tion of mud probably provided most of the pore water which liquefied intercalated sand. The exceptional wavy dikes apparently were intruded earlier and compacted later with their wall rock. Sill-like masses are more problematical; some evidence clearly indicates liquefaction after burial, but others of these masses could have formed at the depositional interface. Certain strata were liquefied in place after burial and are not true intrusions, although they strongly resemble sills. Some synsedimentary folds can be distinguished from tectonic ones where sandstone dikes cut through them and prove an early, soft-sediment origin. Dikes along slaty cleavage have been cited as evidence of early formation of such cleavage. Some intrusions are useful in determining dates of migration and deposition of ores or fluids. Dikes may show close relations with regional structures, but many do not. Though more common in tectonically mobile regions, they also occur in stable ones. They most probably originated by shocks from earthquakes or from sudden loading. They are more common than is generally realized and their usefulness to the geologist has not been appreciated fully.

DOUGLAS, ROBERT, University of California, Davis, California, and SLITER, W. V., University of California, Los Angeles, California

DISTRIBUTION OF LATE CRETACEOUS ROTALIPORIDAE AND GLOBOTRUNCANIDAE IN CALIFORNIA AND NORTHWESTERN MEXICO

A study of planktonic Foraminifera from the Upper Cretaceous of California and northwestern Mexico forms a basis for erecting a preliminary biostratigraphic zonation.

The *Praeglobotruncana stephani* assemblage zone, of late Cenomanian age, is characterized by species of Rotaliporidae.

Strata of early Turonian age are recognized by the first appearance of bi-keeled globotruncanids which characterize the *Globotruncana imbricata* assemblage zone. Within this zone occur *Praeglobotruncana helvetica, G. kuepperi,* and several undescribed species. The *Globotruncana coronata-G. inornata* assemblage zone includes rocks of late Turonian to early Senonian age and contains distinct species of *Globotruncana, Clavihedbergella,* and *Hedbergella.*

The *Globotruncana arca* assemblage zone, of late Senonian age, contains several important stratigraphic markers, *e.g., Globotruncana ventricosa, G. havanensis, G. elevata,* and *Rugoglobigerina rugosa.* These indicate a Campanian to early Maestrichtian age. The planktonic Foraminifera which define the late Maestrichtian in other parts of North America are unrecorded in the eastern Pacific.

The stratigraphic and geographic distributions of selected species of *Praeglobotruncana, Globotruncana,* and *Rugoglobigerina* are compared with those from the Atlantic Coast and Gulf-Caribbean area. This comparison suggests that *Globotruncana arca, G. linneiana, G. fornicata,* and several other species were cosmopolitan, whereas such species as *G. calcarata* were latitudinally restricted during the Late Cretaceous. The genera *Abathomphalus* and *Plummerita* are found exclusively in the Tethyan region. *Globotruncana gagnebini, G. subcircumnodifer,* and others are reported only from the western margin of the Atlantic Ocean; *G. kuepperi, G. churchi,* and *G. putahensis* are unknown outside of the Pacific basin.

DRUGG, WARREN S., Chevron Research Company, La Habra, California

LATE CRETACEOUS-PALEOCENE PHYTOPLANKTON, UPPER MORENO FORMATION, CALIFORNIA

Dinoflagellates and acritarchs are abundant in the upper Moreno Formation (Late Cretaceous-Paleocene) in Escarpado Canyon, California, the type area for the members of the Moreno Formation. Samples of the Marca Shale and the overlying Dos Palos Shale Members were studied from a subsurface cored section. The age of these units is well established by use of criteria independent of palynology, such as ammonites and foraminifers. The Cretaceous-Tertiary boundary usually has been placed somewhat arbitrarily at the contact of the Marca and Dos Palos Shales, but by the use of palynological evidence is placed in the Dos Palos Shale about 20 feet above the top of the Marca Shale. The phytoplankton assemblages exhibit marked changes at this level and further changes are evident higher up in the Dos Palos Shale.

The Maestrichtian is characterized by *Gymnodinium nelsonense* Cookson, *Deflandrea cretacea* Cookson, and a distinctive new species of *Hystrichosphaera.* The Danian is characterized by new species of *Areoligera, Hystrichosphaeridium, Cannosphaeropsis, Deflandrea,* and *Palmnickia.* A new species of *Palaeostomocystis,* and *Membranosphaera maestrichtica* Samoilovitch are abundant in the Danian but occur rarely in the Maestrichtian. Forms restricted to the lower Danian of the Dos Palos Shale include *Peridinium* and a new genus of Deflandreaceae. Forms restricted to the upper part of the Dos Palos Shale include *Cordosphaeridium inodes* Klumpp, *Deflandrea speciosa* Alberti, and *Glyphanodinium facetum* Drugg. Pollen and spores are present also in large numbers in the upper Moreno Formation. With a few exceptions, they are generally inferior to the phytoplankton for purposes of age-dating and zonation. There is good reason to believe that the phytoplankton eventually will prove to be as useful as planktonic foraminifers for correlation purposes.

EBANKS, WILLIAM J., JR., and TEBBUTT, GORDON E., Rice University, Houston, Texas

DIAGENETIC MODIFICATION OF RECENT SEDIMENTS ASSOCIATED WITH A LIMESTONE ISLAND

Recent carbonate sediments on Ambergris Cay, British Honduras, occur as a thin veneer of supratidal and intra-island lagoonal deposits, incompletely mantling an irregular Pleistocene limestone surface. Both sediments and rock exhibit different degrees of diagenetic modification. The supratidal mud flats usually adjoin very shallow hypersaline ponds, where sediments are subjected to extremes of chemical and physical environmental conditions; the raised rims of the mud flats prevent rapid drainage after periods of heavy rainfall or sea-water flooding.

Etching by rainwater and boring by algae tend to destroy or comminute sediment particles on the mud flats. Furthermore, extensive blue-green algal mats commonly are associated with a near-surface crust of dolomitized sediment. Degree of induration of this crust is related to the degree of dolomitization. Low pinnacles of Pleistocene limestone, where exposed near the dolomite crust, also have been partly dolomitized. Recent sediment particles commonly are recrystallized to cryptocrystalline carbonate, without mineralogic change, prior to burial.