Oil– A Raw Material in Great Demand

EVEN TODAY, science cannot give any definitive answers as to how oil was formed. This is one of the theories. Various microorganisms inhabited the shallow ocean waters in earlier time. The microorganisms that died were deposited layer upon layer on the ocean floor with the passage of time. Layers of sand and silt spread over the top of them and, in time, hardened to become sedimentary rock.

After this, so the theory goes, the strong pressure caused by the overlying rock, the increase in temperature and the effects of bacteria must have changed the organic mass into oil.

Most of It Was Lost

Very often the oil-bearing layers were made up of porous materials such as sandstone and limestone. Because of the porosity of these types of stone, the oil that was put under pressure by the rock on top of it could escape toward the upper crust of the earth. Most likely more oil has been lost this way since oil began to form than has ever remained behind in the natural storage places where we find it today.

Millions for Drilling

More than 200 years ago, people already knew how to make use of the crude oil that found its way to the earth's surface. They did so then in eastern Europe. Using a primitive distillation process, they developed a liquid similar to kerosene that was burned in lamps.

The American oil industry was born one hundred years later. The first well was drilled by a man named Drake in the state of Pennsylvania in the year 1859. Since that time, the hunt for "black gold" has been on at an ever-increasing pace and with an ever-increasing use of modern technology.

It is probably true that all the "easy" wells have already been drilled. That leaves us with only the "hard" ones and these are the most expensive. It costs about four times as much to drill for oil offshore as it does to drill on land. In the North Sea, for example, the drilling companies have to spend about 5 to 8 million dollars for every well. Even at that price only one out of every 15 attempts ever results in a well that is actually worthwhile pumping for crude oil.

HYDROCARBONS. Crude oil is a mixture of compounds of the elements carbon and hydrogen. Both hydrogen atoms and other carbon atoms can form compounds with carbon atoms. Because of this fact, there are theoretically an unlimited number of possible hydrocarbon compounds.

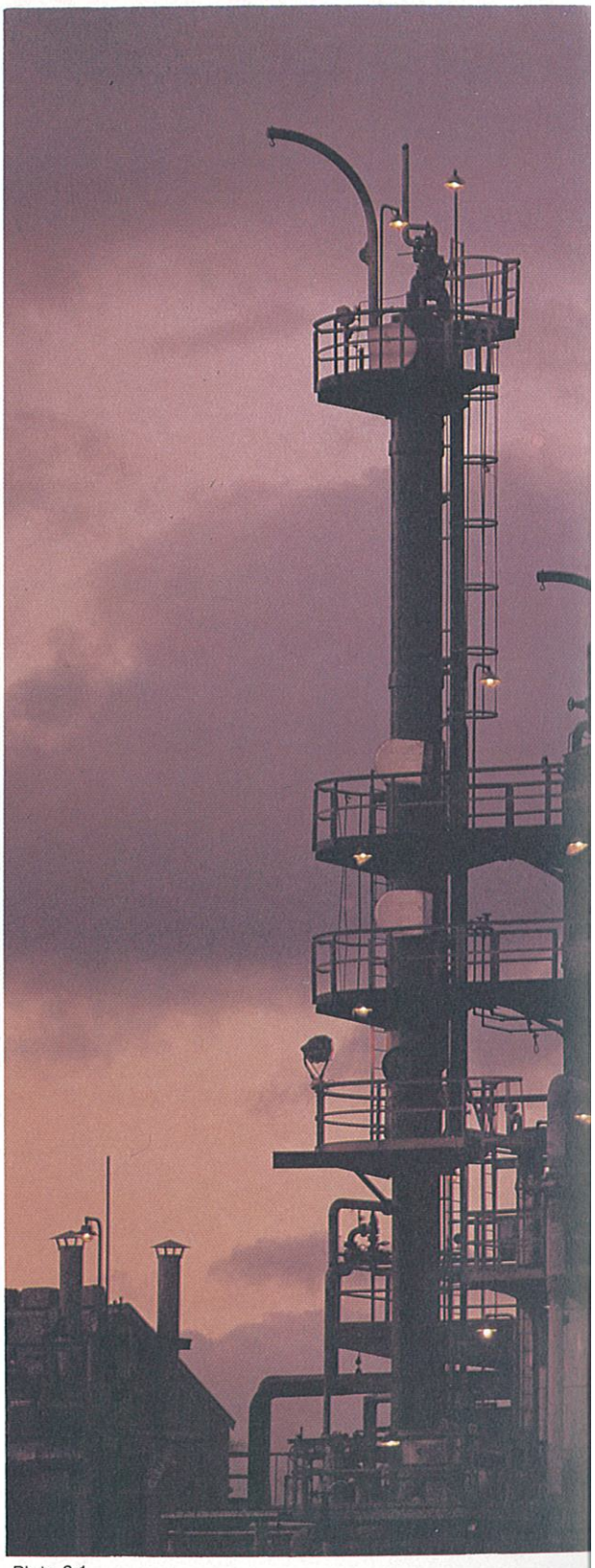

Plate 3:1

The characteristic silhouette of an oil refinery. *The high towers are distillation columns in which the crude oil is broken down into various components.*

Depending upon how it was formed, crude oil is a mixture of varying amounts of the predominant hydrocarbon groups paraffin, naphthene and aromatics. Figure 3:1 shows an example of each of these groups.

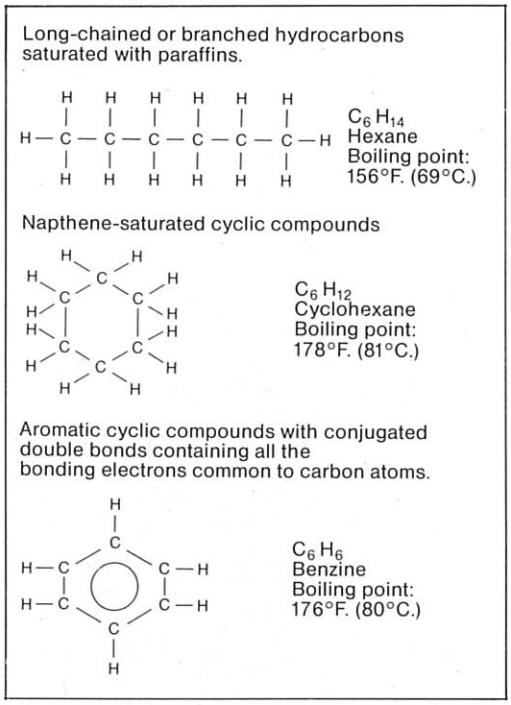

Figure 3:1

The various components that make up crude oil differ from each other especially by virtue of their different boiling temperatures. Paraffins have up to four carbon atoms and have a boiling point as low as 32°F. (0°C.). The boiling point then rises along with the number of carbon atoms. With 5 carbon atoms, the boiling point rises to 95°F. (35°C.), with 10 carbon atoms it rises to 345°F. (174°C.) and with 30 carbon atoms to 650°F. (344°C.). This characteristic, which can be found in all hydrocarbons, is used to separate the various types of compounds from each other.

Separation in Towers

You have probably noticed the typical, high, metal towers that jut up from the surroundings if you have ever driven past an oil refinery. Inside these towers, the crude oil is broken down into its so-called "fractions" and changed into various petroleum products. This separation process is usually referred to as distillation.

Crude oil is heated to a temperature of 662°F. (350°C.) and transported to the lower portion of the tower (fractionating column). Most of the oil changes into gases during this process. The vapors rise toward the top and at a certain level, depending upon their boiling point, they turn back into liquids. In other words, they condense. The products of this condensation are then collected at each of the various levels. This is how the different hydrocarbons are separated from each other.

In general, these are the products that are taken from the columns at the various levels beginning at the top: refinery gas (top gas), gasoline, kerosine, diesel oil, light fuel oil, lubricating oil, paraffin, heavy heating oil, asphalt (see Plate 3:2).

The Road to Plastics

The many products that are separated by the distillation process are mainly the raw materials for an immense number of secondary products. Just as examples, we could mention the following: solvents, gaseous and liquid fuels, lubricating oils and greases, detergents, and chemicals for industry and agriculture. But what interests us most is yet another group of products, synthetic plastics.

To produce plastics, a further refinement of the distilled products is necessary. It is possible to split and transform long chain molecules, to combine smaller molecules into molecule chains (polymerization) and to combine different types of molecules into one compound. The various processes are both diverse and complicated.

In time, petrochemists developed the raw materials used for plastics from crude oil but they developed many other products as well. It takes quite a while to get plastics from crude oil and took quite a while historically to develop them as well. Now the future of plastics is being affected by another problem. The reserves of crude oil are on the decline. We have to make sure that we use what remains in a reasonable way. To simply offer these reserves up to the growing energy demands of the world would have dire consequences for the future.

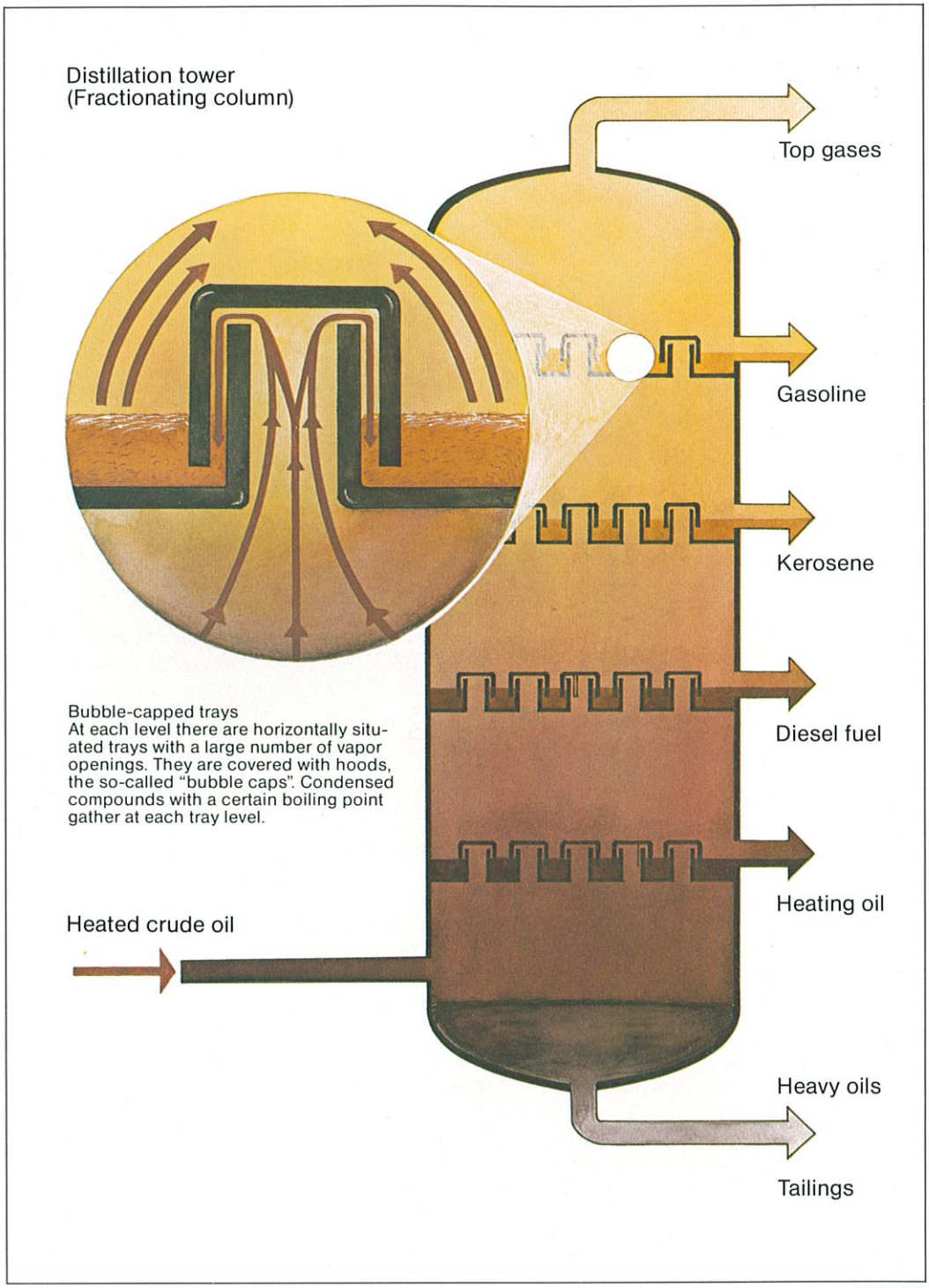

Plate 3:2

Crude oil distillation. *Crude oil vapors are fed into a distillation column where the components condense according to their different boiling points. This is the way that crude oil is broken down (fractionated). The various distillates are then drained off each tray. Distillates with the lowest boiling temperature collect at the top of the tower and vice versa.*