Spring 2007

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Robert T. Boyd
Portland State University, rtboyd@pdx.edu

Cecilia D. Gregory

Citation Details

Boyd, Robert T. and Gregory, Cecilia D., "Disease and Demography in the Plateau" (2007). *Anthropology Faculty Publications and Presentations*. 154.
https://pdxscholar.library.pdx.edu/anth_fac/154

Journal of Northwest Anthropology, 41(1):37-70 (2007)

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PREFACE: 2007

Twelve years ago, Roderick Sprague asked the authors—an anthropologist trained in epidemiology and a physician with training in paleopathology—to prepare this paper for his projected book, *Burial Practices of the Plateau.* Since that volume has not seen print, and with the intention of bringing the information herein to the attention of regional researchers, in early 2004 Sprague asked us if we would be willing to have it published as the first in a special numbered series of articles in the *Journal of Northwest Anthropology.* We agreed, with the proviso that it be at least moderately updated to reflect developments since the mid-1990s.

The 1995 version of the paper incorporated data from three then-unpublished sources: 1) Chapter 8, Plateau Population History, of Boyd's 1985 University of Washington Ph.D. dissertation, *The Introduction of Infectious Diseases Among the Indians of the Pacific Northwest, 1774–1874*; 2) Demographic History until 1990, in 1995 still in manuscript, but in 1998 published as a chapter in the *Handbook of North American Indians, Vol. 12: Plateau* (Boyd 1998); and 3) Plateau Health and Disease During the Protohistoric, Chapter 2 of the still unfinished manuscript, A Disease History of the Plateau Culture Area, which is intended to be a companion volume to and Plateau equivalent of *The Coming of the Spirit of Pestilence: Introduced Infectious Diseases and Population Decline Among Northwest Coast Indians, 1774–1874* (Boyd 1999). The manuscript chapter is quite similar to the present offering, but includes more detailed information drawn (particularly) from the Plateau Indian oral literature.

Paleopathology

Some background is necessary for the paleopathology section of the paper. In 1994 Sprague invited the authors to survey the osteological records in the Alfred W. Bowers Laboratory of Anthropology at the University of Idaho. Until 1990 the Bowers Laboratory kept records of all human remains found by the Laboratory in southern Plateau archaeological sites, including data such as site provenience, osteological measurements, and paleopathological conditions identifiable from bones, before the remains were returned to the tribes for proper reburial. The majority of these records were completed by either Walter H. Birkby (University of Arizona) or later by his student, Thomas M. J. Mulinski (University of Idaho). Although the Bowers Laboratory records constitute the largest and most important inventory of data on Plateau osteology and paleopathology extant, it must be acknowledged that they are wildly inconsistent in the amount and quality of data they record. Skeletal remains ranged from fragments to complete skeletons; some sites had few bones, others many. Data were recorded by different researchers with varying interests, and many techniques used by contemporary paleopathologists were not yet known. So even though the Bowers Laboratory collection remains a gold mine of data, much of it does not meet the high standards of twenty-first century paleopathological investigation.

* Contribution No. 1 in the JONA Plateau Burial Series.

In 1990, NAGPRA (Native American Grave Protection and Repatriation Act) was passed by Congress. It corrected a grievous wrong concerning the treatment of Native American remains, and was (in the opinion of the authors) fully justified and long overdue. Remains now go directly to the tribes, as they should. The previously collected Bowers Laboratory records, recorded anonymously as to individual and family, remain and preserve crucial information on the health and demography of the ancestors of contemporary Plateau tribes. In 2000, as a result of investigations connected with litigation concerning the Kennewick Man remains, a second important data source on historical Plateau disease and demography appeared. This was the inventory of all Plateau archaeological reports, published and unpublished, containing osteological and paleopathological data, prepared by Steven Hackenberger and students at Central Washington University, with contributions from the University of Idaho (http://www.cr.nps.gov/aad/kennewick/hackenberger). Much of this material was not known or available to the authors when we were researching our paper ten years ago. Hackenberger has directed us to a few outstanding sources, whose results are incorporated herein, but a full analysis of the paleopathological content of his inventory is a job yet to be done.

In 2007, looking back at our 1995 contribution, we feel that it represents a fairly complete review of the ethnohistorical and ethnographic data on disease and demography, but only a preliminary survey of the paleopathological record. On the latter we encourage contemporary researchers to return to and re-examine the Bowers Laboratory records, and subject them to a more intensive and up-to-date analysis than we were able to do in our five-day survey; and to combine these findings with the scattered data in the Hackenberger Kennewick inventory, with the goal of obtaining a more complete understanding of traditional and contact-era health and disease, information that is of crucial importance, both to scientists and as part of the cultural heritage of contemporary Plateau tribes.

INTRODUCTION

In the period between the introduction of horses (during the second quarter of the 1700s) to the advent of reservations (after 1855 in the United States; later in British Columbia), the peoples of the Plateau culture area shifted from what was probably a relatively stable system to one of dramatic change, not only culturally, but in disease and demographic characteristics as well. Regional archaeologists refer to the pre-horse period as prehistoric, and the post-horse/pre-reservation time (circa 1700–1850) as the protohistoric. What is currently known about pre- and protohistoric Plateau disease and demography is the subject of this paper.

Three data bases provide information on Plateau disease and demography. Ethnohistorical sources, particularly from the censuses and fort journals of the Hudson's Bay Company, but also from explorers' and missionaries' accounts, constitute the larger part of information on introduced diseases and population size and structure. Burial records—which from the Plateau consist almost entirely of the osteological files in the Alfred W. Bowers Laboratory of Anthropology at the University of Idaho—provide most of what is known about precontact diseases and mortality patterns. The relatively large body of oral traditions from the Plateau, supplemented by ethnohistorical and osteological data, are sources for information on Plateau paleonutrition.

PALEODEMOGRAPHY

Parameters: Mobility and Group Size

The salient features of the basic Plateau culture type that influenced its demography included a foraging subsistence base with a heavy emphasis on seasonal plants, semi-nomadism, and simple, fluid, social structures. Plateau subsistence, on the whole, required a substantial degree of seasonal nomadism or transhumance. A description by Marcus Whitman (Hulbert 1938:296–297) of a typical seasonal round, for the Cayuse in 1843, follows:

> Their migrations are much in the following order & manner...the middle of April is the period for commencing the *Kaush* (biscuit root)...a great staple of native food) they have to disperse along the streams coming out of the Blue Mountains. Some are not more than ten or fifteen miles from the station [Waiilatpu Mission] while others are thirty or forty....From six to eight weeks are given to gathering drying & depositing this root. During this time from the tenth to the fifteenth of May the salmon arrive & some fruits are ripe & each receive their share of attention. At this season all the smaller tributaries of the Columbia are barred by a webb or wiker work of willows for taking salmon. The skill & resource of the natives is well displayed in this simple construction & their small toil amply repaid by the ease with which a considerable number are taken....The last week of June brings the usual period for those to leave who go after buffalo & the same period marks the time for gathering the Kamsh. A migration of from forty to sixty miles brings them across the Blue Mountains to the southeast into the Grand Round which is a large kamsh plain. Here also the river of Grand Round abounds with fish & the mountains with bear, elk & deer...the latter part of July...to the first of October...is marked by a great number coming and remaining for a short time & then going again & others coming, than by great Numbers remaining stationary for any considerable time. During this period their attention is divided between their...huts, hunting & fish & preparing dried fruit...soon after...they begin to disperse for winter quarters.[1]

The non-agricultural, broad-based foraging subsistence strategy practiced by Plateau peoples had strong effects on aboriginal demography. On the one hand, the wide variety of wild foods utilized yielded (relatively speaking) "reliable harvests" which "permitted moderately large population concentrations" (French 1981:2329). On the other hand, the seasonal availability and patchy distribution of these foods dictated that people move often, to take advantage of the foods when and where they were available.

Throughout most of the southern Plateau, the most effective social system appears to have been a central based band organization with a simple, fluid social structure capable of breaking up or coalescing into units whose size varied according to the particular task to be accomplished. The following quotation by Asa Smith (Drury 1958:135–137) gives an idea of the size, flexibility, and distribution of bands among the Nez Perce (neighbors of the Cayuse) in February 1840.

> As an example of the sparseness of population, take the Nez Perce tribe, including the little remnant of Kayuses...from recent estimates there cannot be more than 3,000 souls....they are scattered over a territory not less than...30,000 square miles & perhaps 40,000—so that there cannot be more than one inhabitant to ten square miles. They live in small bands...varying usually from 10 to 100 or 150...along the rivers & small streams...on lands belonging to themselves...these little bands usually live 5, 10, 15, 20, or 30 miles from each other & sometimes more...the people are not only scattered, but they are wandering from place to place during almost the entire year. The manner in which they live renders it necessary for them to wander...out of 497 people who belong within 15 miles of this place [Kamiah Mission], 249 are now in the buffalo country [the Great Plains] & only 248 in this vicinity....the greatest number that have been at this station at any time is about 275.

During winter, people settled down in substantial dwellings at sheltered locations, where they lived off stored food. These winter villages could be very small—a family or two—to several hundred people. Only in rare cases did they exceed 500 in number (Ray 1936).

There were other population aggregations, however, which might be considerably larger. All were apparently resource-based and multi-ethnic. They included fisheries: The Dalles, Musselshell Rapids, the Walla Walla mouth, Priest Rapids, Leavenworth, Spokane Falls, Kettle Falls, and Okanagan Falls on the Columbia; and the Cañon, Skookum Chuck, and Yale in the upper Fraser drainage. Root grounds too might attract sizable numbers: the largest were apparently in the Yakima valley and Botanie valley on the Fraser (Boyd 1985:Map 17). Bison-hunting task-groups crossed the Rockies to the Great Plains for the hunt.

The following two quotations from Nor'wester Alexander Ross (1849:117) attest to how large these seasonal gatherings could be. At The Dalles in 1811:

> The main camp of the Indians is situated at the head of the narrows, and may contain during the salmon season 3,000 souls, or more; but the constant inhabitants do not exceed 100 persons, and are called Wyampams, the rest are all foreigners from different tribes.

The Yakima Valley rendezvous was described as a "mammoth camp" of "not less than 3,000 men, exclusive [sic: should probably read *in*clusive] of women and children, and triple that number of horses." The Indians congregated in the geographic heart of Northwest Sahaptin territory "every spring to lay in a stock of the favorite Kamass and pelica or sweet potatoes" (Ross 1956: 22-23). Finally, the bison hunting task groups, according to Anastasio (1972:163), "ranged from 500 to 2,000 although more often it averaged about 1,000." The important points to be made about group sizes on the Plateau are their great flexibility and their responsiveness to environmental conditions.

Population Size: Lewis and Clark's Estimate of the Western Indians

There are, of course, no prehistoric population enumerations from the Plateau. Determining aboriginal (pre-contact) Indian populations is one of the most contentious areas of contemporary Native American studies. Boyd has estimated Plateau populations before and elsewhere (1985:371 [reprinted in Hunn 1990:28–30]; 1998:469–471); here we would like to (briefly) discuss the data base from which the estimates were derived, and offer some revisions and further thoughts on estimating pre-contact Plateau populations.

Lewis and Clark's Estimate of the Western Indians (Moulton 1990:473–492) constitutes the earliest population estimate for the peoples of the Columbia Plateau (the equivalent for the upper Fraser is the Hudson's Bay Company's 1827 Kamloops census). Lewis and Clark's Estimate was the source for James Mooney's 1928 estimate of aboriginal Columbia Basin populations, and remains the most important single source on early Plateau populations.

Two characteristics of the Estimate must be noted. First, it is not always easy to identify Lewis and Clark's "nations" (particularly those of the northern Plateau, which the explorers did not visit) with those of contemporary Plateau peoples. A lot of ink has already been spilt on this problem (Ray et al. 1938). Earlier identifications used only the published version of the Estimate and map, and relied heavily on translations of recent Nez Perce/Sahaptin terminology for upriver peoples. The identifications in Table 1 are primarily geographical, based on the descriptions given in the earliest draft of the Estimate, compared to the original base map and contemporary maps.[2]

Second, none of the earlier analyses of Lewis and Clark's Estimate took into account the fact that it existed in *two* versions. Up until 1990, version one (Codex I) existed only in manuscript, in the library of the American Philosophical Society in Philadelphia. Version two, first published in Allen (1814 and several times afterwards) contains many numbers that are much larger than those in the original, especially for peoples of the Lower Columbia. The explanation for these differences appears to relate to seasonal movement. When the explorers first descended the Columbia in November 1805, most peoples had returned from seasonal foraging and settled in their winter villages. Version one apparently reflects these winter village populations. In early spring 1806, when the explorers ascended the river, fishing season had begun, and several interior peoples had already converged on the river to take advantage of it. These increases were reflected in version two of the Estimate (the published version). In all likelihood, the higher spring estimates are for multi-ethnic fisheries. This distinction appears clear for the Lower Columbia (Boyd and Hajda 1987), and it offers a hypothesis for explaining some of the Estimate's upriver numbers, which occur at the location of seasonal fisheries and seem too high to represent resident populations.

Table 1 incorporates numbers for Plateau peoples from both versions of the Estimate as well as information on geographic location as given by Lewis and Clark. The figures given here are raw numbers; estimates closer to reality for the different ethnolinguistic groups require some shuffling to account for the differences between versions one and two and the multi-ethnic nature of the fisheries.[3] Totals for Columbia Plateau populations from Lewis and Clark's Estimate are 35,820 (version one) and 40,560 (version two, with adjustments). One final remark concerning Lewis and Clark's Estimate: though it appears to be a comprehensive survey of Columbia Plateau peoples, it may not in fact be so. The explorers themselves acknowledged a possible omission of peoples inhabiting the interior of some tributaries (at least for the lower Columbia) in a footnote to version one.

TABLE 1. LEWIS AND CLARK'S PLATEAU INDIAN POPULATIONS: PROBABLE IDENTIFICATIONS AND NUMBERS [a]

Name	Lodges	1805 Codex	1814 Estimate
Nez Perce (Choppunish)			
1) Upper Snake bands			
("Lewis's river above...the Kooskooske")	80	1200	
a. Upper Snake band ("as high up the Kooskooske as the Forks")			800
b. Salmon river band (Soyennow) ("E. Fork of Lewis's River")			400
c. Wallowa band (Willewa)		500	"
2) Clearwater (Kooskooske) bands	220	3600	
a. Upper band (Kimooenim; "above the forks")			1600
b. Lower band ("below the forks")			2000
3) Lower Snake band (Pelloatpallah)			
("Lewis's river below the Kooskooske")	30h 10t	2300*[b]	"
Northeast Sahaptin			
Palouse (Pallace; included in Pelloatpallah, above?)			
4) Wallawalla (Wallow-wallar)			
("entrance of Lewis's River to Musselshell rappid")	46	1000	1600*
Wanapam (Wanerpo, included in Sokulk, below?)			
Columbia Sahaptin			
5) Umatilla (Pishquitpah; "on Columbia from Musselshell rappid to the commencement of the high country")	71	1600	2600*
6) Wayampam (Wahhowpums) ("the highlands to...the great falls")	33	700	"
7) Tenino (Enechuh; "at the great falls")	41	1200	"
8) Tygh (Shoshones part)			
Upper Chinookan			
9) Wasco-Wishram (Echelute)			
("at the upper part of the great narrows")	21	600	1000*
10) White Salmon (Chilluckkitlequaw; "next below the narrows and extending down on the N. side...to the River Labeash")	56	1000	1400*
11) Hood River (Smackshop)			
("below the Chilluckkitlequaw... to the grand rapids")	24	800	"
12) Cascades (Shahala)("at the grand rappid...down to Wappetoe Island")	62	1500	2800*
Neerchokioo	2	40	100
Northwest Sahaptin			
13) Taitnapam (included in 1814 Estimate populations of:)			
Shoto		(160)[c]	460*
Quathlapohtle	(14)	(300)	900*
14) Klikatat			
a. western bands (Shahala part)		(1500)	2800*
b. White Salmon bands (Chilluckitlequaw part)	(56)	(1000)	1400*
c. Klickitat River (lower "Catteract" bands; Skaddats and Squannaroos)		320	"

15) Yakama			
a. Shallatos ("on the Catteract")		100	"
b. Chimnahpum ("at the forks of a large river which falls into the Columbia about 15M above Lewis's r.")	42	1860	"
16) Kittitas (Shanwappom) ("on the heads of Catteract river & Tapteel river")		400	"
17) Cayuse (Willeletpo; "on the heads of Weaucum river")		250	"
18) Molala ("Shoshones or Snake residing in winter…on the Multnomah river…and in summer…at the Falls of the Towarnehiooks River")		3000*[d]	"
19) Secwepemc of the upper Thompson (Coospellar; "on a large fork which discharges itself into the Columbia above the entrance of Clarks river")[e]	30	600	1600
20) Salish (Tushshepah Nation; "rove on Clark's river")			
a. Flathead			
Oatlashschute ("summer on W side of R Mountains and winter on the Missouri")	33	400	"
Tushshepah ("Northerly branch of Clarks River")	35	430	"
b. Pend Oreille (Hohilpo) ("Clarks river above the Micksucksealtoms")	25	300	"
c. Kalispel (Micksucksealtom; "Clarks river above the falls")	25	300	"
21) Coeur d'Alene (Sketsomish; "on a river of the same name… & around Waytom Lake") (probably includes upper Spokane)	120	2000*	"
22) Spokane (Lartielo) ("at the falls of the Lastaw R below the great Lake Waytom")	30	600	"
Okanagan Salish			
23) Sanpoil (Hihighenimmo) ("from the forks to the enterance of the Lastaw River")	45	800	1300*
24) Colville (Wheelpo; "Clarks river at the great falls")	130	2500*	"
25) Okanagan (Lahanna) ("both sides of Columbia above Clarks river")[f]	120	2000	"
Columbia Salish			
26) Wenatchee (Cutssahnim; "up the Tapteel river")	60	1200	"
27) Sinkayuse (Sokulk) ("on the Columbia near the entrance of Lewis's R")	120	2400*	"
Totals		35820	40560

Table 1 Notes

[a] Table 2 in Boyd 1998:469–470 reproduces the below (with some shuffling of groups) and adds revised group numbers and projected totals.

[b] * = Fishery or other multi-ethnic population probably including several ethnolinguistic groups.

[c] ( ) Number probably represents Chinookan resident winter populations; the larger 1814 figure assumedly includes salmon-season visitors, the bulk of whom were probably Northwest Sahaptin.

[d] Probably represents a grab-bag of interior peoples. Besides Molala *per se*, Tygh and Paiute. Subtract 1000 non- Paiute from the total.

[e] Name is Nez Perce for Kootenai; geographic location is Secwepemc.

[f] Name is Nez Perce for Chelan; geographic location is Okanagan.

Key to geographic names:

Clark's River = Columbia upstream from the Okanogan mouth to the B.C. border; Pend Oreille, Clark's Fork
Columbia (above Clark's river) = Okanagan
Catteract River = Klickitat
East (or North) branch of Lewis = Salmon
Jeffersons River = Yellowstone
Kooskooske River = Clearwater
Labeash River = White Salmon
Lastaw River = Spokane
Lewis's River = Snake
Multnomah River = Willamette
Tapteel River = Yakima
Towarnahhiooks River = Deschutes
Waytom Lake = Coeur d'Alene
Weaucum River = Asotin

Taking Lewis and Clark's total, it is possible, using the disease history method, to extrapolate a rough approximation of aboriginal (precontact) Columbia Plateau population. Lewis and Clark's estimates date from 1805–1806, closely following two documented smallpox epidemics (in the 1770s and 1801–1802). Virgin soil smallpox epidemics claim an average 30% mortality of those infected (data from a mostly Old World sample in Dixon 1962:325). Succeeding epidemics claim fewer, given the phenomenon of acquired immunity among survivors of the first epidemic. A 30% mortality in the 1770s, plus half that in a second outbreak a generation later yields (working back from Lewis and Clark's total), a total of 68,135 for the aboriginal Columbia Plateau. Adding James Teit's (1900:175, 1906:199, 1909:466) estimates of pre-contact, pre-epidemic upper Fraser populations (16,200) plus an allowance for the Klamath-Modoc (2,470) yields an estimated aboriginal Plateau total of about 86,805.

The provisional nature of this figure cannot be emphasized strongly enough. It is the product of one method of estimation alone, and it must be taken in the context of all other information we have—on man-land relations, trends in population history, and so on. For instance, one other (much cruder) estimation method is Henry Dobyns's depopulation ratio (1966), which assumes that the nadir figure of any given Native American population represents (on the average) a 90% decline from the aboriginal total. The Plateau nadir population is 18,751 (in 1890) (Boyd 1998:478). Dobyns's method yields an aboriginal Plateau total of 187,510. This is a possible maximum figure. On the other hand, the 86,805 base is conservative and quite likely well under the true mark.[4] Aboriginal Plateau population was probably somewhere in the range of 86,805 to 187,510. To tighten this figure we need more data and more analyses. Computation and comparison of tribal *densities* (as in Hunn 1990:135) is perhaps the most accessible tool; there may also be possibilities in more sophisticated carrying capacity and settlement pattern analyses.

TABLE 2. PLATEAU POPULATION STRUCTURES, HUDSON'S BAY 1827–1830 CENSUSES (FORTS KAMLOOPS AND COLVILE)

	Men	Women	Sex Ratio	Boy	Girl	Sex Ratio	% Child	Total
SECWEPEMC	434	493	88	377	319	118	43	1623
Fraser	62	71	87	58	53	109	45	244
Alexandria	125	161	78	134	90	149	44	510
N. Thompson	34	44	77	39	20	195	43	137
Shuswap Lake	----	----	----	----	----	----	----	----
Kamloops	195	201	97	136	147	93	42	679
Bonaparte	18	16	113	10	9	111	36	53
NLAKA'PAMUX	326	312	104	205	233	88	41	1076
NICOLA	68	72	94	54	44	123	41	238
OKANAGAN	195	174	112	134	144	93	43	647
Similkameen	75	50	150	46	43	107	42	214
Forks	55	60	92	46	43	107	44	204
Sinkaietk	38	41	93	23	34	68	42	136
Methow	27	23	117	19	24	79	46	93
COLVILLE	130	148	88	86	115	75	42	479
Sxoielpi	96	110	87	61	74	82	40	341
Lakes	34	38	89	25	41	61	48	138
KALISPEL	203	248	82	207	185	112	47	843
Columbia upriver	521	592	88	435	445	98	44	1993
FLATHEAD	150	180	83	164	169	97	50	663[a]
KOOTENAI	182	215	85	118	115	103	37	630
Upper	91	121	75	65	72	90	39	349
Flatbow	91	94	97	53	43	123	34	281
COLUMBIA								
Wenatchee	68	79	86	45	44	102	38	236
Sinkayuse	----	----	----	----	----	----	----	----
SANPOIL	148	126	117	56	55	102	29	385
Sanpoil	57	49	116	32	29	110	37	167
Nespelem	91	77	118	24	26	92	23	218
SPOKANE	222	241	92	111	130	85	34	704
Mission	66	70	94	49	52	94	43	341
Sinahomenish	94	95	99	43	54	80	34	286
Sintatuluh	62	76	82	19	24	80	24	181
COEUR D'ALENE	157	112	140	60	75	80	33	404
Columbia banks	595	558	107	272	304	89	33	1729
NEZ PERCE	440	495	89	255	260	98	36	1450

[a] 1829 Report number. The 1827 figure (362) is apparently partial (including only one band or a total diminished by seasonal absences at buffalo).

There are, of course no population enumerations from the prehistoric period in the Plateau. We are blessed, however, with actual head-counts of local groups, with sex and age (child/adult) breakdowns, taken by Hudson's Bay officials at Forts Kamloops (1827) and Colvile (1829), and for the Stl'atl'imx (Lillooet) and Kamiah Nez Perce in 1839, which constitute an approximation of aboriginal conditions (Tables 2 and 3). The censused groups provide a sample from both the Interior Salish and Sahaptian zones of the Plateau.[5]

TABLE 3. 1839 NUMBERS

	Men	Women	Sex Ratio	Boy	Girl	Sex Ratio	% Child	Total
STL'ATL'IMX (Lillooet)	184	263	70	290	309	94	49	1211
NEZ PERCE	102	(162)[a]	63	102	(100)	102	43	466
(Kamiah band)	27	(59)	46	22	(17)	129	31	125
	18	(32)	56	28	(32)	88	55	110
	17	(36)	47	24	(25)	96	48	102
	28	(19)	147	18	(19)	95	44	84
	10	(14)	71	8	(6)	133	37	38
	2	(2)	100	2	(1)	200	43	7

[a] The original gives number of men, boys, children, and totals. Numbers of women and girls extrapolated.

Two demographic indices are important in these enumerations: percentage of children and sex ratios. In lieu of detailed age break-downs, percentage of children at least provides us with statistics that, comparatively, have some meaning. Eliminating abnormally low percentages from communities along the main Columbia River which were probably influenced by a recent bout of epidemic disease [6] leaves 43.7% children for the remaining Interior Salish groups. For the two 1839 populations, the percentages are 49.5% and 43%, respectively. Percentages like these compare favorably with other non-epidemic coastal and early reservation period Northwest populations (Boyd 1985:445–446), and are in the high range for foraging peoples.

Looking at sex ratios (Table 4), there is another set of patterns, this time internal.[7] Sex ratios are computed by dividing number of males by number of females and multiplying by 100. Low numbers indicate a shortage of males; high numbers a shortage of females. The Plateau pattern is clearest when child sex ratios (c.s.r) are considered apart from adult sex ratios (a.s.r). The most aberrant sex ratios are found among the Secwepemc (Shuswap) peoples of the upper Fraser. Upstream, interior Secwepemc have a child sex ratio of 157; downstream, riverbank peoples a c.s.r. of 98. By adulthood the upstream ratios have reversed to 78 while the downstream ratios remain relatively stable at 95. This pattern does not appear to be the result of a single historical event; it repeats in later censuses (1839 and 1878). It extends beyond the Secwepemc themselves, though the pattern is not as extreme elsewhere. Downstream on the Fraser from the Secwepemc, the Nlka'pamux (Thompson) *add* men: their c.s.r. is 91; the a.s.r. 110. Grouping upriver and downstream Columbia Basin peoples shows the same phenomenon.

TABLE 4. SEX RATIO PATTERNS

	Child Sex Ratio	Adult Sex Ratio	add or subtract Men
Fraser Salish			
interior Secwepemc	157	78	subtract
riverine Secwepemc	98	95	
Nlaka'pamux (plus Simalkameen)	91	110	add
Columbia Salish			
upriver (Kalispel, Colville, Okanagan)	98	88	subtract
Columbia banks (Wenatchee, Sanpoil, Spokane, Coeur d'Alene)	89	107	add

There are two questions here: 1) what explains the high child sex ratios in the Fraser drainage?, and 2) why do sex ratios change so consistently from child to adult? The answer to the first question is clear, and it has an environmental basis. The headwaters of the Fraser are the most inhospitable and resource-poor area of the entire Northwest Coast and Plateau culture areas. Winters are long and cold; salmon runs are late, poor in quality and characterized by great cyclical fluctuations (Sneed 1971). The chance for occasional resource deprivation is high in such an environment, and at such times young children are at great risk. Preferential care favoring male children or (more extreme, female infanticide) are likely. Among the adjacent Athapascans of the Mackenzie drainage (also according to Hudson's Bay censuses) female infanticide occurred at an average rate of circa 20% (sex ratio of 125) (Helm 1980). The pattern appears to have been common throughout the subarctic.

In the Columbia River drainage, upriver child sex ratios start out at near parity, offering no documentary evidence for the upper Fraser/subarctic pattern. The second areal pattern, however, pertains. In both Plateau drainage systems, the sex ratios of interior populations decrease with age from child to adult, while downstream sex ratios show an increase. Although the trend is not pronounced in every case, it is internally consistent, and is undoubtedly real. David Chance, speaking specifically of the Colvile district, interprets the patterns as follows: "It could be suggested that with a situation of uxorilocality, where men were more geographically mobile than women, the fishery [Kettle Falls] may have served as an attraction to unattached men." (1973:128). In other words, permanent migration of excess males from the interior to the economically more productive riverbank communities where they found mates and settled down. This hypothesis fits the demographic data quite well, and matches or parallels a demographic pattern found elsewhere in the Northwest where differential flow of the sexes in adjacent downstream and interior populations evened out aberrant sex ratios.[8]

Vital Statistics

Other ethnohistorical accounts provide an idea of vital statistics in early contact times in the southern Plateau:

Life Span (Fort Nez Perces, 1829)

> The Indians live to a good old age 50 to 60 & older, some very old but can give no account of the Number of Winters they have seen nor have the whites been long enough in the country to form an [illegible] for such calculations....A young Indian when he can get a wife will marry about 20 [years]....women continue to bear until 40 but at this age look very old (Black 1829:questions Nos. 39, 42, & 43).

Infant Mortality (Lapwai Mission [Nez Perce], October 1839)

> This [nomadic] mode of living I consider destructive to life. Many births are premature from the hardships the women are exposed to from being constantly on the horse or under the burdensome packs....A great proportion of the children die within the first four days from violence done them by hard traveling, heat of the sun beating upon their bare heads, and exposedness [sic] to cold, or from want of nourishment (Spalding 1839:231).

To try to pull more information out of the data base on pre-and protohistoric mortality patterns we examined age and sex distributions in five relatively complete southern Plateau prehistoric (91 individuals) and four (non-epidemic) protohistoric burials (104 individuals) in the Bowers Laboratory.[9] Given the limitations of reconstructing demographic patterns from cemetery remains, plus the nature of the Bowers records, what we found should be considered as suggestive only. Sex ratios did not vary significantly, supporting the census records (above). Age distributions for both populations were quite similar, with (rounded) 17% under two years, 33% 0–15, 26% 15–30, 26% 30–45, and 16% 45+. The one age segment which showed a suggestive difference between pre-and protohistoric samples is the oldest (50+—6% difference), implying, of course, an increase in longevity from the prehistoric to the protohistoric periods.

PALEONUTRITION

The first quotation in this paper, on Cayuse seasonal mobility, underlines the great importance of warm-season food sources in Plateau cultures. What the quotation does not address is the cold half of the year, the off-season when wild resources were mostly unavailable and people lived off stored supplies. The preceding discussion of sex ratio variations suggests that winter could be very difficult, with excess mortality, particularly among the very young. Several lines of evidence, from the oral literatures, ethnohistory, the emerging field of paleonutrition, and a few paleopathological conditions suggest that winter was indeed a time when Plateau peoples might suffer from nutritional imbalances, loss of weight, or even death from starvation.

The Lean Season and its Effects

Famine and starvation are ubiquitous themes in Plateau oral literatures, and the lean season of late winter/early spring (March-April) is commonly noted in the Hudson's Bay fort journals as a difficult time for Indian peoples. The myths and tales attribute these bad times to three causes: especially severe weather, failure of a staple food source, or failure to lay in enough supplies to last the winter.

Throughout the Columbia Plateau, there is a myth theme where warm and cold are personified: cold brings freezing weather and people die; warm does battle with cold, wins, and winters are no longer as severe. The Sanpoil myth "Coyote and the Blizzard man" states: "in the old days the winters were very long and cold. Many people died each winter from the cold. Blizzards came which lasted for one or two or some times three months. Food ran out and people starved to death." Coyote (the culture hero) wrestled blizzard man, who brought the storms, blizzard man melted, and winters became milder and fewer people died. (Ray 1933:163) Variations on this theme occur in Coeur d'Alene, Nez Perce, Yakama, Klikatat, and Modoc mythologies (Boyd 1995).

Stories which mention failure of key resources fall in two classes: salmon runs, from the western Plateau, and large game, from the east. Virginia Beavert's (1974) collection of Yakama Legends contains two on salmon run failure: "Spilyay [coyote] Breaks the Dam," in which a slide blocked the runs, and "Legend of the Lost Salmon," where failure to observe the First Salmon Ceremony led to a collapse of the run. In the first story, the people starved; in the second hunger "caused little children [to] cry and old people were forced to beg for food." (Beavert 1974:38) Both Stl'atl'imx (Lillooet) and Nlaka'pamux (Thompson) had versions of the salmon-dam myth; historical texts document Indian deaths from starvation following failure of salmon on both the Columbia and Fraser Rivers (Boyd 1995).

Starvation following failure of game is a theme in virtually all northern and eastern Plateau mythologies (including Secwepemc, Nlaka'pamux, Kootenai, Kalispel, and Nez Perce) (Boyd 1995). Species mentioned are elk, beaver, deer, and bison. In the Nlaka'pamux "Story of the elk-maiden" "all the game suddenly disappeared....Famine was busy among them....When Raven first flew over he was thin and poor, but [after elk-maiden gave him meat and fat]...he grew plump and saucy once more" (Hill-Tout 1978[1]:72).

When Euroamericans commented on Indian hunger they tended to attribute it to laziness, but Plateau myths (such as the Nez Perce "Coyote and fox" and Nlaka'pamux "Coyote and Grisly Bear") share themes on the importance of storing food, the pitfalls of gluttony, and the value of sharing (Teit 1912:312; Phinney 1934:301–306). In "Coyote and Grisly Bear" coyote, angry with grisly [sic] because she wouldn't share "her winter provisions," tricked her into eating them all up, and "she starved to death." The myths demonstrate Plateau Indian cultural values and customs which promoted adaptive behaviors during times of scarcity. A suite of perturbation-dampening practices, from sophisticated preservation and storage techniques, through migration, to social and exchange networks, mitigated but by no means eliminated the specter of starvation.

The myth themes are validated by white observations. At Kettle Falls in late spring 1814 (before the beginning of the annual salmon run) Gabriel Franchere (1969:155) met "a family of Indians who had nothing to eat for several days. They were in a sad state, thin and gaunt, scarcely able to move." They were subsisting on black tree lichen (*Bryoria fremontii*), a Plateau famine food (Turner 1977). Speaking of the people above the Cascade portage in 1824, George

Simpson (1968:94) said "Towards Spring such as have not been sufficiently provident are reduced to the greatest distress by Starvation, and many perish annually from this cause." The Fort Nez Perces Journal (McGillivray; 14 December 1831) stated "before the winter is over many...will be reduced to mere Skin & bone;" at Fort Alexandria (Dakelhne; just north of the Plateau culture area) "Sheer starvation has caused the Death of a number of our Alexandria Indians since the Fall and unless we have a very early spring more will go." (McDougall, 8 March 1828) "Superadded to Starvation" at Alexandria were "Asthmatic, Rheumatic complaints, and Pulmonary Consumptions." (McGillivray 1827:205)

Dietary Staples: Salmon and Game

The two crucial winter foods in the Plateau culture area were salmon in the west and large game in the interior east. Nutritional imbalances, weight loss, and starvation among Plateau peoples appear to relate to failure of or wintertime overdependence on these two staples.

Plateau cultures varied dramatically in access to salmon. Four species (in five major runs) were available in significant numbers. At one extreme, some Plateau peoples had four runs in their territories; at the other extreme, a few had none at all. The salmon peoples (four runs) were the Upper Chinookans and Sahaptins on the Columbia, and Nlaka'pamux and Stl'atl'imx on the Fraser. Three-run peoples included the lower bands of Nez Perce, the Columbia Salish, Okanagan, and lower bands of Secwepemc (Boyd 1998:Table 1). The salmon peoples, given the breadth of their resource base, were least apt to suffer from failure of runs; one would suspect that nutritional problems from over-reliance on salmon would cluster among them. Moving upstream on both the Columbia and Fraser, runs become more unreliable and salmon are leaner (Sneed 1971; Schalk 1977). The further inland one goes, the heavier the reliance on land game becomes.

Although salmon, by itself, is a high quality food, it is not perfect, and its nutritional deficits must be compensated by other foods. Salmon is an excellent source of protein. It is high in calcium and vitamin D. Early run, downstream, fresh salmon is high in fat and calories, but these nutrients are fewer in later runs, at upstream fisheries, and in the dried fish consumed during winter. Salmon contains virtually no carbohydrates or vitamin C, both dietary essentials (Schalk 1977; Hunn 1990:177).

It has been hypothesized that overdependence on dry salmon during winter may have contributed to nutritional diseases such as hypervitaminosis D and scurvy (on the coast) (Lazenby and McCormack 1985; Boyd 1995); failure of runs may be implicated in other deficiencies and starvation. Most nutritional problems would disappear in early spring, with the arrival of fat, oily spring run fish, and the vitamin C, carbohydrates, and other nutrients of spring greens and roots. The beneficial effects of spring salmon are clear in the following excerpt from the Upper Chinookan story "The Killing of Chinook Salmon."

> We found a person the other day, a woman. She was very thin, so that nobody could tell who she was, and by this time she is probably dead. Salmon commanded her to lie down on the ground on her face, and he poured salmon oils on her body from head to feet. By the fifth time she had long, black, glossy hair, plump limbs, and clear skin. This is the reason we regard the Chinook salmon as something wonderful. If a man is thin and sick, he eats salmon, and becomes plump and strong (Curtis 1911:138–139).

Plateau peoples who had no salmon runs in their own territories and, perforce, depended more on other protein sources included Flathead/Pend Oreille, Coeur d'Alene, and Palouse (no runs), and Kootenai, Lakes, Kalispel, Spokane, and Cayuse (one run). Some of these people, given intermarriage rights, traveled to and were able to co-utilize fisheries in territories of neighbors. Others exploited lake fish and local game or (in part) traveled seasonally to the Great Plains to hunt bison.

In a series of articles, John Speth (1987, 1989, 1991) discusses the nutritional problems of diets heavy on protein. Over-dependence on protein (in particular *lean* protein, the variety available in late winter) is dangerous. Protein is difficult to metabolize: it requires excess energy in the form of fats or (preferably) carbohydrates to process. High-protein diets (over 25% intake), without adequate carbohydrates or fat for proper metabolism, may produce weight loss (first fat, then muscle), weakness and increased susceptibility to disease, and in extreme cases diarrhea, fluid loss and eventually uremia. It is, in other words, possible to starve to death on a lean meat diet. Regional dietary preferences for back and organ fat (Plateau), fish oil and sea mammal fat (Coast), and carbohydrates throughout, make sense in terms of winter-time overdependence on protein. Winter starvation in the Northwest, it appears, may have resulted from both an absolute lack of food and an overdependence on protein sources.

Bone Conditions Ascribed to Nutritional Deficiencies

It is important to point out that seasonal resource deprivation would have a particularly strong impact on those segments of the population that require higher than normal nutritional levels: pregnant and lactating women, the fetuses they carry, and the infants they nurse (Speth 1989:334). Interestingly, several abnormalities noted in the Bowers osteological files which may be due to seasonal resource deprivation are concentrated in two vulnerable population segments: the very young and elderly women.

In the young, several bone abnormalities are considered to be markers of stress, nutritional or infectious. Four that have been noted among West Coast fisher-gatherers are Harris or growth arrest lines (transverse lines in long bones), enamel hypoplasia (thin and incomplete development of tooth enamel), and two related conditions, porotic hyperostosis (a pitting and sponge-like consistency in bone, especially of the skull), and cribra orbitalia (porosity of skull bones immediately behind the orbits). Harris Lines (visible on x-ray) and porotic hyperostosis, known from prehistoric California, are not recorded in the Bowers lab osteological sheets. We have not checked the Idaho files for dental pathologies, but cases of enamel hypoplasia are recorded from several Plateau sites (Sprague and Birkby 1970; Minor and Hemphill 1990). Enamel hypoplasia is usually attributed to malnutrition, though several vitamin deficiencies or newborn stressors are also possible causes (Aufderheide and Rodriguez-Martin 1998:407). Cribra orbitalia is recorded in at least sixteen cases in the Bowers records. Demographically none of these was over thirty years old, suggesting that people so afflicted died early or that the bone had remodeled itself. Cribra orbitalia has been explained as due to a deficit of dietary iron, a sign of parasite overload, or both (Cybulski 1994:81).

Among older women, another possible nutritional condition, osteoporosis, was identified in at least a dozen cases in the Bowers records. Osteoporosis is decline of bone mass and increased porosity thought to be related in part to poor calcium intake. Interestingly, meat is "grossly deficient in calcium" (VanSoest, in Speth 1991: 279) and "high protein diets increase the level of calcium excretion" (Stini 1995:408). Seasonal overdependence on meat protein might also explain the otherwise surprising occurrence of at least two cases of rickets in Plateau skeletal remains (45-WT-56, Bowers series; 45-OK-197 in Chatters 1984:F8; both protohistoric).

Although there is precious little *direct* documentary evidence for the influence of seasonal resource deprivation on aboriginal Plateau health and demography, the secondary and circumstantial evidence is, cumulatively, quite strong. Thirty years ago, archaeologist Brian Hayden (1975:12) proposed that "Liebig's law of the minimum" ("the limiting factor is always that period when one has the least") may have been operative in setting the upper limits of many hunter-gatherer populations. The evidence presented here suggests that the hypothesis applies to the precontact Plateau. Before introduced infectious diseases became the most important source of mortality, it appears that lack of food and nutritional imbalances ranked very high as causes of debility and death.

This hypothesis may also be supported by the nature of the pre-contact disease pool (or at least, what we presently know about it). Those constitutional pathologies and infections that are recorded are, though debilitating, in most cases non-lethal.

HEALTH AND DISEASE

General health

In the absence of introduced infectious diseases, general health on the aboriginal Plateau seems to have been good, as indicated by the following passages from early white observers: In the Wenatchee area, 7 July 1811, from David Thompson's *Narrative* (1962:347):

> tho' at present poor in provisions, they [the Indians] were all in good health, and except for the infirmities of old age, we have not seen a sick person, partly from using much vegetable food, and partly from a fine dry temperate climate...like all the other Tribes...they were all as cleanly as people can be without the use of soap.

At Fort Nez Perces, in 1829 in response to question No. 37 Black (1829) reported:

> Few diseases among the Indians, some sore & speckd Eyes, some Fevers from eating too many Green roots perhaps: a Purge cures them they are Subject to the Rash leaving Marks on the Skin there are Cases of Phthisie [tuberculosis] which I have seen cured by a vomit which as well as Fever I think caused by too long a use of Roots on Weak Stomachs there are also symptoms of other diseases but very Mild, very few Cases as yet of the Veneria, the Inds. are in general healthy.

Relative to other Native Americans that Thompson and Black were familiar with, the Indians of the Plateau were more or less healthy. This does not mean, however, that they lived in a disease-free Eden, by any means.

Paleopathology

For several years, starting in the 1960s, the Bowers Laboratory of Anthropology at the University of Idaho served as a clearinghouse for all skeletal remains of eastern Plateau Indians that were unearthed in archaeological excavations of discovered by non-professionals. Before being returned to tribal representatives, the bones were catalogued, measured, and analyzed for signs of disease by a physical anthropologist (throughout most of the period Thomas Mulinski;

some by Walter Birkby). Mulinski's painstaking analyses constitute a large body of raw data, still mostly unutilized by regional researchers, on Plateau physical anthropology. The following is a preliminary overview of Plateau paleopathology, the result of five days in 1995 of research in the files by the authors.

Paleopathology has significant limits, and is only useful for diseases that leave marks on bones. Infectious and rapid-acting diseases, which usually effect only soft parts, leave no record. Additionally, the bones described in the Bowers files are no longer available for reexamination, so Mulinski's and Birkby's recorded data must be taken at face value. New paleopathological methods, such as examination for bone abnormalities that may indicate treponematosis and tuberculosis (Powell 1988) or trachoma (Webb 1990); and X-ray examination and DNA analyses that might uncover otherwise hidden conditions, cannot be performed.[10] The varying and incomplete data recorded on the sheets does not lend itself to the statistical analyses or data control required by contemporary paleopathologists.

Bone Abnormalities and Deformities Ascribed to Non-Nutritional Processes—Periostitis and Osteomyelitis

Trauma can produce fractures, crushing injuries, dislocations, and penetrations of bone by sharp implements such as arrow heads, knives, etc. Periostitis is an inflammation of the periosteum which covers the bone. The bone most often heals, but when microorganisms invade to produce a focus of infection, osteomyelitis can result. Fracture of a bone causes the inflammatory process to begin with proliferation of blood vessels and numerous blood elements into the wounded tissues and bone. An initial focal point of osteomyelitis may spread to other bones by microorganisms in the bloodstream.

After arthritis, periostitis was the second most frequent pathological condition recorded in the Bowers records. Over fifty cases of healed fractures were recorded in the Bowers files. Like arthritis, these indicate which parts of the body were subject to stress. Lower arm bones (radius and ulna) were the usual sites, but there were differences by sex. Women had more broken arm bones than men, and men had a distinctive cluster of broken clavicles.[11] Osteomyelitis was recorded in at least nineteen cases in the Bowers collection. The usual sites were leg bones (femora and tibiae) and humeri (upper arm bones), and a plurality of the cases were among men. In a few cases the infection and deformity spread throughout the body; these individuals were functional cripples.

There are other examples of crippling disability, both in the Bowers files and the ethnohistorical record. In 1853 Dr. George Suckley (1854:126) recorded cases of "deformed hips" and "curvature of the spine" in the northwest segment of the Columbia Plateau. At site 45-OK-250 under Chief Joseph Dam researchers found the remains of an elderly female with "extreme pathological curvature of the spine," probably due to ruptured discs (Campbell 1989:115). The Bowers files contain a case of a middle-aged woman with severe bone deformity associated with a dislocated hip (protohistoric), and a hunched spine from an historic site in Ferry County. Benjamin Bonneville wrote of a Nez Perce woman with a withered leg (Irving 1961:249); a protohistoric burial from Kettle Falls had a woman with atrophied left femur and tibia. The Kettle Falls site also had remains of a man with his right arm carried "in a pronated condition," and the Tucannon burial site contained the remains of a woman with undersized limbs (both arm and leg) on her left side that Mulinski diagnosed as "left sided paralysis."[12]

Arthritis

Arthritis is a general term used when joints between bones degenerate; it usually occurs with advancing age. There are several kinds of arthritis, including degenerative joint disease or osteoarthritis and osteophytosis, a degenerative arthritis of the vertebral column. Other varieties are traumatic arthritis localized to the traumatized joint; ankylosing spondylitis (familial—below); and gouty arthritis which mimics osteoarthritis but with unclear causation.

Of the conditions recorded in the Idaho records, the most common by far was osteoarthritis. Osteoarthritis is caused by mechanical stress; there may be a genetic predisposition. Although a statistical sample was not possible because of the sheer size and fragmentary nature of the collection, the impression is that it was present to some degree in most adults and virtually all of the elderly. More Plateau women than men were arthritic. The most commonly effected site was the vertebral column, particularly the lower (lumbar) vertebrae; second were the leg bones; femur, tibia, and patella; and third the lower arm bones; radius and ulna. In more than a few cases, however, all of these bones and several others were arthritic. These usually elderly individuals must have been disabled and in considerable pain.

Rheumatoid arthritis has also been documented in the Bowers records: as many as a dozen cases, from all time periods. Rheumatoid arthritis is a chronic disease of synovial joint and connective tissues and most often affects the small joints in the wrist, hands, and feet. It is commonly believed to have a genetic component in vulnerable persons and is thought to arise from an auto-immune reaction to an infection. With aging, there is a chronic systemic inflammation affecting multiple joints bilaterally, causing in many cases erosion of cartilage, bone, ligaments, and tendons. It is usually seen in young adults with young women affected more commonly than young men. It has been suggested that RA may have been one of the few diseases that originated in the Americas and spread after Columbus to the Old World (Ortner, Tuross, and Stix 1992:348–349). In 1973 rheumatoid arthritis was documented among Yakama women at three times the United States All Races rate (Beasley, Willkens, and Bennett 1973).

Familial Conditions

Three familial conditions that effect bones and muscles have been identified from pre- and protohistoric Plateau sites. Ankylosing spondylitis or Marie-Strümpell disease, a progressive disease that begins with inflammation of the spine and advances to ossification, from the sacroiliac up, is primarily a disease of males. It was recorded in at least six cases from the southeast Plateau; it has a high frequency today among the Haida Indians of coastal British Columbia. Spondylolysis, or bilateral separation of the neural arch in the lumbar vertebrae, is found spottily throughout the region: 5% of a sample from the Wenatchee area (Congdon 1932); 20% from one Nez Perce series (Mulinski 1974), and nine out of ten skeletons from Modoc territory (Bennett 1972). There were at least eight cases in the Bowers series, and nearly as many cases of a more severe condition, spina bifida, where the cord or meninges may be exposed or even protrude. Both spondylolysis and spina bifida occurred on the Coast as well (Cybulski 1992:138). Finally, Charcot Marie-Tooth disease, a familial neurological disease which causes shriveling of the calf muscles with deformation of the lower limbs, may be cited in the oral literature (Slickpoo 1972:142–143), was definitely recorded by Dr. Suckley in 1853 (1854:126), and occurs today among Nez Perce families.

Bone Tumors

At least fifteen cases of bone tumors and osteomas were diagnosed in the Bowers collection; most were in older individuals, tended to be sited in the skull, and were probably benign. Spontaneous fracture of a bone makes for a probable diagnosis of bone tumor or tumor-like lesion. Tumors are classified according to their cell of origin (bone, cartilage, fibrous-connective tissue, hematopoietic/blood vessel). Benign bone tumors are usually localized and slow growing. Primary malignant bone tumors, called sarcomas, arise from the middle cell layer of the developing embryo. Secondary bone tumors are cancers arising from either the inner or outer layer of the developing embryonic cell layers and are called carcinomas. Carcinomas grow directly and rapidly, and can metastasize widely. Gregory believes a specimen from a Whitman county burial site identified by punched-out small lesions in vertebrae and limbs is a probable case of multiple myeloma, although metastatic carcinoma cannot be ruled out. Advanced bone cancers are rare, but not unknown, for hunter-gatherer populations; another case is documented from a protohistoric Haida skeleton in coastal British Columbia (Cybulski and Pett 1981).

Parasitic Diseases

There has been no study of indigenous Plateau parasites, nor is there much information in any of the standard data bases (archaeological, ethnohistoric, oral literature). On the basis of information from the prehistoric Southwest, plus parasites currently found in the Plateau and known not to be introduced, the following can be deduced.

Mummified remains and coprolites from the Southwest contain preserved eggs of pinworms (*Enterobius vermicularis*), whipworms (*Trichuris trichiura*), roundworms (*Ascaris lumbricoides*), and tapeworms of the genus *Taeniidae* (Merbs 1989:46), all of which occur in the Plateau today. Intestinal parasites may contribute to malnutrition and anemia and lessen the carrier's resistance to disease. Other likely indigenous parasite species include fish tapeworms (*Diphyllobothrium*), *Trichinella* roundworms (which cause trichinosis—from bear meat), the lung fluke *Paragonimus westermani*, from undercooked crayfish, and *Giardiasis* amoeba (found in stream water), which cause hikers' diarrhea. (Schmidt and Roberts 1989)

From entomology, implicated species include two ticks, *Dermacentor occidentalis* and *Ixodes pacificus*, possible vectors of Colorado Tick and Rocky Mountain Spotted Fevers, tularemia, and Lyme disease, all indigenous American diseases which probably occurred in low frequencies in the prehistoric Plateau. Native mosquitoes and fleas, though bothersome, are not known to have been important in the spread of any *precontact* ailments. Flies (*Muscidae* spp.) and eye-gnats (*Hippolates* spp.) may have contributed to the spread of the sore eyes syndrome (below). The scabies mite (*Sarcoptes scabiei*) was certainly present. By far the most obnoxious of indigenous Plateau parasites, however, was the body louse, *Pediculus humanus* (James and Harwood 1969).

Lice bites may well have been chiefly responsible for the sores and scabs which, if we may judge from the frequency these afflictions are mentioned in the oral literature, were prevalent among Plateau peoples. Pediculosis is the rash caused by lice bites; scratching may lead to infection by the cosmopolitan skin bacteria *Staphylococcus and Streptococcus.* The resultant skin disease, impetigo, is characterized by running sores and scabbing; in some cases boils and carbuncles develop. Although all these symptoms appear in the oral texts, the diagnosis offered here is only probable; many other skin ailments may be represented.

In the myths, wildcat was often associated with sores and scabs, probably because he was spotted. People with chronic cases of skin disease were looked down on and ostracized. Repeated sweating was the way to remove the scabs and sores, and make the skin clean again. All these themes appear in the Sanpoil tale "Wildcat, Magpie and Raven" (Ray 1933:138–142):

> Wildcat was not in the bunch. He was camped outside all by himself....One evening he stole over to the main camp. No one wanted to talk to him. No one said much to him because he was so ugly looking. His face was all drawn up. He was sore and scabby and matter was running out of the sores. He was an awful sight of a man. [After Wildcat had sweated for four mornings]....His whole body was silky and fine and pretty. There were no sores left.

Lice, it might be noted, cannot tolerate temperatures higher than four to five degrees (centigrade) above body temperature (James and Harwood 1969:138). Sweating, practiced by all Plateau peoples, not only cleansed and disinfected; it was an aboriginal delousing treatment as well.

Eye and Ear Diseases

Lewis and Clark noted (and treated) both skin lesions and sore eyes among Sahaptian peoples encountered on their expedition. Clark (Moulton 1988:373) observed:

> The natives of the waters of the Columbia appear helthy. Some have tumers on different parts of their bodies, and Sore and weak Eyes are common, maney have lost their Sight entirely, great numbers with one out and frequently the other very weak....They have bad teeth....Swelled legs and thighs.

Lewis (Moulton 1991:178) spoke of "ulsers and irruptions of the skin" and said "soar eyes seem to be a universal complaint." One expedition member (Ordway 1995:313) said a Nez Perce man signed to him that they sweated to treat "Sore eyes."

At Fort Nez Perces "sore & speckd Eyes" were said to be common (Black 1829); Nathaniel Wyeth (1899:183) said 10% of the Indians at the mouth of the John Day had lost an eye. In the 1830s Dr. John Townsend (1978:74) treated a Walla Walla chief for "a severe purulent opthalmia" which he said was rather prevalent among the Indians residing on the river and Dr. Suckley (1854:126) said "chronic inflammation of the external eye, with opacity of the cornea, is very common."

Conjunctivitis, or inflammation of the mucous membrane of the eye, is probably what these observers were describing. The usual agent is staph or strep (Benenson 1990:101), though *Haemophilus* is a common causative agent and a gonoccocal source is also possible. The blindness and "opacity of the cornea," however, suggests *Chlamydia trachomatis.* Early symptoms of chlamydial conjunctivitis appear as inflammation of the lining on the inside of the eyelids, particularly the upper, eventually spreading to the follicles, where lymphoid cells may arrest the infection. In some cases, however, infection spreads further and advances to severe, chronic trachoma with diminished vision and eventual blindness when an opaque scar tissue covers the eye.

Gregory believes other common causes of blindness (cataracts, glaucoma, trauma, diabetes, macular degeneration) were not likely candidates for the amount of blindness and sore eyes described so frequently in the early records. The trachoma epidemic among the Indian population continued into the mid-twentieth century when antibiotics became widely available to cure and control it. Even into the 1950s, the Chemawa Indian boarding school at Salem had dormitories that isolated students with trachoma to prevent spread of the infection.

The occasional mentions of mastoiditis in the Bowers files probably indicate otitis media, or inner ear infection, usually caused by *Streptococcus* or *Haemophilus*, and prevalent among Native Americans in the twentieth century.

Treponematoses and Tuberculosis

Among the diseases noted in the myths and early historical sources *may* have been forms of treponemal diseases and tuberculosis. Varieties of both are now assumed to have been indigenous to the Americas, and in recent years paleopathologists have developed methods for identifying them from bones. Prehistoric cases are now documented from both the Northwest Coast (Cybulski 1994:81, Curtin 2005)) and Plains (Kelley et al. 1994). Several cases in the Bowers records show periostitis of long bone shafts (especially tibia and fibula), an important diagnostic of American treponematosis (Powell 1988:173–175). *If* it occurred in the Plateau, treponematosis was probably non-venereal, and concentrated among children (as is true of the modern South American treponematosis, pinta). Syphilis (venereal treponematosis) was most likely introduced at white trading posts (as it was on the neighboring Northwest Coast: Boyd 1999) though it is nowhere recorded as being a problem among Plateau Indians before the beginning of the reservation period. The usual osteological diagnostics of syphilis, sabershins and caries sicca, are not recorded in the Bowers collection.

The form of tuberculosis prevalent on the Northwest Coast during the protohistoric was scrofula, which causes suppurating lesions on the lymph glands of the neck. Although scrofula is not recorded from the Plateau, spinal and pulmonary tuberculosis may have been present. Pott's disease (TB of the spine) is recorded from one undated Plateau site (35-UM-358); the historic hunchback at 45-FR-36, the curved spine and deformed hips noted by Dr. Suckley may also be examples. The Bowers series also has several possible cases (both pre- and protohistoric) of pulmonary tuberculosis, all characterized by periostitis of the inner ribs, and most from the southeast quadrant (historic Nez Perce lands) of the Plateau. It is tempting to hypothesize a Plains connection for these cases.

The Nez Perce were the focus of TB on the Plateau, from the earliest records through the first decades of this century. In 1829, at Fort Nez Perces, Samuel Black 1829) noted "Cases of Phthisie" (p. 18 previous mention) and in 1840 the Reverend Asa Smith (Drury 1958:137) said:

> Pulmonary difficulties are much more common in this region than I had supposed. Out of three deaths which occurred here last summer, two of them were occasioned by pulmonary affliction. Both were children. Children frequently die here from this cause. This is doubtless owing to exposure, rather than to the climate, as children are seen often almost or quite naked here in the cold weather. The constitution of many are not sufficient to outride such severe exposure.

Two years later the Reverend Spalding (1842:2/18) noted "In the winter there are many cases of lung complaints occasioned by bare feet in the wet & snow & poor lodges which often terminate in consumption & death after a lapse of years." These passages could easily have been repeated in the early decades of the 1900s, when pulmonary tuberculosis was epidemic on the Nez Perce reservation (especially among children). Tuberculosis was the main reason for the continued decline of Nez Perce population into the 1930s, considerably beyond the time when other Plateau peoples had begun to recoup the losses sustained as a result of contact (Boyd 1998:478).

DISEASE INTRODUCTION

It is now accepted that, after 1492, all Native American peoples were exposed for the first time to a long list of human pathogens which had evolved in the Old World (Crosby 1972, Ramenofsky 1993), and that the disease and depopulation that followed constituted what was probably "the greatest demographic disaster in the history of the world." (Denevan 1976:7)

The exact timing of the disease onslaught and demographic collapse varied from region to region. For the Plateau culture area, the bulk of the available data comes from after the decade of the 1770s. Sarah Campbell's 1989 PhD dissertation hypothesizes that the initial collapse may have been 250 years earlier, at the time of the smallpox pandemic that began in Mexico and spread throughout the civilized areas of Meso-and South America. Her evidence is a simultaneous decline in number and size of archaeological components, structured features, and shell and bone residue in a sampled area of the middle Columbia, which she suggests indicate a sudden population decline.

Campbell's (1989) survey shows no comparable archaeological discontinuity in the 250 years following the 1520s. At this writing, however, other hypotheses explaining the shift in archaeological remains have not been ruled out, nor have other regions in the Northwest been tested. So Campbell's hypothesis remains an intriguing possibility. If the Campbell hypothesis is eventually proven true, the implications for Plateau culture change and adaptation in the 1520–1770 period are profound. In 2003, Peter Jones summarized the evidence on possible pre-1770 overland routes for disease entry into the Plateau.

The record of disease introduction for the period following the 1770s has been dealt with elsewhere.[13] Smallpox was by far the most important new disease on the Plateau, with several sequential epidemics; measles, pertussis (whooping cough), and minor respiratory diseases (winter illness) also had a demographic impact. Upper Chinookan peoples suffered from both malaria (fever and ague) and dysentery epidemics. Important Plateau disease episodes are summarized in tabular form below.

The burial sites inventoried in the Bowers Laboratory of Anthropology include some which undoubtedly hold the remains of people who died during epidemics. In a sample of six large protohistoric burial sites used to construct mortality curves and estimate average age at death, two patterns pertained. Four of the sites, taken by themselves, constituted a nice fit with the mortality curve constructed for the prehistoric sample (p 14 previous mention). The other two sites (Freeland, 45-FE-1 and Asotin, 45-AS-9) were dramatically different. Deaths were concentrated among children, with 58% in the former and 66% in the latter. Site 45-FE-1 has been hypothesized as containing the remains of victims of the 1848 measles epidemic (Sprague et al. 1986), it is probable that 45-AS-9 does as well. Similar age breakdowns suggestive of epidemics have been recorded from 45-FE-51B and 45-GR-50 (cited in Campbell 1991:45), Congdon III, The Dalles (Butler 1963:16), and Juniper (John Day) and Canoe Creek on the upper Fraser (Schulting 1995:92, 135–136).

TABLE 5. PLATEAU EPIDEMIC HISTORY

Epidemic Area/ Ethnolinguistic Unit	1770's smallpox	1801 smallpox	1807-08 pertussis	1824-25[1] "mortality"	1831-37[2] respiratory diseases	1844 pertussis dysentery	1848 measles	1853 smallpox	1863 smallpox
(SUBARCTIC)	↑								
Dakelhne					S[3]				X
Tsilhqo'tin									X
NORTHEAST AREA		↑		P[4]					
Stl'atl'mix									X
Nlaka'pamux									
Lower									
Upper			X						X
Nicola									
Secwepemc									
Fraser									X
NORTHWEST AREA									
North Thompson									
Kamloops			X	↓					
Kootenai			X						
Upper									
Flatbow									
CENTRAL AREA									
Salish group									
Flathead			X		X		X		

Table 5 Notes

1. "mortality" identity is unknown.
2. "winter illness" recorded annually at Hudson's Bay Company forts
3. S-1836 smallpox
4. P-1827 pertussis
5. G-1819 "Grate Sickness
6. M-malaria ("fever and ague")
7. D-dysentery

Pend Oreille/Kalispel										
Spokane				G[5]	(X)			X	X	
Coeur d'Alene				(G)	X				X	
Okanagan group										
Colville/Lakes						X		X	X	
Nespelem/Sanpoil/ Sinekalt					(X)					
Sinkaietk/Methow									X	
Okanagan/ Similkameen					X					
Columbia group									(X)	
Chelan									(X)	
Wenatchi									(X)	
Sinkayuse								X	X	
Northwest Sahaptin										
Kittitas									(X)	
Yakama					X			X	X	
Klikatat								(X)	X	
Taitnapam								(X)		
Columbia Sahaptin							P	X		
Tenino-Tygh						M[6]	P	X		
Wayam/Skin						M	P	X	X	
Umatilla/John Day							P	X		
Upper Chinookan						M		(X)		
Wasco-Wishram						M	D[7]	(X)	X	
White Salmon						M	(D)	(X)	(X)	
Cascades						M	D	(X)	(X)	
Northeast Sahaptin										
Walla Walla					X	X	P	X		
Wanapam					X			(X)		
Palus								(X)		
SOUTHEAST AREA										
Nez Perce						X				
Lower Snake										
Clearwater										
Upper Snake										
Cayuse					X	X	P	X		

Cumulatively, the epidemic diseases recorded in Table V caused tens of thousands of deaths, and in just a century, led to a severe demographic decline (if not demographic collapse) of indigenous Plateau populations. We know with a fair degree of confidence that there were around 51,000 Native Americans in the Plateau in 1805–06 (Lewis and Clark plus allowances for upper Fraser and Klamath) by the 1870s there were about 22,256 (Boyd 1998 Table 4), or a drop of 56%. The hypothesized minimum aboriginal population of the Plateau was 86,805; the nadir was 18,751 (1890). So the total decline was at least 78% (probably more), truly a fearsome amount, but not at all out of line with what is recorded elsewhere in the Americas (Ubelaker 1988).

END NOTES

[1] For a similar ethnohistorical description of the seasonal round from the northern (interior Salish) area, see Hale (1846:206-207) on the Flathead.

[2] In 1985, when this table was compiled, the earlier version of the Estimate was available only in manuscript in the archives of the American Philosophical Society in Philadelphia; Lewis and Clark's base map had been published in 1983 in the University of Nebraska Press's *Atlas of the Lewis & Clark Expedition* (Moulton 1983).

[3] Table 2 in Boyd (1998:169-170) offers revised estimates of ethnolinguistic groups which take into account the excess numbers represented in the multi-ethnic fisheries. Details on methodology are given in Boyd (1985:366-372).

[4] Boyd's reasons for this belief are that everything we know about American Indian virgin soil epidemic depopulation uniformly suggests a mortality much larger than Dixon's 30%, and available ethnohistorical information on the first Plateau epidemic also points to a very heavy mortality. (In previous computations, Boyd has also used one-third mortality),

[5] The sources are Archibald McDonald, Thompson River District Report in 1827 (McDonald 1947:224-233) and John Work, Fort Colvile Report (1830). The Stl'atl'imx figures are incorporated in James Yale's Fort Langley census, most easily accessible in James Douglas's Private Papers (1878), Series II, and the Kamiah census is in Asa Smith's letter of 11 November 1839 (Drury 1958).

[6] Wenatchee, Sanpoil, Spokane and Coeur d'Alene, as well as the Nez Perce bands included in the Colvile census. There appears to have been an epidemic, perhaps measles or smallpox, along the banks of the Columbia in the winter of 1824-1825, which claimed a disproportionately large number of children.

[7] Sex ratios should not have been significantly affected by epidemic disease, so there is no need to exclude Columbia bank populations from this sample.

[8] Definite for the interior Dakelhne (Carrier) and coastal Nuxalk (Bella Coola); probable for the Lower Columbia Sahaptins and Chinookans (Boyd 1985).

[9] Prehistoric sites: Wildcat Canyon (35-GM-9), Wilma Bar Silo (45-WT-99), Steptoe (45-AS-2), Wilma Bar Bench (45-WT-102), and Offield Bar (45-GA-100); protohistoric sites: Lower Tammany (10-NP-110), 45-FE-24, 45-ST-46, and Chaudiere (45-FE-47). The poorly aged adults 20+ were not counted in the sample. There were three times as many unaged adults in the prehistoric sites. Both numbers are therefore under the actual average age at death; the prehistoric number much more so.

[10] X-rays, for example, might reveal various inflammatory processes, Harris (growth arrest) lines, and some small benign and metastatic bone tumors.

[11] Sprague (1995, pers. comm.) hypothesizes that these resulted from falling off horses. Another bone condition found in the Bowers files which may relate to distinctive Plateau cultural practices was what Mulinski called "rocker jaw," most commonly found in adult females and possibly associated with chewing hides to soften them.

[12] The first four conditions may be due to tuberculosis; however Gregory believes the latter two may be attributable to strokes.

[13] References in paragraph two of this paper, especially Boyd 1999. On specific disease episodes, consult Boyd (1992, 1994a, 1994b, 1996, 1998). Boyd (1995) has three manuscript chapters on Plateau disease events from the 1770s to 1848.

REFERENCES CITED

Allen, Paul
1814 *History of the Expedition under the Command of Captains Lewis and Clark.* Bradford and Inskeep, Philadelphia.

Anastasio, Angelo
1972 The Southern Plateau: An Ecological Analysis of Intergroup Relations. *Northwest Anthropological Research Notes*, 6(2):109–229.

Aufderheide, Arthur, and Conrado Rodriguez-Martin
1998 *The Cambridge Encyclopedia of Human Paleopathology.* Cambridge University Press, Cambridge, England.

Beasley, R. Palmer, Robert Willkens, and Peter Bennett
1973 High Prevalence of Rheumatoid Arthritis in Yakima Indians. *Arthritis and Rheumatism*, 16(6):743–748.

Beavert, Virginia
1974 *The Way it Was: Anaku Iwacha, Yakima Indian Legends*. Consortium of Johnson O'Malley Committees of Region IV, State of Washington, Yakima.

Benenson, Abram
1990 *Control of Communicable Diseases in Man*, 15th edition. American Public Health Association, Washington.

Bennett, Kenneth
1972 Lumbro-sacral Malformations and Spina Bifida Occulta in a Group of Proto-historic Modoc Indians. *American Journal of Physical Anthropology*, 36(3):435–439.

Black, Samuel
1829 Nez Perces Report. Ms. B. 146/e/2, Hudson's Bay Company Archives, Winnipeg.

Boyd, Robert

1985 *The Introduction of Infectious Diseases Among the Indians of the Northwest Coast, 1774 to 1874.* Doctoral dissertation, University of Washington, Seattle. University Microfilms International, Ann Arbor.

1992 The Columbia River as a Corridor for Disease Introduction: "New Diseases" of the 1840's in the Pacific Northwest. Paper presented at the Great River of the West Conference. Longview, WA.

1994a The 1847–1848 Pacific Northwest Measles Epidemic. *Oregon Historical Quarterly,* 95(1):6–47.

1994b Smallpox in the Pacific Northwest: The First Epidemics. *BC Studies,* 101:5–40.

1995 A Disease History of the Plateau Culture Area. Partial book manuscript in author's files.

1996 Commentary on Early Contact Period Smallpox in the Pacific Northwest. *Ethnohistory,* 43(2):307–320.

1998 Demographic History Until 1990. In *Handbook of North American Indians, Vol 12: Plateau,* Deward Walker, editor, pp. 467–483. Smithsonian Institution, Washington.

1999 *The Coming of the Spirit of Pestilence: Introduced Infectious Diseases and Population Decline Among Northwest Coast Indians, 1774–1874.* University of Washington Press, Seattle.

Boyd, Robert, and Yvonne Hajda

1987 Seasonal Population Movement along the Lower Columbia River: the Social and Ecological Context. *American Ethnologist,* 14(2):309–326.

Butler, B. Robert

1963 Further Notes on the Burials and the Physical Stratigraphy at the Congdon Site, a Multi-Component Middle Period Site at The Dalles on the Lower Columbia River. *Tebiwa,* 6(2):16–37.

Campbell, Sarah

1989 *Post-Columbian Culture History in the Northern Columbia Plateau, A.D 1500–1900.* Doctoral dissertation, University of Washington, Seattle. University Microfilms International, Ann Arbor.

1991 A Critical Review of Protohistoric Research in the Columbia Plateau. *Archaeology in Washington,* 3:41–65.

Chance, David

1973 Influences of the Hudson's Bay Company on the Cultures of the Colvile District. *Northwest Anthropological Research Notes, Memoir* No. 2. Moscow, ID.

Chatters, James

1984 Dimensions of Site Structure: The Archaeological Record from Two Sites in Okanogan County, Washington. Central Washington Archaeological Survey, Central Washington University, Ellensburg.

Congdon, Russell

1932 Spondylolisthesis and Vertebral Anomalies in Skeletons of American Aborigines, with Clinical Notes on Spondylolisthesis. *Journal of Bone and Joint Surgery,* 14:11–525.

Crosby, Alfred

1972 *The Columbian Exchange: Biological and Cultural Consequences of 1492.* Greenwood, Westport, CN.

Curtin, A. Joanne

2005 Prehistoric Treponematosis in the Pacific Northwest; a review of the skeletal evidence. In *The Myth of Syphilis: the natural history of Treponematosis in North America.* Mary Lucas Powell & Della Cook, eds. Pp. 306-330. Gainesville: University Press of Florida.

Curtis, Edward

1911 *The North American Indian*, Vol. 8. Norwood, MA: Plimpton Press.

Cybulski, Jerome

1992 A Greenville Burial Ground: Human Remains and Mortuary Elements in British Columbia Coastal Prehistory. Archaeological Survey of Canada *Mercury Series, Paper* No. 146. Canadian Museum of Civilization. Ottawa:

1994 Culture Change, Demographic History, and Health and Disease on the Northwest Coast. In *In the Wake of Contact: Biological Responses to Conquest*, Clark Larsen and George Milner, editors, pp. 75–86. Wiley-Liss, New York

Cybulski, Jerome, and Bradley Pett

1981 Bone Changes Suggesting Multiple Myeloma and Metastatic Carcinoma in Two Early Historic Natives of the British Columbia Coast. In Contributions to Physical Anthropology, 1978–1980, Jerome Cybulski, editor, pp. 176–186. National Museum of Man, *Mercury Series*, *Archaeological Survey of Canada Paper,* No.106. Ottawa.

Denevan, William

1976 *The Native Population of the Americas in 1492.* Madison: University of Wisconsin Press.

Dixon, Cyril

1962 *Smallpox.* J. & A. Churchill, London.

Dobyns, Henry
1966 Estimating Aboriginal American Population: An Appraisal of Techniques with a New Hemispheric Estimate. *Current Anthropology*, 7(4):395–416.

Douglas, James
1878 Census of the Indian Population on the N.W. Coast....transcription by Ivan Petrov. Private Papers, 2d series, Bancroft Library, University of California, Berkeley.

Drury, Clifford M.
1958 *The Diaries and Letters of Henry H. Spalding and Asa Bowen Smith Relating to the Nez Perce Mission, 1838–1842*. Arthur H. Clark, Glendale.

Franchere, Gabriel
1969 *Journal of a Voyage on the North West Coast of North America During the Years 1811, 1812, 1813, and 1814*. The Champlain Society, Toronto

French, David
1981 Neglected Aspects of North American Ethnobotany. *Canadian Journal of Botany*, 59(11):2326–2330.

Hale, Horatio
1846 *Ethnography and Philology*. Lea and Blanchard, Philadelphia.

Hayden, Brian
1975 The Carrying Capacity Dilemma: An Alternate Approach. In Population Studies in Archaeology and Biological Anthropology: A Symposium, Allan Swedlund, editor, pp. 11–21. *Memoirs of the Society for American Archaeology*, No. 30. Washington.

Helm, June
1980 Female Infanticide, European Diseases, and Population Levels Among the Mackenzie Dene. *American Ethnologist*, 7(2):259–285.

Hill-Tout, Charles
1978 *The Salish People: The Local Contribution of Charles Hill-Tout,* Vol. 1: *The Thompson and the Okanagan*. Ralph Maude, editor. Talonbooks, Vancouver.

Hulbert, Archer , editor
1938 Marcus Whitman, Crusader. *Overland to the Pacific,* Vol. 7. Denver Public Library, Denver.

Hunn, Eugene, with James Selam and family
1990 *Nch'i-Wana, The Big River: Mid-Columbia Indians and Their Land*. University of Washington Press, Seattle.

Irving, Washington
1961 *The Adventures of Captain Bonneville*. Edgeley Todd, editor. University of Oklahoma Press, Norman.

James, Maurice, and Robert Harwood
1969 *Herm's Medical Entomology*. Macmillan Company, Toronto.

Jones, Peter
2003 Old World Infectious Diseases in the Plateau area of North America During the Protohistoric: Rethinking our Understanding of Contact in the Plateau. *Journal of Northwest Anthropology,* 37(1):1–26.

Kelley, Marc et al.
1994 Respiratory Disease Among Protohistoric and Early Historic Plains Indians. In *Skeletal Biology in the Great Plains: Migration, Warfare, Health, and Subsistence,* Douglas Owsley and Richard Jantz, editors, pp. 123–120. Smithsonian Institution, Washington.

Lazenby, Richard, and Peter McCormack
1985 Salmon and Malnutrition on the Northwest Coast. *Current Anthropology,* 26(3):379–384.

Lewis, Meriwether, and William Clark
1805–06 Estimate of the Western Indians. Ms., Codex I, pp. 147–155. American Philosophical Society Library, Philadelphia.

McDonald, Archibald
1947 Thompson River District Report. In Part of a Dispatch from George Simpson…1829. E. E. Rich, editor, pp. 224-233. *Hudson's Bay Record Society,* Vol. 10. London.

McDougall, George
1828 Letter of March 8. In Journals and Correspondence of John McLeod. Ms. A B 40 M22K. British Columbia Provincial Archives. Victoria.

McGillivray, Simon
1827 Report of Fort Alexandria. In *Part of a Dispatch…*(ibid). Pp. 188-221. 1947.

1831–32 Fort Nez Perces Journal. Ms. B. 146/a/1, 2. Hudson's Bay Company Archives, Winnipeg.

Merbs, Charles
1989 Patterns of Health and Sickness in the Precontact Southwest. In *Archaeological and Historical Perspectives on the Spanish Borderlands West*, David Hurst Thomas editor, pp. 41–55. Smithsonian Institution, Washington.

Minor, Rick, and Brian Hemphill
1990 Archaeological Assessment of the Crate's Point Site (35-WS-221), Wasco County, Oregon. *Heritage Research Associates Report,* No. 90. Eugene.

Mooney, James
1928 The Aboriginal Population of America North of Mexico. *Smithsonian Miscellaneous Collections*, 80(7):1–40. Washington.

Moulton, Gary, editor
1983–91 *The Journals of the Lewis & Clark Expedition* (Vols. 1, 5–7). Lincoln: University of Nebraska Press.

Mulinski, Thomas M. J., and Walter Birkby
n.d. Osteological files. Alfred W. Bowers Laboratory of Anthropology, University of Idaho, Moscow.

Ordway, John
1995 The Journals of John Ordway, May 14, 1804–September 23, 1806. *The Journals of the Lewis & Clark Expedition*, Vol. 9, Gary Moulton, editor. University of Nebraska Press, Lincoln.

Ortner, Donald, Noreen Tuross, and Agnes Stix
1992 New Approaches to the Study of Disease in Archaeological New World Populations. *Human Biology*, 64(3):337–360.

Phinney, Archie
1934 Nez Perce Texts. *Columbia University Contributions to Anthropology*, Vol. 25. New York.

Powell, Mary Lucas
1988 Endemic Treponematosis and Tuberculosis in the Prehistoric Southeastern United States: Biological Costs of Chronic Endemic Disease. In *Human Paleopathology: Current Syntheses and Future Options*, Donald Ortner and Arthur Aufderheide, editors, pp. 173–180. Smithsonian Institution, Washington.

Ramenofsky, Ann
1993 Diseases of the Americas, 1492–1700. In *The Cambridge World History of Human Disease,* Kenneth Kiple, editor, pp. 317–328. Cambridge University Press, New York.

Ray, Verne
1933 Sanpoil Folk Tales. *Journal of American Folk-lore,* 46(180):857-875.

1936 Native Villages and Groupings of the Columbia Basin. *Pacific Northwest Quarterly,* 27(2):99–152.

Ray, Verne et al.
1938 Tribal Distribution in Eastern Oregon and Adjacent Regions. *American Anthropologist,* 40(3):384–395.

Ross, Alexander

1849 *Adventures of the First Settlers on the Oregon or Columbia River.* Smith, Elder and Co., London.

1956 *The Fur Hunters of the Far West.* University of Oklahoma Press, Norman.

Schalk, Randall

1977 The Structure of an Anadromous Fish Resource. In *For Theory Building in Archaeology*, Lewis Binford, editor, pp. 207–249. Academic Press, New York.

Schmidt, Gerald, and Larry Roberts

1989 *Foundations of Parasitology.* Times-Mosby, St. Louis.

Schulting, Rick

1995 *Mortuary Variability and Status Differentiation on the Columbia-Fraser Plateau.* Archaeology Press. Simon Fraser University. Burnaby.

Simpson, George

1968 Journal, 1824–25. In *Fur Trade and Empire,* Frederick Merk, editor, pp. 3–174. Harvard University Press, Cambridge, MA.

Slickpoo, Allen

1972 *Nu Mee Poom Tit Wah Tit* (Nez Perce Legends). Nez Perce Tribe of Idaho, Lapwai.

Sneed, Paul

1971 Of Salmon and Men: Investigation of Ecological Determinants and Aboriginal Man in the Canadian Plateau. In *Aboriginal Man and Environments on the Plateau of Northwestern America*, Arnaud Stryd and Rachel Smith, editors, pp. 229–238. Students Press, Calgary.

Spalding, Henry

1839 Letter of 2 October. *Missionary Herald,* 36:331.

1842 Letter 18 February. Ms, Holland Library, Washington State University, Pullman.

Speth, John

1987 Early Hominid Subsistence Strategies in Seasonal Habitats. *Journal of Archaeological Science*, 14:13–29.

1989 Early Hominid Hunting and Scavenging: the Role of Meat as an Energy Source. *Journal of Human Evolution*, 18:329–343.

1991 Protein Selection and Avoidance Strategies of Contemporary and Ancestral Foragers: Unresolved Issues. *Philosophical Transactions of the Royal Society of London,* B 334(1270):265–270.

Sprague, Roderick, and Walter Birkby
1970 Miscellaneous Columbia Plateau Burials. *Tebiwa*, 13(1):1–25.

Sprague, Roderick, Thomas M. J. Mulinski, Thomas Iverson, Walter H. Birkby, Daniel E. Seachord, and Donald E. Tyler
1986 Recent Burial Excavations In Lake Roosevelt. Ms. in procession of senior author, Moscow.

Stini, William
1995 Osteoporosis in Biocultural Perspective. *Annual Review of Anthropology*, 87:39–47.

Suckley, George
1854 Letter of 27 December 1853. In Reports of Explorations and Surveys, 33rd Congress, 2d Session, *House Document*, 1(129):123–126. Washington.

Teit, James A.
1900 The Thompson Indians. *Memoirs of the American Museum of Natural History*, Whole Series, 2(4), *Anthropology*, 1(4); *Publications of the Jesup North Pacific Expedition*, 1(4):163–391a. New York.

1906 The Lillooet Indians. *Memoirs of the American Museum of Natural History*, Whole Series, 4(5), *Anthropology*, 3(5); *Publications of the Jesup North Pacific Expedition*, 2(5):193–300. New York.

1909 The Shuswap. *Memoirs of the American Museum of Natural History*, Whole Series, 4(7); *Anthropology*, 3(7); *Publications of the Jesup North Pacific Expedition*, 2(7):443–789. New York.

1912 Mythology of the Thompson Indians. *Memoirs of the American Museum of Natural History*, Whole Series, 12(2), *Publications of the Jesup North Pacific Expedition*, 8(2):199–416. New York.

Thompson, David
1962 *David Thompson's Narrative, 1784–1812*, Richard Glover editor. Champlain Society, Toronto.

1994 *Columbia Journals.* Barbara Belyea, editor. McGill-Queen's University Press, Montreal.

Townsend, John
1978 *Narrative of a Journey Across the Rocky Mountains to the Columbia River.* University of Nebraska Press, Lincoln.

Turner, Nancy
1977 Economic Importance of Black Tree Lichen (*Bryoria fremontii*) to the Indians of Western North America. *Economic Botany*, 31(4):461–470.

Ubelaker, Douglas
1988 North American Indian Population Size, A.D. 1500 to 1985. *American Journal of Physical Anthropology*, 77(3):289–294.

Webb, Stephen
1990 Prehistoric Eye Disease (Trachoma?) in Australian Aborigines. *American Journal of Physical Anthropology*, 81(1):91–100.

Work, John
1830 Fort Colvile Report. Ms. B. 45/e/3, Hudson's Bay Company Archives, Winnipeg.

Wyeth, Nathaniel
1899 Correspondence and Journals. *Sources of Oregon History,* 1(3–6). Eugene.

Robert Boyd
Adjunct Associate Professor
Anthropology Department
Portland State University
PO Box 751
Portland, OR 97202

pdx01537@pdx.edu

Cecilia D. Gregory
Portland Area Indian Health Service, Retired
6995 NW Cornelius Pass Rd.
Hillsboro, OR 97214

dloris@comcast.net