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Vigesimal Systems Found in California Indian Languages

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THE vigesimal number system is defined by Webster as "divided into or consisting of twenty parts; proceeding by twenties." It may come as a surprise that vigesimal systems, far from being an aberration most notably found among the Aztecs and Maya, are widely found throughout the world. Such a system is employed variously by Eskimos, many Mexican and Central American peoples, the Ainu of Japan, the Enggano of Indonesia, the Yoruba, Igbo, and Ewe of West Africa, some Melanesian peoples, and many more. The fact that most Indo-European and Semitic languages use a decimal system has had far-reaching consequences in diminishing the use of vigesimal systems. For reasons of convenience or coercion, many of the formerly utilized number systems have suffered replacement by the European and Arab decimal systems, particularly as the indigenous peoples were brought inexorably into the respective European and Arab economic spheres.

Europeans, too, have been influenced by vigesimal systems. Gaelic-speakers (Irish, Welsh, Breton) and Basques have fully developed vigesimal systems. In addition, vestiges are found in English ("score"), French (*quatre-vingts*), and Danish. The Danish example is particularly interesting because of the seemingly complicated rendering of the numbers fifty, seventy, and ninety. To take one example, "fifty" is rendered as *halv tres* which is a contraction of *halv tyve i tresindyve* or "half twenty subtracted from three times twenty."

Many examples of vigesimal counting systems are given and ably discussed in Menninger's *Number Words and Number Symbols* (1969) and so, in terms of a world-wide overview, I will not try to improve upon this excellent and comprehensive study. Rather it is my intention to turn to a specific area, namely the rich linguistic province of California.

Hodge, in his *Handbook of American Indians North of Mexico* (1907:353-354), provided the following statement under the rubric "counting":

Two systems of counting were formerly in use among the Indians of North America, the decimal and the vigesimal. The latter, which was used in Mexico and Central America, was also in general use [north] of Columbia [River], on the Pacific slope, while between that area and the border of Mexico it was employed by only a few tribes, as the Pomo, Tuolumne, Konkau, Nishinam, and Achomawi.

As we shall see, Hodge apparently was unaware of a number of other peoples inhabiting this area who also used the vigesimal system. Examples to be found in the literature include the Hūchnom (Yukian) (Powers 1877:487-488), the Nomlaki Wintun (Penutian) (Goldschmidt 1951:388), the Shasta (Hokan) (Holt 1946:341), and, in Oregon, the Umpqua (Athabaskan) (Buschmann, quoted by Trumbull 1875:42). There are indications that several California languages have, within historic times, lost their former counting systems under the onslaught of first the Spanish missionaries, and later the Euroamericans. Due to the fact that the latter incursion took place in relatively recent times

and included several anthropologically minded scholars, a fair number of examples of vigesimal systems have been preserved. In some cases vigesimal counting seems to have been displaced among latter-day speakers of a given language, as will be discussed below. Although we have indications of how the Spanish friars sought to discourage the use of native nondecimal systems, evidence of the prior existence of true vigesimal systems within the mission area is meagre (cf. Kroeber 1925:878; Beeler 1978:33). Whether this indicates their not having been present, or whether it indicates the efficiency of the friars in converting is still problematic.

A final introductory comment as to the rationale for counting systems based on twenty, and why such a seemingly more complicated system should be found among so many "primitive" peoples, is appropriate. The association with counting the fingers and toes is a basic one. Menninger (1969:51-52) provided a succinct commentary on the association of the concrete and the symbolic overlap in vigesimal counting.

When we think of gestures symbolizing numbers, we might well suppose that [twenty-count systems] would be most commonly used and firmly established in areas where people go barefoot and thus can actually count on their toes as well as on their fingers. Yet the Eskimo, who very readily counts in terms of "men" (1 "man" equals 20 fingers and toes) can scarcely do without shoes. The habit of counting by actually touching objects is, to be sure, one path leading to the vigesimal grouping, but not the only one. The mere knowledge of possessing an illustrative supplementary quantity consisting of 20 elements, to which things can be assigned in successive order, is also quite sufficient. It also "invisibly" dominated early man's conception of numbers. It may also be due to the favorable magnitude of the number 20 and its convenience in counting larger quantities; it is neither too small nor too large.

Though Menninger's presumption of what "dominated early man's conception of num-

bers," visibly or invisibly, may cause discomfort to anthropologists, his basic point, that the quantity twenty is physically as well as conceptually natural for humans, is important.

It is tempting to try to draw parallels as to which peoples used decimal and which vigesimal systems. The apparent fruitlessness of this endeavor was expressed by Conant (1896:176-178):

It is not to be understood that any geographical law of distribution has ever been observed which governs (whether a group uses a decimal or a vigesimal system), but merely that certain families of races have shown a preference for the one or the other method of counting. These families, disseminating their characteristics through their various branches, have produced certain groups of races which exhibit a well-marked tendency, here toward the decimal and there toward the vigesimal form of numeration. As far as can be ascertained, the choice of the one or the other scale is determined by no external circumstances, but depends solely on the mental characteristics of the tribes themselves. Environment does not exert any appreciable influence either. Both decimal and vigesimal numeration are found indifferently in warm and in cold countries; in fruitful and in barren lands; in maritime and in inland regions; and among highly civilized or deeply degraded peoples.

The vigesimal form of counting is a sufficiently basic and natural system as to require no diffusionist argument to explain its distribution, although in localized areas some cultural borrowing undoubtedly occurred. Arguments for diffusion from a unique source, such as the assertion by Seidenberg (1960:279) that the northern California vigesimal systems derived from the Aztecs are hampered by an over-reliance on the premise that a given counting system concept must be monogenetic. Two criteria may be: (1) what is the reason for needing large numbers?, and (2) what would be the mechanism of spread? As regards the use of vigesimal systems among California Indian languages, these questions will be critical to this discussion.

Since my interest is in a fairly gross morphemic comparison of terms, I have left the various phonetic renderings in the form used by the sources. Strictly speaking, it is appropriate to refer to the vigesimal systems dealt with as "quinary-vigesimal" systems insofar as they usually proceed first by fives and then by twenties. The most common form is to count by "hands" (and/or "feet") in which the term for five is "hand." When the total of two hands and two feet has been enumerated the resultant sum of twenty becomes the new base upon which multiples may be formed. As mentioned earlier by Menninger, the term for twenty used in various parts of the world is frequently "man." California is no exception though there are examples of an additional abstraction that is based on a standard theme in the creation myths.

CALIFORNIA LANGUAGES USING VIGESIMAL SYSTEMS

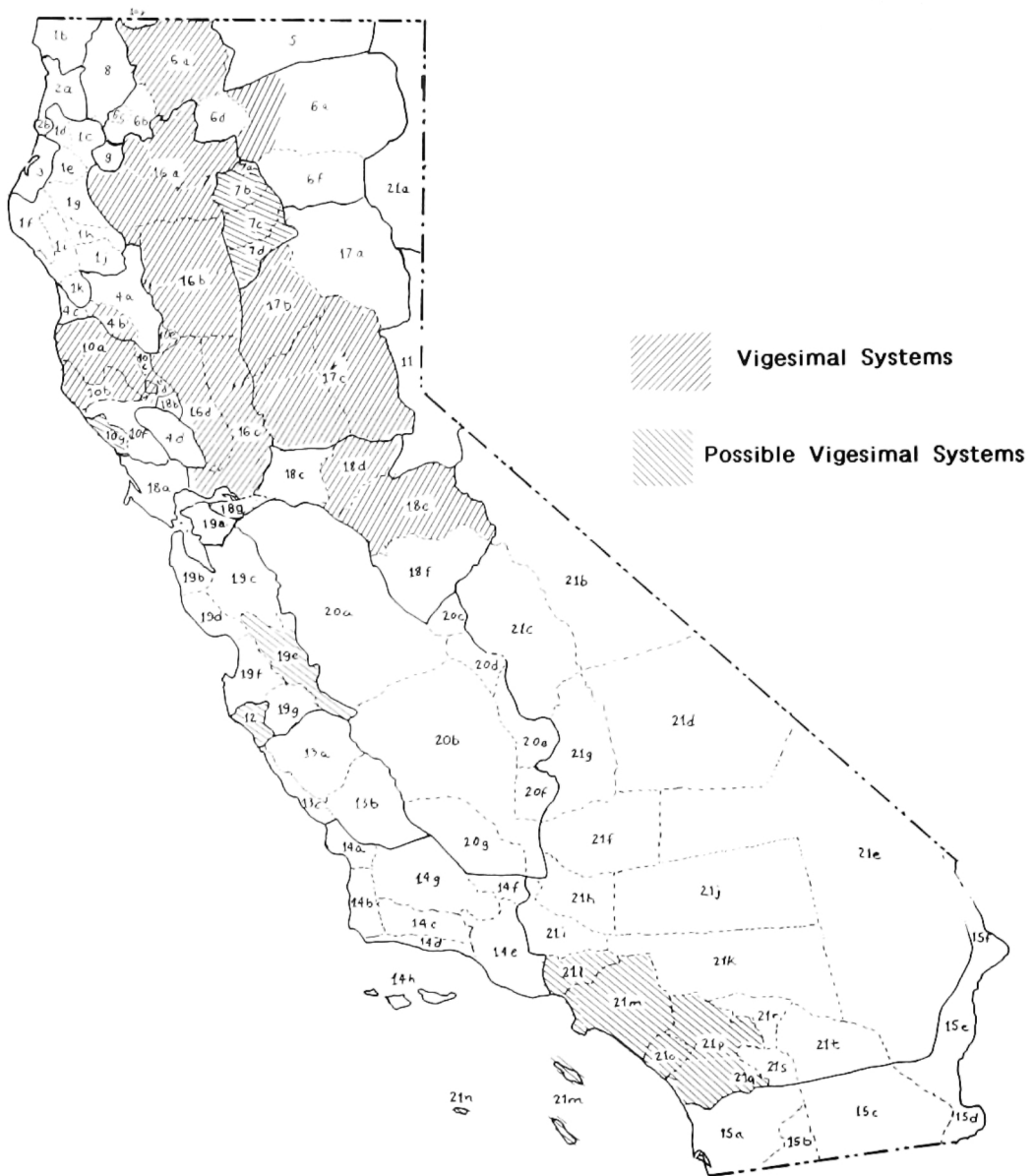
Figure 1 indicates the clustering of Indian languages using vigesimal systems in the state of California. Two points are particularly noteworthy. First, the preponderance of language groups using the vigesimal system is to be found in northern California in the area not dominated by the Spanish missions. Second, there is a general clustering of vigesimal systems around the Sacramento Valley, an area dominated by speakers of Hokan and Penutian-based languages. The northwestern Athabaskan, Algic, and Yukian language-speaking peoples of the northern Coast Ranges seem to have preferred decimal or octonary systems (Kroeber 1925:875-879). In the southern part of the state there seems to be an almost universal use of decimal systems except for one problematic area that will be discussed later.

Among the peoples who used vigesimal counting there is an interesting and possibly

profound difference in the apparent etymologies of the words used to denote the term twenty. The three key variations noted are: (1) a literal rendering meaning "two hands and two feet" (e.g., Luiseño [21p¹]); (2) a more abstract term meaning "man," "person," and/or "Indian person" (often such a term will be based on the term used for a specific group such as using the phrase "one Wintun" for twenty among the Wintu [Dubois 1935:70]); and, (3) an even more abstract (and seemingly less personalized) term meaning "stick" to represent twenty used by various Pomo groups. Of these variations the second form is the most common. Let us now consider specific examples of the vigesimal systems of California in more detail.

The Southern California Examples

Alfred Kroeber showed a great interest in the number systems used by the California Indians and in an article co-authored with Roland Dixon dealt extensively with the subject (Dixon and Kroeber 1907). In that article the Gabrielino (21m), Nicoleño (21n), and Luiseño (21p) were included among the vigesimal users (Dixon and Kroeber 1907: 669). Later Kroeber (1925:878) added the Fernandeño (21l), Cupeño (21q), and Juan-eño (21o). However, on this occasion he temporized, "these people strictly do not count by twenties, but by multiplying fives." An example from Luiseño showing how this count was made is instructive. Fifteen is rendered as "all my hand(s) and one my-foot," twenty by "another finished my-foot the side," and forty by "twice my-hand my-foot finished" (Kroeber and Grace 1960:120). Kroeber probably was on fairly safe ground in including such a cumbersome system under the general heading of vigesimal due to the fact that the maximal unit is made up of the ten fingers and ten toes equalling twenty. However, the obvious inconvenience of its



INDIAN LANGUAGES OF CALIFORNIA

Fig. 1. California Indian languages showing evidence of vigesimal systems. Legend appears on the following page.

Legend for Figure 1
CALIFORNIA LINGUISTIC GROUPS

1a. Rogue River	10e. Northeastern Pomo ^a	19a. Kharkin Costanoan
1b. Tolowa	10f. Southern Pomo	19b. San Francisco
1c. Hupa	10g. Kashaya Pomo ^a	19c. Santa Clara
1d. Chilula		19d. Santa Cruz
1e. Whilkut	11. Washo	19e. Mutsun ^b
1f. Mattole		19f. Rumsen
1g. Nongatl	12. Esselen ^b	19g. Soledad
1h. Lassik		
1i. Sinkyone	13a. Antoniano Salinan	20a. N. Valley Yokuts
1j. Wailaki	13b. Migueleño Salinan	20b. S. Valley Yokuts
1k. Kato	13c. Playano (?)	20c. Northern Hill
		20d. Kings River
2a. Yurok	14a. Obispeño Chumash	20e. Tule-Kaweah
2b. Coast Yurok	14b. Purisimeño Chumash	20f. Poso Creek
	14c. Yneseño Chumash	20g. Buena Vista
3. Wiyot	14d. Barbareño Chumash	
	14e. Ventureño Chumash	21a. Northern Paiute
4a. Yuki	14f. Emigdiano Chumash	21b. Eastern Mono
4b. Hüchnom ^a	14g. Interior Chumash	21c. Western Mono
4c. Coast Yuki	14h. Island Chumash	21d. Koso
4d. Wappo		21e. Southern Paiute
	15a. Kumeyaay	21f. Kawaiisu
5. Modoc	15b. Eastern Diegueño	21g. Tübatulabal
	15c. Kamia	21h. Kitanemuk
6a. Shasta ^a	15d. Yuma	21i. Alliklik
6b. New River Shasta	15e. Chemehuevi	21j. Vanyume
6c. Konomihu	15f. Mohave	21k. Serrano
6d. Okwanuchu		21l. Fernandeño ^b
6e. Achomawi ^a	16a. Wintu ^a	21m. Gabrielino ^b
6f. Atsugewi (Hat Creek)	16b. Nomlaki Wintun ^a	21n. Nicoleño ^b
	16c. River Patwin ^a	21o. Juaneño ^b
7a. Northern Yana ^b	16d. Hill Patwin ^a	21p. Luiseño ^b
7b. Central Yana ^b		21q. Cupeño ^b
7c. Southern Yana ^b	17a. Northeastern Maidu	21r. Pass Cahuilla
7d. Yahi ^b	17b. Concow Maidu ^a	21s. Mountain Cahuilla
	17c. Nisenan Maidu ^a	21t. Desert Cahuilla
8. Keruk		
	18a. Coast Miwok	
9. Chimariko	18b. Lake Miwok	
	18c. Plains Miwok	
10a. Northern Pomo ^a	18d. Northern Sierra ^a	
10b. Central Pomo ^a	18e. Central Sierra ^a	
10c. Eastern Pomo ^a	18f. Southern Sierra	
10d. Southeastern Pomo	18g. Bay Miwok (Pulpunc)	

^a use or used vigesimal systems.

^b have or had possible vigesimal systems.

expression shows a qualitative difference from the relatively abstract and succinct terms "man," "person," and "stick" found in the north. I believe that this is an important point arguing against any easy lumping-together of vigesimal counting systems.

Examples from Northern California

Maidu. The Northwestern or Konkau Maidu (17b) employ the word *maidu-k-wökö* for twenty wherein the term *wökö* means one and so forms "one Maidu." In forms for multiples of twenty the full term, *maidu*, is replaced by *-ma* and is joined to the words for two, three, four and five, respectively, to form forty, sixty, eighty, and one hundred (Powers 1877:594-596; cf. Dixon and Kroeber 1907:679). The Southern Maidu (17c) or Nisenan, by contrast, employed a term meaning "one person" (*wit'-ta-pa*) which was not the same as the term *Nisena-n* used to refer to themselves (Powers 1877:594-596; Dixon and Kroeber 1907:679, 687; Kroeber 1929:289; Uldall and Shipley 1966). As for the northeastern Maidu (17a), the indications are that they used a decimal system (Dixon and Kroeber 1907:679; Shipley 1963).

Wintun. The northern Wintun (16a) or Wintu, employed a term, *ketewint^hun* ("one wintun") to denote twenty (Schlichter 1981:273) and joined to it the terms for two, three, four, and five to form the scores through 100 (Dixon and Kroeber 1907:675; Dubois 1935:70-71). The Central Wintun or Nomlaki (16b) also counted by twenties. However, their term, *kêtêtsak*, is not so clearly associated with a personalized term. By contrast, two terms are given for one hundred: *kêtêtwitat* (one man) and *ketem not* (one arrow) (Barrett 1908a:85-86; Goldschmidt 1951:388). The word for one thousand is *semanot*, which meant one hundred. Goldschmidt (1951:388) (the source of the Nomlaki terms) warned that "the terms for

100 and 1,000 were not given with assurance. Probably another way of saying 1,000, perhaps purely figuratively, was *ketewitat*, 'one big man'." The Southern Wintun or Patwin (16c, 16d) use the word *ete-kai* for twenty and proceed by multiples of twenty up to and including one hundred (Dixon and Kroeber 1907:675; Whistler MS). Kenneth Whistler (personal communication 1978) suggested that the etymology of *-kai* (*kayi*) is a nominalized form of "to walk."

Miwok. Only the Northern (18d) and Central (18e) Sierra Miwok appear to have used vigesimal systems (the Plains Miwok [18c] perhaps should be included, but we have no words for multiples of twenty available), whereas the Coast (18a), Lake (18b), and the Southern Sierra Miwok (18f) used decimal systems (Barrett 1908b:366-367; Broadbent 1964).

The term used for twenty by both the northern (18d) and the central (18e) Sierra Miwok is *naa* (Dixon and Kroeber 1907:680; cf. *na²a*, (Freeland and Broadbent 1960:52; Callaghan 1987:163), while the Plains Miwok used *na²a* (Callaghan 1984:104, 294). It is perhaps notable that in the late 19th century a different term for twenty was recorded for the central Sierra Miwok, *reng-e-me-woom*. In this case the word *reng* was derived from "one" and *me-woom* was a plural for "man" (singular, *me-wook*). In addition, these terms are shown to be very similar to the term for "Indian" and "people," *mah-woom*. The term for "one hundred" is also provided and is said to mean "five people" or "five twenties" (*masse reng-e-me-woom*) (Johnson, quoted in Powers 1877:546-548).

Dixon and Kroeber (1907:680) showed that the multiples of twenty are not compounded of *naa* but rather the terms *mama* and *momo* (Northern Sierra Miwok) and *mumu* (Central Sierra Miwok) (cf. Freeland and Broadbent 1960:52). The meaning of

this word is not clear though conceivably it may be comparable to *me-woom*.

Shasta (6a). The term for twenty as collected by Catharine Holt (1946:341) is *'cháhis* compounded of *'cháa*, one, and *his*, person. Multiples of twenty are formed by prefixing the terms for two, three, four, and five to *his*. However, after "one hundred" (*acháhis*) is reached, higher multiples use this new base so that two hundred is literally "two-five-twenty." Although Dixon and Kroeber showed a decimal system for the Shasta, in a footnote they provided an alternative system which clearly is vigesimal and which generally parallels the terms gathered by Holt (Dixon and Kroeber 1907:678, 690). The one difference is in the term for twenty which is rendered as *tsec*. Whistler suggested that *tsec* (or *t'es*) is a collapsed form of "one plus person" similar to the form recorded by Holt (K. Whistler, personal communication 1978).

Achomawi (6e). Word lists for the Achomawi gathered since the 1920s (de Angulo and Freeland 1931; Olmsted 1966) show an apparent decimal system in use. However, word lists obtained around the latter part of the 19th century and early 20th century clearly show a vigesimal usage. The term for twenty is variously rendered *ma-shish'*, *mah-sis*, *masis*, or *masips* (Powers 1877:605-606; Merriam, quoted in Olmsted 1966). These terms are further corroborated by Kelsey (MS) who obtained the term *mus iēs'* for twenty in 1905. Olmsted (1966:31-32) showed the terms *iēs* and *īs* as meaning "person, people," and particularly "Indian people" in Achomawi.

Initially, it appeared that the differences indicated a shift from vigesimal to decimal by all the Achomawi subgroups around the turn of the century. However, closer study suggests that the split was more in line with "upriver" and "downriver" branches of the

Achomawi. This hypothesis is discussed more fully in a later section.

Pomo. Northern (10a), Central (10b), and Eastern (10c) Pomo all employ systems in which multiples of twenty are referred to as so many "sticks" (Dixon and Kroeber 1907:676; Barrett 1908a:65-66, 91). An excellent synopsis of the Pomo method of counting was provided by Loeb (1926:229-230):

Twenty among the Eastern Pomo is called *xai-di-lema-tek*, a full stick, and in counting small amounts a stick is laid out for this primary unit. . . . I see no reason, however, why Barrett stopped his investigation at two hundred. The Pomo do not stop at this figure, but are well able to continue counting indefinitely. The large counts run as follows among the Eastern Pomo:

- 80. *dol-a xai*. 4 sticks.
- 100. *lema-xai*. 5 sticks.
- 200. *hadagal-a-xai*. 15 sticks.
- 400. *kali-xai*. First (big) stick.
- 800. *xotc-guma-wal*. Two (big) sticks.
- 2400. *tsadi*. (Big) six.
- 3600. *hadagal-com*. Ten (missing) [e.g., less one, GJF].
- 4000. *hadagal*. Ten (big) sticks.

. . . when each of these latter ten sticks have been counted, you reach the number forty thousand, *xai-di-lema-xai*. This is known as "big twenty."

The southwestern (Kashaya) Pomo (10g), whose territory includes the former Russian settlement of Fort Ross, provide an interesting variation insofar as they employed the stick term to mean forty and multiples thereof. Thus eighty was rendered as "two sticks" (Dixon and Kroeber 1907:686). It is tempting to speculate on a Russian influence at work here since there was a traditional count among fur traders emphasizing 40 (*sorok* in Russian) (Menninger 1969:185, 190). Fort Ross was, of course, established by fur hunters of the Russian-American Fur Company. It should also be noted that interspersed within this count is an apparent quinary system in which five is expressed as *hma* (Dixon and Kroeber 1907:676).

Southeastern Pomo (10d) seems to have a decimal count. However, their term for twenty, *ete-kai* apparently is identical to the southern Wintun (Patwin) term. Dixon and Kroeber (1907:685) stated that the southeastern Pomo "largely borrowed" their number system above ten from the neighboring Southern Wintun. Whistler stated that his Patwin informants substantiate this view (K. Whistler, personal communication 1978).

Hūchnom (4b). The speakers of this Yukian-based language occupied a territory bordering the northern Pomo. They used a vigesimal counting system which was quite at variance with the other Yuki languages that use either decimal systems (Wappo and Coast Yuki) or the distinctive octonary system (Round Valley Yuki) (Dixon and Kroeber 1907:677). An interesting feature of the Hūchnom counting system is found in the intermediate decades between the score counts. These are expressed as "ten on the following score" (e.g., fifty would be ten on the third score). This contrasts with the usual additive method of joining ten onto the previous lower score (cf. Nomlaki Wintun, Northern and Central Sierra Miwok, Shasta, and Achomawi). On the other hand, systems similar to the Hūchnom are found among the Pomo (northern, eastern) and the Konkau Maidu. This system is not really so unusual on a world-wide basis. Both the Maya and the Danes express the intermediate decades in this manner. It seems to form an alternative subtractive approach to counting.

Yana (7a,b,c). In addition to the groups mentioned above, Kroeber (1925:875ff) listed the Yana as using a vigesimal system although the evidence is scanty, involving only terms for twenty and thirty (*uciwaii* and *uciwaii hatsermaii*, respectively) (Dixon and Kroeber 1907:678). By contrast, Sapir (Sapir and Swadesh 1960:passim) showed a decimal system in use. Although they agreed on the

term for twenty (*uxsiwai* according to Sapir), the term Sapir produced for thirty is obviously decimal "three-ten."

Yahi (7d). A mention should be made of Yahi since Theodora Kroeber (1961:145) stated that Ishi counted vigesimally above twenty; "when twenty was reached, it became a new unit as one hundred is with us, the twenties or scores being given names not built on the smaller numeral names." When contacted to resolve this discrepancy she was unable to explain it (T. Kroeber-Quinn, personal communication 1978).

Although only minimal evidence is available suggesting inclusion of the Yana and Yahi among the tribes using vigesimal systems, their location, surrounded by the Achomawi, Wintu, and Konkau Maidu would make it reasonable to believe that they too had a twenty-count system.

Esselen (12). Beeler (1978:33) made an interesting comment on the numbers used by this Hokan-family language of the Big Sur Coast:

There are two further Esselen numerals to look at. G. (Galliano) gives *pek-efejedes* for '20.' The etymology of this is clear: *pek-* 'one' plus *efeje* 'person' plus suffix *-des (-tis?)* of unknown force. The term for 'twenty' meant, then, 'one (complete) person.'

Beeler went on to discuss the intrusive aspect of Spanish mission influence on the Esselen language. This notion will be dealt with at greater length below.

Mutsun (19e). The possibility that there had formerly been a vigesimal system at work among the Costanoan peoples of Mission San Juan Bautista is suggested by Older (1938:218-219). She stated: "They (the Mutsuns) counted only to ten. To use eighty they used the French form 'four times twenty.'" Although she apparently derived her information from Fr. Arroyo de la Cuesta, I have not been able to find from where in his works it

might have come. Therefore, the Mutsun language is placed in the category of possible vigesimal systems.

THE DISPLACEMENT OF NONDECIMAL SYSTEMS BY DECIMAL ONES

In historic times two major cultural assaults overtook the California Indians. In the first instance we have the Spanish friars whose missionizing activities encompassed virtually all of southern and coastal California up to the area of the Sonoma and Napa valleys in the coast range and to the Sacramento Delta inland. The fact that the missionaries were generally keen on assuring that the Indians knew their numbers is brought out in the following comment concerning such educational activities in South America.

But as a knowledge of numbers is highly necessary in the uses of civilized life, and above all, in confession, the Guaranies were daily taught at Church to count in the Spanish language, in the public explanation, or recitation of the catechism. On Sunday, the whole people used to count from one to a thousand, in the Spanish tongue, in the church [Dobritzhofner 1822:171-172].

Bringing this attitude closer to home we have a remarkably explicit example of the California priests acting to displace at least one native system of counting with their decimal system. Beeler's translation of the *Señan Confesionario* brought to light this early (ca. 1815) guide to priests for hearing the confessions of the Ventureño Chumash. The following is a sample exchange between priest and neophyte (Beeler 1967:22-23).

- Quest.: Have you ever said that what the Father teaches is untrue?
 Quest.: How many times have you said it?
 Quest.: Have you ever told it to others?
 Quest.: To how many have you told it?
 Answer: To fourteen [Expressed in the Chumash Quarternary System]
 Quest.: I don't understand what you are saying: I don't understand the way

you people count; Count by tens.
 Answer: Ten and four.

In the full confession guide (Beeler 1967:passim) there are more than fifty questions involving "how many?", "how often?", "how much?", etc. in the course of a full confession. Indeed, a knowledge of numbers was important for the confessional and preferably a way of counting convenient to the priest.

It so happened that the Chumash used a quaternary system, not a vigesimal one. However, the procedure of conversion from any nondecimal system is revealed. It is pertinent to know that Fr. Señan was no obscure priest, but was twice called upon to act as president of all the Alta California missions. It is therefore reasonable to assume that his "confesionario" outline may have been adopted by other missions. Ethno-historians and linguists searching through mission documents may well add more to the list.

Regarding the number system of another missionized tribe, the Esselen, Beeler (1978: 33) concluded they used "a basically quinary system that has been overlaid, in prehistoric time, by a quaternary and, later by a decimal system." Bear in mind that quinary systems are often linked with vigesimal systems. The Esselen term for twenty certainly was a "person" term in the style of the other vigesimal systems discussed in this paper. The use of "four times twenty" to express eighty by the Mutsun could well be a remnant as tantalizing as the French term, *quatre-vingts*.

As previously mentioned, virtually all of the examples of well-described vigesimal systems are found outside the mission area. Perhaps it is merely a coincidence that this is so. However, it is worth noting that two large linguistic groups having multiple branches that happen to lie on the northern frontier of the missionized area show an interesting division between decimal and vigesimal use. Of the seven Pomo subgroups, it is the two

southernmost (the Southern and Southeastern) that are recorded as using the decimal system whereas the northern five used some form of vigesimal system. Likewise, among the Miwok, we find that the Coast, Lake, and the Southern Sierra Miwok used decimal systems. Too few data are available to decide where the Plains and Bay Miwok fell in this division. The Southern Sierra Miwok provide a puzzle if one seeks to argue missionization as the sole causative factor for the presence of decimal systems where they did exist. What we may have here is an example of a group being tied linguistically to the members of their own language family (Northern and Central Sierra Miwok) but sharing a strong material-culture link with the decimal-counting Yokuts. A similar situation may be seen with the vigesimal-using Hūchnom (Yukian) having stronger material-culture interaction with the Northern Pomo. If such a link could be demonstrated, we would have stronger evidence for the association of counting systems with material culture. Such an association would appear to go without saying since one does count material things.

Unfortunately, the information available for the mission area offers only circumstantial evidence of the *possible* displacement of vigesimal systems in southern California. The situation in northern California is rather different, perhaps the opposite in a way. The explicit, language-shaping methods suggested in the *Señan Confesionario* do not seem to have been the source for change. Rather, it seems practical considerations prevailed. For instance, there is the apparent replacement of a vigesimal system by a decimal one in the language of the Nisenan.

In the case of the Nisenan or southern Maidu (17c), Powers (1877:594-596) gave a rendering of twenty as "one person" (*wit'-ta-pa*) along with the numbers for forty ("two-twenties") and sixty ("three-twenties"). The

intervening decades are formed by adding ten to the previous score. However, the term for one hundred unaccountably appears to be an apparent decimal figure with ten in its root. In fact, if it were following the pattern set down by the earlier numeral figures, it would properly be an equivalent to "two hundred." This inconsistency may be a product of the interviewer-informant relationship or it may be reflective of the informant being out of his or her depth with traditional numbers and simply repeating a term for which the real sense of quantity was lost.

Next we have some word lists published by Dixon and Kroeber (1907:679, 687-688) that seem to indicate a trend toward a decimal system in which thirty is rendered "three-tens," and forty, "four-tens." However, the term for twenty is still "one maidu" (*kōm maiduk*). In a footnote dealing with variations found throughout the Nisenan region they show that at Sacramento the vigesimal system yet prevailed. On the other hand, the word for twenty at Spanish Flat (*witem maiduk*) was being challenged by a decimal form (*pen-pai matcam*, lit. "two times ten").

Kroeber again wrote on the subject following interviews with a Nisenan man made during the 1920s (Kroeber 1929:289). Here he showed what appears to be vigesimal counting but with some terms that had not shown up previously. The informant was 70 years old at the time (ca. 1929) and Kroeber indicated his uncertainty with some of the words provided.

Another linguist who concentrated on the Nisenan language about this same time (ca. 1930) was Hans Jørgen Uldall. Unfortunately for this study, Uldall seems to have failed to gather the words for numbers between twenty and one hundred (Uldall and Shipley 1966: passim). However, the words he obtained for twenty are interesting. They are *huje* and *majdyk*. The word for "one hundred" is

given as *hondot* and is duly noted as coming from English.

There is an intriguing footnote to one of the Nisenan stories obtained by Uldall (Uldall and Shipley 1966:174): “*ma·camni ma-wykym huje·* means 110, but in his English version the informant said 90, so that is probably what he meant. He was somewhat shaky in the higher numerals, which were probably never in general use.” It seems that Uldall was unable to work out properly the vigesimal system of the Nisenan and failed to provide any numbers for the scores between 20 and 100 that would have elucidated this counting system. However, when one looks at the numbers obtained by Dixon and Kroeber (1907:679, 687), one finds that the word for 50 is literally “ten on three-twenties.” Therefore, it is entirely consistent that the informant in the quote above would have meant “ten on (i.e., less than) five-twenties” rather than “five-twenties plus ten.” It is ironic that Uldall would not have considered such a subtractive form since the Danish language works in much the same way. This seems to be what the Nisenan informant was saying.

The case of vigesimal and decimal systems among the Achumawi is another example. Upon examining the number words found in the Olmsted (1966:passim) Achumawi dictionary, one finds that the Achumawi version of twenty is given as *haʔaqelmalūsti* (lit., two-tens). This is indeed made up of the words for two (*haʔaq*) and ten (*malūsti*). However, when one looks at the word which Olmsted obtained meaning nineteen, *masīshammisanji* (lit., twenty, one-naked), we are faced with a curious form, *masīs*, meaning twenty which does not seem to correlate with the obvious “two-tens” form mentioned above. On the other hand, it makes much more sense when compared with the apparently vigesimal terms for twenty obtained by

Powers and Kelsey (*ma-shishʹ, mus īsʹ*). Likewise, the word obtained by Merriam for twenty-five, *mah-sis lah-tah ah tooʹ-me*, and the word for two hundred, *mul-selʹ mah-sis*, both clearly utilize this vigesimal form (Powers 1877; Merriam, quoted in Olmsted 1966; Kelsey MS).

Kelsey provided two other number lists obtained from different informants within a week of the interview that produced the vigesimal form. In both of these latter cases the counting system is decimal. Also, de Angulo obtained only decimal forms (de Angulo and Freeland 1931).

There is the possibility of there being a split in the usage found in “upriver” and “downriver” Achomawi dialects (Richard Hughes, personal communication 1978). Merriam also pointed out the environmental differences between the country occupied by the more westerly tribe (the Mo-desʹ-se or Mahdesiwi) and the easterly tribes that inhabit an open or broken country similar to the sagebrush plains and open deserts of northern Nevada (Merriam 1926:12). A look at the map (Fig. 1) suggests the influence of different tribes surrounding the westerly Achomawi versus those surrounding the easterly or upriver peoples. The westerly groups are in contact with the Shasta, Wintu and Yana, all speaking languages identified as having vigesimal systems, while the easterly Achomawi people bordered the Modoc, Atsugewi, and Paiute, all decimal-system users.

In order to examine the supposition of an upriver-decimal and a downriver-vigesimal split more closely it is necessary to look at the derivation of the informants who provided the various forms. Powers was not much help since he said only that his word lists came from two individuals who were then (1875) on the Round Valley Indian Reservation (Mendocino County). Kelsey named George Bush of Indian Springs as the source

of his vigesimal example. The two decimal counts were from a woman known as "Old Wool" of Fall River Mills and Johnnie Steele of Alturas. I have been unable to locate "Indian Springs" as a town or place name, although it may relate to Little Hot Springs Valley, about nine miles north of McArthur. On the other hand, the locations of Fall River Mills and Alturas are, respectively, at the cusp of the upriver-downriver split and at the extreme upriver end.

The dialect associated with the vigesimal words obtained by Merriam is Madesi (Mades'-se), the extreme western branch. De Angulo and Freeland did not specify their informant nor which dialect was spoken. Olmsted's informant for the words nineteen and twenty mentioned above was from the Ajumawi (Fall River) dialect group which he listed as a downriver band. This was possibly the same group as that of Kelsey's informant, "Old Wool." It would appear that theirs is a mixing of the decimal and vigesimal in this case.

There would seem to be two main possibilities for explaining the mix of vigesimal and decimal in the Achomawi dialects. One is that there may have been a shift from vigesimal to decimal in the past century. However, another possibility is that, as is suggested for the Southern Sierra Miwok and the Hūchnom, the counting system was influenced by their immediate neighbors and trading partners. I am inclined to accept the latter proposition in this particular instance.

There are a number of examples of languages which, while being influenced by some outside force in a shift of systems of counting, may *adopt* a foreign word to express a given number concept as opposed to *adapting* terms from within the language. For instance, in many cases the Spanish word *cien* was adopted to refer to one hundred (e.g., Eastern Pomo *kálisè-nt?*; McLendon 1975:128) or

even the English word hundred (e.g., Nisenan *hondot*; Uldall and Shipley 1966). In other languages this term is expressed as "ten times ten" using the indigenous term for ten (e.g., Achomawi *malūsel malūstsi*; Olmsted 1966). One might argue that replacement through adoption rather than adaptation is a function of an inability to express the term using words from the language itself. Alternatively, it may be an example of linguistic pliability, pragmatic convenience in taking the new word. Possibly what is reflected is that the concept of one hundred was less important to people using a nondecimal system in their domestic affairs but became necessary when dealing with the Euroamericans. Indeed, we have an example among the Eastern Pomo of eighty being a threshold figure but being shifted over time to one hundred.

In counting large quantities of beads two methods are employed. According to the first, and older, method a small stick is laid out for every eighty beads. When five of these small sticks have been laid out, they are taken back, and a larger stick substituted for the Pomo large unit of four hundred. According to the second method, a small stick is laid out for every hundred beads, four of these small sticks making the large unit [Loeb 1926:230].

The figure of eighty or multiples thereof is also recorded for the Nomlaki Wintun (Kroeber 1932:356-358).

Such adoptions virtually never appear in terms for less than one hundred with the possible exception of terms like *tú-pič* (two bits) for 25 cents and *síkspič* (six bits) for 75 cents among the Karok (Bright 1957).

The view of linguistic pliability is most appealing because it is ludicrous to argue that the Pomo with their highly developed number system were in any way incapable of expressing the quantity one hundred. In some cases an adopted concept became a bit skewed as in the example of the notion of eight bits to a dollar when the amount "two bits" (25

cents) was not capable of being halved. In an effort to inject the decimal monetary system two dimes were often equivalent to a 2 real (25 cent) piece (cf. Farris 1980:24-25). Thus the Lake Miwok used the same term (?*tta tawlik*) for 25 cents (2 bits) as for 20 cents (two dimes) and similarly used a single term for four bits and forty cents (Callaghan 1965). Likewise, the Northern Sierra Miwok used the term *wanpi-ti* (one "bit") for either a dime or "half a quarter" (Callaghan 1987:244).

SOME POSSIBLE EXPLANATIONS FOR THE DISTRIBUTION OF VIGESIMAL SYSTEMS

Alfred Kroeber evidently found number systems in California quite intriguing, but the distribution of the vigesimal system left him puzzled. In his *Handbook* he made the following observation.

The situation may be summed up by saying that from 20 up, all California counts decimally except the people of two areas. The first comprises half or more of the Pomo, most of the southern Wintun, in general the western Maidu, and the northerly divisions of Interior Miwok. This is precisely the region of the intensive development of the Kuksu cults. Here the count is by twenties. The second area is that of the Gabrielino and Luiseño, with whom the Fernandoño, Juaneño and perhaps Cupeño must be included, but no others. (These people strictly do not count by twenties, but by multiplying fives.) Now this, strangely enough is precisely the tract over which the Chungichnish religion had penetrated in its full form. *The connection between a system of religious institutions and a method of numeration in daily life is very difficult to understand, and the bonds must be indirect and subtle.* That they exist, however, and that it is more than an empty coincidence that we are envisaging is made almost indisputable by the fact that the northern tract of decimal counting for low numbers coincides very nearly with the area of the northwestern culture in its purest form as exemplified by New Year's rites and the Deer-skin dance [1925:878; emphasis added].

As has been seen, Kroeber for some reason overlooked the vigesimal count of the Yana, the Achomawi, and the Shasta. He likewise did not deal with the potential loss of examples of vigesimal counting which may have existed in the missionized area. However, neither of these demurrers by itself is sufficient to cause rejection of his observations. There is no reason why contiguous peoples would not have been influenced by a neighboring group in their numerical system and the Shasta, the Yana, and the Achomawi all border on the rather extensive core area of vigesimal-counting languages. Again, as has been argued above, vigesimal systems are natural enough so as to be amenable to independent invention. Thus even if there were in former times a greater proliferation of vigesimal systems in the missionized area, it would not profoundly affect Kroeber's observations.

What seems to be inadequately appreciated or discussed is the peculiar nature of the term used by each group to denote the quantity "twenty." There is a general realization that some form of the term "man" is often expressed as a representation of the ten fingers and ten toes basic to the concept of vigesimal counting. In the case of the Luiseño we have seen how a terminology can remain on an apparently very simple level. Higher numbers were rendered by a complicated enumeration of fingers and toes. In stark contrast we see the far more sophisticated process at work among the northern peoples in which twenty was rendered by a relatively abstract notion of "man," not to speak of the truly abstract image of "stick."

Of particular interest is the quality of the term for "man" that is used. It is not simply the biological term for a human being, but a highly personalized term meaning "person," and in some cases could be seen to mean "us," "our people" as in the cases of "one

Wintun" and "one Maidu." Such a personalized form of counting would seem to be permissive of a mystical association by people. However, attempts to find indisputable relations with vigesimal counting in either the Kuksu Cult (relying on Curtis 1924; Loeb 1932, 1933) or the Chinigchinich religion (Boscana 1933) met with no success. There is, of course, the association of the Kuksu Cult being thought to have originated among the Wintun of the western Sacramento Valley and then spreading out from there. In fact, the purest usage of the personalized "twenty" term is among the Maidu and the Wintun. However, if we consider the role of Kuksu as a Creator figure then we have a potential association. Several ethnographers have noted that there is a recurring theme in California Indian creation myths of people being created from sticks (cf. Kroeber 1906: 177-178; Sapir 1910:74-77; Mason 1912:187). This may well be our link between the forms of "twenty" meaning "person" and those meaning "stick." It seems probable to me that the putative association of vigesimal systems and the Kuksu cult suggested by Kroeber has some foundation.

A second association often made by ethnographers is the relation of the vigesimal system to the counting of beads. We have already heard from Loeb on the subject and he commented further:

My informant, Benson, has himself seen counting in which five or six of the four-thousand-bead sticks were utilized. Large counts were commonly performed by the Pomo at the time of deaths and peace treaties. In a myth recounted by Barrett the first Bear shaman gave forty thousand beads in pretended sympathy for the victim whose death he had caused. . . . Kroeber believes that the interest which the Pomo showed in counting developed from the wealth they acquired by being the principle purveyors of the standard disk currency to north-central California [Loeb 1926:229-230].

Concerning the Shasta, Holt (1946:341) associated the vigesimal count with its use in counting dentalia.

In counting dentalia the first ten were laid aside, the next ten put with these, then they were grouped by twenties and every five groups of twenty each were kept separate as a unit of one hundred. . . . The count proceeds quinary from one to ten, decimally from ten to twenty, and vigesimally beyond twenty.

Holt (1946:312) also stated that in their trading with the Wintun (Wintu), the Shasta received clamshell-disk beads.

It seems curious that Shasta vigesimal counting should be emphasized as being linked to dentalia which are described as coming from the Karok, Yurok, and Hupa, peoples who used a decimal count. Very likely trade with the Wintu and the south in general had been greatly diminished by the Euroamerican incursions into the Sacramento Valley long before Holt arrived on the scene.

The Wintun, like the Pomo, were facile with numbers due to counting beads (Kroeber 1971:64). Dubois (1935:70-71) stated that

for 20 and beyond, two different systems of counting were used, one for ordinary purposes and the other for clamshell disk beads and possibly also for arrowheads. . . . The same terms were used by the Wintun according to Curtis (1924:227). It may indicate a relation between the southern origin of clam disks and a southern terminology of counting them.

The position of the Wintun along the eastern edge of Pomo territory made them appropriate middlemen between the Pomo and peoples of the Sacramento Valley and the Sierra Nevada. A high degree of association with bead (money) counting, and particularly clam shell beads, would help to explain the rough pattern of vigesimal systems. The fact that this bead type is thought to have spread widely only in the late prehistoric period (King 1978:59) is consistent with a late spread of the Kuksu Cult.

CONCLUDING REMARKS

Despite evidence to the contrary (e.g., Closs 1988), the popular image of "primitive" peoples envisions them as counting in no more sophisticated a manner than "one, two, three, many." In some cases the ethnographer may have been fooled by an unfamiliarity on the part of the informant with abstract counting, counting for counting's sake. Theodora Kroeber recounted an amusing story regarding the supposed inability of Ishi to count to high numbers. When A. L. Kroeber and T. T. Waterman asked Ishi to count he did so, from one to ten, stopping at ten. When they asked him to continue he said that there was no more, that was all. Kroeber and Waterman went on the lecture circuit talking about this interesting example of cultural limitation. However, somewhat later, Kroeber noticed Ishi patiently counting out the half dollars with which he was paid. When questioned as to the number of coins Ishi easily brought forth the Yana terms for twenty, forty, sixty and eighty.

Why had Ishi said "No more" at ten? Counting in the abstract was something he was not accustomed to do. He probably found it trying, and surely he found it pointless. Counting is for counting something tangible such as beads or treasure. . . . Abstract numbers did not interest him as such, nor did they figure in philosophy in the Yana world view. Ishi's interrogators knew this, as they knew also that the questionnaire form of putting a query may be expected every so often to yield misinformation, since the presuppositions from which it arises may be unknown or meaningless to the person being questioned. They were disconcerted to be caught out using it [T. Kroeber 1961:145-146].

The aim of this paper is to point out a cultural element which was once widespread, at least in part of California, and to give examples of its amenability to cultural diffusion, not to speak of acculturation. Linguists today may very well be unaware of the possi-

bility that the number system used by their informants, even though expressed in indigenous terms, is actually a relatively recent example of linguistic borrowing. Madison Beeler, in studying Ventureño Chumash, had assumed that their use of the decimal system was natural until he was introduced to the *Señan Confesionario* (Beeler 1963). Likewise, Olmsted in compiling his *Achumawi Dictionary* primarily from living sources also accepted the idea that a decimal count was *the* system used by the speakers of Achomawi (D. Olmsted, personal communication 1977). This concern with current usage is undoubtedly appropriate to one preparing a lexical document for a living, if not flourishing, speech community. However, for ethnohistorical researchers such a linguistic displacement should be a matter of some interest.

Even though a vigesimal system may seem rather exotic to one raised to think in decimal terms, it is actually quite a common and "natural" conceptual device. However, this is not to say that when we see a concentration of peoples speaking different languages all using vigesimal systems we may not anticipate some high level of interaction which would explain it. Whether, in the case of the Indians of northern California, this is due to a religious connection (Kuksu) or an economic one (shell-bead trade) may turn out to be unprovable. The fact that the apparent core area of vigesimal counting systems is occupied by the speakers of Penutian languages is intriguing, although it could be argued that the preponderance of Hokan-language speakers in northern California also employ this system. In contrast, it does not seem to be indigenous to the Algonquian, Athabaskan, Yukian, or Shoshonean peoples also resident in the northern part of the state. Considering the various levels of abstraction noted between the literal-minded Luiseño, the person-oriented Maidu, and the highly commercial Pomo,

it would appear that the latter have reached the highest level of abstract numerical thought. Whether this is due to a maturity of culture or of use of this system is hard to tell. Assuming the hypothesis that the Hokan language stock is older in California than the Penutian, it would seem that the Pomo would be the better candidate for the local origin of vigesimal use both in terms of longevity and as an apparent commercial disposition as producers and traders of a high-volume commodity (i.e., clam-shell disk beads).

It is possible that there is a relationship between the personal nature of the Kuksu religion and the personal form of the term applied to the vigesimal systems of northern California. It would further seem that the extensive clam-shell bead trade may have reinforced the use of this counting system. The resultant association of the vigesimal system and the bead trade may well have been the cause of the expansion of the use of this counting system beyond the area associated with the Kuksu cult.

In turn, during the latter part of the 19th century both Indian religion and Indian economics in California were dealt blows by the Euroamerican arrivals. What resulted was an amazingly rapid shift to the decimal system that was prevalent in the dominant culture.

NOTE

1. Each language mentioned will be marked by a numeral and letter linked to the plan in Figure 1.

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