recognized. Early references to Lower Silurian faunas in the Great Basin are Lower Silurian in the old European sense, that is, Ordovician.

The rocks in the western facies are predominantly black shale with minor amounts of sandy and calcareous shale and rare interbeds of limestone.

The fauna in the western shale facies is largely pelagic. Locally well preserved graptolites range from Middle to Late Silurian in age. The Upper Silurian shales locally contain eurypterids.

RICHARD H. JAHNS, California Institute of Technology, Pasadena, California, AND LAUREN A. WRIGHT, California Division of Mines, Los Angeles, California
Tabular Masses of Disordered Breccias in Southern California

Breccias with highly disordered internal structure are widespread in southern California, especially in non-marine parts of the Tertiary and Quaternary sections. Nearly all of them occur as tongue-like or otherwise tabular masses and as erosional remnants of such masses, and they range from a few feet to several miles in maximum exposed dimension. At different localities they have been variously referred to as megabreccias, chaotic breccias, rubble breccias, cyclopean breccias, monolithologic breccias, and as slide, slump, mudflow, debrisflow, or fault breccias.

The most characteristic features of these rocks are the following.

1. The clasts are angular to sub-angular, and pebble-size to cyclopean; most of the very large ones are fractured to severely shattered.

2. The abundance ratios of clasts to matrices are very high; the matrices are themselves predominantly clastic.

3. Sorting is poor to good, and in general can not be attributed to the process of breccia formation per se.

4. Stratification is crudely developed or absent.

5. Many of the breccia masses are essentially monolithologic and commonly intertongue with other monolithologic masses of similar or contrasting lithologic character, or with breccia masses that consist of heterogeneous clasts.

6. The abundance of rock types among the clasts is directly related to the cliff-forming characteristics of the same rocks where they are exposed in place in the same regions.

Most of the breccia masses are underlain and overlain by fanglomerates and other sedimentary rocks with clasts that are lithologically similar to those in the breccia masses but generally more rounded. The masses have sharp lower margins and sharp to gradational upper margins, and most of them butt against or interfinger with various kinds of sedimentary rocks. No lower margins have been traced into major faults; instead most of the masses conform with the structure of the underlying rocks. Nearly all of the breccias occur near zones of major faulting or flank areas of major uplift.

Many of the breccia masses are demonstrably of sedimentary rather than tectonic origin, and most of the others seem best interpreted in this way. They evidently were formed under conditions that permitted rapid mass migration of rock debris, in some areas for distance measured in miles. Debris flows, derived from localized source areas, are thought to account satisfactorily for most occurrences. This specialized type of sedimentation may well have been more widespread in both space and time than has been recognized heretofore.

ALVIN A. ALMGREN AND WILLIAM N. SCHLAX, The Superior Oil Company, Bakersfield and Los Angeles
Post-Eocene Age for "Markley Gorge" Fill Sacramento Valley, California

In the southern Sacramento Valley there is a buried erosion surface of marked relief, which is usually called the "Markley Gorge." It is a post-Eocene erosional feature, eroded into a sequence of marine strata, which range in age from Late Cretaceous through late Eocene (Markley sand).

The "Markley Gorge" was filled with sediments of diverse lithologic and mineralogic character, distinctly different from earlier strata. In their lower part, these sediments contain an indigenous microfaunal assemblage indicating Oligocene age. Some coarse zones contain detrital shale fragments. Foraminifera of late Eocene age were obtained from one core sample. Apparently they were derived from the shale fragments.

The "Markley Gorge" fill is separated from the Markley formation and older strata by a regional unconformity.

EDWARD A. GRIBI, JR., consulting geologist, Great Falls, Montana
Santa Cruz Basin Oil Province

The Santa Cruz basin is a highly compressed structural and stratigraphic basin extending from Half Moon Bay, through the Santa Cruz Mountains, and may extend across the San Andreas fault to include the Hollister basin on the southeast. It is bounded on the southwest by the Ben Lomond-Gabilan granitic shelf, and on the northeast, by the Montara granite mass and the Gilroy Franciscan shelf.

The Tertiary rocks of the region are divided into two sequences by an angular unconformity. The lower sequence includes rocks of Eocene to older Miocene age. It is more than 10,000 feet thick in the Santa Cruz basin, but thins southwest. Several thousand feet of the lower sequence are present in the Hollister basin but are absent on the Gilroy shelf.

The upper sequence includes rocks of younger Miocene to Pliocene age. The sequence is thickest in the area of Half Moon Bay (10,000+ feet), and in the Hollister basin (8,000+ feet). It is 1,000–3,000 feet thick over the Ben Lomond-Gabilan shelf and less than 1,000 feet thick on the Gilroy shelf.

The primary feature of structural importance is the right lateral San Andreas fault. The Santa Cruz basin proper is a highly mobile belt between two moving buttresses—the Ben Lomond granite mass and the Gilroy Franciscan shelf. There were two episodes of intense structural deformation—one at the end of lower sequence deposition, and one during the Pleistocene and Recent epochs.

The region has been prospected for oil since 1886. A period of intense exploration since World War II has resulted in several oil and gas discoveries of some importance in the last 5 years. Because of the structural history of the region, it is believed that prospecting will be most successful where searching for structural and stratigraphic traps formed prior to the more recent deformation.

ROBERT B. MORAN, JR., Moran Instrument Corporation, Pasadena, California
Radiation Logging in Shallow Bore Holes

In the half century that has elapsed since a French physicist discovered that gamma rays would fog a photographic plate, much progress has been made in the field of nuclear physics and instrumentation. Commercial gamma-logging service for oil wells has been offered for the past 15 years and during the past 5 years, considerable work has been done by the A.E.C. and others, in the development of slim-hole-logging equipment for use in exploration for radioactive minerals.

Gamma rays are the most penetrating form of natural radiation given off by the daughter products of uranium, thorium, and potassium. Traces of these elements occur in varying amounts in all common rocks, so that the gamma log has become a valuable geophysical tool both for stratigraphic correlation and for the determination of the presence of radioactive material.

During 1955, 5½ million feet of exploratory shallow holes were drilled in the search for uranium in the United States. The development of reliable scintillation-logging equipment has now made it possible rapidly to assay radioactive ore bodies in place, and at the same time, produce a stratigraphic log of overlying barren formations. These data can be correlated between holes to give a geological structure map. Because of improved gamma-logging instruments which are now available, and the greater experience which mining operators have in interpreting the logs, it is now possible accurately to evaluate a buried ore body by means of bore holes instead of core holes. As core holes cost 2–3 times as much as bore holes, the new, more reliable gamma-logging equipment quickly pays for itself by reducing the exploration costs.

JOSEPH KAPLAN, Professor of Physics (UCLA) and chairman, U. S. National Committee for the IGY
International Geophysical Year

The United States program for the International Geophysical Year is part of a world-wide scientific undertaking by more than 50 nations in an internationally planned and coordinated effort to study geophysics on a truly global scale during the period of high solar activity, 1957–1958.

The second general assembly of the CSAGI, the international committee for the IGY, in Rome in the fall of 1954, developed criteria for the selection and planning of observational programs in the individual geophysical disciplines. Each participating nation followed these criteria in planning its own program. The major emphasis is given to problems requiring concurrent synoptic global observations involving coordinated efforts by many nations. Also of great importance are the activities undertaken in remote regions of the earth, such as the Antarctic, the Arctic, and the vast oceanic areas.

In the United States, the National Academy of Sciences, as the adhering body of the U. S. scientists to the International Council of Scientific Unions, established the United States National Committee for the International Geophysical Year. This committee, with its technical panels and regional committees, is responsible for the planning, direction, and execution of the U. S. program. The membership of the technical panels and committees is made up of scientists drawn from private, governmental, educational, and research institutions from all over the country. Department of Defense research and logistics efforts are being utilized in certain areas to supplement and expand the IGY activities.

Closely following the criteria established by the CSAGI, the USNC-Technical Panels developed programs in Meteorology, Geomagnetism, Aurora and Airglow, Ionosphere, Solar Activity, Cosmic Rays, Longitude and Latitude, Glaciology, Oceanography, Rocketry, Seismology, and Gravity, and, as announced by the President of the United States on July 29, 1955, scientific studies using earth-circling satellites. Activities in these programs range geographically from the Arctic to the Antarctic, throughout all of the continental United States, its territories and possessions, and parts of the Atlantic and Pacific oceans, penetrating deep into the earth, oceans, and ice, and high into the atmosphere.