typical form live suspended deeper than about 50–100 m. Basing the beginning of the Pleistocene on planktonic foraminiferal criteria, benthic Foraminifera indicate that outer-shelf conditions prevailed at the beginning of the Pleistocene in some areas, upper-bathyal depths existed in other places, middle-bathyal depths in some areas, and lower-bathyal depths at still other locations. Thus, a boundary based on upper limits of benthic species (*Epistominella pacifica* and *Uvigerina peregrina*), and defined by comparing sections from different parts of the Los Angeles basin, differs hundreds of meters in stratigraphic position.

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LIVING PLANKTONIC FORAMINIFERA IN SOUTH ATLANTIC

The distribution of living planktonic Foraminifera from equatorial to Antarctic waters of the South Atlantic has been determined from plankton tows. Of 24 species recognized, the faunal diversity is greatest in subtropical and temperate waters and is least in the Antarctic region.

Four faunal zones were established. The tropical-subtropical fauna consists mainly of *Globigerinoides sacculifer, G. ruber, Globigerinella aequilateralis, Hastigerina pelagica, Globorotalia menardii,* and *Globigerinoides conglobatus.* Indicator species of the temperate fauna are *Globorotalia inflata, G. truncatulinoides,* and *G. hirsuta.* The sub-Antarctic fauna is characterized by *Globigerina bulloides,* and the Antarctic assemblages are dominated by left-coiling *Globigerina pachyderma.*

The relations between living populations and dead assemblages in bottom sediments were examined, and their implications for paleo-oceanographic interpretation are considered.

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WORLD OCCURRENCE OF PETROLEUM IN PRE-SILURIAN ROCKS

Marine sedimentary rocks of Precambrian, Cambrian, and Ordovician ages constitute a major frontier for petroleum exploration. In regions where appreciable thicknesses of such rocks exist, the distribution of test wells ranges from sparse in most Ordovician sections to virtually non-existent in Precambrian rocks. The prospects for petroleum occurrence within these strata appear to improve with decreasing age. However, the fact that the environment favorable for shelf sedimentation expanded progressively through the same space of time suggests that time is not the overriding factor and that no region of marine sedimentary rocks should be discounted simply on the basis of age.

Petroleum hydrocarbons in apparently commercial quantities are known from pre-Silurian rocks of four continents: North America, Africa, Asia, and Australia.

In Asia and Australia, pre-Silurian rocks have not been tested adequately, and production of petroleum to date is negligible. In Africa, although the presence of pre-Silurian petroleum has been established only recently, very significant production rates already have been achieved.

Approximately 94 per cent of all oil produced from pre-Silurian rocks has come from North America, where the lower Paleozoic rocks have been important petroleum reservoirs for many years. Trillions of cubic feet of gas and an estimated 4.8 billion barrels of oil had been produced by the end of 1963 from pre-Silurian rocks of North America. The most significant area of pre-Silurian oil production is a belt occupying parts of Kansas, Oklahoma, Texas, and New Mexico, where productive beds are found in the Arbuckle, Ellenburger, and Simpson. Elsewhere in North America, the Trenton Limestone of Ohio, Indiana, and Michigan has yielded more than a half billion barrels of oil and more than a trillion cubic feet of gas.

Only in North America has the pre-Silurian section been extensively explored, and it is in North America that most of the known pre-Silurian hydrocarbon accumulations have been found. It would seem reasonable to anticipate that newly discovered petroleum from pre-Silurian rocks in Africa, Asia, and Australia will lead to intensive exploration programs and result in significant discoveries.

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GEOLOGY OF LOWER PERMIAN MINNELUSA OIL FIELDS, POWDER RIVER BASIN, WYOMING

Upper Minnelusa sandstone reservoirs of the Powder River basin produce oil from structural and unconformity traps. This sandstone probably is Wolfcampian in age and was deposited in shallow-neritic to littoral environments which characterized eastern Wyoming. Post-Wolfcampian erosion left remnants of Minnelusa sandstone beds which were covered by red shales and evaporites of younger Permian age.

Minnelusa oil fields of the northeastern Powder River basin, such as Raven Creek and Halverson, are mainly unconformity traps. Updip truncation of the Minnelusa is reflected by abrupt thickening of the overlying Opeche red shale, basal member of the Goose Egg Formation. Minnelusa fields of the western Powder River basin, such as North Fork, are largely structural traps, but post-Wolfcampian truncation may account for as much as half of the closure. In these fields Minnelusa sandstone is preserved on top of structures, and truncation on the flanks is reflected by abrupt thickening of the entire overlying Goose Egg section.

More than 100 million barrels of oil has been found in the upper Minnelusa. As productive trends are revealed by drilling, more oil will be discovered in structural, unconformity, and combination traps throughout the Powder River basin.

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PHYLOGENETIC AND TAXONOMIC PROBLEMS OF SOME TERTIARY PLANKTONIC FORAMINIFERAL LINEAGES

The basic phylogeny and classification of five major lineages of Tertiary planktonic Foraminifera are considered and several revisions are suggested. The definition of *Globorotalia* is broadened to include keeled and non-keeled forms; its range is Danian to Recent. *Globorotalia pseudobulloides* (Plummer) is interpreted to be highly polytypic and ancestral to all later Tertiary members of the Globigerinacea with