

fication and redefinition of these series subdivisions. Thus, employing the criteria for biostratigraphic correlation summarized by Berry, the type San Lorenzo Formation has been shown to be Eocene at its lower zones, and equivalent in age to the Oligocene lower Vaqueros Formation in its upper beds. In turn, the Vaqueros at its type locality is seen to be in part age-equivalent to the generally still younger Temblor Formation. Locally, the lower parts of the Monterey Shale are correlative to parts of the Temblor, whereas stratigraphically higher intervals have been shown by the late George Richards to be age-equivalents of the type Santa Margarita Formation. Further, the type Santa Margarita is in part age-equivalent to the partly coarse clastic typical Modelo and Puente Formations of southern California, which in turn are partial age-equivalents of the organic shales of the Monterey. The type Santa Margarita is also in part age-equivalent to the Rodeo-Briones-San Pablo sequence of the Berkeley Hills.

Refined microfaunal studies thus have made possible significant progress in our understanding of the complex stratigraphic relations of the West Coast middle Tertiary formations. A residue of confusion remains, however, which can be traced in part to the persistent use of reconnaissance "index species," as well as the dual use of names for the descriptive formational terminology and the interpretive time-rock terminology.

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#### ECOLOGY AND THE ENERGY INDUSTRY

California is dependent on oil and gas for 98% of its total energy needs. Petroleum is the state's number one mineral commodity, with an annual value of \$1.2 billion. Industry's payroll is \$1.3 billion, and its tax bill to state and local government is \$274 million.

Statewide regulation of the industry, which started in 1915, was directed primarily toward preventing waste and damage. Numerous governmental agencies are now engaged in regulation directed at protection of the environment; at the federal level there are five agencies, at the state level, six. The petroleum resource must be utilized, but at the same time extraction and refining must have minimal effect on the environment.

The "oil patch" philosophy is out of date. Most industry people do not think sumps, derricks, or piles of tubing are ugly, but many other people do. It can be shown that a spill in the ocean has no lasting effect on the biota, but it is a disaster to the person that gets oil on his feet. Industry has done a remarkable job in responding to the new environmental philosophy by starting programs to clean up sumps, beautify drill sites, and install pollution-prevention devices. To clean up the "oil patch" is not just good public relations; it is a necessity in order to stay in business.

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#### HISTORICAL GEOLOGY OF THE PACIFIC

The development over the past few years of a high-resolution biostratigraphic scheme based on joint occurrences of Radiolaria, nannofossils, and planktonic Foraminifera enables us to make new progress on problems of paleogeography, paleoceanography, sedimentation, and tectonics in the Pacific. Results from the Deep Sea Drilling Project, combined with other geologic and geophysical data, suggest the following post-Jurassic history for the Pacific plate.

Sedimentary facies patterns reflect a northward motion of the plate relative to the equatorial zone of high biologic fertility, as well as progressively increasing sea-floor depths as newly formed crust moves away from the East Pacific Rise. Superimposed on these gross patterns are evidences of fluctuations in the width of the zone of high productivity, changes in the calcium carbonate compensation depth, and variations in the

intensity of bottom-water circulation.

Extensive Early Cretaceous volcanism inundated much of the older western part of the plate and was succeeded by the building and subsidence of long chains of seamounts as the plate moved northwestward, possibly over hot spots beneath the lithosphere. Comparison of plate motion, as indicated by equatorial-zone sediments, with motion indicated by trends and age progressions in seamount chains leads to the hypothesis of a south-moving counter flow in the asthenosphere.

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#### LATE MIOCENE AND EARLY PLIOCENE CORRELATIONS IN CALIFORNIA PROVINCE

The late Miocene of California was divided into four Opehian zones by Kleinpell. He grouped these zones into larger time-stratigraphic units, the Mohnian and Delmontian Stages. As a discipline for these zones and stages, Kleinpell used benthonic foraminifers and larger invertebrates in continuous stratigraphic sequences. The *Bolovina modeloensis*, *Bulimina uvigerinaformis*, and the *Bolovina hughesi* Zones represent the Mohnian, and the *Bolovina obliqua* Zone represents the lower half of the Delmontian Stage. No foraminiferal zone was designated for the upper half of the Delmontian Stage. These two stages and four foraminiferal zones can be found in continuous stratigraphic (superpositional) relation with demonstrable middle Miocene, late Luisian, faunas below and early Pliocene faunas above in the following areas: Palos Verdes Hills, Huasna-Nipomo, Monterey, San Pablo Bay area. Additional continuous stratigraphic sections representing the middle Miocene and early late Miocene, the Luisian and Mohnian Stages, are found in Newport Beach; the Luisian, Mohnian, and Delmontian Stages are found in the Naples Bluff section; the Mohnian and Delmontian Stages are found in Woodland Hills (type Mohnian); the Delmontian and early Pliocene are found in the Reef Ridge area. All of these stratigraphic sections contain one or more of the following groups of microfossils: diatoms, radiolarians, silicoflagellates, and planktonic foraminifers. These microfossil groups, together with the benthonic foraminifers and larger invertebrates corroborate Kleinpell's original zonal sequence.

#### MEMBERSHIP APPLICATIONS APPROVED FOR PUBLICATION

The executive committee has approved for publication the names of the following candidates for membership in the Association. This does not constitute election, but places the names before the membership at large. If any member has information bearing on the qualifications of these nominees, he should send it promptly to the Executive Committee, Box 979, Tulsa, Oklahoma 74101. (Names of sponsors are placed in parentheses.)

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