respects comparable in size and type of workmanship to some of the forms of this collection. Many of the Lake Mojave implements, as is evident from the published plates, have been much modified by the cutting of wind-driven sand and their original form obscured. It would be premature to attempt a correlation by typology. Nevertheless, the existence of the Lake Majove types lends support to the hypothesis that the finds at Cerro Pedernal, are not blanks, but the implements of a hitherto unrecognized culture or cultures.

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VEGETATION ON SHELL MOUNDS, LOWER CALIFORNIA

THE interesting note by Hrdlička[1] on the distinctive plant life of native village sites in Alaska brings to mind parallel phenomena observed by the writer two thousand miles farther south on the Pacific coast.

The marine terraces which skirt the northwest coast of Lower California are dotted with shallow but extensive Indian shell middens. Near Pabellon Canyon (southeast of San Quintín), where the marine terrace zone is eleven miles wide and rises by gentle steps from sea level to 1,600 feet above sea level, a field survey was made across the entire terrace zone. Shell mounds were largest near the coast, but even along the six miles at the landward end of the survey line twenty shell middens were observed. On the average, each of these inland middens covers about an acre and is a foot and a half deep at the center. The deposits consist principally of ashes, broken clamshells and blackened rock chips.

The middens are covered with dense brush, of *Franseria chenopodiifolia* interspersed with California sagebrush. The surrounding terrace surface is either gravelly, with an open formation of agave and cactus, or a crumbly clay sparsely covered with low annuals, especially tarweed (*Hemizonia lobii*). The compactness, height and color of the *Franseria* thickets made it possible to discover middens from a considerable distance. In July, the dirty yellow-green of the thickets stood out in marked contrast to the grey-brown of the higher agave and the buff-yellow of the lower tarweed formations.

Accidental transportation of seed by Indians and favorable soil in the middens explain the dominance of *Franseria*. A small tenacious burr favors dissemination. Coastward, the plant grows abundantly on the silty lower terraces below a level of 800 feet, and Indians must have involuntarily accumulated many burrs as they returned inland from digging clams along the coast. *Franseria* also abounds on the silt floors of the deep canyons which traverse the terraces, and some burrs may have been picked up when the Indians brought water from the arroyos to their camps on the dry ridges along which ran their trails to the interior. Since the plant had no known economic value to the Indians, deliberate transportation is ruled out as a possibility. Once brought to the middens, the seeds thrive on the rich ashy soil, but do not grow on the surrounding gravel and clay.

Seaward from the 800-foot level, midden vegetation is distinguished by the fog-loving ice plant, *Mesembryanthemum crystallinum*. This plant flourishes not only on shell mounds but wherever else the soil has been recently disturbed: on abandoned roads and fields, disintegrating adobe mission walls, rodent diggings and recently eroded surfaces.

Twenty miles farther south, another detailed survey revealed similar relations between middens and vegetation on the ridges and canyons of the eroded marine terrace.

Expert comparative study of midden vegetation might throw light on such subjects as Indian routes and (through analysis of plant successions) the relative recency of abandonment of *ranchería* sites.

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THE LEVEL OF THE OCEAN DURING PART OF THE CENOZOIC ERA

THREE problems of the Cenozoic Era are: (A) Submarine channels on the continental shelf; (B) severe changes in climate, including a period of continental glaciation, and (C) intercontinental migration of land animals.

The submarine channels on the ocean side of the continental shelf of North America, both on the Atlantic and the Pacific side, show from the recent surveys extended consequent courses with deep narrow valleys of the canyon type. They have tributaries with branching angles of less than ninety degrees. The evidence is that they were formed by corrasion of running water.

A great lowering of the ocean level would give gravitational impulse to river water to accomplish this sculpturing.

Following the theory of the origin of nebulae by tidal disruption on the approach and close passing of two heavenly bodies, it is plausible to think of a minor heavenly body so passing the earth. This passing might well abstract surface water from the globe, including a large fraction of the volume of the oceans. Instead of a single approach there may have been a series.

The water so withdrawn would be lifted into the stratosphere and assume a configuration like the

[1] Aleš Hrdlička, SCIENCE, 86: 559–560, 1937.