The northern and northwestern border of the mountains has been considered as a great overthrust front with a frontal sole thrust succeeded to the south and east by a number of higher overthrusts. However, none of the structures in this outer zone supports this concept. If flat thrusts were present one would expect strong or uniform northward overturning of folds, and gentle to moderately dipping fault planes. Shearing and strong mechanical rock deformation should be widespread and conspicuous at the overthrusts.

On the contrary, at mapped major overthrusts weak shale sequences are intact and maintain regular bedding despite juxtaposition to mechanically stronger units. The mapped overthrusts are partly steep reverse faults, and partly no faults can be found.

The basis for most mapped "thrusts" apparently has been the tectonic interpretation of the boulder-bearing "Johns Valley shale" as a "friction carpet." However, the boulders of Arbuckle rocks are depositional as are the Ozark region exotics found near Boles, Arkansas. Ulrich (1927) affirmed a depositional origin for these boulders, and the present authors consider his hypothesis of ice rafting as substantially correct. Moreover, though the "Johns Valley shale" customarily is assigned to the interval between the Jackfork group and the Atoka formation, the boulder-bearing shales actually occur as three separate and distinct members within the Jackfork group.

The contrast between the rocks of the Ouachita Mountains and those of the Arbuckle region, though real, is not abrupt. Some units are identical, others differ relatively little, and others differ strongly. Most of the contrasted facies have transitional relationships. Some transitions are gradual; others have been accentuated by shortening resulting from folding and reverse faulting. None exceeds those often encountered in adjacent, connected basins or different parts of the same basin.

Of major importance is the fact that facies changes occur both along and across the structural trend. Moreover, certain units and facies boundaries cross from the Arbuckle region into the Ouachita Mountains. The greatest facies contrast is supposed to be between the Arbuckle limestone and its presumed Ouachita clastic correlatives. However, part of the Ouachita rocks may be younger than the Arbuckle limestone, the customary correlation being open to question. Moreover, below the Ouachita clastic rocks there is a limestone which might correspond with part of the Arbuckle limestone.

RICHARD M. RIGGS, Huffman and Malloy, Oklahoma City, Oklahoma

Thrust Faulting along Wichita Mountain Front

The orogeny that produced the Wichita Mountains in southwestern Oklahoma began in early Pennsylvanian, culminated in early Permian, and resulted in a multiple overthrust structural complex along the mobile southern rim of the Anadarko basin. Structure within the numerous fault blocks is complicated by steep dips, overturned folds, etc. Periods of mountain building are reflected by transgressive granite wash facies which confuse the post-Morrow stratigraphy.

Representative cross sections from the mountains into the basin, through wells that have encountered thrust faulting, are presented.

ROSS R. GAHRING, Sinclair Oil and Gas Company, Ardmore, Oklahoma

History and Development of North Madill Field, Marshall County, Oklahoma

The North Madill field is in Secs. 9, 10, 14, 15, 16, 22, and 23, T. 5 S., R. 5 E., Marshall County, Oklahoma. Production is from the 1st, 2d and 3d Bromide sands and the basal McLish sand of the Simpson group.

The structure is a thrust-faulted anticline with the production on the northeast or upthrown block. The date of this faulting and structural formation can not be determined within narrow limits, but it is believed to be of Pennsylvanian age. The Comanchean beds on the surface rest unconformably on rocks of lower Morrowan age and very slightly reflect the underlying structure.

The discovery well was started in August, 1954, and completed in December, 1954, producing from the basal McLish sand.

As of July 1, 1957, the field covered approximately 1,240 acres with 62 producing wells. Total cumulative production to July 1, 1957, was about 1,450,000 barrels. Development is continuing northwest, northeast, and southeast.

ROBERT W. MAXWELL, Gulf Oil Corporation, Oklahoma City, Oklahoma

Post-Hunton Unconformity and Its Effect on Pre-Mississippian Distribution in Southern Oklahoma

The post-Hunton unconformity in southern Oklahoma is evidenced by the age of the rocks encountered at the base of the Woodford shale. A pre-Pennsylvanian paleogeologic map, showing surface distribution, accompanied by a pre-Woodford distribution map, illustrates the extent of post-Hunton folding and suggests a tectonic framework for dividing southern Oklahoma into six geologic provinces. Hunton thickness contours define areas of pre-Woodford structural movement. It is suggested that the first pronounced structure building and truncation of Hunton beds occurred during middle Hunton time at the close of the Silurian period. The Hunton exhibits radical variations in thickness as a result of the post-Hunton unconformity, and Woodford rests unconformably on rocks varying from Arbuckle in the Hollis basin in southwest Oklahoma to Upper Hunton in south-central Oklahoma. A unique carbonate sequence with maximum thickness of 125 feet in the subsurface occurs at the base of the Woodford shale, and rests unconformably on beds as old as Viola along the Mansville-Aylesworth trend in Marshall County, Oklahoma. This carbonate is an oil reservoir on the north flank of the Aylesworth anticline, and has been informally called "Misener" and "Hunton detritum" in the Ardmore area. This carbonate occurrence, its lithologic description, and its possible relationship with the outcrop are briefly discussed.

J. DURWOOD PATE, consultant, Oklahoma City, Oklahoma

Stratigraphic Traps along Northern Shelf of Anadarko Basin

Extensive stratigraphic accumulations of oil and gas along the northern shelf of the Anadarko basin have been the visions of petroleum geologists for more than two decades; however, only recently have these visions become a reality. Prolific discoveries at Laverne, Southwest Stockholm, Woodward, and pools of the "Cherokee trend" have focused the attention of all exploration men to the stratigraphic trap possibilities of the northern shelf area.

Early exploration along the shelf area was derived from surface indications and geophysical study. Test wells were drilled without the aid of gas detectors and modern methods of surveying the bore hole. Consequently, many prolific gas reservoirs were penetrated with the drill without evaluation.

The remedy for this situation has come from the many advancements made in the field of research which has developed new evaluation tools for the geologist.

Numerous deep tests along the shelf area and in the basin proper have enabled the geologist to familiarize himself with the vast possibilities of stratigraphic traps in sediments throughout the Middle and Upper Paleozoics, from the Silurian-Devonian into early Permian.

Convergence due to truncation and onlap, and interruption in deposition of sands and "reef" type limestones provide most of the stratigraphic traps of the northern shelf area. Multiple traps of this nature in any area are not uncommon. Two wells in Laverne have as many as four prolific gas horizons, all stratigraphic, which will gross the operator approximately $4,000,000 per well. More than 50 per cent of the completions in this pool are dual.

The area has a great future, and the returns will be gratifying to those adept in delineating stratigraphic traps.

CHARLES H. GLIDDEN AND W. MARTIN BORG, Union Oil Company of California, Tulsa, Oklahoma

Morrow Formation of Northwestern Oklahoma

Morrow sediments occupy the northwestern Anadarko basin-Hugoton embayment area southwest of a northwest-southeast diagonal line extending from north-central Harper County to the southeastern corner of Dewey County. More than 1,400 feet of Morrow has been encountered in a deep well in southern Ellis County. The formation thins to zero, due to transgressive overlap northeast.

Very few of the wells that drilled the entire Morrow section have failed to encounter shows. Production now extends along a 60-mile trend. Both oil and gas have been found. At present it is felt that the gas reserves are by far the more important.

Maps and cross sections illustrate the structure, distribution and thickness of the Morrow formation.

VICTOR J. VERODA, Republic Natural Gas Company, Hugoton, Kansas

Morrow Rocks of Western Kansas and Panhandle Counties of Oklahoma

The Morrow rocks of Western Kansas and the Oklahoma Panhandle have a maximum thickness of 700 feet and pinch out northeast on the flank of the Anadarko basin.

Sands within the Morrow series occur in two basic intervals designated as upper and lower. Upper sands are very lenticular but usually produce where present. They account for production in the Camrick pool, Texas County, Oklahoma; Light pool, Beaver County, Oklahoma; Interstate pool, Morton County, Kansas; and the Leslie pool, Meade County, Kansas. Lower sands produce in the Mocane pool, Beaver County, Oklahoma; Keyes pool, Cimarron County, Oklahoma; and the Sparks pool, Stanton County, Kansas.

Morrow sands produce more than half of the area's crude oil and a large percentage of the pre-Permian gas. Production from the 60 pools in the area is from simple anticlinal to complex stratigraphic traps. Common completion practice is through casing with fracture treatment following a light-mud acid wash. Some excellent quality sands are completed natural.

Wells sufficient to test the Morrow range in depth from 4,600 to 8,500 feet. Well costs average $10 per foot dry and $15 per foot completed. Reservoirs range from 3 to 90 feet in thickness, resulting in non-commercial to excellent wells with fast payout (less than 1 year). Average porosity is 14%; average connate water saturation is 25% with instances of 40% in commercial wells. Reserves in place