rite deposition. The present-day Gulf of Mexico, a large gravity maximum, appears to be closely related to the original salt depositional basin.

A more or less continuous bed of Louann salt is believed to underlie the entire Gulf Coastal basin. The Louann is probably the source or mother bed for all the salt found in the piercement domes of the four subbasins, which now exist within the Gulf Coast basin. Although the salt found in the downdip Texas-Louisiana Coastal basin domes theoretically could be younger than Louann, a study of the available evidence points to this salt also being Louann. The absence of salt domes in the "barren" or "void" band, which runs west-east from east-central Texas through central Louisiana and into southern Mississippi, may be due to shifting areas of sediment overburden, and (or) the possibility that salt was thinly depositied in this area.

FRANCIS X. BLAND and WILLIAM E. GARDNER, geologists, The California Company, Jackson, Mississippi
Raleigh Field, Smith County, Mississippi—Example of Lower Cretaceous Oil Field

The Raleigh field structure is illustrated at several horizons and in structural cross sections. The multiple-pay sand character of the field is presented as an example of the economic potential of the Lower Cretaceous in Mississippi. The evolution of industry exploration effort in the area is reviewed as an example of many of the other current and future prospects of the Gulf Coast area.

PAUL E. BORISKE, Southwestern Louisiana Institute, Lafayette, Louisiana
Lac Blanc Field, Vermilion Parish, Louisiana

The purpose of this study is to show the relation between faulting, sedimentation, and accumulation of hydrocarbons as they occur in the Lac Blanc field. The Lac Blanc field is in White Lake which occupies the southwest part of Vermilion Parish, Louisiana. The structure of the field is that of a north-south striking anticline which is cut by a down-to-the-south normal fault.

Faulting in this area was contemporaneous with sedimentation as evidenced by thickening of sediments with depth on both sides of the fault.

Production comes from several sands which lie between the *Discorbis bolivarensis* and *Siphonina davisi* markers (lower Miocene) and are found on both the upthrown and downthrown sides of the fault.

E. ANN BUTLER, micropaleontologist, Louisiana Geological Survey, Baton Rouge, Louisiana
Miocene-Oligocene Boundary Problems in Gulf Coast

The Oligocene Vicksburg marine beds, the Frio massive sands and shales, and the Anahuac shales and limestones constitute one of the best known, yet controversial petroliferous sequences in the coastal Louisiana-Texas subsurface. The position of the Miocene-Oligocene boundary within this sequence has been the subject of many debates among Gulf Coast geologists. The problem originated when the middle Anahuac *Heterostegina* species were erroneously identified as *Heterostegina antillea* of the middle Oligocene on the Island of Antigua, British West Indies. The problem resulting from the assignment of the *Heterostegina* zone to the middle Oligocene on the basis of this species determination was further complicated by the application of the Texas surface term Frio to the sands and shales that occur between the Anahuac and Vicksburg. Later it was determined that the surface Frio of Texas was actually the equivalent of the subsurface Vicksburg; and that the so-called subsurface Frio was younger than previously believed.

Many proposals have been made for the placement of the Miocene-Oligocene contact in the Louisiana and Texas subsurface, each at a different stratigraphic level. The purpose of this paper is to establish the relation of the subsurface "*Cibicides*" *hazzardi* zone of the upper Frio with the fossiliferous surface units on the east in Mississippi, Alabama, and Florida by means of Ostracoda; not to establish an indisputable Miocene-Oligocene boundary.

The Tampa limestone (basal Miocene, Florida Geological Survey) has been assigned to the Aquitanian stage of Europe and correlated with the Paynes Hammock sand of Alabama and Mississippi by the United States Geological Survey. A detailed study of the Ostracoda of the basal Tampa and Paynes Hammock formations shows that they contain the same ostracode fauna. A similar study of the Ostracoda of the "*Cibicides*" *hazzardi* zone in the Superior Oil Company's Duplantier well No. 1, University field, East Baton Rouge Parish, Louisiana, points to a correlation of this unit with the basal Tampa and Paynes Hammock formations. Whether the correlation of the Tampa with the Aquitanian is correct is beyond the scope of this study; however, if correct, this does not necessarily establish a definite Miocene age for the upper Frio since the Miocene-Oligocene boundary in Europe is still in dispute.

P. EISENSTATT, division geologist, Shell Oil Company, Jackson, Mississippi
Little Creek Field, Lincoln and Pike Counties, Mississippi

The Little Creek oil field is in south-central Mississippi in the belt of production from the lower Tuscaloosa formation of Upper Cretaceous age. Prior to its discovery, only six other fields in this trend in Mississippi were expected to produce relatively large quantities of lower Tuscaloosa oil (in excess of 10,000,000 barrels ultimate). The discovery well, completed in January, 1958, was located on the basis of geophysics. The field developed very rapidly with 129 producing wells and 30 dry holes completed by the end of April, 1960.

Structural data show a gentle south-plunging nose. Only 30 feet of counter-regional dip is present; however, an oil column of about 110 feet indicates the presence of a structural-stratigraphic trap. The producing sand body has an irregular shape both in area and thickness. The thickest known occurrence of the sand is 81 feet and in many places it thins abruptly to zero.

The present daily average production is about 15,000 barrels of oil, or 127 barrels daily per well, and the ultimate production should be on the order of 25,000,000 barrels of oil.

HERSHAL C. FERGUSON, JR., Department of Geology, Louisiana State University, Baton Rouge, Louisiana

Turtle Bayou-Kent Bayou-North Turtle Bayou Complex

The Turtle Bayou-Kent Bayou-North Turtle Bayou Complex, located about 65 miles southwest of New Orleans in Terrebonne Parish, Louisiana, consists of three separate fields producing from middle Miocene strata. The producing structures appear to be two domal-like features south of a regional, east-west-trending, down-to-the-south normal fault. As it enters the complex, the regional fault splinters into several separate faults, and on the north side of each of the "splinters" a producing upthrown block is present. The closures developed on the regional fault splinters appear to be related to domal growth older than that accounting for the other two producing structures at the south.

Sand development throughout the middle Miocene is best in upper parts of this interval, for deeper in the section some sands lose the blanket characteristic found in shallower zones and instead exhibit a channel-like geometry. The origin of deposition of any particular potential reservoir sand provides the limitations for the shape and extent of the bed and probably is a controlling factor in hydrocarbon accumulation.

J. A. Gilreath, Schlumberger Well Surveying Corporation, New Orleans, Louisiana

Interpretation of Dipmeter Surveys in Mississippi

The study of patterns of closely spaced dip computations throughout the length of continuous dipmeter surveys is producing greatly increased geological information in Mississippi wells. Structural dip (or regional dip if no structure is present) is the basic dip shown by the dipmeter. Superimposed on the basic dip are the dips resulting from faults, unconformities, and local depositional features. These are generally greater than structural dips and in random directions.

Faults are most commonly shown by the increasing dip in the drag zone as the bore-hole approaches the fault plane from the downthrown side. Complex faulting over shallow ridges or domes may be recognized by the change in dips between faulted blocks. Buried bars are detected in wells drilled on the steep slopes by the decreasing dips exhibited by the successively younger beds deposited above them. Other changes in dip indicate the location of unconformities, most of these being reasonably easy to recognize, since they appear at the same general position in the geological column. Cross-bedding shows as erratic dips within sands.

It is emphasized that detailed geological interpretations of the dipmeter survey require numerous closely spaced computations studied in relation to the well log.

Warren A. Grabau, Midwest Research Institute, Kansas City, Missouri

Geology as an Historical Tool

Geology is at best a synthetic science; the general geologist must have a working knowledge of chemistry, physics, biology, mathematics, and many other sciences. This training in a spectrum of skills makes the geologist peculiarly fitted to deal with multiple-variable problems, especially those which can be reduced only to qualitative solutions. Such problems are numerous in historical criticism; history, like geology, is a reconstructive art involving the interplay of large numbers of variables. Many otherwise incomprehensible events, particularly in military history, become logical and understandable when methods of inquiry based on geological information and techniques are applied. Such examples from the Civil War in the Vicksburg area include the location of the ironclad gunboat *Cairo*, the non-intervention of the Confederate trans-Mississippi armies in Grant's march through Louisiana, Grant's decision to march far inland in Mississippi after the battle of Fort Gibson, and several others. Based on such examples, it seems obvious that geologists are not exploiting their peculiar skills to a maximum.

C. C. M. Gutjahr, Shell Development Company, Houston, Texas

Palynology and Its Application in Petroleum Exploration

Palynology, the study of pollen and spores, is the only known universal method by which marine sediments can be correlated with fresh-water sediments. Study of the history of pollen analysis shows a rapid expansion in the use of this technique from 1916 onward. The Royal Dutch Shell Group initiated palynological studies in 1938, and many oil companies now have palynological laboratories.

Pollen and spores can undoubtedly be preserved because the outer wall of the grains is extraordinarily resistant. The chemistry of this outer wall (exine) is unfortunately very poorly understood. Relation to terpenes or similar compounds has been suggested.

Although exact information concerning the distribution of pollen and spores by wind is difficult to obtain, there is considerable evidence that they can be transported very great distances. Transportation by water is important, and examples of Recent studies in the Orinoco Delta, Volga River, and Gulf Coast are discussed.

Pollen and spores can not withstand prolonged oxidation. The spore and pollen wall takes up oxygen (autooxidation). This photo-chemical process adds oxygen molecules to double linkages in the pollen and spore wall, with the formation of peroxides. Since oxygen is the main enemy of the spore and pollen wall, it is obvious that strata deposited in reducing environments commonly contain well preserved pollen and spores.

Determination of ancient shorelines, age determination of Gulf Coast salt, and palynological correlations in Venezuela, Canada, and France are examples of practical applications of the palynological method.

Dudley J. Hughes, Triad Oil and Gas Company, Triad Drilling Company, Inc., Jackson, Mississippi

Faulting Associated with Deep-Seated Salt Domes in Northeast Part of Mississippi Salt Basin

Faulting in the northeast part of the Mississippi salt basin is principally of the local graben-type resulting from salt doming. On deep-seated salt-dome structures, the faulting appears to exhibit common characteristics throughout the area which can be applied to great advantage in subsurface interpretations.

The strike of the faults associated with deep-seated salt domes through this area does not exhibit a consistent regional alignment, as the faults are localized over each dome. The general fault strike is usually parallel with the long axis of the deep-seated dome with which it is associated.

Faulting over deep-seated salt domes can usually be related to derivative gravity minimums which are expressions of the salt uplifts causing the faulting. The primary faults generally strike parallel with the long axis of the derivative gravity minimum, and faults on the outer margin of a graben structure are usually downthrown toward the long axis of the minimum. Generally, the relative intensity of the derivative gravity minimum becomes greater as the complexity of the faulting becomes greater.

On complexly faulted structures in this area, the outer faults of a graben system are considered to be the primary faults as they were usually the first faults initiated and they predominate with depth.

Fault dips over deep-seated domes in the northeast part of the Mississippi salt basin average approximately 45° in the Upper Cretaceous and 60° in the Lower Cretaceous.

An increase in throw with depth is exhibited by faults over deep-seated domes at a rate determined principally by the rate of differential uplifting which the salt exhibited during deposition of the sediments through