one common goal: *To find and exploit reserves of oil and gas at a profit.* Today the economic factors are playing a dominant role in the highly competitive world petroleum situation. In order to justify his existence in the forecast 70-billion-dollar exploration effort set during the next ten years, the scientist must translate his thoughts into terms the nontechnical business man or executive can readily grasp. The obvious common language is dollars and cents in terms of anticipated profits. These economic terms transcend the semantics barrier that normally exists between the executive and the oil finder.

Various methods are discussed to show how geophysicists and geologists can convert exploration factors into anticipated profit-to-risk ratios. The authors include examples.

Significant factors contributing to a successful exploration program are: (1) The exploration and economic analysis must be compatible with, and integrated into, modern business techniques. That is, the analysis must enhance the executive's ability to make decisions. (2) The explorationist must recognize and avoid "marginal ventures," because 60 per cent of the wells completed in the United States are submarginal economically. (3) The laws of probability must be taken into consideration when establishing an exploration program. (4) To insure success, a company must hold risks to a minimum. This can be accomplished, in part, by participating in a large number of potentially profitable ventures, and/or by taking only a part of each drilling venture rather than the entire deal. (5) Anticipated profit-to-cost ratios can be estimated for many areas. Oil companies can use this information in evaluating and accepting wildcat prospects that have at least double the normal odds of developing into a profitable oil field.

The scientist who applies quantitative analyses skillfully will quickly achieve both recognition within his company and the status of a key decision-maker in his company's exploration program.

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March 15, 1965

LEWIS M. CLINE, Univ. of Wisconsin, Madison

"Geology of the Ouachita Mountains"

The Stanley-Jackfork-Johns Valley-Atoka rocks of the Ouachitas and the Tesnus-Haymond sequence of the Marathons typify what Alpine geologists call black shale flysch. Wild flysch and calcareous flysch also are represented.

In late Mississippian and early Pennsylvanian time a minimum of 22,500 feet of alternating sandstones and shales was deposited in a rapidly subsiding, linear trough. During the cannibalistic stage of the Ouachita geosyncline, (*sensu lato*) the Oklahoma-Arkansas trough probably was but one part of an 1800-mile foldbelt stretching from the Marathons to the Appalachians. Deposition of fine pelitic muds and siliceous shales was interrupted hundreds of times by deposition of quartzose sandstones. The sandstones debouched from a shelf environment exhibit convolute bedding, graded bedding, sole marks and other features now commonly ascribed to turbidity current deposition.

The foldbelt is structurally complex, with several major thrust faults striking parallel to the axis of the foldbelt and thrust toward the craton. Where observed at the surface the thrusts emerge at high angles but some (at least) seem to flatten with depth and probably become bedding plane faults.

The facies patterns and structural characteristics compare closely with those of the Polish Carpathians, Swiss Alps, and Italian Apennines and the characteristic sedimentary features are duplicated in intricate detail in the four mountain systems. Direct comparisons will be made between the Ouachita flysch and that of the classical European areas.

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March 22, 1965

C. J. MANKIN, W. H. BELLIS, and R. L. KERNS, JR., Univ. of Okla., Norman

"Regional Clay Petrology of Permian Shale in Southwestern Oklahoma"

Permian strata cover an area in excess of 50,000 square miles in the western half of Oklahoma, northern Texas, and southern Kansas. These strata are about 4,000 feet thick, are essentially flat lying, and consist dominantly of shale, mudstones, siltstones, and sandstones. In addition to these terrigenous redbeds, the Blaine and Cloud Chief Formations contain on the outcrop two major evaporite units.

This study and the resulting preliminary report are directed toward the genetic relationships of this redbed-evaporite sequence. Funds for the study are from a two-year National Science Foundation Grant No. G19186 entitled, *Mineralogy and Chemistry* *of Permian Shales in Western Oklahoma.*

Samples for this preliminary report were obtained from four-inch cores supplied by the U. S. Army, Corps of Engineers. Information from the unpublished master of science thesis of Mr. A. Gordon Everett was used to supplement the core-hole data.

The framework clay mineralogy of the Wichita, Hennessey, Flowerpot, Blaine, Dog Creek, and Marlow Formations is a mixture of illite and chlorite. The intensity and width of the first-order (001) reflections suggest variations in the degree of crystallinity of the illite and chlorite.

A 7-angstrom clay mineral in the overlying Rush Springs Formation marks a significant change in the clay mineralogy. Part and perhaps all of this 7-angstrom material is a trioctahedral analogue of kaolinite. This may be related to the 7-angstrom chamosites, but a detailed study has yet to be completed.

The overlying Cloud Chief Formation contains montmorillonite as the major clay mineral. This well-crystalline montmorillonite has a widespread distribution and defines a significant change from the mineralogy of the preceding units.

The mineralogy of the Doxey Member of the Quartermaster Group is similar to that of the lower units, except the 14-angstrom material may be a vermiculite.

A source for all the clay minerals cannot as yet be accurately defined. However, the abundance of illite and chlorite in the lower Paleozoic rocks of the Ouachita Mountains area suggests a source for the illite and chlorite of the Permian strata. The polytypism (2 M) of the illite in the Permian rocks is the same as the polytypism of the illite in the Ouachita Mountains. This fact lends support to the above hypothesis. The abundance of montmorillonite in the Cloud Chief Formation suggests a source area of basic igneous rocks, possibly volcanic.

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April 5, 1965

EYSTEINN TRYGGVASON and BOB QUALLS, Univ. of Tulsa, Tulsa

"Crystal Structure of Oklahoma"

During the summer of 1964 a long range seismic refraction profile was shot and recorded NE-SW across Oklahoma. This reversed profile was 376 km. long and extended from near Chelsea northeast of Tulsa to near Maniton southwest of Lawton. A model of the near surface layers of the earth fitting the observed wave propagation consists of three horizontal layers in the crust and a horizontal boundary (moho) between the crust and the upper mantle. In addition there is a low velocity surface layer of sedimentary rocks approximately 0.5 km. thick. The first crustal layer extends to a depth of 13.7 km. and has a P-wave velocity of 5.96 km./sec. An intermediate layer extends to a depth of 29.6 km. and has a P-wave velocity of 6.66 km./sec. The third crustal layer has a P-wave velocity of 7.20 km./sec. and extends down to moho at a depth of 50.9 km. Below moho the upper mantle velocity is 8.32 km./sec. Compared with other continental areas, the observed upper mantle velocity and the mean velocity in the crust is unusually high. The total thickness of the crust is also greater than in most continental areas, and greater than earlier estimates for Oklahoma.

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April 12, 1965

DANIEL A. BUSCH, Consultant, Tulsa

"Oil Production in Israel"

Approximately 5,000 barrels of oil per day is the current rate of production in Israel. Production is from three contiguous pools situated just northeast of the Gaza Strip of northernmost Egypt. They are known as the Brur, Heletz, and Kokhav pools. The producing formations include about 10 thin sand members of Early Cretaceous (Barriasian)age and the Zohar Limestone of Jurassic (Oxfordian) age. The Lower Cretaceous sands of the Coastal Plain area grade abruptly into a marly shale in a general westward direction. Oil and gas occur in the updip wedge edges of these sands where they shale out on the east flank of a pronounced anticlinal feature. Isolated bar-like trends of oil productive sands also are present. These producing sands both overlie and underlie a reefal dolomite; their western margins, trends, and positions appear to be genetically related to it. Jurassic production is principally from fracture porosity on a well-defined structural anomaly in the Kokhav pool. Although there are only three wells producing oil from the Jurassic (Zohar Limestone) at the present time it is believed that these strata offer the greatest potential for really significant future production in Israel.

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