FACT SHEET 13

PETROLEUM

Introduction

Imagine a world without petroleum. There would be no petrol to fuel our cars, oil or gas for power generation, bitumen for roads or plastics for children's toys.

Since early times, man has collected petroleum. Over 2000 years ago the Chinese used bitumen to build the Great Wall of China and Ancient Egyptians found thick oil useful to grease the wheels of their chariots.

Petroleum literally turns the wheels of industry, but many people take the energy and fuel that it produces for granted. Without continued exploration and research the future growth and security of world industry would be uncertain.

Like any natural resource, petroleum needs to be managed and understood to ensure a future supply.

How does it form?

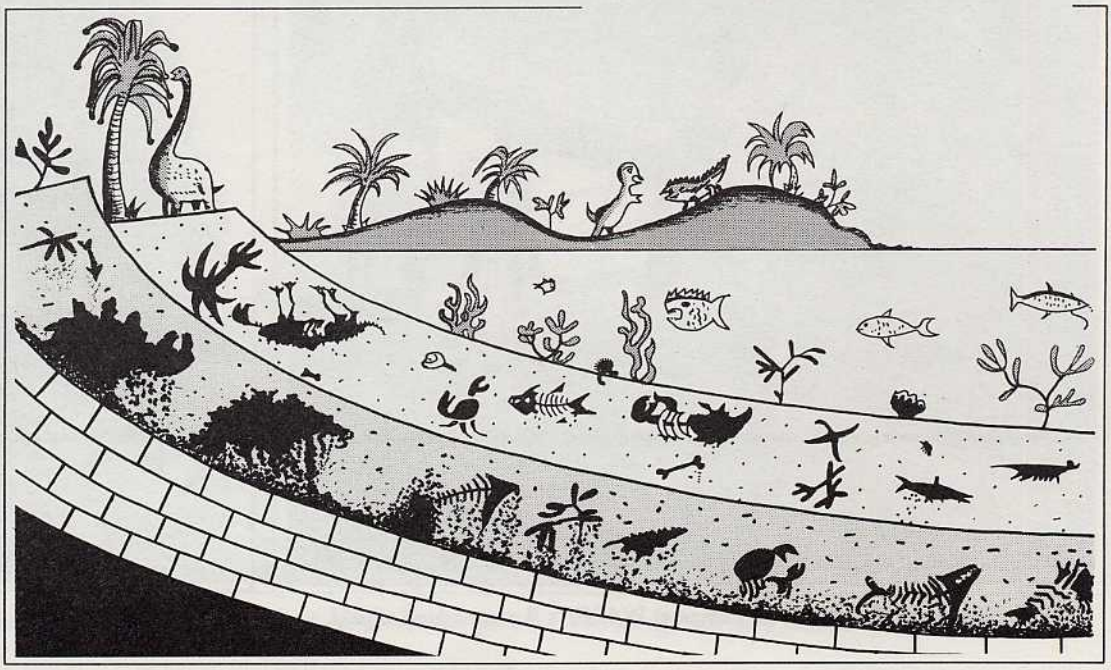
The most popular theory supported by scientists is that petroleum forms from the ancient remains of plants and animals. Indeed, it has been discovered that oil contains many compounds that are similar to those found in living plants and animals.

So how did plants and animals turn into oil? Initially the dead matter built up in stagnant areas of the world's oceans and swamps. Bacteria changed the dead matter into fatty and waxy substances which became buried by layers of sediment. As these layers increased in thickness, the pressures and temperatures increased also, causing petroleum to form. This process can take from a few to many hundreds of millions of years and can produce fields containing oil, or gas, or both together.

Petroleum is usually formed in fine shaley rocks and later squeezed out to occupy the small spaces within coarser, sandier rocks.

The movement of the petroleum continues until it is halted by a trap. A trap occurs when porous and permeable rocks are sealed by overlying impermeable rocks (caprock). It is here that petroleum collects in the pores of what is referred to as the reservoir rock. It is these traps that explorers look for.

An artist's impression of how oil is formed.

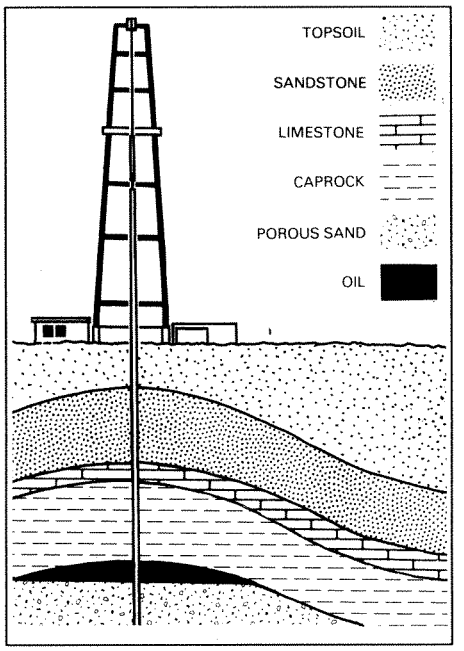


The whole process of rock formation, petroleum formation, migration and final accumulation may take many millions of years to complete.

Exploration

Petroleum exploration is generally concentrated in areas where large sections of sedimentary rocks are present. In exploration and geographic terms these areas are known as sedimentary basins. There are approximately 50 basins in Australia. It is important to note that sedimentary basins can occur beneath the seabed as well as on land.

The first stage in oil exploration involves mapping and surveying sedimentary basins where porous reservoir and source rocks may exist. Techniques include seismic surveys, geochemical sampling and geological mapping. These methods provide valuable information, but cannot guarantee the presence of petroleum. It can only be done by actual drilling which is a costly exercise. It is therefore important that the exploration has been extensive and as accurate as possible to determine the existence of petroleum. It



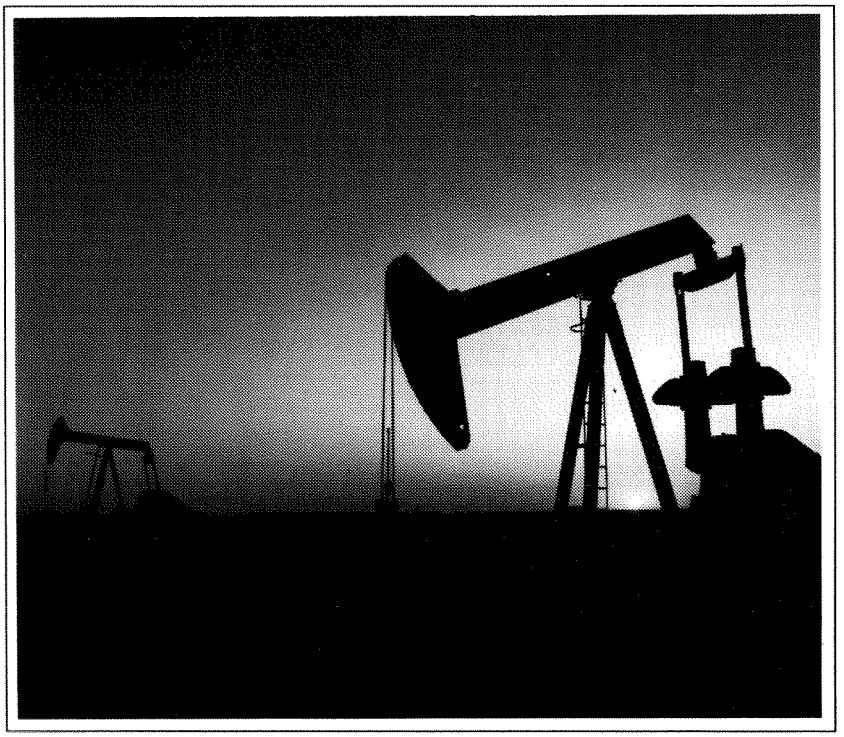
Δ *The structure of a typical oil trap.*

is extremely easy to miss a reservoir if a drill is incorrectly located.

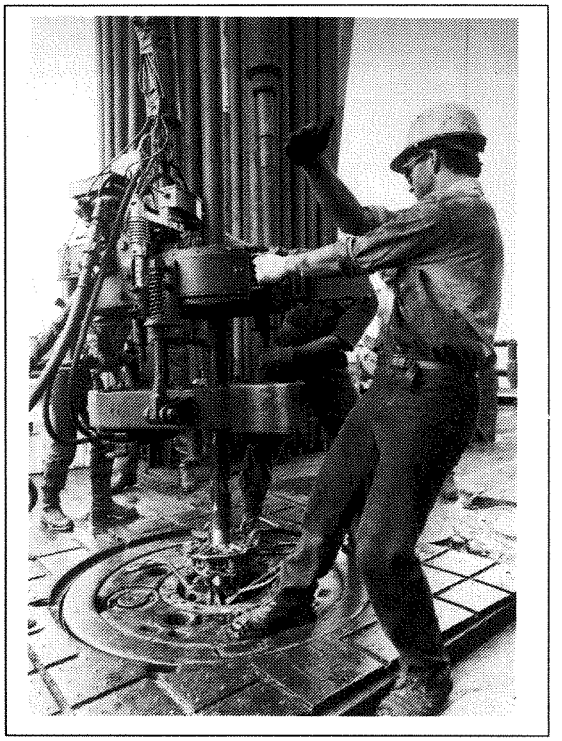
Drilling and production

Drilling for petroleum on shore is reasonably straightforward. The drill bit is attached to a length of drill pipe and rotated at high speed. As the drill bit cuts into the rock and penetrates deeper, extra pipe lengths are added. A mud-rotary system is used. In this process a specially prepared drilling mud is circulated through the drill-pipe and bit in order to carry rock cuttings to the surface for analysis. These rock cuttings help geologists establish the type of rock being drilled and the potential for petroleum being found. The heavy weight of the drilling mud also helps to decrease the possibility of high pressure petroleum blowing out at the surface end of the drill site. In the past, blow outs have completely demolished drill rigs. Mud-rotary holes can go as deep as 9000 metres and cost over $20 million to complete. The drill bit is made of either tungsten carbide or industrial diamonds which help cut through the layers of rock.

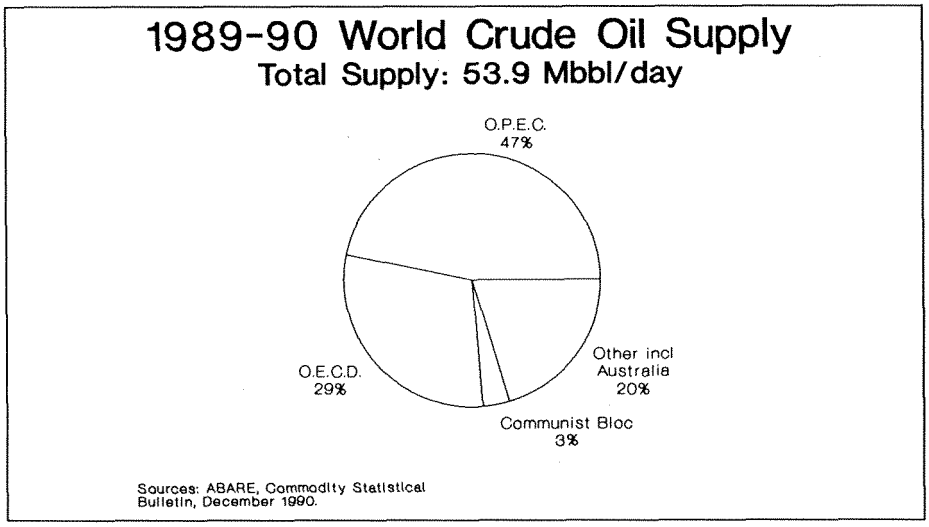
Offshore drilling, while similar in drilling operation, is complicated by hundreds of metres of water between the drilling platform and the sea bed. The problem facing offshore drilling operations is the movement of the rig created by swells and tides. This problem has been overcome by employing different types of platforms according to the depth and conditions of the water. The three main platforms are a jack-up barge, a drilling ship and a semi-submersible rig. A jack-up barge



Δ *The silhouette of Lufkin beam pumps at WAPET's Barrow Island oilfield.*



Δ *Action on the drill floor of an oil rig.*



is a self-elevating platform. The barge carries huge legs and is towed to a drilling site. The legs are lowered into the water and secured to the sea bed. The legs of the barge are then jacked up until the vessel is well above the water level. This type of platform is only used in waters which are less than 100 metres deep.

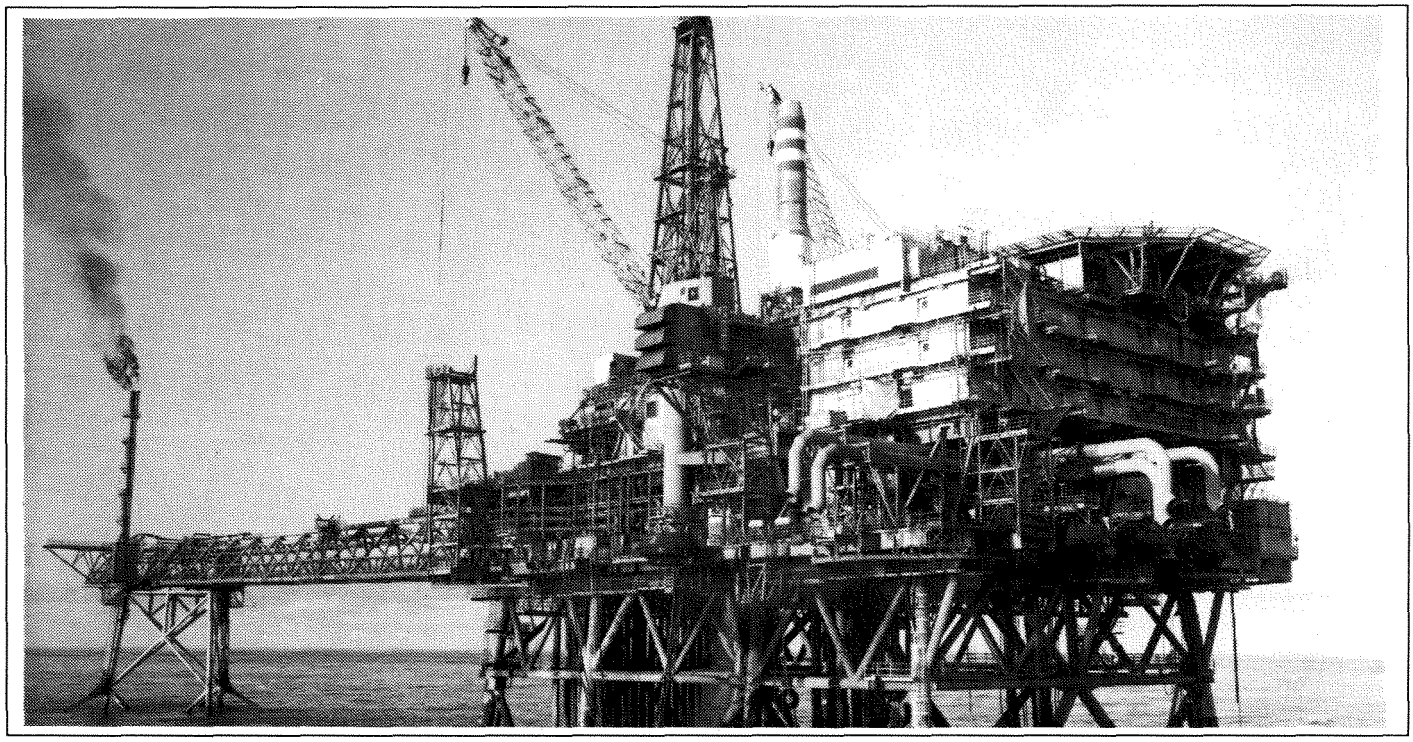
Drill ships are used in much deeper waters. They are built so that the drilling can take place through a hole in the bottom of the vessel. Drill ships are able to move from one site to another without difficulty, but are disadvantaged by their design. If the wind and sea movement becomes too great, drilling must stop until it is safe to proceed again. Drill ships can operate in deep waters (1200m), but are more efficient in calm, protected waters.

The latest and most extensively used deep water platform is the semi-submersible type. Designed along the same principles as an iceberg, much of the platform's bulk is beneath the waterline. The giant buoyancy tanks provide stability so that drilling in rough, deep waters can continue. In shallow waters the tanks can rest on the sea bed. In the past, anchors have been used to secure the platform over the drill site, but technology now allows computer-operated motors to keep the platform in a precise position over the drill site.

When a hole is drilled into rock containing petroleum the pressure is often enough to allow the oil or gas to come to the surface through the tubing. On occasions there is no pressure and oil may have to be pumped to the surface. Control over the petroleum flow is very important. Therefore the flow rate is very carefully monitored so that oil production is maximised on the site. Oil brought to the surface is then sent to a refinery for processing.

Uses

The uses for petroleum are many and varied. Out of every 100 barrels of oil, 88 are used to produce energy. Petrol, electricity, heating, kerosene and factory based energy account for the 88 barrels. The remaining twelve barrels go towards producing rubber, ink, plastics, medicines, cosmetics, detergents and a wide variety of chemicals. Australia is a large consumer of petroleum and has an extremely high level of car ownership. While a considerable amount of North

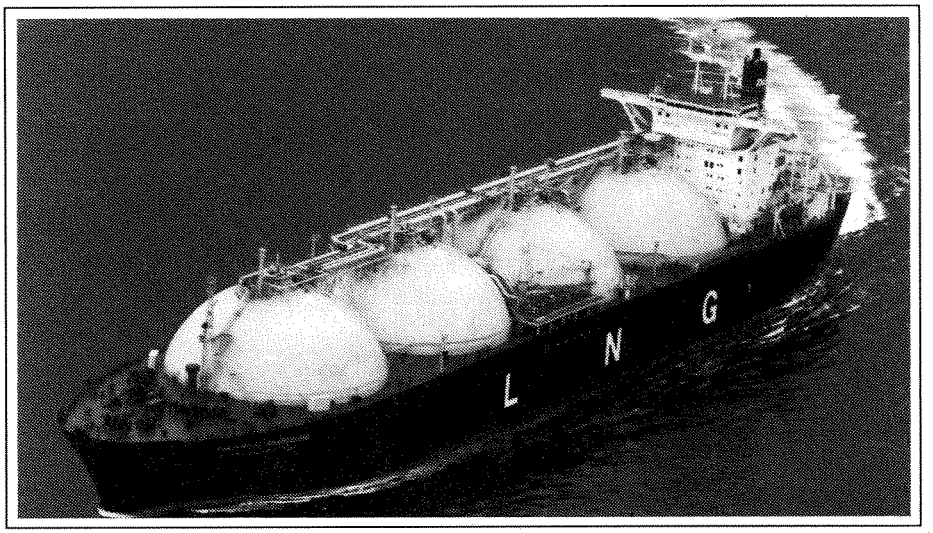


Δ Woodside's massive North Rankin A gas production platform, 130 km offshore from Dampier.

West Shelf gas is exported to Japan, virtually the remainder of Australia's natural gas and liquid fuel resources are used by people and industry within our own country.

History in Australia

The first petroleum discovery was made in 1900 near Roma, Queensland, when a water bore intersected a natural gas field. Aside from this discovery and an oil field discovery at Lakes Entrance in Victoria in 1924, Australia's commercial petroleum industry did not really commence until 1953. It was in this year that the Rough Range well in Western Australia began producing 550 barrels per day. It was during the 1950s that the initial exploration programs began with a Government subsidy being introduced in 1957. Commercial production of petroleum on a large scale began on the Moonie oil field in Queensland in 1964. The search for petroleum subsequently intensified with widespread exploration and discoveries around Australia. Some of the more notable finds were on Barrow Island in Western Australia in 1964, Bass Strait in 1967 and the North West Shelf in 1971. Up to 1971, 1450 onshore exploration wells had been drilled and of these, 772 were developed for further use.

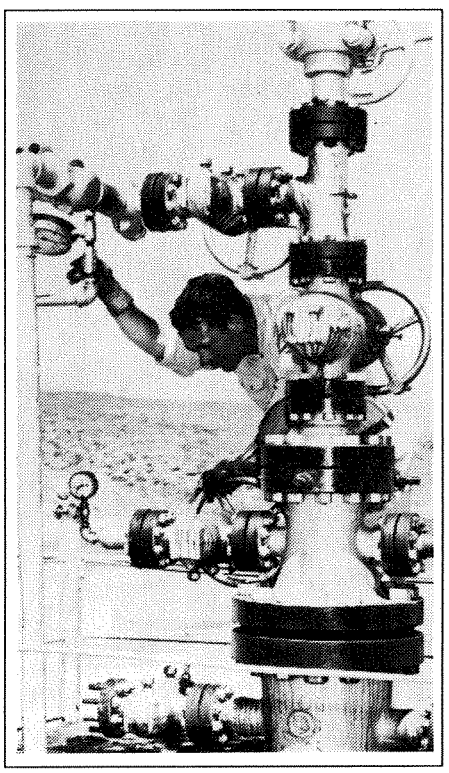


Δ *Much of the natural gas produced from WA's North West Shelf is exported to Japan in LNG tankers such as this one. The fuel is used in power stations to produce electricity.*

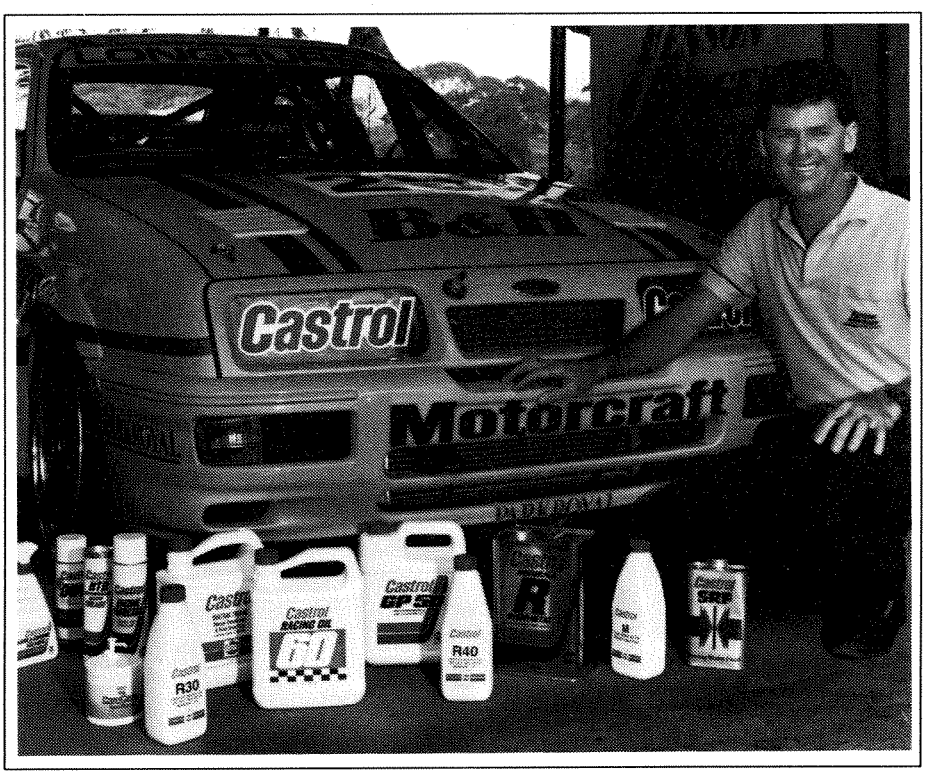
In Western Australia offshore drilling began in 1968, and since then enormous quantities of natural gas have been discovered on the North West Shelf. Several significant oil discoveries have been made in the same area with new oil fields such as Saladin, Cossack, Wanaea, Griffin and Roller. So exciting is the potential of the area that Western Australia is likely to overtake Victoria as the nation's biggest oil producer by the mid 1990s.

Petroleum and natural gas industries are now an integral part of Western Australia's economy with hundreds of millions of dollars spent annually on oil exploration and development.

■ ***Produced by the Communications Branch, Department of Mines Western Australia.***



Δ *The historic Rough Range A1 well in 1953.*



Δ *Oil has a wide variety of uses, including lubricants for racing cars.*