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SURFACE RUPTURES EAST OF MEXICALI FROM THE IMPERIAL VALLEY EARTHQUAKE OF 15 OCTOBER 1979

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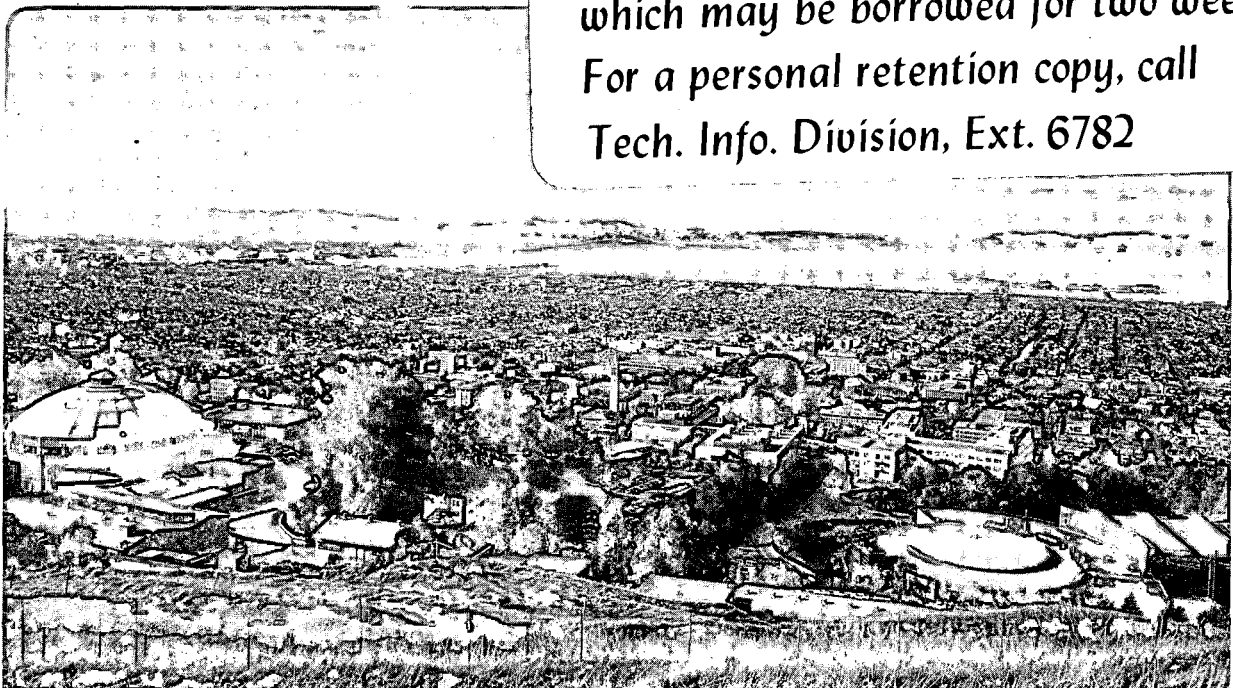
SURFACE RUPTURES EAST OF MEXICALI FROM THE IMPERIAL VALLEY EARTHQUAKE OF 15 OCTOBER 1979

Stephen Vonder Haar

May 1981

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IMPERIAL VALLEY EARTHQUAKE OF 15 OCTOBER 1979

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1 May 1981

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OBSERVATIONS AND COMMENTS

In the late afternoon of 15 October 1979, an earthquake in the Imperial Valley caused slight surface ruptures east of Mexicali, Baja California (Figure 1). The quake registered a local Richter magnitude ( $M_L$ ) of about 6.6 (Johnson and others, 1979) and 7.0 at Berkeley. Algermissen and others (1979) estimated the intensity of shaking to be VII to IX on the Modified Mercalli scale. The information presented here was obtained on October 16 within the study area outlined in Figure 2. Background studies of the Salton Trough which pertain to the Imperial Fault can be found in Brune and others (1979), Crowell and Sylvester (1979), and Johnson (1979). Epicenters of the 1940 quake near El Centro and the 8 June 1980 quake south of the Cerro Prieto geothermal field at Victoria, Baja California, are shown in Figure 1 for reference.

Slumps and fissures were best developed at location "A" (Figure 2) along an unimproved road that parallels a north-south earthen canal, a portion of Canal Principal del Oeste (Figure 3). Many of these rotational slumps of earth into the canal were up to 10 m<sup>3</sup>. Approximately 5 to 25 m from this canal, three faint fissures were found with strikes of 330°, 340°, and 345°. Each fissure was about 4 m long, but no reliable displacements could be obtained from them.

The only crack found in the paved highway was at location "B" of Figure 2, and is illustrated in Figure 4. This crack, on the north side of the divided highway, was downthrown 2.5 cm to the east and showed 1 cm of right-lateral

displacement. This crack and two nearby cracks showing less displacement had strikes of  $331^{\circ}$ ,  $326^{\circ}$ , and  $331^{\circ}$ . The crack in the pavement was patched the second day after the quake.

The curbs of the 1.5-m-wide concrete highway divider were shattered, but the divider itself was not cracked. The dirt shoulder south of the crack in the blacktop showed a series of seven faint fissures trending approximately  $340^{\circ}$  ( $+8^{\circ}$ ). They were very similar in appearance and length to the fissures near location "A."

Structural damage to the overpass 50 m east of the break in the highway was considerable (Figure 5). The cracks showed 5.5 cm of left-lateral displacement and 2 to 8 cm of east-west separation. These breaks, however, appeared to follow lines of engineering weakness, and were thus unreliable indicators of fault direction.

A concrete-lined canal was checked for breaks along a 1-km stretch near location "B." Although none were found there, a single crack with 1 cm of downward displacement was found in the same canal near location "D" (Figure 2).

Approximately 9 km west of the international Airport, a cemetery with extensive new masonry walkways and parking areas was visited to look for signs of the temblor (location "C," Figure 2). Curbs were cracked and offset 1 to 3 cm. One of the more notable features is shown in Figure 6. This man-made step, higher to the northeast, was pushed 3.5 cm horizontally to the southwest.

On the drive southeast to San Luis Colorado, on the Baja California-Sonora border, no cracks were noted in the paved highway, but a major slump was observed at location "E" (Figure 2), where approximately  $200 \text{ m}^3$  of siltstone had moved from the roadside into a deep earthen canal.

These observations, as sparse as they are, are of importance because few reports are available south of the Mexican-American border for the earthquake. A visit to sites of surface displacements north of the border the next day revealed that the surface ruptures around Brawley and Calexico were of a similar scale and style to those observed east of Mexicali (see Sharp, 1979, for initial comments on north-of-the-border surface displacements).

Previous studies on regional faulting (Vonder Haar and Puente Cruz, 1979; Vonder Haar and Howard, 1981) corroborate the observed  $329^{\circ}$  to  $340^{\circ}$  fault trends. The suggested implications of the Imperial Fault for projected 30-year geothermal development in the Salton Trough are: (a) that microfracturing at depth must be extensive and relatively frequent; (b) that surface ruptures produced by moderate-intensity earthquakes of this type appear to be limited to areas approximately 15 km wide and 40 km long; and (c) that surface effects appear to follow old faults; in this study the traces were 1 to 2 km west of the faults produced 39 years ago.

Discussion of the 8 June 1980 earthquake ( $M_L = 6.7$ ) approximately 65 km southeast of Mexicali (see Figure 1) by Mexican and American scientists at the Third Symposium on the Cerro Prieto geothermal field (March 24-26, 1981, in San Francisco, California) suggested little if any surface fracturing. Extensive slumping due to liquefaction was the hypothesis put forth and generally accepted (see also Reyes Zamora, 1980).

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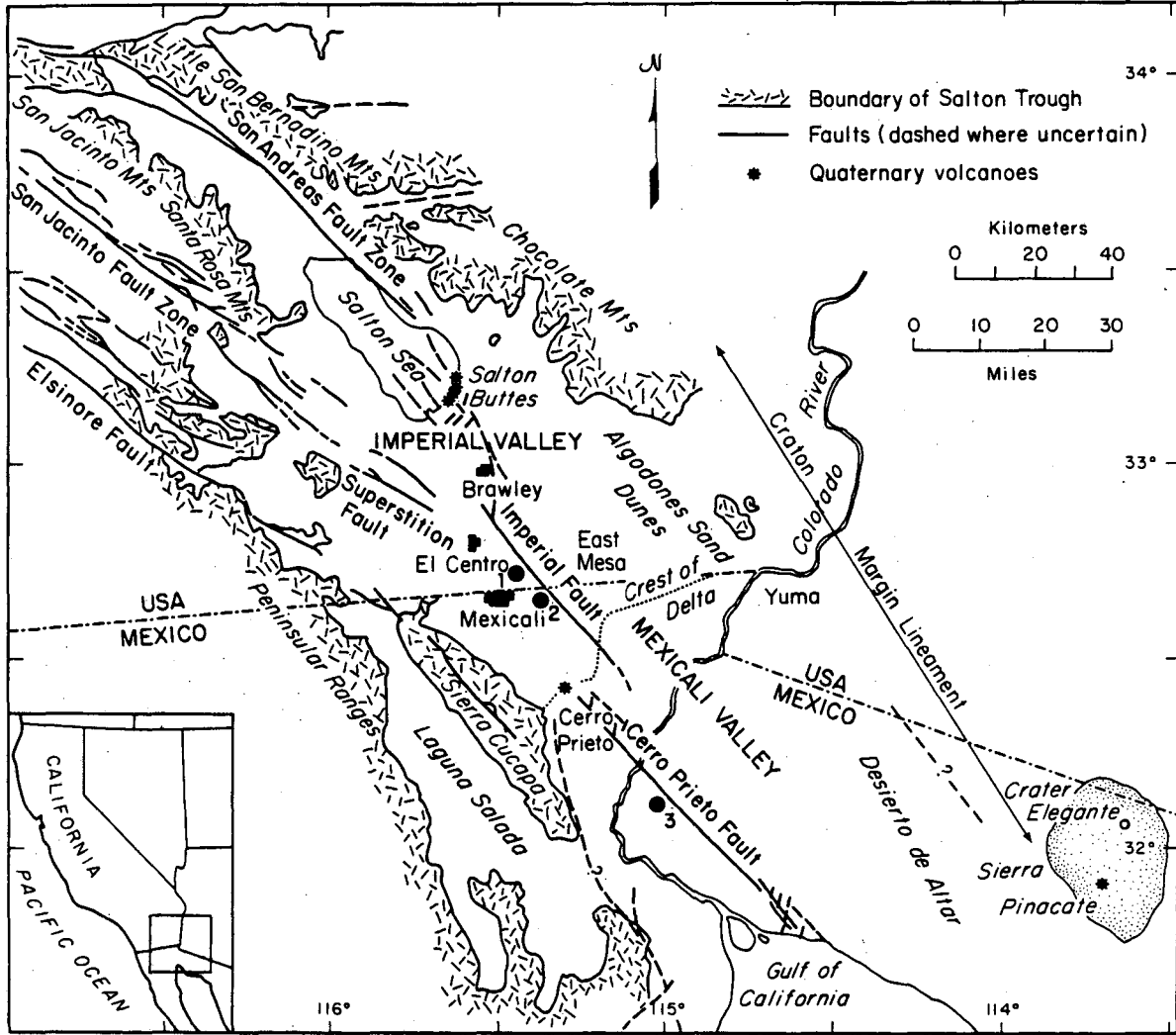


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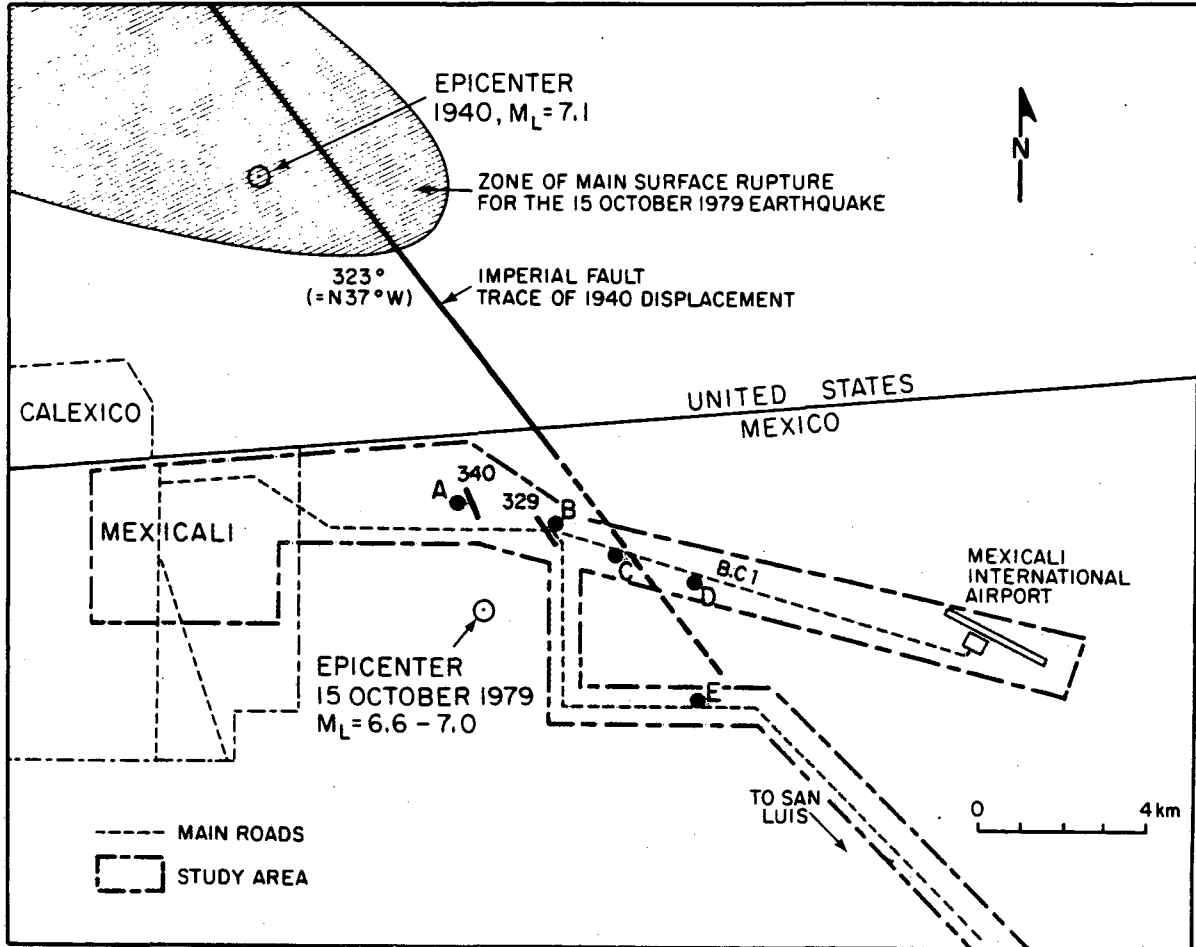
## FIGURE CAPTIONS

- Figure 1. Location map of the Salton Trough showing the Imperial and Cerro Prieto Faults and epicenters of three earthquakes: (1) 1940; (2) October 1979; (3) June 1980.
- Figure 2. Map of the study area east of Mexicali. Letters "A" through "E" mark the locations of the features described in the text.
- Figure 3. Fissures due to slumping of the dirt road into the earth-lined canal located to the right. Scale shown by backpack (1 ft wide) on the road in the upper center of the photograph; view is south at location "A" of Figure 2.
- Figure 4. Crack in paved highway at location "B" of Figure 2; view northwest. Backpack at far side of road shows scale (1 ft wide). Displacement is down 2.5 to the east with 1 cm of right lateral movement.
- Figure 5. Overpass damaged by earthquake at location "B" of Figure 2. See text for discussion; view southwest.
- Figure 6. Cemetery parking lot at location "C" of Figure 2. View is west; white 1-ft ruler shows scale. Note the apparent overthrusting of the step to the south-southwest.



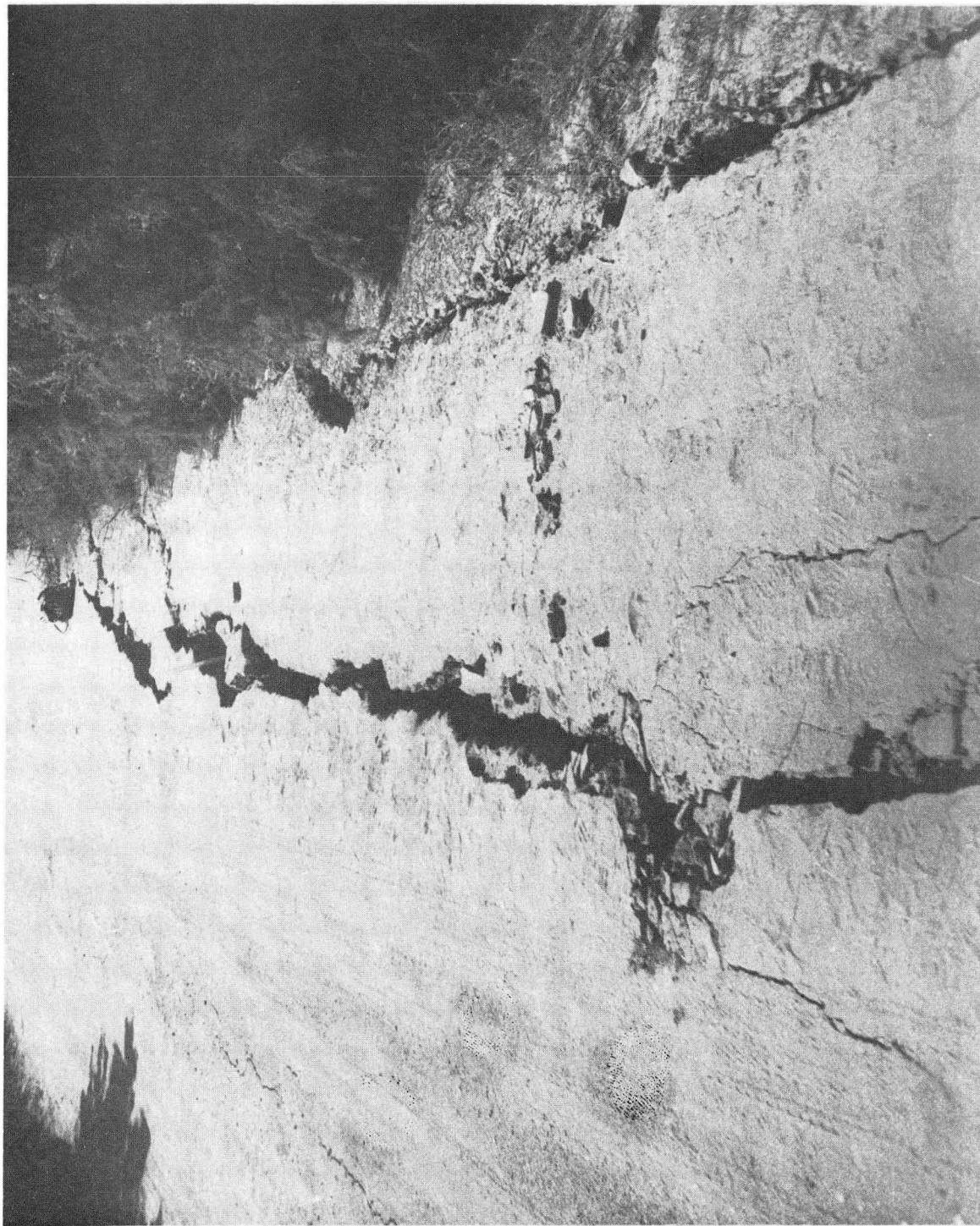
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Figure 1



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Figure 2



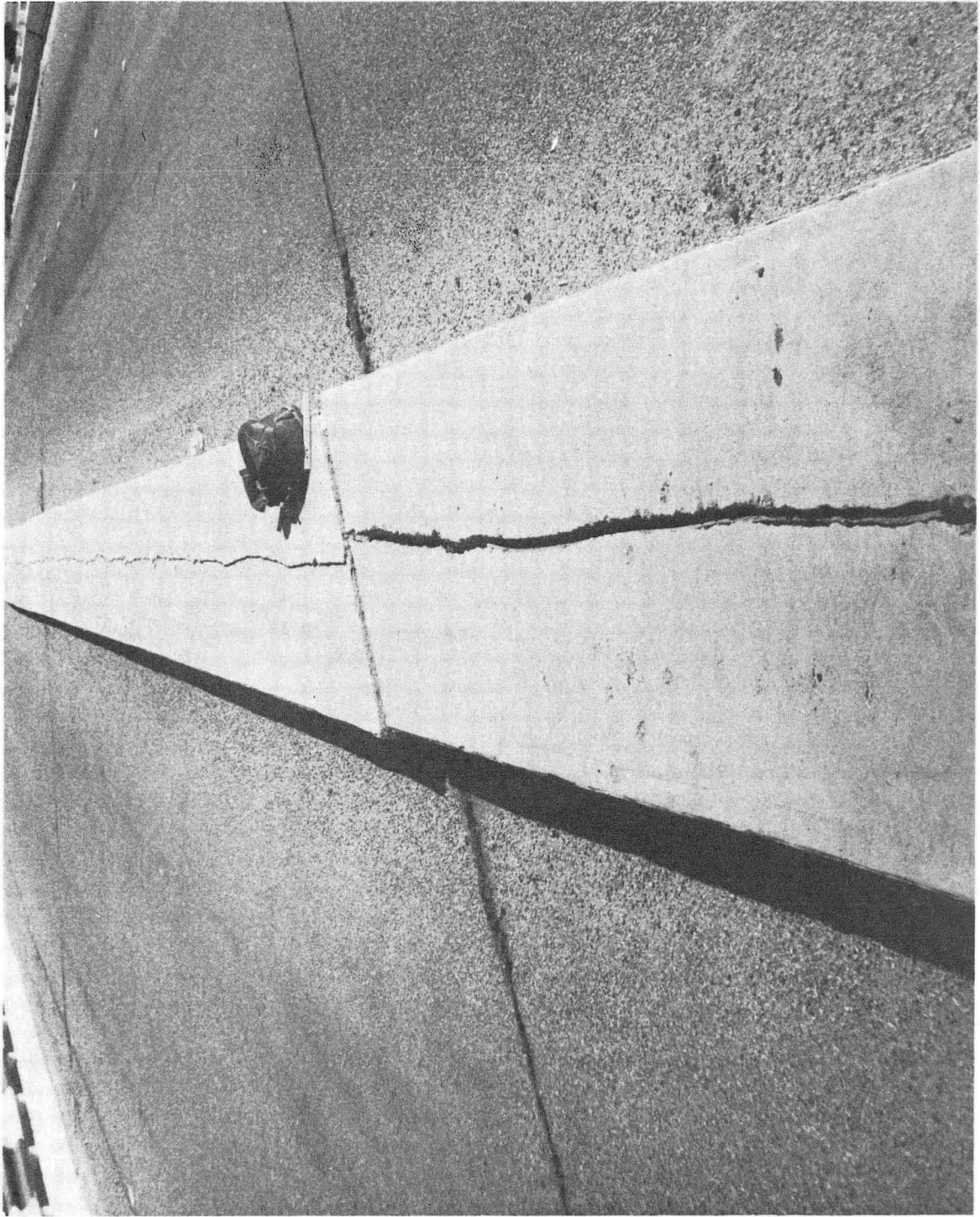
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Figure 3



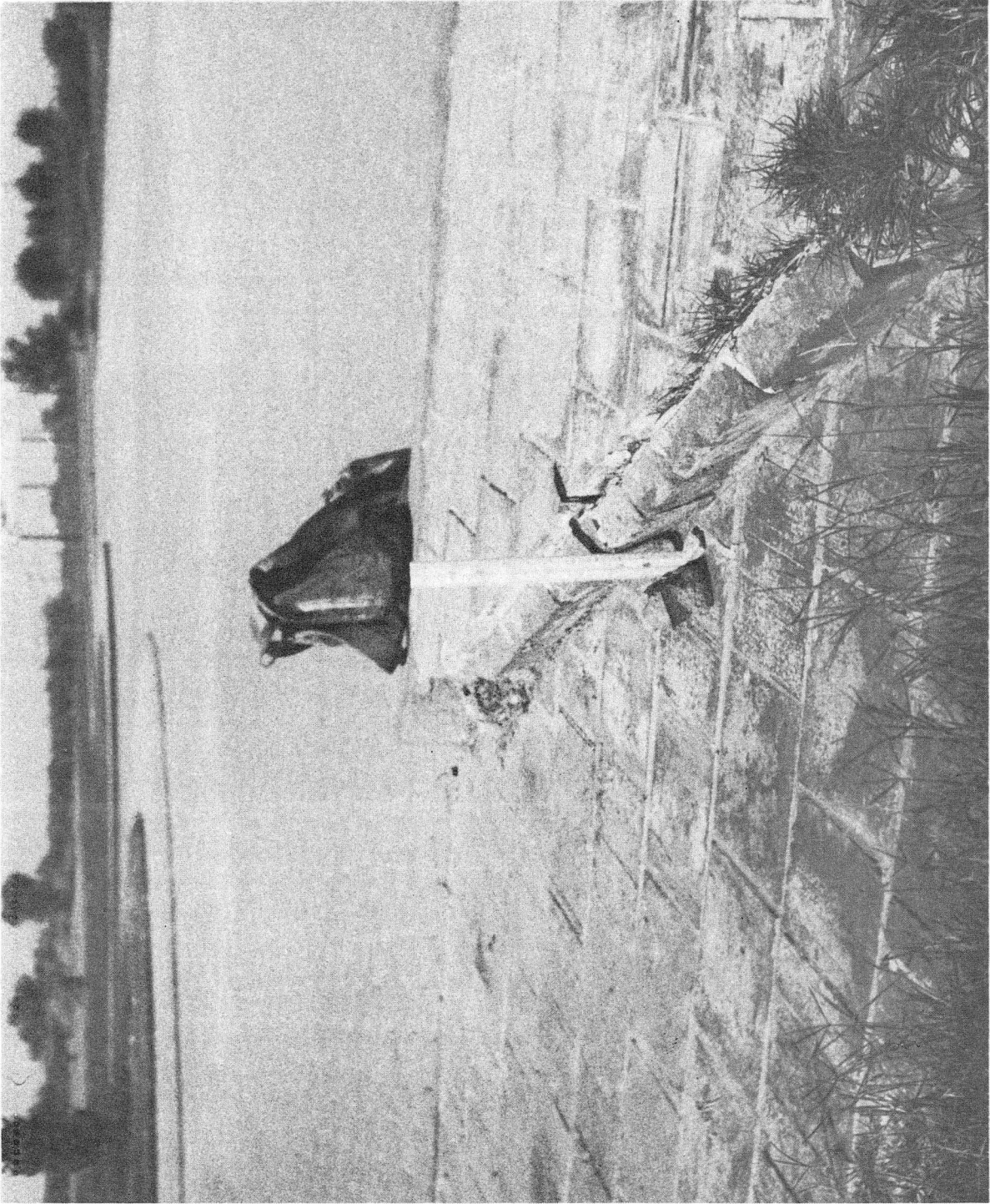
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Figure 4



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Figure 5



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Figure 6



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