of Weaver (1912), the Twin River formation of Arnold and Hannibal (1913), and the upper part of the Lincoln formation of Weaver (1912) in Washington. Further collecting and study of these vertebrate remains may aid in determining the position of the Oligocene-Miocene boundary on the Pacific coast of North America.

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Reconnaissance Observations on Geology of Trinity Islands, Alaska

The Trinity Islands, Tugidak on the west and Sitkinak on the east, form the southwesterly extent of the Kodiak Islands group. Each island is approximately 5 miles wide by 20 miles long. The surface of Tugidak Island is a series of low wave-cut terraces maximum elevation 200 feet. Sitkinak Island comprises a group of hills on the east and west, maximum elevation 1,640 feet, separated by a valley enclosing Sitkinak tidal lagoon.

The bedrock of East Sitkinak Island is Cretaceous (?) marine epineritic bedded graywacke and siltstone complexly folded and faulted. West Sitkinak Island is Cretaceous (?) marine infraneritic thin-bedded siltstone and fine graywacke isoclinally folded and faulted. The thickness of these units is unknown; structural trends are northwest.

Sitkinak lagoon and valley lie in a northwest-trending graben in which about 4,000 feet of Eocene (?) continental to brackish marine conglomerate, sand, silt, and coal crop out.

The bedrock of Tugidak Island consists of Plio-Pleistocene soft mudstone and thick-bedded gray sands, which strike N. 45° E. and dip 5° NW.

The Cretaceous sediments were deposited in a northeast-trending mobile, extra-continental, geosyncline and were probably derived from a volcanic landmass on the southeast. Late Cretaceous or Laramide diastrophism brought to a close the Cretaceous sedimentation cycle. The Tertiary sediments were deposited in a similar less well developed geosyncline but had a northwesterly source. Intermittent orogenic uplift near the close of this cycle caused non-deposition or erosion of mid-Tertiary sediments. Late Tertiary diastrophism that closed the Tertiary cycle of sedimentation has continued to Recent time and includes differential orogenic movements, in part along major northeast-trending faults.

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Geology of San Nicolas Island, Ventura County, California

San Nicolas Island is the outermost of a group of eight islands off southern California. Point Mugu is the nearest point on the mainland, about 63 miles north; Los Angeles City Hall is approximately 90 miles northeast.

A geologic study of San Nicolas Island was begun by personnel of the U. S. Geological Survey in March, 1955, at the request of the director of Naval Petroleum Reserves.

About 3,550 feet of alternating sandstone, siltstone, and conglomerate constitute the exposed Tertiary section on the island. Foraminiferal studies indicate that these rocks are of late Eocene age. Several small igneous dikes that may be Miocene cut the sedimentary rocks in the southeastern part of the island. Quaternary dune sand and marine terrace deposits cover much of the central and western parts of the island.

Structurally, San Nicolas Island is a broad complexly faulted anticline with a southeast plunge. The axis roughly parallels the long dimension of the island and lies near the southwest shoreline. Two sets of intersecting faults which trend approximately north-south and east-west appear to have formed almost simultaneously. Most of these faults are high-angle normal faults, the largest having maximum apparent vertical displacement of about 400 feet.

Geologic diving operations were conducted off the west end of the island in an attempt to trace the seaward extent of the anticline mapped on shore. Self-contained underwater breathing apparatus was used by the divers in the study of approximately 5 square miles of sea floor at depths ranging from 30 to 120 feet.

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Silurian of Great Basin

The Silurian rocks in the Great Basin can be assigned to two distinct facies: an eastern carbonate facies and a western shale facies. The line separating the two facies, actually a narrow transition zone, trends northeast from Independence, California, through Beatty, Eureka, and Elko in Nevada.

The rocks in the eastern carbonate facies are composed almost entirely of dolomite. The dolomite is heterogeneous, varying from fine- to coarse-grained, black to white, and from almost pure dolomite to very silty dolomite.

The dolomite facies is one of the poorest systems for paleontological studies in the Great Basin. Fossils are scarce and where present are usually poorly preserved. A few localities yield silicified fossils that can be etched and studied in detail. Both Middle and Upper Silurian fossils are present in the dolomite. The faunas seem to be most closely allied to those of Australia and the Orient, and have little similarity to the Silurian forms in eastern North America. No Lower Silurian fossils have been

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.

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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.

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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.

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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