OREGON ARCHAEOCLIMATOLOGY:

SAUVIES ISLAND- VANCOUVER LAKE

ALISON STENGER AND REID BRYSON

THE COLUMBIA RIVER VALLEY AND CLIMATE

Few climatologists have recognized the great significance of the Columbia gorge and the Portland basin to the climate of the interior. In general the Coast Ranges, Cascades and Sierra Nevada constitute a great western wall that the moist low level air from the Pacific cannot cross, since it usually does not have enough kinetic energy when crossing the coast to climb over the mountains. Whether the air can cross the mountains or not depends on the west-east kinetic energy component of the wind and the vertical stability of the air.

In California the air arriving at the coast is very stable, but there is a passage through the mountain barrier in the Los Angeles- Riverside area. In British Columbia the winds are stronger, the air less stable, and the mountains are lower so that the air can pass over and inland. Between southern California and British Columbia there is only one effective opening into the interior--the Columbia Gorge. Because the developers of the west recognized these three gateways as the easiest routes to the Pacific coast, we can think of them as the Canadian Pacific, Union Pacific, and Southern Pacific routes. Our emphasis here will be on the "Union Pacific" gateway, or the Columbia Gorge. (Bryson and Hare, 1974)

Borchert (1948) showed that the amount of air leaving the Cordillera at low levels on the east was about seven times the amount arriving at low levels on the west. This excess had to be dry subsiding air. Without the Columbia Gorge no moist oceanic air would penetrate the interior from the Pacific,. Mitchell (1976) showed that the Columbia gateway was indeed the source of moisture for the Columbia Plateau and the Palouse. Bryson (1966) showed that this air continued eastward through the Wyoming Gap and was a major source of air in the Prairie Peninsula of the Midwest, thus extending Borchert's work (*op cit.)*

At the present time the air flows down the Columbia from the cold interior in the winter and upstream towards the interior from the high pressure over the Pacific in summer. During late glacial time, as suggested by figure 1, the flow was downstream to the west year-round. The model suggests that in the early Holocene the winds in the warm season alternated between east and west enough that the net east-west component was near zero, with only a slight excess of winds from the interior on occasion. During mid-Holocene time the shift to - from the sea started, becoming dominantly upstream in the summer in

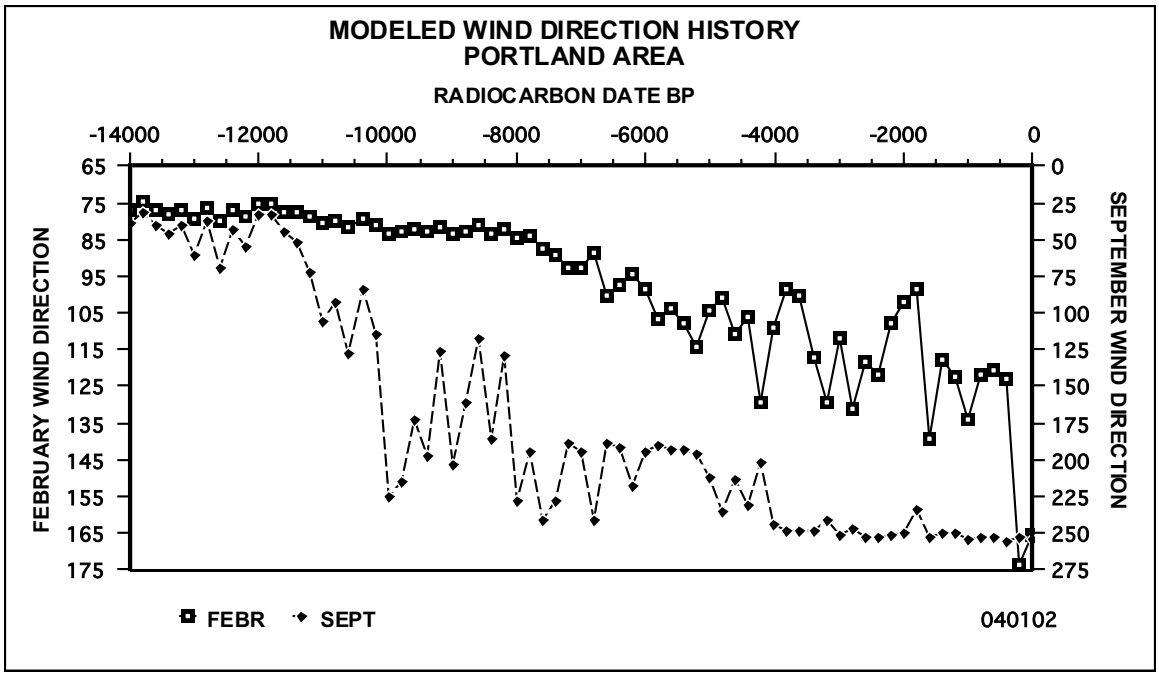

Fig. 1 Modeled resultant wind direction in the Portland-Vancouver area.

late-Holocene time. The significance of these changes lies in the fact that the wind from the sea is moist and the air from the interior is dry. Thus, in the late Pleistocene and early Holocene the Vancouver area was usually quite dry, as shown in figure 2, with dry air from the interior dominating the year.

With the advent of the mid-Holocene the precipitation for the year seems to have increased to exceed the present by perhaps 20%, but the summer rains increased three- or four-fold. The summer rains then returned to near present values in the Late Holocene, but the annual precipitation stayed quite high- near the present value.

This sequence of precipitation stages, along with the variation of temperature from late Pleistocene through the Holocene, gave rise to the succession of water balance stages shown in figure three:

-Late Pleistocene- Arid tundra
-Early Holocene - Steppe or Taiga
-Mid-Holocene - Dense forest
-Late Holocene - Mesic forest, becoming more dense in the "Little Ice Age".

The Late Holocene would appear to have been the most amenable to occupation by hunter-gatherers because the mesic forest would be optimal for game and the dryer summers would allow good maturation of plants and drying of seeds. This might have been an especially good in the slightly moister interval around 3500-2800 BP, 2000-1600BP, and the period of the last 300-400 Radiocarbon years.

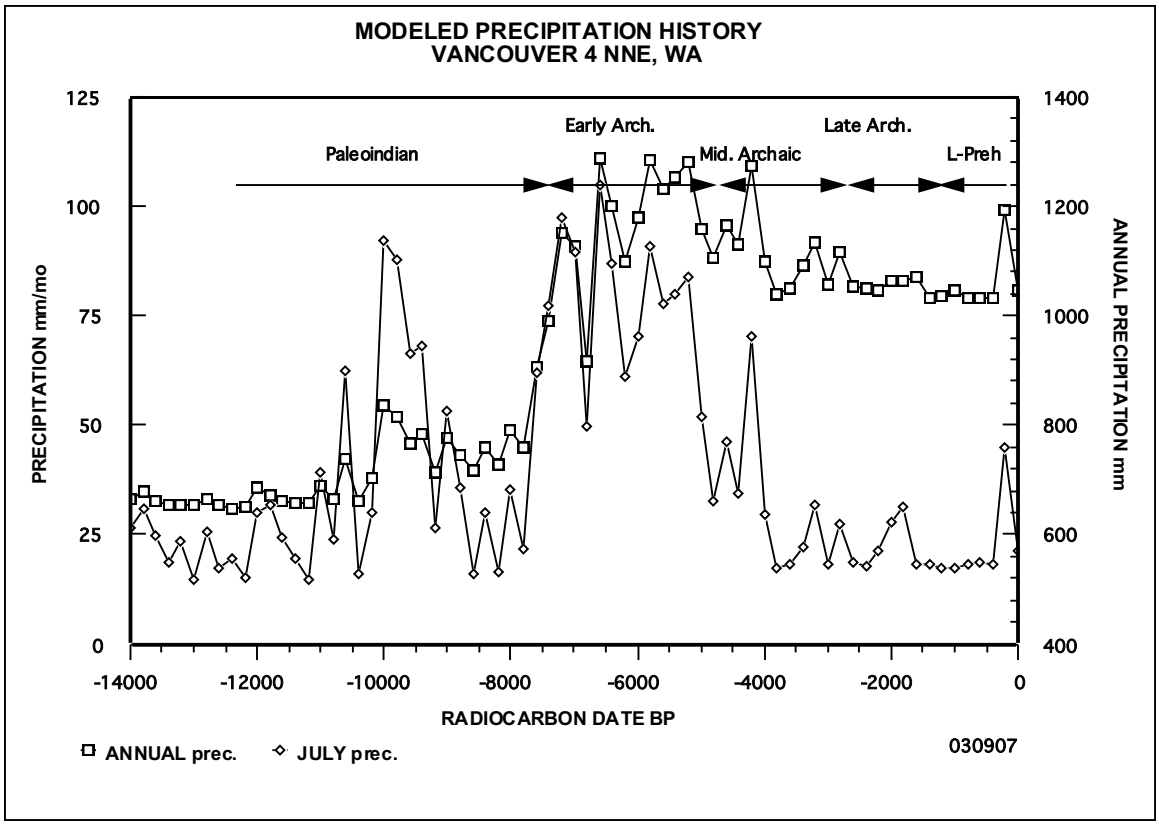

Fig. 2 Modeled precipitation near Vancouver, WA, using the archaeoclimatic model of Bryson and Bryson, 1997.

Large changes in precipitation, either way, would have drastically affected the animal populations, as well as many plant species. The result would have been the movement of people away from these changed environments. Responding to a natural tendency to stay within a familiar environment, populations would have moved from one area to another, in an effort to maintain a stable and sustainable lifestyle. Thus, sedentary, semi-agrarian people would leave areas such as the Willamette Valley in search of an environment that was familiar. This would make their previously held territory available to the next incoming group of people. On the other hand if a population stayed in the changed habitat, they would have had to adapt their life style.

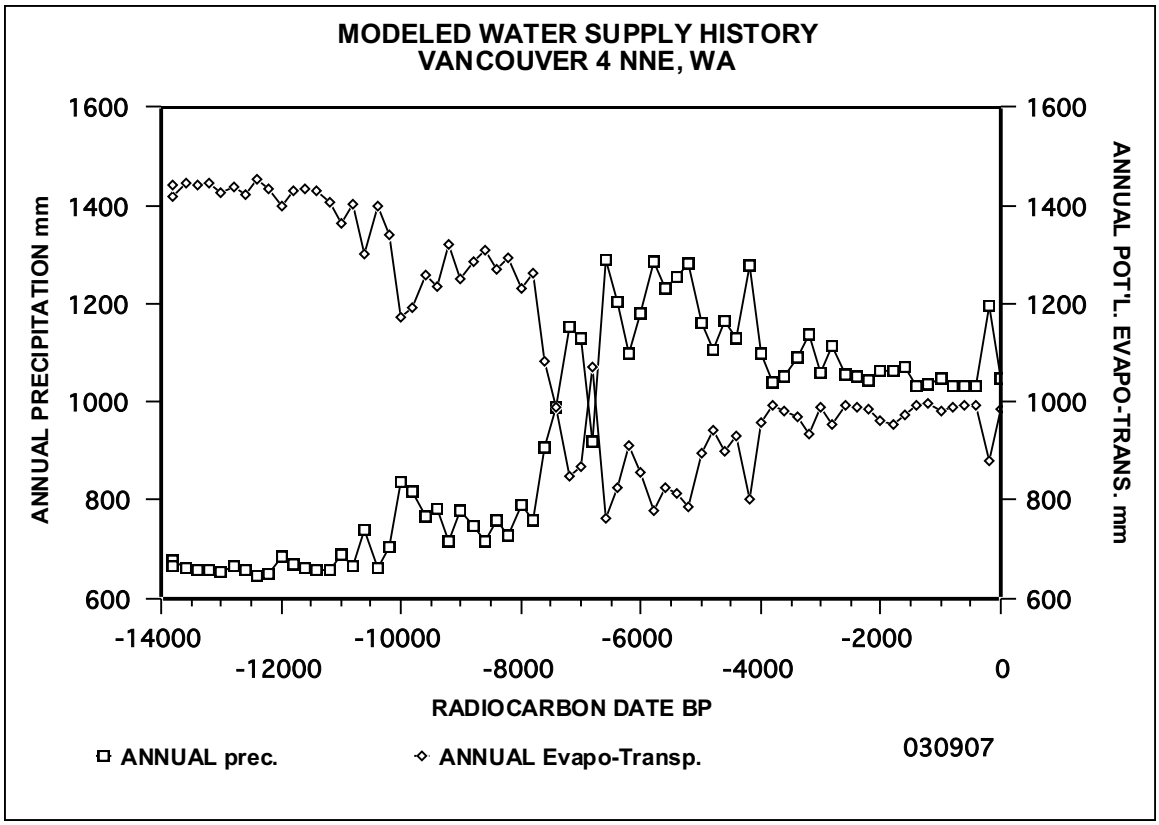

Fig. 3 Modeled comparison of Precipitation and Potential Evapo-transpiration in the Vancouver, WA area.

Field and Archaeological Evidence

Evidence from archaeological sites gives testimony to changes in human, animal and even plant populations. Evidence of culture change is often easily documented, and dramatic. Alterations in life patterns are evidenced in ancient to late-Prehistoric sites. The material culture and features record these changes.

When the time horizons for change are compared with the modeled precipitation history (see figure 2), some significant patterns seems to emerge. When viewed as individual segments of prehistory, a fascinating picture of change is revealed. Man has survived through the millenia by developing a life style that is sustainable. Known foods, a water supply, source material for tools, and other factors are all part of the formula for a continued existence.

By 10,000 years ago, the Ice Age animals had vanished from our region (Stenger, 2003). While different animals moved into their niche, different plants also took over the landscape. This meant that the humans who had developed a life way dependent upon those animals and plants had to quickly change their lifeway for survival. The alternative was for the humans to move, in an effort to locate an environment that would be familiar to them. The artifact record tells us that people, the hunter-gatherers of the Late Pleistocene, did exactly that—they left the area. In some locales, all evidence of a human presence ceases by 10,800 years ago.

Other people eventually moved into the vacated area. These people would also become known to archaeologists primarily by the tools that were left behind. These people, too, ultimately vacated the area. They would be referred to later as Clovis, or as the Windust or Cascade (or other) cultural group or phase.

The Sauvies Island and Vancouver Lake areas yield sparse evidence of these early cultures. Although the presence of these early people has been documented, the frequencies are consistently low and the proximity between sites is not close. Later cultures would reverse this pattern, with a nearly unprecedented population density in this area. That would, however, be thousands of years more recent in time.

Approximately 7,000 years ago, several dramatic changes occurred. The first people to be biologically identifiable with modern American Indians arrived. They moved into a very much wetter environment with year-round rains. Teeth, hair follicles and other physical evidence can now be identified (Davis, 1988). This evidence distinguishes them from what remains of the earlier people, whose mtDNA can not be related to modern Indians (Baker, 1999).

It is at this time, approximately 6800 years ago, that Mt. Mazama erupted, creating what is now Crater Lake. This event heralded a disastrous regional environmental change for people, animals, and vegetation. Mazama was about at the end of a global group of volcanic eruptions that had kept the climate semi-glacial. Many feet of ash covered the ground over large areas in the Northwest, making ash free areas hugely desirable (see Figure 4). Thus, some surviving

Figure 4 A stratum of Mazama ash, several meters thick, gives a datable boundary for items immediately above and below it. Photograph generously provided by National Park Service.

populations headed toward the Portland Basin while others headed elsewhere, depending upon their position relative to the wind direction and the ash fall. An example is the disappearance of people who produced petroglyphs before Mazama's eruption, but never again (Fig. 5).

Figure 5 The Long Lake petroglyph is buried below a thick stratum of Mazama ash, testifying that this work was done prior to 6800 years ago. No similar rock art panels have been found since the time this was made, suggesting that the culture that produced this work vanished from this region. Photograph generously provided from the slide file of Charles H. Hibbs, Jr.

One of the most important things that the ash did for archaeology was to create a datable boundary. By identifying the ash layer within a site, scientists can usually ascertain quickly what cultural material dates from before the eruption, and what items and features are more recent. It is exactly this reality that defines another change in cultures

The precipitation pattern for the period from approximately 6,000-4,000 years ago is quite different from the time before the Mt. Mazama eruption. Now, a pronounced increase in moisture ushers in another period of cultural change. The hunter-gatherers, with their distinct tool assemblage, are gone. In their place are people with different tool kits, and different ways of life. It is at this time that sedentary communities seem to form (Connolly, 2003). To the south of Portland, populations become involved in semi-agricultural pursuits, while on the island and around the lake, communities expand into fish procurement. In all areas, tools and tool making materials are different now than in the past. Although it may be more pronounced in the Valley, boundaries seem now to be formed. Distinct use areas or territories become the rule.

Change again occurs after 4,000 BP, both in precipitation and in cultures. One of the most dramatic changes would not occur, however, until approximately 1800 years ago. This is not tied to weather and precipitation alteration, but solely to the introduction of the bow and arrow. This one tool is pivotal in the degree and nature of warfare between Tribal groups. Slaving, too, becomes an important issue in the scheme for survival (Connolly, 2003; Gilsen, 2003).

At approximately this time, the archaeological record again reflects change. In some areas, round, semi-subterranean houses are replaced by square

houses--or small rectangular houses. The large, rectangular houses come a bit later. The tool types are also changing. Different sources for materials are often selected, and the focus again reverts to that of earlier times—toward hunting. Defense, however, remains a major concern.

One change occurs that is nearly unique to our subject area. That is the introduction of a ceramic, or fired clay, industry. Some culture came into the area with a fully developed technology for ceramic making. These people made figurines, pipes, pendants, bowls and other objects, and the items were important to their culture. The care in manufacture and the labor intensive decorations testify to the significance of the items. Yet it seems that these people were only here for a brief period, from about 1200-1500 A.D. Though it does not show clearly in the local climatic record, this interval of time is often distinguishable as a distinctive climatic regime elsewhere, which at least raises the possibility that these ceramic makers were intrusive from elsewhere as a response to environmental change there.

The people who replaced the ceramic makers had no need of ceramics. Ethnologists report that the replacement population had no traditional use or need of fired clay items. Further, the language of these people did not include ceramics in any form.

What all of this tells us is that environmental factors are often critical to the successful existence of a population. Importantly, when the environment changes, people must alter their lifestyle or move, like the refugees from the Great Plains in the Dust Bowl years. Over and over again, people chose to give up their territory, opening that area for another group to occupy it. Only by examining the archaeological record can we see the evidence of change that is so strongly suggested by the climate and precipitation history.

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