metastable mineral equilibrated.

Because aragonite and magnesium calcites, in most cases, equilibrate moderately rapidly in time, either by replacement, inversion, exsolution, or dissolution. their disappearance from a rock might be a logical process of carbonate diagenesis. If true, diagenetic processes, as opposed to post-diagenetic processes, would in many cases reflect the environment of deposition.

LANDES, KENNETH K., Ann Arbor, Michigan

Petroleum in Time and Space

Conditions favorable to the formation of petroleum precursors have been in existence since early Precambrian time. Indigenous petroleum in commercial quantities is known today in strata ranging in age from Cambrian to early Quaternary. Discoveries of indigenous oil in the Precambrian can be anticipated where the limitations of space are met. Petroleum in space has no limitation in latitude, longitude, or present shoreline. It is limited to continental platforms and other sedimentary environments. It is also limited by a low tolerance for metamorphism. For this reason there is a "twilight zone" where oil and gas give way to gas only, both laterally in those basins that are bordered by tectonically disturbed belts, and with depth in deeper basins. Where coal is present, the degree of incipient metamorphism, or eometamorphism, can be determined roughly by carbon ratios, and more accurately by reflectance.

The lateral phase-out of oil caused by eometamorphism is found in many basins, including the Appalachian, Arkoma, and Alberta. Vertical phase-out occurs in the Gulf Coast, Permian basin, Anadarko basin, and the Baku district. During the last 16 years, 68 per cent of the new discoveries in the United States below 15,000 feet were gas (or gas and condensate); during the same period, only 30 per cent of the new discoveries above 15,000 feet were gas. Because of wide differences from place to place in thermal gradients and down-hole pressures, the depth of the oil "floor" changes considerably from place to place. In some areas oil phase-out can be expected from 15,000 feet (or above) to 17,000 feet; in others oil can exist a few thousand feet deeper. There is a distinct possibility that there is very little commercial oil below 22,000 feet.

LATHRAM, ERNEST H., and GRYC, GEORGE, U. S. Geological Survey, Menlo Park, California

New Look at Geology and Petroleum Potential of Northern Alaska

Three terranes in northern Alaska have potential for petroleum: a Tertiary basin in the eastern Arctic Plain, a post-Neocomian Cretaceous basin in the Northern Foothills and western Arctic Plain, and a complex of thrust-faulted late Paleozoic and pre-Albian Mesozoic rocks in the Brooks Range and Southern Foothills. Recent re-analysis of these terranes suggests that the disposition of extensive thrust sheets may have controlled the distribution of petroleum reservoirs in much of the area. This interpretation has significant implications in evaluating the petroleum potential of northern Alaska.

The Tertiary basin contains interfingering marine and non-marine clastics. A few open folds are present and may provide structural traps. Stratigraphic traps may be expected along the tectonically active southern margin and along the stable basement rise under the present continental shelf. Elements of the Brooks Range may have been thrust over the southern margin of the basin in late Pliocene time. This basin awaits exploratory drilling. In the post-Neocomian Cretaceous basin, interfingering marine and non-marine terrigenous clastic sediments in open folds offer a host of structural and stratigraphic traps. Some of these have been drilled, and a few contain sizable reserves of high-quality oil and gas. Stratigraphic traps may be expected also in pre-Cretaceous rocks along the basement rise that forms the northern margin of the basin. Buried detachment fault planes may underlie some of the southern folds, offering the possibility of different, and possibly equally interesting, structures and stratigraphic sections.

The Brooks Range and Southern Foothills terrane is the most complex and difficult to assess, but its geology and oil potential are the most intriguing. The distribution of formations and facies is the result of northward movement of extensive thrust sheets during at least two major episodes of thrusting in mid-Early Cretaceous (pre-Albian) and early Tertiary times. Tectonic movement may have been as much as 75 miles, thus telescoping facies trends in all formations. As a result, Upper Devonian through Lower Cretaceous (Neocomian) rocks of numerous facies are now exposed in a belt of imbricate thrust plates. Holes drilled in this terrane can test a variety of structures and numerous facies of several formations, but the geology is so complex that paleogeographical and palinspastic reconstructions must precede the drilling. Similar terranes elsewhere have been very productive.

LAWSON, DON E., and SMITH, JORDAN R., Forest Oil Corporation, Casper, Wyoming

Pennsylvanian and Permian Influence on Tensleep Oil Traps, Bighorn Basin, Wyoming

The Bighorn basin is located in northwestern Wyoming in the central Rocky Mountain province. Near the close of Desmoinesian time, regional uplift on the west and north elevated the Tensleep Sandstone of the Bighorn basin above sea-level. Broad, low-relief, northeast-trending folds developed during this orogenic uplift. Drainage patterns superimposed on the exposed Tensleep surface provided stream courses which furnished eroded Tensleep Sandstone sediment for the younger, upper Minnelusa Formation deposited in the east and southeast. During Middle Permian time, the Phosphoria sea transgressed the area, and the stream channels which had been incised in the Tensleep surface were filled with impervious shale, anhydrite, and reworked Tensleep Sandstone. Subsequent Phosphoria deposition onlapped post-Tensleep cuestas and monadnocks.

The majority of Tensleep accumulation discovered to date has been in traps which are structurally controlled. The effects of hydrodynamics have been recognized by many as factors in anomalous oil-water contact conditions. However, it is proposed here that accumulations in several of these traps are the result, partly or wholly, of three stratigraphic variables: (1) an intraformational change in permeability and (or) lithofacies, thereby providing a stratigraphic trap; (2) incised channels in the Tensleep surface which were later filled with impervious sediments, providing a truncational subcrop trap; and (3) a combination of (1) and (2) with later Laramide anticlinal folding superimposed on or near these primary traps, which commonly results in tilted oil-water contacts. Meteor-