GEOSCIENCE NOTES

Abstract:
The Earth's Changing Climates,
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Our present climates are believed to be abnormal in terms of those of the greater portion of the geologic past. Evidence for the reconstruction of past climatic conditions on land is derived primarily from the study of fossil plants. Methods of study include the following:

1. The overall facies of a fossil assemblage, in which ancient climates are inferred from those of the living relatives of the fossil forms.

2. Selected climatic indicators, like palms or breadfruit, whose presence in a fossil assemblage may give a fairly reliable climatic picture.

3. The use of morphological characters of fossil plants, such as the size, shape, texture, and marginal features of leaves, which differ according to the climatic conditions under which they developed.

Other investigations contributing to our knowledge of ancient climates have been based on studies of the fossil remains of certain climatically-sensitive animals, such as the warmth-loving alligators and manatees or the cold-tolerant musk-oxen and walruses. Among the marine invertebrates various groups, such as reef-building corals and certain foraminifera, have been used as reliable indicators of temperature conditions below sea level. Other studies have been based on the ratio in ancient shell-fish remains of isotopic Oxygen 18 to Oxygen 16, which is controlled by the temperature of the sea water in which the shells grew. Even the rocks themselves, as exemplified by glacial till

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or tillite, red-beds, and evaporites, have been useful as climatic indicators.

The results of all these studies indicate that our present world climate is rather unusual and is basically a cold "glacial" climate. It has further been shown that during more than three quarters of the time since the beginning of the Cambrian Period climates have been much warmer and more uniform than they are today. Glacial climatic epochs have interrupted the warm, uniform climates several times before the onset of our present "ice age".

The last optimum of warm, non-glacial climate occurred in the Eocene Epoch, which began about 55,000,000 years ago. Near the end of this Epoch lush subtropical forests are recorded as far north as southeastern Alaska, Washington, Oregon and northern Wyoming. In the succeeding Oligocene and Miocene Epochs there was a gradual, fluctuating, southward shifting of these subtropical forests due to the slow cooling of the climate. As a result the subtropical forests were gradually replaced by temperate forests until the close of the Pliocene Epoch, about 1,000,000 years ago, when climate conditions in North America were not very different from those of today.

Since that time, some of the most rapid and most significant, yet least understood, climatic changes have taken place. Numerous plant fossils, mainly of pollen grains, indicate a shifting of forest belts southward in front of slowly advancing ice sheets and subsequent northward reoccupation by forests as the ice sheets melted away - not only once, but four successive times during the course of the Pleistocene Epoch. The magnitude of the southward shifting of forest zones is at present controversial.

Since the recession of the last ice sheet from the North American mainland, the climate has varied from glacial cold and humid to a warmer dry stage about 5,000 years ago, followed by a cooler and then a warmer cycle. The later cool episode, "the Little Ice Age" of 1650 to 1850 A.D., has been followed by the present warming trend which should continue with minor cooler fluctuations for at least a few more centuries.