semblymen and senators, and even engineers, can be of some assistance. The profession has dallied for years on the primrose path of apathy, except for periodic outraged reaction to intrusion on its preserve by others. As a "program" this mixture of apathy and outrage is reminiscent of the life of a porcupine. Fortunately there are other paths to take. The profession has the capacity for making a rational choice from the overlapping yet conflicting programs offered by registration (equals licensing), certification, and incorporation (equals chartering). If you do not know the precise differences among these terms, this is as good a time as any to find out. If you do know, and have an interest in the profession at which you work, this talk offers a 20-minute interval in which to think about it.

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CHRONOLOGY OF DEFORMATION OF PALEOZOIC AND TERTIARY SUCCESSION NEAR RAILROAD VALLEY, NEVADA

Principal structures occurring in the Paleozoic sedimentary section of the Horse Range are thrust faults (some placing older over younger rocks, but most placing younger over older), north-south-trending, asymmetrical, eastward-overturned folds, and high-angle faults. Pre-Oligocene deformation of these Paleozoic rocks is indicated by Oligocene volcanic rocks lying with angular unconformity on overturned Ordovician strata.

In the dissected pediments west of the Horse Range, a 10,000-foot-thick sedimentary and volcanic succession of Oligocene, Miocene, and Pliocene rocks crops out (Moores, 1965). The Miocene-Pliocene part of the section lies disconformably on Oligocene volcanic rocks and consists of an assemblage of terrestrial strata, including indurated ash beds, lacustrine limestone, and immature detrital deposits which contain angular Paleozoic carbonate and Oligocene volcanic clasts derived from adjacent ranges.

The general parallelism of the Paleozoic and Tertiary successions given as evidence for contemporaneous deformation (Moores, 1965) is expressed only in that they are in contact with one another for a distance of approximately 12 miles. There the parallelism ends. Folds and thrust faults in the Paleozoic rocks trend north-south, whereas folds within the Tertiary succession trend east-west and plunge steeply toward the west. These relations, together with the angular unconformity between the Oligocene volcanic rocks and Paleozoic rocks, temporally separate tectonic deformation of the Paleozoic and Tertiary successions.

Principal deformation of the Paleozoic succession at least preceded the Oligocene volcanic rocks, and may be as old as Pennsylvanian (Ptacek, 1963). Deformation of the Tertiary succession occurred, at least in part, after the Pliocene rocks were deposited, and probably during the Oligocene and Miocene, as is suggested by several unconformities reported in the Tertiary succession (Moores, 1965).

Some occurrences of Paleozoic rocks are in positions that suggest emplacement by gravity sliding during or after deposition of Tertiary rocks. These occurrences can be explained easily as gravity-slide blocks emplaced from adjacent ranges (*e.g.*, Horse and Grant) as the ranges were uplifted along high-angle faults, but in no way imply that the principal deformation of the Paleozoic strata was contemporaneous with deformation of the Tertiary succession.

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CLOSING THE ONSHORE-OFFSHORE GAP

(No abstract submitted.)

ROTHWELL, W. T., JR., Atlantic Refining Company, Long Beach, California

STRATIGRAPHIC FACIES PREDICTION AND RECOGNITION IN YOUNG OFFSHORE BASINS FROM STUDIES OF FOSSIL ENVIRONMENTS

Basic principles of stratigraphy provided by Cambrian paleontology have analogies with Pacific Coast Oligocene, Pliocene, and other rocks. Re-examination of concepts from the time of Hutton (1795) and restudy of the complete fossil record are proposed to interpret the geologic history of new areas of petroleum exploration.

The doctrine of uniformitarianism in sedimentary processes, and uniformitarian biologic laws, provide the key to solution of stratigraphic problems if they are combined with the principle of uniqueness of environments (Nairn, 1965).

Stromatolite reef occurrences from the Precambrian of Glacier National Park (Rezak, 1957) to the Recent of Shark Bay, Australia (Logan, 1961), with oölite, glauconite, and shoal sediment features, illustrate the first principle (unchanging physical geologic processes).

Palmer's biomere concept (1965) for benthonic trilobites and his Upper Cambrian agnostid studies, and the Middle Cambrian agnostid studies of Robison (1964), provide analogy with benthonic and nektoplanktonic fossils of any age under the second principle (uniformitarian biologic laws).

The stratigraphic limitation of the fossil biomere in Cambrian, Oligocene, or Pliocene by historical events, by the migration from eurybathyal to stenobathyal habitats, and by the effect of cyclical climatic events on evolution or extinction shows the third principle (uniqueness of environments).

Analogous examples of the fundamental principles are provided by Foraminifera in benthonic uvigerinid biomeres in the Oligocene of the Pacific Coast. Analogy with cyclothems is found in correlations between cyclical climatic stages of the Pliocene planktonic *Globigerina pachyderma* (Bolli, 1950) in the Los Angeles and Ventura basins, California (Bandy, 1961), and synchronous climatic history in Japan (Kobayashi and Shikama, 1961).

Correlation of cyclical historical events rather than reliance only on syntax of animal or plant fossils is important for regional correlations and sedimentary-facies studies.

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CONTINENTAL MARGIN OF NORTHERN AND CENTRAL CALIFORNIA

The geology of the continental margin offshore from northern and central California, though actively studied in recent years, still is very incompletely known. Much of the available data consists of measurements made at the ocean surface from which deductions have been made regarding the rocks and structures on the sea floor. The nature of the young sediments on the surface of the sea floor is moderately well known from dredge sampling, though not nearly so well known as in the broad shelf area off the coast of southern California. Bedrock that underlies these sediments has been sampled only by a few dredgings, but is, of course, exposed in a few islands and along the shore. Although the offshore geology is very complex, the continental margin of northern and central California is unusually youthful, and thus is particularly suited for the study of basic problems of the development of continental shelves and slopes, and of the transition between continental and oceanic crustal rocks and structures.

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Santa Barbara Channel Federal Sale

(No abstract submitted.)

SPAULDING, ARTHUR O., Petroleum Administrator for the City of Los Angeles, California

Oil and the Asphalt Jungle—Part 2

Oil in commercial quantities was first found in Los Angeles in the latter part of the 19th century. Today, several generations later and after most of the exploratory potential of California has been evaluated, the search for new accumulations of oil and gas in the heart of Los Angeles continues at a rapid pace. Indeed, the current tempo of drilling activity in the downtown parts of the city must be considered remarkable in view of the many decades which have passed since the date of initial oil discovery.

The City of Los Angeles in 1946 adopted its present Comprehensive Zoning Plan which, together with subsequent amendments, provides the regulatory framework for urban oil-well drilling and exploration. The first successful urbanized oil-drilling district was created in 1953. Since then, 150 of these supplemental-use districts have been established for the development of oil prospects throughout the city. Three years ago the city enacted a new ordinance permitting the drilling of deep geological core holes as a means of testing these oil prospects without the necessity of forming districts and drilling high-cost, exploratory wells. As a consequence, interest in the oil potential of the densely populated sections of Los Angeles has risen dramatically.

Currently, nine rigs are busy in central Los Angeles drilling either oil wells or core holes. Several more strings should be added in the near future. Production from approximately 185 downtown wells amounts to 22,000 bbls./day of oil and 55,000 Mcf./day of gas. Reserves in excess of 100 million barrels of oil already have been proved in the area extending from City Hall to Santa Monica Bay, and it is likely that 50 million barrels will be added to this estimate as a result of current drilling operations.

STORY, RICHARD F., Shell Oil Company, Los Angeles, California

Middle Ground Shoal Field, Alaska

Middle Ground Shoal oil field is in the Anchorage basin, Alaska, 21 miles west of Swanson River oil field, about 52 miles west-southwest of Anchorage, and is located centrally in Cook Inlet just north of the restriction formed by the East and West forelands. It was discovered by the Shell-Richfield-Standard group drilling from a floating vessel in the summer of 1963. This was about 4 years after the first marine reflection-seismic survey was conducted in Cook Inlet by an 11-company group, and almost 6 years after the discovery of Alaska's first major oil field, Swanson River.

Cook Inlet is probably one of the most difficult marine areas in the world in which to look for and develop oil reserves. Conditions, such as 25–35-foot tides, 6–8-knot tidal currents, strong winds, and pack ice make all phases of the operation extremely hazardous and tax the ingenuity of the men involved. A motion picture of the platform construction portrays this aspect.

First production was accomplished late in 1965 when the valve on the 7-mile pipeline to shore was opened. At the present time, operations are being conducted from two permanent platforms; a third will be constructed in 1966; and others may follow.

As the early phases of development are begun, the Middle Ground Shoal accumulation appears to be trapped by a very tightly folded north-south trending anticline. It is bounded along the west side by a major fault with a throw of 10,000 feet or more. In gross aspect, this anticline is near the western side of a long, narrow, non-marine Tertiary basin where vertical tectonics appear to be dominant.

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Project Mohole

Project Mohole is this country's scientific effort to explore and sample all layers of the earth's crust and the underlying mantle.

The need for such a project is basic: the mantle comprises about 84 per cent of the earth's volume. When geologists and geophysicists know its composition and physical properties, they will be able to reason more intelligently about the earth.

There is also a possibility that knowledge of the mantle may be applicable to other planets in this solar system, for many scientists now believe that all of the planets were created at about the same time and may be similar in composition. Thus, exploration of *inner* space may contribute to exploration of *outer* space.

The most favorable sites for drilling to the mantle are in certain areas of the deep ocean basins where the crust is thinnest. At the site recently selected for Mohole drilling in the Hawaiian Islands, the mantle lies only 6–7 miles below sea-level. In contrast, the depth to the mantle beneath the continents averages about 20 miles.

The idea of drilling to the mantle from a floating vessel in deep water was first conceived in 1957 and, with National Science Foundation funds, Phase I of Project Mohole was completed in 1961 off the coast of lower California. The objective of this part of the Mohole program was to prove that the ultimate goals of the project were feasible by carrying out a shallow drilling (coring) program in deep water from a floating vessel.

In this respect, Phase I was successful; in 1962, the National Science Foundation initiated Phase II of Project Mohole. The purpose of Phase II is to achieve the original objectives of the project—making the penetration of the crust and mantle as meaningful as possible through collection and study of rock samples and scientific measurements to be made in the hole both during and after completion of drilling.

The technical problems which confronted the Phase II Mohole staff, when it was organized in 1962, could