to be the result of a violent explosion caused by meteorite impact in very early Cincinnatian time.

Each recognizable stratigraphic interval thins over the brecciated core of the structure. Part of this thinning may be the result of differential compaction, comparable with that found over Silurian reefs. The possibility also exists that the brecciated core has been gradually and continuously uplifting, either by rebound after impact or by internal pressures locally exerting an upward movement through the area of disturbed rocks.

Isopach and structure maps indicate that the structural deformation continued into the Pennsylvanian Period and perhaps to the present time. Relative uplift of the dome has taken place at a gradually reducing rate, particularly after Devonian time.

SABINS, FLOYD F., JR., California Research Corporation, La Habra, California

Symmetry, Stratigraphy, and Petrography of Cyclic Cretaceous Deposits of the San Juan Basin

Late Cretaceous strata of the San Juan Basin consist cyclically interstratified non-marine, nearshore marine, and offshore marine clastic sediments which were deposited both during marine transgressions and regressions. Thickness of the transgressive and regressive parts of these cyclic sequences varies, permitting subdivision into two types of cycles: symmetrical and asymmetrical. In symmetrical cycles the thickness of transgressive and regressive parts are nearly equal; in asymmetrical cycles the transgressive sandstone is thin or absent.

The Hosta-Point Lookout wedge is an example of a symmetrical cycle. At its base the transgressive marine Hosta Sandstone overlies non-marine strata of the Crevasse Canyon Formation. The Hosta Sandstone grades upward into the offshore marine Satan Shale. The Satan Shale marks the mid-point of the cycle and the maximum marine inundation; it grades upward into the regressive marine Point Lookout Sandstone. The Point Lookout is overlain by the non-marine Menefee Formation. Southwestward, toward the former shoreline, the Satan Shale pinches out and the transgressive and regressive sandstones merge into a single massive sandstone, which is also called the Point Lookout Sandstone. Still farther southwestward this massive sandstone grades into non-marine strata of the Crevasse Canyon and Menefee formations.

The Mulatto-Dalton cycle is asymmetrical for it lacks a basal transgressive sandstone. Instead, the offshore Mulatto Shale directly overlies the non-marine Dilco Coal with only scattered marine sand lenses at the contact. The Mulatto Shale grades southwestward (toward the former shoreline) and upward into the regressive marine Dalton Sandstone which in turn grades southwestward into, and is overlain by, non-marine deposits of the Crevasse Canyon Formation.

Petrography is closely related to the sandstone depositional environments as follows.

Sandstone Type	*Petrography*
Regressive	Upward increase in maximum and median grain diameter; upward decrease in abundance of primary dolomite grains
Transgressive	Upward decrease in maximum and median grain diameter; upward increase in abundance of primary dolomite grains
Nonmarine	Wide range of grain sizes; primary dolomite grains absent; abundant carbonaceous material

These petrographic properties may be used to identify and correlate units in problem areas.

SANDERSON, G. A., Shell Oil Company, Midland, Texas
KING, W. E., Eastern New Mexico University, Portales, New Mexico

Dimple Limestone Microfossils from the Marathon Region of Texas

Several exposures of the Dimple limestone in the western part of the Marathon region of Texas contain microfossils indicative of a shallow-water carbonate shelf biocoenose. Diagnostic microfossils include species of the fusulinid genera *Millerella*, *Staffella*, *Eochubertella*, *?Profusulinella* and *Fusulinella*, as well as algae and smaller Foraminifera. The fusulinids demonstrate that the Dimple Limestone is, at least in part, no older than Bendian (Atokan).

The limestone beds examined from the western and northwestern parts of the Marathon region consists, in part, of grainstones containing fossil fragments which indicate exposure to wave action. Graded bedding is generally absent, in contrast to the well graded turbidite beds (Thomasson and Thomson, 1963) on the east and southeast which contain redeposited, shallow-water benthonic fossils. Whether the western outcrops comprise redeposited material or *in situ* shelf sediments, the contained fossils establish at least a maximum age limit for the beds.

SCHAFER, SIDNEY, and WEYAND, JACK C., Sidney Schafer and Company, Houston, Texas

Role of Gravity Data in Offshore Exploration

Oil men, geophysicists, and geologists have been searching for years to find a direct method for locating oil and gas deposits. Strangely enough, an old method, gravity, comes very close to being such a method in certain areas such as the salt-dome province of South Louisiana. Most of the oil and gas fields of South Louisiana, both onshore and offshore, are associated with salt domes or salt masses. The gravity method is almost infallible in locating salt domes or salt masses.

The usual geophysical exploration procedure, a reconnaissance gravity survey followed by detailed seismic surveys of the gravity anomalies found, was not practical or feasible in the beginning of offshore exploration. Gravity exploration costs approximately ten times as much offshore as onshore and seismic exploration costs one third as much offshore as onshore. Except for a few instances, most companies completely dismissed gravity data in connection with their offshore prospecting. Improved underwater gravity meters and electronic surveying now make offshore gravity surveys practical and feasible but still rather costly. However, since the advent of joint participation by companies in extensive gravity programs, gravity data are now available at a nominal cost.

The next problem was to convince geophysicists, geologists, and management that they should obtain and use gravity data together with seismic data to evaluate offshore prospects. Many exploration people had been led to believe that the seismic method had rendered the gravity method obsolete and unnecessary.

There are numerous examples of failures on offshore seismic prospects which were selected and drilled without confirmation by gravity anomalies. In some areas seismic data are not at all conclusive, due to misleading multiple reflections, poor energy return and stray reflections, the sources of which can not be definitely determined. Since most oil fields in South Louisiana are