CLIMATIC HISTORY AND THE ANTIQUITY OF MAN IN CALIFORNIA*

Ernst Antevs

Since most records of Early Man in the West occur in dry regions and derive from moist ages their dating is closely connected with the dating of the moist ages. This paper will present the evidence of Late Pleistocene climatology and the archeological evidence for human antiquity in the light of such geological data.

Climatic History

At present precipitation in California is controlled by an anticyclone, an area of high atmospheric pressure, in the eastern Pacific. In summer when this anticyclone is strong and to the north, centering about Lat. 40°, it blocks cyclonic storms, and as a consequence summer rains are scarce and scanty. In winter the anticyclone is weaker and is located to the south, centering on Lat. 30°. Sometimes it is absent. Then cyclonic storms reach the continent and bring rain.

Location and development of the Pacific anticyclone determine to a great extent where the winter precipitation will come (16, 17; 19, pp. 143-149). When the Pacific anticyclone is relatively strong and far to the north and extends west-east, and when there is no strong anticyclone over western Canada, then as a consequence the difference in pressure on Lats. 35° and 55° is relatively large so that the cyclones travel to the north and bring precipitation to British Columbia, Washington, and Oregon. On the other hand, when the Pacific anticyclone is very weak and abnormally far to the south, or when it is absent, and when at the same time a strong anticyclone extends from western Canada over the Plains and the Rocky Mountains so that the pressure difference between Lats. 35° and 55° is very small or negative, then the cyclonic storms take a southerly route and bring rain to southern California. When these conditions are intermediate the storms enter central California.

The rainfall is heaviest in the latitudes of the British Columbia-Washington border, where in places it exceeds 100 inches. It is 20 inches in San Francisco, 15 at Los Angeles, 10 at San Diego, and 5 inches at Needles.

During the glacial ages the large ice sheets forced the belts of pressure and precipitation south of their modern positions. In California and the Great Basin the winter and especially the rainy season were longer. The Pacific anticyclone did not develop to block cyclones as it does during our present summers. Therefore, in the Great Basin the pluvials were contemporaneous with the ice sheets; and the pluvial lakes may have attained

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*Parenthetical numbers refer to numbered items in "References" at end of paper.

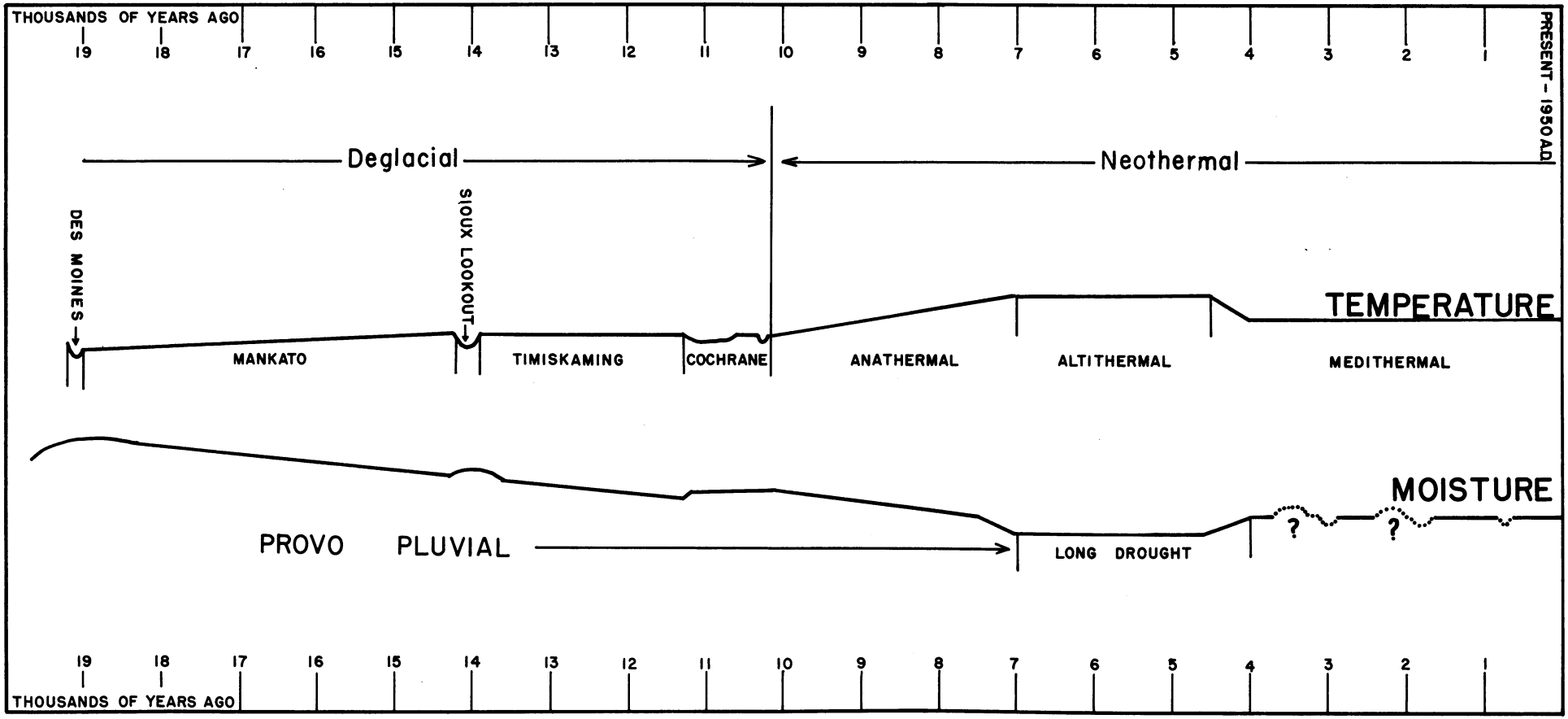


Chart I.

Tentative graphs of temperature and moisture.

Main time divisions of Deglacial and Neothermal ages.

their highest levels just after the glacial maxima. The largest lakes centered on Lat. 40°, suggesting that the belt of heaviest precipitation was 8° of latitude south of its present position. Most of the precipitation undoubtedly came as snow in the high mountains. Dependent on pressure changes, which may have occurred every few weeks as they do today, the winter storms entered the continent at different latitudes; and the precipitation was dispersed during the course of the winter in a wide north-south belt. Also in southern California it must have been heaviest when the ice sheet and the climatic belts were farthest south.

Therefore, the pluvial lakes in the entire belt in which the bulk of the precipitation now comes in winter, that is from Oregon to the Gulf of California and western Arizona, may have attained their highest levels just after the glacial maximum. The last great pluvial, the Provo, corresponded to the Mankato maximum of the Wisconsin Glaciation. After the Provo culmination the lake levels slowly fell, as evaporation began to exceed nourishment most of the time. But at times, as during cold ages, the subsidence ceased or was interrupted by a temporary rise. (While the Provo Pluvial in the Great Basin and California was mainly a result of heavier winter precipitation and coincided with the glacial maximum, the main pluvial in New Mexico and contiguous regions, the Estancia Pluvial, which was out of proportion to the puny glaciers in the adjacent mountains, apparently were caused by heavier summer rains and relatively small evaporation, and probably culminated during the cold Cochrane age.)

In Europe, there is abundant evidence of a distinct drop in temperature, when the ice border stood some 35 miles south of Stockholm and an equal distance north of Helsingfors. The ice sheet ceased to retreat and advanced forming stadial moraines, the Central Swedish moraines and the Finnish Salpausselkäs I and II. Arctic vegetation flourished again, provoking paleobotanists to name the age the Younger Dryas age. A Finno-Swedish chronology based on 650 historical years, 380 interpolated years, and the remainder on postglacial and glacial clay varves (annual deposits) date the age at 10,810-10,150 B.P. (before the present).

This cold Salpausselkä-Younger Dryas age, together with preceding centuries of generally falling temperature, is probably represented in North America by the ice re-advances at Cochrane south of James Bay. By this correlation the Cochrane stage is dated at 11,300-10,150 B.P. Going backward in time, varve counts (with low estimates for the gaps in the varve records) date the Mankato maximum at Des Moines, Iowa, at about 19,000 years ago.

The radiocarbon date of 11,000 years for the Mankato maximum (actually 11,400 for the slightly older Two Creeks forest bed in Wisconsin, determined, like other C-14 dates mentioned here, by W.F. Libby and J.R. Arnold) is much too low, while that of 11,450 for charcoal, wood, and dung in sand in front of Danger Cave, Wendover, Utah, is excessively high. During the Provo Pluvial the water level rose more than 625 feet, perhaps 1,000 feet, above the zero of Great Salt Lake which is 4,203 feet above sea level. The sand at Danger Cave stands 100 feet above Great Salt Lake and must therefore date from the very last part of the Provo Pluvial. The C-14 dates, however, suggest that this last lake stage antedated by half a millennium the glacial maximum which in all reasonableness coincided with the Provo culmination.

Chart 2 -- LEVELS ON OWENS LAKE

Feet:	
3790	Highest beach
3764	Divide in overflow channel, filled by alluvial fan
3675	Crest of big bar at Dolomite
	Mohave industry
	Pinto industry
3650	Folsom industry
3615	Highest soft beach
3597	Owens Lake in 1872, highest modern level
3547	Floor of basin

* * *

While the Provo maximum cannot have lasted very long, the decline of the pluvial lakes occupied many millennia. Several records of Early Man derive from the time when the pluvial lakes (without overflow) were much reduced but still fairly high. The pluvial was followed by a transitional stage and this in turn by a long, very dry age, the Long Drought, during which most basins in the West went dry.

In Europe, the period of approximately 7,000-4,500 years ago was distinctly warmer than the present. This warm age should have prevailed in North America, for the modern temperature rise is common to both continents. In the West the high temperature should have increased the evaporation producing a dry age. This reasoning has been confirmed by Hansen (7, p. 114) who has found evidence of warmer and drier age at comparable levels in peat bogs in the Northwest. The Long Drought in the West may thus have been the correlative of the warmer age dated in Europe, and its beginning has been set at 7,000 B.P. Heizer (12, pp. 95, 96) inclines to the belief that the drought began somewhat later, because a burned basket with an infant (sample 554) from the lower 4 inches of the eolian dust in Leonard rockshelter, Nevada, has a C-14 age of 5,735 years. However, since the child must have been buried, this evidence has little weight.

When the climate again grew moister several basins began to store water which they would still do, if white man had not tapped their supply streams. The amount of salts, accumulated in these reborn lakes, indicates that they have existed for some 4,000 years. That is, the dry age ended about 4,000 years ago.

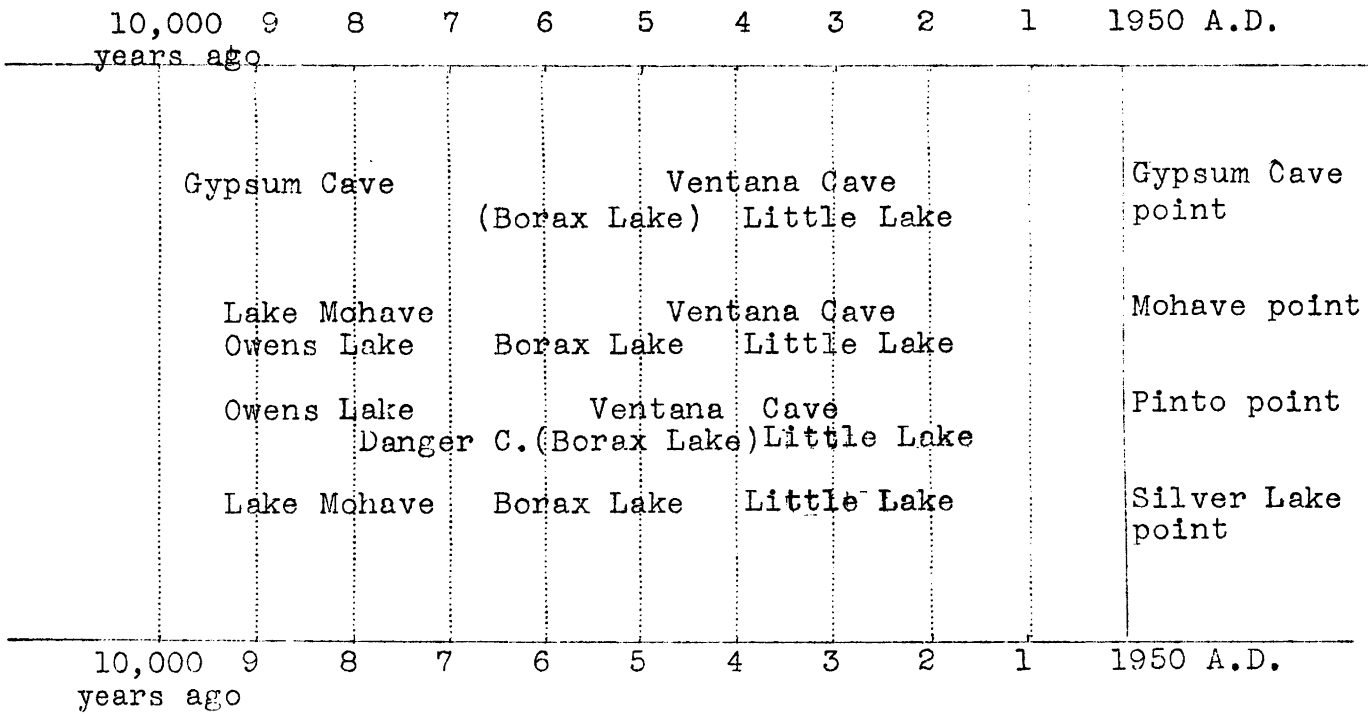
During the past 4,000 years the lakes once or twice stood higher than at any time since 1850, but not much higher. For instance, Great Salt Lake reached 4,262 feet, while it attained 4,211 feet during the 1870s. Pyramid Lake, Nevada, attained 3,930 feet, while it reached a maximum of 3,879 feet during the 1860s. Compared to the pluvial lakes which at their culminations stood several hundred feet higher, these prehistoric lakes were puny. The higher lake levels seem to have been attained before Christ, and their age will probably be determined more accurately from the beds in Hidden Cave near Fallon, Nevada, which Norman Roust and Gordon Grosscup excavated in 1951.

Age of Industries

Gypsum Cave point. Sloth dung from an unspecified level in Gypsum Cave, Nevada (8), contains remains of a vegetation which is found at present only at elevations of 3,000 or more feet higher than the cave, and which consequently postulates a much moister climate than now prevails in the region (13). It must derive from the Provo Pluvial. Still, the radiocarbon age of 10,450 of dung (sample 221) from the lowest occupation level in the cave seems high, especially when compared with other C-14 dates.

Mohave industry. On pluvial Lake Mohave, California, camp sites and artifacts occur at the overflow levels, about 40 feet above the playa floor near the north end (4, pp. 32, 35, 40-43). The range of the occupation levels is about 10 feet. Since the lake naturally fluctuated with rainy and dry seasons, the camp sites and artifacts at low overflow levels may derive from the seasonal low-water stages.

Chart 3 -- PROBABLE AGES OF SOME POINTS



At present the evaporation from shallow lakes in the region is 7 feet (15, map 4) rather than the 4 feet that seemed probable to me in 1937. Therefore, to exist today Lake Mohave would require several times the present inflow to the basin. The fact that the exceptional rains of January, 1916, which gave rise to the heaviest flood on record in the drainage basin, produced a 10-foot deep lake in the Silver Basin, has been much overplayed, for all the water had disappeared by July, 1917, after a year and a half (4, p. 47). The data we have on Medithermal lake levels in the Great Basin indicate that no part of this age was sufficiently moist to maintain Lake Mohave at the overflow level. This lake must have existed during the Provo Pluvial. Since the lake overflowed and could not rise higher, it may have maintained this level for a long time. The cultural remains probably derive from the last stage of the Pluvial, from about 9,000 B.P.

Mohave artifacts also occur on Owens Lake, California, which together with the adjoining Little Lake region was included in an archaeological survey by Mr. and Mrs. W.H. Campbell (5), a survey in which I partook in 1936 and 1939. The main data are given in Table 1, most of the levels after Gale (6). The big bar at Dolomite near the north end must mark the overflow level during the Provo Pluvial, and since that time the channel must have filled with 90 feet of fan debris. Beaches above 3,615 feet are firm and old-looking, while those at 3,615 feet and lower are soft. The former may antedate the Long Drought, and the 3,615-foot level may mark the highest stand reached by the lake during the last 4,000 years, or since more than 7,000 years ago.

The Mohave artifacts occur on and just below the crest of the big bar. They must derive from the Anathermal.

Pinto industry. The age of the Pinto culture in the Pinto Basin, California (3), is difficult to judge. In Owens basin Pinto artifacts were found by the Campbells on the north side of the big bar, just below the crest, or at about 3,660 feet elevation. They thus occur 45 feet above and a distance from the young beaches and must be old. Also old is the Pinto-Amargosa II industry in the lowest occupation level in Danger Cave, Wendover, Utah, which Jesse Jennings reported at the Pecos Conference at Point of Pines, San Carlos, Arizona, in August, 1951.

In Ventana Cave, southwestern Arizona, non-typical Pinto points occurred in the red sand, in Ventana-Amargosa I, and true Pinto points were found in the lower layers of the midden as part of the Chiricahua-Amargosa II culture (11, pp. 203, 293, 523). If the dates of the typical Chiricahua stage are applicable, these Pinto points may range from 6,000 to 3,500 or 3,000 years old.

On the other hand, the Pinto industry at Little Lake, some 45 miles south of the Owens Lake sites, derives from the last two millenia before Christ and the succeeding centuries (10). There were then probably other springs in the region besides the one which feeds the existing lakelet.

It therefore appears that Pinto points were made during thousands of years, from well before till long after the Long Drought.

Secondary Occurences. The mentioned points have also been found in small numbers or solitary specimens in younger deposits. Thus, a few Gypsum Cave points occurred in Ventana Cave, in the lower level of the midden, in the Chiricahua-Amargosa II (11, pp. 280, 295, pl. 22). At least one point was found at Little Lake (10). One Mohave point occurred in the lower midden at Ventana Cave (11, pp. 275, 276, 298), and a few points have been found at Little Lake (10). The Silver Lake point, which is frequent on the beaches of Lake Mohave, is represented by a few specimens at Little Lake (10).

Of course, these few or solitary points can occur in secondary position: They can be actually old points which had been picked up, brought home, and lost again. Therefore, it is uncertain that the Gypsum Cave, Mohave, and Silver Lake points spanned the Long Drought.

However, Mohave and Silver Lake points, and possibly Gypsum Cave and Pinto points, were found by Harrington also at Borax Lake, 90 miles north of San Francisco (9, pp. 87, 90, 91). This site which produced many other kinds of artifacts, including fluted point, occurs mainly in an alluvial fan. The occurrence is very difficult to date, but my latest suggestion is that the fan was built when the vegetation cover was reduced and the erosive effect of occasional heavy rains was great, that is during the Long Drought (see 20, p. 104). If so, the site would partly fill the gap between the old and the relatively young occurrences of the points under discussion.

The Corral
Globe, Arizona

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