Category I (Ellenburger and Simpson oils). The Simpson shale is considered as a likely source.

Category II (a few Ellenburger and Simpson oils, Fusselman, Devonian, Mississippian, Pennsylvanian, Wolfcamp, a few Yeso oils). Probable sources are dark basinal shales of Woodford, Mississippian, Pennsylvanian, and Wolfcamp age, commonly associated with unconformities.

Category III (Yeso and San Andres oils). These occur commonly now on the Northwest and Eastern shelves where sulphate content is high.

Category IV (Spraberry, Delaware Mountain, some Wolfcamp, and Yeso oils). These are relatively unaltered oils, associated with or derived from basinal shales.

Category V (San Andres, Grayburg, Queen, Seven Rivers, Yates, Rustler, Castile, Cretaceous oils). These oils appear altered; suggested reasons: reaction with sulphur, fresh-water leaching of volatile aromatics, microbial oxidation of wax.

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HYDRODYNAMICS OF PERMIAN BASIN

A hydrodynamic study of several stratigraphic units in the Permian Basin shows a regional west to east dip of the potentiometric surface. The Ellenburger and Devonian have closed lows against a part of the Ft. Stockton uplift and against some faults in the general area. The Devonian has a steeper dip of the potentiometric surface in New Mexico than in Texas. The Mississippian has too sparse data to show significant features other than east dip. The Strawn potentiometric surface has steeper east dip on the east flank of the Midland Basin and approaches hydrostatic conditions around the Central Basin Platform. The dip of the Wolfcamp is to the east and north in New Mexico and east and northeast in Texas. The San Andres shows east dip. The Delaware Mountain group has general east dip, but anomalous conditions are suggested in central Reeves County.

The potentiometric surface of all units mapped is approximately the same regionally, in spite of the wide differences in elevation and location of the outcrops and subcrops. However, locally there are many variations. Tilting of the hydrocarbon accumulations is a significant factor in a few fields. Vertical and horizontal pressure relationships around faults and subcrops, vertical and lateral continuity of oil, relative permeability to oil, and other hydrodynamic conditions can be critical factors to be considered in exploration in the Permian Basin.

The quality of drill-stem-test instrumentation and programming in the Permian Basin needs to be improved to furnish the pressure data that should be available to the industry.

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MINERAL FLUIDS AND AMERICA'S FUTURE

Subsurface mineral fluids and the substances recovered from them constitute a major part of the value of all minerals produced in this country, increasing from about 48 per cent in 1946 to 58 per cent in 1961, not including ground water. Each mineral fluid has its own preferred habitats, and finding new sources will require ever-increasing knowledge of geologic principles and processes.

The predicted annual demand for petroleum and natural gas by the year 2000 is three to four times present domestic production. This increased demand must be balanced by increased rate of production from known fields, by new discoveries, by increased imports, or by synthetic products extractable from coal and oil-shale deposits, or by utilization of other energy sources.

Other natural gases that come from subsurface reservoirs include helium, carbon dioxide, and hydrogen sulphide. Helium is in particular demand because of its unique physical and chemical properties; its geologic habitat is becoming better known.

About one-sixth of the country's present water supply comes from ground water. In some areas withdrawal exceeds recharge, but in other areas withdrawal can be increased greatly without exceeding potential recharge. Currently about one-third of the ground water withdrawn is not being replaced. The behavior, quality, and quantity of both surface and ground water are geologically closely interrelated. Increasing water usage will require improved scientific and legal coordination.

Subsurface saline waters pose a threat to some fresh-water supplies; but with improved conversion techniques saline water can provide additional fresh water. Some fossil brines are now rich sources of valuable chemicals and other brines are potential sources.

Development of geothermal energy from subsurface thermal water and steam has begun, and further exploration will increase the power output. Recovery of valuable chemicals dissolved in some geothermal fluids is being considered.

New uses for low-value fluids include "fluidizing" solids for easier transport and handling, and "solution mining" of low-grade ores.

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BAKKE FIELD, ANDREWS COUNTY, TEXAS

The Bakke field is a multi-pay field located adjacent to the town of Andrews in central Andrews County, Texas. The areal extent covers approximately nine sections, or about 5,700 acres. The producing zones are in Ellenburger and Devonian strata, where oil accumulation is controlled by structural closure with a well defined oil-water contact, and in Pennsylvanian and Wolfcamp zones, from structural-stratigraphic traps with no definite oil-water contact. The gravity of the produced crude generally increases from the Wolfcamp downward with the exception that the Ellenburger has slightly lower gravity than the Devonian. Viscosity is greatest in the Wolfcamp and Pennsylvanian and least in the Devonian and Ellenburger pays. The produced water shows the greatest salinity in the Wolfcamp and decreases to the Devonian, which is only slightly salty. There is a slight increase in the Ellenburger salinity.

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MIGRATION AND SEGREGATION OF OIL AND GAS

The mechanisms and extent of oil and gas migration have long been controversial subjects among petroleum geologists. Acceptance of proposed "primary" migration mechanisms, which involve the initial transfer of oil or gas from source rock to reservoir, is further complicated because several of these hypotheses require that petroleum formation occur during the primary migration stage. "Secondary" migration, which refers to the movement of oil and gas from one reservoir position to another, is better understood because geochemists have shown that petroleums undergo small but measurable changes in chemical composition during