22. ON DIVISION OF THE LAST 20,000 YEARS

By Ernst Antevs

Introduction

The main controlling factor of physical conditions and processes, and of distribution and spread of plants and animals, is climate and its changes. Low temperature and, in some regions, excessive snowfall have caused extensive glaciations. The withdrawal of water to form the ice sheets lowered the oceans. Increased precipitation and reduced evaporation induced pluviations in arid regions. Rise of temperature has made ice sheets and glaciers shrink and disappear. Climate has thus controlled the geological factors. Biota have moved latitudinally and altitudinally with the climatic belts. Plants and animals have been trapped by climatic changes in unfavorable locations to become regionally or universally extinct.

The temperature rise which has occurred during the last hundred years in North America and in Europe (and perhaps elsewhere), together with the general parallelism of the past temperature histories, indicate that the marked, long-continued temperature ages have prevailed simultaneously in the two continents. The major temperature ages and their sequences consequently supply a basis for long-distance correlation; and the temperature changes should therefore be used for the principal division of time. Regionally, subordinate divisions on other conditions may be practical. In dry and semiarid regions the natural basis is conditions and changes in moisture. For stratigraphic divisions erosions are suitable markers.

Broad Classifications

Although the term Quaternary (and Tertiary) is unsuitable and ought to be dropped (Schuchert and Dunbar, 1941, pp. 383-84, 411, 425; Flint, 1947, p. 205), it is deeply entrenched in some countries. Regardless of when the Quaternary is assumed to begin, it is mainly characterized by the Ice Age, which consisted of recurrent cold ages producing extensive glaciations and of intercalated relatively warm ages, interglacials. The last glaciation ended as an extensive phenomenon some millennia ago. This last age -- named the Postglacial, Recent, Neothermal -- resembles in all known respects the interglacial ages and obviously is not an epoch of the same rank as the Pleistocene, which in its most restricted definition includes four glaciations and three interglacials and occupied 600,000 to 1,000,000 years. It is clearly a part, a subdivision, of the Ice Age, the Pleistocene, as suggested by Kay and Leighton (1933, p. 672) and stressed by Flint (1947, p. 208). The Pleistocene is thus equivalent to the Quaternary. The broad classification and division therefore is:

Pleistocene or Quaternary	(Preglacial ages)		
	Ice Age	Glacials	
		Interglacials (Thermals)	
		Neothermal (Post glacial, Recent)	

General Division Based on Temperature

The deglaciation or wastage of the ice sheets included long ages of predominant retreat and shorter ages of halt and readvance of the ice border. Since retreat was caused mainly by relatively high temperature and halt by low temperature, ages of retreat and of halt form an excellent basis for a time division. The deglacial subages since the Des Moines maximum-St. Johnsbury halt some 19,000 years ago so far distinguished are: the Mankato-Valders retreat, the Sioux Lookout-Pembroke halt, the Timiskaming retreat, and the Cochrane halt. This division is usually suitable for correlation with stages of ice retreat in other regions and with climatic ages recorded by plant remains in bogs and lake sediments. For instance, the Timiskaming retreat may correlate with the Gothiglacial retreat and the relatively warm Allerød age in northern Europe, and the Cochrane halt with the Salpausselkä (Fenno-Scandian moraines) halt and the cold Younger Dryas age. There is, however, a striking exception: The ice expansion to the Des Moines (Mankato) glacial maximum west of the Mississippi River must have coincided with ice retreat in the East, probably because of difference in the amounts of snowfall.

The end of the last glacial was set by Enquist (1918, pp. 82, 94, 101, 102) at the end of the Salpausselkä stage, and by the writer (1931, pp. 2, 6) at the attainment of the modern temperature level in the southern belts of the formerly glaciated regions. Enquist argued that the glacial climatic conditions ended with the formation of the Fenno-Scandian stadial moraines because the temperature rise which caused the ice border to withdraw from them was abrupt and pronounced. Since this temperature rise was accompanied by a marked change in the vegetation from Younger Dryas to Birch-Pine, Enquist's demarcation line is now rather generally accepted in Europe, and it is here adopted by me, for it should be recognizable in North America. Thus it is assumed that the last glacial ended 10,150 years ago, as determined by Finno-Swedish varve chronologies, ended with year 0 in the Finnish chronology, with the Salpausselkä stage and its probable correlative the Cochrane.

The subsequent age is usually named the Postglacial in Europe. In America the Postglacial usually means the age since the ice left any particular locality or region, that is, it has no definite time meaning, is no true time term. Since, as defined by the U.S. Geological Survey, the "Pleistocene epoch includes the deposits of the Great Ice Ace . . . and contemporaneous . . . rocks" (Wilmarth, 1925, p. 49), the Recent to the USGS must signify deposits formed since the total disappearance of the ice sheets. The time of this disappearance is not known, but fell perhaps during the Altithermal. Clearly, so defined the Recent is inapplicable. On the other hand Kay and Leighton (1933, p. 672; also Schuchert and Dunbar, 1941, pp. 426, 433, 434) apply the Recent to the time since the Des Moines glacial maximum. Others have used the word in still other meanings. Thus both the Postglacial (in America) and the Recent have long been used loosely and do not denote a definite time unit. Therefore the writer (1948, p. 176) recently proposed the term Neothermal, the "new warm age" which is now assumed to be equivalent to Enquist's Postglacial and to comprise the last 10,000 years.

The Neothermal is divided into the Ana-, Alti-, and Medithermal ages (ages of rising, maximum, and moderate temperature). The Altithermal,

dated in Europe at 7000-4500 B.P., was distinctly warmer than the present.

Such thoughtless expressions (loose terms) as "climatic improvement," "climatic optimum," and "climatic deterioration" naturally provoke the question: "improvement, optimum, deterioration for whom or for what?" The higher temperature of the Altithermal may have created a relative optimum for man in high latitudes, but not for the biota which were adjusted to the earlier conditions. In the deserts the higher temperature and associated intense dryness produced the opposite -- would some say a "climatic pessimum?"

Great Basin Division Based on Moisture

The Great Basin and contiguous regions call for a separate time division based on the important moisture conditions, though their fluctuation and the ages of the maxima and minima are only in part known. The moisture variations considered were associated with, and probably in part caused by, temperature changes. In the Great Basin each glaciation was accompanied by a pluviation. The pluvial lakes appear to have culminated just after the glaciers had begun to withdraw from their most advanced positions. The Provo pluviation was contemporaneous with the Mankato-Tioga-Pinedale glaciation. The lakes receded as the ice sheets and glaciers retreated. Their subsidence was interrupted by temporary halts and rises, which probably were caused by the same temperature lowerings as were the halts in the ice retreat. The best known halt in the subsidence, the Stansbury II stage (at 325 feet above Great Salt Lake) in the Bonneville basin might be a correlative of the Cochrane halt (Salpausselkä halt, Younger Dryas age). (There was probably a Stansbury I stage between the Bonneville and Provo pluvials.)

The lakes seem to have remained relatively high during the early Anathermal and to have dropped to their modern levels 8000 to 7500 years ago. They thereupon fell further or disappeared entirely during the longest and severest drought on record in the region, the Long Drought.

During the last few millennia the lakes have once or twice held higher levels than at any time during the last hundred years.

A Regional Stratigraphic Boundary

In the Denver region Charles Hunt of the USGS has found that glacial gravels containing camel and mammoth have been deeply dissected and superimposed by alluvial deposits which lack remains of extinct mammals. He would classify the former beds as Pleistocene, the latter, which were formed during the trenching and later, as Recent, and he would put the boundary between the Pleistocene and the Recent at the beginning of the Altithermal, dated in Europe at 5000 B.C.

Since Altithermal channeling occurred generally in now semiarid (and arid?) regions of the West and probably in those of Mexico, this stratigraphic boundary may be recognizable in a large area. However, no Altithermal stratigraphic break is to be expected in eastern North America, though the temperature was higher there also. (For moisture regions in the United States see Thornthwaite, 1948, pl. 1).

Holding that the Long Drought in part induced the extinction, Roger Morrison argues that, while physical geologists probably would prefer to put the boundary at the beginning of the Altithermal, paleontologists might want to place it near the end. To my knowledge no extinct, only modern, mammals have been found in the deposits from the time of the Altithermal channeling. Therefore in most cases the break dates perhaps from the middle of the Altithermal, from about 4000 B.C.

This regional stratigraphic boundary should be useful. But the terms are inappropriate, for the Pleistocene still prevails, and Recent has been used too loosely for too long to denote a special age.

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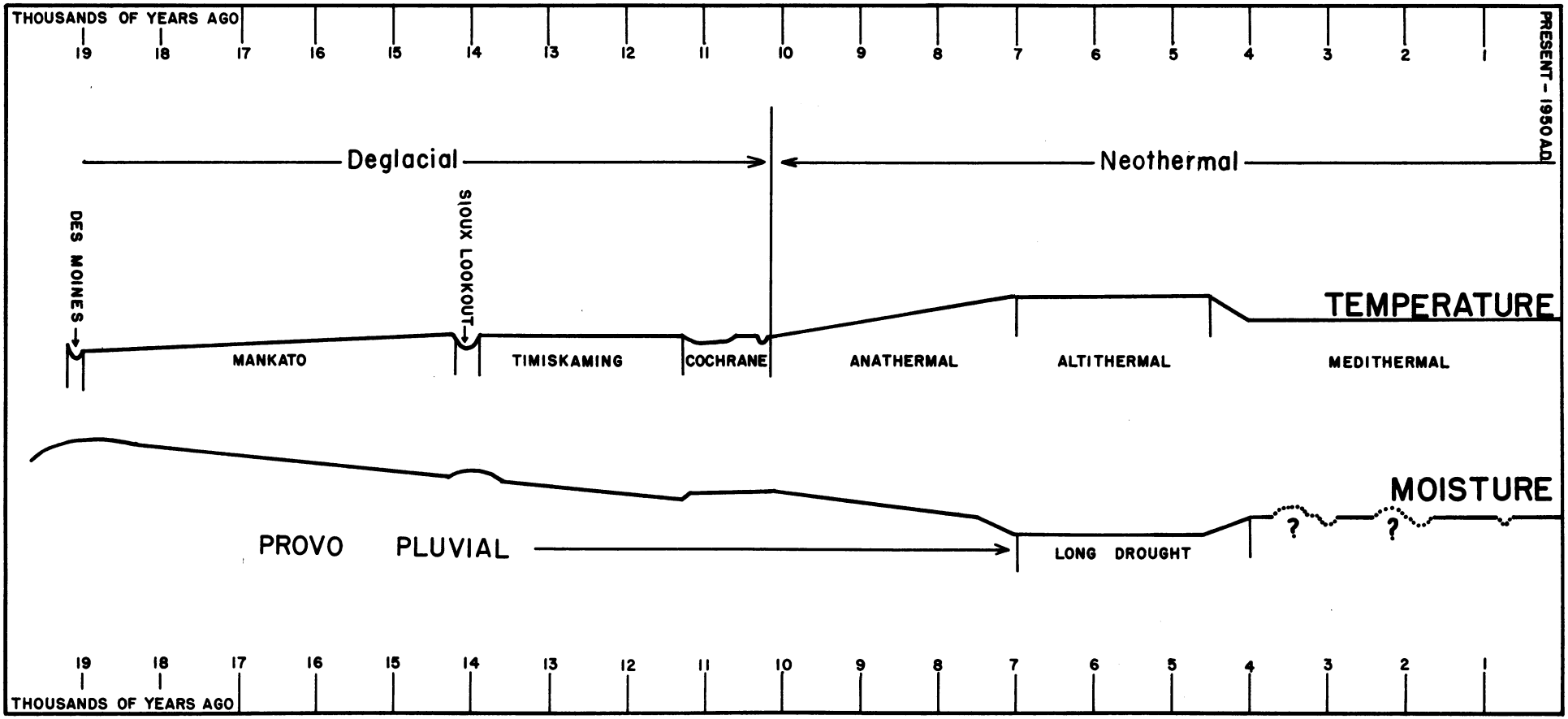

Chart I.

Tentative graphs of temperature and moisture.

Main time divisions of Deglacial and Neothermal ages.