ies, case histories of individual fields, producing trends, and programs. Other sessions will feature world and international petroleum geology (stratigraphic and structural), delta systems, petroleum and geology of northeastern and Gulf Coast Mexico, environmental geology, sediments of the Gulf Coast province, geophysics, and general papers of interest.

This meeting will also be the 48th annual meeting of the Society of Economic Paleontologists and Mineralogists. General sessions will be held in paleontology, stratigraphy, sedimentation, sedimentary petrology and mineralogy, and geochemistry. Symposia will feature "Implications for Oceanic and Continental Evolution," and one on Bryozoa.

Field trips will include two preconvention trips—one featuring environmental geology, and a 1-day trip on "Precambrian-Paleozoic Rocks of the Central Mineral Region of Texas." Four postconvention trips, including (1) a 2-day trip to the Lower Cretaceous Edwards Group, (2) a 3-day trip to the Big Bend area, (3) a 3-day trip in south-central Texas with special emphasis on the stratigraphy, petrology, and regional facies of the Lower Cretaceous Trinity Group, and (4) a 4-day excursion to Mexico City.

Special entertainment has been planned which will include a cocktail party on the River Plaza and "A Night in Old San Antonio" staged by the San Antonio Conservation Society, with a variety of foods, beverages, strolling mariachis, an orchestra for dancing, favors, and lots of atmosphere.

General chairman of the meeting is **M. O. Turner.** Other members of the Coordinating Committee include **Frank I. Brooner,** Jr., general vice-chairman of operations; **Edgar W. Owen,** general vice-chairman; **Edward E. Schleh,** vice-chairman for SEPM; **Leonard C. Bryant,** finance chairman; and **M. L. Johnson,** technical program coordinator.

DISTINGUISHED LECTURE ABSTRACTS

AMORUSO, JOHN J., Independent Geologist, Houston, Tex.

Smackover Trend from Mexico to Florida

The Smackover trend within the United States extends approximately 1,000 mi from South Texas to western Florida. Prolific production has been obtained from this Upper Jurassic carbonate formation in East Texas, South Arkansas, North Louisiana, and eastern Mississippi. Continuing exploration currently is extending the productive areas eastward into Alabama and western Florida and promises to extend production into South Texas.

Most of the production has come from upper Smackover oolitic and pelletal limestones or their dolomitized equivalents. The three most important types of reservoir rocks are oomoldic dolomite, saccharoidal dolomite, and oolitic limestone with interoolite porosity. Reservoir porosity and permeability vary widely depending on the quality of the primary porosity, amount of secondary porosity development, and magnitude of porosity destruction.

Low-relief anticlines, with up to about 400 ft of closure, are the most important structural traps in terms of present production. These closures usually are associated with Louann Salt swells which underlie the Smackover section. Fault traps, traps associated with high relief structures, and salt piercements are of lesser importance at this time, but it is anticipated that they will provide major reserves as exploration continues.

Stratigraphic traps have become increasingly important exploration targets, particularly in the more mature areas where better well control adequately defines the potential trap. Major reserves already have been found in stratigraphic traps, and exploration for this trap type is rapidly increasing. Entrapment generally is provided by the updip termination of porous carbonate zones, commonly, but not necessarily, in conjunction with low relief structural noses or closures.

Exploration of diverse Smackover traps has resulted in prolific production over a significant part of the trend. Continued exploration promises to extend the production into sparsely drilled areas and to discover significant new reserves even in the "old" producing parts of the trend.

BRUCE, C. H., Mobil Oil Corp., Houston, Tex.

Pressured Shale and Related Sediment Deformation—Mechanism for Development of Regional Contemporaneous Faults

Regional contemporaneous faults of the Texas coastal area are formed on the seaward flanks of deeply buried linear shale masses characterized by low bulk density and high fluid pressure. From seismic data, these masses, commonly tens of miles in length, have been observed to range in size up to 25 mi in width and 10,000 ft vertically. These features, aligned subparallel with the coast, represent residual masses of undercompacted sediment between sand-shale depoaxes in which greater compaction has occurred. Most regional contemporaneous fault systems in the Texas coastal area were formed during times of shoreline regression, when periods of fault development were relatively short and where comparatively simple down-to-the-basin fault patterns were formed. In cross-sectional view, faults in these systems flatten and converge at depth to planes related to fluid pressure and form the seaward flanks of underlying shale masses. Data indicate that faults formed during times of shoreline regression were developed primarily through differential compaction of adjacent sedimentary masses. These faults die out at depth near the depoaxes of the sand-shale section.

When subsidence exceeded the rate of deposition, gravitational faults developed where basinward seafloor inclination was established in the immediate area of deposition. Some of these faults became bedding-plane type when the inclination of basinward-dipping beds equaled the critical slope angle for gravitational slide. Fault patterns developed in this manner are comparatively complex and consist of numerous antithetic faults and related rotational blocks.

Conclusions derived from these observations support the concept of regional contemporaneous fault development through sedimentary processes where thick masses of shale are present and where deep-seated tectonic effects are minimal.

HENNES, MARK E., Consulting Department, Core Laboratories, Inc., Dallas, Tex.

Depositional Anticlines of Deep Environments—Past Success and Future Exploration

As the energy quest probes deeper into the oceanic environment, enormous depositional anticlines formed by deep current action are being documented, and certain of these with favorable rock properties beckon to the explorationist.

Wind-driven surface currents, such as the Gulf Stream, can shape these anticlines at the outer edges of detrital sedimentation where such high-velocity currents sweep the bases of continental slopes. Similarly, the "bottom" currents which are moving at slower velocities deeper on the continental rises will form varied anticlinal profiles characteristic of particular bottom conditions. Redistributed terrigenous materials which in great part compose these anticlines are carried into both current systems by intermittent gravity sliding and turbidity currents.

A striking example of wind-driven current deposition occurs in the Florida Strait where calcareous sands from the Florida reef vicinity are swept along a trough by the Gulf Stream, then onto a broad anticlinal rise. Examples typifying "bottom" current anticlines are numerous in the North Atlantic, and deep-water coring programs have partly revealed their sedimentary sequences.

A wind-driven current origin can plausibly explain the Poza Rica trend in Mexico. As the Golden Lane Reef contributed its Tamabra talus downslope into swift currents of the Chicontepec foredeep, anticlines were shaped at the base of the slope. Similar origins are suggested for other examples in the geologic record.

Significant reserves in anticlines formed by current action will be found beyond the reefs and laterally away from the deltas in the deep environment where the subtle character of these features must come to be recognized. Reservoirs such as Poza Rica attest to the excellent rock properties and trap conditions which can be realized in an inspired search for such targets.

HUBBERT, M. KING, U.S. Geological Survey, Washington, D.C.

World's Energy Economy

The earth is a virtually closed material system composed of the 92 naturally occurring chemical elements, all but a minute radioactive fraction of which obey the laws of classical chemistry. Into and out of this system there occur a continuous flux and degradation of energy. As a consequence, the materials of the earth's surface undergo either continuous or intermittent circulation. The principal energy influxes into the earth's surface environment are three: solar energy 174,000 trillion thermal watts; geothermal energy, 32 trillion; and tidal energy 3 trillion. The outfluxes are low-temperature radiation into outer space.

During more than 3 billion years of geologic history, a minute fraction of the materials of the earth's surface has been aggregated into the dynamical system of living organisms. By the process of photosynthesis, a small fraction of the incident solar radiation is captured by the green leaves of plants and is stored chemically in the organic molecules of carbohydrates and other more complex chemical compounds. This is the source of the physiological energy requirements for the entire plant and animal kingdoms. The rates of decay and of oxidation of organic materials are almost equal to their rate of formation, but a small fraction becomes buried in peat bogs or other oxygen-deficient environments of incomplete decay. Such accumulations during past geologic time have become buried under thick accumulations of sedimentary strata and have become transformed into the earth's present supply of fossil fuels.

By about 2 million years ago the ancestors of the present human species began to walk upright and to use stone tools. From that time to the present, this species has distinguished itself from all others in its cumulative inventiveness in means of capturing ever-larger quantities of the energy of its environment. A great increase in the consumption of energy per capita was not possible, however, until the exploitation of the large stores of energy of the fossil fuels was begun about 9 centuries ago. The rise of the world's present technological society, with its concurrent ecological disturbances, including that of the human species, has been an inexorable consequence.

The length of time during which this has occurred is deceptive unless account is also taken of the exponential growth in the rates of consumption. During the 9 centuries since the beginning of coal mining, approximately 142 billion metric tons had been mined by the end of 1972. Of this, one half has been produced since about 1940. Eighty percent of the world's initial coal supply will be consumed within the next 2–3 centuries, and the middle 80 percent of the world's oil during the 65-year period from about 1967 to 2032.

As to the future, the fossil fuels are short-lived; nuclear power is potentially large but also hazardous; water power is large but inadequate; and geothermal and tidal power are inadequate. On the other hand, the largest source of energy available to the earth is that of solar radiation. Because the earth itself cannot tolerate more than a few tens of doublings of any biological or technological activity—and most of these have occurred already—it is now becoming evident that the present episode of exponential industrial growth can be only a transitory epoch of about 3 centuries duration in the totality of human history. It represents a brief transitional period between two very much longer periods, each characterized by rates of change so slow as to be regarded essentially as a period of nongrowth. Although the forthcoming period poses no insuperable physical or biological difficulties, it can hardly fail to force a major revision in those aspects of our current economic and social thinking which are based on the premise that the growth rates which have characterized this temporary period can somehow be sustained indefinitely.

MASURSKY, HAROLD, U.S. Geological Survey, Flagstaff, Ariz.

Mars Geologic History and Processes

The year-long observations of Mars by Mariner 9, combined with earlier spacecraft and ground-based data, have demonstrated a complex evolution for the Martian crust and a complex interaction between crustal and surficial processes that is still in progress. Volcanic, tectonic, and impact processes are prominent in the development of the crust; eolian, glacial, fluvial, and mass-wasting processes are paramount in surface modification.

Maps of Mars prepared from television pictures can be correlated with the planetary shape from occultation data, pressure elevation mapping, ground-based radar, and gravity measurements. The southern hemisphere and equatorial zone are underlain by high standing "continental" rocks; the northern region by low-lying "oceanic" basins underlain by basaltic rocks.

Based on these data, a history of the crust of Mars can be developed. The major events are (1) early differentiation of the crust and segregation into highlands and lowlands; (2) impact cratering; and (3) continued volcanic activity in the highlands and lowlands involving emplacement of basaltic and silicic rocks. Concurrent or later modification includes (1) formation of chaotic terrain by slumping; (2) formation of three types of fluvial channels in the equatorial belt; (3) formation of glacio-eolian deposits in the polar regions; and (4) regional eolian erosion and deposition.