trated on shallow punch cores, there are now cooperative programs underway that will drill deep holes from the Continental margins out into the ocean basins in order to learn more about the composition, age and history of marine sediments.

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April 18, 1967

T. F. GASKELL

The British Petroleum Company, Ltd., London

"Exploration in the North Sea"

The main drawback to North Sea exploration is the uncertain price situation.

There has been talk of leveling-out of North Sea gas prices at about 3 pence per therm (30 cents per thousand cubic feet). However, this is an undesirable situation because Dutch onshore gas brings about 3.6 pence, and the selling price of gas to British householders is about 25 pence. It is believed that the operators are working on a cost-plus basis without allowance for oil they don't find. North Sea drilling is expensive and this method does not appear to be the proper way to handle sales.

While only small quantities of oil have been produced in offshore exploration to date, this does not rule out the possibility of subsequent significant discoveries.

Several reasons are cited why the North Sea had not previously produced oil. These are: (1) the geology of the North Sea area has been known for many years and the rocks looked good, but. onshore work yielded only small oil fields; the increased costs of offshore work just didn't look economical, (2) there has been, and still is, trouble over just who owns the minerals in the sea, and (3) the offshore production business came into being within the last twenty years, mostly through American work in the Gulf of Mexico. However, unlike the Gulf, the North Sea is a real nasty place to work. Winter lasts almost eight months and is very unpredictable. Also, big rises and falls in waves make diving operations almost impossible, and can raze the seabed from under stationary-type drilling rigs.

Despite all the minuses in North Sea exploration, the fact still remains that large quantities of gas have been located and others still remain to be found.

April 18, 1967

LLOYD E. ELKINS

Pan American Research Center, Tulsa

"Petroleum Supplies Through the 1970's—Summary of Department of Interior Symposium"

The United States Department of the Interior, Office of Oil and Gas, conducted a symposium in Washington on March 9-10, 1967. The title of this symposium was "Assessment of Factors Affecting Future Availability of U. S. Oil and Gas Supplies." Three significant papers were presented bearing directly on oil and gas. These were:

1. "The Effect of Advancing Technology —Geology," by Dean A. McGee.
2. "The Effect of Advancing Technology —Geophysics," by Milton B. Dobrin.
3. "The Possible Role of Some New Drilling and Production Technology in Maximizing Future Productive Capacity of Oil and Gas and Improving Recovery Efficiency," by Lloyd E. Elkins.

The speaker summarized these presentations and developed background and supporting information bearing on the following quotes taken from each of the three papers:

Quoting Mr. Dean A. McGee, "Now, what about the future? There are many relatively untested trends and other potential areas within the producing provinces that for various reasons have not been thoroughly prospected. There are obscure structural features lying at presently uneconomic depths in basins where the sediments are extraordinarily thick. Undoubtedly there are undiscovered stratigraphic accumulations, some of which can be large, in most of the producing basins. There are large areas on the Continental Shelf where attractive structural anomalies are known to be present, that have not been opened for leasing. The present geologic knowledge and exploration technology will continue to find many of these deposits and discoveries will continue to be made fortuitously by prospectors who encounter the unexpected.

"But there is doubt that oil and gas reserves discovered and developed with this present technology will be sufficient to meet the country's requirements through 1980. For this reason and since additional oil-bearing sedimentary basins cannot be created, the industry should be concentrat-

ing increasingly on the creation of new exploration technology. For, in this scientific and technological era the United States oil industry has not for some time been successful in adding significantly to its well advanced exploration technology."

Quoting Mr. Milton B. Dobrin, "To summarize, it is not likely that any presently predictable seismic method can detect stratigraphic traps with such great success as to lead to a major increase in our oil and gas supplies over the next decade or so. Does any other geophysical tool offer more promise for finding stratigraphic oil? There is reason to believe that with only moderate improvement electrical resistivity methods may be able to locate oil-bearing sands under proper environmental conditions.

"Although our prospects for developing an effective geophysical technique for finding stratigraphic oil are not too favorable we can expect continued improvement in our ability to discover new oil in structural traps, particularly at greater depths than before. We should look forward to a continual upgrading of seismic equipment now in the field. . . . Immediate benefits may come from extending the application of the more advanced techniques to a larger proportion of our geophysical field work. One of the most promising aspects of our digital and optical filtering procedures is that they can be applied to data recorded in the days before they were even developed. Reprocessing of old data with new tools has often brought to light drillable structures which were originally missed. In this and other ways the full impact of our existing technology on oil discovery may not be felt for some years to come.

"Often factors which limit exploration effort, and consequently the discovery of oil, are not so much technical as economic; and economic factors must be given particular consideration when there is concern about our dwindling oil and gas resources. The new developments which have been described have increased the effectiveness of geophysics as an oil-finding tool but they have also increased exploration expense greatly."

From Mr. L. E. Elkins' paper: "New developments in technology applied in drilling and production, since World War 2, have significantly enhanced crude oil reserves and productive capacity in the United States. A little more than two-fifths of the reserves added and a larger fraction of the approximately doubled productive capacity are attributable to new technology related to well completion and oil recovery methods.

"A number of new and improved recovery methods are still semiproven or in the experimental stage. These, and others yet to be discovered, will contribute to advancing the presently estimated cumulative recovery efficiency of 36 per cent to ultimately 50 or 60 per cent. An average annual increase rate of one-third to one-half per cent per year experienced since World War 2 has a good chance to continue at least through the 1970's. Thus, with the current 350 billion barrel volume of total oil in place discovered, it indicates that, considering the rate of improving recovery efficiency, there will be added 1¼ to 1¾ billion barrels annually to reserves from past discoveries. As additional oil is discovered this annual increment will increase.

"Well completion and well operating technology are well advanced. Therefore, productive capacity trends into the future should be mainly related to recoverable reserves and the nature of the recovery methods being applied in the various reservoirs.

"Drilling technology has contributed significantly to holding down the costs even though labor and material costs have steadily increased. Technology now in the semiproven or experimental stage should, in the future, continue minimizing cost increases. This new and evolving technology will have the greatest impact as drilling depths increase to explore and develop deeper formations.

"Offshore exploration drilling is now capable of locating oil and gas reservoirs in waters deeper than those in which production can be economically developed. Exploration capability will gradually extend to even deeper waters. New technology now semiproven or experimental and directed at installing and operating underwater wellheads, control systems, and well repair and workover systems holds the key to major increases in offshore, commercially attractive reserves of oil and gas. This type of offshore technology is commanding the attention of many major industrial concerns, including some in the aerospace industry.

"Much of the technology related to oil development also applies to natural gas. Nuclear explosion fracturing intended to

aid in exploiting massive tight gas formations may open up new opportunities for gas development. However, the future supply of natural gas is primarily related to exploration effectiveness which depends more on profitable expectations than on technological developments.

"In brief, the overall picture suggests that, with appropriate profit incentives, there is considerable room for improving recovery efficiency and developing productive capacity in our crude oil and natural gas reservoirs through the 1970's. If this, coupled with exploration effectiveness, turns out to be less than desired, the industry is developing technology for providing crude oil and gas supplements from tar sands, oil shale, and coal."

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April 24, 1967

EDWIN D. GOEBEL

Kansas Geological Survey,
Lawrence, Kansas

"Cowley Problem, Mississippian of Southcentral Kansas"

Lee (1940) named the Cowley Formation for rocks which he believed were deposited in a basin eroded from Osagian and older rocks in a large area in southcentral Kansas in pre-Meramecian time. The Cowley Formation is mapped by Lee as extending in an east-west belt 15 to 75 miles wide north of the Oklahoma border in southcentral Kansas. Silty and siliceous dolomite, limestones, dolomitic siltstone, and variably large amounts of dark, opaque, microfossiliferous chert and chalcedonic chert characterize the Cowley. Locally noncherty carbonate rocks make up the Osagean and Meramecian rocks within the area of the Cowley. Lee reported that a concentration of glauconite occurs progressively lower stratigraphically westward in Kansas from the eastern Kansas border in pre-Meramecian rocks.

Cores and acid residues examined in the studies by Thompson (1964) and Goebel (1966) revealed the presence of conodont faunas that indicate the Cowley Formation ranges in age from early Osagian into late Meramecian. A normal sequence of Osagian and Meramecian formations is present in southcentral Kansas. Traces of glauconite and secondary sulfide minerals are present locally in these formations. The term Cowley Formation should be replaced by Cowley Facies.

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May 1, 1967

JOHN WONCIK

Apache Oil Corporation, Tulsa

"Recent Drilling Activity in Cook Inlet, Alaska"

Commercial production was established in Alaska in 1957 at Swanson River. Since then, four major oil pools and two major gas pools have been discovered. Future exploration should uncover reserves which will place Alaska as a major oil-producing State in the next ten years.

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May 8, 1967

RAYMOND H. POTTS

Potts-Stephenson Exploration Company,
Oklahoma City

"The Deposition Environments of the Spiro Sands in the Arkoma Basin"

Isopachs and electric log cross-sections of the Spiro Sands in Wilburton, Kinta, and Milton-Cartersville Fields are used to illustrate the speaker's interpretation of the depositional environment of these sands in the Arkoma Basin.

At least three sands, differeing genetically and in age, have all been termed the Spiro Sand in the Arkoma Basin.

In the Wilburton Field, the Spiro Sand appears to be a marine facies of the Wapanucka Limestone and is possibly Morrowan in age.

Such characteristics as geometry of the sandstone bodies, sedimentary structures, composition, nature of the boundaries and other features, leads the speaker to believe that in the Kinta and Milton-Cartersville areas the Spiro Sands were deposited in an environment likely to produce channel, as well as transgressive unconformity sand deposits.