Oca fault in the west and the Pilar fault in the east. It is possible that these faults are at least as old as Cretaceous, that they are related to the tectonic history of the general Caribbean area as suggested by Bucher and others, and that they have played a major role in the deformation of northern Venezuela.

The displacement on other large wrench faults, such as the northeast-trending Bocono fault in the Andes and the northwest-trending Urica and San Francisco faults in the eastern Serrania del Interior, must be taken into account in reconstructing past structural and sedimentological trends and relationships.

The two most prominent tectonic features of Venezuela, the Coast Range (northern Caribbean Mountains) and the Andes, differ rather markedly from each other in the following respects: (a) the Coast Range had its origin in a trough of more-or-less geosynclinal character; the Venezuelan Andes did not; (b) many of the Coast Range rocks were metamorphosed during deformation; no metamorphism took place during the Andean orogeny; (c) volcanism was common in the Coast Range area both somewhat before and during deformation; no post-Lower Mesozoic volcanism is known in the Andes; (d) the Coast Range has a belt of serpentinites; the Andes does not; (e) the major deformation of the Coast Range was Middle to Late Cretaceous; that of the Andes was latest Eocene to Miocene.

The contact between the Coast Range and Andean trends at the Barquisimeto Gap is abrupt and may be modified by later faulting. Genetic and structural continuity of the Venezuelan Andes and the Caribbean Ranges as suggested by many geologists is questionable.

14. Tectonic History of South-Central American Orogen: JOEL J. LLOYD, Union Oil Company of California, San Jose, Costa Rica

The Middle American channel connecting the primeval Atlantic and Pacific oceans was subjected to forces in Upper Jurassic time that folded the sea bed into a series of parallel ridges striking SE. to NW. The westward and most tenuous of the ridges was ruptured by extrusive material that grew from the channel floor and emerged to form a chain of volcanic islands, the Western Archipelago. Erosion of the islands and deposition to the northeast provided the sediments of the Nicoya complex now exposed along the west coast of Costa Rica and Panama.

Volcanic eruption and continuing erosion throughout the Cretaceous supplied sediment to the shallowing Channel area. Deposition during this period was mainly from the Archipelago although some material was derived from the northern nuclear Central American mass. By the end of Cretaceous most of the denuded islands had foundered and the Western Archipelago had disappeared.

Diastrophism accompanying the Laramide revolution rejuvenated and further upfolded one of the interior ridges. The Guanarivas Island emerged in northern Costa Rica and southern Nicaragua. Volcanoes on Guanarivas were the north end of a chain that continued as volcanic islands southward and eastward through Panama. Eastern Panama, belonging to the Choco borderland, which had been emergent throughout the Cretaceous, began to founder in lower Eocene and was submerged by the beginning of the middle Eocene. Volcanic detritus and submarine laval flows are predominant in the accumulating Eocene sediments of the channel.

Guanarivas Island and the volcanic islands had disappeared by lower Oligocene time which was an epoch of comparative quiescence. Renewed activity in the middle Oligocene resulted in the growth of the Talamanca ridge and the appearance of islands in southern Costa Rica and northeastern Panama.

Continued growth through early Miocene culminated in development of the West Talamanca fault and total emergence of the ridge by the end of the middle Miocene. The faulted upthrust block was tilted eastward, creating compressive forces that fractured the eastern front of the high area and initiated folding on the Atlantic foreland of southern Costa Rica and northeastern Panama. The Miocene diastrophism was accompanied by the growth of volcanoes on the ridge in Panama.

Total emergence of a narrow strip of land, bordered by the Pacific Ocean and the Nicaraguan depression opening to the Caribbean, resulted in the first uninterrupted connection of South America with nuclear Central America in Pliocene time. During the Pliocene, strike-slip faulting on the west side of the new Isthmus extended from Nicaragua to Panama bringing up the Jurassic Nicoya complex that is now exposed as the core of peninsulas from Santa Elena to Azuero. In what may have been the same adjustment that caused the faulting a new chain of volcanoes appeared along the Pacific coast from Nicaragua to the northern edge of the Talamanca ridge.

By Quaternary time the Talamanca ridge had become stabilized and adjusted, the Nicaraguan depression was filled in leaving only Lakes Nicaragua and Managua and the San Juan River to mark its former course, and the Isthmus had assumed the shape we know today.

This relatively simple tectonic history provokes questions concerning forces and crustal behavior, validity of fixed mobile continental theories, isthmian links, volcanic island arcs, and continental front folding that cannot be answered today. The scope of the problems are indicated, however, and direction of investigation indicated that may occupy geologists for many generations.

15. Nuclear Central America Hub of Antillean Transverse Belt: J. H. BRINEMAN, Argus Petroleum Corporation, Guatemala, and G. L. VINSON, Esso Standard (Guatemala) Inc.

Nuclear Central America comprises the eastern part of the Sierra Madre del Sur geanticline and its flanking geosynclinal portion of the Gulf Coast and Caribbean embayments. Southeastern Mexico, Guatemala, British Honduras, Honduras, and Nicaragua make up the principal land area. Nuclear Central America disappears toward the east into the Caribbean Sea in easterly trending tectonic lineaments. The north flank of this geanticline is the crucial area for regional geologic interpretation.

The Mesozoic-Cenozoic Chapayal basin, or the eastern extension of the Chiapas foredeep, and the southern part of the Yucatan platform are the prime sedimentary areas involved. Chapayal basin, one of the local deep basins that ring and nearly surround the Gulf Embayment, is sharply asymmetric, having a steep and highly folded and faulted south limb and a gentle opposing limb which shelves northward over the Yucatan platform. The eastern part of the shelf area is interrupted by the Maya Mountain uplift in British Honduras which developed during the Paleozoic and was rejuvenated at the end of the Paleozoic. The Maya Mountains represent a remnant of an older Paleozoic hinterland that provided a source for later Paleozoic and Mesozoic sedimentation. It was a stable or slightly positive area during much of Mesozoic and Cenozoic time.

The Late Paleozoic-Mesozoic mobile belt, which sets the pattern for the geology of the nuclear Central America and the Antillean region, extends eastward