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Serpent in Eden: Dispersal of Foreign Diseases Into Pre-Mission California

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Old World diseases are credited as the chief agencies of native destruction in California only after the establishment of the first mission in San Diego in 1769. What is neither appreciated nor generally accepted is that the holocaust initiated by Europeans upon California's peoples, cultures, and environments may have begun during the two and a half centuries preceding the laying of the foundations of Mission San Diego. It was a post-Columbian process that not only threatened native patterns of land and life in California before 1769, but also cast doubt on some long-standing assumptions concerning the nature of the state's aboriginal dwellers after missionization.

The purpose of this paper is to show that California was in close and intimate proximity to the germs and vectors required for pre-mission pestilence. In addition, the perception of California's geographic immunity will be revealed as unwarranted owing to the multiple pathways available for conveyance of microbial infection into the state. This examination will trace the routes which may have channeled exotic diseases into pre-mission California and illuminate the dispersal mechanisms that transported them. Once California specialists are convinced of the probabilities of pre-mission pestilence, they may be motivated to more confidently search for new evidence of its arrival and reevaluate the old. The goal of this geographic assessment is to stimulate these long overdue efforts.

Old world disease did spread in advance of the mission frontier, destroying or altering the fabric of Indian society prior to sustained contact with Spaniards.

[Reff 1992:272-273]

IN the entire context of European New World colonialism, the role of disease in the destruction of the aboriginal population of Alta California has been virtually ignored.¹ Only after the relatively late introduction of missionization in San Diego in 1769 is disease credited as the chief agency of aboriginal demise in California. That event and subsequent missionization renewed a juggernaut of death (a reduction in population of 90% between 1769 and 1900) in which the specific contributions of disease are well documented (Cook 1978:91, 1976a). The associated impacts upon lifeways and environments after 1769 are equally understood and accepted as conventional wisdom (Heizer 1974; Cook 1976b). What is neither appreciated nor gener-

ally accepted is that the story of foreign-induced destruction is incomplete, and thus far has displayed only the "tip of an iceberg." The holocaust loosed by Europeans upon the peoples, cultures, and environments of California is likely to have actually begun during the two and a half centuries before the laying of the foundations of Mission San Diego. This would not only have altered native societies in varying portions of California, but its recognition would also threaten several long-standing academic assumptions concerning aboriginal lifeways and demography prior to missionization (Kroeber 1925:238-239; Cook 1976a:24). It is argued herein that California was in close and intimate proximity to the germs and vectors required for pre-mission pestilence. In addition, the perception of California's absolute geographic immunity will be revealed as unwarranted owing to both the multiple pathways available as well as the opportunities for conveyance of microbial infection into the state.

The foci of this paper include: (1) the routes by which exotic diseases may have been channeled into pre-mission California; and (2) the dispersal mechanisms that may have transported them. This examination will be conducted in light of the colonial precedent of exotic contagion upon adjoining New World lands on the one hand, and modern epidemiological hindsight on the other. The goal is to present a plausible assertion that, within two and a half centuries after the landing of Hernando Cortés in 1519 on the Veracruz coast of Mexico, post-Columbian diseases had impacted the populations of California.

PRE-MISSION CALIFORNIA: AN ISLAND OF IMMUNITY?

The contemporary notion that California remained isolated and aboriginally pristine prior to 1769 reflects conventional wisdom (Cook 1978: 91; Jackson 1994:164), but is somewhat puzzling in light of epidemiological understanding elsewhere in the western hemisphere. The spread of introduced diseases throughout north-western New Spain (i.e., Sonora, Baja California, American Southwest) during the sixteenth, seventeenth, and eighteenth centuries is widely accepted (Sauer 1935; Cook 1937; Aschmann 1959; Dobyns 1981; Jackson 1981a, 1985; Reff 1991a). Furthermore, little resistance has been voiced concerning the demographic consequences of exotic diseases that preceded Europeans into the eastern regions of North America—an acceptance that is emerging as the new conventional wisdom for these areas (Cook 1973; Dobyns 1983; Crosby 1986; Ramenofsky 1987; Smith 1987).² Somehow, California has escaped this kind of epidemiological attention and, as a consequence, the recognition of pre-mission pestilence. The reason that pre-mission California seems to go against the colonial precedent may be linked to a paucity of archaeological and historical documentation, incorrect perceptions of California's geography, and the re-

luctance to recognize the true importance of disease upon the evolution of history.

For centuries, California stood apart, both within the colonial realm and in the collective mind (Fig. 1). To this day, colonial images and perceptions of California as an "island" persist in modern historical analysis. It is true that California remained just beyond the initial Spanish colonial pulse, having reached an apex in northern Baja California and Santa Fe by the middle of the eighteenth century. In addition, the hesitant and infrequent visitation by explorers (a 167-year gap occurred between the last official exploration in 1602-1603 and the founding of Mission San Diego in 1769) left a dearth of written materials and sustained accounts. Traditionally, researchers of California's protohistoric period (interpreted as the period from 1519 to 1769 in this paper) have relied upon a variety of archaeological and ethnographic materials—information often interpreted by mindsets that cling to a California viewed as unique, separate, and divorced from most processes manifested in Hispanic lands to the south.³

Important also to the perception of California as a colonial exception are its topography and climate. The great bulwark of the Sierra Nevada and the aridity of the southern deserts (e.g., the Mohave and the Colorado) tend to support the impression that protohistoric development in California was insulated from and relatively independent of southern colonial processes. This interpretation of California's physical geography is dubious, however, and the perceived cordon sanitaire is argued herein to have been in reality as porous to native interaction and exotic diseases as were the arid and topographical barriers of Latin America.

Perhaps of even greater importance to an understanding of traditional interpretations of California's protohistory is the common perception of the Native Americans who inhabited the southern periphery of the state. Early Hispanic

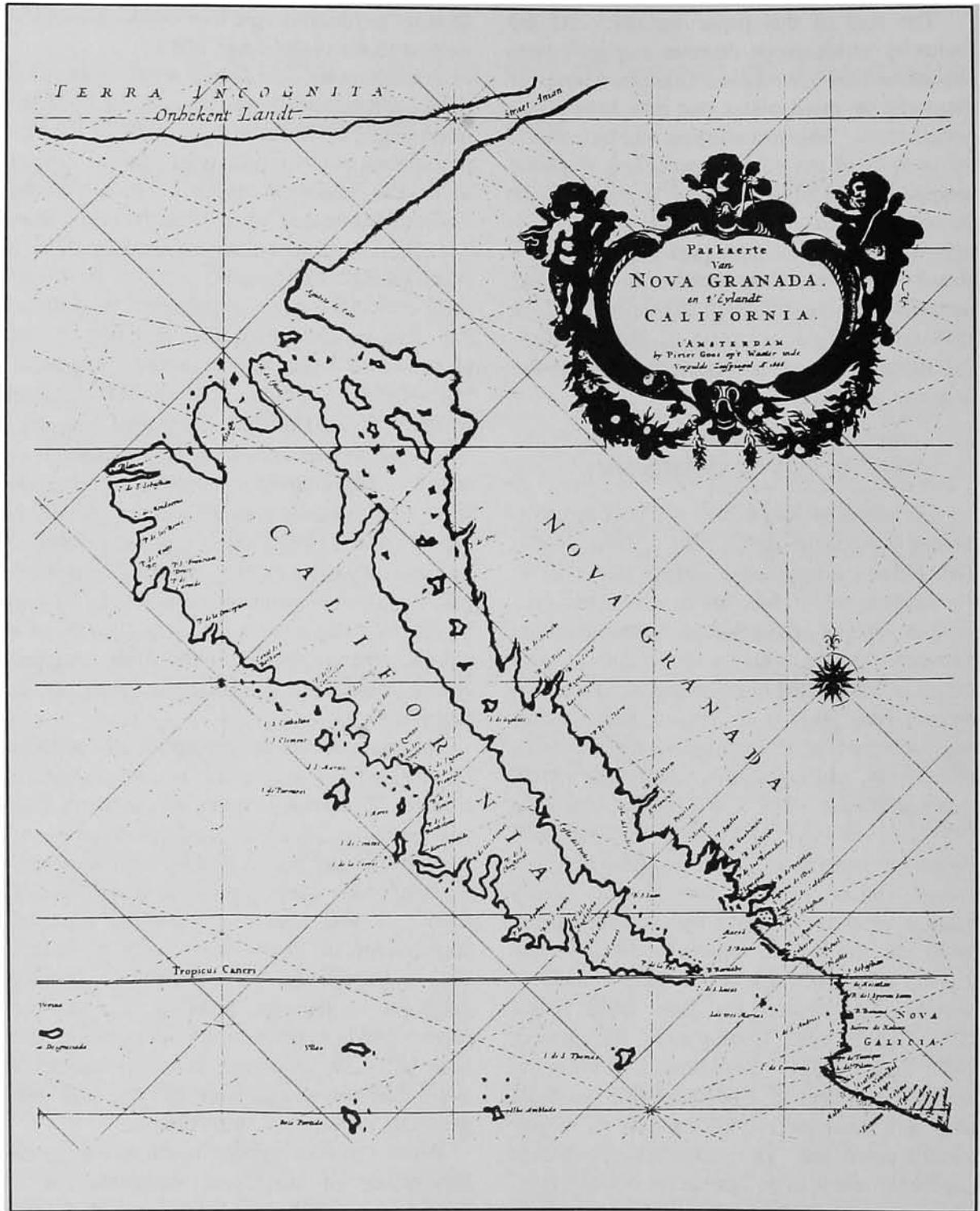


Fig. 1. A portion of Pieter Goos' 1666 *Map of New Granada and the Island of California* (Goos 1972). Interpretation of the state's frontiers as safeguards to disease diffusion before 1769 tends to reinforce the perception of California as an island of immunity during its protohistoric (1519-1769) period.

accounts, which appear verified by ethnographic research, describe natives living simple lives in a sparsely populated land.⁴ More often than not, the low population density and material status inherent to these societies are not considered to be conducive to the spread of epidemic disease (Dobyns 1983:13; Ramenofsky 1987:6-21). This judgment is based on the acceptance that descriptive observations and retrospective accounts made after 1769 were accurate reflections of native numbers and lifeways. From these historical records alone, it would be difficult to determine whether low population densities in southern California were the initial native (pre-colonial) condition or a consequence of disease. Similarly, native oral traditions and ethnographic evidence are suspect as accurate depictions of catastrophic events that occurred two to three hundred years prior to their collection (Campbell 1990:28-29; Fagan and Maschner 1991:974).

Archaeological evidence apparently does little to weaken the case that California remained immune to the scourge of epidemic disease until 1769. Part of the reason for this may be explained by noting that osteoarchaeological techniques are still in their infancy and that human bones rarely exhibit the consequences of the types of acute infection that were the most responsible for the devastation of many New World populations after Columbus (Ortner 1992:5-6). Archaeological interpretations that accept only a late introduction (post-mission period) of exotic diseases are largely based upon lack of evidence, rather than on specific studies designed to address the issue (Campbell 1990:190).⁵ Once California archaeologists and other specialists are convinced of the possibilities, or even probabilities, of pre-mission disease introduction, they may be motivated to more confidently search for new evidence and reevaluate the old.

A few California specialists have broken from the isolationists' ranks and have addressed the prospects of pre-mission contagion in Cali-

fornia (see Brown 1967:35, 78; Gerhard 1982:309; Chartkoff and Chartkoff 1984:256; Kelsey 1984:502; Walker et al. 1989:358; Walker and Johnson 1992:128, 1994:116; Walker and Hudson 1993:20-23; Erlandson and Bartoy 1995, 1996).⁶ However, these authorities have yet to address in detail a question that warrants and demands a geographic assessment—dispersal mechanisms and the routes of contagion for the introduction of Old World diseases into pre-mission California.

TWO TYPES OF PARASITIC ECOSYSTEMS

The first Europeans to make landfall in the Americas encountered a land and people essentially free of many of the contagions that afflicted the Old World. This unique epidemiological dichotomy between colonist and colonized was a product of the pre-colonial isolation of the two regions as well as the timing and nature of the initial peopling of the western hemisphere (see McNeill 1976:30, 45-48; Wood 1979:159-164; Dillehay 1991; Butzer 1992:364). Before colonial intrusion, however, New World environments were anything but bucolic and disease-free (Denevan 1992a; Butzer 1993; Larson 1994:114-117). The record is well established and clear that New World ecosystems harbored a variety of human infections (Fig. 2). However, these ailments provided negligible protection from diseases spawned in Old World habitats and were seldom (with the possible exception of syphilis) lethal when returned to Old World peoples and societies (Aufderheide 1992:165-166; Meltzer 1992:39).

Human pathogens that survived the Upper Paleolithic migrations (along with those that may have developed in the Americas) evolved into an endemic accommodation with their hosts, and in subsequent generations would be described as hepatitis, encephalitis, polio, pneumonia, tuberculosis, dysentery, helminthic infections, and a form of venereal syphilis (treponematosi-

Selected Pathogens	
Old World	New World
Chickenpox	Pinta
Common Cold	Yaws
Influenza ^a	Polio
Measles	Encephalitis
Mumps	Hepatitis
Rubella	Intestinal Parasites
Smallpox	Syphilis ^a
Yellow Fever	Tuberculosis ^a
Dengue Fever	Pneumonia ^a
Diphtheria	
Pertussis (Whooping Cough)	
Pneumonia ^a	
Scarlet Fever	
Tuberculosis ^a	
Typhoid Fever	
Syphilis (Spirochete) ^a	
Anthrax	
Bubonic Plague	
Cholera	
Epidemic Typhus	
Malaria	

^aVariants possibly endemic to both hemispheres.

Fig. 2. Selected pathogens originating in Old and New World environments prior to the "Columbian Exchange" (from Ramenofsky [1987:137-171, 1993:322-324], Cook and Lovell [1992:218-229], Merbs [1992], and Larson [1994]).

(Merbs 1989:48-51, 1992:36; Verano and Ubelaker 1991:213-214, 218; Powell 1992:41; Larson 1994; Rothschild and Rothschild 1996:560).⁷ These afflictions were assuredly a nuisance to New World peoples and had impacts on aboriginal demography. However, these indigenous diseases were endemic threats to tribal health and not the tribal destroyers that the exotic microbes proved to be.

By the colonial period, the majority of the virulent microbes that previously had decimated Europe were rendered mostly endemic there. In the process, they became the anticipated diseases of childhood, which had severe consequences for

the young, but with proper care and nutrition could be survived and immunity gained (influenza, cholera, and malaria being among the exceptions). The contagions that evolved in these Old World environments included smallpox, measles, chicken pox, diphtheria, influenza, typhus, typhoid and paratyphoid fever, cholera, bubonic plague, malaria, scarlet fever, mumps, whooping cough, yellow fever, dengue fever, amoebic dysentery, and a number of helminthic infections (Fig. 2) (Dobyns 1983:11-24, 34; Crosby 1986:198; Butzer 1992:35; Ramenofsky 1993:324). The colonial surge rapidly disseminated these European ailments to a newly vulnerable ecosys-

tem, where their impacts were once again rendered lethal in most areas.

THE ECOLOGY OF NEW WORLD CONTAGION

Several biological traits of colonial pestilence are germane to their potential for geographic spread (Cook and Lovell 1992:232-239). Noteworthy in this respect was the susceptibility of their New World victims and the biological characteristics (of parasites and vectors) that aided in their dispersal.

In biological terms, Native Americans were virgin and therefore vulnerable to microscopic intruders from the Old World. Having had no experience with exotic pathogens, Native Americans exposed to them were immunologically defenseless (Ashburn 1947). Pathogens new to the population of a region and that are consequently spread are known as virgin soil epidemics.⁸ Typically, they are characterized by inordinately high rates of infection (from 50% to 100% of those exposed) and mortality (40% to 100% depending on the ailment) (Crosby 1976:293-295; Ramenofsky 1987:171; Zubrow 1990:760).⁹

The health of New World peoples may have been further jeopardized during colonization by the reaction of endemic maladies, such as infectious tuberculosis and treponemal disease, with their Old World counterparts.¹⁰ Societal disruptions fostered by exotic pathogens and possible hybridizations among the contagions may have changed the endemic diseases into more virulent and epidemic forms. Both of these infectious diseases are thought to have been indigenous to California and their presence during the proto-historic era may have contributed to the creation and spread of epidemic forms (Stodder and Martin 1992:63-64).

Rates of infection and the abilities of Old World diseases to spread were heavily influenced by the mechanisms of dispersal peculiar to each disease. The so-called crowd diseases (e.g., smallpox, measles, and influenza), which

are spread from person to person through inhalation, comprised the first epidemic waves and were among the most lethal to Native Americans. Indicative is the smallpox virus (*Variola major*), which is dispersed through the air by means of droplets and dust. Owing to its ability to survive long periods (years) outside its host, the smallpox virus was able to spread over long distances on either air currents or objects of trade like textiles, most particularly on cotton.¹¹ As a medium of dispersal, cotton is significant because cloth was an important article of exchange in northwestern New Spain, both before and during the colonial period (Bolton 1948:80; West 1949:81; Reff 1991a:23).¹²

The diffusion potential of some crowd diseases was enhanced by varying communicability and incubation periods peculiar to each (Fig. 3). The incubation period for the smallpox virus, for example, averages 10 to 14 days, long enough for an infected but otherwise healthy carrier to cover considerable ground, infecting others along the way (Dixon 1962:68; Ramenofsky 1987:147).

Later to arrive, but no less virulent, were diseases transferred by intermediate vectors such as fleas, lice, mosquitoes (i.e., zoonotic), and surface water. These plagues—malaria, yellow fever, cholera, amoebic dysentery, typhoid fever, and typhus—may remain for long periods in the host and be infective inside and outside the victim for varying periods.¹³ Such characteristics have dispersal advantages, but their dependence upon intermediate vectors makes these contagions more susceptible to varying climatic and topographical conditions (Dixon 1962: 299-301; Cook 1981:62; Cook and Lovell 1992: 224). When geographic conditions are suitable for vectors, the associated afflictions can infect an expansive swath of territory. The great malarial epidemic of 1830-1833 in Oregon and California provides a clear example of this dispersal capability. The infection originated along the Columbia River in 1830, and before running

Selected Old World Pathogens	
Viral	Diffusion Potential^a
Direct Transmission	
Chickenpox	7-14 days
Common Cold	24 hours
Influenza	less than 6 days
Measles	7-14 days
Mumps	7-14 days
Rubella	7-14 days
Smallpox	9-14 days (several years in dry state)
Indirect Transmission	
Yellow Fever	..b
Dengue Fever	..b
Bacterial	Diffusion Potential^a
Direct Transmission	
Diphtheria	1-4 days
Pertussis (Whooping Cough)	15 days to 4 weeks
Pneumonia	variable
Scarlet Fever	7-14 days
Typhoid Fever	8-14 days
Syphilis (Spirochete)	..b
Tuberculosis	..b
Indirect Transmission	
Anthrax	..b
Bubonic Plague	..b
Cholera	7-14 days
Epidemic Typhus	10-14 days
Malaria (protozoal)	..b
^a Based upon periods of communicability and incubation.	
^b Unknown or inapplicable.	

Fig. 3. Selected Old World pathogens demonstrating varying communicability periods, which influenced their diffusion potential (from Dixon [1962], Ramenofsky [1987:137-171], and Cook and Lovell [1992:218-229]).

its lethal course in 1833, had traversed a thousand miles to the upper San Joaquin Valley (Cook 1955). The geographic spread of this vector-communicated epidemic is even more remarkable given the demographically reduced

nature of California at this relatively late historical date. That vectors were available for the transmission of malaria into California prior to missionization is incontrovertible (Giglioli 1968; Wood 1975:93, 97-98; Borah 1992:18). In fact,

the natural habitats of anopheles mosquito species were present in California and adjoining territories.

The diffusion of foreign microbes was also abetted by the tendency of one contagion to facilitate the spread of others. New World sufferers of an initial onslaught of an Old World disease such as smallpox, who might have survived had they been exposed to only that one illness, often experienced a coup de grace with accompanying sicknesses like pneumonia or pleurisy (Zinsser 1934:87-88; Crosby 1972:515; Ramenofsky 1987:148).

HEMISPHERIC CONTAGION: THE COLONIAL PRECEDENT

Immediately after the first visit of Columbus in 1492, the native peoples of the Americas began to perish in unprecedented numbers (Sauer 1966:155, 160; Dobyns 1983:254-259). They died as a consequence of battle, slavery, malnutrition, and despair; but the greatest destroyers of human life were the microbes that accompanied the European interlopers (Ramenofsky 1987:171; Whitmore 1991:479). Being geographically distant from the initial colonial landings in the Caribbean, California and adjacent vicinities probably remained immune to alien infections until the first onslaught of pandemic smallpox, which persisted from 1518 to 1525.¹⁴

Hispaniola was the initial disembarkation point for the smallpox pandemic. However, the virus was quickly transported by the legions of Cortés to the Mexican mainland, where it may have proved more valuable than gunpowder in the subjugation of the Aztec realm (Stearn and Stearn 1945:19; Shurkin 1979:108). In short order, this and subsequent virulent waves may have skipped ahead of the Spanish intruders and entered Andean South America (Cook 1981). Thus, when Pizarro arrived there in 1531, he and his few hundred followers laid claim to an Inca empire, which contained far fewer subjects

than it had a decade earlier (Dobyns 1963a:494).

The progress of the great smallpox pandemic beyond the Incan and Aztec core regions to which the Spanish were initially drawn is less certain (see Dobrizhoffer 1822:338; Pyle 1976; Crosby 1986:184-204). The disease, nevertheless, had proven capable of traversing every conceivable environment (e.g., rainforests, highlands, arid coastal deserts) in its deadly journey southward from the Valley of Mexico (Fig. 4). There is considerable debate as to whether the same epidemic swept northward through the densely inhabited regions leading to the North American heartland. Nevertheless, in strictly geographical terms, a disease that is credited with covering the straight-line distance of 4,222 km. (2,639 mi.) between Mexico City and Lima (a further distance on the ground) assuredly could have traversed the 800 inhabited km. (500 mi.) to the Rio Grande and the 144 km. (90 mi.) separating Florida from smallpox-afflicted Cuba (Bandelier 1904:133; Sauer 1971:302; Dobyns 1981:50).

In the case of smallpox, these geographic inferences require considerable caution because distance is more or less irrelevant when compared to time and human vectors. Smallpox may have traveled from the Isthmus of Panama to Peru aboard watercraft in a relatively rapid coastal passage. It is not clear whether similar conditions were available for Sonora or California. Owing to the north-south flow of the California current, maritime passages to California were slow, if they occurred at all during this time. Thus time, rather than distance, is critical for the transmission of smallpox.

The possibility that the great smallpox pandemic of 1518-1525 may have afflicted northwestern New Spain (in what is now Sonora, Baja California, and the American Southwest) is pertinent because of the close proximity of this general area to California. The prospect is strenuously debated, but strong assertions have been set forth suggesting that this pestilence

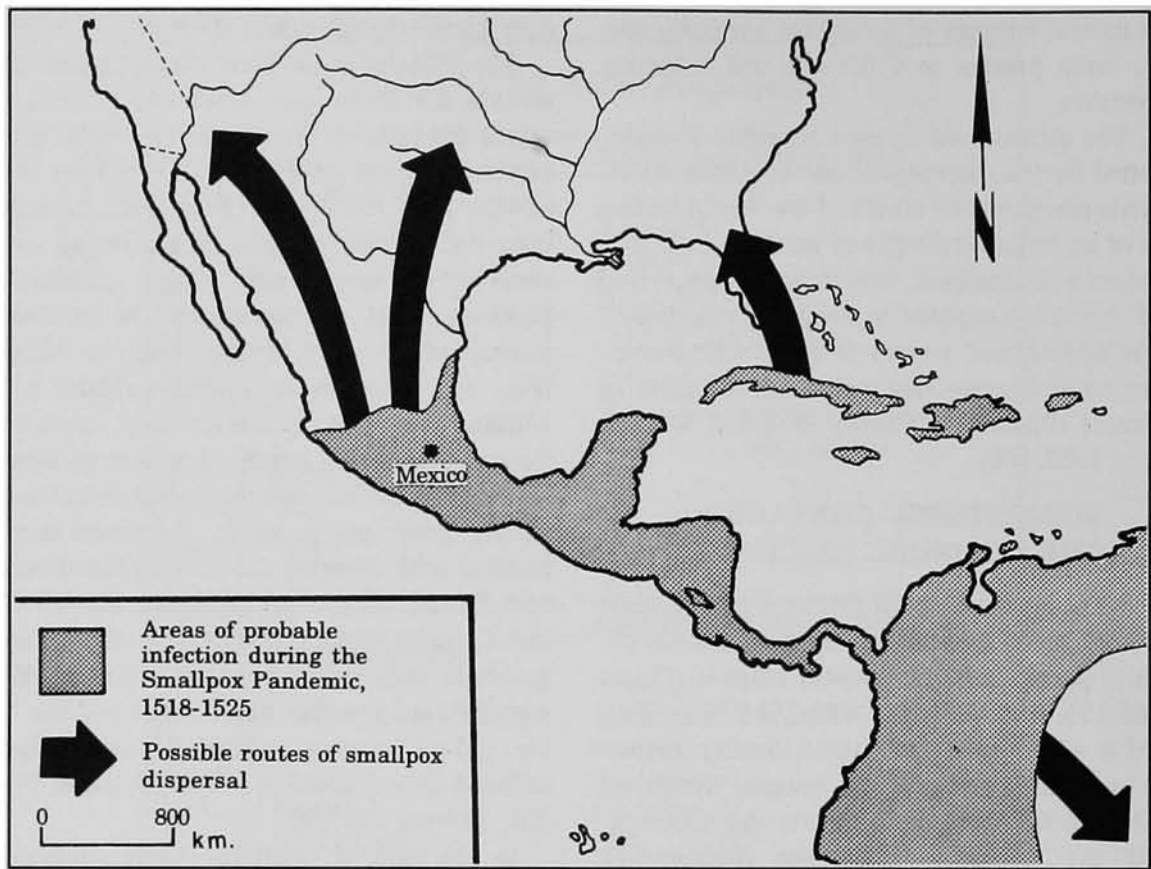


Fig. 4. The spatial dimensions of the Great Smallpox Pandemic of 1518-1525 (Reff 1991a:Fig. 8).

extended through Sonora along trade routes into the Gila River watershed and beyond, where it is said to have ravaged the Piman speaking and Puebloan populations (Dobyns 1981:50; Rushforth and Upham 1992:75). This pandemic has been postulated as the agency responsible for the recognized lack of archaeological continuity that separates the Hohokam from the subsequent and less complex Piman cultures in Arizona (Dobyns 1981:48-50, 1990:303; Reff 1991a:280-281).¹⁵ Dobyns (1983:13) believed the epidemic surged forward and "swept through all of the most densely populated portion of the Americas." His hypothesis suggesting that the epidemic was hemispheric in scope and terminated native lifeways throughout North America was strongly corroborated by Campbell's (1990) revelations

addressing aboriginal demography on the Columbia Plateau.¹⁶ For a portion of the Plateau, she reported an abrupt and dramatic decline in population numbers that roughly corresponds chronologically with the great smallpox pandemic (Campbell 1990:186).

On the other hand, recent investigations in the American Northeast seem to disprove Dobyns's (1983) hemispheric assertions (see Snow and Lanphear 1987; Snow 1992). Despite the enormous territory, stated by at least one researcher to have been desolated by this initial pulse of introduced smallpox, California is still glaringly absent as one of the specified and probable victims (see Dobyns 1983:15, 25). This is a particularly curious omission, since California's frontiers would seem to be as vulnerable to the epi-

demiological conditions in northwestern New Spain as that region proved to be to the epidemiological conditions in Mesoamerica (Riley 1987:129-151, 368-372, 1990:230). Whether the smallpox pandemic of 1518-1525 actually infected California is still uncertain. However, an instructive analogue occurred later in 1778-1780, when a smallpox epidemic, originating in the Valley of Mexico, spread northward all the way to the Dakotas (Ramenofsky 1996:169-170). It is noteworthy that this contagion was able to move through environments which were much less populated than at the time of the great pandemic of 1518-1525. In any event, the pandemic was merely the first of dozens of epidemics that devastated adjacent regions for the following 250 years that preceded the 1769 founding of Mission San Diego.

Epidemics that followed closely on the heels of the smallpox pandemic generally conformed to a chronological and geographic pattern linking central Mexico and northwestern New Spain. Successive epidemics frequently originated in the disease reservoir of central Mexico and spread outward to infect a greater and ostensibly less populated realm. The more densely populated core region of central Mexico usually sustained enough human hosts even after epidemics to accommodate these infections in endemic and less lethal form (Cooper 1965).¹⁷ Peripheral environments (i.e., Sonora, Arizona, and Baja California), on the other hand, may not have possessed the population base to accommodate epidemic disease organisms indefinitely. Once they had time to recover demographically, these non-endemic environments were therefore epidemiologically more vulnerable to a renewal of contagion (returning diseases and especially new ones) originating in the core or reservoir region (McNeill 1976:53; Milner 1980:41). Once the population of the peripheral regions was reduced below the demographic threshold necessary to sustain the epidemic, the particular disease quickly dissipated. This pattern repeated itself dozens of

times during the colonial period in northwestern New Spain (Dobyns 1963a:514). The exact timing and magnitude of each periodic epidemic episode, as well as the specific regions affected by such episodes, are unknown, but there is no doubt that prior to 1769 microbial death repeatedly rippled northward to the very doorstep of California.

PESTILENCE IN SONORA, ARIZONA, AND BAJA CALIFORNIA: AT THE DOORSTEP OF CALIFORNIA

In terms of proximity, the Old World diseases that accompanied the extension of the colonial frontier northwestward to California's very doorstep prior to 1769 are particularly noteworthy. Examination of the spatial dispersal and lethality of these deadly parasites sheds a critical light on the notion that they diffused to the California frontier and conveniently traveled no further.

Sonora

Following the great smallpox pandemic of 1518-1525, the Sonoran region of New Spain's northwestern frontier underwent the familiar sequences of diseases that originated and rippled northward out of central Mexico (Dobyns 1981: 50). Before 1620, the pathogens were transferred by biological vectors and native peoples along trade routes, or they were directly introduced into Sonora by sporadic expeditions, such as Nuño de Guzmán's in 1530-1531 (Reff 1990: 279, 1992:268).¹⁸ After 1620, the diffusory process and the coincidental mortality were intensified by the opening of the Jesuit missions in Sonora and the permanent use of transportation networks like El Camino Real and the Pacific Coast Road (Fig. 5) (Reff 1992:26). By the 1640s, the mission frontier had spread northward to the present Arizona boundary (Fig. 6). In the mid 1700s, both the pace of introduction and the dispersal potential of European contagion were further enhanced in Sonora by the establishment of farming and mining communities

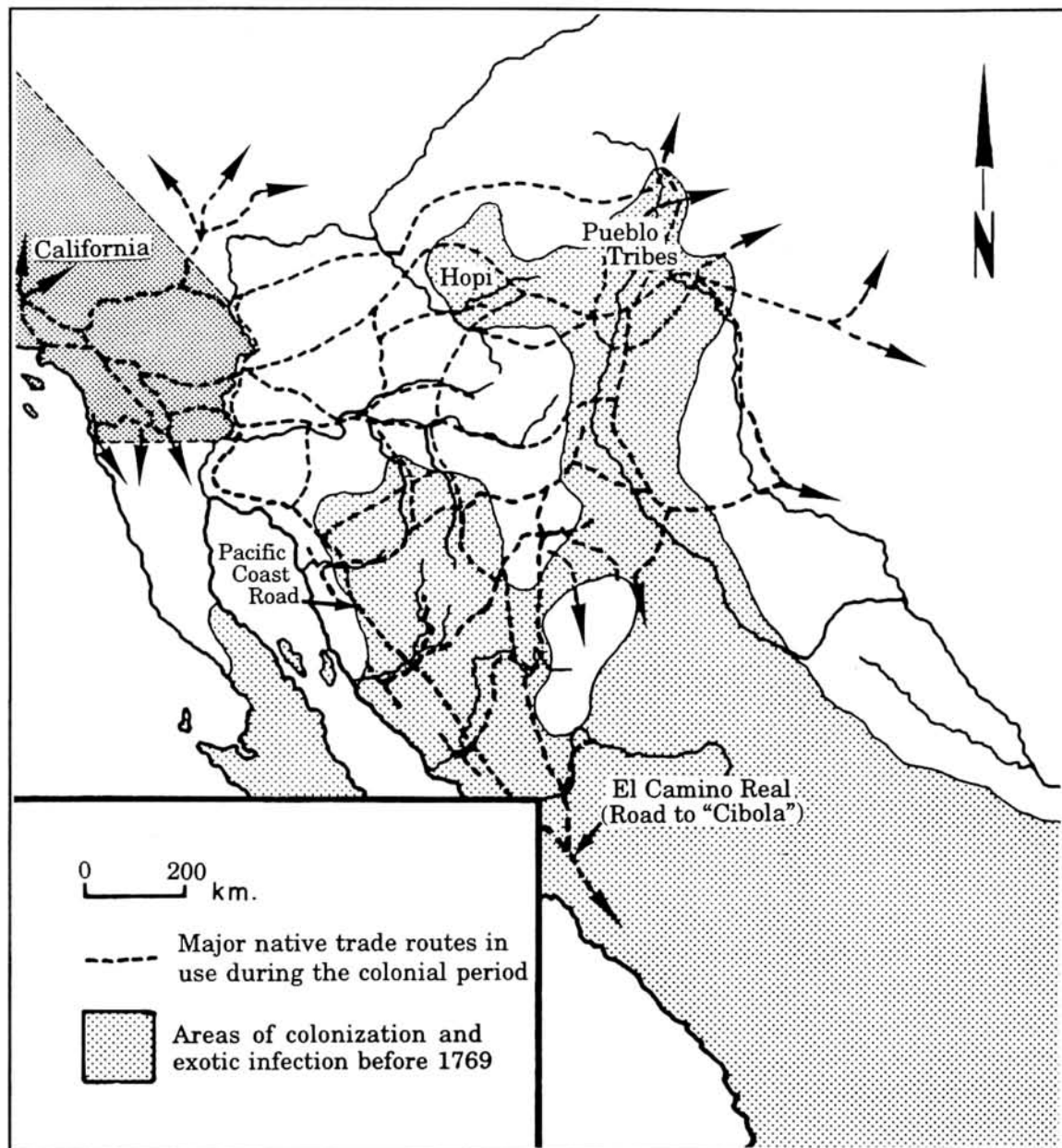


Fig. 5. Major native trade routes in portions of northwestern New Spain utilized prior to 1769 (from Davis [1961:Map 1], Riley [1982:Fig. 7, 1976, 1987:Map 1], and Ford [1983:719]).

(Reff 1987a:86; Sheridan 1992:158-165). This colonial framework proved fertile ground for the destructive diseases that diffused through portions of Sonora on an average of once every five to eight years (Reff 1987a:89, 1987b:704, 1991b).¹⁹

Many of the consequences to Sonoran aboriginals were dutifully and meticulously recorded by the Jesuits prior to their expulsion in 1767 (Sauer 1935:11-12).²⁰ It has been estimated that native peoples, who originally may have surpassed 500,000, were reduced to 50,000 by

1600, and subsequently these remnant populations were largely destroyed by 1678 (Reff 1991b:179, 194-195, 202). This epidemiological rendering of Sonora provides telling testimony to the inability of landscapes ranging from the hyperarid to rugged mountains to entirely thwart Old World contagion. Indeed, according to West (1993:69), "the decimation of native population through disease was as manifestly severe in Sonora as in the rest of Mexico and Central America during the colonial period." For Native Americans dwelling just outside the settlement frontier, the epidemiological consequences were also profound. Ample evidence indicates that Old World diseases were carried by both nonhuman vectors and natives beyond the Sonoran settlement frontier into adjoining portions of northwestern New Spain during several of these recorded epidemics (Gerhard 1982:23, 26; Reff 1991a:86, 177-178).

Arizona

Numerous expeditions preceded missionization and settlement further north in present-day Arizona (Pimeria Alta) as they had in Sonora. Of particular relevance were the expeditions of Melchior Diaz (1540), Hernando de Alarcón (1540 by sea), Don Juan de Oñate (1604-1605), and Eusebio Kino (1701), all of whom skirted or entered California near the Colorado River Delta (Walker and Bufkin 1979:13). By the latter half of the seventeenth century, the native inhabitants of southern Arizona were in sustained contact with Spanish miners in upper Sonora (Reff 1991a:231). After a failed missionization effort among the Hopi by Franciscans between 1629 and 1680, the Jesuit mission frontier was extended into the lower Santa Cruz Valley, beginning with the founding of the first mission among the upper Pima peoples in 1687 (Fig. 6) (Jackson 1985:414).²¹

Largely as a consequence of these developing connections to disease-afflicted environments to the south, epidemic events in Arizona in-

creased in recorded numbers and severity. By 1767, the population south of the Gila River (among the native Pima, Papago, and Sobaipuri) is reported to have diminished from a suggested prehistoric number of 64,000 (down to 30,000 in 1687) to just 6,000 (Sauer 1935:32; Jackson 1981a:245; Reff 1991a:234, 1991b: 645). The greatest number of deaths can be linked to Old World germs, some of whose documented victims resided near the California frontier (Dobyns 1963b:176).²²

Baja California

During the 164 years from the first Spanish sighting (1533) of Baja California to its first mission in 1697, sporadic contact with the mainland by explorers, pearl divers, and natives provided substantial opportunity for the introduction of disease (Gerhard 1982:289-292). The lands and locations (e.g., Sinaloa, Sonora, Acapulco) from which these voyagers embarked had been routinely ravaged by plagues such as smallpox and measles.²³ Indeed, on a resupply voyage to La Paz Bay in 1535, Cortés found "distressing deaths from . . . disease" (Holmes 1963:76). During this pre-mission interlude, it is thus probable that Old World pestilence was transmitted across the Gulf of California to wreak undocumented havoc upon the natives (Holmes 1963:422; Jackson 1981b:317; Dobyns 1983:37; Mathes 1989:409, 419; Reff 1990:279).²⁴

By the end of the Jesuit period (1767), the mission frontier in Baja California had advanced northward to within 240 km. (150 mi.) of the present international border (Fig. 6). Jesuit exploration forays, as well as native refugees, extended the colonial presence to the north of the mission frontier, where tribes closer to California (e.g., Cocopa) were regularly contacted (Aschmann 1959:31, 166-167; Mathes 1989:420-421). Every conceivable Old World disease (e.g., smallpox, measles, diarrhea or dysentery, typhoid fever, and malaria or typhus) followed suit and raged (often in clusters) up

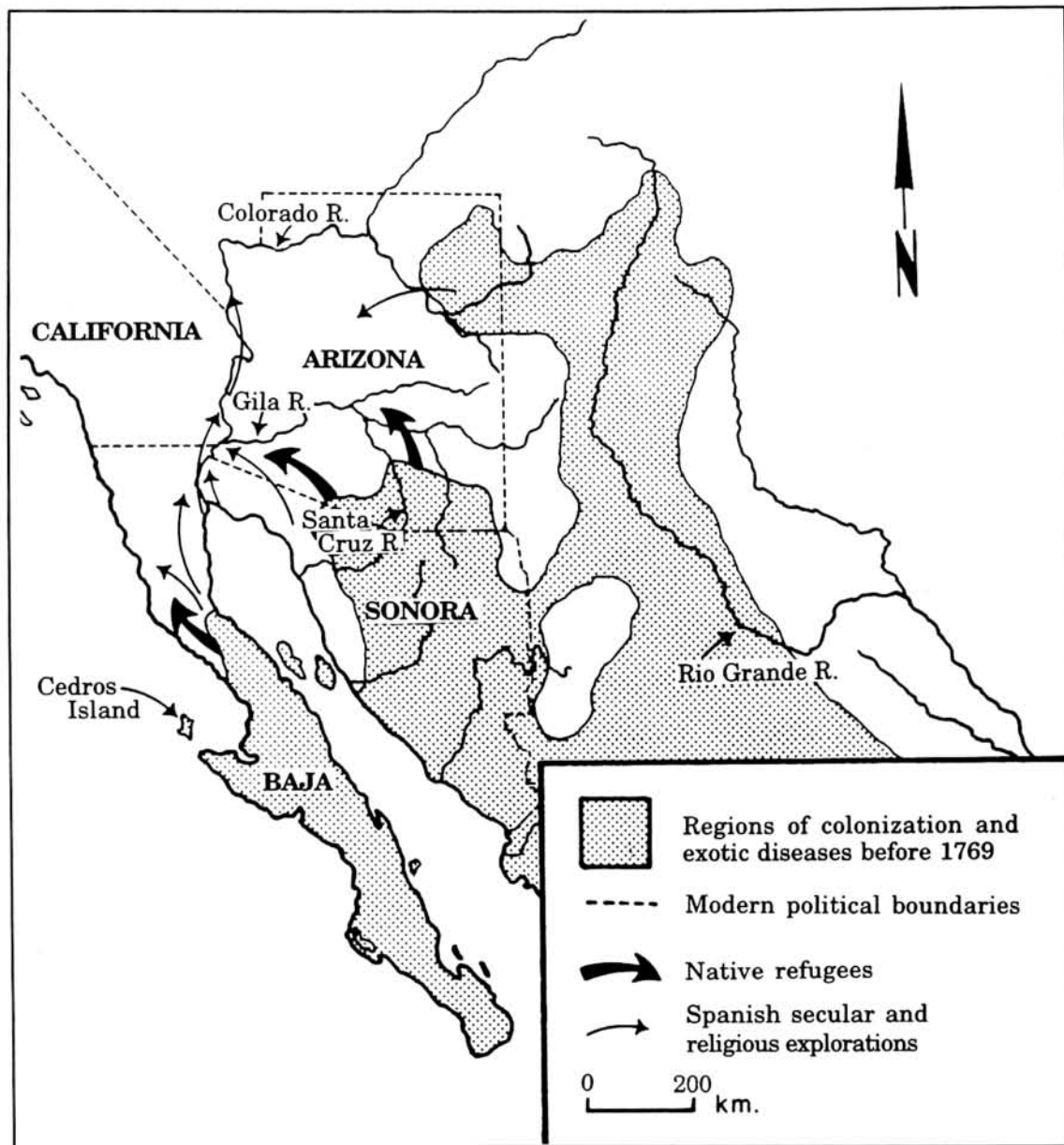


Fig. 6. Lands in northwestern New Spain under Spanish influence or control by 1769. Old World diseases are documented or alleged to have repeatedly ravaged these environments and to have spread beyond the Spanish frontier (from Spicer [1962:Map 18], Walker and Bufkin [1979:Map 13], Riley [1982:Fig. 6, 1987:Maps 2-3], and Reff [1991a:Fig. 8]).

and down the peninsula on the average of about once every four years (Aschmann 1959:189; Jackson 1985:468). The loss of life was horrendous (net reduction of over 60% in places during

severe episodes) and prompted one observer of a 1709-1710 epidemic to remark, "the smallpox broke out in a terrible manner among the Indians, sweeping away by far the greater part of

the children, and many of the adults" (Cook 1937:20).

Given the documented interaction between mission converts and surrounding neophytes, it is a virtual certainty that the casualties of epidemic episodes extended far beyond the colonial frontier.²⁵ A relevant example occurred on Cedros Island where, according to Aschmann (1959: 166-167), "a smallpox epidemic had preceded the first mission contacts with the population of Cedros Island, and had wiped out three-fourths of those Indians before the missionaries ever saw them." From an estimated population of 60,000 in 1697, the number of natives in Baja California plummeted to a reported 20,000 in 1750 and to around 1,500 by secularization in 1835 (Jackson 1981b:308, 310).

The records of epidemiological events and colonial consequences in northwestern New Spain are conclusive. Within a century of the first exotic disease episode, nearly 90% of the native inhabitants were dead. In light of these tragic colonial precedents, the possibility that neighboring California remained immune to the infectious plagues that unrelentingly destroyed native life in northwestern New Spain prior to 1769 seems an unlikely scenario. Indeed, as European exploration and settlement surged north and westward in the centuries prior to 1769, the number of sources for disease threats to California increased and the distance to these sources continued to decrease.²⁶

CLIMATE AND TOPOGRAPHICAL INFLUENCE ON DISEASE DISPERSAL

An analysis of post-Columbian disease dispersals in northwestern New Spain and elsewhere in the western hemisphere suggests that geographic factors such as altitude, topography, and climate had minimal bearing on the ultimate dissemination of crowd diseases such as smallpox, influenza, and measles. These are passed most efficiently from one person to the next through inhalation. Where people were in con-

tact with one another, these viral germs were often transported through environments that varied from arid coastline to rainforest-covered mountains (Cook 1981:62).²⁷ Nonetheless, certain climatic conditions may have assisted the spread of crowd diseases. In the case of smallpox, the virus remains infective for a number of years (especially in arid environments) and aerial convection may occur (Dixon 1962:304, 307-309; Christie 1980:229-230). The issue of aerial transmittal of smallpox is contested, but arguments have been forwarded maintaining that arid regions lying between 2,000 and 6,000 feet are the most favorable conditions for this mode of transport (see Upham 1986:120-124; Reff 1987b; Rushforth and Upham 1992:81-94). Such conditions are prevalent in northwestern New Spain.

Climatic variation, however, did seem to influence both the rate and spatial spread of malaria and yellow fever, as well as other infectious diseases passed by intermediate vectors. Warm, moist climates at low elevations nurtured vectors such as mosquitoes (e.g., *Anophele albimanus*) and provided the optimum conditions for affliction and dispersal of their associated maladies (Newson 1993; Ramenofsky 1993:325).²⁸

Topography functioned as a significant factor in hindering disease dispersal in places where it interfered with the distribution of zoonotic vectors and when it served to restrict contact between human communities through physical isolation (Cook 1973:500). This restrictive agency became ever more prominent when sequential epidemics reduced New World highland populations to a point where interaction among the remaining peoples was severely diminished. Considering the epidemiological evidence, the physical diversity of New World environments seemed to have influenced the rate and direction of disease diffusion depending on the nature of the vectors involved and the demographic context. However, the environmental influence was secondary to cultural agencies in determining the

ultimate spatial dispersion of epidemics involving those germs that colonize and reproduce only in humans and their domesticated animals. Consequently, the conduits of contagion leading into California were primarily conditioned by demographic and cultural factors.

CULTURAL DETERMINANTS OF DISEASE DISPERSAL

The efficiency of exotic disease dispersal was seldom influenced by cultural differences among New World populations. Old World pathogens were culturally indiscriminate in whom they infected, be they highland agriculturalists in Peru or hunter-gatherer groups in Baja California. The only qualifications for infection were immunological susceptibility and exposure to a human carrier or vector.²⁹ However, cultural factors, such as settlement organization and trade alliances that influenced the degree of human interaction, would have affected the spatial and temporal behavior of an epidemic.

Native medicinal practices were largely ineffectual in curing these deadly diseases, and in many instances may have actually contributed to their dissemination. Since most Native Americans had no concept of germ theory, their customs and religious practices did not include quarantine (Crosby 1976:291-299). The prevalent customs of visiting relatives, traveling shamans, and healing rituals involving whole villages would have guaranteed a wider scope of infection (Powers 1877:23, 27, 142, 271; Kluckhohn and Leighton 1946:160-163; Margolin 1978:127, 133). Interaction of this nature and that associated with ritual and trade often continued unabated during epidemics, thereby exacerbating the potential for disease transfer (Krech 1978:715).

Owing in large measure to the ghastly symptoms of eruptive diseases, natives commonly abandoned those already afflicted and simply fled. Case studies reporting this native response to Old World diseases abound in northwestern

New Spain, as well as throughout the New World (Jackson 1981c:139, 141-142; Crosby 1986:200; Smith 1987:59; Reff 1990:280; McGrath 1991:407).³⁰ Given the communicability and long incubation period of some pathogens (e.g., the smallpox virus), such behavior was hazardous, to say the least, as fugitives carrying a variety of maladies could infect others at great distances and thus prove to be catalysts for a chain-reaction dispersal (Dixon 1962:171, 299-301). In fact, according to a survey of the Human Resources Area Files (McGrath 1991), the most frequently reported response to epidemic disease by Native Americans was indeed flight. This oft-reported cultural response to exotic contagion is particularly noteworthy and important in its diffusionary implications, especially given the proximity of the colonial frontier to California in the century prior to its first mission in 1769.

Native cultural reactions to infection, in combination with the biological peculiarities of Old World diseases, proved conducive to the rapid diffusion of epidemics beyond colonial frontiers. This indirect mode of transmission is seldom questioned as an agency of dispersal in the New World and particularly within northwestern New Spain prior to 1769 (see Crosby 1976:290; McNeill 1976:22; Jackson 1981b:327, 1981c:139; Gerhard 1982:23; Reff 1991a:177, 1992:272-273; Borah 1992:14). Nor is the Indian-to-Indian transfer of nonindigenous contagion controversial, either within California or between California and northwestern New Spain and elsewhere after 1769 (see Cook 1937:25-26, 1943:12, 1955:318-319, 1960:267, 1976a:11; Jackson 1981c:141-142). Indeed, Indian-to-Indian or vector transmittal of diseases into California after missionization is well-documented and noncontroversial. Documented examples of this mode of introduction were the malarial and smallpox epidemics of 1830-1833 and 1838, respectively (Cook 1939:183, 1955; Thornton 1987:94-95; Walker and Johnson 1992:133-135).

Each of these disastrous epidemics spread rapidly through various regions, some of which had long since lost a large percentage of their native inhabitants (e.g., portions of the San Joaquin Valley). The introduction into California of similar maladies prior to 1769 does not seem unreasonable to assume, given that its frontiers during this period possessed greater numbers of reciprocating and susceptible native hosts.

That lethal pathogens ravaged portions of northwestern New Spain for two and a half centuries prior to 1769 is clearly documented. The probability that those same pathogens might somehow have failed to penetrate California, whose native density has often been touted (e.g., Cook 1976a:199; Thornton 1987:29), would seem a unique exception to the colonial precedent. Given the recorded environmental and cultural determinants for disease dispersal, such a circumstance could have occurred only if all the aboriginal residents of California remained completely isolated from infected residents of adjacent territories and nonhuman vectors for the entire colonial period prior to 1769. That is a scenario that simply did not exist.

TERRESTRIAL PATHWAYS OF PRE-MISSION CONTAGION

Prior to the establishment of the mission at San Diego in 1769, colonial endeavors in Sonora, Arizona, and Baja California eventually brought epidemic disease to the very frontiers of California. The associated demographic and indirect dispersal mechanisms of exotic contagion have been documented and debated (e.g., Henige 1986b; Upham 1986; Reff 1987b, 1991a; Dobyns 1992). Where does California fit into this spatial framework of disease? Considering the determinants of disease dispersal, the answer has to be predicated upon whether California natives were directly or indirectly in contact with infected natives and zoonotic vectors of adjacent lands. The following discussion demonstrates that California, rather than an island of immu-

nity, was simply a geographic extension of the processes governing the spread of lethal microbial contagion in northwestern New Spain.

The flight of natives from diseased environments in northwestern New Spain near California is well known, but whether these refugees sought haven within California, bringing disease with them, is uncertain. This unknown is not crucial to the issue, however, because aboriginal trade between northwestern New Spain and California was an ideal medium for disease introduction. Reciprocal trade elsewhere among New World peoples is recognized as an efficient disseminator of pestilence, which is not surprising since human contact is inherent to the medium (Thwaites 1896-1901:16, 101; Helms 1979; Trigger 1985:231; Crosby 1986:214; Dobyns 1992:215).

Neither the southern deserts nor the Colorado River constituted an interruption to trade; on the contrary, both provided opportunities and avenues for it. A continuous progression of tribal territories extended from southern California into Arizona, Sonora, and Baja California, forming a network of interaction that lasted throughout the colonial period (Fig. 7). Our knowledge of tribal geography is based on the ethnohistoric present and may not exactly mimic the distributions present during the initial colonial surge. Nevertheless, no one has suggested that these lands were vacant nor that human numbers were smaller prior to historical times. In fact, an understanding of the epidemiological history of this region would most likely lend credence to the idea that northwestern New Spain possessed even a denser tribal and demographic fabric than was recorded ethnographically.

The degree of native contact between California, northwestern New Spain, and central Mexico fluctuated throughout prehistory, but was, according to Riley (1978:53), firm enough in the sixteenth century to have conveyed the great smallpox pandemic (1518-1525) from central Mexico deep into the North American heartland

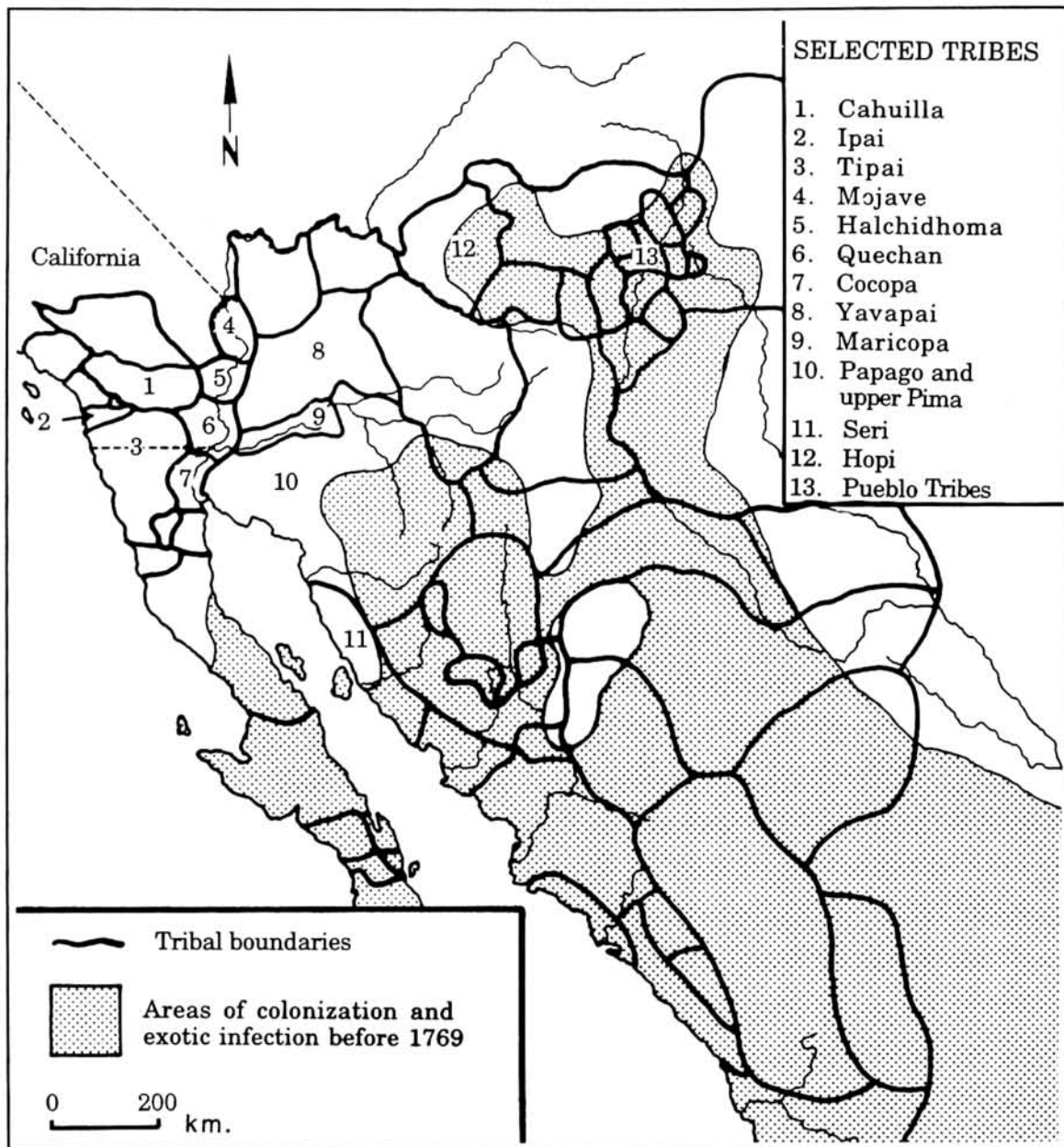


Fig. 7. Tribal territories in northwestern New Spain during the colonial period (from Heizer [1978:ix], Ortiz [1983:ix], and Massey [1992:Fig. 11]).

and possibly into California. This trading network between central Mexico and northwestern New Spain (including California, Arizona, and New Mexico) is known to have been in sustained operation since late pre-Spanish times, and remained in operation until the middle of the

sixteenth century (Kelley 1980:65; Riley 1980: 46-48, 1982:146, 1990:230).³¹ The principal routes for this trade extended north through Sonora, and included a major branch leading into Arizona's Gila River watershed and a subsidiary trail that crossed the arid northwestern

corner of Sonora to the Colorado River delta (Fig. 5) (Ives 1939:89, 1959:33; Sauer 1971:297; Riley 1976:24-25, 40, 1982:44; McGuire 1980:29). Sonoran peoples and the Hohokam were important middlemen who facilitated the exchange of goods (e.g., Pacific shells, cotton, turquoise, feathers, and ceramics) and, by inference, people. With the onset of initial colonization, the passing of merchandise (including cotton) from one tribal entity to another provided a ready conduit and opportunity for the spread of foreign germs and biological vectors (e.g., fleas, lice).

The main north-south corridors served Mesoamerican traders (e.g., Tarascan Pochteca) on their journeys to the American southwest (Riley 1982:47; Ford 1983:712). In turn, southwestern traders (e.g., Hohokam, Puebloan) carried local and Mesoamerican products to California, and California natives traded eastward into Arizona (Riley 1976:40, 1982:47; Pailes 1978:141-142). Along these pathways of exchange, people (as well as trade items) commonly moved across sociopolitical units. The traders and the early Spanish explorers who traversed these highways of commerce were potential carriers for a number of plagues (including the smallpox pandemic) that afflicted central Mexico in the sixteenth century.³²

Owing to the disruption caused by disease and other colonial impacts, the native connections between the American Southwest and Mesoamerica diminished considerably in the seventeenth and eighteenth centuries (Riley 1976:44; McGuire and Villalpando 1989:172). By the latter half of the seventeenth century, however, native interchange with Mesoamerica was an unnecessary requirement for the transport of Old World pathogens northward. As previously noted, this period heralded a permanent colonial presence (and sporadic pestilence) just beyond California's frontiers in Sonora, Arizona, and Baja California. Furthermore, the native inhabitants of these afflicted frontiers

remained in sustained contact with the natives of California up to and beyond its missionization (Bloom 1936:94; Dobyns et al. 1963:114, 120-121; Riley 1976:44, 1982:46, 65, 78).

Subsequent interchange between tribes in southern California and those in Baja California, Sonora, and Arizona prior to 1769 involved ceremonial exchanges and refugees in addition to reciprocal trade (Merriam 1955:88-89; Davis 1961:2-3; Bean 1978:575).³³ The Colorado River peoples (e.g., Cocopa, Quechan, Halchidhoma, Mohave) were linchpins in this generally east-west oriented interaction (Foreman 1941:190-225; Dobyns et al. 1963:118; Fowler et al. 1978:160; Heizer 1978:691; Fowler and Fowler 1981:150; Riley 1982:68).³⁴ In addition to their role as middlemen, the Colorado River peoples were known to have carried items (including textiles) as far west as the Pacific coast and the San Joaquin Valley (Bolton 1948:80; Forbes 1965:14-17; Riley 1982:78). Other California groups (e.g., Cahuilla), in addition to Arizona peoples (Piman and Puebloan), traveled east and west respectively to and beyond the Colorado River region during the period of Spanish colonization (and infestation) of northwestern New Spain (Bloom 1936:74; Ives 1939:108; Heizer and Treganza 1944:335; Frisbie 1975:126-127; Riley 1976:40, 42; Bean 1978:575, 582).

Prior to 1769, east-west interaction between California natives and their neighbors (in Arizona and northwestern Sonora) is better documented than north-south exchanges. Nevertheless, communication between southern California and northern Baja California was well established prior to colonial times. The Ipai (Northern Diegueño) held territory north of San Diego Bay and carried on considerable trade with the Tipai (Southern Diegueño), whose territory straddled the present border and extended south of Ensenada (Fig. 7). Both groups also had strong ceremonial and trade linkages with Colorado River peoples, who in turn were in contact with Spaniards and colonized natives to the south and east

(Bolton 1930:2; Castetter and Bell 1951:58-59; Dobyns et al. 1963:68; Luomala 1978:601; Williams 1983:99). Communications between the native peoples of southern California and their neighbors to the east and south were thwarted neither by arid lands nor by the advent of colonialism. The degree of contact before 1769 assuredly waxed and waned owing to intertribal warfare, colonial disruption, and disease-induced devastation. Nevertheless, during the protohistoric period, the flow of traders, refugees, and goods continued to spill across the frontiers of California.³⁵

Affirmation of the continued interchange of native peoples on both sides of the California frontier (despite Spanish interference) is illustrated by the Halchidhoma on the Lower Colorado River. Their location proved ideal as a trading center that benefitted from the flow of native commerce into and out of California. As a consequence of their skills and middleman position, the Halchidhoma trading center seems to have flourished from the late sixteenth century into the nineteenth century, even during periods of foreign-induced perturbations (Dobyns et al. 1963; Dobyns 1984:30). Some of the native entrepreneurs among the Halchidhoma were even known to have served as couriers between Sonora and California, making them serious candidates as a medium for the extension of a measles epidemic into California from afflicted Sonoran villages in 1826 (Dobyns 1992:217). Further doubt is cast on the perceived insulating capacity of the California deserts to foreign pestilence by other accounts that postdate 1769, a time when the numbers of native peoples and commercial exchanges were diminished as a result of the usual array of lethal colonial consequences (see Jackson 1981b:326). Among the most notable was the observation in 1826 by Jediah Smith of cattle in Mohave camps along the Colorado River. The cattle once belonged to Spanish missionaries on the Pacific coast, but ended up in the hands of the Mohaves, who herded them

eastward across long, arid distances to their homes on the river (Morgan 1953:200).

Instead of serving as pre-mission barriers to human and commercial interchange, the varied landscapes of California's southern periphery provided an uninterrupted channel to the infected colonial domains of northwestern New Spain, domains that are documented to have contained exotic microbes and biological vectors and whose surviving native inhabitants maintained relations with California's peoples (Reff 1991a: 123). Therefore, the notion that epidemiological processes—which for over a century had repeatedly spread catastrophic diseases into various areas of northwestern New Spain—abruptly and mysteriously halted at California's frontier (and only until 1769 at that) seems puzzling at best, particularly in light of the fact that this same frontier continued to flourish as an avenue of commerce and human interaction.

MARITIME PATHWAYS FOR PRE-MISSION CONTAGION

Terrestrial opportunities for the pre-mission introduction of Old World pathogens into California would have relied primarily upon the indirect (native-to-native) transfer of contagions and associated zoonotic vectors. Concomitantly, California natives were also subjected to disease possibilities and vectors carried directly to them by seaborne Europeans. Numerous pre-1769 landfalls have been recorded for coastal California; landings that, in the context of similar events in the Caribbean and elsewhere, offered ideal opportunities for viral and bacterial assaults (Fig. 8).

The first documented seaborne contact between Europeans and California natives occurred during the voyage of Juan Rodriguez Cabrillo in 1542-1543. In his search for the fabled Strait of Anian (Northwest Passage), Cabrillo's vessels and crews made numerous stops along the California coast and had a variety of face-to-face encounters with native inhabitants, particularly

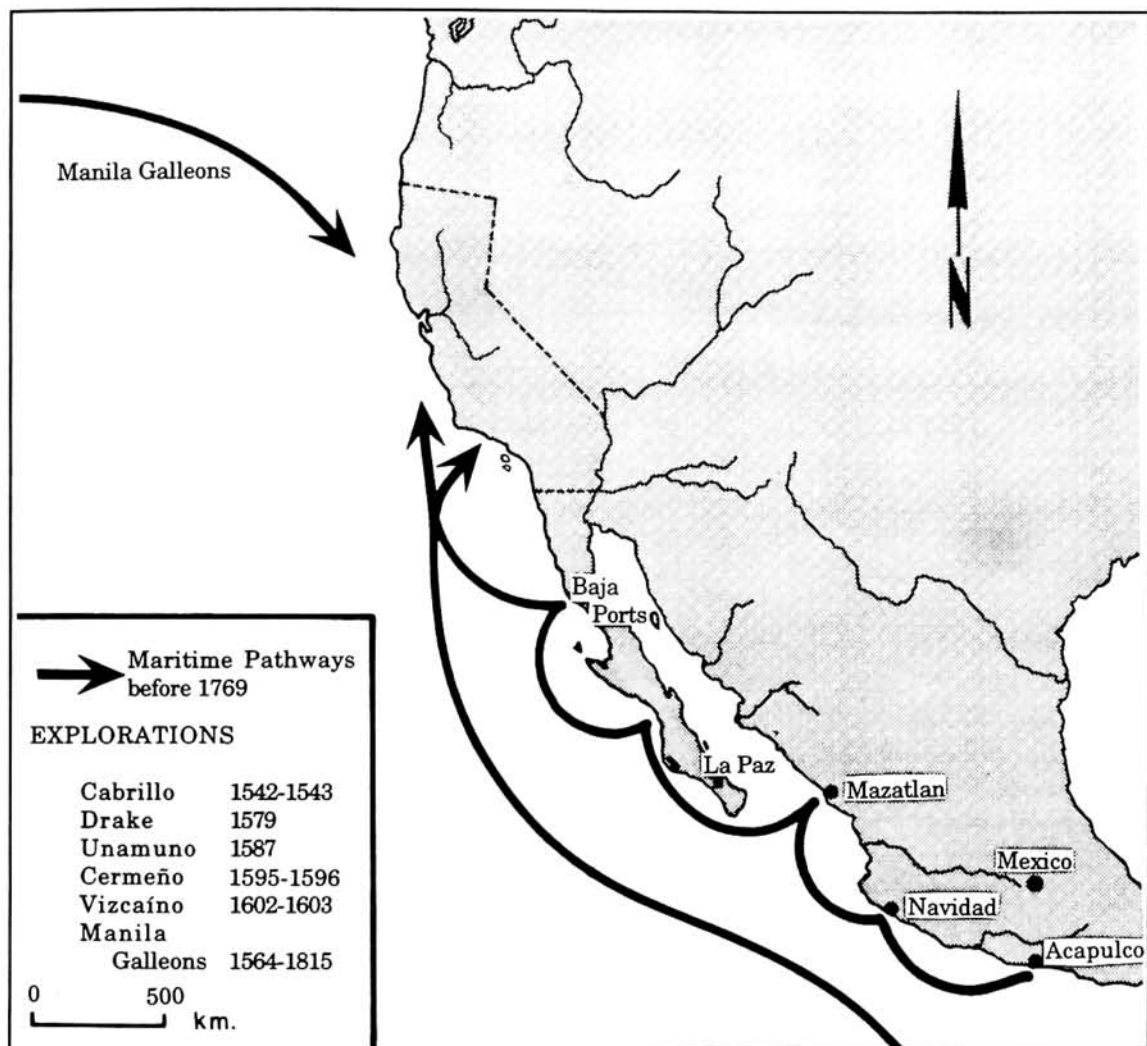


Fig. 8. Maritime pathways for exotic infections in California before 1769 (Beck and Haase 1974:Map 11).

those of the Channel Islands (Wagner 1929: 73-93; Gerhard 1982:304; Erlandson and Bartoy 1995). By the end of the voyage, Cabrillo's crews were debilitated by the effects of battle, hunger, and—of special pertinence—disease (Kelsey 1986:161). The unhealthy conditions reported aboard the vessels may have been due to noncommunicable afflictions such as scurvy, but Cabrillo's foray was only the beginning of maritime arrivals by Europeans and whatever parasites may have accompanied them.

Several decades later in 1579, Sir Francis Drake landed north of San Francisco Bay and lingered for five weeks among the Coast Miwok. He and his crew had close, intimate relations with the natives, as exemplified by Drake's account of natives seeking aid for their ills by requesting the English to "but blow upon their griefes [*sic*], or but touched the diseased places, they would be whole" (Heizer 1947:267). Albeit infrequent, several additional opportunities for infection followed on the heels of Drake. In

1587, members of Pedro de Unamuno's voyage spent a week on shore somewhere between Monterey and Santa Barbara (Cook 1973:7). Nearly a decade later, Sebastian Rodriguez Cermeño's ill-fated voyage of 1595-1596 provided the Coast Miwok with another opportunity for exotic infection. After spending a month in close association with the Miwok, their ship was wrecked in a storm. As a result, Cermeño and his men were forced to coast-hop southward to Mexico in the ship's launch (Wilcox 1991:62-64).

Interspersed among the official voyages of the late sixteenth century was the potential for numerous unreported landfalls by the Manila galleons along California's densely populated littoral (Chartkoff and Chartkoff 1984:255). These galleons, along with the recorded European expeditions, were "unusually prone to infestations of rats and other pests and were incubators for disease" (Cook 1973:7). Most, if not all, of the ships arriving in California from the south had previous ports of call in western Mexico and stopovers on the western shore of Baja California. Many of these locations, especially Mexican ports of call such as Acapulco and Navidad, were often rife with disease, thus providing potential sites for on-board transfer of exotic parasites.³⁶

The introduction of disease through seaborne vectors initiated colonial epidemiological history, and such vectors were common dispersal agencies during subsequent centuries throughout the western hemisphere (see Clendinnen 1987:19). This maritime phenomenon is perhaps best illustrated by disease events in colonial Brazil, Alaska, and Hawaii during the eighteenth and nineteenth centuries, when most epidemics are attributed to seaborne introductions (Alden and Miller 1987:35-111; Fortuine 1989:200-213, 227-228; Stannard 1989:99). California is recognized as conforming to this colonial pattern only after missionization (i.e., post-1769). Indeed, some post-mission epidemics (e.g., the smallpox epidemics of 1828 and 1844), which severely re-

duced mission and gentile populations, have been traced to maritime introductions (Cook 1939: 182, 187-188). It does not seem reasonable to believe that vessels traveling to California from ports in Mexico before 1769 were any healthier than those sailing after that date. While the spread of disease due to contacts with Spanish and other European exploration vessels is certainly possible, much depends on the length of the voyage (and the type of germs) before the ships landed in California. Long periods at sea could have resulted in a cleansing of some parasites, depending on their individual incubation periods. On long, uninterrupted voyages, diseases may have infected all of the susceptible crew and run their infectious course before landfall. Venereal afflictions would have been an important exception to the purging effects of long passages and most likely would have endured to threaten California's native inhabitants.

The final official pre-mission maritime contact was that of Sebastian Vizcaino, whose fleet sailed north to California during the winter of 1602-1603. Vizcaino's visitations may have proven particularly detrimental to California's native dwellers, because his entire crew was reported sick at various times (albeit mostly due to scurvy) (Bolton 1916:95-96, 102; Wagner 1929:252-256). In fact, they returned prematurely to Mexico because of illness among the crews, prompting Vizcaino to report that "the ship seemed more like a hospital than a ship of an armada" (Bolton 1916:97). His journey was the last recorded maritime contact between Europeans and natives in California until the expedition of Gaspar Portolá in 1769. The intervening 167 years proved to be no epidemiological respite for California natives, however. Overland avenues for indirect dispersal of exotic pestilence remained in varying degrees of operation, and undocumented maritime incursions from a variety of sources may have punctuated the 167-year hiatus with additional seaborne opportunities for parasitic mayhem.

DISCUSSION

Researchers are coming to grips with evidence that during the first colonial century some New World populations (e.g., in central Mexico) were tragically reduced by up to 90%, due mostly to alien germs (Cook and Lovell 1992:216). It is possible that some western hemisphere lands escaped Old World pestilence during this period as a result of their geographic remoteness. However, it is not reasonable to insist that California should be included among the uninfected and thereby pristine environments throughout the two and a half centuries since the landing of Cortés. A geographic assessment of the dispersal determinants of Old World germs existing in this period and the epidemiological history of nearby lands make such an assertion implausible.

California was anything but remote from disease sources, especially during the final 150 years preceding its first mission. As the colonial frontier of northwestern New Spain expanded during the seventeenth and eighteenth centuries, source regions for infection grew in number and crept inexorably closer to California's frontiers. Although the disease processes in surrounding lands are little understood during the first hundred years after Columbus, considerable agreement exists with respect to the 150 years immediately preceding the first permanent mission in California (e.g., Jackson 1985, 1994; Reff 1991b). During this period, colonial history indicates that disease dispersal was determined primarily by demographic density and interaction. In comparison to demographic variables, aspects of physical geography such as aridity and topography were ultimately negligible as epidemic inhibitors. On the contrary, the diverse landscapes of California's southern protohistoric regions served as natural habitats for both human and intermediate vectors (e.g., fleas, lice, and mosquitoes) necessary for the spread of exotic diseases.

Neighboring lands in northwestern New Spain experienced repeated surges of foreign pestilence that preceded missionization and swept ahead of the Spanish in nearly every locality. This contagious tide, originating in Sonora, Arizona, and Baja California, is documented to have spread to areas adjacent to southern California on numerous occasions during its protohistoric period (Fig. 9).

Crucial to the question of whether Old World germs actually made the crossing into California is the geographic and demographic nature of southern California's pre-mission frontiers. As noted, southern California's physical landscapes could have provided insulation in the face of epidemiological assault only if they nullified native and zoonotic interchange. California's frontiers accomplished neither. On the contrary, the state's mountainous and desert periphery nurtured a continuity of tribal territories that were regularly traversed by native merchants and merchandise throughout the colonial period. Likewise, the native inhabitants of these southern lands are documented to have been in frequent and often sustained contact with people from infected portions of Arizona, Sonora, and Baja California before 1769.³⁷

Sporadic seaborne opportunities prior to 1769 augmented the terrestrial routes of contagion. The maritime medium provided native groups in California with a number of face-to-face encounters with Europeans and their parasites. These alien contagions were transported by vessels known to have departed from often unhealthy Mexican ports or to have made landfalls along the western coastline of Baja California, where epidemic diseases periodically raged. There is no doubt that contagions of various kinds (especially syphilis) found passage on the ships that plied the protohistoric coastline of California.

Instructive to this discussion are the observed epidemiological events that occurred during California's historical (post-1769) period. Immediately following the first sustained presence of

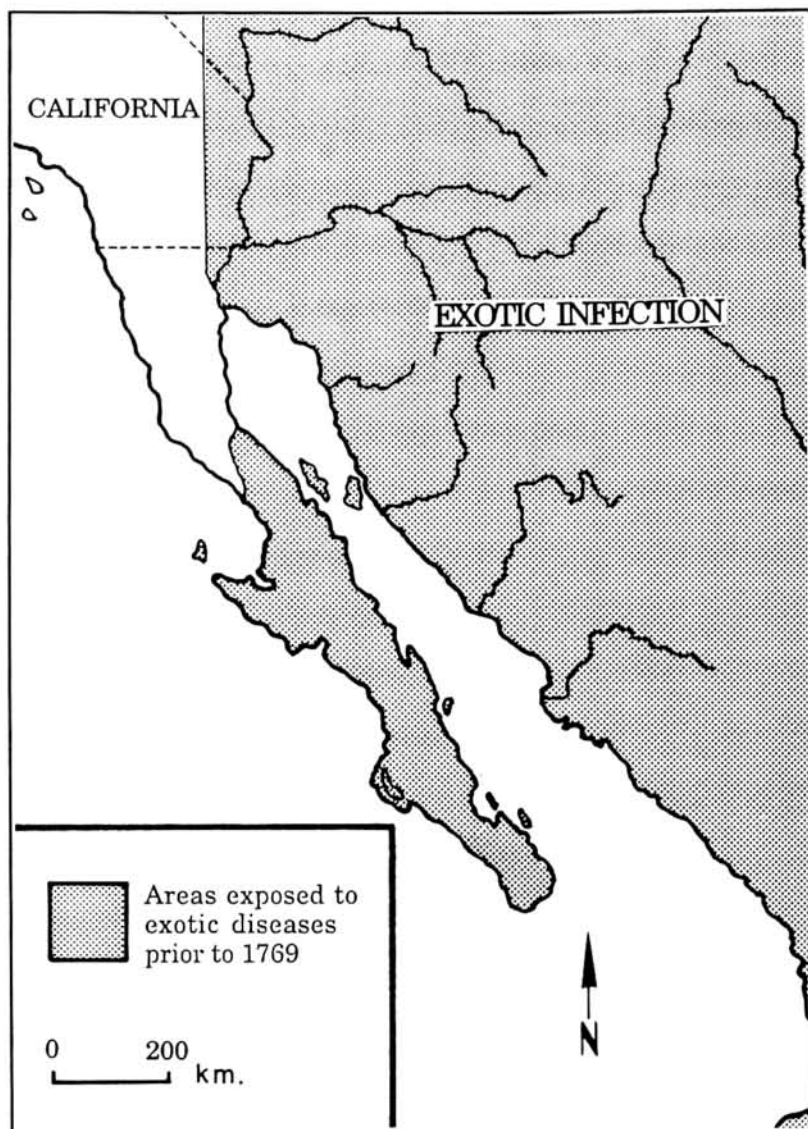


Fig. 9. Portions of northwestern New Spain documented or alleged to have been contaminated by Old World diseases prior to 1769 (from Cook [1937], Jackson [1981c], and Reff [1991b:Fig. 26]).

Spaniards in 1769, the historical record documents numerous episodes of Old World contagion attendant with the usual disastrous consequences for native peoples. Exotic maladies sporadically entered California by both land and sea throughout the 77 years (1769-1846) of Hispanic settlement and control (Jackson 1994:117-118). These lethal epidemics (crowd and vector-

transmitted ailments) were patchy in their spatial diffusion, yet were often spread through extensive portions of the state despite sharp and ongoing reductions in the aboriginal hosts.

In epidemiological terms, it is generally assumed that California required the sustained presence of Europeans before being infected by exotic pestilence. This circumstance is excep-

tional and highly doubtful when compared to colonial disease histories everywhere else in the New World.

CONCLUSIONS

There has been a tendency to think of the ethnographic record of the 17th-19th centuries AD. as a true record of the state of native American society along the west coast before European contact . . . nothing could be further from the truth.

[Fagan and Maschner 1991:974]

Is it reasonable to surmise, then, that California remained absolutely immune to exotic pestilence in light of the pre-mission epidemiology of northwestern New Spain and post-mission accounts of contagion? If this is indeed the case, then California, given its proximity to nearby sources of exotic contagion in northwestern New Spain and its epidemiological susceptibility, would have been an utter anomaly to all the conditions governing colonial disease diffusion in the western hemisphere. In essence, it would represent the only Spanish colonial land where exotic germs did not precede missionization. Furthermore, California would prove the only colonial realm whose native inhabitants remained uninfected despite having regular cultural interaction with natives from adjoining environments known to have had exotic disease experiences. Finally, it would have been a very rare environment indeed, had every shipborne encounter with Europeans somehow occurred without an exchange of bacteria or viruses. The chances that all three conditions remained valid for the entire 250 years of California's protohistoric period would be slim, to say the least.

The frequency, magnitude, and regional variability of protohistoric contamination are important considerations yet to be clarified. Theoretically, just one epidemic entry of Old World pestilence, the likes of which repeatedly decimated portions of Arizona, Sonora, and Baja California before 1769, could have dramatically changed the lives of those exposed to it.³⁸

Inferring from colonial episodes elsewhere and from post-mission examples from within the state, the native mortality for the portion or portions of the state afflicted by just one epidemic exposure of a crowd disease (e.g., influenza, smallpox, or measles) could have ranged from 40% to 90%, a demographic catastrophe which would render inapplicable the use of the term "pristine" as a valid description of California's protohistoric period. Albeit more subtle and less dramatic, a maritime introduction of venereal infection at a coastal enclave would have achieved a similar result.

Assuredly, the arrival of Old World diseases in California before 1769 will become irrefutable only when sufficient evidence is compiled from within the state itself. Nevertheless, ethnohistoric and archaeological findings provide indicators of pre-mission contamination, but until recently they have proven insufficient as catalysts for sustained research addressing the issue (see Shaler 1935:57-59; Cook 1940:25; Kitsepawit 1977:11; Walker and Johnson 1992:135, 1994: 112, 116; Erlandson and Bartoy 1995). This geographic exploration of disease diffusion should serve to move the issue of pre-mission pestilence from the realm of the possible to the highly probable. Good evidence of the likelihood of pre-mission disease will loosen the time-worn perceptual constraints that have tended to unnecessarily bias interpretations of California's protohistoric period. Therefore, the introduction of new findings and the reinterpretation of existing evidence should shed further light on the protohistoric colonial consequences in California.

NOTES

1. All references to Alta California will be as California.
2. Acceptance of the assertion that disease spread beyond the settled frontier throughout the New World is not universal, however. Henige (e.g., 1986a, 1986b, 1989) has challenged this idea, as well as the evidence supporting it.
3. California's present-day southern political border coincides with an older Hispanic administrative

divide and today forms a cultural and economic watershed that reinforces the insular perception of California as separate. How this may have influenced (if at all) the contemporary interpretation of colonial history is unknown.

4. Some researchers may be influenced by the notion (known as the Civilization-Savagery Myth) that Europeans brought high civilization to primitive native cultures. Acceptance of the savagery myth may be blinding many researchers to the evidence and consequences of European diseases among Native Americans. As Reff (1990:283, 1991a:9-15) stated, "Only by ignoring disease-induced change in size and complexity of native populations has it been possible to perpetuate the myth."

5. Epidemic disease has traditionally been underplayed by historians who tend to emphasize processes that are calculable, definable, and often controllable (McNeill 1976:3-4). With too few exceptions (e.g., Zinsser 1934; McNeill 1976), the random nature of virulent diseases as spoilers of predictable processes has been discounted as exaggeration (see Kroeber 1925:881).

6. Several researchers have alluded to the probability of pre-mission epidemic disease in California during the course of their research on other regions (see Dobyns 1983:15, 17; Ramenofsky 1987:170; Trimble 1989:48; Campbell 1990:190; Borah 1992:15; Stannard 1992:134; Moss and Erlandson 1995:30). Others have thought it possible, but due to the lack of firm data were content to accept the assumption that life and land in what became the Golden State were pristine until 1769 (see Cook 1955:31, 1976a:199).

7. For a discussion of the origins and dispersal of syphilis, see Crosby (1972:122-164), Baker and Armelagos (1988), Qué tel (1990), Bogdan and Weaver (1992), Borah (1992:11), Ortner (1992:12), and Rothschild and Rothschild (1996). Recent findings in California using osteoarchaeologic methods have determined that streptococcal or staphylococcal and gastrointestinal infections were fairly common. Tuberculosis, coccidioidomycosis, and treponematoses were also reported as probably endemic to the state (Cybulski 1980; Hoffman 1987; Walker et al. 1989:356).

8. Virulence of epidemic diseases is a function of both relative immunity and the detrimental status of the individual pathogen. Pathogenic microbes continuously produce a variety of strains that respond to host conditions. There are indications that more deadly forms emerge in virgin soil epidemics where human populations are dense and the opportunities for diffusion greater (see Ewald 1991, 1993). New World peoples also may have been individually and inherently immune deficient in the face of invading

pestilence. Native Americans were unusually genetically homogeneous in comparison to Old World peoples and possessed less variety in MHC glycoproteins (histocompatibility antigens) which are presumed to be important in withstanding viral diseases (Black 1992).

9. An example of mortality induced by exotic pathogens among Native Americans is the malarial epidemic of 1833. This event alone killed approximately 75% of the native inhabitants of California's Central Valley (Gilbert 1879:12; Branch 1881:94; Cook 1955:322). In some instances, such as the Atlantic seaboard, mortality among Native Americans was nearly 100% (Cook 1973:500-505; Spiess and Spiess 1987). Excellent studies of the role of disease in depopulating parts of America north of the Rio Grande River prior to the arrival of Europeans are found in Dobyns (1983), Ramenofsky (1987), and Smith (1987). Exceedingly high mortality among Native Americans was also a product of deleterious human biological response to introduced pathogens. For native cultural reactions to smallpox see Burnet and White (1972:79-81, 97-100), Martin (1978:50), and Crosby (1986:199).

10. The precontact presence of tuberculosis and treponematoses was not adequate to protect Native Americans from Old World versions of these diseases. Indeed, where they were endemic, the natives probably were more vulnerable when exposed to new strains of the same disease (see Powell 1992:50).

11. Smallpox becomes infectious the fourth day after the onset of illness and can remain infectious for over three weeks (Dixon 1962:297). Consequently, even a human corpse can prove a virulent and continuing source of infection and dispersal (Shurkin 1979:28-39; Upham 1986:117). The survival time of the infectious smallpox virus outside of the host is far from clear. For divergent assessments, see Dixon (1962:296-318) and Fenner et al. (1988:480).

12. To a lesser degree, cloth also is thought to harbor both the measles and the influenza virus in infectious form (May 1958).

13. Typhus also qualifies as a crowd disease because its vector, the flea, may move directly from human to human. Several additional biological traits of Old World diseases (such as tendencies to remain latent until susceptible hosts become available and the peculiarities of vectors) have dispersal advantages and are discussed in Crosby (1972:46), McNeill (1976:444-445), Dobyns (1983:11-24), Ramenofsky (1987:140-160), Cook and Lovell (1992:221-229, 235), and Ewald (1993).

14. The geographic extent, timing, and magnitude of this initial smallpox epidemic are fraught with controversy and uncertainty, as are most of the epi-

demics that followed. Some of the skeptics of the assertions of Dobyns (1983) and others concerning the scale and impacts of New World disease episodes have examined the complex epidemiological and demographic histories of specific regions in light of these claims, and have often found them lacking in archaeological substantiation (see Henige 1986b; Snow and Lanphear 1987; Ubelaker 1988; Thornton et al. 1991; Snow 1992; Brooks 1993:17-18). Accordingly, the discussion that follows is not intended to clarify or take sides in this debate. The exact temporal and spatial epidemiological dimensions at the core of the debate are secondary to this work because all sides agree that at varying times and places Old World germs were conveyed to the protohistoric frontiers of California.

15. The collapse of the Hohokam and Trincheras cultures of northwestern Mexico and southern Arizona is said to have occurred around A.D. 1400-1450 (Doyel 1989:142-144; McGuire and Villalpando 1989:173). Dobyns (1981:48-49) and Reff (1991a: 645), the principal detractors of this interpretation, have challenged the accuracy of the dating and have argued that these cultures persisted into the colonial period. Indeed, Reff (1990:276, 284-285, 1991a: 280-281), in professing more doubts than Dobyns (1983) about the northward spread of the smallpox pandemic, viewed the lack of continuity (once these cultures do collapse) as exactly what would be expected given disease-induced reductions in population and cultural complexity.

16. There is evidence indicating that conditions for rapid disease dispersal were not necessarily as ideal as Dobyns (1983) suggested (see Larson 1994: 123; Walker and Johnson 1994:113). Instead of a rapid and uniform spread, diseases tend to infect areas in a patchy, discontinuous pattern and at varying rates.

17. The continuance of dense populations in Latin America is not to suggest that casualties were not enormous. Between 1520 and 1600, central Mexico endured 14 epidemics and Peru endured 17 (Crosby 1972:38). The demographic and cultural consequences of this epidemiological onslaught, in combination with deaths brought about by other colonial agencies, were enormous. Central Mexico is reported to have declined from a preconquest population of over 25 million to a little more than one million in 1605 (Borah and Cook 1963:4, 88). Further south, the pre-Spanish population in Peru of 12 to 14 million (probably more) plummeted to 600,000 by 1620—a decline of 96% (Dobyns 1963a: 503, 1966:412; Cook 1981:53, 62, 114).

18. Evidence that Sonora was still heavily populated despite the previous ravages of the smallpox

pandemic was provided by a companion of Guzmán's, who described the land near the Culiacán River as "more densely peopled than had been seen in the Indies" (Sauer 1935:7-8). This is perhaps an exaggeration, but Sauer (1935:12), who believed that "European epidemics probably preceded the white man into this area," estimated a native population of 540,000 for this arid region. Incidentally, Sauer (1935:10, 12) believed that the pestilence and famine recorded in 1535 was triggered by Guzmán's earlier pillaging.

19. For an exhaustive and detailed analysis of the timing and spatial extent of each epidemic in northwestern New Spain, see Reff (1991a). A composite map within his text (Reff 1991a:178, Map 26), displaying the regions he believed were afflicted by exotic disease up to the year 1660, shows western Arizona and southeastern California as affected zones (see Fig. 9). This inclusion of a portion of California (pre-1769) is not explained or alluded to in the text.

20. Sauer deserves special recognition as one of the first colonial scholars to emphasize disease as an important agency of depopulation in the New World and its potential for outdistancing the Spanish frontier (see Sauer 1935:10-12).

21. The Franciscans observed that the Hopi were exposed to disease and were greatly reduced by the period of initial missionization (Vetancurt 1961:276; Reff 1990:278).

22. The same epidemiological demographic pattern repeated itself elsewhere in northwestern New Spain. Pueblo peoples of New Mexico, who may have numbered over 100,000 in 1598, shared an interaction network with the rest of northwestern New Spain. By 1680, their numbers had been reduced by 80% (Riley 1990:234; Reff 1991a:229, 1992:270; Dobyns 1992:218; Stodder and Martin 1992:66; Upham 1992:223-230; Ramenofsky 1996:161).

23. While preparing for Cortés's expedition to Baja in 1534, measles broke out among the workers in Acapulco. The same malady may have been transferred the short distance to Baja aboard ship (see Holmes 1963:231; Jackson 1981b:317).

24. Visitors from non-Spanish lands evidently made ports of call in pre-mission Baja California as well. Natives are said to have had friendly interaction with British ships plying the Pacific, and may have resulted in Creole children and pestilence of British descent (Moriarty and Smith 1970:60-63).

25. The annals of epidemic disease in Baja California are inordinately full of accounts of natives fleeing the diseased mission environs (see Cook 1937: 25-26; Jackson 1981b:326-327, 1981c:139). While generally discounting the northward extension of Baja California diseases to California prior to 1769, Asch-

mann (1959:146) recognized that "virulent disease such as smallpox could leap ahead of the Europeans to gentile populations."

26. The northern frontier of California should not be ruled out as a pathway for Old World diseases into pre-mission California (see Lyman 1991:15). Sporadic contact by Europeans and Russians with Indians of the Northwest Coast did occur prior to 1769, but firm evidence for contagion postdates this (Woodward 1986:253; Boyd 1992:249).

27. A good example of the variety of environments through which epidemic disease is capable of traversing is the account of an epidemic in 1718-1719 that spread through the South American viceroyalty from Peru's west coast to the missions of Paraguay (see Dobyns 1963a: 511).

28. Perhaps illustrative of this geographic influence were the higher net losses due to epidemic diseases on the lowland coasts of both Mexico and Peru in comparison to adjacent highland areas (Borah and Cook 1963:89; Smith 1970:453-460; Cook 1981: 62). The influence of elevation (and hence climate) on disease diffusion was probably more important during and after the second century of colonial contact due to the relatively late arrival of malaria and yellow fever.

29. Some cultural practices, like the burial of bodily secretions in order to avoid spiritual poisoning by enemies and the burning of a deceased person's dwelling (and perhaps the victim as well), may have somewhat diminished the chances of further infection. However, the effect was no doubt negligible with crowd diseases such as measles and smallpox, and ineffectual in thwarting malaria.

30. For specific examples of Indian-to-Indian transmission of disease for varying regions, see Hackett (1937:122), Cook (1943:11-12, 1955, 1976a: 207), Stearn and Stearn (1945:22), Centerwall (1968: 79), Crosby (1976:290), McNeill (1976:186), Hemmings (1978:444-445), Shurkin (1979:116), Clark (1981:91-94), and Reff (1991a:177).

31. Not everyone is in agreement that steady communication between Mesoamerica and northwestern New Spain was sustained at the time of the conquest (see Reff 1991a:102-103). Reff (1987b: 705, 1992:266) argued that hostilities among peoples on the northwestern edge of Mesoamerica would not have proven conducive to trade during the period of the great smallpox pandemic (1518-1525). His hypothesis has been challenged by accounts of trade continuing through regions experiencing hostilities (Hammond and Rey 1940:251; Dobyns 1981:56).

32. Some visiting Spaniards mentioned how rapidly goods, people, and news circulated between the Colorado River region and the Pacific coast. Indica-

tive were the accounts of Juan Rodriguez Cabrillo (1542) at San Diego Bay and Hernando de Alarcón (1540) on the Colorado River. Cabrillo's party encountered California natives who had previously received word of other Spanish intruders from inland natives (Bolton 1916:23; Hammond and Rey 1940: 147; Riley 1976:43, 1982:77). During his investigation of the Lower Colorado River, de Alarcón saw bison hides and parrot feathers among the Yuman inhabitants (Hammond and Rey 1940:140-151). Acorns were also traded to the Yuman peoples (Colorado River tribes) from the west and were observed by Oñate (1604-1605) (Bolton 1916:270-280). These early descriptions of the exchange of news and trade goods are especially instructive when assessing the opportunities available for the dispersal of "crowd diseases." Indeed, "such is the communicability of smallpox and the other eruptive fevers that any Indian who received news of the Spaniards could also have easily received the infection of the European diseases" (Crosby 1972:51).

33. Indicative of this east-west exchange was the observation by Spanish explorers in 1671-1702 of similar types of shells among the inhabitants of Baja California's Pacific coast and the natives living along the Colorado River (Kelsey 1984:501).

34. The Yuman facilitated the movement of various goods eastward, including Pacific coast and Gulf of California shell and coral, in exchange for turquoise, bison products, and probably ceramics (Dobyns et al. 1963:118; Riley 1987:129-159, 368-372).

35. The notoriety of Colorado River peoples as the primary middlemen in this cross frontier traffic prompted Dobyns et al. (1963:125) to suggest that "without doubt, at least some of the smallpox and measles epidemics which swept New Spain during the 18th and 19th centuries spread beyond the Sonoran frontier to the Halchidhomias."

36. An incident in May 1798 provides clear testimony to the potential of ships as conduits for infectious disease into California. Smallpox broke out among the crew and passengers of the *Concepción*, which had left San Blas, Mexico, en route to California. On receiving word of shipboard conditions, Governor Borica ordered quarantine and inoculation precautions (see Cook 1939:163-167).

37. The geography of Southern California (despite some commonly held perceptions) is not comprised of empty, sterile deserts. Continuous mountainous regions stretch from northern Baja California into the southwestern portions of the state (e.g., Laguna and Santa Ana mountains). They provided a diversity of habitats for aboriginal Californians owing in part to their greater rainfall, which averaged 10 to 30 inches annually, depending upon elevation. These habitats,

including parts of the San Bernardino Mountains, are in turn located within 100 miles of the Colorado River. This intervening eastern zone is lower and drier but is punctuated with mountains (e.g., Chocolate Mountains), valleys (e.g., Coachella Valley) and freshwater springs.

38. Any protohistoric penetration of exotic disease through the terrestrial and coastal frontiers of California would have entered a landscape possessing great dispersal potential. California's littoral and Great Central Valley nurtured extremely dense aboriginal populations characterized by large villages and complex trade relations. These concentrations were in turn connected to peripheral tribes in an interaction sphere afforded by a network of extensively used trails (see Davis 1961:Map 1; Erlandson and Bartoy 1995, 1996:305). This demographic fabric, as well as California's diverse habitats, would have provided favorable conduits for exotic plagues and rich possibilities for airborne assaults by intermediate vectors (e.g., mosquitoes).

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