oregon and offshore oil

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Prepared for the
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Oil and Gas Development

by the

OREGON STATE UNIVERSITY
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Oregon and energy

Log trucks freighting timber from Oregon's forests to sawmill and ship.

Tractors turning the soil on Oregon's farms for the next year's crops.

Fishing vessels hauling in nets and lines with fish from Oregon's ocean.

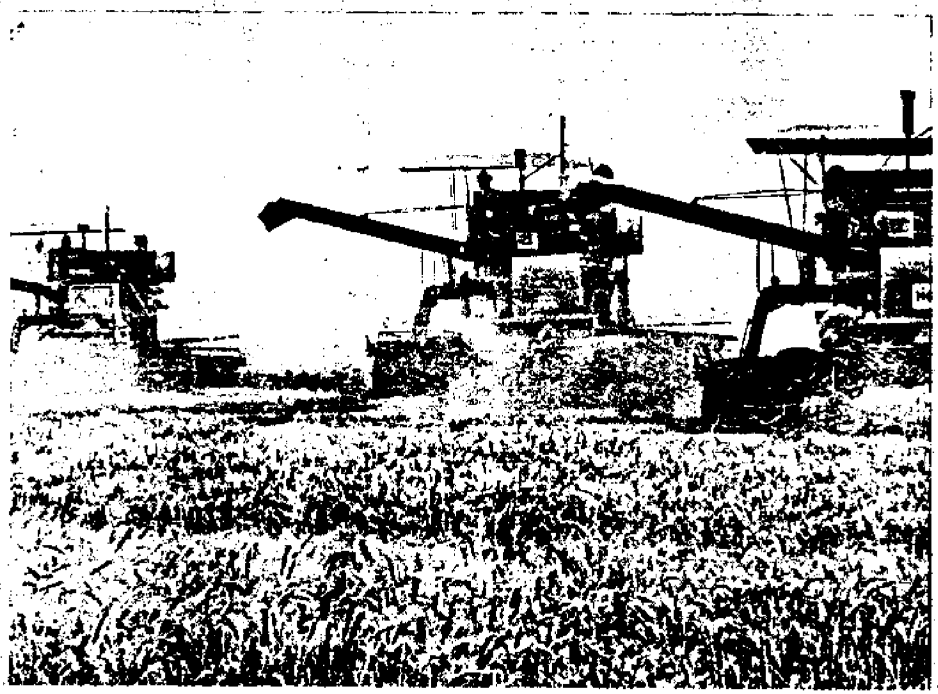
Add to these images the automobiles that carry tourists and business executives on Oregon's highways, the factories that process raw materials, the furnaces that warm many of Oregon's homes.

Energy is the common key that unlocks each of these scenes. Energy enables Oregonians to harvest and transport the state's abundant natural resources. Energy fuels production on farms and in factories. Energy makes possible comfortable, convenient homes and puts recreational opportunities within reach for Oregon's citizens.

The energy that powers Oregon's economy comes to the state primarily as electricity or fossil fuels. Only about one-quarter of the electricity we use is generated within Oregon's boundaries, and we import all of the petroleum products and natural gas that we need for our industry, homes, and transportation. Oregon is literally at the end of the oil and gas pipeline, as residents found out during the "energy crisis" of 1973.

But Oregon's role in the unfolding energy drama may soon change. Apart from potential oil or natural gas reservoirs that could be found on land, Oregon's outer continental shelf could be tapped for oil and gas as the federal government opens up additional offshore areas to exploration for new energy sources.

Producing oil wells in Oregon's offshore waters won't necessarily guarantee the state endless and plentiful energy. And the positive and negative impacts of offshore oil development on the state's coast and coastal communities could be considerable. Such development could also create economic and social changes throughout the state.



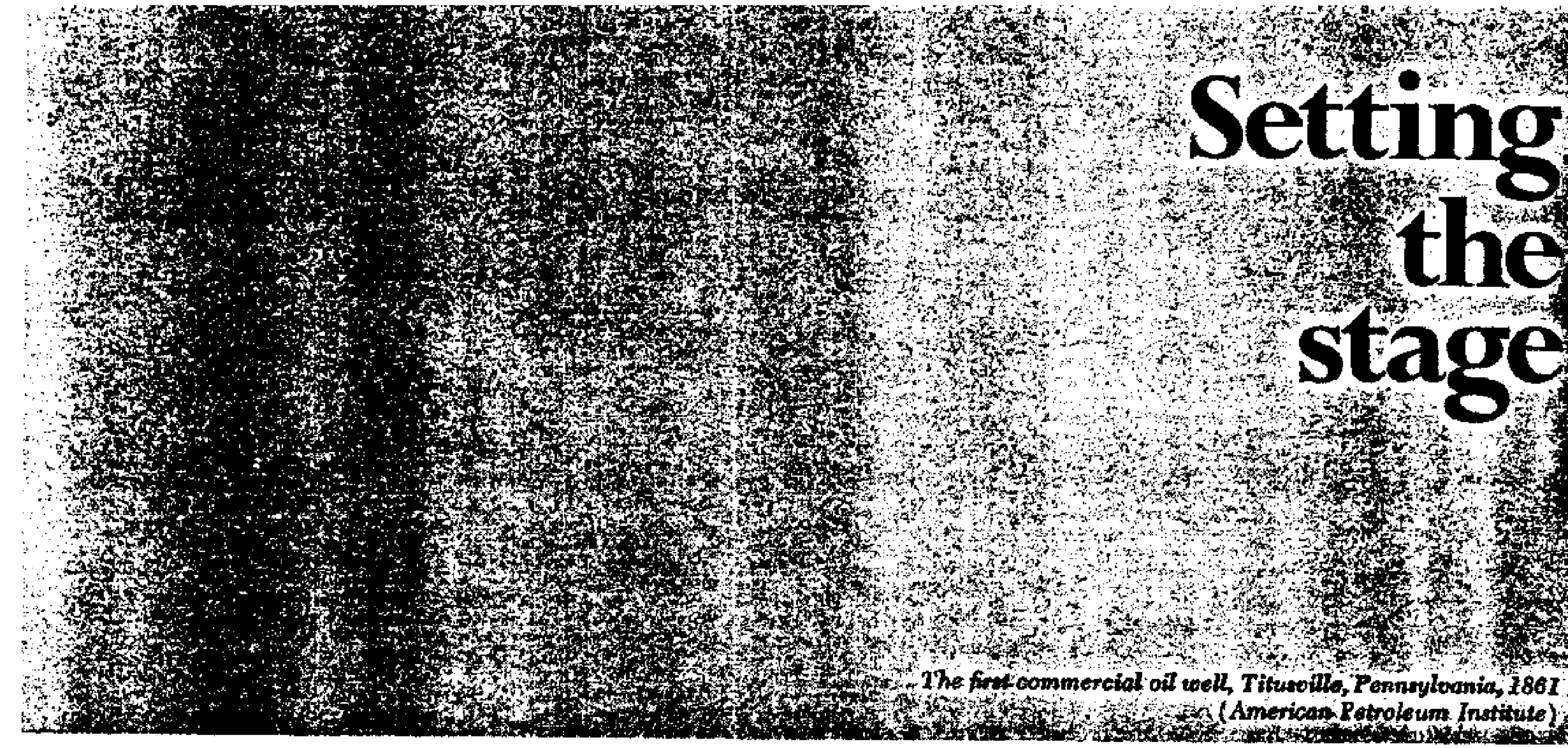
(*Oregon Agricultural Experiment Station*)

When offshore oil comes to Oregon, we as citizens must be ready to make wise decisions on such factors as the best areas for leasing, the siting of onshore facilities for exploiting this energy, and the management of social and economic change. In order to decide wisely, we need information.

As a prelude to Oregon's entrance into the offshore oil picture, this booklet will give citizens concerned about Oregon and energy some useful background on the process of exploiting continental shelf petroleum and on the possible economic, social, and environmental effects of such energy development.

(*OSU Forest Research Laboratory*)

Setting the stage



The first commercial oil well, Titusville, Pennsylvania, 1861 (American Petroleum Institute)

American progress has built upon a foundation of plentiful energy. From wood fires and candles in colonial homes to coal and whale oil lamps in the early 1800s, new forms of fuel made possible refinements in lifestyles and industry.

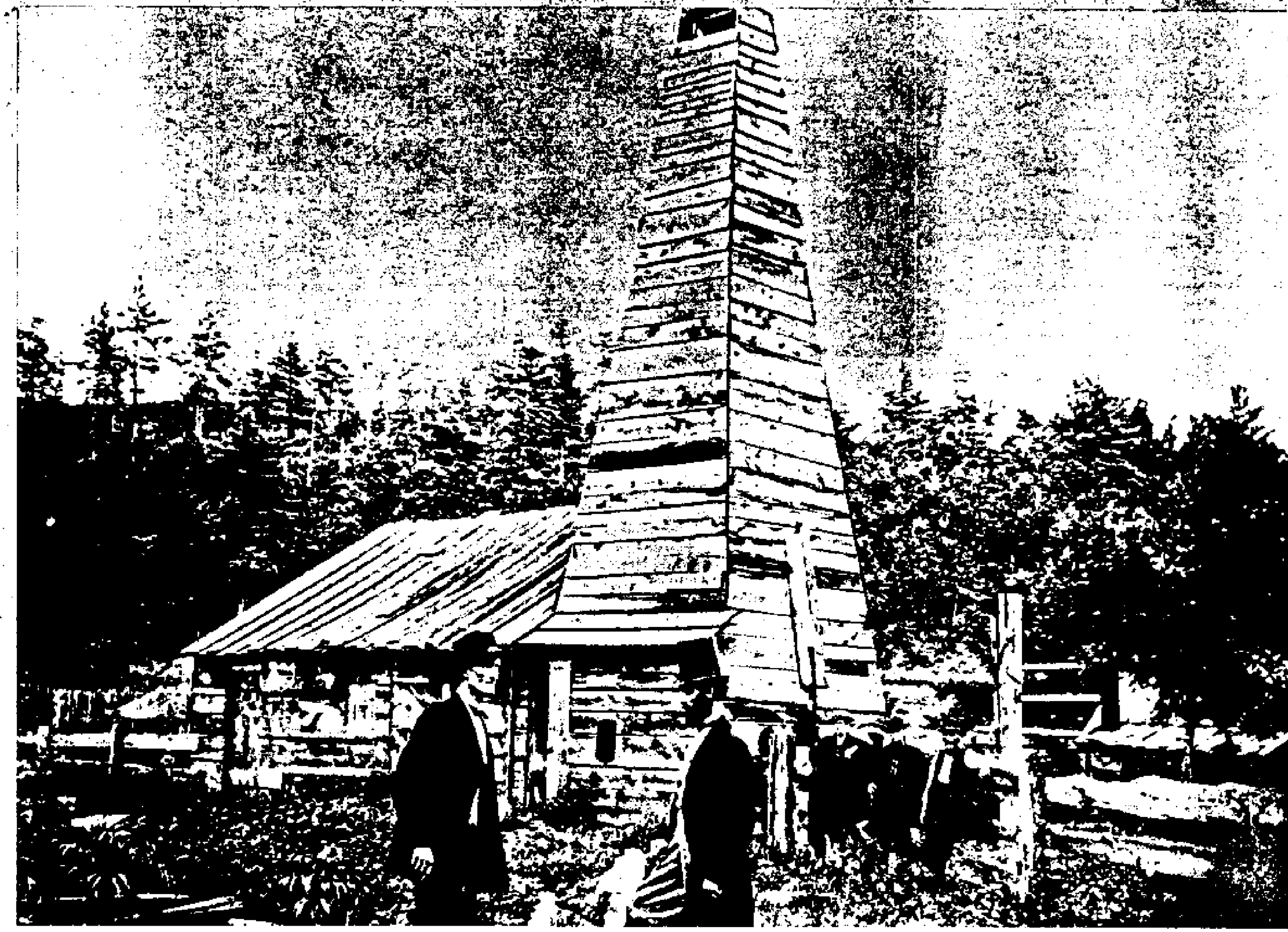
By the 1850s, whale oil for lighting homes was in short supply as whaling ships from Nantucket and other seaports decimated whale herds around the world. Attention turned to the rock oil that appeared in some places as seeps or slicks on the surface of streams. Pursuing underground the source of one such petroleum spring, Edwin L. Drake brought in the first successful, producing oil well at Titusville, Pennsylvania, in August 1859.

Other wells quickly followed. As the nineteenth century ended, lamps in American houses burned with kerosine refined from petroleum that was pumped from reservoirs in Pennsylvania, Texas, California, and other states.

Cousin of coal, also a fossil fuel, petroleum had versatility that spurred other uses. Refined into gasoline and lubricants, petroleum fed the internal combustion engine upon which twentieth century transportation depends. As heating oil, it replaced coal in the furnaces of many American homes and in generating plants that produce another form of energy, electricity.

Cracked into its components, petroleum made possible the petrochemical industry, which produces plastics, pesticides, and fertilizers for agriculture and pharmaceuticals for modern medicine. The natural gas often found with petroleum was piped into houses for heating, lighting, and cooking, and into factories as a fuel and raw material for industrial processes.

By the 1970s, petroleum and natural gas accounted for three-fourths of the energy consumed in the United States.



The Oil Rush

The search for oil and natural gas ranged over much of the mainland United States, from Montana and Wyoming to Texas, from West Virginia to Oklahoma to California. As the search progressed, locating oil reservoirs on the sites of natural seeps gave way to pinpointing potential wells with precise geological techniques.

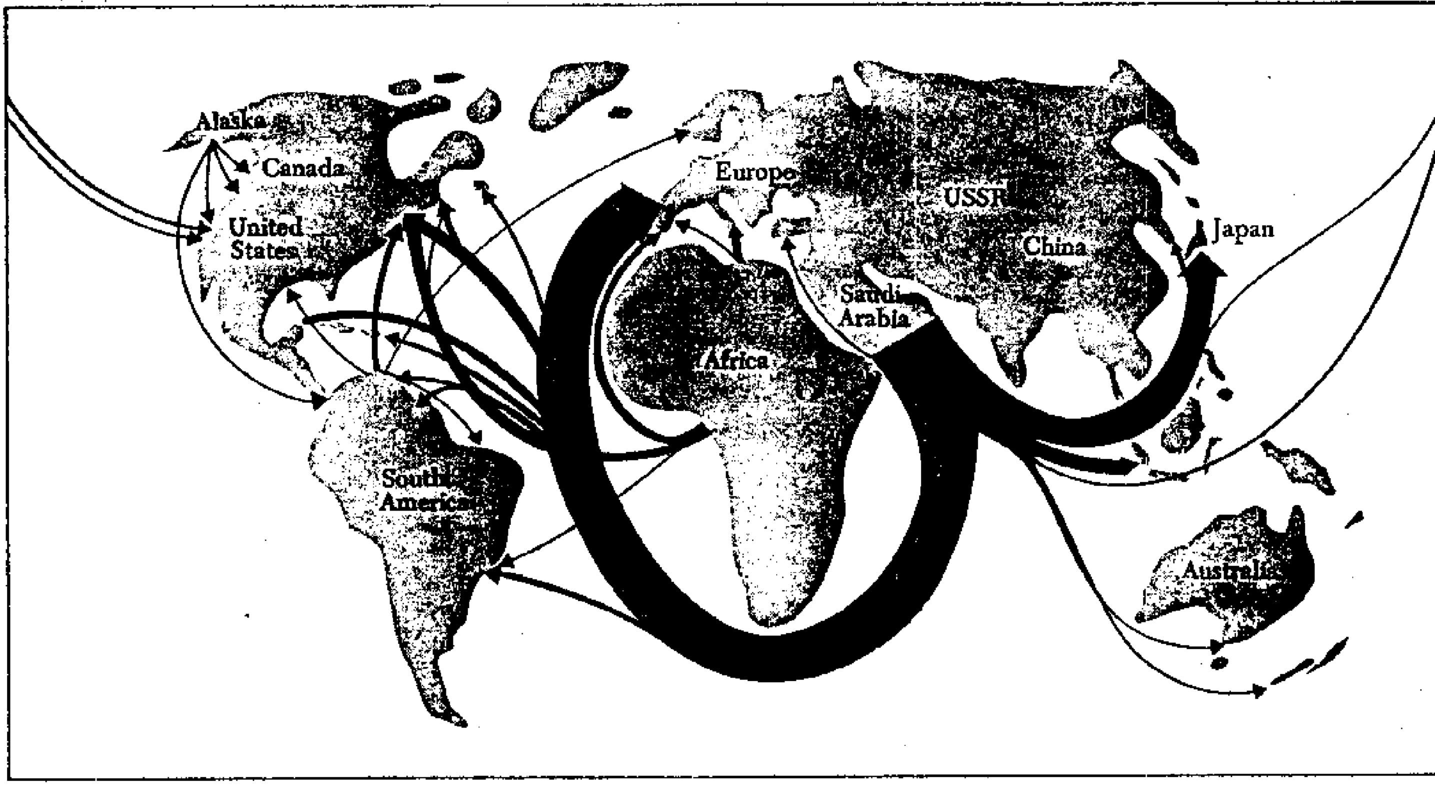
In 1897, near Santa Barbara, California, petroleum engineers followed a coastal oilfield discovery offshore, and drilled some 400 shallow wells from wooden piers. In Louisiana, in the late 1930s and early 1940s, oil rigs set up in coastal marshlands followed oil-bearing geological formations out into the Gulf of Mexico.

Since that time, offshore oil has played an ever larger role in the total production of petroleum companies. These companies have extended the search for oil from shallow coastal waters to the outer continental shelf, the undersea rim of land lying beyond the states' boundaries—three miles seaward from their shores.

Controlling the Continental Shelf

As oil companies, and government agencies, began to realize that potential petroleum reservoirs lay offshore beneath the continental shelf, the federal government moved to assert United States control over these resources.

On September 28, 1945, President Harry S Truman proclaimed that the government considered the natural



resources of the continental shelf lying off the U.S. coast as subject to the United States' jurisdiction and control.

The Submerged Lands Act of May 22, 1953, reasserted this proclamation's intent, and made clear that coastal states were entitled to control the waters and submerged lands three miles seaward of their coastlines.

The Outer Continental Shelf Lands Act of August 7, 1953, once again affirmed federal control of the outer continental shelf. The act authorized the U.S. Department of the Interior to grant mineral leases for the shelf and to create regulations to carry out the act's provisions. In 1978, Congress amended this act to give planning funds to coastal states affected by outer continental shelf oil activities and to provide environmental safeguards.

Fueling the Debate

These acts responded to the widening search for sources of petroleum and natural gas, as the United States' demand for these fossil fuels grew. At the same time, the nation had been importing ever larger amounts of oil from the Middle East, South America, and Asia. In 1973, the consortium of oil producing and exporting countries (OPEC) cut imports to the United States, and overnight we became conscious of our vulnerability as an energy-intensive society.

With all the resulting talk about energy independence and a national energy policy, the push to extract offshore oil has expanded. As if anticipating the "energy crisis" of 1973, the U.S. Department of the Interior in 1971 had published a new timetable to promote faster exploration for offshore oil.

Since then, the timetable has been revised and amended; the latest version, issued in the fall of 1977, looks to new leasing areas off New England, the mid-Atlantic and southern states, California, and Alaska. Though Oregon and Washington were not included on this latest schedule, the chances are good that the search for oil will come to Pacific Northwest waters in the not too distant future.

Other trends also influence the nation's interest in offshore oil, and the debate surrounding these resources. Since the 1950s, we've become increasingly aware of how important marine resources are to the United States' future. Through a variety of programs, the federal government is promoting new technologies to tap these resources.

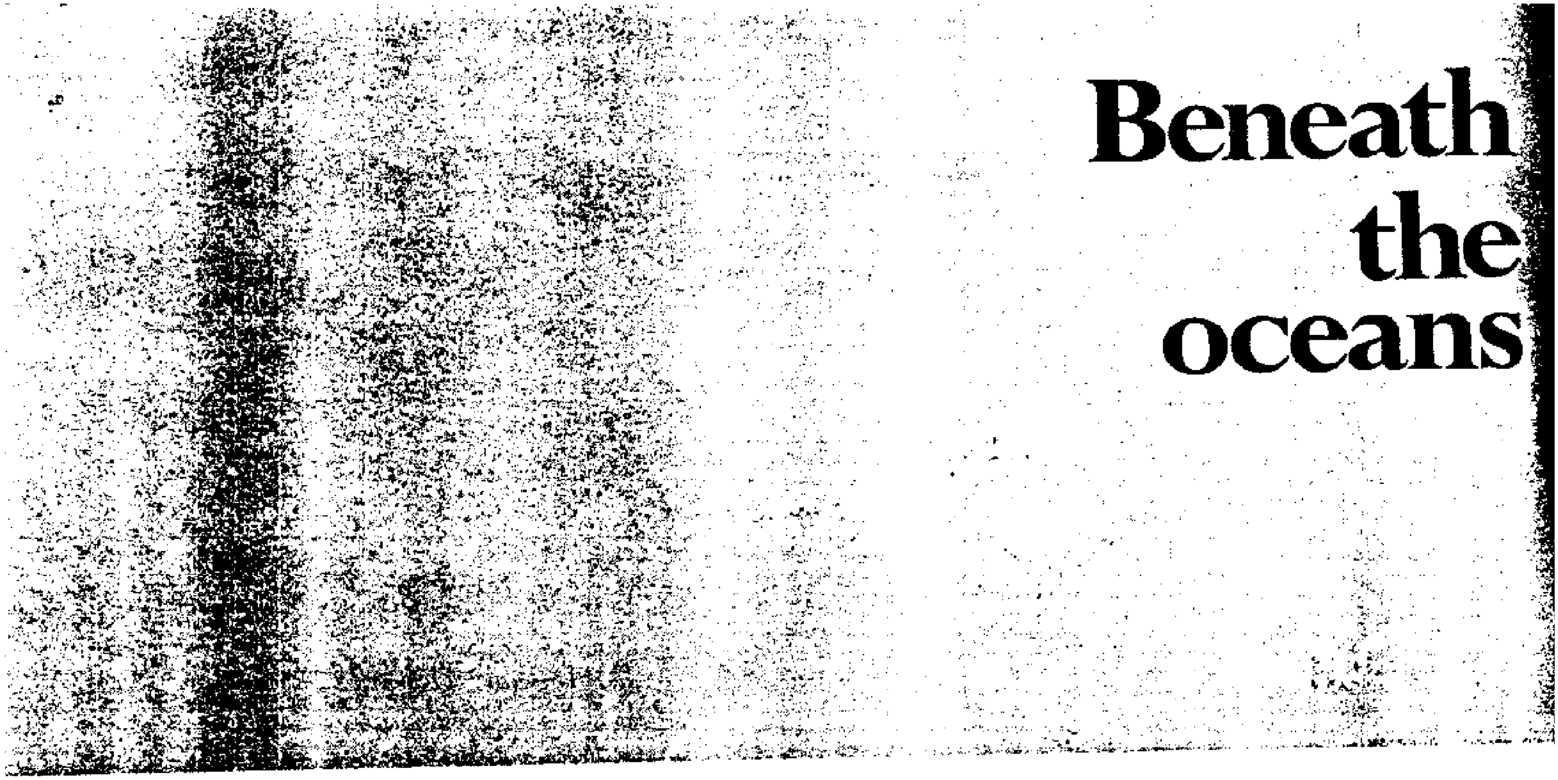
Transport of oil worldwide
(adapted from National Geographic, July 1978)

Since 1969, the year of the Santa Barbara oil spill, citizens have become increasingly anxious about the health of our environment. Oil spills are a particularly visible symbol of industrial pollution. Disasters like the grounded tankers *Argo Merchant* (December 1976) and *Amoco Cadiz* (March 1978), whose ruptured tanks spilled millions of gallons of oil, can spoil sea life and recreational beaches. However, many experts argue that our expanded search for offshore oil is wise, since oil rigs at sea cause far less pollution than do the tankers importing oil to coastal cities.

Many states, especially those that face the immediate prospect of oil rigs off their coastlines, are ambivalent about outer continental shelf oil. Though national policy has stated the need to exploit continental shelf mineral resources, it is the federal agencies that take the lead in leasing these lands and regulating offshore operations. But the states see the possible onshore impacts—"boomtown" construction on the coast, an oil spill damaging rich coastal fishing grounds, the hard questions about economic benefit and social cost.

The federal government is helping the states sort out the positive and negative effects of outer continental shelf oil development. The Coastal Energy Impact Program, administered through the Office of Coastal Zone Management and state coastal management agencies, provides planning, environmental, and assistance grants to states to help them anticipate and cope with the changes that offshore oil brings.

As Oregon citizens, we may soon face some of these changes. As you read through this booklet, you will find out what the effects of offshore oil can be. First, however, let's look at offshore oil: where it comes from, how the government makes it available, and how the oil companies extract it.



Beneath the oceans

From Plankton to Petroleum

Oil's origin lay in the sunlit, shallow, coastal waters of ancient seas, where vast numbers of tiny marine plants and animals flourished. As countless generations of these organisms grew and died, their remains settled to the seafloor, and were covered by fine particles of clay, silt, or sand.

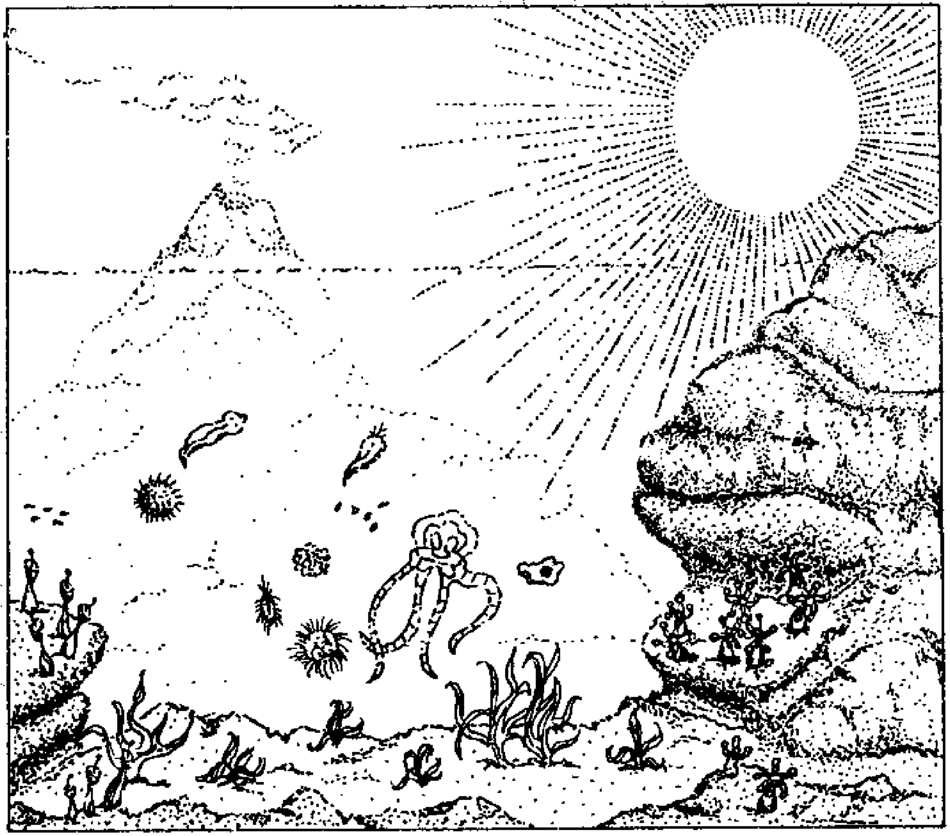
This process, repeated through thousands of years, led to the accumulation of dense sediments on the ancient seabed. The weight of these sediments, combined with certain chemical, bacterial, and temperature conditions, transformed the buried organisms into petroleum and natural gas, much as ancient forests were converted into coal.

Unrefined petroleum, or crude oil, consists primarily of the elements carbon and hydrogen linked into complex molecules with much smaller amounts of other elements. The oil may contain many different kinds of hydrocarbon molecules, such as naphthenic, paraffin, or aromatic compounds. The natural gas found with oil represents mostly the hydrocarbon compound methane that is also known as marsh gas or the explosive "firedamp" feared by coal miners. Natural gas may also contain lesser quantities of carbon dioxide, nitrogen, hydrogen sulfide, or other gases.

The compacting pressure of the ancient sediments also changed the clays, silts, and sands into rock: shale, mudstone, or sandstone. Oil and gas, squeezed from the denser source rocks such as shale, migrated into porous sandstone and limestone.

As the earth's crust fractured or folded, the shifting layers of rock formed traps, barriers to the oil's migration. Lying next to or beneath impermeable rock, a reservoir was formed, holding a pool of natural gas and petroleum above a deeper layer of water.

In many regions of the world, these petroleum reservoirs now underlie dry

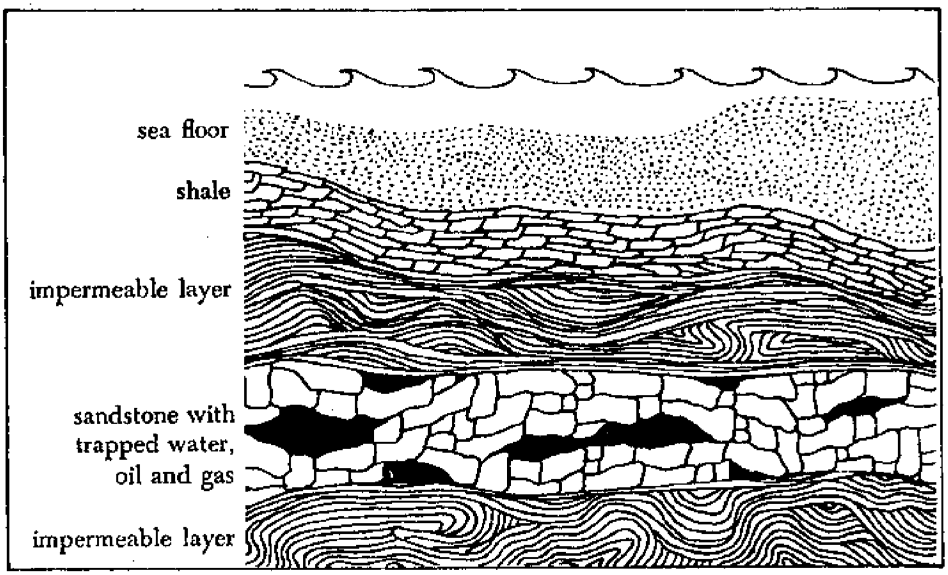


A prehistoric seascape

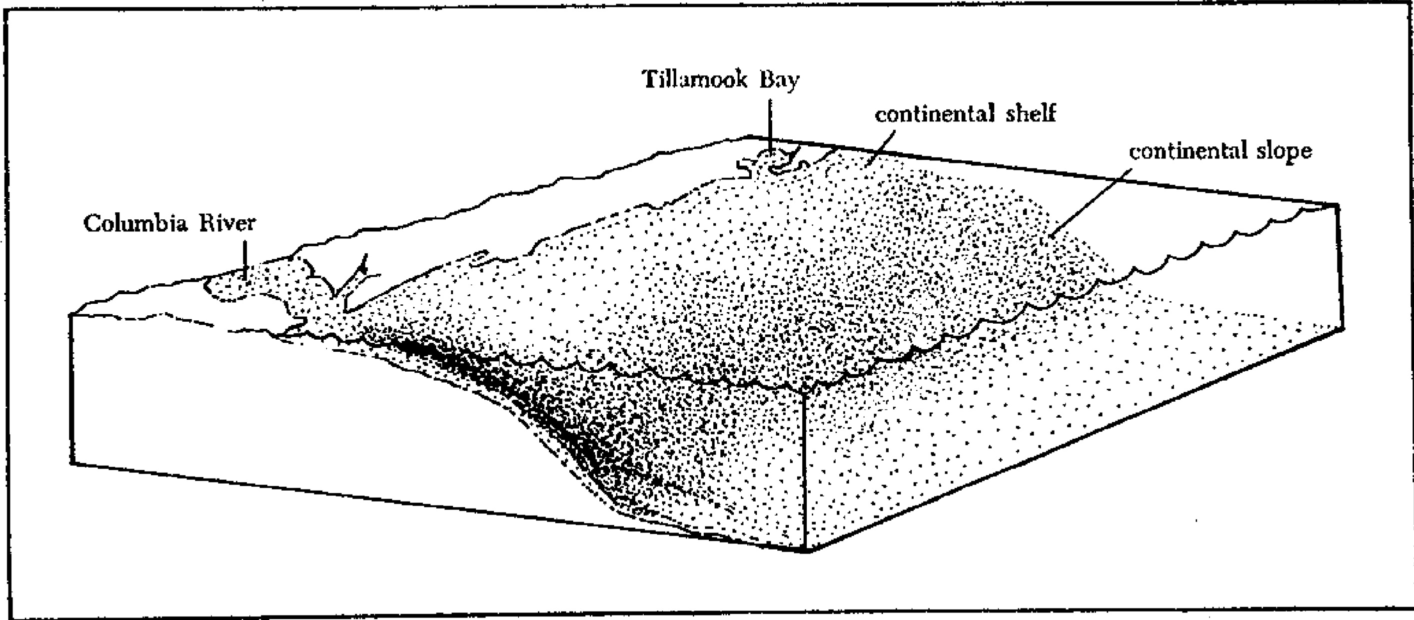
land, as geological change raised and drained ancient seabeds. But oil fields, consisting of one or more pools of petroleum and natural gas, are also found beneath the continents' submerged seaward rims.

The Shape of the Shelf

The continental shelf is the shallow, undersea terrace surrounding the dry land mass of a continent. Where it borders coastlines characterized by geologically young mountain ranges, the shelf may be quite narrow, deep, and variable. The west coasts of North and South America have this kind of continental shelf. Off the United States' East Coast, which is an older lowland shoreline, the shelf is wide, shallow, and covered by a uniform blanket of sediment.



General oil geology



A profile of the continental shelf

The terrace extends as far out to sea as the continental shelf edge, where the shelf steepens rapidly. Toward the bottom of this steeper continental slope, the continental rise dips seaward in a gentle incline that leads to the abyssal plains of the deep ocean floor.

In the United States, the legal definition of the continental shelf imposes jurisdictional boundaries on the submerged lands. Most states control the shelf within three miles of their shorelines. Federal courts, interpreting historical documents, have extended this state boundary to nine miles seaward for Texas and Florida. Under the international Geneva Convention of 1958, the federal government has jurisdiction over the outer continental shelf to a depth of 650 feet (200 meters), or beyond if the water's depth permits exploitation of the shelf's resources.

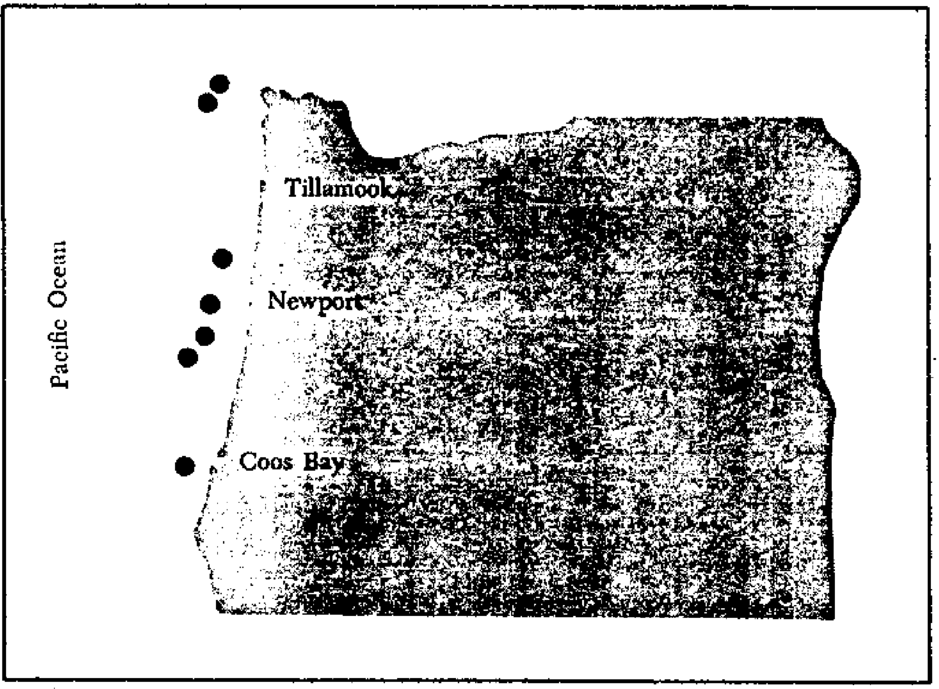
Geological structures on the continental shelf resemble those of the mainland. The shelf consists of the lighter continental rocks that allow the continental masses to "float" on heavier, underlying rock layers. The sedimentary rock formations and geological faults and folds that contain oil and gas are the same as those found on dry land.

Oregon's continental shelf is narrower, steeper, and deeper than the average continental shelf worldwide. From nine to 40 miles in width and between 480 and 600 feet deep at its edge, the shelf off Oregon is smooth and covered with sand and mud except for a few small, rocky hills, such as Heceta Bank and other offshore reefs. Seaward of the Columbia River's mouth, Astoria Canyon gouges a deep chasm in the shelf, down to 6000 feet deep. A fault zone near Cape Blanco represents the only known region of unstable rock on Oregon's continental shelf.

Exploring for Offshore Energy

Locating oil and natural gas reservoirs is the first step in supplying these fossil fuels for America's energy needs. Because of the characteristic rock formations associated with petroleum fields, geologists looking at a likely site attempt to profile the underlying rock and sediment layers. The thickness of the sediments and the existence of folded or faulted rock increase the chance that oil may be found. On Oregon's continental shelf, for instance, sediments more than 15,000 feet thick indicate some hope for finding oil and gas.

In searching for offshore oil, petroleum geologists employ techniques similar to those used on land to build a three-dimensional picture of the subsurface structures. Seismic surveys use reflected sound waves to create this picture. A survey ship uses a seismic signal generator to send out pulsed sound waves. As these sound waves penetrate the seafloor, the different kinds of rock layers reflect the signals back at different times to sensitive receivers—geophones —that trail behind the ship on a cable



Exploratory oil drilling sites off Oregon, 1964

up to 9,000 feet long. Special instruments on the ship record the varying signals on magnetic tape, which a computer can process to print out a profile of the subsea formations.

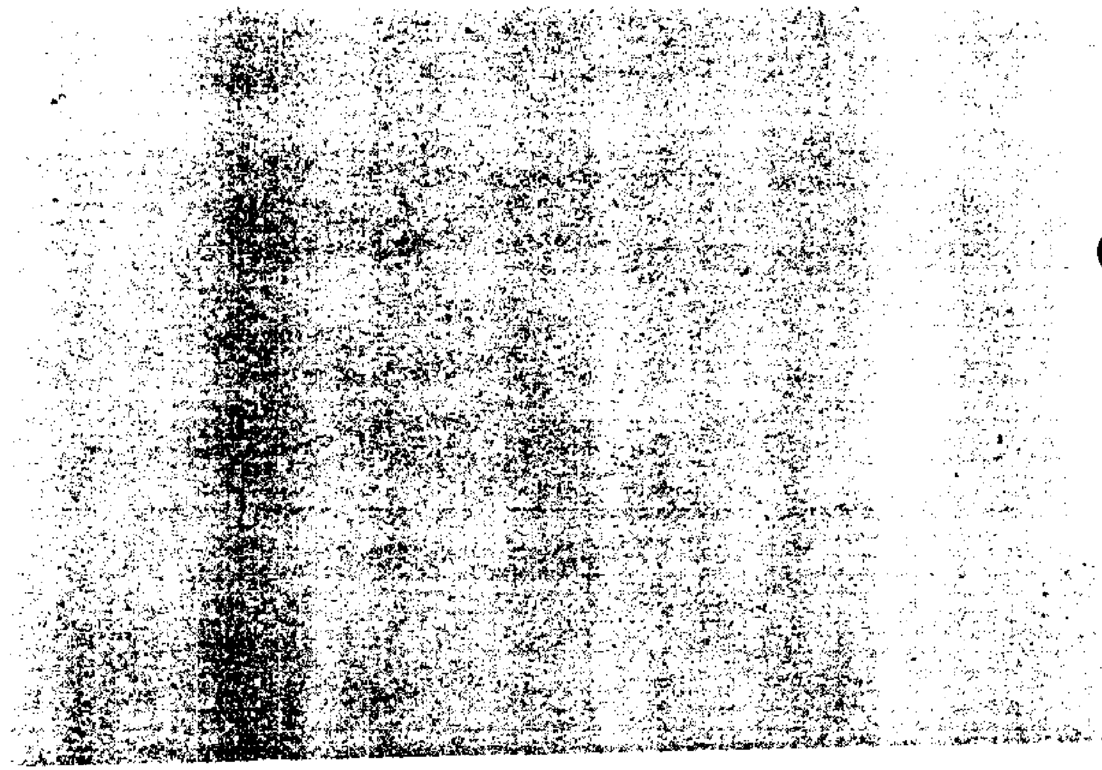
Petroleum geologists must also know something about the kinds of rock and sediment and their age and source, as well as their contours. Divers and submersibles can sample the seabed in shallow water. In deeper areas, several techniques, such as shallow coring that uses scaled-down drilling equipment, bring up cores of rock and sediment. Geologists examine these long cylinders to determine the exact nature of the seabed layers.

Such sampling programs on the outer continental shelf are conducted under strict permits issued by the U.S. Geological Survey. For instance, these permits limit seafloor coring to a depth of 500 feet in length, or up to 750 feet if bedrock is not found by the 500-foot mark. While the Geological Survey collects its own data to evaluate potential resources, the oil companies and geophysical exploration firms collect most of the information needed to judge the possibility of finding commercial amounts of oil and gas. For Oregon's submerged lands, geological exploration and core sampling are done under permits from the Division of State Lands with advice from the Department of Geology and Mineral Industries.

Explorations on Oregon's Shelf

Oregon has already observed offshore oil activity on its continental shelf. In 1964-65, on outer continental shelf lands leased from the federal government, oil companies drilled eight exploratory wells; several more wells were drilled on state lands within the three-mile boundary. Though traces of petroleum were found in all the offshore areas, and one actually produced 60 thousand cubic feet per day of natural gas, none demonstrated the presence of commercial quantities of oil and gas. Geological explorations did not find the reservoir rocks essential for producing petroleum fields.

Because only about 6 percent of exploratory wells ever bring in producing fields, the fact that nothing has been produced on Oregon's outer continental shelf so far does not shut out the possibility that oil and gas may yet be found. The thick sediments located off the Columbia River's mouth and near Newport and Coos Bay may be likely sites. Also, the U.S. Geological Survey and the oil companies stand a better chance of finding oil and gas today than they did 10 years ago. Since the exploratory drilling in 1964-65, new, more accurate surveying techniques have been developed that could lead to more precise siting of areas for exploration.



Leasing offshore lands

Just as logging firms lease national and state forest tracts to cut timber, and mining industries lease public lands to extract minerals, so the oil companies must lease areas of the continental shelf to drill for petroleum. For the outer continental shelf, the leasing process brings together the federal government, the states, the oil companies, and citizens to work out the best ways of tapping offshore oil.

Reporting Potential Resources

The U.S. Department of the Interior plays the lead role in making offshore lands available and regulating development activities. As the first step in this process, the department's Bureau of Land Management makes up a schedule for leasing various areas on the outer continental shelf. The schedule reflects estimates from oil companies and the U.S. Geological Survey on the potential petroleum resources each area may contain.

The latest schedule, published in fall 1977, emphasizes the leasing of continental shelf areas with the highest probability of commercial quantities of oil and gas. Because petroleum companies had ranked the Oregon/Washington continental shelf lowest among all the areas in terms of its resource potential and desirability for leasing, this region was dropped from the most recent timetable.

Oregon's governor has requested that the outer continental shelf off the state's coast be placed on the schedule. This very likely will not happen until after 1980, which would mean that oil production could not occur before 1988.

After the schedule is issued, the U.S. Geological Survey continues its work of gathering data on the possible mineral resources in an area considered for leasing. Oil companies and geophysical survey firms often participate in such data collection, but will make their own interpretations of the information. The

Geological Survey also details, in the resource reports it prepares, the marine resources that offshore oil development may affect. Other federal agencies comment on the proposed lease area, giving their perspectives on the uses and values of the resources the area holds.

A Call for Nominations

The Bureau of Land Management has three objectives for the outer continental shelf leasing process it manages: orderly development of the shelf's resources, protection of the environment, and receipt of a fair market value for exploration rights and for the oil and gas produced.

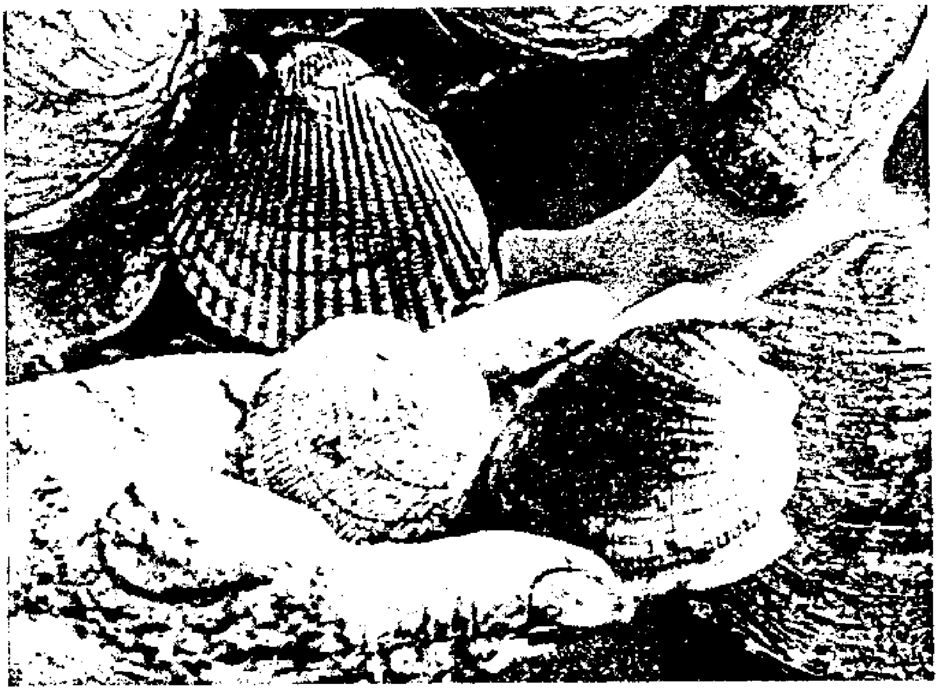
Each area in the continental shelf leasing schedule is divided into nine-square-mile tracts. When the Bureau of Land Management issues a call for nominations, the oil companies respond by naming, or "nominating," the tracts that they would like to lease for exploration and development. In nominating tracts, the oil companies use the results of their initial geological surveys.

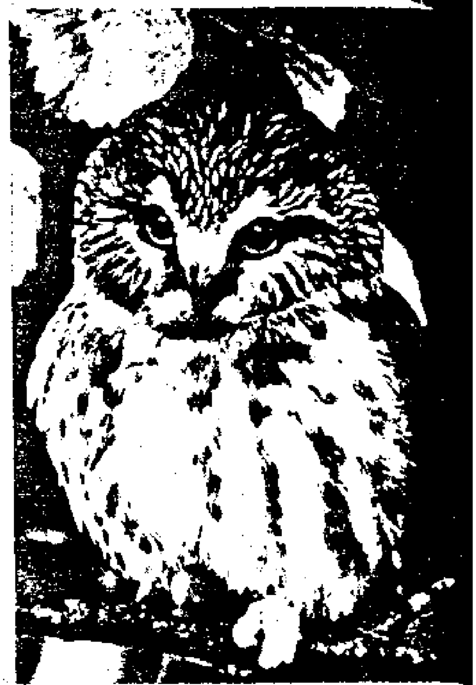
Some offshore tracts may represent more than probable sites for finding oil and gas. These tracts may contain prime fishing grounds, breeding areas for marine life, shipping lanes, or unstable rock or seafloor conditions. At the same time that oil companies indicate their preference, state and local governments, other federal agencies, public interest groups, and individual citizens can nominate tracts that they would like excluded from leasing to preserve the tracts for other uses.

Once all nominations are received, the Bureau of Land Management must decide which to accept. The bureau selects tracts to meet several objectives—to offer areas with the highest potential for oil and gas, to avoid environmental hazards, to test additional geological structures, and to protect producing petroleum pools. The bureau also invites the governors of nearby states to comment on the tentative tract selection.

Bench Marks at Sea

Once tracts for leasing have been decided upon, the Bureau of Land Management initiates studies of the existing environmental conditions in the geographical region that the tracts represent. These studies, carried out by universities, the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, or consulting firms, describe the ocean currents, weather





patterns, seafloor sediments and rock formations, seawater chemical components, and marine life that are found on a tract.

The data collected during the studies become a bench mark of current conditions. Future changes can be measured against this bench mark to indicate when oil production is having an adverse effect on the ocean environment. The studies can also point to tracts that should be deleted from the lease sale for critical environmental reasons.

Using bench mark data, the Bureau of Land Management writes a draft environmental impact statement for the group of tracts it has selected for leasing. The statement reports on existing environmental conditions and describes the possible positive and negative impacts offshore oil development may cause. Citizens and federal, state, and local government agencies review the draft statement. Their comments are aired at public hearings, and are incorporated into a final environmental impact statement.

Selling Offshore Leases

At this point, the Secretary of the Interior reviews the environmental impact statement, the results of the public hearings, and advice from other government agencies, and then decides whether or not to hold a sale of the leases for the chosen offshore tracts.

If the decision is to proceed, the Bureau of Land Management publishes a notice of the sale and establishes terms for the lease, which may be tailored to meet special environmental requirements. The Geological Survey prepares estimates of the value of the mineral resources that tracts offered for lease contain. The U.S. Department of Energy receives the notice of sale to set oil production rates.

The oil companies, responding singly or in joint venture with other firms, submit sealed bids for the exploration and production rights to each tract they want to lease. The Department of the Interior reviews the bids, and awards the lease to the highest bidder. The department may also decide to reject the bids it has received, if these bids do not reflect what it considers to be the fair market value of the tract's mineral resources, and can reschedule the lease sale for a future date.

Leasing Oregon's Offshore Lands

Oil companies that wish to lease continental shelf lands within three miles of Oregon's coastline will follow through state agencies a process similar to that of leasing federal lands. In Oregon, the Division of State Lands has jurisdiction over the leasing of areas for exploration and development.

The Oregon Department of Energy and the Energy Facility Siting Council issue permits for construction of offshore and onshore structures related to energy production, and the Department of

Geology and Mineral Industries sets regulations for the extraction of mineral resources. The Oregon Department of Environmental Quality issues permits to guarantee that air and water quality are maintained.

The Department of Land Conservation and Development, the agency responsible for Oregon's coastal management program, will review offshore oil activities, both within state boundaries and on the outer continental shelf. The department will check oil companies' plans for outer continental shelf exploration and development to make sure that these plans are consistent with the state's coastal management program. No federal permits or licenses for development can be granted unless the plans have such consistency.

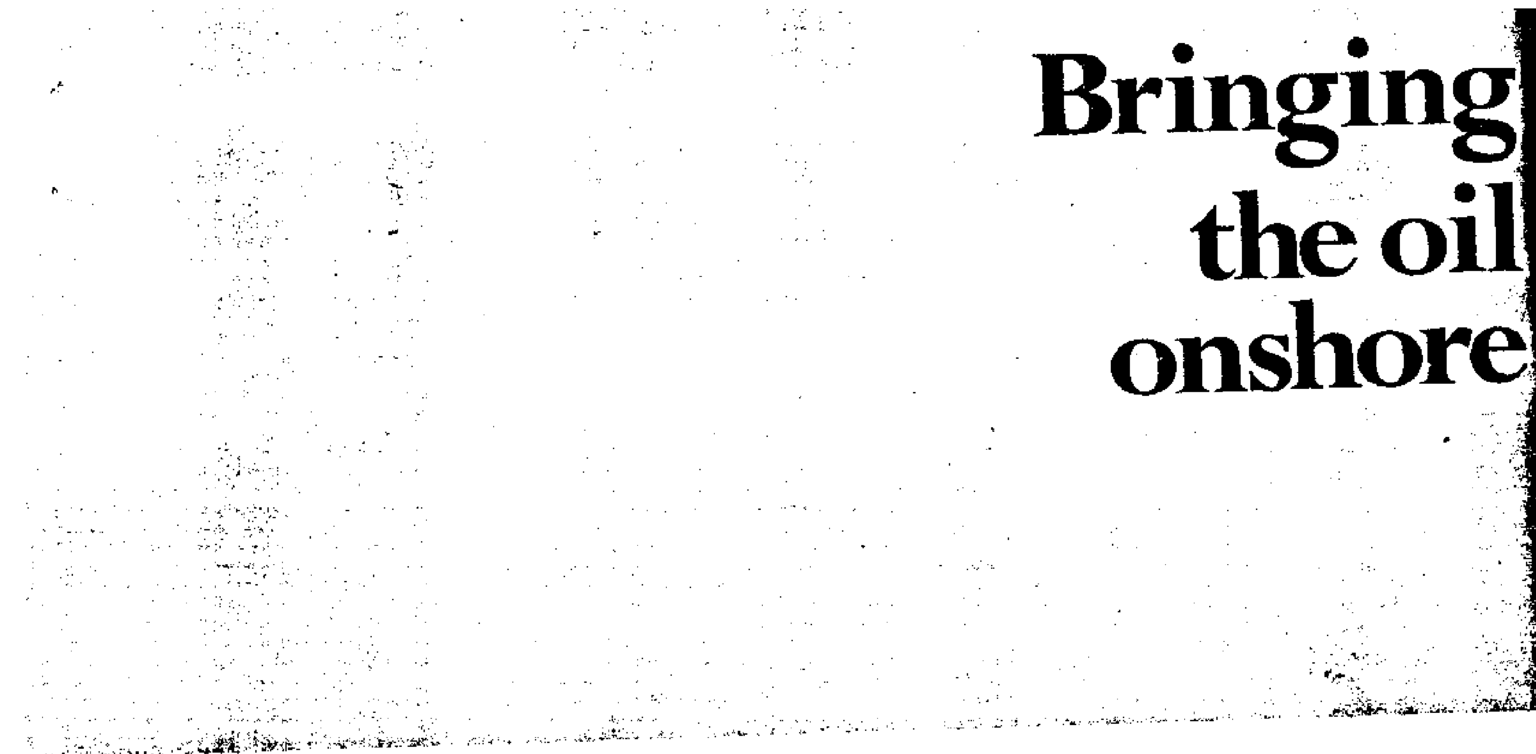
To oversee the state's interests in offshore oil development, Oregon's governor has appointed a special task force of representatives of the main agencies with roles to play when offshore oil comes to Oregon.

On to Production

The oil company that successfully bids for an offshore lease has the right to explore for oil for five years, under normal conditions. If oil is found, the firm has production rights for as long as the wells pump out petroleum.

During the leasing process, onshore activity is slight. Coastal residents may see no more than seismic survey vessels using existing harbors. Once the lease has been granted and intensive exploration begins, local communities near the leased tracts begin to experience the first social and economic effects from the oil field off their shores.

Bringing the oil onshore



Oil fields, whether onshore or offshore, have a distinct lifetime—usually between 15 and 40 years for a productive location. For offshore oil fields, as with onshore oil, four separate phases of activity follow leasing: exploration, development, production, and shutdown. Each phase has its own limited duration and its own particular impact.

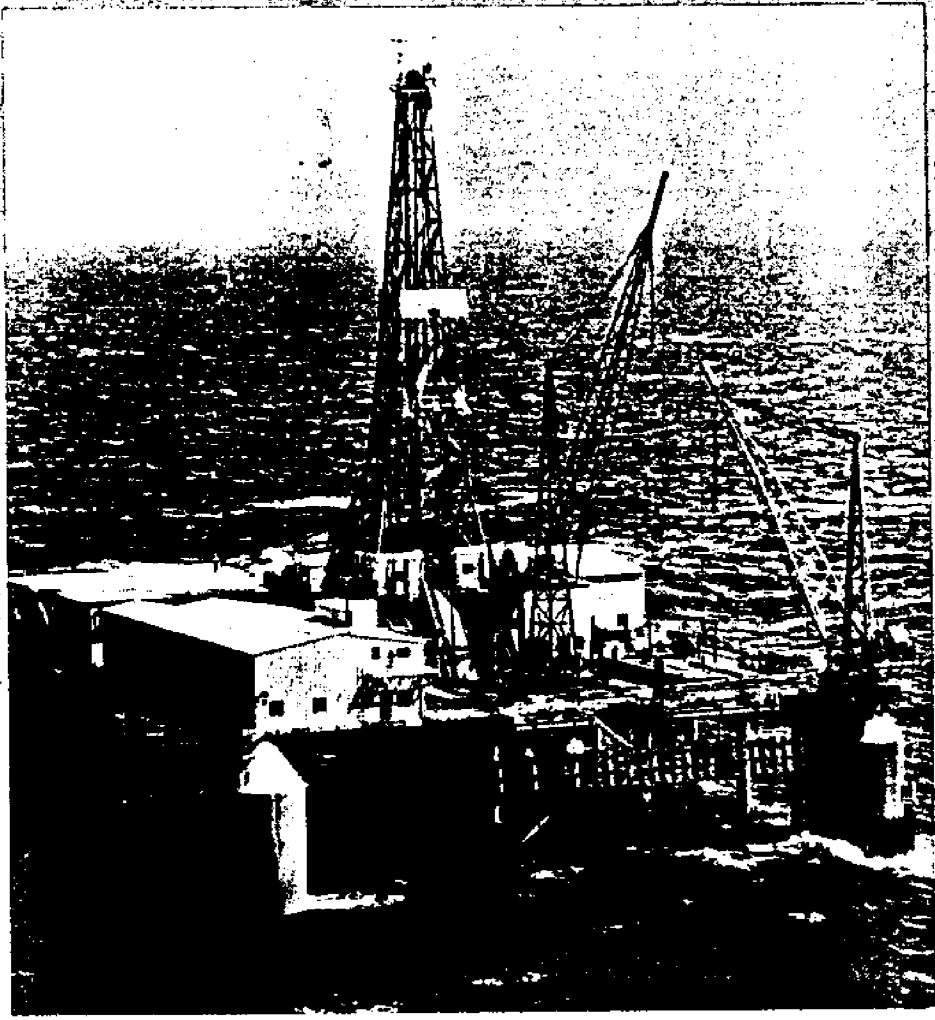
Exploring Leased Lands

Once an oil company leases an offshore tract, it begins exploring in earnest to locate precisely any oil or gas deposits. The company may conduct additional geological surveys, though usually these have been completed before leasing to provide information for tract selection. The geological contour map developed from prelease surveying may be refined with additional seismic profiles before companies use it as a guide to locate exploratory drilling sites.

Oil or natural gas can be physically located only by exploratory drilling, unless natural seeps are present. Most often the oil companies hire a drilling contractor to undertake this phase of offshore field development.

The contractor may use any one of three types of mobile exploratory drilling rigs, depending on the water's depth and sea conditions. Jack-up rigs, which have legs that can be extended to the seafloor to raise the drilling platform above the waves, are preferred for shallow water from 100 to 350 feet deep. Semisubmersible rigs are huge barges supported by giant floats or caissons, which are partially flooded when the rig is anchored in place to stabilize the floating platform in heavy seas. Since it can withstand rough weather and waves and drill in up to 3000 feet of water, this type of exploratory rig is preferred for many offshore areas and would most likely be used for exploratory drilling off Oregon's coast.

Both jack-up rigs and semisubmersibles are towed to the drilling site, and can be towed away once exploration is



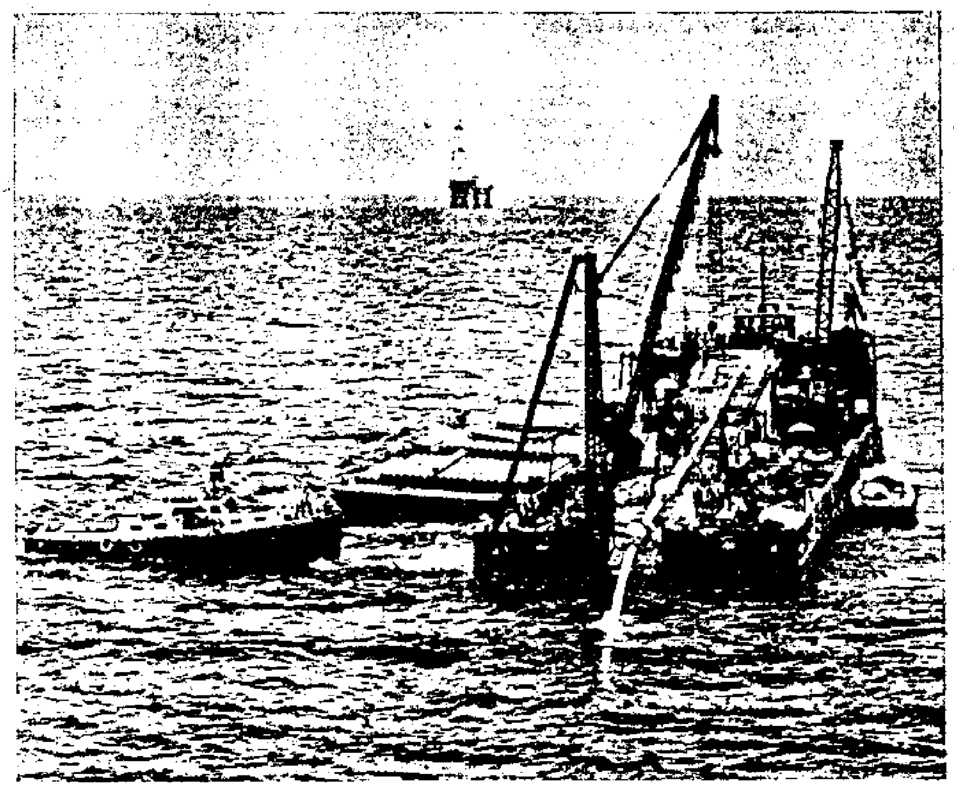
Blue Water II, exploratory oil rig off Oregon, 1964 (V. Newton, Department of Geology and Mineral Resources)

completed. Drill ships, the third type of exploratory equipment, are self-propelled and self-contained. These ships require special anchoring methods and cannot withstand storms at sea as well as the floating platforms, but they are able to drill in waters up to 20,000 feet deep.

Exploratory drilling operations begin with the cementing into place, up to 300 feet into the seabed sediments, of a conductor pipe that is about 2½ feet in diameter. The drill string, with a rotating drill bit on its lower end, passes through this conductor pipe. As the bit chews into the seafloor, it is cooled by a fluid called drilling mud that is pumped down through the drill string. The mud, a special mixture of clay, water, and chemicals, maintains pressure on the drill hole to help prevent blowouts, or gushers, and flushes bits of rock and sediment away from the drill bit and back up the conductor pipe. At the surface, the seabed cuttings are removed and the mud is recycled into the drill string.

As the drill string penetrates deeper into the seafloor, additional steel casings are extended to prevent the drill hole's collapse and seepage of oil, gas, or water between the rock strata. Before drilling below 300 feet, the drilling contractor installs a mechanical blowout preventer at the wellhead where the drill bit first enters the seafloor. As the drill bit bites deeper, the contractor measures the physical nature and electrical charge of the rock layers to determine if enough oil-bearing reservoir rocks are present to justify commercial production.

Once a reservoir is found, the contractor puts down a series of extra confirmation holes to determine the field's extent. The geologists describe the formations and characteristics of the rock layers to make estimates of the total volume of oil and natural gas the reservoir contains. The oil companies also estimate how much of this oil and gas can actually be produced: usually only about one-third of the oil present is



Laying pipeline offshore
(Continental Oil Co.)

recoverable, given the normal pressure that surrounding rocks exert on the pool of oil. Special techniques, such as injections of water or gas to increase the pressure, or of steam or chemicals to make the oil flow more easily, can boost this recovery figure to 50 percent.

At this point the oil company, with regulatory agencies' approval, decides how many producing wells should be drilled; how they should be spaced; the number and location of platforms; and how the oil will be transported or stored. The drilling contractor cements in and levels off the exploratory holes, which are not usually retained for production, and moves on.

If no commercial discovery of oil occurs during the five-year exploration period the lease allows, the oil companies abandon the lease. This happened in 1966 off Oregon's coast.

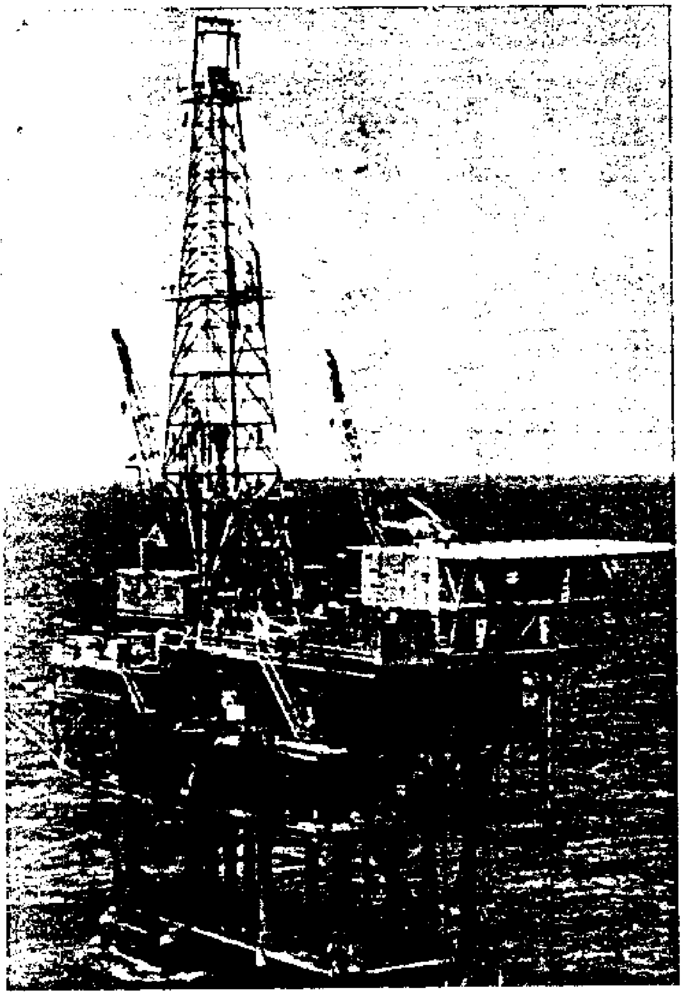
The federal government supervises all phases of outer continental shelf exploratory drilling to ensure that it is done safely and with minimum environmental impact. The U.S. Geological Survey reviews and approves exploration plans, issues drilling permits, and monitors drilling procedures. The Environmental Protection Agency issues pollution control permits. The U.S. Army Corps of Engineers and the U.S. Coast Guard regulate navigation.

During exploration of an offshore leased area, the oil companies and drilling contractors establish temporary service bases onshore: mooring or staging areas for supply boats and helicopters and small storage yards for equipment. Existing harbors are often adequate for these activities. If oil is found, the oil companies begin to seek land for permanent service bases and construction or storage space. At this time local communities, particularly small ones, start to feel the impact of offshore oil.

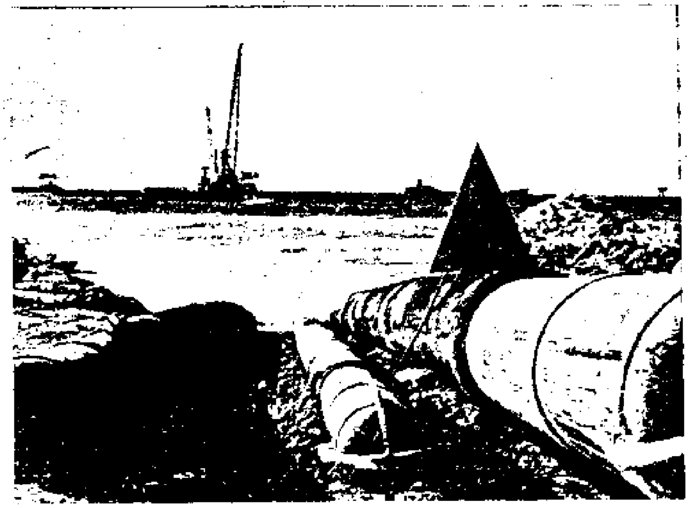
Boom-Time: Development

The oil field's development phase, lasting from four to nine years or more, begins with the installation of fixed production platforms. First, the U.S. Geological Survey reviews the oil company's plan for development and its application to drill production wells. The agency checks carefully all components of the proposed production system to catch potential hazards.

The oil company chooses one of three types of production rigs to match the weather and water depth on its leased offshore tract. Steel truss rigs, attached to the seafloor by steel pilings, are common in fairly shallow, calm waters such as the Gulf of Mexico off Texas and



Offshore production platform (Nobel Drilling Co./API)



Pipeline coming on shore (J. Ray McDermott & Co., Inc.)

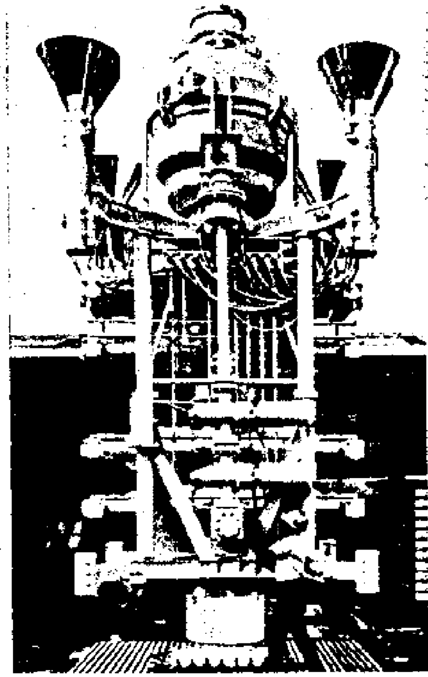
Louisiana. They would probably be used off Oregon as well. These rigs carry production and drilling equipment, crew living and work spaces, and a helicopter landing zone on several levels of a platform positioned over the "jacket" of tubular steel that is welded into a truss pattern and pinned to the seabed. A simple platform may cover 2½ acres of ocean space.

Oil companies may also choose to use concrete gravity platforms, which are held in place on the production site by their own weight. The hollow concrete base of the platform can store oil before it is transshipped to tankers. These rigs function in very deep or very stormy waters.

For depths even greater than a fixed platform can manage, subsea production systems may be constructed. This new type of equipment contains all the necessary production machinery and is mounted directly on the seafloor after drilling is accomplished from a drill ship. Though these systems are still unproven, they hold the promise of decreased navigational hazards and increased safety in bad weather.

From development platforms, up to 36 diagonally drilled wells can tap four square miles of petroleum reservoir. The steel liner that encases the development well hole is perforated at the subsea level of the reservoir rocks. The oil or gas flows into tubing inside the steel casing

Blowout preventer (*API*)



and is carried to the surface, where it is controlled by a special series of wellhead valves called the "Christmas tree." Special safety valves installed further down the well hole can shut off the oil flow if the casing or tubing ruptures at the upper end.

The process of installing these safety valves and control mechanisms is called well completion, and is carefully prescribed by orders from the Geological Survey's oil field supervisor. Through such orders, the supervisor attempts to balance maximum production with the safety of crew and environment.

During development, oil companies and offshore industries begin to construct onshore the facilities they will need to support oil production at sea. Depending upon the location of the leased tracts, the companies that fabricate offshore platforms may buy onshore acreage for platform construction yards. Brown and Root, Inc., one of the world's largest offshore engineering and construction firms, has proposed such a fabrication yard for the east bank of the Skipanon River's mouth in Warrenton, Oregon, near Astoria. Platforms built here would be towed at sea to offshore oil fields in the Gulf of Alaska and the Santa Barbara Channel off southern California, and could be used in Oregon waters.

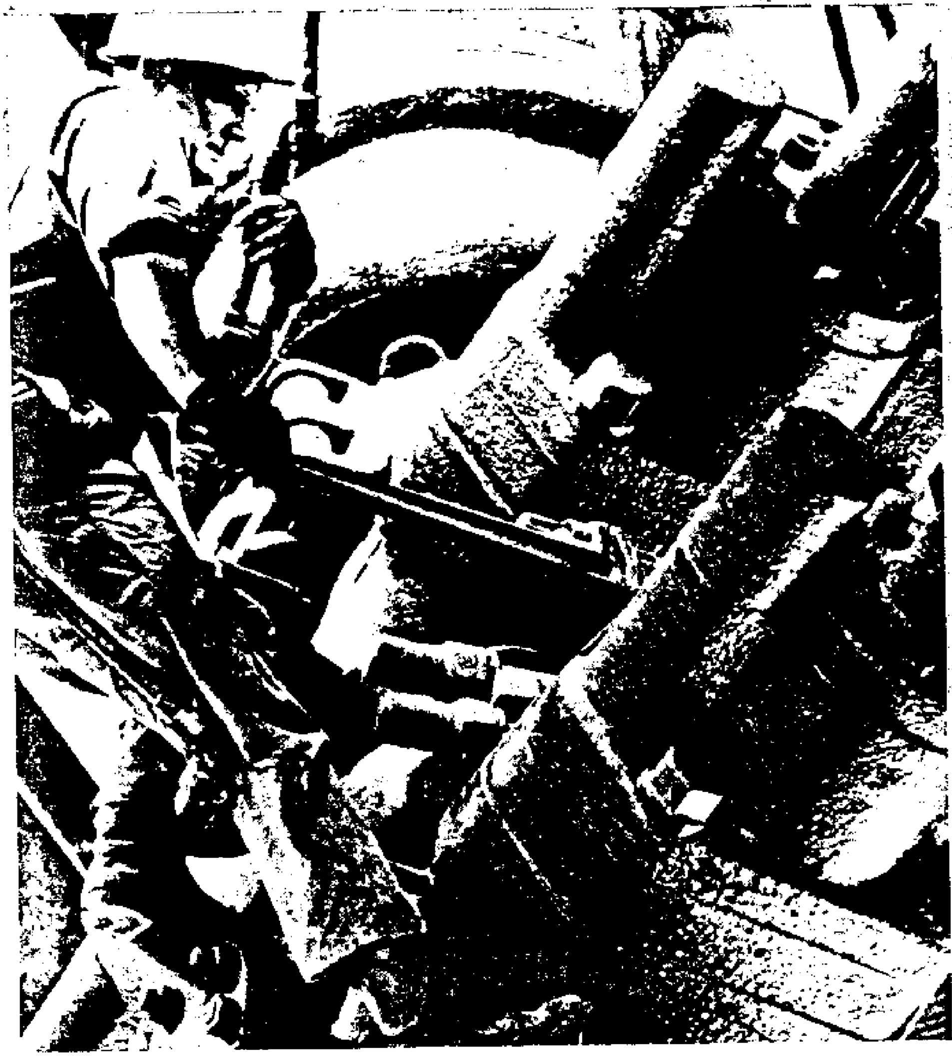
Yards for treating and storing the different sizes of pipe essential to development and production drilling are required, as are areas for storing, repairing, and maintaining the other types of equipment production platforms use. Service industries establish shore support bases that stock supplies for platform operations and crew quarters.

During the development period, an oil company may also decide to construct onshore facilities for processing or transporting the oil and gas. Partial processing plants separate the petroleum and gas from water and suspended minerals, and gas treatment plants strip impurities and liquid hydrocarbons from natural gas. Marine terminals provide space and structures for waterborne shipments of crude oil or petroleum products.

From Seafloor Well to Station Pump

Once industry completes oil field development, the production phase begins. Production equipment consists of the well, final casing and tubing, and preliminary processing machinery mounted on a platform or on the ocean bottom as part of a subsea production system. An oil company may separate drilling and production: a single production platform may gather in lines from several subsea completions or drilling platforms. For safety on gas field platforms, crew quarters and the helicopter pad are often housed on a separate platform that is connected by a causeway to the production platform.

On the production platform, the hydrocarbons pumped from the undersea reservoir pass through a flowmeter,



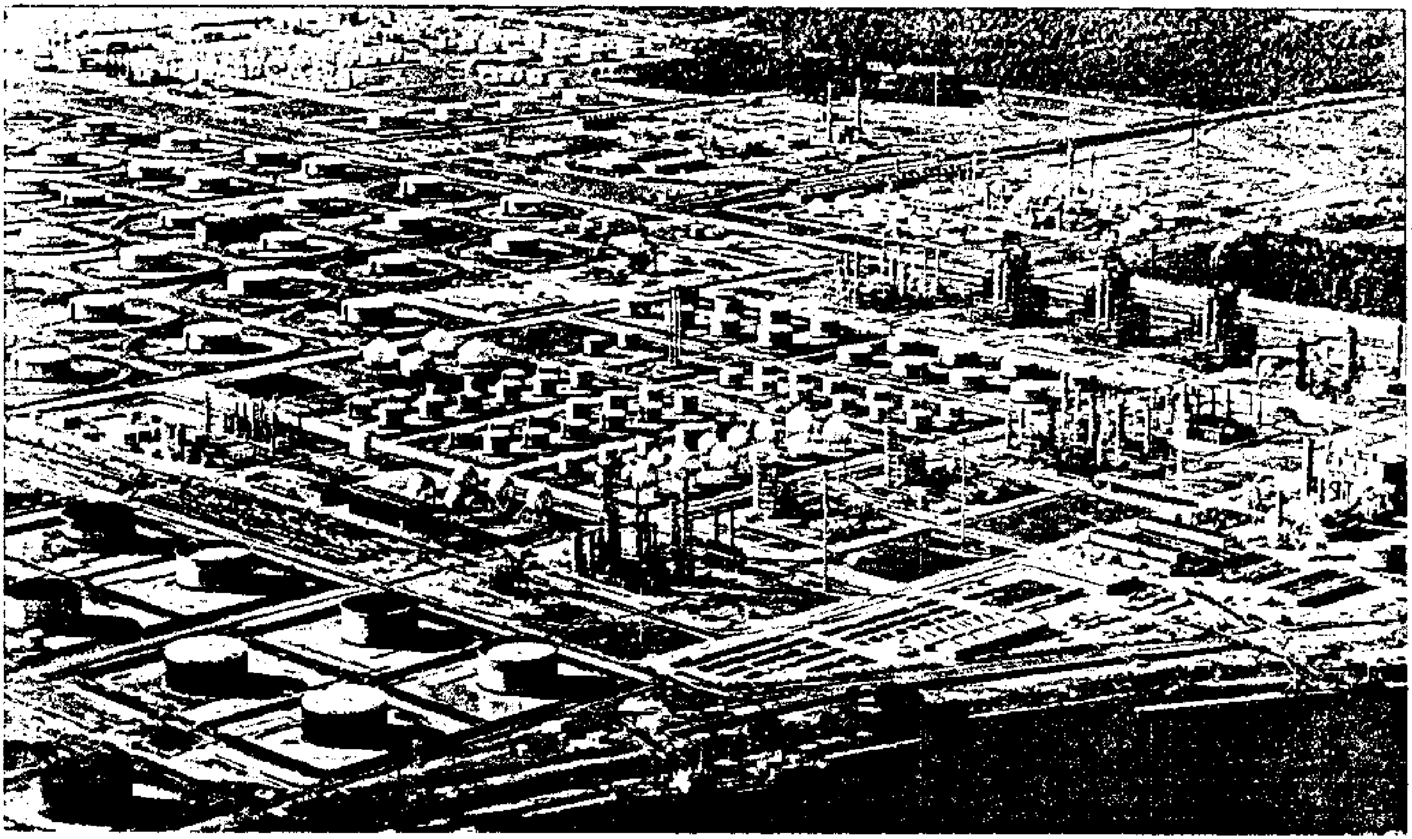
Working on the blowout preventer (John Keller, Texaco, Inc.)

which monitors the amount of oil and gas produced, and through a separator, which removes sand and water for cleaning and discharge and splits the petroleum mixture into oil and natural gas. With additional treatment, separation becomes partial processing. This treatment stage usually occurs on the platform if tankers rather than pipelines are used to transport the oil and gas to shore. Because of periodic rough weather on Oregon's ocean, lease stipulations or the Geological Survey may require oil companies to use pipelines for transport, which would mean construction of partial processing facilities onshore.

Pipelines are expensive—one mile of pipe 20 inches in diameter can cost more than $500,000—so the oil field's future must be assured to justify pipeline construction. Trunk lines can collect the output of several producers' wells. Oil and gas lines are usually separate.

To construct pipelines, a "lay" barge releases into the water sections of pipe that are welded together and coated with concrete for weight. As the lay barge moves forward, a separate barge follows, using jets of water to dig a trench for the pipeline. Oil companies don't have to bury the pipelines, but the Geological Survey supervisor may require it, especially in fishing areas where the pipes, with their valves and couplings, could be struck by towed fishing gear.

Instead of pipelines, tankers may transport the oil and gas to shore. The crude oil pumped from a producing well is stored on the platform until a small tanker offloads it for transfer at a transshipment terminal to a larger tanker that gathers the output of several wells. If commercial finds on Oregon's outer continental shelf were so widely scattered that pipelines would not be economical to construct, such a tanker transshipment terminal could be located on the state's coastline. Since Oregon currently has only one small petroleum



Oil refinery (API)

asphalt refinery in Portland, the tankers would most likely carry the crude oil to refineries in Puget Sound or California. Oil brought ashore by pipeline could also be transshipped onto large tankers for delivery to these refineries.

A refinery is a series of processing units that can convert crude oil into different types of petroleum products—gasoline, lubricants, home heating oils, and the like. The refinery's design depends upon the nature of the crude oil it has been built to process: for instance, "light" crude oils, containing a high percentage of gasoline, require a more complex refinery than "heavy" crudes. Constructing a refinery requires the guarantee of a longer-term supply of oil than an offshore field will usually yield in its 10- to 20-year lifetime. In Oregon, several proposals have been made that would place refineries near the Columbia River to process crude oil from Alaska. One company, Cascade Energy, Inc., has gathered all the permits necessary to start construction of a new refinery at Rainier to process Alaskan crude oil.

The natural gas found associated with the reservoir's oil can be reinjected, if the pool tapped by the platform does not contain commercial quantities of gas. If the oil company decides to extract, process, and market the gas, it will either pipe the gas ashore to a treatment plant, and from the plant to the nearest commercial delivery line, or may choose the more expensive option of liquefying the gas by cooling it to −260° F and then loading it on tankers and shipping it to a liquefied natural gas storage tank, such as the one recently constructed at Newport. At the storage tank, the natural gas can be reconverted and injected into commercial pipelines when necessary.

The production phase for offshore oil fields usually lasts between 10 and 25 years, or sometimes longer. During this period industry operates the facilities constructed in the development phase and adds new ones to improve and maintain the volume of production. Throughout development and production, the government and the oil

companies work together to establish and apply safety rules. The U.S. Geological Survey continuously revises standards for blowout prevention equipment and for training of platform personnel. Federal and state agencies and industry are coordinating prevention and clean-up of oil spills. The oil companies and agencies are also developing methods to reduce hazardous accidents offshore by improving fire control and extinguishing systems and by installing special life-saving equipment that helps crew members escape from the high platform.

As the production phase draws to a close, the volume of oil flowing from the reservoir declines. An oil company may undertake special operations, termed workover, to increase or restore production: deepening the well hole, pulling out and resetting the liner, fracturing the reservoir rocks so that more oil can flow into the bore hole, or injecting water and gas to increase the reservoir's pressure.

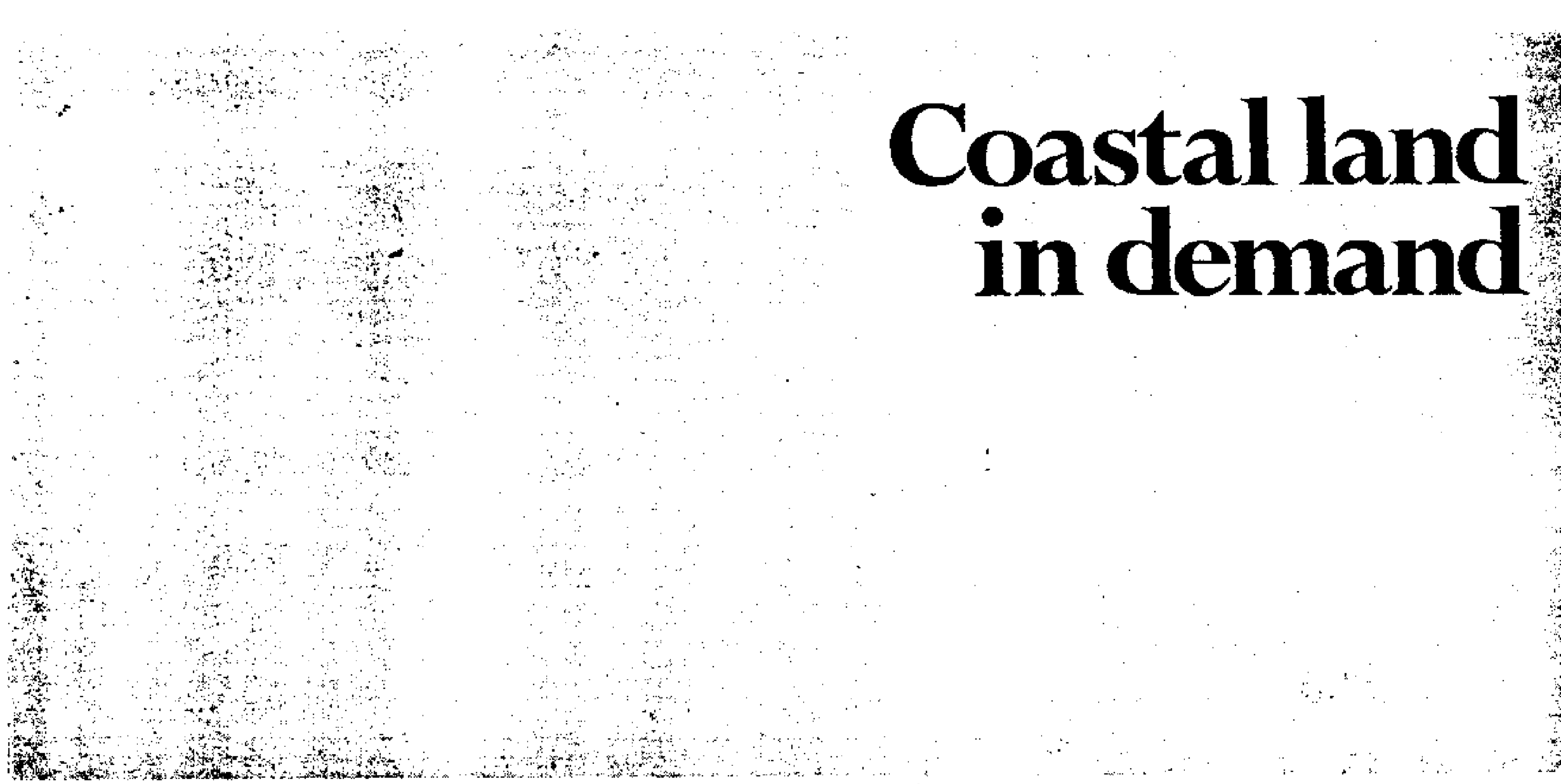
Shutting Down the Oil Field

After 20 to 30 years of production, the oil company will have depleted the offshore field it has leased. When the cost of extracting a barrel of oil from the reservoir exceeds the market price that the oil can command, the oil company will shut down its operations on the oil field.

The shutdown phase lasts from one to three years. At sea, the U.S. Geological Survey sets regulations for field abandonment and monitors the shutdown process. To seal the offshore wells, the platform operator isolates oil, gas, and fresh water zones, installs a cement plug inside the well casing just beneath the seafloor, and cuts off the casing so that it does not protrude above the ocean bottom. Following well closure, the operator clears all debris from the well site, and finally dismantles and removes the offshore platform.

As oil field operations cease, onshore communities will have to adjust to changes as the oil companies and service industries move on. Facilities constructed to support the offshore operations must be closed down or converted to other industrial or commercial opportunities. Many communities will seek the latter option to maintain the economic base and revenues they have built up during the development and production phases.

A vast find of oil or natural gas may prolong the life of the offshore field and onshore economic growth. This is unlikely for Oregon, since our continental shelf probably will not contain reservoirs as large as those found on Louisiana's or Alaska's shelves.



Coastal land in demand

We've described for you what offshore oil and gas are, and how oil companies and the government work together to bring them onshore. We've also discussed in passing some of the kinds of impacts offshore oil development can have on the ocean and on coastal communities.

Let's talk now about these physical, social, and economic impacts—what they are and how they can best be managed. We'll start with the physical impacts of outer continental shelf oil development.

Land: What Happens Onshore

The amount of ocean space that an oil rig occupies is very small compared to the coastal land required for industrial development to support offshore oil extraction. A coastal community located near an outer continental shelf oil field may find oil companies, offshore engineering firms, and service industries seeking land for several different kinds of support facilities.

What are these onshore facilities, and what are their requirements? We'll follow the comprehensive list the New England River Basins Commission has drafted in helping New England to prepare for offshore oil.

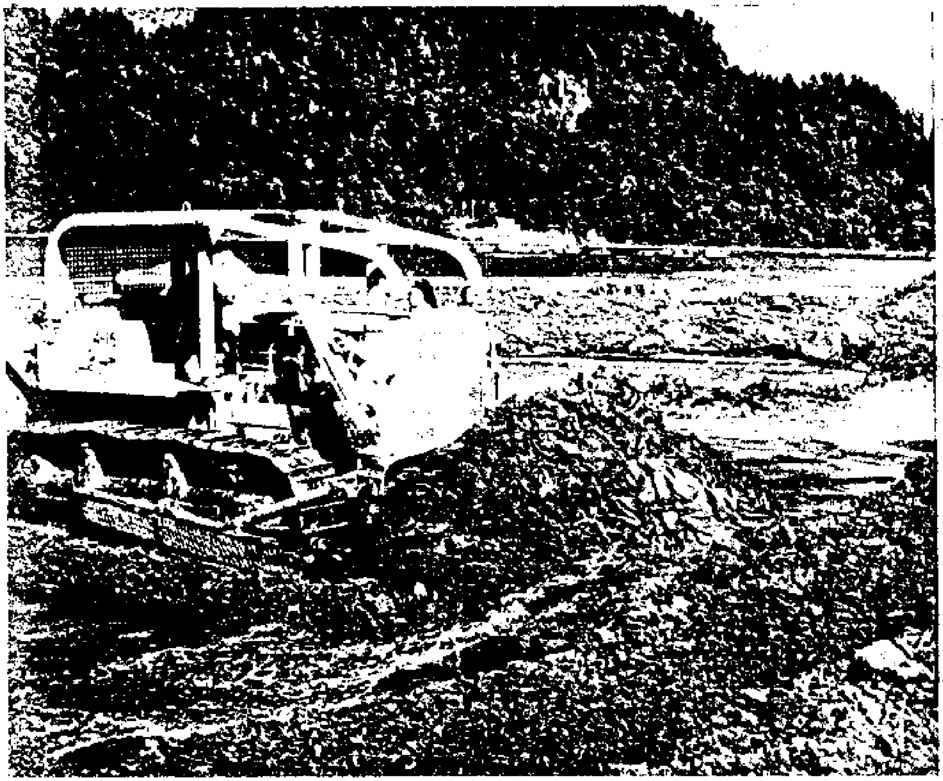
During geophysical surveying and exploratory or development drilling, the oil company or contractor sets up:

- TEMPORARY SERVICE BASES, staging areas from which equipment, supplies, and personnel can be ferried by supply boats and helicopters to offshore rigs; these bases are usually small, and occupy leased land.

  Land: 5 to 10 acres on an all-weather harbor for warehouses, open storage, operations and office space, helicopter landing sites, and parking.

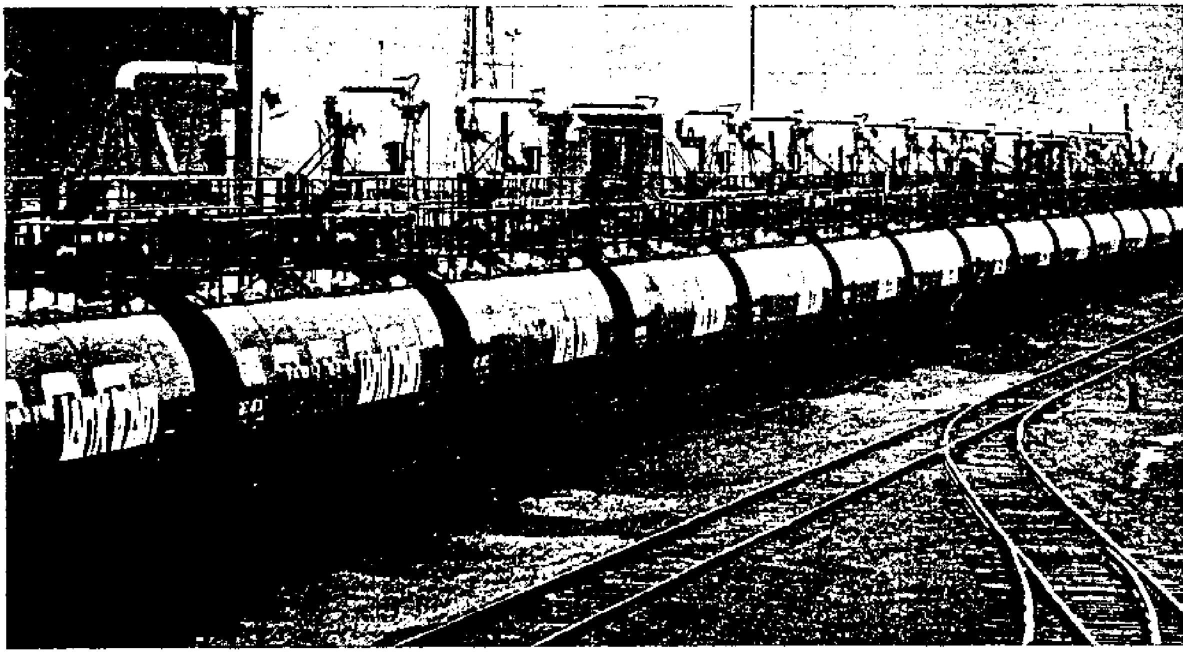
  Waterfront: 200 feet of wharf per rig, with 15 to 20 feet of water depth at the pier.

  Water: 14,000 gallons per rig per day for supply boats.



As the development and production phases get underway with finds of offshore oil, the pace of onshore development quickens:

- PERMANENT SERVICE BASES, which expand temporary bases' activities.
  Land: 25 to 50 acres on an all-weather harbor.
  Waterfront: 200 feet of wharf per offshore platform.
  Water: 23,000 gallons per platform per day during development drilling; little during production.
- REPAIR AND MAINTENANCE YARDS, set up by firms that contract to provide repair and maintenance services for offshore vessels and equipment; often local firms can respond to the need for such services.
  Land: location accessible to road, rail, or air transportation.
  Waterfront: drydock or haul out sites and equipment.
- GENERAL SHORE SUPPORT, associated industries that provide miscellaneous services, and district offices of the oil companies and contractors.
- STEEL PLATFORM FABRICATION YARDS, whose location and size depend on the size and number of platforms constructed annually and on the nature of the offshore find. The yard does not have to be laid out on a coastal site nearest the offshore tracts, since one yard can build platforms for several adjacent leased areas and the platforms can be towed into place. A yard may also be established to join together platform components manufactured elsewhere.
  Land: 200 to 1000 acres on a navigable waterway.
  Waterfront: 15- to 30-foot water depth at the pier, and between 210 and 350 feet of channel and bridge clearance for access to the sea.
  Water: 100,000 gallons per day for nine platforms, if the yard does not heat process (roll) its own steel; 1.24 million gallons per day for two to four platforms with steel rolling.
- CONCRETE PLATFORM FABRICATION YARDS, which contain drydocks, dock space for delivery of raw materials, a concrete mixing plant, warehouses and office buildings, cement storage silos, and buildings for constructing platform decks.
  Land: 50 acres or more per platform.
  Waterfront: 35- to 50-foot depth of water at pier, with 150 to 300 feet



of depth adjacent; 400 feet of vertical clearance (through bridges) for access to the sea.

Water: 40,000 gallons per day at a one-platform yard, 165,000 gallons per day at peak activity.

- STEEL PLATFORM INSTALLATION SERVICE BASES, which provide warehousing, wharfage, and repair and maintenance support needed while an offshore platform is being erected on its site at sea.
  Land: 5 acres of waterfront land.
  Waterfront: 200 feet of wharf space per four platforms installed, with 15 to 20 feet of water depth at pier.

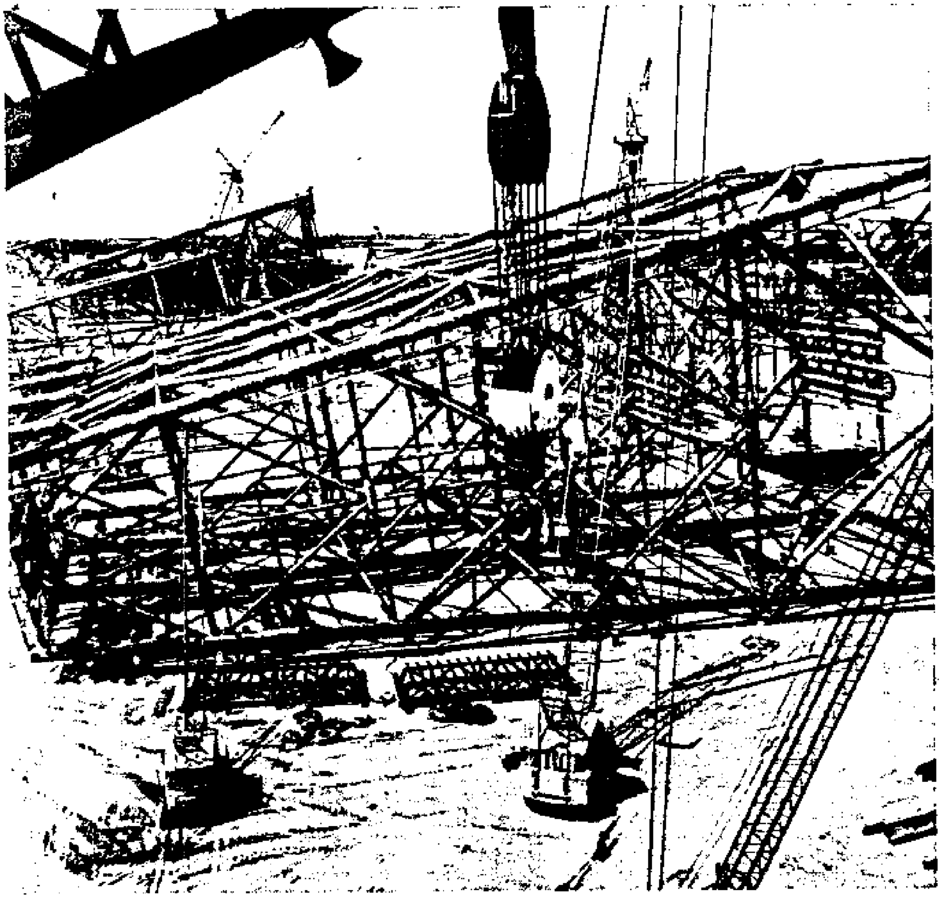
- PIPELINES AND LANDFALLS, for bringing the oil ashore. Pipelines are preferred if large amounts of oil and gas are found reasonably close to shore and if the seabed contours permit. The landfall is usually at the point on shore closest to the offshore rigs, but may be located to take advantage of a smooth seafloor, a nearby natural gas transmission line, or a local marine terminal and tank farm for oil storage and transshipment. Landfalls require a 50- to 100-foot right-of-way, and, if needed, 40 acres for a pumping station or 60 acres for a terminal.

- PIPELINE INSTALLATION SERVICE BASES, which provide space and services for the lay and burying barges, the cargo barges that hold pipes and equipment, and tugboats. These bases are placed as close as possible to the pipeline installation area, and are usually operated only as long as pipelaying is in progress.
  Land: about 5 acres
  Waterfront: 200 feet of wharf per base, with 15 to 20 feet of water depth at the pier; a channel wide enough to maneuver barges.

- PIPE COATING YARDS, which prepare pipelines for installation by coating the pipe with concrete and asphalt sealers that protect it and weight it so that it will sink.
  Land: 100 to 150 acres on waterfront, though inland locations are also possible.
  Waterfront: 750 feet of wharf space, with 20 to 30 feet of water depth at the pier.
  Water: 3,000 to 15,000 gallons per day.

With the production phase fully underway, oil companies may need to construct additional onshore facilities. Their decision to build will depend on the location and size of the offshore find, how the oil and gas will be transported, and the ultimate destination of the fuels. Such facilities may be:

- PARTIAL PROCESSING FACILITIES, located either onshore or offshore. If onshore, the plant will



Oil platform fabrication yard (McDermott)

require 15 acres per 100,000 barrels of petroleum mixture processed, and 10,000 gallons of water per month.

- GAS PROCESSING AND TREATMENT PLANTS, which will very likely be constructed if commercial quantities of natural gas are found.

  Land: 50 to 75 acres.

  Water: 200,000 gallons per day.

- MARINE TERMINALS, essential to waterborne transport of crude oil or petroleum products. Three types are possible: for transshipment of crude oil, for receipt of crude oil for a nearby refinery, and for delivery of refined products. Terminals involve a berthing system for vessels, loading and unloading equipment, storage tanks, terminal control and safety equipment, and navigational facilities.

  Land: 30 waterfront acres, mainly for storage tanks.

  Waterfront: 50- to 60-foot depth of sheltered water at pier or mooring buoy.

- REFINERIES, which will include processing units, storage tanks, water treatment facilities, offices, a machine shop, warehouses, an electrical substation, firehouse, pumping station, truck loading areas, pipelines, a railroad siding, parking areas, and a buffer zone. A 250,000 barrel per day refinery will need:

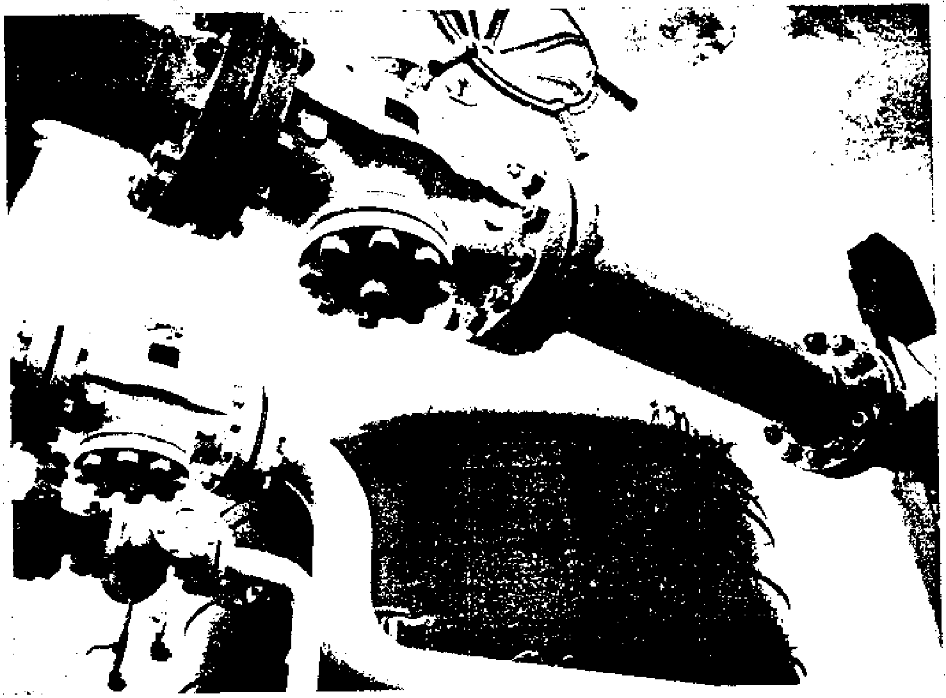
  Land: 1,000 to 1,500 acres of clear, flat land zoned for industry.

  Water: 10.5 million gallons per day will be withdrawn from local supplies.

Other energy-related development might also occur. Petrochemical plants would be built only if very large amounts of the natural gas that these plants convert into plastics and other compounds were found. If liquefying and tankering natural gas becomes more economically feasible than it is now, liquefied natural gas storage tanks such as the one that now stands on Yaquina Bay might be constructed.

Impacts for Oregon's Land

The amount of land required by each type of facility for offshore oil development is known. But Oregon's coastal communities may not know what facilities will be constructed within their



Liquefied Natural Gas storage facility at Newport, Oregon (Northwest Natural Gas Co.)

boundaries until the size and nature of a possible oil or gas find off the state's coast are measured.

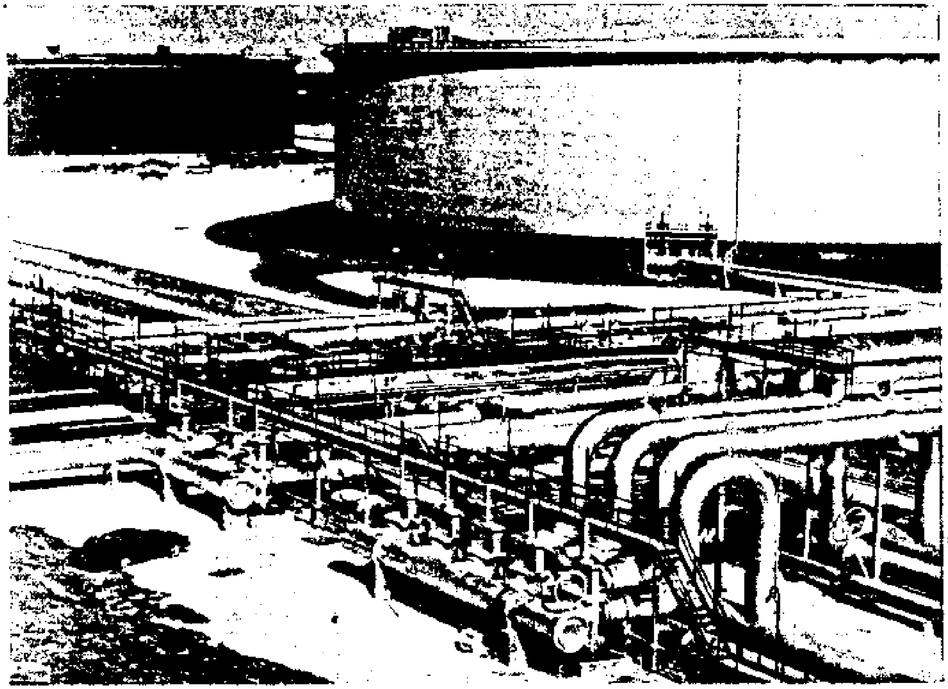
If oil and gas are found, the oil companies and contractors will acquire through lease or purchase the land they need for service bases in coastal towns having the necessary waterfront area and water depth. Such bases, along with additional support yards and processing plants, will most likely be sited in larger communities that have industrial land and waterfront space available.

In Oregon, Coos Bay, Newport, and Astoria offer the most probable locations for development related to offshore oil. These towns supported temporary service bases for the offshore exploration that took place in the mid-1960s. Newport already is the site of a liquefied natural gas storage tank, built to receive the output of Alaskan and foreign fields. The platform fabrication yard that Brown and Root, Inc. proposes to locate near Astoria would be established on acres leased to the firm by the Port of Astoria. Further up the Columbia River, at Port Westward, Oregon, the GATX Corporation of Chicago may upgrade the marine terminal, at which Alaskan—or Oregon's—oil would be transshipped onto tank cars and hauled to the Glacier Pipeline terminus at Cut Bank, Montana.

Onshore energy development is coming to Oregon; offshore finds will bring more. Most of the onshore facilities described earlier depend on waterfront land, both acreage and harbor space. This shoreside land becomes unavailable for other uses, and the pressure for coastal land development increases. Local industries may have difficulty finding sites for their own expansion, and may be at an economic disadvantage in competing for prime locations. Such development may also require dredging and filling of waterways, which could alter productive wetlands and estuaries.

Onshore facilities need more than land. The water and power consumed and sewage and solid waste generated will strain existing supplies and systems. Local roads will bear an increase in truck and car traffic.

New jobs in construction of onshore facilities and associated industry will create an inevitable influx of population to a community. The increase in population will create additional demands on the community's land and other resources. Private business will seek land for new homes, stores, or restaurants. Local governments will need to add water and sewer lines and roads to meet the needs of new development. Buildings housing other community services, such as police and fire protection, hospitals and schools, may need to be expanded or upgraded. Such growth may mean that a community obtains services and facilities that it could not otherwise afford, and this may offset possible undesirable effects of oil-related development.



Oil storage facility (*McDermott*)

Managing Land Use: Techniques and Timing

How severely onshore impacts of offshore oil affect land use patterns in local communities depends on several factors. A fast-growing population boosts the demand for and price of land and other services, creating a boomtown climate. A large community with residential, business, and industrial areas well defined can adjust to rapid growth more easily than a small town. Urban centers nearby can absorb some of the new development, taking pressure off smaller communities. A large outer continental shelf oil and gas find will more likely lead to permanent and extensive facilities than a small discovery.

Finally, state and local governments have available the techniques of land use planning and zoning to ensure that growth and industrial development spurred by offshore oil have as few adverse impacts on the community as possible. Land use planning involves defining the types of uses suited to various parcels of land, while zoning is the community's acceptance of these definitions as law.

In Oregon, the Land Conservation and Development Commission has set up statewide planning goals and guidelines. These principles for land use in the state help local town and county planners to work out specific details of a community's pattern of land development—what areas should be reserved for housing, light industry, open space, or other kinds of uses.

Oregon communities meet the state's planning goals through local comprehensive plans that weave together goals for future growth, land use, and economic and social characteristics the towns seek. All of Oregon's major coastal communities also have economic models that can forecast the probable impact of different rates of growth. Local port authorities can also ease the impacts of growth through the terms of leases for their waterfront land.

Local planners, citizens, and officials will have an extra advantage if they have advance knowledge of the possibility of outer continental shelf oil production and what its effects can be. We in Oregon are fortunate that we have both time in which to plan and the techniques with which to plan the wise use of our land and resources.

Oregon's environment

Many people feel that the environmental effects of offshore oil and its onshore facilities represent a more serious impact than the ocean space, coastal land, and community resources this development consumes. Among scientists, agency and industry staff, and citizens, much controversy exists about the exact extent of these effects. Most agree, however, that proper regulations, and cooperation between industry and agencies, can prevent or minimize environmental damage that extracting oil offshore might cause.

Rigs and Yards: How Much Impact

Oil rigs on the outer continental shelf or in coastal waters do little to disrupt the vast stretches of ocean around them. A production platform will discharge into the ocean sediment and rock cuttings brought to the surface during drilling. The minor fraction of drilling mud that is not recycled for reuse and briny water separated during processing from the reservoir's petroleum mixture is also disposed of at sea.

However, ocean currents rapidly disperse the mud's components and the lighter sediments so that they have little lasting effect on marine life. The heavier rock cuttings, settling to the seafloor around the rig, may disturb or displace bottom-dwelling organisms. Off California, these areas of deposited sand and sediment have in some cases attracted new colonies of seafloor organisms, causing environmental change.

Industry often points to one positive change oil rigs can bring to the ocean environment. The platforms can function as artificial reefs: smaller forms of marine life attach themselves to the rig's underwater legs and attract a number of kinds of fishes. In the Gulf of Mexico, sportfishermen on charter boats from Texas and Louisiana harbors often find a good day's fishing near offshore platforms.

Environmental impacts that onshore facilities cause resemble those that result from any sort of similar industrial development. Substances released into the air include carbon monoxide, sulfur and nitrogen oxides, and hydrocarbons from operating vehicles and equipment; sand and metal dust from fabrication; and particles from pipe yards and processing plants. Potential water pollutants consist of different kinds of chemicals, hydrocarbons, and metals. Pollution control devices, as prescribed by federal and state water and air quality regulations, can curb some of these discharges.

In addition, how a company locates a facility affects the environment: the site may require alteration of contours, improved access to water, new roads, or adjacent development. These changes can disturb or destroy existing open space, wildlife habitat, or wetlands. Proper zoning of the community's land resources and an adequate environmental impact statement can help citizens and industry locate the new facilities in areas that can best accommodate the environmental changes.

Oil Upon the Oceans

These days, the word "oil" more often conjures up the image of a catastrophic spill at sea than of a useful and essential fuel. Oil spills have become a symbol of pollution at its worst, but also represent a risk that may be unavoidable if we are to obtain the energy we need.

Offshore production platforms release very small amounts of petroleum into seawater during normal operations. Water discharged from the rig's separator contains traces of oil, which add to the ocean environment about 6 barrels of petroleum per million barrels produced. Minor accidental spills contribute about 1,500 barrels of oil per year.

Fires and blowouts on offshore platforms do happen, but the industry has a fairly good record of safety. Between 1953 and 1975, 6,104 producing wells were completed on the outer continental shelf; 62, or 1 percent,

The offshore platform as an artificial reef (McDermott)

suffered some major accident. The Santa Barbara blowout in 1969 resulted from a combination of unstable seafloor geology, misjudgements in drilling operations, and regulations that were not stringent enough.

Three major blowouts since the Santa Barbara spill have been the consequence of human error and poorly designed control valves. Spurred by these disasters, the U.S. Geological Survey and the offshore industry have developed stricter operating regulations, and have continuously improved technical standards for the effectiveness and safety of platform design and blowout prevention systems.

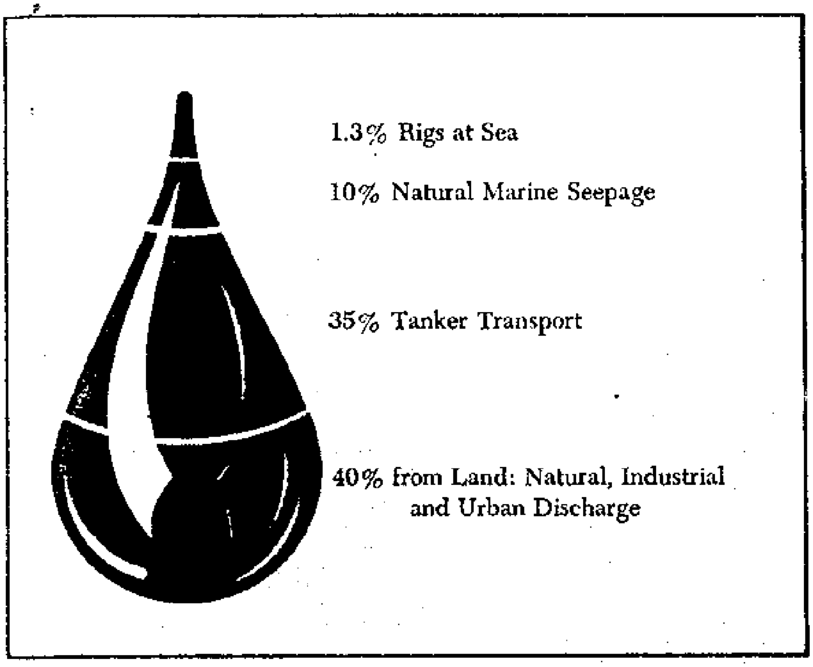
Offshore production's contribution to oil pollution in the ocean is far less than that of other sources. Rigs at sea are responsible for only 1.3 percent of all marine oil pollution. By contrast, natural seeps cause 10 percent of this pollution, and tanker transportation of oil 35 percent. Industrial discharge, city wastes, and urban and river runoff contribute almost 40 percent of oil pollution at sea. Such regular, small-scale (chronic) discharges may pose far greater hazards for marine organisms than large spills.

Because transporting oil by tanker causes more than one-third of the world's marine oil pollution, many believe that obtaining the oil the United States needs from the nation's continental shelves is preferable to importing foreign oil in tankers. Solely on the basis of environmental risk, this conclusion seems warranted by the statistics cited above. The statistics also indicate that, where possible geographically and economically, bringing offshore oil onshore via pipelines is a safer transport method than tankers.

Spills at Sea: How Serious?

When a spill does occur, its effect on ocean resources depends partly on the nature of the oil and partly on the location of the spill. Refined petroleum products contain varying amounts of the hydrocarbon components of crude oil, and thus can harm marine life in varying degree. No. 6 oil, a heavy industrial fuel, is among the least toxic of refined compounds, but No. 2 home heating oil, a lighter fuel, is considerably more poisonous.

Spilled on the open ocean, oil immediately begins to disperse and weather. Winds and currents spread the spill into a slick, with the heavier components cohering in large lumps. Some of the oil evaporates into the atmosphere, and waves disperse part of the spill as molecules on the surface and



Sources of marine oil pollution

deeper in the water. Over time, the heavier patches solidify into globules of tar that float far at sea or wash up on beaches. Whether as slick or tar ball, the oil gradually decomposes through chemical or biological action.

Spills closer to shore can have more serious consequences, and are of course more visible to those concerned about their effects. A nearshore spill may not actually reach the coast: prevailing winds and currents can carry the slick out to sea. Thus, when the tanker *Argo Merchant* grounded on Nantucket's offshore shoals, strong northwest winds pushed the 7 million gallons of bunker C fuel away from the beaches and salt marshes that line the island and nearby Cape Cod. However, prevailing westerly winds on Oregon's ocean could drive an offshore spill onto our coast.

If the spill has taken several days or longer to reach shore, weathering and evaporation will have decomposed and dispersed the more toxic fractions of the oil and thickened the heavier lumps, so that the oil presents less of a danger to coastline life. The most critical spills are those that reach shore within a day or two. On a rocky coast, surf can emulsify the oil and gradually scatter it; seabirds and tidepool organisms may be affected. But if the spill washes onto beaches or coastal salt marshes, or occurs in an estuary or bay, the oil can become incorporated into the sand and sediments. Buried, the oil's toxic components can persist for years.

Though the exact nature of a spill's effect on coastal and marine life is still uncertain, the oil appears to harm organisms in at least three ways. Floating on the water's surface, the oil can smother plankton—minute marine plants and animals—and fish eggs or larvae, and coat seabirds, leaving them without the insulation and water resistance their feathers usually provide. Taken up by animals in the tidal zones, salt marshes, and estuaries, oil molecules may increase the death rate among these organisms by causing biochemical changes in their tissues. Finally, the oil may also create behavioral changes, inhibiting normal feeding and reproduction.

Some organisms resist the toxic effects of oil better than others. Thus a spill may alter the characteristics of a coastal ecosystem by suppressing the less resistant species so that hardier organisms replace them.

A Pound of Prevention . . . and of Cure

As long as oil is a primary source of energy for our nation, oil spills will be with us. But their occurrence, and their consequences when they do happen, can be held to a minimum through improved technology, prudent regulations, and above all cooperation between industry and state and federal agencies. The Federal Water Pollution Control Act Amendments of 1972 have made it national policy that no oil or hazardous substances can legally be discharged into

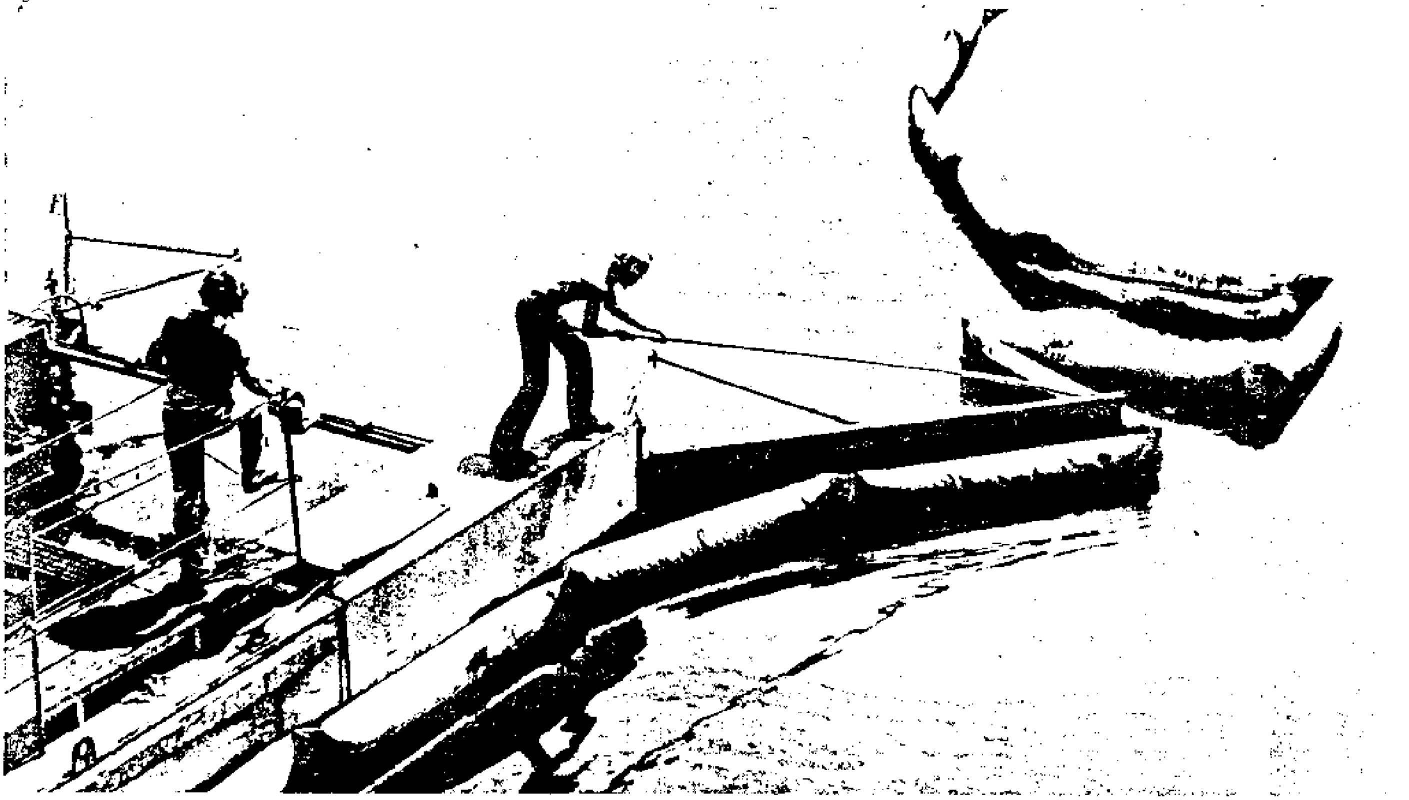
Oil Spill from the Toyota Maru on Oregon's shore, 1978 (Bill Kettler, Oregon Environmental Council)

the United States navigable waters or on its adjoining shorelines.

On the offshore platform, prevention of spills receives the greatest attention. Continuous redesign and improvement of complex check valves and blowout preventers, and Geological Survey operating orders that specify adequate equipment and proper operating procedures, lessen the chance of catastrophic or chronic spills. The Geological Survey has recently moved to reduce the chance of blowouts by requiring that all drilling crews be certified in the causes, danger signs, and prevention of blowouts by December 1, 1979.

Preventing spills from tankers has been a more complicated problem. Under the Ports and Waterways Safety Act of 1972, the U.S. Coast Guard has the authority to set construction standards for vessels bringing oil into domestic ports and to establish regulations for these tankers' operations. Rules that prescribe methods of cleaning out holds after the oil has been unloaded and of separating seawater ballast tanks from oil storage areas will help to reduce the extensive amount of oil that tanker operations put into the sea.

Adequate vessel design standards include double hulls, so that grounded vessels do not spring leaks as easily, twin propulsion screws to provide a fallback steering mechanism should the rudder fail, and other improvements, especially



Cleaning up the Toyota Maru spill (Kettler, OEC)

for the enormous supertankers that now ply the world's oil trade routes. Implementing these design standards, and enforcing operating rules, has proved somewhat difficult. The shipping industry has resisted changes in vessel construction, which add to the expense of building or maintaining tankers. Tanker crews may still wash out the oil holds at sea, beyond the effective reach of regulations.

When a spill occurs, agencies and industry have an arsenal of techniques at hand to combat it. Booms and floats control the spill by surrounding it. Straw and foam may be used as absorbents to clean up the oil. Special vessels can skim oil from the water's surface. All these methods vary in effectiveness, and rough waves or an isolated location may render them useless. However, research underway in industry and at universities may help to upgrade spill clean-up equipment and techniques.

Government has a role in responding to oil spills. Both the Water Pollution Control Act Amendments of 1972 and the Trans-Alaska Pipeline Authorization Act establish liability plans for compensation to those whose property or livelihood is affected by an oil spill. Part of the 1978 amendments to the Outer Continental Shelf Lands Act provide for an offshore oil spill pollution fund to cover clean-up costs and damages to natural resources, property, or income.

In Oregon, as prescribed by federal law, the U.S. Coast Guard has jurisdiction over spills in coastal waters, along the Columbia River to Bonneville Dam, and on the Willamette River to the Oregon City falls. The state's Department of Environmental Quality functions for the Environmental Protection Agency in oil spill regulation on inland waters, and has joint jurisdiction with the Coast Guard over Oregon's coastal waters.

The Coast Guard, the Environmental Protection Agency, and the Department of Environmental Quality have each developed Oil Spill Contingency Plans that specify response procedures, from the requirement that a spill be reported to the file of private contractors who can be tapped for clean-up operations. The Department of Environmental Quality's role complements and coordinates these plans, and prescribes procedures for recovery and disposal of oil spilled on Oregon waters.

Oregon's fishermen

Oregon is nicknamed the "Beaver State." But Oregon might also be called the "Salmon State," considering the historic role these fish have played in the state's economy. Despite reduced salmon runs in recent years, fishing for crab, rockfish, clams, flatfish, shrimp, and other species in addition to salmon still constitutes Oregon's third largest resource-based industry. Sportfishermen setting lines and pots from jetties, charter boats, and private vessels also pump dollars into Oregon's economy.

Fish are a renewable resource. With proper management under Oregon's Department of Fish and Wildlife and through the Pacific and North Pacific Fishery Management Councils that oversee resources in the 200-mile fishery conservation and management zone off our shores, the stocks of finfish and shellfish in Oregon's waters will continue year after year to bring economic return to fishermen, coastal communities, and the state.

We have seen that offshore oil development requires ocean space, coastal land, harbors, and local services and labor. We have described offshore oil's potential effect upon the marine and coastal environment. In each of these areas, offshore oil may compete directly with the fishing industry. Yet oil, unlike fish, is a nonrenewable resource: in time, the offshore reservoirs run dry. Because of this, local, state, and federal managers will attempt to achieve a balance that allows oil development while preserving the fishing industry.

Fishing: A Kingpin in Oregon's Economy

The productive Pacific Ocean off Oregon's coast holds for harvest more than 50 species of commercially valuable fish and shellfish. Oregon's 22 estuaries provide a breeding ground for a number of these species, a lifelong habitat for others. Maintaining the quality of these offshore and coastal environments is essential to maintaining the abundance of fish and shellfish stocks.

Economists calculate the fishing industry's value to Oregon in two ways: through direct figures, or the prices paid for the landed fish, and through indirect figures, the revenue generated by local commerce associated with the fishing industry. In 1976, fish and shellfish landings in Oregon's ports brought a total of $40 million to commercial fishermen. The indirect, "multiplier" figure this produces is $108 million. Oregon issued 2604 licenses to professional and part-time commercial fishermen in 1976, and a number of people earned a living by providing services to commercial and sport fishermen. Fifty-seven hundred people work in Oregon's fish processing businesses which exported $100 million worth of seafood products in 1976.

Rigs and Trawlers

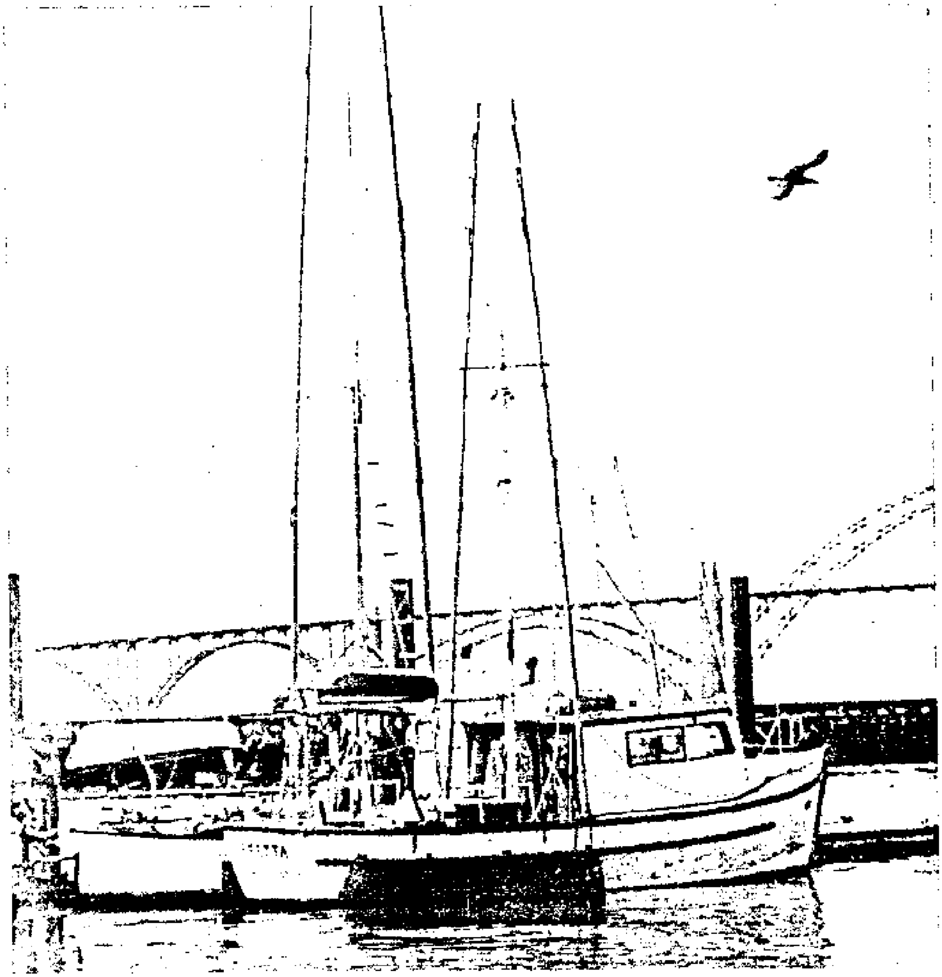
Offshore platforms could put the oil industry in competition with fishermen for ocean space. How much space in a leased tract is excluded from fishing activity will depend on the safety zone established around each platform. This zone may be up to a mile in diameter, and of course the total number of platforms will depend on the size of the petroleum field.

Fishermen can have a voice in deciding where the oil companies place platforms. Working as individuals, through industry associations, or with the Oregon Department of Fish and Wildlife and other state agencies, they can nominate the most productive fishing grounds for exclusion from leasing.

Negotiations during leasing may still result in offshore development in popular fishing areas, if these tracts offer the best chance of a find. To fishermen working these areas, platforms present both hazards and benefits. Severe weather conditions at sea create the chance that a fishing vessel might collide with a rig's support structure. However, platforms can also transmit information on weather and sea conditions, and can respond with emergency assistance for fishing boats in trouble or for injured crew members. To reduce the risk of collision, the U.S. Coast Guard can define traffic patterns to separate rigs and commercial vessels at sea.

Platform debris, exposed pipelines and wellheads, and heaps of drill cuttings left on the seabed can snap or rip towed nets and lines. Scottish fishermen have complained of this side effect of North Sea oil development. At the same time, oil companies don't want their pipelines or subsea completion systems damaged by fishing gear, and fishermen themselves often jettison scraps of net or broken equipment.

Fishermen also express concern that offshore oil production may introduce oil or chemical pollution into their fishing grounds. Until an oil spill has weathered and dispersed, or is cleaned up, the fishing area in which it occurred could be closed, perhaps disrupting the fishing

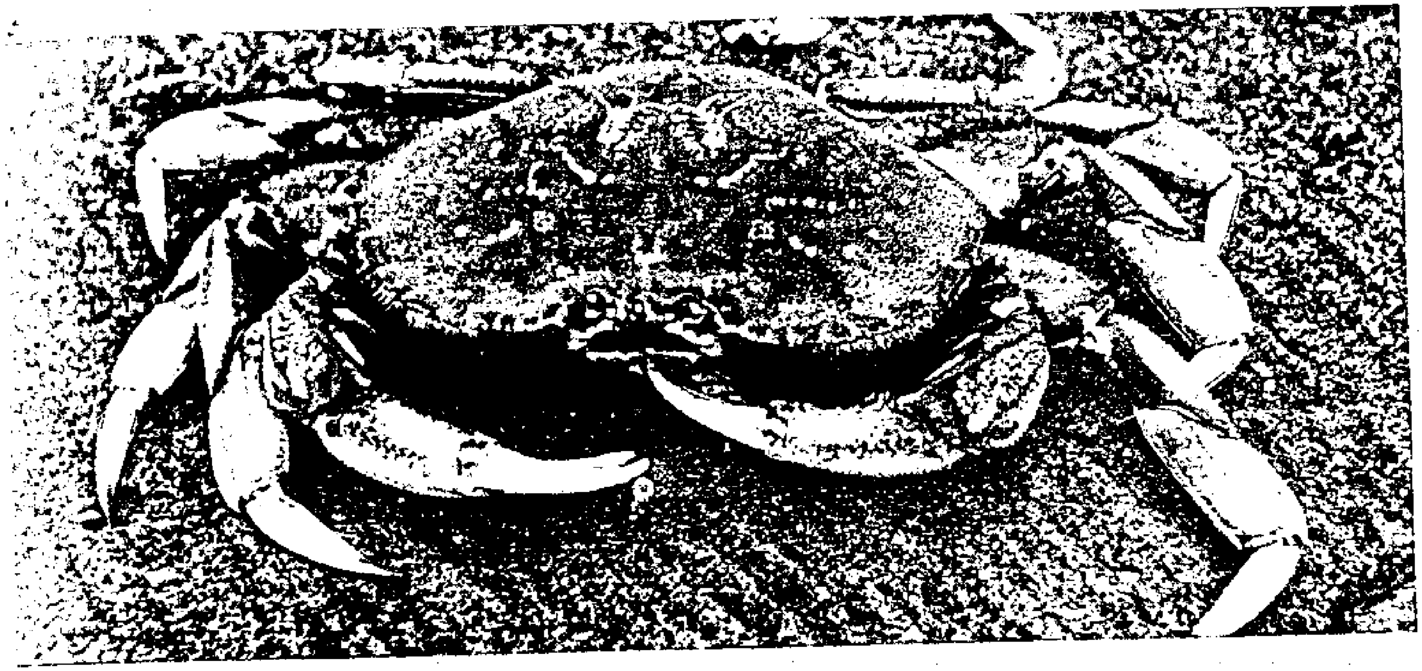


season. Later, residues of the spill could foul fishing gear and the catch. Marine pollution from offshore platforms might also affect the stocks of fish and shellfish.

Cooperation and regulation are the keys to preventing these potential conflicts. Enforcement of good operating practices on the rigs can hold to a minimum the problems of debris and pollution. The oil companies and fishing industry can work together to set guidelines for activities in the leased tracts. In addition, an amendment to the Outer Continental Shelf Lands Act establishes a fund to compensate fishermen for gear or vessels damaged or profits lost because of offshore oil and gas activities.

Oil and Fish: Onshore Coexistence

In harbors and coastal towns, as on the open ocean, oil companies and fishermen will have to work out patterns of coexistence. Many of Oregon's harbors are quite small, and even in the larger port towns wharf space is at a premium. The crew boats, work boats, and supply vessels will need part of the available



wharf area if offshore production begins, and may compete with fishing boats for docking space.

The larger ports, such as Coos Bay, Astoria, and Newport, might be better able to provide wharfage for both kinds of vessels than smaller harbors. Too, offshore oil may provide incentives, and capital, for port authorities to upgrade and expand the facilities they now have, so that both the oil industry and fishermen benefit.

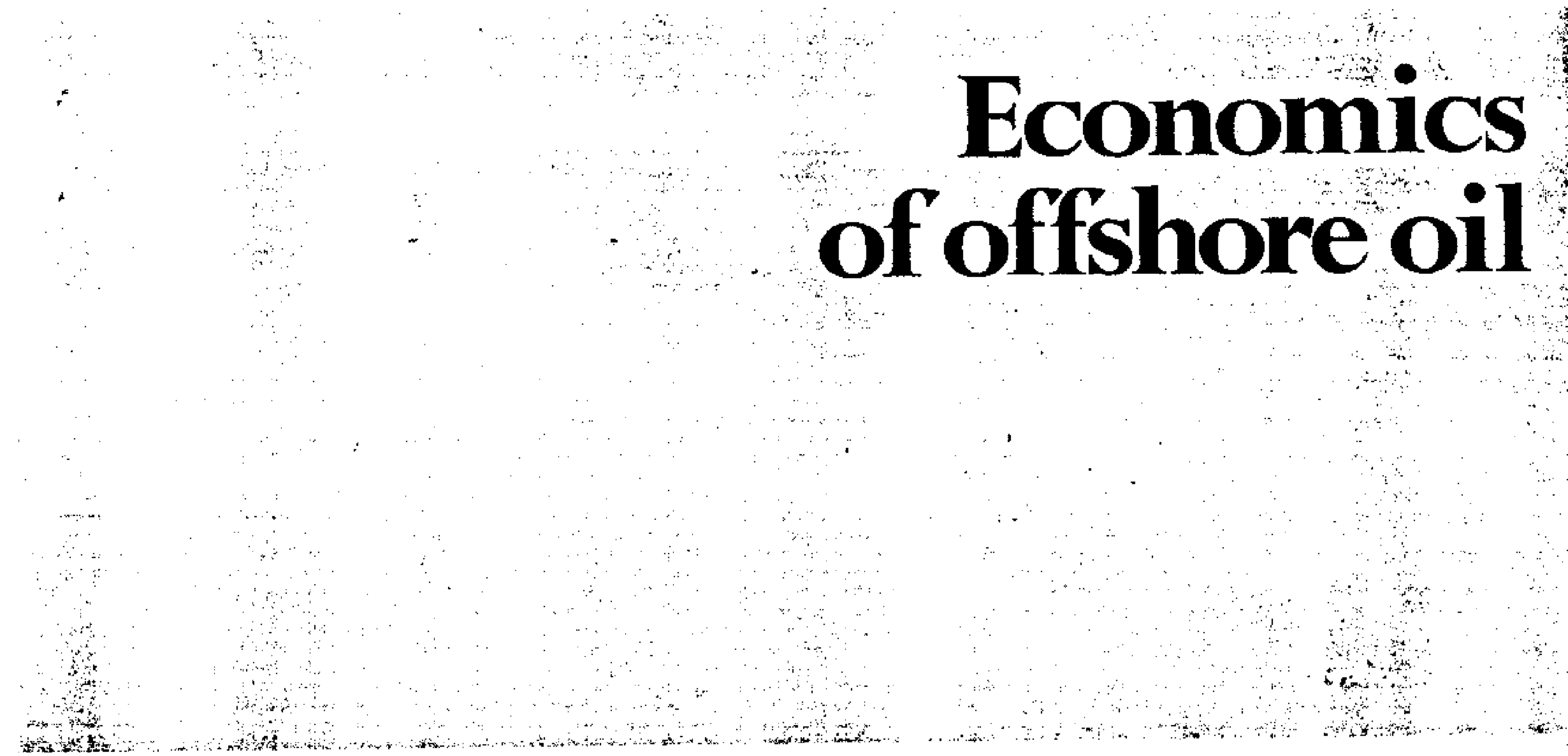
Vessel service and repair yards in Oregon's port communities derive much of their business from fishing boats. Demand for these yards' services fluctuates over the course of a year, depending on the season and the amount of fishing activity. Rig supply and crew boats will also use the repair yards; their demand for services may also be seasonal, and can coincide with fishermen's time of peak need.

The contractors and oil companies who own these boats may have an economic advantage over local fishermen: their financial base enables them to pay more for the work they need and to pay cash rather than charging on credit. As well, service yards in smaller ports often have limited space for expansion to meet increased demand. On the East Coast, some have suggested that, to diminish the problems of competition for repair yards, oil rig supply boats can be referred to underused facilities in the larger port cities. On Oregon's coast, the distance between major harbors could make this sort of solution impossible for vessels requiring quick repairs.

The enactment of the 200-mile fishery conservation and management zone means a brighter future for the nation's, and Oregon's, fishermen. As the industry expands to take advantage of new opportunities, jobs on fishing boats and in processing plants will open up. If offshore oil comes to Oregon, local labor will find job opportunities in onshore facilities and to some extent on the platforms themselves. Again, as with vessel repair yards, the oil industry's ability to pay well and the year-round nature of the work it offers will be significant attractions for local residents seeking work. Captains of fishing vessels and fish processors may find it more difficult to recruit crew members, and will most likely have to increase wage scales to match the rates that the oil companies and service contractors set.

In each of these arenas of competition, productive coexistence between the offshore oil and fishing industries depends on their willingness to find avenues of cooperation. Planning sessions that bring together representatives of each industry with local port authorities, small business organizations, and labor experts can create agreements on ways in which oil development and fishing can interact.

Economics of offshore oil

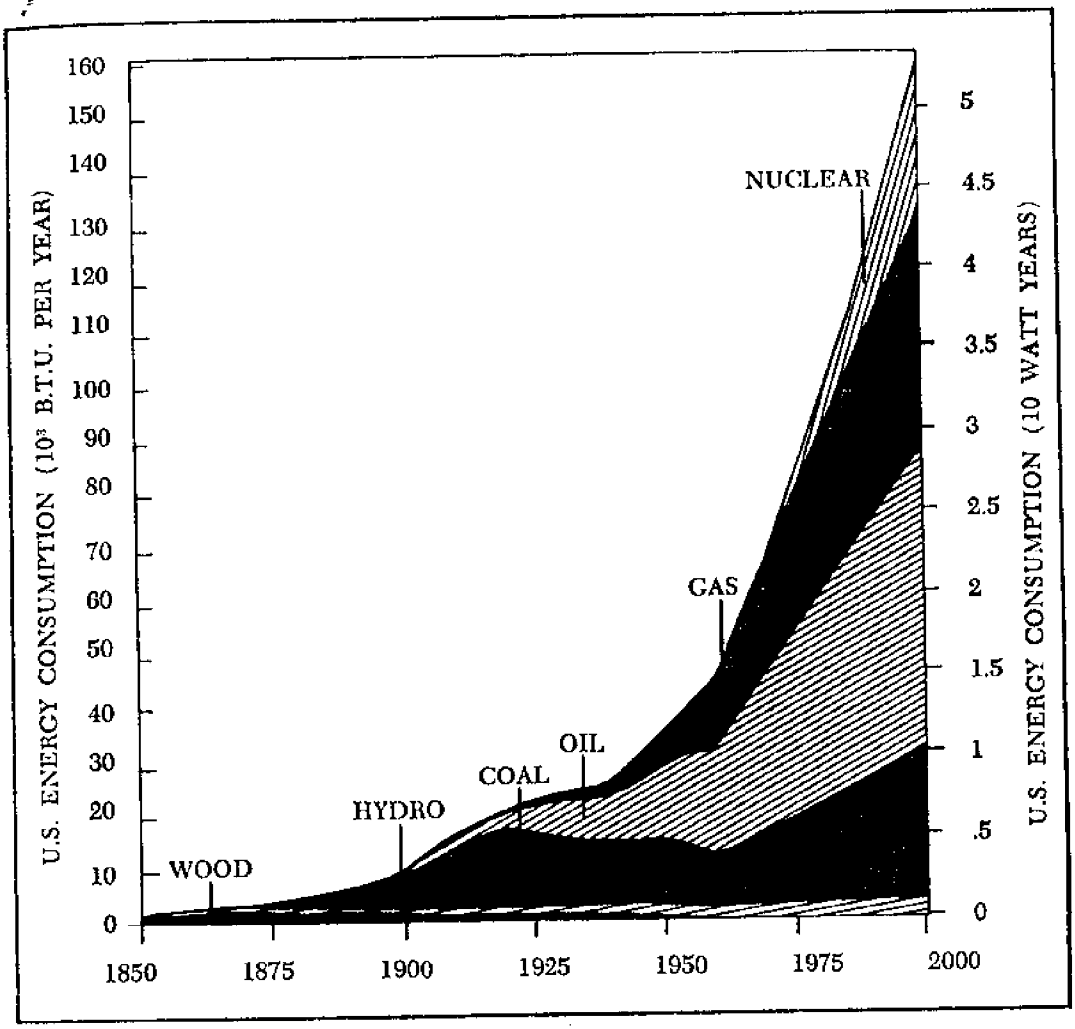


Offshore oil's place in the national energy picture depends upon the economics of the United States' energy supply. Until alternative sources can be developed, oil and natural gas will remain the major source of the energy that our industrial nation needs. Until policies that promote conservation and efficiency are adopted, our consumption rate for all forms of energy will continue to rise, bringing closer the day on which oil and gas, nonrenewable resources, run out.

Plotting varying rates of production and consumption, some economists predict that the world's oil supplies will last only 15 to 30 more years. Our nation's economy is based on the concept of growth, which depends on continued increases in energy supply. Thus the demand for oil has increased at a constant rate and, without constraints on production, will exceed supply in the mid-1990s. As fossil fuel supplies dwindle, prices the consumer must pay for gasoline, home heating oil, natural gas, and petrochemicals will rise sharply, cutting economic growth.

At least in the near future, outer continental shelf development can help to fill the anticipated gap between the supply of oil and natural gas and the demand for these fuels. New sources of offshore oil can also to some extent lessen our dependence on imports that make up an ever larger fraction of our total energy consumption.

As the last domestic moderate-cost oil, continental shelf petroleum competes favorably with imports at current prices, and does not contribute to the drain of U.S. dollars paid to foreign nations for raw materials and services. As the larger, more accessible reservoirs are tapped out, the oil industry will have to seek oil from smaller fields in more difficult locations, and production costs will rise. Since Oregon's offshore environment would require considerable investment in



***Energy consumption in the United States** (adapted from Scientific American, Sept. 1971)*

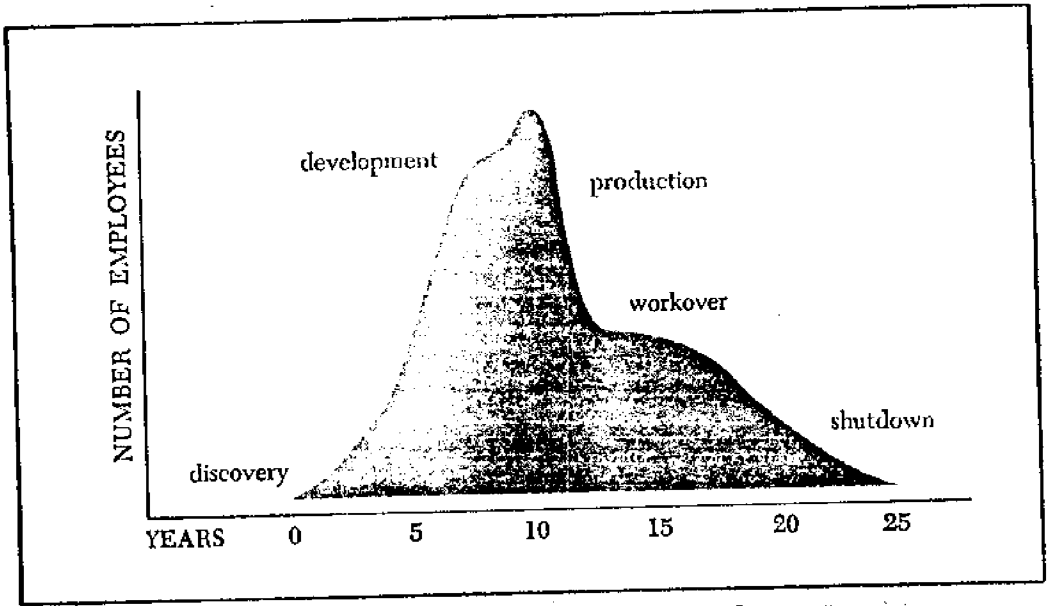
production equipment, and since reservoirs are likely to be small, the oil companies will most probably develop Oregon's shelf only when the cost per barrel of oil rises high enough to justify the expense of production.

Oil for Oregon

Oregon imports 95 percent of the energy the state's homes, industries, and transportation require. While part of our imported energy comes from Columbia River dams, a federally subsidized source, the fossil fuels we consume reach Oregon through natural gas pipelines from British Columbia and by oil tanker, truck, and pipeline from refineries in California and Washington.

Oil found on Oregon's continental shelf would most likely not come straight into the state, but would be shipped by tanker or pipeline to refineries elsewhere. Most of the Northwest's existing refineries are concentrated at Anacortes and Cherry Point in northern Puget Sound. Originally built to process crude oil from Canada, these refineries now handle oil from Alaska's North Slope or from foreign sources.

Not all of Washington's refineries can accept the North Slope crude oil, since it has a high sulfur content. In Oregon, the proposed Columbia River refinery at Rainier would process Alaskan crude. Since refineries are usually designed for a specific grade of crude oil, Oregon's continental shelf oil would have to be of a grade similar to Alaskan crude for the proposed refinery to handle it.



***Patterns of employment in offshore oil** (adapted from "Offshore Oil Development, Implications for Massachusetts Communities")*

Only in this case, and provided that the refinery is actually constructed, would there be a possibility that oil found on Oregon's outer continental shelf would go directly to Oregon consumers, though natural gas could be delivered to the liquefied natural gas storage tank at Newport and distributed to local users, and oil companies operating on Oregon's territorial shelf could furnish to the state part of the oil and gas they find as royalties. Overall, however, finds off our shores are not likely to affect either the state's supply of refined oil products and natural gas or the prices we pay for these fuels.

Revenues and Costs

The federal government receives revenues from petroleum production on outer continental shelf lands. At the time offshore leases are sold, an oil company provides a bonus bid payment to the government for the tracts it obtains. In 1972, bonus bids for leases off Louisiana averaged between $2000 and $3000 per acre. Thereafter, the company pays annually either rent on lands that have not been proven producible, or royalties on lands the Geological Survey determines capable of producing commercial quantities of oil and gas. Rents and royalties are the same dollar amount, fixed as one-sixth of the wellhead value of the oil and gas.

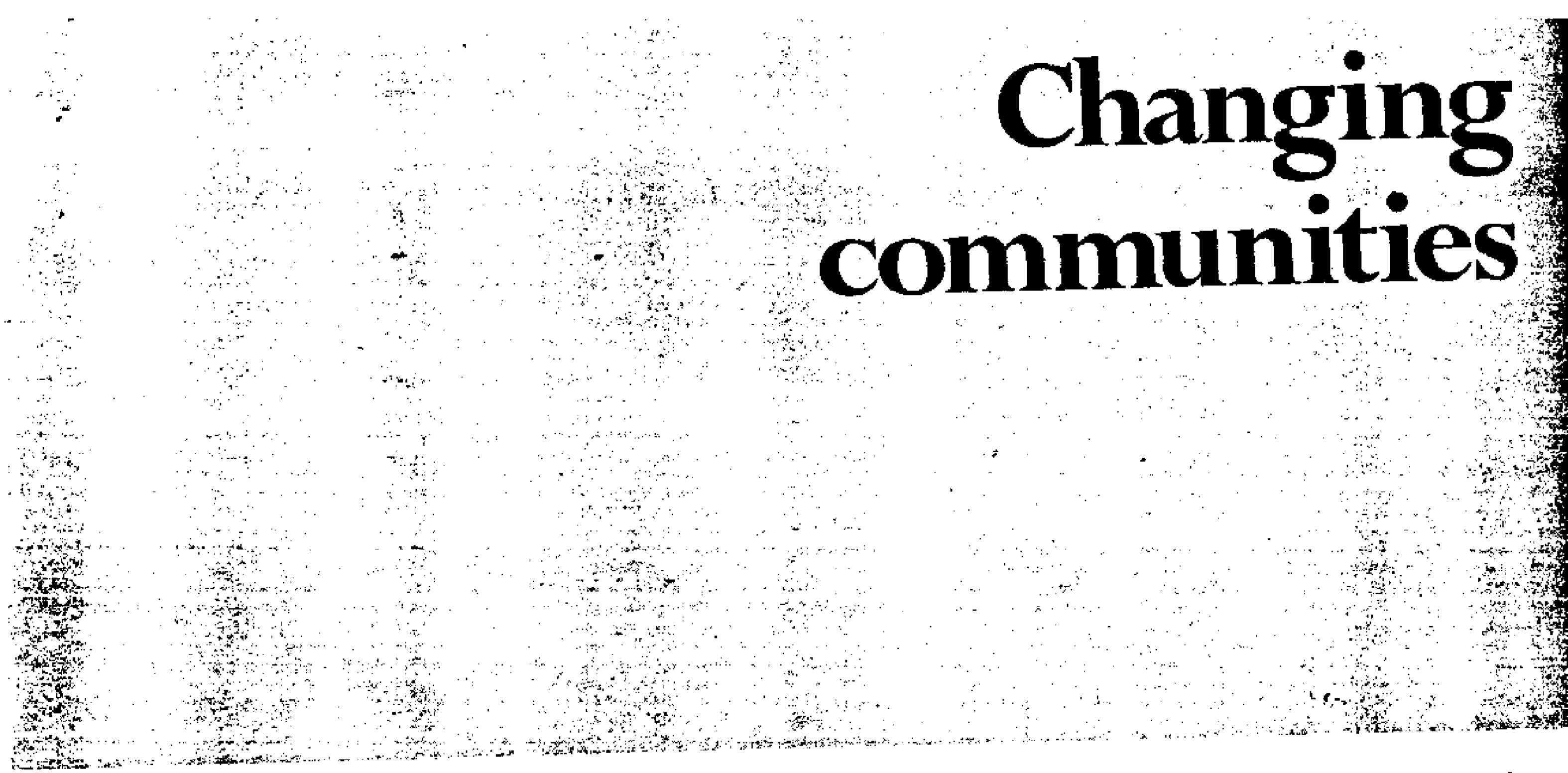
Only if oil production takes place within their three-mile seaward boundary do states receive royalties from offshore development. However, the federal government passes along some outer continental shelf petroleum revenues to the states for use in assessing the impacts of offshore production and protecting the environment. Because Oregon has an approved coastal management program, the state is eligible for dollars to aid in mitigating adverse environmental effects of oil development.

Offshore petroleum brings both economic benefits and costs to an adjacent state and its coastal communities. As offshore development stimulates growth on shore, the jobs and business the oil industry brings create additional jobs and commercial opportunities in other segments of a state's or city's economy. Economists call this a multiplier effect, and use it to measure the net economic gain or strain an industry causes for the area in which it locates.

Economic benefits Oregon could realize from offshore production are the increased property taxes that local towns acquire through construction of onshore facilities and new business, the income taxes that new jobs create for state coffers, and the influx of funds as workers move into a community and buy goods and services. Community costs caused by outer continental shelf petroleum activities include the funds necessary to upgrade or expand existing public services, such as schools and police and fire protection, and the loss of revenue as the oil field is pumped dry and local support operations shut down.

It may take several years for state and local revenues generated by offshore oil to reach a level at which they contribute to meeting the costs of providing social services to the new industry and its employees. Also, economic strain can result if one community houses the tax-paying facilities, while a growing population needing public services lives in an adjacent town. As with the physical impacts of onshore development, larger towns may handle these best, since they can respond to a rapid growth rate more readily than small communities.

Changing communities

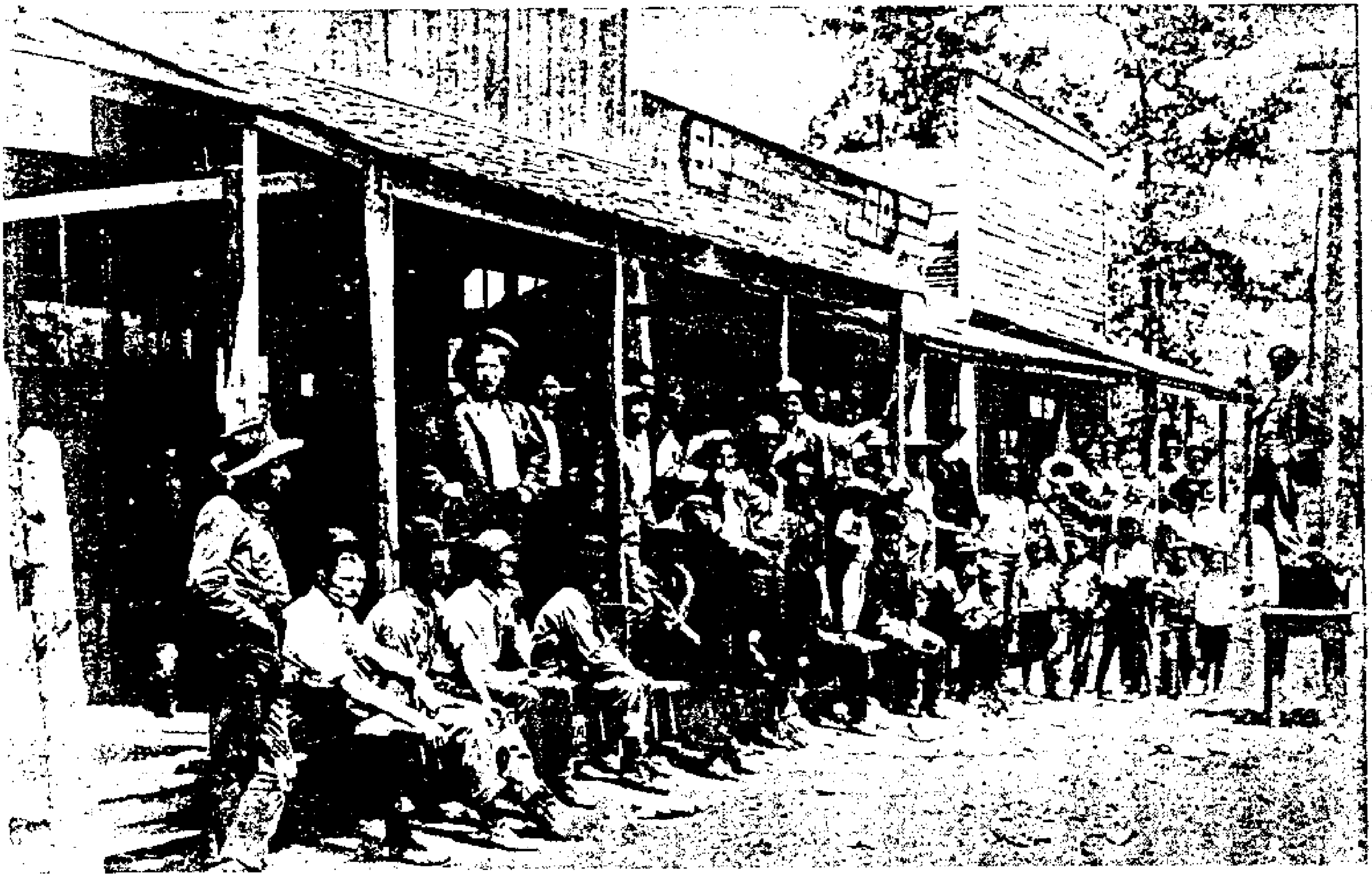


Offshore oil development brings to coastal communities social changes that are linked closely to the physical and economic impacts we have described. Social changes involve shifts in the size of a community's population, which lead to an altered community lifestyle. Of course, physical, economic, and social impacts will result from any large industry that moves into an area, but offshore oil may have somewhat different effects because of the predictable lifetime of a reservoir and the kinds of services that extracting the oil requires.

The development and production phases of offshore oil activity create jobs for many kinds of skilled labor, such as welders, pipe fitters, construction workers, or rig crews. Most often, the oil industry imports from other oil fields the trained workers needed to fill these specialized jobs, though some openings will provide opportunities for Oregonians. However, the state's small coastal population might not represent a sufficient pool of skilled labor for the oil companies to tap.

Each 10 jobs directly involved in support of offshore production on rigs and at coastal support bases creates two indirect jobs for manufacturing the equipment and materials needed to extract and transport the petroleum and natural gas. Since most supplies will be shipped to the coastal staging site from established firms in distant industrial centers, the small number of indirect jobs represents the small amount of manufacturing that would take place along a rural coastline near an offshore oil field.

Studies estimate that three to eight additional local job opportunities result from each 10 jobs created directly or indirectly by offshore oil. These estimates depend on whether the region is one of large metropolitan centers or small towns. Both indirect and induced employment will afford more job opportunities for Oregon residents than direct employment



An oil boomtown, Saratoga, Texas, 1910 (*Sun Oil*)

if offshore oil comes to the state, but the number of jobs available in all three types of employment will depend on the size of the oil or gas fields found.

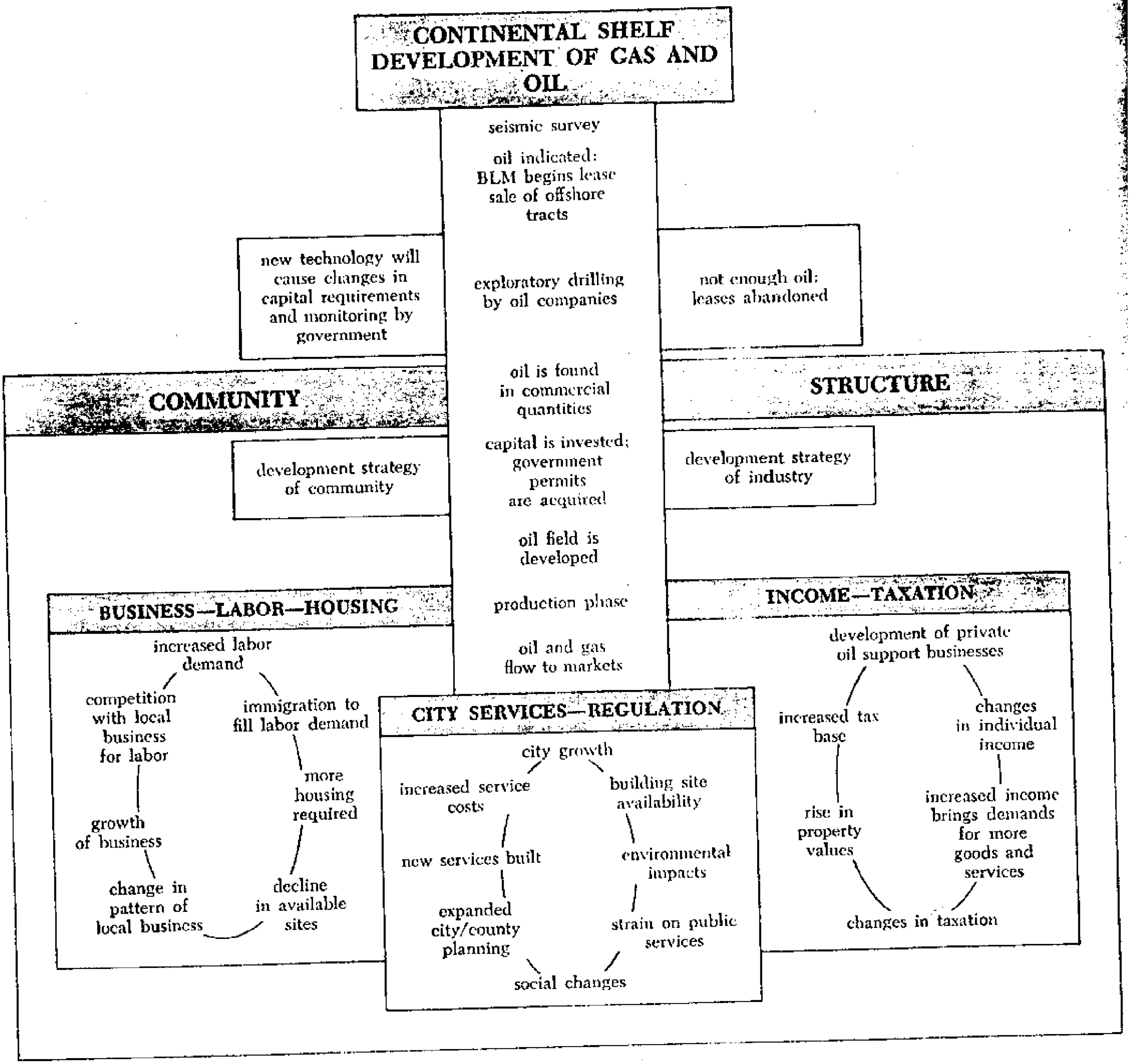
Cycles of Community Development

We have seen that as development and production proceed in the offshore oil field, the need for labor and services may cause a "boomtown" effect in a coastal city. The development phase entails the fastest rate of local growth as workers and their families move into the community to fill new jobs.

Offshore support firms compete with local businesses for available manpower, driving up wage levels. Demand for new housing and business sites can inflate property values, sometimes making it harder for the elderly and others with fixed or low incomes to retain their homes. Rapid growth can also strain existing social services, such as schools, police and fire departments, utilities, and transportation.

Each resident of a community that offshore oil affects sees different aspects of the development. Local businesses may perceive the bonanza that results from greater numbers of people who purchase goods, eat in restaurants, or buy homes. Long-time residents may resent the crowding and congestion that a growing population brings, or may oppose the loss of recreational areas or undeveloped open space. Others may welcome upgraded or expanded community services that meet new residents' needs.

Some observers of offshore oil's effects note differences in lifestyle between those who work directly for the offshore industry and those who have resided in a community prior to development. Differences they cite include the fact that oil workers, often transient, do not stay long enough to become involved in the life of the community; and that new



Interaction of a community and the offshore oil industry

SOCIAL SERVICE STANDARDS PER 1,000 PEOPLE

POLICE	1.5 officers .3 cars 335 square feet of station
FIRE	.4 full-time firemen 1,050 square feet of station* 250 gallons per minute for 1 hour of water flow 360,000 gallons per day
LIBRARY	6,000 square feet 10 seats 3,000-4,000 books .7 library staff
PARKS	1.3 acres of playground 1.1 acres of neighborhood park 1.6 acres of community park
HEALTH	4 hospital beds
WATER	150,000 gallons per day
SEWER	1,000,000 gallons per day capacity treatment plant 6.5 plant operators
TRASH	.3 collection vehicles per 1000 homes 1.3 operators per 1000 homes
SCHOOLS	480 elementary school students per 1000 homes 220 high school students per 1000 homes

Social Service standards for a community (adapted from "a framework for projecting employment and population changes. . . ; 1976" Argonne National Laboratory)

residents are likely to bring "urban" modes of behavior, with a faster pace of living and attendant social problems. Whether these differences materialize depends both on how the community plans and manages its growth, and on its acceptance of the new residents.

When the oil field reaches full production, employment opportunities level off and begin to decline, until only a modest permanent work force remains to handle oil rig servicing and production monitoring. This slowdown in employment growth can put a crimp in the community's expansion and cause economic hardship for the local businesses that have come to count on the increased trade. When the oil field's life cycle ends, the community will be faced with an additional loss of revenue as businesses and service facilities close.

With a small offshore find, the rate of community growth may be low enough so that severe economic and social dislocation will probably not occur. But even in this case, and especially if a sizable offshore field has been developed, a community will want to seek opportunities to convert the facilities that have been built and to encourage new, more permanent industries to move in. Local port authorities can be active in planning for reuse of sites they lease to offshore oil service industries. On Oregon's coast, for instance, a revitalized fishing industry, possible under the new 200-mile fisheries management zone, could take advantage of waterfront sites.

No matter what size the oil or gas find, planning for management of offshore development's physical, economic, and social impacts is essential at all phases of the field's life cycle. Neither the boom town nor the ghost town are healthy options for a community that seeks long-term stability.

Charting a course for change

Because current federal plans for outer continental shelf oil have postponed lease sales off the Pacific Northwest coast, Oregon will have ample time to prepare for the prospect of offshore development. As Oregonians, we will want to ensure that our state receives the most benefit from offshore petroleum and natural gas production with the least disruption to our economy and environment. That kind of readiness requires planning—state agencies, local government, and citizens working together to set guidelines for managing the onshore impacts of offshore oil.

Perspectives from Salem

In the planning process, Oregon's state agencies take a lead role in establishing policies and guidelines for the use of our natural resources and the balance of our economy. Facing offshore oil will involve several of these agencies in a coordinated response.

Oregon is a national leader in statewide land use planning. In 1973, the state legislature created the Land Conservation and Development Commission, which sets standards for land use throughout Oregon. The commission reviews local plans for conformance with statewide land use goals; coordinates the planning efforts of other state agencies; and ensures citizens' involvement in all phases of statewide planning. The Department of Land Conservation and Development carries out the goals—planning regulations equivalent to state law—and guidelines—suggested methods to achieve the goals—that the commission establishes.

Since its start, the Land Conservation and Development Commission has directed much of its efforts to planning for coastal management, under the federal Coastal Zone Management Act of 1972. The commission's statewide land use goals include four goals that refer

Government working with people to plan

specifically to coastal resources—estuaries, shorelands, beaches and dunes, and the ocean. Through these particular goals, which seek to preserve the long-term benefits of renewable coastal resources by proper management and use, the commission has a definite interest in the offshore oil development that would affect these four types of resources.

Because Oregon has an approved coastal management plan, the federal government's actions on or near the state's coastline must be consistent with our own land use goals. Thus Oregon will have some say in the conduct of offshore exploration and production. Applications to the federal government for permits and licenses or for financial assistance, and federal construction projects themselves, must meet state goals for resource development and conservation.

Other state agencies will also take an active role in the process of offshore oil development. The Division of State

Lands will issue leases for exploration and production on Oregon's continental shelf within the state's three-mile seaward boundary, will monitor the oil companies' adherence to the lease provisions, and will collect royalties from production. The Department of Geology and Mineral Industries will issue permits for and regulate actual drilling operations. Oregon's Department of Energy, Energy Facility Siting Council, and Public Utility Commission have statutory jurisdiction over instate pipelines and other energy-related construction, while the Department of Economic Development will survey the effects of offshore development on the state and local economy. The Department of Environmental Quality will take the lead in applying federal or state air and water quality regulations to the oil companies' activities in state waters. The Department of Fish and Wildlife will comment on proposed development that could affect offshore fish stocks or coastal wildlife populations.

Because each of these state agencies would have considerable interest in the offshore and coastal effects of outer continental shelf production, the governor has created an Outer Continental Shelf Oil and Gas Development Task Force. Bringing together representatives from the agencies, the task force will identify state concerns in continental shelf development; coordinate Oregon's responses to proposals for development; recommend a permanent government body to manage continental shelf oil and gas activities that would affect Oregon; and mesh Oregon's offshore oil-related regulations with those of other states.

As the possibility of offshore development approaches, the task force may take on additional missions, such as determining the consistency of federally regulated programs with state planning goals. In the future, the governor may designate one particular agency to take the primary role in responding to offshore oil, but until that time the task force will carry out this function on behalf of all the agencies.

On the Local Level

Following the Land Conservation and Development Commission's statewide planning goals, each city and county government develops a comprehensive plan for land management within its boundaries. Activities permitted under state and federal jurisdiction must be consistent with the provisions of a local community's approved comprehensive plan. When activities such as offshore oil development and its onshore support facilities have been found in compliance with the community's comprehensive plan, then the local government keeps tabs on the activity to ensure that it maintains this consistency. Funds and information may flow from the state and federal levels to help local communities cope with planning to meet and mitigate the onshore impacts of continental shelf production.

Perhaps the most important part in Oregon's response to offshore oil will fall to the state's citizens. The bill creating the Land Conservation and Development Commission mandated citizens' involvement in the statewide planning process and in the formation of local comprehensive plans. Oregonians will be encouraged to participate in local and state agency responses to outer continental shelf development. For instance, a second statewide task force could join representatives from private associations and industry organizations operating along Oregon's coast to comment on the federal leasing process and on local and state actions.

For its future, Oregon needs to preserve its renewable economic resources. Oil and gas are not among these, and the state must ensure that the horizon for its planning extends beyond the 15- to 40-year time frame potential oil and gas development represents. Citizens and citizens' groups can make their concerns about offshore oil and gas heard in Salem and Washington, D.C., so that government agencies can know residents' concerns about jobs and changing lifestyles. Both sets of actors, citizens and government, can listen to and learn from each other to plot the wisest path for Oregon's involvement in offshore oil.

A CALL TO OREGON CITIZENS

Do you cut timber, farm, or fish for a living?

Do you drive a car for work or pleasure, hold a manufacturing job, or heat your home with oil or natural gas?

Do you live in one of Oregon's coastal towns, or vacation along the state's 400 miles of beach and rocky shore?

As Oregonians, each of us are able to answer yes to one or more of these questions, and each yes gives us a reason to participate in Oregon's response to offshore oil.

Of course, oil production on our continental shelf is only one aspect of a larger question the entire nation faces: How can we best manage our energy demand and supply. We should not only be thinking about what offshore oil and its onshore impacts will mean to Oregon. As citizens, we must also consider what sort of policy the United States will need for the future, and what each of us can do now to conserve energy. As planners predict, only if we slow our escalating demands for fossil fuels can we gain the time we need to convert to other forms of energy while maintaining our standard of living.

We have described for you the source of offshore oil and gas, the industry that extracts and delivers these fuels, and the impacts this industry could have on Oregon and Oregon's coast. Perhaps, as you've read this booklet, you have thought of concerns or questions about offshore oil and Oregon.

If you want answers to your questions, or a way to express your concerns, please call or write the Governor's Task Force on Outer Continental Shelf Oil and Gas Development, Department of Land Conservation and Development, 1175 Court Street NE, Salem 97310, 503/378-4926.

Glossary

aromatic compounds—petroleum hydrocarbons that are usually heavier than other compounds found in crude oil, and that are considered more toxic to living organisms.

asphalt—a thick, tarry hydrocarbon compound found in natural beds or left as a by-product of petroleum refining.

bench mark (baseline)—existing physical, chemical, and biological characteristics of an area's environment against which future changes can be measured.

blowout—the eruption of a well when a tremendous change in the well's gas and/or oil pressure cannot be contained by the control valves.

bore hole—the hole made by drilling or boring a well.

carbon—an element that is a basic component of coal, petroleum, and organic compounds derived from living matter.

carbon dioxide—a heavy, colorless gas formed primarily by the combustion and decomposition of organic compounds; plants absorb carbon dioxide as they use sunlight to synthesize carbohydrates.

carbon monoxide—a colorless, odorless, very toxic gas that is formed as a by-product of the incomplete combustion of carbon compounds.

casing—the large steel pipes placed in a well as drilling progresses to seal out water and prevent cave-in of the well's sides.

commercial find—a discovery of oil or natural gas large enough to justify the financial investment necessary to extract the resources.

comprehensive plan—coordinated land-use map and policy statement of a state agency, city, county, or special district, which interrelates all natural and fabricated systems in a particular region.

conductor pipe—the outer shell of pipe between the drilling platform and seabed sediments through which the drill bit and pipe string pass.

continental margin—the extension seaward of a continent's land mass out to an average water depth of 660 feet (200 meters).

continental shelf—a shallow, subsea plain bordering a continent that extends out from a coastline to the edge of the steep slope that descends to the deep ocean floor.

crude oil—unrefined petroleum.

cuttings—the rock debris left from well drilling.

drill bit—the cutting or boring mechanism at the subsea end of the drill string.

drill string—the column of drill pipe that extends from the drilling platform to penetrate the seafloor.

ecosystem—a particular environment together with the community of plants and animals that inhabit it.

emulsify—to put an insoluble mixture into suspension in another.

environmental impact statement—a complete description of the changes a proposed project will bring to an area's environment; required by the National Environmental Policy Act of 1969 and corresponding state laws.

estuary—a body of water at the mouth of a river in which the ocean tide mixes with river currents.

fault zone—a region of fractures in the earth's crust; slipping of one side of a fracture relative to the other is a major cause of earthquakes.

fossil fuel—energy sources (coal, oil, and natural gas) derived from prehistoric living organisms that have been converted through pressure, heat, and other conditions.

geology—the science of the earth's history as recorded in the structure and composition of rocks.

geophysics—the science of the earth's physics, including the influence of weather, water, earthquakes, volcanoes, magnetic fields, radioactivity and earth measurements.

goals—general, statewide, land use standards adopted by the Land Conservation and Development Commission.

guidelines—suggested approaches designed to aid cities and counties in the preparation, implementation, and adoption of comprehensive plans to meet state land use goals.

habitat—the place or kind of site in which an animal or plant normally lives and grows.

hydrocarbon—an organic compound that contains only carbon and hydrogen and that is usually a component of coal, oil, natural gas, or tars.

hydrogen—the simplest and lightest of the chemical elements.

impermeable—not permitting passage of fluids or other materials through its substance.

joint venture—several companies in partnership to develop a resource or an industrial process cooperatively.

larvae—the immature forms of insects, fishes, and other animals that undergo physical change to become adults.

lease—the acquisition by an oil company of fixed-term petroleum development rights to a tract of publicly owned land.

liquefied natural gas—gas that is supercooled and compressed for storage and shipment.

marine resources—the harvestable living and mineral resources contained in the ocean and seabed.

molecule—the smallest particle of a substance, composed of one or more atoms and retaining the substance's properties.

nitrogen—a colorless, odorless, gaseous element that is a component of all living tissues.

nonrenewable resource—a natural resource like fossil fuels that, when consumed, is irreplaceable.

oil/gas field—a region in which one or more reservoirs of petroleum or natural gas are located.

oil slick—the film that coats the water's surface when petroleum is spilled.

operating orders—regulations set by the U.S. Geological Survey that stipulate how outer continental shelf exploration and development are conducted.

paraffin—a light, waxy, flammable compound whose general type occurs as one component of some crude oils and that can be obtained by distilling oil, coal, shale oil, or wood.

petrochemical—chemical substances, such as plastics, paint, artificial fibers, ammonia, detergents, and fertilizers, that are manufactured from some refined oil or natural gas products.

petroleum—oil and/or natural gas.

plankton—minute plants and animals that float passively or swim weakly in a body of water.

reef—a ridge of rocks or sand at or near the surface of the water.

renewable resource—a natural resource that, with proper management, can be harvested and replenished indefinitely.

reservoir—an individual pool of oil and/or natural gas.

salt marsh—a flat, swampy, coastal area that is periodically flooded by seawater and that is one of earth's most productive regions for plant and animal life.

sediment—tiny particles of mineral or organic matter that settle to the bottom of a body of water.

seep—a site at which an underground source of water, oil, or gas oozes to the surface.

seismic—resulting from or caused by an earthquake or created explosion, or relating to vibrations of the earth.

service base—onshore site of operations providing services and supplies to offshore rigs.

submersible—a small, independently operated, submarine vessel used for undersea research or construction.

sulfur—a nonmetallic element that occurs in free or combined forms and that has many industrial uses.

tidal zone—the coastal region that is subject to the influence of the tides.

tract—the geographical unit of offshore leasing, containing 5,760 acres or nine square miles.

transshipment terminal—the wharf area at which oil is transferred from one form of transport to another (ship, tank car, or pipeline).

well—the hole drilled or bored into the seafloor to obtain oil or natural gas.

wellhead—the top of the well with the equipment used to maintain control of the oil or gas flow rate.

wetland—coastal or inland marshes or swamps.

workover—operations undertaken to increase or restore production in an oil or gas well.

Agencies involved

If you have further questions, contact the appropriate agency or organization listed here.

OREGON AGENCIES

Toll-free number for calling any state office:
Dial 1-800-452-7813

Governor's Task Force on Outer Continental Shelf Oil and Gas Development
Contact: Department of Land Conservation and Development

Oregon Department of Economic Development
317 SW Alder, Ninth Floor
Portland, Oregon 97204
229-5535

Oregon Department of Energy
111 Labor and Industries Building
Salem, Oregon 97310
378-4040

Oregon Department of Environmental Quality
522 SW Fifth Street
Portland, Oregon 97201
229-5395

Oregon Department of Fish and Wildlife
506 SW Mill Street
Portland, Oregon 97201
229-5406

Oregon Department of Geology and Mineral Industries
1069 State Office Building
Portland, Oregon 97201
229-5580

Oregon Department of Land Conservation and Development
1175 Court Street NE
Salem, Oregon 97310
378-4926

Oregon Public Utility Commission
Labor and Industries Building, Third Floor
Salem, Oregon 97310
378-6604

Oregon Division of State Lands
1445 State Street
Salem, Oregon 97310
378-3805

FEDERAL AGENCIES

Council on Environmental Quality
722 Jackson Place, NW
Washington, DC 20006
202/633-7034

U.S. Department of Energy
Office of Leasing Programs
12th Street and Pennsylvania Avenue, NW
Room 2317
Washington, DC 20585 202/566-9422

Environmental Protection Agency
Office of Federal Activities
401 M Street, SW
Washington, DC 20460
202/755-0777

U.S. Department of Commerce
Office of Coastal Zone Management
3300 Whitehaven Street, NW
Washington, DC 20235
202/634-4232

U.S. Coast Guard
OCS Safety Project
400 7th Street, SW
Washington, DC 20590
202/472-5160

U.S. Department of the Interior
Office of OCS Coordination
18th and C Streets, NW
Washington, DC 20240
202/343-2186

Bureau of Land Management
Pacific OCS Office
300 North Los Angeles Street
Room 7127
Los Angeles, California 90012
213/688-7120

ORGANIZATIONS

American Petroleum Institute
2101 L Street, NW
Washington, DC 20037
202/457-7000

Oregon Environmental Council
2637 SW Water Street
Portland, Oregon 97201
222-1963

Sierra Club
530 Bush Street
San Francisco, California 94108
415/981-8634

Western Oil and Gas Association
Roosevelt Building
727 West 7th Street
Los Angeles, California 90017
213/627-4866

References for further reading

Facts About Oil. American Petroleum Institute, 2101 L Street NW, Washington, DC 20037. 44 pp. No charge.

Effects on Commercial Fishing of Petroleum Development off the Northeastern United States. David W. Allen, et al. Marine Policy and Ocean Management Program, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543. 1976. 80 pp. Publication number WHOI-76-66, limited availability, no charge.

Energy Facilities in the Oregon Coastal Zone. Mathematical Sciences Northwest. Oregon Department of Land Conservation and Development, 1175 Court Street NE, Salem, Oregon 97310. 1978. 2 vol. Limited availability, no charge.

Energy Under the Oceans; a Technology Assessment of Outer Continental Shelf Oil and Gas Operations. Don E. Kash, et al. University of Oklahoma Press, Norman, Oklahoma. 1973. 378 pp. $4.95 ($5.25 with postage and handling).

Management of OCS-related Industrial Development: a Guide for Alaskan Coastal Communities. David M. Dornbusch and Company, Inc. Division of Community Planning, Alaska Department of Community and Regional Affairs, Pouch B, Juneau, Alaska 99811. 1976. 130 pp. Limited availability, no charge.

Managing the Social and Economic Impacts of Energy Developments. Centaur Associates. Office of Planning Analysis and Evaluation, Energy Research and Development Administration, 20 Massachusetts Avenue NW, Room 7113C, Washington, DC 20545. 1976. 171 pp. No charge.

The Marine Plant Biomass of the Pacific Northwest Coast. Robert W. Krauss, ed. Oregon State University Press, Corvallis, Oregon 97331. 1977. 397 pp. $12.75.

Offshore Oil Development: Implications for Massachusetts Communities. Massachusetts Office of State Planning. OCS Coordinator, Massachusetts Office of Coastal Zone Management, Executive Office of Environmental Affairs, Saltonstall Building, 100 Cambridge Street, Boston, Massachusetts 02202. 1976. 68 pp. Limited availability, no charge.

Oil and Gas in the Coastal Environment. U.S. Council on Environmental Quality. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. 1977. 153 pp.

Onshore Planning for Offshore Oil: Lessons From Scotland. Pamela L. Baldwin and Malcolm F. Baldwin. The Conservation Foundation, 1717 Massachusetts Avenue NW, Washington, DC 20036. 1975. 183 pp. $10.00 hardcover, $5.00 softcover.

Oregon and Offshore Oil: Concerns and Recommendations. Jeffrey M. Stander and Robert L. Holton. Sea Grant College Program, Oregon State University, Corvallis, Oregon 97331. 1978. Limited availability, no charge.

Parable Beach: Primer in Coastal Zone Economics. J. W. Devanney III, G. Ashe, and B. Parkhurst. MIT Press, 28 Carleton Street, Cambridge, Massachusetts 02142. 99 pp. $7.95.

Petroleum in the Marine Environment. Ocean Affairs Board, National Research Council. Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, DC 20418. 1975. 107 pp.

Ports '77. American Society of Civil Engineers, 345 East 47th Street, New York, New York 10017. 1978. 2 vol. $24.00.

Recommendations for Baseline Research in Washington and Oregon Relative to Offshore Resource Development. Bureau of Land Management, U.S. Department of the Interior, Washington, DC 20420. 1977. 308 pp. Limited availability, no charge.

The Story of Oil and Gas. J. Ray McDermott and Company, Inc., 1010 Common Street, New Orleans, Louisiana 70112. 1975. 28 pp. No charge.