routes: (1) a theoretical application of scientific knowledge to the already known geological details to determine where prospects should be; (2) working by "analogy"—finding areas where geological details resemble those of known producing areas; and (3) a "bird dog" search for details that have been overlooked or improperly interpreted that point up prospects. These approaches are interrelated.

The most important exploration methods can be summarized as surface geology, subsurface well geology, seismic survey, gravity survey, and magnetic survey. In a highly explored area surface geology, if feasible at all, is detailed and fairly complete. Gravity and magnetic surveys do not ordinarily refine an anomaly sufficiently to provide drilling prospects. Thus, the subsurface picture, growing more complete with each new well, becomes the most effective source of new prospects. Seismic survey commonly is useful in bridging the information gap between wells, especially when programmed to test a specific prospect lead.

How do discoveries result in highly explored areas?

1. Refinement of, or finding, new structural details.
2. Reinterpretation of structure.
3. Refinement of, or finding, new stratigraphic details.
4. Reinterpretation of stratigraphy.
5. Improvement of producing techniques.
6. Improvements in equipment.
7. Change in economics or management attitude.
8. "Stumbling into" an unanticipated productive situation.

Interesting examples of the foregoing include Dutch Slough; Little Sand Draw, Wyoming; Castaic Junction; Asphalto; Poso Creek; Brentwood; Lathrop; Beverly Hills; Anaheim; and Grimes.

LACOSTE, LUCIEN J. B., LaCoste and Romberg, Inc.

STABILIZED PLATFORM SHIPBOARD OR AIRBORNE GRAVITY METER

Previous LaCoste and Romberg air-sea gravity meters have been operated in gimbals, and gravity corrections have been made for the swinging of the gimbals. Because there is reason to believe that better accuracy and operation in rougher weather might be possible with a gravity meter mounted on a gyro-stabilized platform, such a model has been made.

The gyro-stabilized platform uses inertial guidance quality gyros and is accurate to about 1 minute of arc. It appeared to be entirely adequate both for laboratory tests on motion-testing machines and for tests on a ship. The gravity meter used in the first tests was one which had been used previously with a gimbal suspension, although it was known that some modifications would be desirable for operation on a stabilized platform. The overall accuracy obtained was about the same as that of the gimbal-suspended type, and it was capable of operation at about the same accelerations as the gimbal type.

In order to be able to attain the improved performance expected from a good stabilized platform, a newly constructed air-sea gravity meter was disassembled and modified as follows:

(1) It was made several times stiffer in the horizontal directions, because operation on a stabilized platform requires greater stiffness than operation in gimbals;

(2) The linearity of response of the gravity meter to vertical accelerations was greatly improved, in order that errors would be negligible at much greater accelerations.

A device for computing errors resulting from interaction between horizontal and vertical accelerations also was added. Laboratory tests on the new model are now in progress and it is hoped that ship tests will be completed in time to report the results when giving this paper.

LIAN, HAROLD M., and HENK WORIES, Union Oil Co. of California

RECENT OIL AND GAS DEVELOPMENTS IN AUSTRALIA

The past year has witnessed a breakthrough in Australian oil and gas exploration with 8 new discoveries scattered over a wide geographical area, and adding Northern Territory, South Australia, and Western Australia to the discovery list. However, the commercial potential of most of these discoveries has yet to be established.

Queensland continued active, with the most important developments being Union and Kern County Land Company's Alton discovery in the Surat basin and Phillips' deep gas discovery in Devonian strata at Gilmore. Several small, questionably commercial gas fields were found in the Surat basin and in the Bowen basin. The first Drummond basin well found oil "shows" in the Lower Permian. The Roma gas field can now supply about one-third of Brisbane's requirements.

Exoil's Mereenie field in the Amadeus basin, Northern Territory, now has 4 large gas wells producing from the Ordovician. The field has a proved length of 17 miles. Two outer wells indicate 300 feet of oil column in a tight sandstone. Reserves are indicated to be 1 trillion cubic feet.

Delhi's Gidgealpa field in South Australia has five large gas wells producing from the Permian in a 30-sq.-mi. area, with estimated reserves of 450 billion cubic feet. Another field of this size will be necessary to justify a pipeline to Adelaide.

In the Perth basin, Western Australia, Wapet's Yardarino field has two large oil and gas wells in Permian strata and two dry holes in a small fault-block trap. Wapet's Barrow Island discovery, the first success in the Exmouth Gulf since the Rough Range disappointment in 1953, has three 180–900 B/D flowing wells from thin multiple zone Cretaceous-Jurassic sandstones.

Other interesting developments include oil "shows" in two Cretaceous sandstones in the Port Campbell area, State of Victoria, oil "shows" in Cambrian dolomite and gas "shows" in Precambrian limestone in the Alice Springs area of the Amadeus basin, and "shows" in the Cambrian at Sandover in the Georgina basin. A gas "show" in Devonian was logged in the Bonaparte basin of Northwest Australia.

The year 1965 should have considerable exploration in the basins where production has been indicated, and new ventures in untested basins, including the Bass Strait where Esso is now drilling, and several other offshore areas.

LONG, J. A., United Geophysical Corp.

EXAMPLES OF OPTICAL ANALYSIS AND FILTERING OF SEISMIC RECORD SECTIONS

When coherent light from a laser beam is passed through a transparent reduction of a variable-density or variable-area record section, the seismic signals act as an optical grating to produce a diffraction pattern which is the two-dimensional Fourier transform of the section itself. By using suitable lenses, the diffraction pattern can be converted into an image of the original section. By obstructing portions of the pattern cor-

responding to particular frequencies or dips on the section, one can remove such frequencies or dips from the reconstructed image. This is the basis for a new technique of optical filtering which United Geophysical Corporation has designated as LaserScan.

With this optical processing technique, the first step is an examination of the spectrum of the data. This technique lends itself well to the analysis and evaluation of the information on the seismic record sections being processed. Such a study commonly suggests optimum positions for filtering settings. Examples are given of this, and of the effects of some of the suggested filtering.

A number of seismic record sections are shown before and after filtering. The various examples show the enhancement of reflection data previously confused or concealed by the undesired events which are filtered out during the optical processing. Unwanted events are rejected by taking advantage of the differences between their dips (move out) and (or) frequencies and those of the desired reflections. Examples are discussed in which LaserScan techniques have been applied:

Reject multiple reflections which override or obscure genuine reflections dipping in different directions.
Remove diffractions and (or) reflected refractions.
Attenuate high velocity noise events.
Eliminate high frequency interference. LaserScan is very effective as a frequency filter because of the sharp cut-off slopes obtained.

Because hundreds of information channels can be processed in a single photographic operation, optical filtering has proved to be an efficient and economical method of frequency and velocity filtering.

MAYNE, HARRY W., Petty Geophysical Engineering Co.

COMMON REFLECTION POINT TECHNIQUES IN HIGHLY EXPLORED AREAS

Experience in some highly explored areas has demonstrated the need for enhancement of reflection record quality and attenuation of multiple reflections and other disturbances. The overall objective is to improve the signal-to-noise ratio.

A summary of the Common Reflection Point (CRP) Horizontal Data Stacking Techniques is given and the general application and advantages of the method are described.

Specific areas are chosen for typical field comparisons between conventional and stacked traverses to illustrate the improvement with CRP.

McGEE, DAVID C., San Diego State College

UPPER CRETACEOUS (CAMPANIAN) FORAMINIFERIDA FROM PUNTA BAJA, BAJA CALIFORNIA

The oldest post-batholithic fossils recognized in northwestern Baja California occur in an intricately faulted mudstone-sandstone-conglomerate section exposed at Punta Baja, near El Rosario. Foraminifers, mostly agglutinated species, occur through a part of the section which consists of 101 ft. of mudstone. That part of the section also contains the characteristic Campanian ammonoid, *Metaplacenticeras pacificum* (Smith). Representatives of the genera *Epistomina* and *Bulimina* (spinose forms) with the microfossil assemblages suggest an outer sublittoral or, more likely, bathyal environment of deposition for the mudstone.

McMURRY, H. V., The New Jersey Zinc Co.

OPTIMUM USE OF GEOPHYSICAL TOOLS IN EXPLORATION FOR BASE METAL ORES

The procedures generally used in prospecting for sulfide ore bodies are discussed. It is shown that entirely different circumstances govern the search for massive sulfide ore bodies compared with those involved in prospecting for disseminated sulfide deposits.

Massive sulfide deposits are excellent electrical conductors which commonly yield strong anomalies during rapid reconnaissance electromagnetic survey procedures. The difficulty in detecting them is that there are hundreds of barren non-sulfide geological conductors for every sulfide mass. For this reason the biggest problem in prospecting for massive sulfide ore bodies generally is that of devising means of screening large numbers of equally promising targets to find those few which are most likely to be rich in sulfides. Facts are presented to show that the screening processes can be carried out rapidly, thoroughly, and economically by intensive use of the gravity meter and the portable refraction seismograph.

The induced polarization method is the only geophysical procedure which responds to buried, disseminated, metallic mineral deposits. It is, therefore, widely used in prospecting for buried porphyry copper ore bodies. The feasibility of and need for extensive calculations of the induced polarization responses of geological bodies of simple geometrical form is explained. Examples are presented which show how work of this kind has been valuable in evaluating the merits of the induced polarization method, in the planning of induced polarization surveys, and in the interpretation of field data.

NETTLETON, L. L., Gravity Meter Exploration Co., Geophysical Associates International

SURFACE SHIP GRAVITY METER OPERATIONS OFF PACIFIC COAST

A survey of approximately 3,000 miles of traverse off the Pacific coast of Oregon and Washington was carried out in the summer of 1964. The instrumentation was the LaCoste and Romberg mobile gravity meter using the suspended system and horizontal accelerometers for Browne corrections. The work was controlled by occasional observations with an underwater gravity meter on bottom. Precision of results can be evaluated by comparison with these observations and by gravity differences at intersecting traverses. The paper will describe the operation, present a sample traverse and map area, and will include an evaluation of the precision of the observations.

OBRADOVICH, JOHN D., U. S. Geological Survey, Denver

AGE OF MARINE PLEISTOCENE OF CALIFORNIA

Isotopic ages determined on glauconite from the Lomita Marl Member of the San Pedro Formation indicate that the marine Pliocene-Pleistocene boundary, as recognized in California by Woodring and others, is at least 3 million years old.

PARKER, FRANK S., consultant

SUMMARY GEOLOGY OF OFFSHORE OIL PRODUCING AND POTENTIAL AREAS OF PACIFIC COAST

The area is bounded by the shoreline, the 100-fathom line, and the Mexican and Canadian borders, but these