Although the conodont fauna of the Brassfield Limestone conforms in general with that of Zone-I, it appears to be transitional with the *celloni*-Zone fauna in southeastern Indiana, where the formation is younger than in its type area in east-central Kentucky. Correlation with the European sections is made more difficult because specimens assigned by Walliser to *Icriodina irregularis* and considered by him to be indicative of the upper part of Zone-I may in fact belong to *Scyphiodus*, a genus that is present in beds as young as the lower part of the Clinton Group in Ontario. A new platform-type genus derived from *Spathognathodus* is first recorded in the upper part of the Brassfield.

Above the Brassfield Limestone in its classic concept is another lithologic unit, tentatively assigned to the Brassfield, that has a mixed conodont fauna. The conodonts considered indigenous include *Icriodina irregularis, Hadrognathus staurognathoides, Carniodus* spp., *Spathognathodus celloni, Pterospathodus amorphognathoides,* and new species thought to belong high in the *celloni*-Zone. Overlap of *S. celloni* and *P. amorphognathoides* shows extension of the known range of one or both species. The conodonts of this zone are morphologically unstable, but the thinness of the unit and admixed material, including Ordovician specimens, do not allow recognition as yet of precise evolutionary development and zonation.

The conodonts in the basal part of the overlying Salamonie Dolomite belong in the *amorphognathoides*-Zone and include *Pterospathodus amorphognathoides* and *Ozarkodina gaertneri*. In Europe the upper terminations of these two species and *Carniodus* coincide, whereas in the Cincinnati arch area the two extend considerably above the highest level of *Carniodus*. These facts suggest that an unconformity is present in the Carnic Alps between the *amorphognathoides*- and *patula*-Zones. If so, most of the Salamonie above the lower beds that contain *Pterospathodus* may represent an unrecorded time interval, but it is possible that the absence of *Kockella patula* reflects provincialism.

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Consolidation Characteristics of Selected North Pacific Sediment Clays

A recent theoretical analogy of the consolidation process of clay-type sediments, with reference to their viscous resistance to compression, indicates that engineering properties other than rheology can be determined from the consolidation test. A consideration of the lithology of selected north Pacific sediment cores, correlated with consolidation and other soil-mechanics test results, verifies this conclusion. In this circumstance the pore fluid functions as a highly viscous media which controls the deformation of such sediments under load. A mathematical statement of this viscous resistance to compression is combined with a new stress equation to present a statement which adequately expresses the consolidation process. Interpretation of consolidation curves using this approach enables prediction of viscous resistance to shear. This resistance is controlled primarily by stress level and to a lesser degree by compositional factors. These studies are supported by the conclusions of other researchers of the mechanical behavior of such materials.

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Sedimentologic Process Analogies Between Earth and Moon

(No abstract submitted.)

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Paleogeographic and Paleoecologic Analysis of Planktonic Foraminifera

Abundance studies of extinct planktonic Foraminifera are proving a fruitful method of paleogeographic and paleoecologic analysis. Population counts of species and genera in fossil faunal assemblages give approximate percentage figures for paleo-faunal studies. Comparison of population data between two or more stratigraphic sections can be used as an indication of paleo-faunal differentiation and can outline paleogeographic distribution of species. Abundance analysis based on faunal sequences appears to reveal patterns that are repeated within sections from the same faunal province.

Application of this method of analysis to planktonic foraminiferal faunas from Maestrichtian and Paleocene assemblage zones in selected sections of the Atlantic, Gulf, and Mediterranean regions indicates distinct paleogeographic and paleoecologic differentiation. Broad generic distributions are evident, whereas there are more distinct geographic limitations on species in the Maestrichtian and Paleocene. There also is some indication of possible geographic subspecies variation. The most marked differentiation occurs along lines of longitude with more favorable comparisons and less marked differences along lines of latitude. A greater number of genera and species are found in low latitudes than in high latitudes in rocks of the Maestrichtian and Paleocene.

Faunas from sediments deposited in shallow-water environments are characterized by a limited number of species. The species that do occur usually are the most abundant elements in the planktonic faunas found in sediments deposited in deeper-water environments.

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Application of Water-Classification Methods to Waters from Carbonate Formations

Many reports of formation-water analyses show determinations for only carbonate, bicarbonate, sulfate, chloride, calcium, magnesium, and sodium ions. An attempt to utilize these analyses has been made by using the methods of Palmer, Sulin, Schoeller, and Chebotarev to classify some waters from carbonate and other types of formations. The purpose of this study is to determine whether these methods effectively classify waters associated with petroleum formation and whether this information can be used in exploration or the identification of formations.

It was found that the more extensive water-classification methods of Sulin and Schoeller better classify waters associated with petroleum formation than the methods of Palmer and Chebotarev. In this study, waters that were classified by Sulin's method as chlo-

ride-calcium or chloride-magnesium gave a positive index of base exchange when classified by Schoeller's method. Waters known to be in contact with petroleum were classified by Sulin's method and were found to be of the chloride-calcium, chloride-magnesium, and bicarbonate-sodium types, but not of the sulfate-sodium type.

It was concluded from the study that classification of the above types of data from water analyses would not be positively indicative of petroleum, but might have some application as an aid in exploration. Water classification could, in some instances, be used to identify formations, analyses for organic and minor constituents dissolved in waters associated with petroleum formation will add to the value of data from water analyses. It was found that unless extreme care is used in obtaining water samples for classification or formation identification, contaminated samples will give erroneous results.

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ROCK-BORING ORGANISMS AS MARKERS OF STRATIGRAPHIC BREAKS

Borings made by various kinds of organisms are characteristic of many disconformities from the Ordovician to the Recent. Borings are especially abundant on Jurassic, Cretaceous, and Tertiary discontinuity surfaces in shallow-shelf carbonate sequences. The organisms that made most of these borings are mollusks, sponges, various kinds of worms, barnacles, and algae. Of these groups the bivalve mollusks are the most common and most highly adapted borers.

The recognition of the rock borings and their distinction from burrows made in unlithified sediment commonly is necessary for the identification of otherwise obscure disconformities. Rock borings in carbonate sequences imply stratigraphic breaks with histories of (1) emergence, (2) lithification, and (3) resubmergence; whereas, in the same sequences burrows do not necessarily imply any sort of stratigraphic break. Shapes of burrows and borings and relations with sediments and structures are reviewed as the essential criteria for recognizing borings and bored surfaces and for distinguishing them from burrows and burrowed surfaces.

Cretaceous and younger rock sequences of Texas and Mexico include many disconformities characterized by borings. The magnitude of the stratigraphic breaks which these bored surfaces represent ranges from local intraformational interruptions to major intersystemic unconformities. Examples of these surfaces are compared in terms of (1) surface morphology, (2) encrusting faunas, (3) shape and variation of borings, (4) corrosion features, (5) areal extent, and (6) lateral correlatives.

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EAGLEFORDIAN (CENOMANIAN—TURONIAN) STRATIGRAPHY IN MEXICO AND TEXAS

The biostratigraphy of the San Felipe Formation of Mexico and the correlative Eagle Ford Group of Texas has been studied extensively from well cores and measured sections. The San Felipe was examined in outcrop at Boca Canyon south of Monterrey whereas the Eagle Ford was studied at Chispa Summit in Jeff Davis County, at Lozier Canyon near Langtry, at Sycamore Canyon near Del Rio, on Bouldin Creek in Austin, at Atco near Waco, and at the type locality at Dallas.

Previously, Eaglefordian strata in Texas and Mexico were included in the *Rotalipora cushmani-greenhornensis* Subzone of the *Rotalipora* s.s. Assemblage Zone and the *Marginotruncana sigali* and *Whiteinella archaeocretacea* Subzones of the *Marginotruncana helvetica* Assemblage Zone. At Boca Canyon in Mexico all of these units are represented. Through most of Texas, however, sampling indicates that the *Marginotruncana sigali* Subzone is consistently absent, and the *Whiteinella archaeocretacea* Subzone rests unconformably on strata assignable to the *Rotalipora cushmani-greenhornensis* Subzone of the *Rotalipora* s.s. Assemblage Zone.

In view of these discoveries, the writer proposes to subdivide the Eaglefordian Stage of the standard Gulf Coast Upper Cretaceous section into three substages: (1) the Lozierian (late Cenomanian), (2) the Bocian (early Turonian), and (3) the Sycamorian (late Turonian).

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DISTRIBUTION AND ORIGIN OF PENNSYLVANIAN CARBONATE MOUNDS, PARADOX BASIN

Shelf carbonate mounds of Desmoinesian (Pennsylvanian) age were developed in cyclic repetition along the southwestern flank of the Paradox basin. Optimum carbonate deposition occurred in an elongate northwest-southeast belt, approximately 50 miles wide and over 100 miles long, which contains about 35 Pennsylvanian oil and gas fields. Porosity occurs in three types of carbonate reservoirs: algal plate mounds, foraminiferal mounds or bioherms, and "leached oölite" banks. Most of the production is from limestone, but dolomite also is important as a reservoir rock.

Stratigraphic-facies mapping of the mound-bearing strata can be done on the basis of basin-wide, black, sapropelic shale marker beds, in conjunction with lithologic-petrographic analysis of rock types and associated faunal content. Shelf carbonate rocks occur in each main cycle of the Paradox Formation, grading basinward into evaporite and shoreward into sandy limestone and terrigenous clastic rocks.

The origin, distribution, and cyclic repetition of the carbonate-mound belts are thought to be related to periodic eustatic changes in sea-level associated with late Paleozoic glacial cycles of the Southern Hemisphere. The mounds probably developed along shallow-water mud banks or platforms which built basinward during the early clastic phase of each cycle. Completeness and duration of a cycle were major factors in determining the size attained by the mound complex.

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RATES AND MECHANISMS IN FORMATION OF DOLOMITE

Dolomite is forming in Deep Springs Lake, California, and marine-associated Coorong lakes of South Australia. Dolomite forms via a surface-layer precursor, which is commonly calcium-rich in comparison