

sands are, in places, considerably better sorted than graded-bedded deep-sea sands which were supposedly deposited by turbidity currents; (3) cross-laminated sands, in places, contain a rich deep-sea benthonic fauna, suggesting a rate of deposition slow enough for the establishment of this fauna; (4) presence of parallel ripples and interference ripples on top of some such cross-laminated sediments; (5) the direction of transport shown by cross-lamination is, in places, quite different from that shown by bottom markings which were supposedly scoured by turbidity currents.

The question whether turbidity currents could deposit cross-laminated sediments remains unsolved. The writer points out, however, that an indiscriminate assumption of turbidity current deposition of all deep-marine sandy sediments has led to confusion, inconsistencies, and controversies. The postulate of bottom-current redeposition helps to resolve this paradox.

HURLEY, ROBERT J., Institute of Marine Science, University of Miami, Miami, Florida

#### EVIDENCE FOR A COUNTERCURRENT BENEATH THE FLORIDA CURRENT

About 60 per cent of the area shown in photographs taken at the axis of Florida Straits exhibit well defined current ripple marks. These ripples indicate a flow of water of at least .23 to .59 kts. from the north. This current is in the opposite direction from the surface currents of 2 to 4 or more knots.

INGLE, JAMES C., JR., Inglewood, California

#### PALEOECOLOGIC, SEDIMENTARY, AND STRUCTURAL HISTORY OF THE LATE TERTIARY CAPISTRANO EMBAYMENT, CALIFORNIA

The Capistrano Embayment comprises a distinct geologic unit of the southern California area. Paleobathymetry, sediments, and microfaunas within the embayment indicate that it has had a different structural history, different from the Los Angeles Basin on the north. Marine invasion of the trough began in the Paleocene and ceased in the Pleistocene. This report develops a detailed history of the embayment from middle Miocene to late Pliocene time using data from two well exposed sections within the boundaries of the embayment.

Analogy between ecologic niches of living benthonic Foraminifera and fossil forms encountered indicates that middle bathyal depths were attained by the middle Miocene. By late Pliocene the trough was filled to shelf depths. Repetitive changes in morphology of benthonic species provides additional evidence of varying paleobathymetry.

Variation in abundance of cool and warm-water planktonic Foraminifera indicates three periods of distinctly cool surface temperature between late Miocene and late Pliocene time. Increase in radiolarian diameter provides evidence for surface temperatures in sediments barren of Foraminifera.

Peak radiolarian abundance suggests that the deepest point in basinal evolution existed in the early Pliocene at which time water depth neared 1,750 meters.

Correlation of the two sections is based on: (a) a Mohnian horizon of *Globigerina pachyderma* which coil sinistrally, (b) the uppermost point of abundant radiolarian tests, (c) the uppermost point of the radiolarian *Prunopyle titan*, and (d) the horizon of peak radiolarian number. These mutually corroborative planktonic criteria demonstrate the time transgressive relationship of existing stages based on benthonic Foraminifera.

Repetitive faunas, for example, appear much earlier in the rapidly filling southern end of the embayment than in the northern deeper area.

A restricted, oxygen-deficient, closed-basin system, characterized by laminated diatomaceous sediments, originated during a period of early Miocene diastrophism. Closed-basin conditions allowed only a marginal benthonic foraminiferous fauna to exist, analogous to the existing fauna of the oxygen deficient Santa Barbara basin. Restricted basin plain conditions prevailed until the end of the Miocene.

Instantaneously deposited coarse sediments (turbidites) emphasize pulses of structural activity in the middle Miocene, late Miocene, and middle Pliocene. Sediments provide evidence of a landmass to the west of the embayment. Turbidites are recognized on the basis of displaced Foraminifera, plant material, and sedimentary structures.

Paleoecologic and sedimentary analyses delineate a characteristic basin-filling sequence in the Capistrano Embayment, similar to events taking place today in the Gulf of California and off southern California.

JOHNSON, J. HARLAN, Emeritus Professor, Colorado School of Mines, Golden, Colorado

#### LOWER DEVONIAN ALGAE AND ENCrustING FORAMINIFERA FROM NEW SOUTH WALES

An algal florule of 13 species, belonging to 11 genera, is described from New South Wales, Australia. Of these, one genus and 7 species are new. The majority are green algae mixed with a few attributed to the blue-green. Five of these genera have been previously known only from the Kasbas region of the U.S.S.R.

LAMING, D. J. C., AND \*LAWSON, D. E., Department of Geology, University of New Brunswick, Fredericton, New Brunswick, Canada

#### SEDIMENTARY FACIES AND PALAEOCURRENTS IN THE BOSS POINT FORMATION, SOUTHEASTERN NEW BRUNSWICK

The Pennsylvanian Boss Point Formation was examined in gently folded coast sections on the Bay of Fundy and Petitcodiac estuary, including the type section north of Joggins, Nova Scotia, more than 3,130 feet thick.

Two main intergrading facies are present. At Hope-wall, Dorchester, and Aulac, cross-bedded sandstones and quartz-pebble conglomerates are greatly dominant; to the south and southwest, mainly cross-bedded sandstones alternate with siltstone and thin sandstone sequences. The coarser beds are interpreted as river channel and levee deposits, and the interbedded siltstone sequences, with root beds, represent flood-plain deposits. Mud-pellet conglomerates and marl-nodule conglomerates are common in the sandstones, the latter usually filling channels near the base of each sequence; probably these are the result of redistribution of the more tenacious flood-plain deposits during major changes of river course. Bituminous shales with non-marine pelecypods (*Carbonicola* and others) and nodular argillaceous limestones occur sparingly. Plant fragments, including transported *Calamites* and *Lepidodendron* logs, are abundant, especially in lenses of irregularly bedded sandstone thought to represent crevasse fillings in levees. Quicksand slump structures were identified in conglomeratic sandstones. No marine beds were found.

\* Present address: Sedimentary Research Laboratory, University of Reading, Reading, Berkshire, England.

Lenticularity of both major and minor sedimentary units makes correlation between sections difficult, though siltstone sequences may be traced for several miles. The Boss Point Formation is underlain conformably by Hopewell Group redbeds, and the lowest siltstone sequence in most places is red, with "kunkar" nodules indicating semi-arid conditions. Higher siltstones are predominantly gray, with a partial return to oxidizing conditions near the top. The gray color probably results from increased or more constant river flow rather than a climatic change, being associated with greater thicknesses of coarse clastics.

Palaeocurrents indicated by cross-bedding and plant fragments show that the coarser northern sediments were deposited by currents flowing south and east, while elsewhere the flow was north and east. In conglomeratic beds plant fragments tend to be oriented parallel with the current direction, but they are perpendicular in finer-grained rocks.

The palaeogeography indicated is a delta forming between northeast-southwest-trending metamorphic ridges. A large northeasterly flowing river on the site of the Bay of Fundy supplied most of the detritus, and streams flowing off the Caledonia Mountains deposited the conglomeratic beds, probably mixing with detritus from a south-flowing river entering the delta near Dorchester, which may have flowed into the adjacent Moncton basin from the southwest.

LEVORSEN, A. I., Consultant, Tulsa, Oklahoma

#### BIG GEOLOGY FOR BIG NEEDS

If we are to continue the current rates of petroleum demand and production, it will be necessary to obtain more petroleum during the next 37 years, or by 2000 A.D., than during the past 100 years. And, if discovery of new deposits is to continue as the most important source of petroleum, then the question becomes: "Is there that much oil yet to be discovered within the United States?" This is a geological question.

As has happened so often in the past, one or more of the chief ingredients for a discovery may lie staring us in the face, sometimes for years, before being put into the discovery recipe. The petroleum industry has gradually developed a great many fine geological administrators who deal with reports from highly trained specialists—but the administrators move farther and farther away from the rocks and the specialists become more and more specialized and more microscopic in their outlook. Needed are more experienced geologists in between, who are still with the rocks and able to integrate the various specialized elements of structure, stratigraphy, and fluids into a discovery picture.

Two situations typical of the "in between" problems, with their import to discovery.

1. One is the arched, updip, wedge-out of a potential reservoir rock coupled with a downdip flow of the water. The flanks of every fold, large or small, from the surface to the basement and in every sedimentary area, both productive and non-productive, offer innumerable opportunities for petroleum discovery.

2. The second is the simple fact that many oil fields and oil provinces—including some of the largest—occur in close association with truncated reservoir rocks. Large volumes of potential reservoir rocks, with many unconformities, well known and staring us in the face, but as yet unexplored, are potentially productive on a large scale.

The answer from this "Peek at the Deep" seems to be, "There is enough potential, favorable geology to supply a normal expected demand." The big question

that remains is "Will there be sufficient incentive to do the exploring?" And this is in the realm of economics and politics.

LLOYD, S. H., Blue Water Drilling Corporation,  
New Orleans, Louisiana

#### FLOATING DRILLING METHODS OPEN AREAS FOR OIL EXPLORATION

Until recent years, prospecting for oil has been limited to land areas. While marine drilling methods date back as far as the early 1900s, the most concerted effort to develop inundated properties began in the Gulf of Mexico off the Louisiana Coast in 1947. First attempts to drill in open water utilized the platform-tender method, still in use today. It appeared obvious that cheaper methods of wildcatting were required, as the expense of installing the platform was prohibitive in the event of a dry hole. The solution was found in the submersible drilling barge, a mobile platform for exploratory work.

Approximately 50 submersible barges were constructed for use in the Gulf of Mexico. Existing leases were in water depths of 100 feet and less. Enormous reserves were discovered in this area and it was assumed that substantial reserves should likewise be found on all of the Continental Shelf. Immediately, water-depth limitations for available equipment were reached and again it became necessary to search for new solutions to the inherent problems.

The drilling equipment for this new project would necessarily be required to operate in open water of depths as great as 600 feet and be capable of drilling to 15,000 feet with a minimum of risk and shut-down time due to weather. This paper discusses the evolution of one such piece of equipment, the problem involved in its design and the results of operation in deep water. In this way, new areas have been opened to oil exploration.

LUDWIG, W. J., EWING, JOHN I., AND EWING, MAURICE, Lamont Geological Observatory, Columbia University, Palisades, New York

#### STRUCTURE OF THE ARGENTINE CONTINENTAL MARGIN

Long lines of end-to-end seismic refraction profiles, shot parallel with the coast line, have defined several major sediment-filled depressions on the Argentine continental shelf. Two large elongate depressions which trend perpendicular to the coast and extend out to the edge of the continental shelf in the Province of Buenos Aires, are the only ones presently known. Extensions of land basins exhibiting a similar seismic sequence of layers were found to close on the continental shelf in the Golfo San Jorge, Magellan Straits, and Tierra del Fuego regions.

The section of shelf lying between the Province of Buenos Aires and Tierra del Fuego exhibits a marked lithologic change from that to the north and south. Undoubtedly the northern Patagonian Mesozoics extend well out onto the continental shelf in this region and may be part of the seaward extension of the central craton of Argentina. The basins, therefore, are associated with the evolution of a central craton, a dominant continental mass of enormous proportions which has influenced the geologic history of Argentina.

LYONS, PAUL L., Sinclair Oil & Gas Company,  
Tulsa, Oklahoma

#### CONTINENTAL GEOPHYSICS

Assembly maps may now be made of regional gravity