Division, Western Region, Torrance, Ca. January 27, 1983
John Ray Kimble, Oil and Gas, Jal, N.M. December 3, 1982
Walter H. Loftis, Oil and Gas, Kenai, Ak. December 11, 1982
Don C. Martin, Union 76 Division, Western Region, Downey, Ca. January 23, 1983
Malcolm P. Ohman, Union 76 Division, Eastern Region, Kewadia, Mi. January 12, 1983
James C. Ramos, Oil and Gas, San Antonio, Tx. January 2, 1983
Albert W. Schenken, Corporate, Covina, Ca. November 29, 1982
Donald Shuemaker, Molycorp, York, Pa. December 13, 1982
Ida Van Kirk, Union 76 Division, Western Region, South Gate, Ca. December 9, 1982
Mary A. Walsh, Corporate, Los Angeles, Ca. January 23, 1983
Luther Ward, Oil and Gas, Lafayette, La. August 20, 1982
Lawrence Willis, Union 76 Division, Eastern Region, Chicago, Il. December 5, 1982
Francis P. Wilson, Jr., Union 76 Division, Eastern Region, Walls, Ms. January 25, 1983
Willard Zucker, Union 76 Division, Eastern Region, Elk Grove Village, Il. December 6, 1982

Retirees

John Anderson, Union 76 Division, Western Region, Tacoma, Wa. December 16, 1982
Glenn A. Berger, Union 76 Division, Eastern Region, Temperance, Mi. January 11, 1983
E. P. Copeland, Union 76 Division, Western Region, Vallejo, Ca. November 30, 1982
Gilbert E. Corbin, Union 76 Division, Eastern Region, Newark, Oh. December 15, 1982
John E. Crackel, Pure Transportation, Clay City, Il. January 10, 1983
Leonard R. Dane, Oil and Gas, Houston, Tx. December 29, 1982
Jeff E. Davis, Union 76 Division, Eastern Region, Gadsden, Al. December 6, 1982
Cleda Decker, Corporate, Whittier, Ca. December 16, 1982
Tillie A. Defee, Pure Transportation, Van, Tx. December 31, 1982
Carl Dehmlow, Union 76 Division, Eastern Region, Elgin, Il. January 20, 1983
Lucile E. Dickason, Union 76 Division, Western Region, San Juan Capistrano December 4, 1982
Vincent Egidi, Union 76 Division, Eastern Region, Beaumont, Tx. December 10, 1982
Marion Evans, Oil and Gas, Wafford Heights, Ca. January 11, 1983
Preston, L. Fimble, Oil and Gas, Bacliff, Tx. June 18, 1981
John K. Fondren, Union 76 Division, Eastern Region, Zavalla, Tx. December 9, 1982
Clark C. Fry, Union 76 Division, Western Region, Fullerton, Ca. January 4, 1983
Roy B. Geoghegan, Union 76 Division, Eastern Region, Donalsonville, Ga. December 5, 1982
Sam Gully, Union 76 Division, Eastern Region, Dearborn, Mi. January 9, 1983
Vivian Haley, Union 76 Division, Eastern Region, Tulsa, Ok. January 1, 1983
Fred W. Henson, Oil and Gas, Flora, Il. December 2, 1982
Nicholas J. Hermann, Union 76 Division, Eastern Region, Downers Grove, Il. January 7, 1983
William L. Horspool, Union 76 Division, Western Region, Brea, Ca. December 6, 1982
Vivian D. Hulbert, Union 76 Division, Western Region, Mercer Island, Wa. December 3, 1982
Dagny M. Hultgren, Union 76 Division, Eastern Region, Rolling Meadows, Il. December 30, 1982
Hobert R. Inge, Union 76 Division, Eastern Region, Nederland, Tx. December 20, 1982
Evan H. Jones, Union 76 Division, Eastern Region, Granville, Oh. December 1, 1982
Frederick S. Keen, Union 76 Division, Western Region, Long Beach, Ca. January 3, 1983
Alexander LeTourneaux, Union 76 Division, Eastern Region, Alpine, Ca. December 24, 1982
Royal Linden, Union 76 Division, Western Region, Arcadia, Ca. December 28, 1982
John P. Lingle, Union 76 Division, Eastern Region, Hattiesburg, Ms. December 11, 1982
Alvin W. Maples, Pure Transportation, Millington, Tn. December 31, 1982
Thomas C. Mays, Union 76 Division, Eastern Region, Beaumont, Tx. December 8, 1982
John J. McDowell, Union 76 Division, Western Region, Harbor City, Ca. December 22, 1982
Emma Miller, Union 76 Division, Western Region, S. Pasadena, Ca. December 4, 1982
Walter E. Mooney, Union 76 Division, Eastern Region, Venice, Fl. December 31, 1982
Charles S. Parker, Jr., Union 76 Division, Western Region, Dana Point, Ca. December 16, 1982
Lorin F. Potter, Union 76 Division, Western Region, Long Beach, Ca. December 13, 1982
George Ramsay, Oil and Gas, Pahrump, Nv. January 17, 1983
Lawrence J. Ray, Union 76 Division, Western Region, Martinez, Ca. January 13, 1983
John W. Smith, Union 76 Division, Eastern Region, Newark, Oh. December 19, 1982
Jack Swift, Pure Oil Co., Reed City, Il. January 18, 1983
Daniel B. Trout, Union 76 Division, Western Region, Arroyo Grande, Ca. December 17, 1982

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UNION OIL COMPANY OF CALIFORNIA

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VOLUME LXII, NUMBER 2
MARCH/APRIL, 1983

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COVER: Split-second photography captures the sequence of a drop of crude oil falling into a petrie dish. Story on page 1.

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