acter are apparent, including from north to south the following.

(1) Arctic coastal region
(2) Brooks Range isostatic minimum
(3) Central Alaska region of low gravity relief
(4) Southeastern Alaska region of large complex gravity anomalies due to local isostatic and geological adjustments
(5) Bristol Bay positive area
(6) Aleutian Islands maximum
(7) Aleutian Trench minimum

Proper recognition of the types of large gravity anomalies to be expected in each region will greatly improve the interpretations of gravity meter surveys run in local areas for petroleum exploration.

F. J. HORTIG, State Lands Commission

California Offshore Oil—Present and Future

The base for report of the status of present development of offshore oil and for prediction of future developments is contained primarily in the past history of California offshore development, starting with the first tideland well drilled in 1896. Current annual (1959) production from State-leased offshore lands is 15 million bbls. from Orange, Ventura, and Santa Barbara counties. In addition, production has been developed from offshore lands granted by the State to municipalities at Newport Beach, Long Beach, and Redondo Beach.

Five leases, comprising 19,200 acres, are under exploration development in Santa Barbara County. Potential lease offers are under review by the State Lands Commission in both Santa Barbara and Ventura counties. Submarine seismic and geological (core drilling) surveys are being continued over the majority of the Southern California offshore area extending seaward to the Channel Islands. Exploration and technological developments in drilling and production indicate that the maximum California offshore development will be achieved in the future.

JOHN C. HAZZARD, Union Oil Company of California

Bioherms in Middle Devonian of Northeastern Spanish Sahara, Northwest Africa

Two groups of Middle Devonian (Eifelian) bioherms, here defined as the Gor Loutad and the Gor Morehba reef areas, have been recognized east and southeast of Semara, a village about 160 km. east-southeast of El Aaiun. The Gor Loutad reef area (Lat. 26°45′ N.; Long. 10°45′ W.) which was seen only from the air, comprises about 20 biohermal mounds and ridges distributed in a narrow northeast-southwest trending belt. To the southwest is the Gor Morehba reef area (Lat. 26°30′ N.; Long. 11°25′ W.) which was visited on the ground.

The Gor Morehba reefs are expressed topographically as an elongate area of low hills trending northeast-southwest for approximately 52 km.; the width of the belt ranges from 10 to 15 km. This area comprises more than 15 elongate reef ridges and elliptical to circular reef mounds. The ridges are as much as 5–6 km. in length and 1 km. in width; the mounds have an average maximum diameter of 1–2 km. Topographically, these reefs stand as much as 100 meters above present drainage levels.

The reef-forming limestone averages less than 30 meters in thickness and the total thickness of section affected in any way by the reefing is about 100 meters. Flank dips on the ridges are as much as 20° while dips on the flanks of the mounds are as great as 50°; such dips are in contrast with the average 2° regional dip of the Devonian section. The core of the reef mounds and ridges is a massive light gray limestone made up of broken fragments of coral, calcareous algae, and clastic limestone. It is overlain by, and grades down the flanks into, well bedded dark gray limestone which in turn passes into the shaly limestones and calcareous shales of the inter-reef areas.

Well exposed sections of the ridges and mounds suggest that the pattern of reef development was partly controlled by submarine channeling prior to deposition of the reefs. The inter-channel ridges and more isolated "highs" became the loci for growth of carbonate-secreting organisms. Such limestone (or reef) growth continued for a relatively short time until the influx of clastic material filled the inter-reef areas and eventually passed over the centers of reef development. Locally, initial dips exposed in the overlying clastic section reflect the underlying reef pattern.

STANLEY J. LASTER and FREEMAN GILBERT, Geophysical Service, Inc.

Line Source Problem for Solid-Solid Interface

This paper deals with the elastic waves propagated along an interface between two solid elastic half-spaces (Cagniard's problem). Classically it has been shown that interface (Stoneley) waves should exist only for those limited values of the elastic parameters of the two solids for which the Stoneley pole is real and lies on the sheet of integration. Solutions for the similar, but algebraically simpler, Lamb's problem indicate that interface waves may also be associated with complex poles not on the sheet of integration. Exact solutions are presented for Cagniard's problem for a large number of materials, lying both inside and outside the classical existence diagram. These seismograms support the conclusion that attenuated Stoneley waves can be propagated at the interface of almost any two solid materials. Additional information on critical refraction phenomena is also presented.

JOHN SILCOX, Standard Oil Company of California

General Geology and Development of West Thornton and Walnut Grove Gas Fields Sacramento Valley, California

The West Thornton and Walnut Grove gas fields occupy a position astride the east-west–trending Thornton arch which extends from Lodi to Rio Vista and is one of the major structural features of the Sacramento Valley gas province. Production along this trend was first established in 1943 at the Thornton and Lodi fields which are areas of anticlinal closure. Down plunge to the west, additional production was subsequently developed in 1956 and 1958 with discoveries at West Thornton and Walnut Grove respectively.

The productive section at the West Thornton and Walnut Grove fields includes the Domengine and Midland sands of Eocene age, Paleocene Martinez sands, and Cretaceous Winters-Millar sands. Gas accumulation in these intervals is controlled by a combination of faulting and stratigraphic changes on the plunge of the Thornton arch. Cretaceous production of the Thornton arch was first established at Walnut Grove from the Winters-millar sands in the Brazos Locke Unit No. 1 well in 1959. Three wells are presently productive from this interval. Erratic sand distribution in the lower Eocene Meganos sediments, attributable to either rapid facies changes or channel development similar to the "Markley Chan-