

the next decade. It is evident that the needed reserves will not be found by employing current exploration methods. We must take a hard look at present exploration methods and philosophies and at ourselves, as petroleum geologists, to determine whether we, individually, and as a scientific group, are traveling in exploratory directions which will lead to the discovery of large, needed, new domestic reserves.

The direction and growth of oil companies during the 70's will, to a great degree, depend on the quality and loyalty of the petroleum scientist. The scientist who feels that the company regards him as an asset will be an asset to that company. Make him fear for his job and he will be not only nonproductive, but a liability.

I stress, as I have done in the past, that the geologic profession as a whole must start looking purposely for the hidden and subtle traps—those which are stratigraphic and paleogeomorphic—by employing all of the known disciplines to assist in this search, but more particularly, to use the geologic mind to determine indications that initiate and lead to the discoveries of those traps.

GEORGE C. HARDIN, JR., Royal Resources Corp., Houston, Tex.

IMPACT OF FUNDED OIL AND GAS PROGRAMS ON OIL INDUSTRY

Since 1966, funded oil and gas programs have supplied more than \$1 billion of much needed capital to the oil and gas industry. Although precise figures are not available, it is safe to say that at least 25,000 wells have resulted from the activity of funded drilling programs since 1966. This is a significant portion of the total of 138,666 wells drilled in that period.

This nation is in dire need of both oil and gas reserves and productive capacity. We have no way to determine how much oil and gas has been found and developed by funded programs since 1966, but even a pessimistic view of their cost for finding and development would lead to a conclusion of at least 500 million bbl of oil or gas equivalent. A continuation of this new source of capital is vital if we are to close the gap between the \$100 million needed for exploration and development in the next decade and the estimated \$50 billion the oil industry can generate internally.

More than 800 petroleum geologists are now employed full-time by drilling programs, either as employees or consultants. Other professionals, such as landmen, attorneys, and petroleum engineers, would add at least another 1,500 people. Adding the usual complement of staff, at least 5,000 people are employed today by the oil and gas programs.

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SEARCH FOR THE SUBTLE CLUE—CARBONATE EXPLORATION IN THE SEVENTIES

Exploration of carbonate reservoirs in the next decade will necessitate knowledge of the diagenetic and epigenetic processes influencing porosity origins.

New tools and methods (some exotic and expensive) will be used to extend our analytic and perceptive ability. However, most of our exploration effort will rely on less expensive disciplines, combined with original exploratory thinking and studies of the rocks.

Most current carbonate research programs are concerned with depositional environments and fabrics and their relation to currently productive areas. The less-explored changes induced by burial, uplift, and struc-

ture are of equal importance in modifying or destroying original fabric. Porosity traps are formed through recrystallization, fracturing, and tectonic dolomitization.

Surface studies of structurally controlled carbonate porosity can be related directly to major, structurally complex, oil-producing reservoirs.

During the 70's our responsibilities will include the search for the subtle clue, which may indicate a nearby potential reservoir, modify our thinking on preexisting reservoirs, and refine our techniques of predictability of both depositional and structurally controlled porosity.

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FUTURE PETROLEUM PROVINCES OF GULF COAST—UPPER CRETACEOUS

According to the findings of a geologically oriented study of the National Petroleum Council's Region 6, the prospects for significant additions to reserves in the Gulf Series are good in southeast Louisiana, Mississippi, Alabama, and Florida, and fair to poor in the rest of the area. In order to assign more finite terms to the potential of the unexplored area of the Gulf Series of Region 6, the following parameters have been derived: an area classed as "good" has a yield of 150,000 bbl/cu mi; "fair" has a yield of 80,000 bbl/cu mi, and "poor" has a yield of 50,000 bbl/cu mi. The presence or absence of reservoir-type rocks, source beds (which usually can be assumed to be present in the Gulf basin), and trap-forming structural deformation is used as criteria for rating the various geographic areas.

In the explored area of southeast Louisiana-Mississippi-Alabama-Florida, which contains 30,000 cu mi of sedimentary rock, limited additional reserves may be expected in new discoveries and extensions. In the unexplored area containing 17,000 cu mi of sedimentary rocks, lenticular Tuscaloosa sandstones should provide excellent possibilities for both structurally and stratigraphically trapped oil. Fair possibilities exist in similar sandstones of the Eutaw Formation. Carbonate buildups of reeflike limestones are possible in beds of the Navarro Group on the carbonate banks off the Florida Gulf Coast.

Louisiana-Arkansas' explored area (10,000 cu mi) may have minor additions. The unexplored part (4,700 cu mi) of south Louisiana has poor potential with one possible exception; where Woodbine sandstones may occur as turbidites or as deep-water sands swept out past the Comanchean shelf, prospects are fair.

The explored part of East Texas (11,200 cu mi) will have minor additions to reserves through further exploitation. The potential of the unexplored area (3,600 cu mi) is rated poor to fair. In the Woodbine, possible turbidites and marine sandstones on the south and southwest flanks of the Sabine uplift offer fair prospects. In the Austin-Eagle Ford section, possibilities are poor to fair on the south and southeast flanks of the Sabine uplift.

South Texas potential in the explored area (8,800 cu mi) is poor except for minor additions. The potential of the unexplored area (10,200 cu mi) is also rated poor, because of the expected absence of reservoir beds.

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