Right here in the U.S. offshore deposits are definite possibilities for the future. Gravel, sand, cement materials, manganese and phosphate are definitely offshore work. There are also on shore opportunities too.

The tar sand and oil shale business must be initiated in the near future. Of course, an intelligent group must approach Congress and the states involved to obtain a reasonable tax on such ventures, but I am confident that our government will see the wisdom of such proposals and will take the necessary steps to provide the incentive for the development.

When you look at the picture and consider the fact that every year we are importing more and more things that only a few years back we never thought we'd bring in from other countries, we must recognize that we have a serious situation within the confines of our own boundaries. There are projects of great magnitude here in this country that have to be tackled and solved. What we must recognize, however, is that the potential exists. It is a matter of timing and techniques and economics. For example, there is one thing in particular that, in my opinion, could bring into being narrow profit margin projects and convert them to reasonable investment opportunities. This would be a proper point of application of the depletion allowance.

It is not a difficult matter for an oil company to diversify into the mining business. The necessary qualifications are already on hand. What is needed is careful investigation, thorough long-range planning, and research.

There are many likely answers to why some companies succeed and others fail. However, it must be said that the increasing complexities and magnitude of research for analyzing ventures make it difficult for a small independent concern with its limited staff to keep abreast of its need to replenish its reserves.

The most successful investments have resulted from seemingly "tailor-made" situations which actually came about after careful investigation and analysis of the facts. The results appear to be unbelievably easy, but planning in great depth was the underlying reason for success.

Technology is also an extremely important matter which must be considered in diversification planning. The size of modern equipment no longer appears to be an obstacle in future mining projects. Remote control devices, materials handling innovations—such as are used in the oil industry and the atomic energy industry—and other specialties, have been continually improved. New treatment processes have been developed, such as for the treatment of tar sands, and the result of this change in ingenuity of equipment adaptation is that narrow-margin operations have become profitable ventures. It is not always necessary to depend upon an increase in demand to turn the scales in favor of a venture, as other conditions, due to technological changes, might be the key factors.

Long-term research projects are not new to the oil business. I, therefore, suggest that the companies in the petroleum industry adopt basic research for the big mining projects of the future. These steps must be undertaken, however, as soon as possible. Ten to fifteen years is not too much time for research, study, testing, developing, construction and operating phases for some of the large projects of the future to reach the actual production and profit stage.

Oil companies should first adopt a well-defined company policy and organize a study group to steer the program. The members of this group should have a broad background in basic industry, particularly in the mineral industry. Their task will be to review projects, analyze a mass of information to keep up with impending changes, and to select mineral projects that offer earning potential in the not-to-distant future.

There are large new mineral projects looming in the future that will require large capital investments. They will also require a combination of the best available skills and know-how. The oil industry is in an excellent position to meet this challenge and to assure its own expansion for the future.

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November 4, 1963

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"Gas Occurrences in the Paleozoic Rocks of Western Alberta"

One-third of Canada's known natural gas resources, or 13.5 trillion cubic feet of indicated gas reserves, are contained in Paleozoic rocks of the Alberta Plains. The constant growth of Alberta's proved reserves since 1947 has encouraged the gas industry to seek extensive markets on the North American continent.

The Paleozoic rocks are predominantly shelf carbonates, limy marine shales and evaporates. These sediments are located on the eastern flank of the Alberta syncline and dip southwestward at an average of 40 feet per mile. They form a wedge which is over 5000 feet thick near the Rocky Mountain foothills and thin to the outcrop in the northeastern corner of the province. Emergence of the Alberta Plains between the end of Cambrian and Middle Devonian times, plus periodic emergence between Mississippian and Cretaceous times, interrupted sedimentation causing the erosion of considerable portions of each of the Paleozoic systems.

The major Paleozoic reservoirs are organic and clastic carbonates of the Devonian and Mississippian systems. They form three types of stratigraphic traps: reefs, lithologic pinch-outs and unconformity traps. "Draped" anticlinal structure also aids in localizing accumulations in Nisku reefal reservoirs which overlie Leduc bioherms.

The Devonian reefs of the Swan Hills, Leduc and Nisku units indicate the existence of shoaling conditions when the Devonian seas transgressed over the Elk Point basin. The reef fields contain gas reserves of eight trillion cubic feet, 50 percent of which are essentially non-associated.

In the lithologic pinch-out fields gas occurrences of the Wabamun group frequently include hydrogen sulphide gas up to 35 percent by volume. The indicated reserves in these fields are 1.9 trillion cubic feet of non-associated residue gas and 19 million tons of sulphur.

Gas accumulations associated with the post-Paleozoic unconformity have reserves of 3.4 trillion cubic feet in Mississippian rocks, 60 percent being non-associated.

Production to date from Paleozoic gas fields has been mainly dissolved gas from oil producing areas. Non-associated gas production awaits the development of adequate markets. Paleozoic gas reserves are expected to increase considerably as exploration continues in the deeper drilling areas of the Alberta Plains. An estimate of the ultimate potential gas resources in the Paleozoic rocks of the Alberta Plains, based on similar criteria used in recent forecasts for Canada and the United States, is 50 trillion cubic feet.

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November 11, 1963

GROVER E. MURRAY, LSU, Baton Rouge

"Geology and Oil and Gas Prospects of Australia"

Australia, with a land area of 2,974,581 square miles, is the largest accessible land area in the world which is relatively unexplored for oil and gas. Approximately 600 exploratory wells have been drilled in the country whereas the figure for the United States, on a comparable area basis, is 1,500,000. Exploration has resulted in the discovery of one medium-sized field (Moonie) in Queensland. Oil and gas indications and residual hydrocarbons have been found in several basins in Late Precambrian, Paleozoic and Mesozoic strata.

The island continent is one of the most stable cratonic regions of the world. No major orogeny has affected it since Permian times, the structural history since then being primarily one of epeirogenic movements. Throughout the western two-thirds of the continental mass, no geosynclinal development or extensive orogeny has occurred since the Precambrian. No widespread marine invasions of the western half of the craton have taken place since the Ordovician.

A Precambrian craton, exposed throughout most of central and western Australia, forms the nucleus of the continent. Large areas of unmetamorphosed, mildly deformed Late Precambrian sedimentary rocks are an integral part of this craton. Relatively minor additions to the western and southern parts of the continent have occurred through deposition in a series of fringing, partly embayed, partly transient sedimentary basins which have been intermittently negative since the early Paleozoic.

East of the exposed Precambrian craton, additions to the continental mass took place during the Paleozoic through deposition in a series of belts which appear to have progressed generally to the north and east with time. Zones of tectonic activity and igneous intrusions occur in broadly similar time and spatial patterns.

Sandstones, siltstones and limestones are the predominant lithic types in most of the sedimentary basins; shales, clays and marls are generally subordinate in amount. However, as the basinal facies of most areas are as yet unknown, conclusions based primarily on surface data may be incorrect.

Precipitates, other than carbonates, appear generally to be scarce in the continental area. Chlorides and sulphates are present in the Canning-Fitzroy Basin of Western Australia and in the Amadeus trough of the Northern Territory.

Major regional unconformities exist in all the major basins. In many places, the sedimentary strata above these discontinuities are arenaceous, a condition usually not conducive to the entrapment of hydrocarbons. Lithic variability does exist throughout the sedimentary section .however, and appreciable numbers of situations exist where entrapment could occur. The conclusion is hardly escapable that stratigraphy will prove to be