Climatic Change and The Initial Middle Missouri Tradition

David L. Cook

University of Nebraska-Lincoln

Follow this and additional works at: https://digitalcommons.unl.edu/nebanthro

Part of the Anthropology Commons


https://digitalcommons.unl.edu/nebanthro/138

This Article is brought to you for free and open access by the Anthropology, Department of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Nebraska Anthropologist by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.
CLIMATIC CHANGE
AND
THE INITIAL MIDDLE MISSOURI TRADITION

by

David L. Cook

It has been postulated that a favorable climatic change occurred worldwide at approximately 900 A.D. At this same time, many cultures expanded and many cultures appeared for the first time, specifically the Initial Middle Missouri Variant in North and South Dakota. In this paper, I will try to demonstrate that a climatic change did occur worldwide, that cultures do respond and change to shifts in climate, and I will try to demonstrate the responses of certain cultures to the 900 A.D. climatic change. Specifically, I will try to show what may have happened to the Initial Middle Missouri culture area during the climatic shift and what may have happened when the beneficial climate started deteriorating.

It must be realized that the 900 A.D. "warm" period had minor temperature fluctuations within it. The past 3,000 year period, Neoglacial, has had fluctuations, as shown by Lamb (1971:161):

post-warm era climate (since Climatic Optimum) has fluctuated, seemingly with both periodic and aperiodic elements involved. The warmest periods, in the early Middle Ages around A.D. 950-1300, and to a lesser degree around A.D. 400 and 1900-1950, all seem to be associated with a poleward shift of the middle latitude westerlies and the associated traveling depressions.

Ladurie (1971) also states that there have been climatic fluctuations for he gives a total of five glacial advances since 1400 B.C., the last two occurring between 1200 (perhaps 1150) to 1300 (perhaps 1350) A.D. and a 1550-1850 A.D. advance. This last advance had the coldest temperatures globally since the last Ice Age and is known as the "Little Ice Age". Denton and Karlen (1973) note that there was a glacial advance around the fourteenth century which culminated in the Little Ice Age.

In his 1965 article, Lamb gives many references for the warming period occurring in the early Middle Ages of Europe, or at approximately the time period we are interested in, 900 A.D. Lamb notes that: (1) Arctic pack ice was less extensive and drift ice was unknown between 1020 and 1194. After 1200, there was a rapid
increase in the amount of drift ice seen in the North Atlantic around Iceland. (2) North American Eskimoes, during the Thule culture, first occupied Ellesmere Land and expanded their range northwest as far as the New Siberian Islands and northeast to just north of Greenland. (3) Northern Alaska may have had summer temperatures around 1100 A.D. higher than the 1851-1950 average by as much as 2.3°C. (4) In central Norway, forest clearance and cultivation, which had been fairly static since the early Iron Age, spread rather rapidly 100-200 m in altitude farther up the valleys and hillsides in the course of two centuries from around 800 A.D. It retreated just as fast around the fourteenth century and remained so for hundreds of years. (5) The upper limit of forests in the Alps and in central Europe has been estimated to have been 220 m higher than at present. Bryson, Irving, and Larsen (1965) also confirm the higher tree line for they found a fossil forest in Canada north of the present tree line. "By A.D. 1000 the forest had again advanced to at least 61°30' N or 62° N." (Ibid:47). It must be remembered that a higher altitude can be correlated to a higher latitude.)

Oliver (1973) noted that the Domesday Book of England recorded that northwest Europe was warmer and drier than at the present. There was widespread growth of grape vines in areas where they are not climatically suitable today. Oliver also noted that tree ring analysis of Alaskan species indicate that temperature was about 2°C higher than today and that in the American Rockies, the snowline may have been 370 meters higher than at present.

Dansgaard, et al., (1969), states that in the Greenland Camp Century ice core a change in the relative frequency of 018/016 isotopic ratio indicates that at approximately the same time period, 1150 A.D., there was a sudden increase in the mean 018 value of the sea water (increasing 018 corresponds to warm temperatures, decreasing indicates cold temperature).

It is also interesting to note that from 978 to 986, Snaebjorn Galti and also Eirik the Red took advantage of a sea relatively free of ice (as noted previously) and sailed due west of Iceland and reached Greenland, Where Eirik established his large farm, Brattahild. In less than a hundred years, other lands had been discovered further west, one of which had grapes and other fruit growing in abundance and strange copper-skinned natives, whom they called Skraelings, or wretches (Magnusson and Palsson, 1965). Recently, one of the Norse settlements has been excavated. It is located at L'Anse aux Meadows, Newfoundland, and has a mean radiocarbon date of 910 ±20 A.D. (Ingstad, 1970).

The Norman burials excavated at Hefoljness, Greenland, were found in ground, which is now, frozen year-round. The
excellent state of preservation of the fabrics and wooden objects can only be explained by a long period of permanent frost. The permafrost did not exist at the time of the burials because the roots of shrubs were able to bore through the biers, the skeletons, and the materials they were clothed in (Ladurie, 1971). Lamb (1966) suggests that the mean annual temperature for Greenland at the time of the burials must have been $2^\circ - 4^\circ$ above present values.

The global climatic patterns, as reflected in all this data, suggests an increase in temperature from between $2^\circ - 4^\circ$ and with weaker westerlies and more meridional circulation (Bryson and Wendland, 1967) occurred around A.D. 900. And also that from approximately 1200 to 1300 A.D. the climate started deteriorating from this "Little Climatic Optimum" with the readvances of glaciers and with lower temperatures than today, which would probably lower the evaporative rate. This combination may have helped cause the abandonment of Greenland, lowered the European vineyards and farms to their present altitudes, and perhaps affected other cultures in similar ways.

The next step, now that it has been shown that a warming climatic change occurred at about 900 A.D. and then deteriorated, is to see if a change in the climate can bring about a cultural change.

Climatic changes can be considered to be like square waves - abrupt changes from one climatic regime to another. This is the step-wise model of climatic change of Bryson and Wendland (1967). This model suggests that dependent environmental variables, pollen, glacial advances and retreats, culture, etc., should record abrupt discontinuities in their own response to the climate.

If climatic discontinuities are sufficiently abrupt and of sufficient magnitude, environmental subsystems which respond to the climate should contain discontinuities in their record, thus providing a 'proxy' indicator of the covariate, climate, or some function of it... (Wendland and Bryson 1974:10)

Two independent sets of data were analyzed by Wendland and Bryson (1974) to identify times of large-scale hemispheric discontinuities. One set of data is comprised of C$^{14}$ dates if interruptions within pollen profiles, glacial records, sea level heights and peat beds. The other data set consists of radiocarbon dates associated with cultures.

If the discontinuities are globally significant, one would expect to find evidence of their impact on other variables which respond in some measure to the environment. If some activities of man are at least partly dependent on the environment, then perhaps when a change in the environment occurs, such a change could be
found recorded in the history of man's activities. This is not to suggest that man responds solely to the environment, but that the initial conditions may be established by the environment (Wendland and Bryson 1974).

If this concept of the relationship between man and the environment is correct, one would expect:

that cultures, once established, would tend to continue throughout one or more times of stable environment, but be more likely to terminate or change at climatic discontinuities rather than during stable intervals. Thus the most likely times of beginning and ending of climatically sensitive continua, such as cultural regimes, should be related to the times of climatic discontinuity...

If globally synchronous climatic changes are considered, then the global assemblage of $^{14}C$ dates associated with various cultures should tend to form continua starting and stopping preferentially about the times of climatic change (Wendland and Bryson 1974:14-15).

Wendland and Bryson found that the discontinuity dates with the highest t value, or significance, were 1260 (990 B.C.), 2510 (560 B.C.), 4230 (2260 B.C.), 9530 (7580 B.C.) BP. The large significance values identify the most important discontinuity dates. The next three dates in significance. The other discontinuity dates may mark divisions within the major episodes (subepisodes) or they may be insignificant. Wendland and Bryson should not make the distinction because of the 'relative nature of the significance statistic'. (Ital:19).

If the synchronous discontinuities recorded in the independent response records are a reflection of worldwide climatic changes, then the data suggests that common cultural interruptions occur after botanic discontinuities. Cultural lag is not apparent from all the data, but dates most closely associated with each other - 850 and 330, 1630 and 1820, 2760 and 2510, 4240 and 4230, and 6950 and 5000 BP

suggests that cultural discontinuities tend to occur with, or follow somewhat, the associated botanic discontinuities. The mean deviation of the five instances shows cultural change lagging botanic changes by almost fifty years. If vegetation lags climatic change by 100 years or less as
suggested by Cole (1969), the mean cultural lag after the climatic event is about 150 years (Wendland and Bryson 1974:23).

Wendland and Bryson's research shows that globally synchronous discontinuities occur in both the environment and culture. This synchronism suggests a geophysical cause, probably climatic change rather than cultural causes. The interruptions in both sets of data supports the "square wave" model of climatic change and the similarity of the two sets of discontinuities suggests that environmental change has been a factor in cultural change.

Cynthia Irwin-Williams and C. Vance Haynes in their 1970 paper also show that climatic changes in southwestern United States has changed, or at least influenced, cultures through time. They have used the archaeological record and compared it to evidences in the geomorphological record. They started their analysis with the Clovis tradition, which they date at 9000-9500 B.C.

They state that the Clovis material represents a considerable population increase and settlement of territory never previously occupied. Pollen analysis indicates a more mesic environment with more effective moisture than at present. The environment was capable of supporting key economic faunal species. After this period, there is a break in the geologic units with the paleobotanical evidence indicating less effective moisture. This period seems to correspond to a period of change, areal shrinkage, and economic readaptation for the Paleo-Indian cultures of the Southwe

The following Paleo-Indian materials range from 8500 to 5500 B.C. and occur in a pedological context indicating decreasing soil moisture. The pollen data indicates a series of fluctuations in the amount of moisture: (a) A cool or more moist interval about 8500-8000 B.C. which corresponds with the Folsom occupation of the area. The Clovis economic faunal assemblage had been drastically reduced in numbers by 8700 B.C. and the now extinct bison had increased and had become the main animal hunted. (b) A period of less effective moisture from about 8000 to 6500 B.C. Agate Basin, Hell Gap, and the Alberta occupations of the High Plains occurred at approximately this time. Materials of these complexes are absent in western New Mexico and are rare in the eastern portion. (c) A brief return to more effective moisture at about 6500 to 6000 B.C. Western New Mexico was being reoccupied or frequently penetrated during this time.

The period 5500 to 3500 B.C. is represented by an erosional surface representing Antevs' Altithermal Period. It was a time of hotter and drier conditions compared to the present (Jennings 1968). Archaeologically, this is the least known of all periods in the Southwest culture area. It is possible that the human population was concentrated around the principal remaining resources leaving large areas with only marginal or temporary occupation. Reeves (1973) has suggested that the area did support a viable population
with the economy centered around the communal hunting of bison. The lack of evidence for this period, he suggests, is due to a lack of sampling, geological variables, and nonrecognition of artifact types in surface collections.

Frison (1975) gives an alternative model for the lack of evidence of human populations in the Northwestern Plains during the Altithermal. He believes that the carrying capacity of the shortgrass plains was reduced, although expanded in area:

...the Northwestern Plains could not have supported a bison population of a size compared to that before and after the period. ...Continued adverse winter conditions and reduced spring growth of grasses may also result in the animals failing to attain peak condition for the breeding season which may adversely affect the population. It is suggested here that the main bulk of the bison herds probably abandoned much of the Northwestern Plains during the Altithermal period except for some oasis-like areas and followed the expanding short-grasses as they intruded into the now tall grass areas....There was a definite reduction of human occupations on the Northwestern Plains during the Altithermal and the ones that remained were centered in areas peripheral to the Plains.  

(Frison 1975:295-296)

Irwin-Williams and Haynes move on to the period 3000 B.C. to A.D. 1. This period was a time of greater effective moisture. There is good evidence of the occupation of the entire Southwest by a continuum of related cultures which Irwin-Williams has termed the Elementary Southwestern Culture. The basic economy of the area was one based on plant gathering and foraging with incipient horticulture present in a few areas. Overall, there is a gradual population increase.

A final shift in the settlement pattern of northwestern New Mexico falls in the time range at the end of the Basketmaker III period and the beginning of the Pueblo I period, or about 700 A.D. This was a period of drastically decreased effective moisture. This was a time of arroyo cutting which may have destroyed the alluvial farmland and lowered the water table. There was abandonment of some areas which had been occupied since the Elementary Southwestern Culture first appeared. McGregor (1965) also notes that the period 1200-1300 A.D. marks the decline of the Classic Pueblo (Pueblo III) period.
Irwin-Williams and Haynes (1970) paper clearly indicates that environment can influence, and perhaps change, a culture(s). The dates they gave were fairly general, but one, 700 A.D., when changed into its before present date, 1250, is remarkably similar to the 1260 BP. discontinuity date as determined by Wendland and Bryson. So, the dating does seem to indicate that geo-physical changes of some sort did occur at approximately that time period.

If one looks at the Northern Plains culture area after this date, a number of cultures appear in the archaeological record. Among them are the Initial Middle Missouri Variant, Mill Creek, Great Oasis of northwest Iowa, Great Oasis of southwest Minnesota and northern Iowa, Oneota, Nebraska Culture, Old Village Mississippian (Cahokia and Aztalan), and Steed-Kisker (Kansas City Mississippian).

The radiocarbon dates for some of these are as follows (taken from Henning, 1967):

- Mill Creek: 900-1400 A.D.
- Oneota: 1150-1350 A.D.
- Glenwood Nebraska Phase: 950-1550 A.D.
- Dixon Oneota site (western Iowa): 930 ± 80 A.D.
- Steed-Kisker: 1150-1350 A.D.

Although Great Oasis has never had many C14 dates, it does appear to be contemporaneous with Mill Creek. Great Oasis and Mill Creek materials have been found in association at the Wittrock site in northwest Iowa. Great Oasis pottery has been recovered from a midden on the Kimball site, also a Mill Creek site. At the Beals site in northwest Iowa, there were two separable components an earlier Woodland and a later Great Oasis occupation. Mill Creek ceramics were found in association with both components (Henning 1967).

The many cultures within this area were undoubtedly interacting with one another. Woodland people in the Plains and in the Mississippi Valley were starting to develop along similar lines, probably in response to the favorable climatic change, already discussed which had occurred by this time. The best phrase for this interaction is that given by Joseph Caldwell: "...the cultures were growing up together" (Hall, 1967:181).

There was some interaction between Mill Creek and Cahokia, in the similarity of materials (seed jars, bowls with effigies, Anculosa beads, etc.) suggests. Mill Creek did not assume the Mississippian pattern totally, but did share elements with it. Great Oasis apparently shared in the trade network between Mill Creek and Cahokia and/or Aztalan, perhaps as intermediaries. Great Oasis does seem to have other affiliations with the Eastern Woodland culture area besides the Mississippian influence, for the Lake Michigan Ware in the Effigy Pound area is very similar to Great Oasis ceramics (M.W. Caldwell, personal communication 1975). Great
appears to have been more conservative than Mill Creek, for they retained more of a Woodland pattern.

Interactions between these populations and the others, probably served to erase some of the differences that existed and migrations extended the area of interaction further (Hall 1967). It is probably one of these interactions that has been termed the Initial Middle Missouri Variant. This culture appeared fully developed at this time period (Husted and Caldwell, 1968 and Lehmer 1971).

At one site, the Hitchell site in South Dakota, which has been identified as an Initial Middle Missouri village, the earliest component consists of Woodland and Great Oasis sherds. The sherds cannot be separated stratigraphically, so it appears that the Woodland-Great Oasis materials represents a single occupation (Johnston 1967).

Johnston believes that since Woodland groups were living along that section of the Missouri River, the Woodland Great Oasis manifestation may have been a late expression of these cultures which was immediately preceded or was incorporated into an assemblage representative of Initial Middle Missouri.

Along with this, the long, rectangular houses of the Initial Middle Missouri are very similar to houses excavated at the Great Oasis settlement of Broken Kettle West, north of Sioux City, Iowa (Anderson 1975, and Warren W. Caldwell, personal communication 1975). Thus, the Great Oasis may be forerunners or mark a transitional development that contributed to the formation of the Middle Missouri Variant.

Lehmer's 1970 model for the Middle Missouri area states that the Initial Middle Missouri Variant was "...an intrusive complex, which was carried to the Missouri Valley from southwestern Minnesota and northwestern Iowa at the beginning of the tenth century. This movement coincided with the beginning of the Neo-Atlantic episode" (Lehmer 1970:118).

Lehmer thought it was reasonable to assume that the climate was favorable for corn growing on the Plains and must have resulted in lush pasture for the game animals. He believed that these early villages appeared to have migrated onto the Plains in response to the beneficial climate.

Lehmer seems to be following Bryson and Baerreis (1968) and Bryson and Wendland (1967) descriptions of the Neo-Atlantic, when he described it as being a period when "there was an influx of moist tropical air into the Great Plains region. This situation encouraged the westward extension of corn agriculture and was responsible for the prairies expanding westward at the expense of the Steppe" (Lehmer 1970:118).
Around 1100 A.D., according to Lehmer (1971), another closely related cultural complex moved into the Middle Missouri Valley. This was the Extended Middle Missouri Variant. They seem to have displaced the older Initial Middle Missouri population from upstream of the Bad River, but it appears that the two populations occupied adjacent sections of the valley. Since the two groups were so similar, Lehmer tended to believe they were both derived from the same ancestral form.

Lehmer noted that there is an almost complete lack of radiocarbon dates for the period 1250-1450 A.D. from the southern Extended Middle Missouri sites, although there was a remnant population left similar to the Initial Middle Missouri termed the Modified Initial Middle Missouri. Lehmer suggested that the villages were abandoned around the mouth of the Bad River due to the beginning of what Baerreis, Bryson, and Wendland have at various times called the Pacific I episode. This episode was "characterized by circulation patterns which brought an increased flow of the western lies into the Northern Plains" (Lehner 1971:105).

Lehmer's model suggests a close interrelationship between climatic events and cultural events in the Middle Missouri area. He attempted to show the relationship between the two phenomena, discuss the effects of climate on the resident populations, and their responses these people made to the climatic change. David P. Griffin (1976) has reviewed Lehmer's model and has derived an alternative model which contradicts many of Lehmer's assumptions.

Lehmer considered three variables of cultural ecology that would have been sensitive to climatic change and important to the maintenance of villages along the river in the area we are concerned with. These three are:

1) Corn growing which he states is dependent on a combination of precipitation, summer temperature, and length of the growing season.
2) Big game hunting, especially bison, whose pasturage is dependent on precipitation and temperature.
3) Growth and availability of timber which was used for fuel, stockades, houses, etc.

Baerreis, Bryson, and Wendland have given four climatic episodes which pertain to the time period being dealt with. They are:

1) Neo-Atlantic (900-1250 A.D.) - conditions favorable for growth of corn and abundant pasturage for large game.
2) Pacific I (1250-1450 A.D.) - less favorable for growth of corn, decreased pasturage, and decreased tree growth through decrease precipitation and an increased evapotranspiration rate.
3) Pacific II (1450-1550 A.D.) - climate similar to Neo-Atlantic.
4) Neo-Boreal (1550-1800 A.D.) - climate similar to Pacific I
These cycles are based on variations in the relative amounts of precipitation and increase or decrease of estimated annual mean temperature. These are conditioned by altered atmospheric winds and their circulation patterns. What David E. Griffin shows is that the climatic episodes may be correct, but Lehmer's assumptions about the responses of the important variables—corn, pasturage and timber—are perhaps incorrect.

First, Lehmer assumed that the adverse conditions of the Pacific I episode, which were a result of increased westerlies which brought cool, dry air, lowered temperatures, and decreased precipitation, would have had disastrous effects upon the horticulture of corn. There is evidence that corn growing could still be feasible under the stressful conditions. Will and Hyde (1917) and Galinat (1965), "have all commented on the ability of flint corn...to withstand stress by being highly adapted to short growing seasons, drought, and high altitude (i.e., high latitude cold" (Griffin 1976:34).

Furthermore, the water table of the Missouri River floodplain has not been taken into account as a "potential and constant source of moisture for plant growth. If prehistoric gardens were on the floodplains, as the historic ones were, then the subsurface moisture may have greatly diminished the stress upon plants from decreased precipitation" (Griffin 1976:34).

Second, the pasturage being considered is in the short grass plains which is known to be highly adapted to drought conditions. It is also known that in times of altered atmospheric circulation patterns, the short grass plains expand and contract to the detriment of the tall grass prairies—enlarging in area during dry conditions and contracting during more moist times (Küchler 1973 and Griffin 1976).

Under Pacific I times, the short grass pasturage should have expanded and have been more available, rather than being diminished. Plus, short grasses quickly attain and maintain a high proportion of protein to carbohydrates, as required by bison for sustenance (Johnson 1951 and Griffin 1976). The herds of buffalo may have expanded and contracted along with the short grass plains during the Neo-Atlantic and Pacific I times. Even if the forage yield of protein were decreased, the increased area of the short grass plains may have compensated for the decreased yield, allowing the bison population to remain constant. Bison may have maintained the same size population during unfavorable climatic conditions, but were perhaps less nucleated (Reeves 1973 and Griffin 1976). This suggests that the bison hunters may
have to travel farther and be gone longer in order to get the same amount of meat and raw material during the Pacific I period than during the Neo-Atlantic.

Third, although Lehner and Baerreis, et. al., said that tree growth would be inhibited during Pacific I times, the tree growth in the Middle Missouri may have been unaffected. The timber grows in the bottomlands of the Missouri River, which has been a stable ecological unit during postglacial times. The availability of surface moisture considerably reduces the stress upon plants from decreased precipitation (Griffin 1976). Also, soil exhaustion has been a factor assumed to be partially responsible for population shifts. This may not be all that important. The annual flood of the Missouri River deposited fresh soil, saturated the ground and would have replenished nutrients removed by horticultural activities (Griffin 1976).

I propose that the Initial Middle Missouri Variant was not a culture that underwent change as a result of the Neo-Atlantic conditions, but was already in existence and presumably had its origin in the Mill Creek - Great Oasis territory. The favorable climatic conditions of the Neo-Atlantic, plus the introduction of a new breed of corn, Marinoso de Ocho, which was adapted to a short, growing season, droughts and high latitude cold (Calinat 1965), enable the existing cultures of the Northern Plains to expand in population and form multilineage villages, as Steward (1955) suggests.

These multilineage groups may have undergone a budding-off relationship with daughter groups breaking away from a parent group. More than likely this occurred as a result of a depletion of critical resources. The most critical of the resources used and upon which population growth would have put the most stress, would be the timber supply (Griffin 1976).

Perhaps one, or more, of the daughter communities of Great Oasis and/or Mill Creek in the northwest Iowa - southwest Minnesota area moved to the Middle Missouri area in order to have relatively unused resources, since the daughter communities would have to compete with the parent villages for the same resources if they had stayed in the same area. Eventually, the daughter communities would become parent villages with their own daughter villages. Finally, the parent-daughter villages would have to compete between themselves for the resources as well as with other parent-daughter villages and with other populations also in the area. The result of competition for critical resources would be fortification and the building of villages in defensible locations, as has been recorded for the Initial Middle Missouri Variant (Griffin 1976).

When the Pacific I episode occurred, the sedentary villages on the Middle Missouri River Trench would not have been affected to the degree implied by Lehner and others. Horticultural activities could still be practiced, as Bryson and Baerreis (1968) have noted, bison could still be hunted, although more energy would have been
expended to obtain sufficient quantity, and timber resources
would not have been seriously affected by the climate
(Griffin 1976). The abandonment of the Bad River area be-
tween 1250-1450 A.D. is probably only slightly related to
the advent of the Pacific I episode. It is more likely to
assume that cultural factors are involved instead of geo-
physical causes.

I have tried to demonstrate that 1) climatic changes
do occur worldwide, 2) that there was a favorable climatic
change, termed Neo-Atlantic, at approximately 800-900 A.D.,
that the climate deteriorated around 1200-1300 A.D. in what
has been termed the Pacific I episode, and 3) that climatic
changes can affect human populations. The Middle Missouri
River Trench is shown to provide a special case under the
circumstances given. The three variables considered, corn,
big game hunting and timber, did not vary to a great degree,
as previously thought. The area remained stable during the
adverse conditions of Pacific I times. The Middle Missouri
River Trench proved to be a beneficial physiographic anomaly
and permitted the continued expression of a prehistoric
population.

REFERENCES

Anderson, Duane
1975 Western Iowa Prehistory. Iowa State University
Press, Ames.

Bryson, Reid A. and David A. Baerreis
1968 Introduction and Project Summary. in Journal of the
Iowa Archeological Society. Dale R. Henning (ed.)

Bryson, Reid A., W. Irving and J. Larsen
1965 Radiocarbon and soil evidence of former forest in
the Southern Canadian Tundra. Science 147 (3653):
46-48.

Bryson, Reid A. and W. H. Wendland
1967 Tentative Climatic Patterns for some Late Glacial
and Post-Glacial Episodes in Central North America.
in Life, Land and Water. William J. Hayer-Oakes (ed.)
University of Manitoba Press. Winnipeg pp.271-298.

Dansgaard, W., S. J. Johnson, J. Moller and C. Langway
1969 One thousand centuries of climatic record from
Camp Century on the Greenland ice sheet.
Science Vol. 166, No. 3903, pp. 377-381.
Denton, George H. and Wibjorn Karlen  

Frisson, George C.  

Galinat, Walton C.  

Griffin, David E.  

Hall, Robert L.  

Henning, Dale R.  

Husted, Wilfred M. and Warren W. Caldwell  

Ingstad, Anne Stine  

Irwin-Williams, Cynthia and C. Vance Haynes  

Jennings, Jesse D.  

Johnson, C. W.  
Johnston, Richard B.

Küchler, A. W.

Ladurie, Emmanuel LeRoy

Lamb, H. H.
1971 Climates and circulation regimes developed over the northern hemisphere during and since the last Ice Age. Palaeogeography, Palaeoclimatology, Palaeoecology, Vol. 10, pp. 125-162. Amsterdam.

Lehmer, Donald J.

McGregor, John C.

Magnusson, H. and H. Palsson
1965 The Vinland Sagas, the Norse Discovery of America. Penguin Books, Baltimore.

Oliver, John E.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Publication Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steward, Julian D.</td>
<td>Theory of Culture Change</td>
<td><em>University of Illinois Press</em>, Urbana.</td>
</tr>
<tr>
<td>Hyde</td>
<td>Corm among the Indians of the Upper Missouri</td>
<td><em>William Harvey Miner Co., Inc.</em>, St. Louis.</td>
</tr>
</tbody>
</table>