shore and is represented by a change in trend of Triassic and older rocks ashore. The implications of this and other newly established features are discussed.

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EARLY VADOSE SILT IN TOWNSEND MOUND (REEF), NEW MEXICO

Vugs, fractures, interstices, and other voids in the Townsend carbonate mound (reef) are floored with internal sediment composed of well sorted calcite silt. Internal sedimentation predates precipitation of blocky cement, and post-dates both precipitation of early drusy cement and early internal erosion. The crystal silt differs from associated marine sediment in its scarcity of clay-size particles, sand-size particles, and recognizable skeletal debris.

The age relationships and texture of crystal silt seem best explained by sedimentation inside pre-existing crumbly rock in the vadose zone during early emergence. If the explanation is valid, similar internal sediment might be a valuable clue to previously unrecognized subaerial stages in other carbonate mounds.

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CONCEPTS OF THE ATOKA

The Atoka was named and defined as the formation between the Hartshorne Sandstone above and the Wapanucka Limestone below (1900, 1901).

The basal part of the Atoka is considered by some to correspond with the Kessler Member of the Morrow.

Minute fusiform fusulinids are known from the basal Atoka at Clarita, Oklahoma; and it is commonly believed that *Fusulina* is entirely a post-Atokan genus.

However, "Fusulina" was already described from beds assigned an Atokan age (in New Mexico and Wyoming); and now prolific *Fusulina* was found about 400 feet below the Hartshorne northwest of Clarita.

It would be logical not to expect lithologic boundaries, no matter how locally persistent, to coincide with major steps in evolution of embedded fossils, no matter how seemingly rapid. Hence, biostratigraphic boundaries postulated on the evidence of evolution of fusulinids need not correspond with lithologic boundaries, although they may do so at places. The first appearance of the fusiform fusulinid *Fusulinella* appears to coincide roughly with the basal sediments of the Atoka, at least in the type area of the Atoka; but the first appearance of *Fusulina* is undoubtedly well within the upper and perhaps even middle part of the original Atoka.

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CHARACTERISTICS OF CONTINENTAL SHELVES AND SLOPES

One of the most important and interesting geological questions awaiting solution is that of the origin of continental shelves and slopes. Just as for other geological features, more than a single origin is involved for different areas or for different times. Data on structure, composition, and topography provide the clues for interpretation of geological history and thus of origin, but such clues are presently so incomplete that interpretations are uncertain. Common to many areas is the presence of a downwarped basement under the slope and(or) a topographic depression beyond the slope—but is this cause or effect? Also common is the composition: marine sediment—but what can we infer about the precise environment of deposition of these sediments? Are they neritic under the inner part of the shelves and bathyal beneath the slopes? How important are turbidites for the continental rise beyond? How similar are the Mesozoic and Tertiary sediments to those of the Pleistocene and Recent? The present topography is reasonably well known—but is it similar to ancient topography? In many areas the present shelf has been shaped by processes unique to the Pleistocene—does this mean that continental shelves did not exist before the Pleistocene? New data will be presented by the different speakers, all of whom have been active in field studies. We, perhaps, will find that a comparison of the results of their field work in large, but widely separated, areas will provide a much needed fresh approach to the question of the origin of continental shelves and slopes.

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SEDIMENT AND STRUCTURE IN THE DEEP BASIN OF THE GULF OF MEXICO

Underway seismic reflection measurements have been made almost continuously since January, 1961, on expeditions of Columbia University's Research Vessel VEMA. Reflection profiles reveal the sedimentary layers down to a strong, rough-surfaced reflector which is assumed to be basement. These profiles display, in the deep basin of the Gulf of Mexico, buried structures which are believed to be salt domes. The sedimentary layers revealed in the Gulf of Mexico are discussed and hypotheses are offered about the geological history of the region and the possible means by which salt domes could emerge in deep oceanic basins.

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MODEL FOR CYCLIC SEDIMENTATION IN THE APPALACHIAN PENNSYLVANIAN

The basic elements of an idealized or model cyclic deposit in the Pennsylvanian strata of the Appalachian region are the commonly occurring rock types—siltstone, shale, sandstone, coal and associated "seat rock," ironstone, and limestone. These rocks can be considered as members of genetic classes which reflect dominance of either "physical" or "chemical" depositional processes. Siltstone, shale, and sandstone are mainly the product of physical deposition of solid particles from suspension, whereas coal, "seat rocks," ironstone, and limestone wholly or in part originate from biochemical or physical-chemical processes. Pennsylvanian sequences consist of alternating layers of these "physical" and "chemical" deposits of varying thicknesses and such alternations comprise, perhaps, the only completely unequivocal manifestation of cyclic sedimentation. Specific differentiation of lithologic types beyond this simple "physical"-"chemical" dichotomy leads to increasing complexity in describing the cyclic deposits. Stratigraphic sections commonly show "chemical" units which may include only one or all three of the common chemical rocks. Likewise, physical units may include one or more rock types and the sequence of these rock types differs from cycle to cycle.

Detailed studies at lateral variation of completely exposed small cyclic deposits and of larger cycles with a small rate of lateral variability suggest the generalized model shown diagrammatically. This diagram, shown