edited by FOUR ARROWS (DON TRENT JACOBS)

UNLEARNING
the Language of Conquest

Scholars Expose Anti-Indianism in America

UNLEARNING THE LANGUAGE OF CONQUEST

(Deceptions that influence war and peace, civil liberties, public education, religion and spirituality, democratic ideals, the environment, law, literature, film, and happiness)

Scholars Expose Anti-Indianism in America

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ECOLOGICAL EVIDENCE OF LARGE-SCALE SILVICULTURE BY CALIFORNIA INDIANS

Chapter 9

Lee Klinger

The previous chapter raises some questions about possible reasons for anti-Indian hegemony. For example, if humans are not necessarily by our indigenous nature a warring species, or if most of the original people of the Americas managed to live in relative peace, then why are we led to believe the opposite through literature, film, the Academy and popular discourse? Is it because we then are more likely to acquiesce to the existence of wars, trusting our leaders to decide which ones are for liberty or democratic ideals?

If such a design exists, then indeed cultural/educational hegemony is operating. Whether we are learning false histories about Indigenous People; or that Columbus was a hero; or not learning that true heroes like Helen Keller or Martin Luther King, Jr. were avid anti-war activists, we tend to use this "knowledge" in ways that cause a blind form of common sense to support the policies of those in power. The current Iraq war may be a classic example of the ultimate effect.

In this chapter we are reminded that there is another war that profit those in power and also seems to benefit from a false history of Indigenous People and their ways of seeing the world. I refer to a war against the natural systems of the planet. For example, during just the first few years George W. Bush's administration, hundreds of environmental protections were dissolved and some of the worst corporate polluters were placed in key environmental protection positions.[1] *In supporting the claim that pre-contact indigenous people devastated their natural environment, we are left to again trust that because of technology and American leadership, we have no reason to question the dominant worldview. Yet how difficult is it to see the corporate/government profit motive behind such hegemony? Robert Wheelan even reveals it in his book, Wild in Woods: The Myth of the Noble Eco-Savage, "The opposition of native wisdom to market forces is as familiar as it is wrong. Thus, the cases where native peoples did practice sustainable use of resources it was because they had developed the institutions of private property and the market, often as a result of contact with white settlers."*[2]

In this chapter, Dr. Klinger gives us one of many examples that reveal that the Indigenous perspective may have more to do with preserving our Earth for future generations than technology alone. (Note: Although he refers to the distant past, there are also many examples of how indigenous people today work against great odds to stop the corporate, military and government policies that are unnecessarily killing life on this planet, such as the Duwamish River Cleanup project trying to fix one of the most toxic sites in the nation in Seattle and King County.)

LUMINOUS Project Director Dr. Lee Klinger has worked in the fields of ecology, complexity, and Gaia for more than 20 years and is recognized as one of

the world's leading scholars in earth systems science. His recent work at the Institute of Noetic Sciences has helped to expand human consciousness through revelations of the profound ecological wisdom of indigenous peoples. His studies have taken him to all the major ecosystems of the earth, from arctic Alaska to central Africa, where the key stories of Gaia's metabolism are told. Dr. Klinger also helped to found the Gaia Society (now a part of the Geological Society of London) and served for several years as its Vice-Chair. He has held scholarly appointments at The National Center for Atmospheric Research, The University of Colorado, The University of Oxford, and The University of East London. He is currently a Senior Visiting Scholar with the Chinese Academy of Sciences, and serves on the Graduate Faculty of Eco-psychology at Naropa University.

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"The Earth does not belong to us. We belong to the Earth."

- CHIEF SEATTLE

The native trees of California are famous for being among the oldest, largest, and tallest creatures in the world. Besides their great age and size, these trees possess various idiosyncrasies in their arrangements and shapes that are revealed in ecological surveys. Indeed, some characteristics, such as the extremely narrow and disjunct distribution of the giant Sequoia groves, appear to defy basic principles of population biology. When taken together, the odd features of California's ancient trees and forests present an anomalous situation that cannot be explained using our current ecological understanding of old-growth forests. It seems that unknown forces are at work in the older forests (those greater than 200 years in age) that defy the normal tendencies of nature. In this chapter I describe several abnormalities of California trees and forests recorded during ecological surveys in the Sierra Nevada foothills and Coast Ranges in 1997 and 2003. The described features are all plainly visible, expressed as gross variations in the appearance and distribution of the dominant trees and surrounding soils. In the search for a plausible and parsimonious explanation of these anomalies, I am drawn by previous experiences to consider the potent wisdom and ways of the Indigenous People.

THE SEQUOIA GROVES

The most massive of any tree species, the giant sequoia (*Sequoia giganteum*) is a California endemic found only in a handful of sites in the western foothills of the Sierras. For such a massive and dominating species, it's narrow range (totaling only 14,410 ha) and highly disjunct distribution [3] are quite remarkable, especially if one considers it is a pioneer species that reproduces best after fires [4]. In June and September of 2003 I investigated several giant sequoia sites in the Sierra Nevada

foothills (Table 1) and observed that the trees grew in isolated, mono-dominant clusters (groves) separated by several kilometers of mixed conifer forest within which was seen not a single sequoia individual, seedlings and saplings included. The populations of trees in Muir, Giant Forest, Redwood Mountain, Grant, and Tuolumne Groves were all seen to be comprised almost solely of very large sequoia individuals each on the order of a thousand years or more in age. It has been shown that this kind of lop-sided demographic represents a population which, following a long period of proliferation in most of it's current locales, now lacks sufficient recruitment of younger trees needed to maintain a viable population[5]. Despite the evidence from fire scars of many historical fire events[6], it is puzzling that the regeneration of this fire-adapted species has been nearly absent for the past several hundred years in and around most sequoia groves.

Perhaps even more puzzling are the circular and semicircular arrangements of giant sequoias that were found in Muir and Redwood Mountain Groves. Whereas the many circles or "rings" formed by the coast redwood (*Sequoia sempervirens*) are attributed to the stump-sprouting behavior of that species, the giant sequoias are known to reproduce only from seed. Given the lack of a plausible mechanism for how a natural population of trees growing from seed could establish and maintain themselves in this way, the occurrence of tree circles and other orderly formations of *S. giganteum* is highly problematic. Even among the coast redwoods, stump sprouting behavior cannot explain the many large circles (> 10 m diameter), as no remnants of any massive former stumps can be found inside these circles.

The shapes and orientations of fire scars on many giant sequoias present another dilemma. In sloping terrain, fire scars typically form at the uphill base of a tree, places where fires smolder for extended periods due to fuels moving downslope and piling against the trunk[7]. In June of 1976 while fighting a large fire on Comforter Mountain near Boulder, Colorado and again in June of 1979 while fighting a smaller fire near Brown's Lake on the Kenai peninsula of Alaska, I indeed noticed that fires tended to linger and smolder on the uphill sides of the larger trees. Yet, observations last year of giant sequoia trees on slopes revealed that downhill-side fire scars, which are rare or absent in other forests, were fairly common in the sequoia groves, and often with little or no sign of uphill scarring. Furthermore, many of these scars were huge (>10 m high) and bore evidence of multiple large fires, each of which burned only the downhill side of the trunks. This odd pattern of fire scarring was observed, as well, in coast redwoods at the Mill Creek, Esalen, and Samuel Taylor State Park sites (Table 1).

Most curious of all are the findings from Redwood Mountain Grove in September of 2003 where soils within a meter or two from the bases of several giant sequoia were found to contain a thin, white mineral horizon approximately 1 cm thick. The horizon was situated either within the O horizon or between the O and A horizons at depths of 10 to 20 cm. This white mineral horizon was not found in the soils located 10 m or so away from the trees. Similarly. white mineral layers were likewise observed around several coast redwood trees in October of 2003 at Mill Creek and Esalen sites in Big Sur (Table 1). Here the layers were comprised of crushed shells,

bones, and limestone. The origin of these lime-rich horizons cannot be explained by any known depositional sources or processes of soil genesis.

Table 1. Study site coordinates and vegetation types.

Site	Vegetation Type	Obsv. Period	Latitude	Longitude	Elev. (m)
		Sierra foothills			
Muir Grove	Giant sequoia forest	June 2003	36°38.0'N	118°50.1'W	2080
Giant Forest	Giant sequoia forest	June 2003	36°34.1'N	118°45.6'W	2050
Grant Grove	Giant sequoia forest	June 2003	36°44.9'N	118°58.5'W	1920
Redwood Mountain Grove	Giant sequoia forest	Sep. 2003	36°42.5'N	118°55.0'W	1850
Tuolumne Grove	Giant sequoia forest	June 2003	37°45.9'N	119°48.7'W	1860
China Garden	Oak-pine savanna	Sep. 2003	35°32.1'N	118°38.9'W	650
Latrobe Road	Oak savanna	June 1997	38°33.5'N	120°59.1'W	250
		Coast Range			
Olompais*	Oak savanna	July 2003	38°10.5'N	122°36.4'W	170
Olompais	Oak-bay savanna	July 2003	38°10.6'N	122°36.5'W	110
Samuel Taylor State Park	Redwood forest	Aug. 2003	38°01.9'N	122°44.6'W	100
Esalen	Tan oak-redwood forest	Oct. 2003	36°08.6'N	121°39.2'W	30
Mill Creek	Redwood forest	Oct. 2003	36°00.2'N	121°28.2'W	650

* designated as Mt. Burdell on modern maps

OAK SAVANNAS

The oak savannas of California are a dominant and defining feature of the state's landscape, characterized broadly as a scattering of trees, mostly oaks, throughout the native grasslands. The oaks occur as individual large trees or in clusters of a few, with broad canopies and thick trunks that indicate the trees are centuries old. Open grasslands adjacent to the oaks are in certain places distinctly terraced, especially on steeper slopes and in draws. Young trees are notably few or absent in oak savannas. As in the case of the giant sequoias, a predominance of old trees and a lack of regeneration means that the population of trees in these savannas is not sustainable, nor has it been sustainable for several hundred years. This abnormality in age structure a concern, for instance, in the blue oak savannas where a problem of regeneration in the oaks is reported to be widespread[8]. On top of this is the concern lately that many of the larger oaks are experiencing elevated levels of mortality (*e.g.*, sudden oak death).

In the Sierra foothills, oak savannas dominated by interior live oak (*Quercus wislizeni*), valley oak (*Q. lobata*), and blue oak (*Q. douglasii*) and were studied at the Latrobe Road site in June of 1997 and at the China Garden site in Sept. of 2003. Coast Range oak savannas dominated by coast live oak (*Q. agrifolia*), valley oak (*Q. lobata*), and black oak (*Q. kelloggii*) were examined in July of 2003 at Olompais (Table 1). At all three sites the populations were comprised mostly of very old oaks (~300+ years) around which were observed little or no regeneration, indicating that the population of oaks in the savannas is clearly not being sustained. Unlike other savannas and woodlands that I've studied where in the course of succession oaks are eventually replaced by pines or other evergreen species[9], succession at these sites appears to be arrested at the oak stage. A recurring wildfire regime could account for

the maintenance of oaks in the savannas by creating conditions that favor the early-successional tree species (*e.g.*, oaks). Still, the lack of regeneration, as well as the scarcity of fire-scarred trees in these areas can not be left unaccounted.

Within oak savannas that exhibit some regeneration, there is evidence of an age-related dimorphism in the growth forms of the trees. At all the oak savanna sites the trees appeared as two types. The older (larger) trees were observed to have unusual and varied forms, with crooked trunks that, on slopes, tended to grow towards the hillside. At a point just a few meters high, the trunks of these older trees were split into two to several large boles or branches that were often bent or trailing. Conversely, younger (smaller) trees in these same areas tended to have less-varied and more normal forms, with trunks which grew more-or-less straight and upward, and which rarely possessed multiple boles. Forces such as high winds or landslides, that elsewhere fashion trees into bent and distorted forms, could not be seen to account for the varied suite of shapes and orientations of these old trees. This feature of cohort-related dimorphism, where the older cohorts (~200 or more years) differ significantly in stem architecture from the younger cohorts (less than ~200 years), seems to be common throughout the oak woodlands of California.

There is evidence, too, for an age-dependent developmental dimorphism occurring strangely within individual trees. Large trees at both Olompais and China Garden showed two general phases of development, an earlier period of atypical growth (*i.e.* bent and lateral-tending growth with much branching) and a recent/modern period of more typical growth (*i.e.* straight and an upward-tending growth with little branching). This type of age-related dimorphism is apparent in many species of California oaks, as well as in tan oak (*Lithocarpus densiflorus*), California buckeye (*Aesculus californica*), bay laurel (*Umbellularia californica*), Pacific madrone (*Arbutus menziesii*), Monterey cypress (*Cupressus macrocarpa*), and several species of pines (*Pinus* spp.), which seems to rules out genetics as a cause.

Upon closer inspection, more oddities appear in the oak savannas, like scatterings of seashells under the trees. A cursory examination of soils beneath several large oaks at Olompais turned up a fair number of shell fragments, mainly in the upper 15 cm, though no obvious layers of shell material appeared in the soil. Also, on the trunks of several large valley oaks and coast live oaks at Olompais were observed peculiar white crusts covering the bark. Not to be confused with certain whitish-colored crustose lichens, these white crusts are curious in that no mosses, liverworts, or other such acid-loving organisms grew on them, even when found on the north sides of the trees. The distribution of these white crusts revealed that, in places, they were slowly being dissolved by waters flowing down the trunk. Positive tests for reaction using a 1 M solution of HCl indicated the crusts were, curiously, rich in lime.

NATIVE AMERICAN AGRICULTURE

The interpretation of these unusual features of sequoias, oaks, and other ancient trees of California presents a formidable problem as they cannot be explained using our current ecological knowledge of natural processes and forces. This assumes, of course, that the unusual distributions, shapes, and behaviors of the trees are the

mainly result of "natural" influences (*i.e.*, those not involving humans). On the other hand, we know that throughout the Americas people have for thousands of years been heavily engaged in the care and cultivation of their lands[10]. In a comprehensive work on the topic of pre-settlement agriculture in North America, Doolittle[11] presents clear evidence that the indigenous people engaged in a number of traditional farming and gardening activities. Fields and plots were burned, drained, mounded, terraced, tilled, weeded, fertilized, and mulched; canals and aqueducts were built for irrigation; crops were sown, thinned, and transplanted; and orchard trees were pruned and coppiced. Therefore, it is prudent to consider here the possibility that the anomalies reported above are the result of intentional and purposeful cultivation practices by California tribes over many centuries. It is well-established that the California Indians employed fire in the management of their lands[12]. Grasslands were regularly burned in order to remove brush cover and to encourage the growth and regeneration of the native grasses and forbs used by the Indians for both food and fiber[13]. Besides burning, the people employed a variety of other agricultural techniques, including irrigating, pruning, selective harvesting, sowing, terracing, tilling, transplanting, and weeding. Knowledge of this comes from documentary, ethnographic, and archeological evidence found in published works on the Cahuilla, Chumash, Kamia, Kumeyaay, Miwok, Paiute, and other California tribes[14]. With regards to the practice of plant husbandry, the California Indians were considered "masters"[15].

This challenges then the conventional notion of native peoples being primarily hunter-gatherers, as many of the major tribes in California were clearly well-engaged in agriculture and silviculture. Therefore, if we consider that all the native people of the state probably had access to the knowledge and skills of agriculture and so likely practiced agriculture to some degree, then perhaps we should ponder how an array of traditional cultivation techniques may have affected the California landscape. In doing so we quickly see that many of the ecological anomalies described above can be attributed in a sensible way to the recent secession of age-old agricultural activities by the native peoples. With the understanding that the harvest of acorns was what largely fed the people, the curious gnarly forms of the oaks and other nut-bearing trees should perhaps be viewed and appreciated as the culmination of seven generations or more of caring acts[16].

The age-related dimorphisms of oaks and other "crop" trees are explainable, as well, by certain plant husbandry practices of the local Indians. The crooked and many-boled forms of older oak cohorts, with large spreading branches and with bent and trailing boles are probably the result of coppicing, pruning, and training (altering stem growth using ropes and stakes) by native people mainly for the purposes of maximizing the size of the tree canopy and, thus, the production of acorns. The low, lateral-tending branches also would have greatly facilitated the gathering of the acorns. Oak cohorts established since white settlement were not traditionally tended and so have taken on normal, more upright and unbranched growth forms. The individuals of the older cohorts that still thrive today should plainly reveal these two modes of land management in their architecture, an earlier cultivated phase expressed as highly branched and lateral-tending forms, and a recent, non-manipulated phase

seen as more normal, upward forms attributable to the cessation of plant husbandry at the time of white settlement. It would seem that both the cohort-related and the developmental dimorphic features described here can be explained by the shift in land management practices that occurred with white settlement.

Many of the anomalies seen in the giant sequoia and redwood groves also appear to be attributable to manipulations by the native people, though in this case perhaps not for agricultural purposes. While tannins extracted from the giant sequoia were used in the tanning of hides, and the bark of the redwood was used in the construction of lodges, these tall trees may have served more of a ceremonial or ritual purpose. The circular and semicircular arrangements of the giant sequoias, and in some cases coast redwoods, are strongly indicative of intentional planting by the native people. Perhaps instead of building them, the Miwok decided several thousand years ago to grow their temples, by planting and tending sequoias and redwoods in sacred groves. The downhill-side fire scars as well as the excessive size of these scars indicates that the use of fire in tending these groves included the setting of virtual conflagrations at the bases of many sequoias. It seems strange, at first, why the native people would have intended to scar these sacred trees severely and repeatedly in the same place on the trunk. But in noticing how the trees respond to scarring, by growing thick stocks of scar tissue on either side of the fire scar, one can see that this regrowth around the base would help to stabilize the trunks, thus preventing the tall sequoias and redwoods from being knocked over by winds or by falling trees. Furthermore, after repeated burning certain trunks are seen to become hollow, allowing access to the center or “heart” of the tree. These fire-carved cavities at the base of the sequoia and redwood trees served, and continue to serve, as sacred places for native rituals and initiations.

The above explanations rest on the assumption that the California tribes possessed, collectively, the knowledge, tools, and abilities necessary to alter many thousands of trees in the landscape in a prescribed way. In the author's view there is good circumstantial evidence indicating that this assumption is quite plausible, though not enough to say it is probable. The probability that this assumption is correct depends on whether evidence exists for landscape-scale agriculture by California Indians. In the search for that evidence let me consider carefully the latest theories and findings in the field of landscape ecology, then return to the questions regarding seashells and white crusts.

GAIA THEORY AND FOREST HEALTH

The connection of native people with the anomalous shell fragments appears to be profound, but it only becomes obvious in the light of a holistic understanding of the complex behaviors of ecosystems. The holistic or *systems* approach in ecology is grounded in a solid body of theory that is ultimately tied to the well-known concepts of complexity and Gaia[17]. The idea that the earth and its ecosystems are living systems, which the main tenet of Gaia theory, represents fundamentally the same a view that indigenous people in the Americas and elsewhere have long held - that all of nature is alive[18].

The large volume of studies on lime treatments of declining forests together indicate that that addition of lime-rich minerals clearly improves the health of trees[19], improves root and mycorrhizae growth[20], improves soil fertility[21], reduces levels of toxic metals in soils[22], and reduces moss cover[23]. In short, remineralization appears to slow or arrest the aging process in ecosystems. The native people could well have known this by observing how the ash from fires accomplished this, and so applied the knowledge in ways that benefited the many edible plants and trees. However, could they also have known that, in lieu of fire, one can effectively ameliorate systemic acidification and maintain a healthy soil through the periodic application of lime-rich minerals?

MORTARS, MOUNDS, AND MIDDENS

It may not be obvious at first, but if we assume that the answer to the above question is *yes*, then immediately a whole number of long-standing problems involving bedrock mortars, shell middens, and the association of these with large trees begin to make perfect sense. The first step in seeing the ecological wisdom of the ancients is to recognize that the many types of refuse mounds and middens, including shell middens, bone middens, and rock middens originate not from the gradual accumulation the waste products of daily living, such as food remains, ashes from cooking fires, and broken pots and tools, but rather from the intentional stockpiling of gathered or recycled lime-rich materials for use as mineral fertilizers. Strategically located for the purposes of access and trade, these middens are to be found in those regions of the world where the trees were heavily tended.

Findings from the Emeryville shellmound, a well-studied midden on the eastern shore of San Francisco Bay near Oakland, illustrate many of the problems encountered by archeologists in understanding the genesis and stratigraphy of middens as refuse piles. An excavation conducted by Nels Nelson[24] revealed the mound to be comprised mainly of highly-compacted fragments of mollusk shells. Within the "shell matrix" were found many rocks, pebbles, charcoal, animal bones (including humans), and various stone, bone and shell artifacts. Nearly all the materials recovered from the mound were broken, shattered, fragmented, or splintered, and many of the shell, bone, and rock remains had apparently been burnt or charred *in situ*. Clay casts derived from some intact mollusk shells indicated that these shells held no living contents when collected. Interestingly, of the mere 70 artifacts recovered from the 22 cubic meters of excavated midden material, a relatively large number (27) were mortars or pestles, whereas only six points were found. It was noted that the mortar and pestle artifacts were of such a small size as to suggest to Nelsen that these items may have been "purposely shattered by attacking enemies"[25].

Nelson reported that the structure of the mound "presents some curious problems"[26]. One remarkable feature of the mound is its great size. The mound forms a truncated cone over 10 m high (originally over 12 m high) and at least 80 m in diameter at the base. A village of considerable size would have had to flourish for most of the 2500 years of the mound's existence in order to generate so much refuse.

Yet, no evidence of such a village has been uncovered at or anywhere near the site. Nelsen also found evidence that the mound had periodically been excavated or reworked during its formation, and that much of the substructure of the mound was likely "not in the place of its original deposition"[27].

An important question that keeps arising about shell middens is: *Why were the Native people consuming so much mollusk meat?* The nutritional value of mussels is not particularly high[28], and it is not uncommon for mollusks to become toxic at certain times of the year. It has been suggested that rather than eating them all, the native people of the California coast may have smoked the mussels and traded them with interior tribes[29]. Similar to findings from shell middens elsewhere, the Emeryville excavations have produced very little in the way of vegetal matter such as seeds, grains, husks, and other kinds of crop food refuse. This scarcity of plant refuse is a key reason why archeologists conclude that the native people here and elsewhere, whose diets and habits the middens are thought to reflect, were simple hunter-gatherers. The apparent lack of plant foods in their diets is interpreted to mean that the native people either had no knowledge of agriculture or, having had the knowledge, chose not to conduct it. This assumes, of course, that the middens are indeed refuse piles.

The Emeryville mound is only one of hundreds of shell mounds recorded in and around San Francisco Bay on lands formerly occupied by the Ohlone. The Coast Miwok, too, built many shell mounds in the bay area. Along Miller Creek several kilometers south of Olompais are found six shell middens of significant size comprised of shell and bone fragments, charcoal, and heat-fractured rock[30.] Mortar fragments were reported to be common, while clusters of whole mortars were found at sites adjacent. Another midden located a short distance north of Olompais was found to be closely associated with several bedrock mortars[31]. This midden was comprised mainly of mollusk shell fragments, splintered mammal bones (including fragments of human cranium), chert and obsidian flakes, pieces of quartz, various stone, bone and shell artifacts, and a single plant remain (a carbonized pinenut). Shellfish species in the midden were reported to be "out of place in this habitat".

A recent examination in the Big Sur region found that while shell middens were clustered about the coast, they also occurred well inland[32]. Some middens were found 20 to 30 km inland and up to 850 m elevation. Radiocarbon analyses indicate that these middens date to about 6400 years B.P. The radiocarbon data reveal, too, that the materials in the middens are commonly out of stratigraphic order, that is, older materials are found overlying materials significantly younger in age. Here is incontrovertible evidence that these middens have been disturbed or reworked. Again, the association of shell middens with pestle and mortar artifacts, including bedrock mortars, was noted at the Big Sur sites.

Bedrock mortars throughout the Sierras are generally found to be closely linked with both middens and giant sequoia groves[33]. At a large number of these sites (~200) are reported curious large circular depressions called rock basins or "Indian bathtubs". They appear to have been used to grind a large volume of materials at one time, though archeologists are at a loss to explain the real purpose(s) of the basins.

Nearby these basins are typically found middens that contain substantial quantities of fire-fractured rock and ash, as well as bones, pottery shards, and even shell fragments[34]. Whatever the explanation for these unusual rock basins, an accounting must be made of their close association with middens and giant sequoias.

Elsewhere in the Pacific coast region huge trees can be found to grow upon substrates containing shells and shell layers. In a study I conducted in 1985 and 1986 of over 12,000 trees and associated soils in southeast Alaska, I found that in the plots containing the very largest (>1 m in diameter) trees (mainly Sitka spruce [*Picea sitchensis*] and western hemlock [*Tsuga heterophylla*]), a thin layer (~1 to 2 cm) of crushed shells (inexplicable at the time) occurred in the upper part of the soils[35]. In a detailed account from the Jesup North Pacific Expedition of the lower Fraser River in British Columbia, H.I. Smith described Douglas fir trees growing on shell middens that were over two meters in diameter. Of these middens, he wrote "The typical shell-heap is several hundred yards in length, about thirty yards in width, and three to four feet in height. Others are miles in length, and some reach a height of over nine feet."[36] Smith also observed "Some of the barnacles, being attached to the inner side of the shells, show that the latter were of mollusks that had died before leaving the sea."[37]

The problems regarding the composition and stratigraphy of shell middens, along with the close association of middens with bedrock mortars and with large trees, point to the likelihood that middens served not as refuse dumps, but rather as recycling centers for mineral-rich materials that were piled, smashed, and sometimes burnt (to enhance the reactivity of the minerals) for the ultimate purposes of ameliorating acidification and remineralizing the ecosystem. Midden materials were eventually ground into fine-sized particles using mortars and pestles and then spread generously on the ground around trees of special importance in order to suppress moss growth and to enhance soil fertility. In some places, it appears that a limewash prepared from a mixture of finely-ground midden materials was also painted on the bark of the trees, much like the whitewash that is still being used today by other indigenous cultures. I suspect that similar associations between middens and old-growth trees will be found in places like Florida, Denmark, Japan, New Zealand, Australia, and other places where shell middens occur.

CONCLUSION

Drawing from the observations of odd shapes and distributions of old-growth trees, from the findings of shells and shell layers in the surface soils around the largest of these trees, and from the many published reports on related activities and practices of the native people, I conclude that the California Indians of the Sierra Nevada and Coast Ranges were not simple hunter-gatherers, but, instead, were sophisticated farmers who practiced sustainable silviculture that involved the cultivation of oaks, buckeyes, bays, pines, and other nut-bearing trees in vast orchards. Besides cultivating the trees one can see that the native people terraced many of the hillsides to prevent erosion and increase water infiltration, and gathered shells and quarried rocks to stock the various middens with the materials needed for making mineral fertilizers. Standing as convincing testimony to the cultivation skills of the native

people are the mighty coast redwoods and the giant sequoias, the largest trees in the world, which were apparently planted many thousands of years ago and have been carefully tended ever since. Today this ancient wisdom casts new light on a promising cure for sudden oak death and many other tree decline syndromes simply by improving mineral nutrition and, thus, growing healthier trees able to resist attacks by pests and diseases.

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