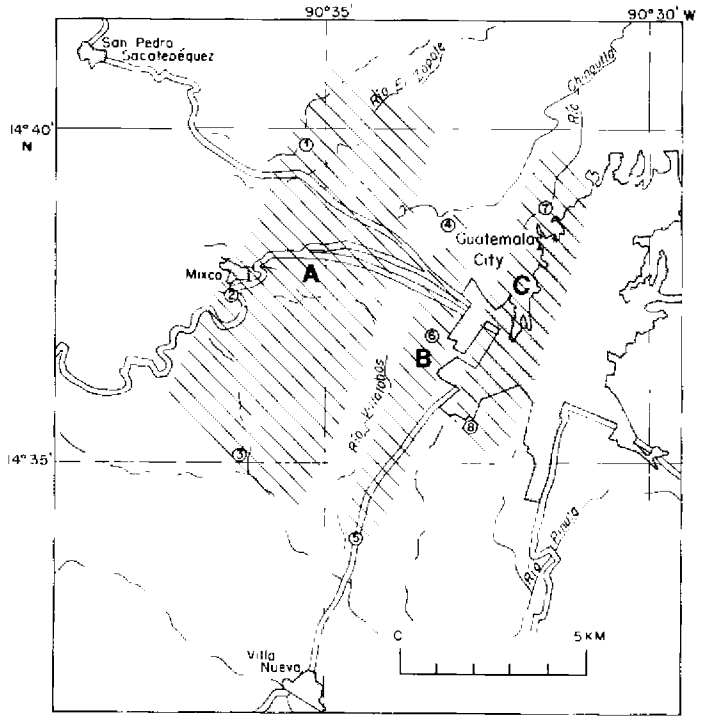

FIGURE 29.—Zones A, B, and C (hatched areas) of secondary faults, and numbered localities discussed in text. A, Mixco zone; B, Villa Linda-Castañas zone; C, Incienso-Santa Rosa zone.

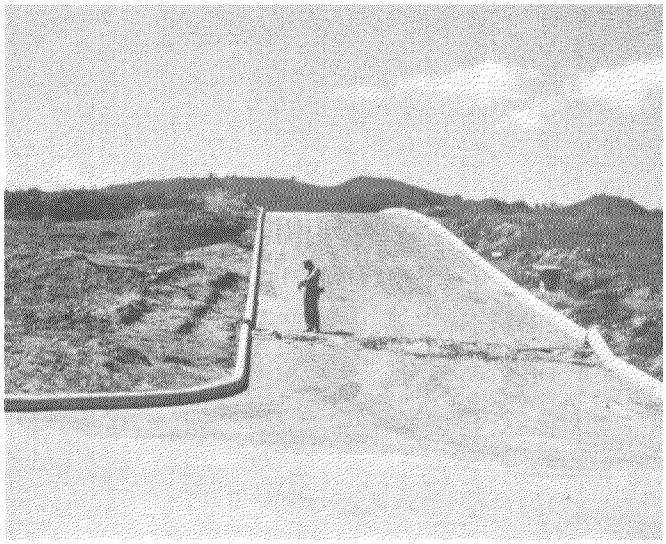

FIGURE 30.—Fault displacement of road at locality 1 (fig. 29). Note right-lateral component of displacement.

REGIONAL TECTONIC RELATIONS OF EARTHQUAKE FAULTS

The Motagua fault is part of a complex zone consisting of four major subparallel arcuate fault zones that trend in a general east-west direction across Guatemala and northern Honduras. As used in this paper, these are the Motagua and San Agustín faults in the Motagua Valley; the Polochic zone to the north, comprised of the Polochic and Chixoy (not labeled in fig. 23) faults; and the Jocotán Jocotán and Chamelecón faults (fig. 23). For convenience, this broad group of faults is referred to zone to the south, which consists primarily of the herein as the Motagua fault system.

The nature of the faults in this system and their relationship to the Cayman Trough (also referred to as Bartlett Trough) and the tectonics of the Caribbean region have been the subject of much study and speculation. Most workers agree that the faults in the Motagua system are old fundamental breaks that have undergone recurrent displacement at least since the late Paleozoic. Some have postulated large sinistral displacements on the faults in this zone during the Cenozoic, although significant vertical movements occurred during the earlier history of the zone. Excellent recent comprehensive summaries of the onshore geologic data relevant to the tectonic development of the region, including extensive bibliographies, have been given by Dengo (1968), Dengo and Bohnenberger (1969), Malfait and Dinkelman (1972), and McBirney and Bass (1969). Data on seismicity and marine geology and geophysics in the Caribbean and their relationship to plate-tectonics models have been presented by Molnar and Sykes (1969) and Jordan (1975).

The secondary faults of the Guatemala City-Mixco area are part of a system of predominantly dip-slip faults in Guatemala, western Honduras, and El Salvador that lie between the Motagua fault and the chain of stratovolcanoes that passes through the highlands of Guatemala and El Salvador (Dengo, 1968; Williams and others, 1964; Williams and McBirney, 1969). As shown in figure 23, these secondary faults group roughly into three sets that may in part reflect reactivated fractures in the crystalline basement rocks. The dominant set trends generally north to north-northeast; in a number of places, faults in this set bound prominent structural depressions such as the graben in which Guatemala City is located, the Ipala Graben of eastern Guatemala and western El Salvador, the Ulúa Graben in western Honduras, and a series of grabens along the Chamelecón-Jocotán fault zone. A second important set of faults is located along, and approximately parallel to, the northwest-trending chain of stratovolcanoes (fig. 23) that comprise the Middle America volcanic arc. This set of faults becomes

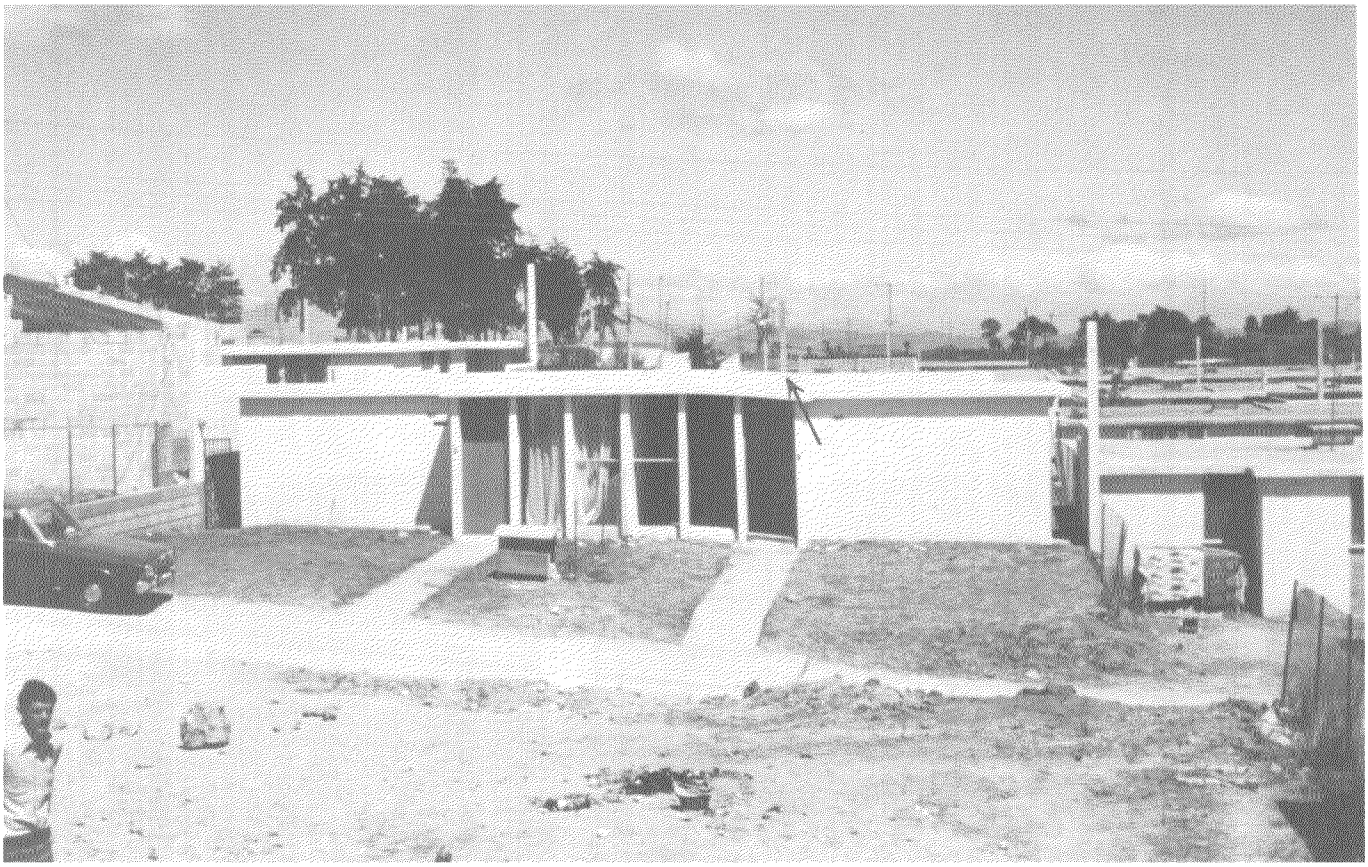

FIGURE 31.—Fault damage to a house in Guatemala City. The roof, foundation, and sidewalk have been displaced vertically.

increasingly prominent towards the southeast, where it bounds the central trench of El Salvador and the broad Nicaragua Depression (Williams and others, 1964, fig. 5; Dengo, 1968, fig. 9). A third set of oblique faults, not shown in figure 23, strikes northeast; it is locally well developed in the southeastern part of Guatemala and is present in much of the adjacent area to the southeast (Williams and others, 1964). Although detailed studies of the displacement histories of these faults have not been published, there can be little doubt that many of them are geologically youthful features. Most of them offset upper Tertiary or Quaternary deposits, in places they are marked by prominent scarps that border topographic depressions, and some of them serve as conduits for Quaternary volcanic eruptions.

Available data on the 1917–18 series of moderate-sized earthquakes that heavily damaged Guatemala City raise the possibility that those earthquakes may have originated on faults south or southwest of the city. The description by Vassaux (1969, p. 18–22) shows that Amatitlán and Villa de Guadalupe, both south of Guatemala City, sustained more damage than the city proper in the November 17, 1917, earthquake, which initiated the destructive series. Vassaux (1969, p. 21) concludes that there were at least two centers of activity during the series, including Petapa (about 15 km south-southwest of Guatemala City) and Escuintla (45 km southwest of Guatemala City). However, we suggest that the most likely cause of these earthquakes was a series of fault displacements on the Mixco system and, perhaps, on the extension faults that bound the graben in which Lake Amatitlán is situated (about 16 km south of Guatemala City).

LANDSLIDES

The main event and some of the large aftershocks triggered numerous landslides throughout a broad region of central Guatemala parallel to the main fault and extending as far westward as long 91°30′ W. (fig. 33). The landslides, numbering in the thousands, were mainly falls, slides, and flows involving thick pumiceous pyroclastic rocks, but they also included slides of consolidated bedrock (figs. 34 and 35). The overwhelming majority of the