BACKGROUND BOOKS

CLIMATE

Why did dinosaurs suddenly disappear, along with dozens of plants and other animal species, in what appears to have been a mass extinction some 65 million years ago?

That question has long fascinated schoolchildren and scientists alike. In the popular imagination, the answer always seemed obvious: A colder climate did in the dinosaurs. To scientists, as Stephen H. Schneider and Randi Londer report in **The Coevolution of Climate and Life** (Sierra Club, 1984), the answer is not nearly so clear.

Some researchers have suggested that dinosaurs were sterilized when the Earth suddenly warmed due to an early "greenhouse effect." Others have proposed that they were destroyed by a supernova exploding in outer space.

Recently, physicist Luis Alvarez and his son Walter, a geologist, have found evidence that the planet was struck by a huge asteroid at about the time of the dinosaurs' extinction. If so, it may have thrown up a massive cloud of dust, shrouding the Earth against sunlight and leading to a catastrophic cooling. On the other hand, the Earth may have *warmed*—or it may have gone dark, or it may have temporarily lost part of its protective ozone layer. The Alvarezes are not sure. Many scientists are intrigued by the asteroid theory; but others reject out of hand the whole notion of such a catastrophic extinction.

Such are the difficulties of the climatologist; and Schneider, himself a climatologist, and science writer Londer are by far the best guides to the work of these scientists. Their book becomes, in effect, an intriguing essay on how much is still unknown.

Planet Earth, now about 4.6 billion years old, appears to have been a hot, dry, generally inhospitable place during most of its history. During the seven relatively brief Glacial Epochs, each, on average, a mere 50 million years long, Planet Earth has been, in general, *cold* and inhospitable.

If those 4.6 billion years were compressed into 46 years, then the dinosaurs vanished just over six months ago, humanity emerged about seven days ago, and the Industrial Age is about two minutes old. The last Ice Age began about a week ago. From this perspective, as Britain's Sir Crispin Tickell notes in **Climatic Change and World Affairs** (Univ. Press of America, 1986), "we live in a tiny, damp, curved space at a pleasantly warm moment."

In modern times, at least, scientists have concentrated most of their efforts on simply trying to calculate what past climates were like—with mixed success. And readers in search of cosmic speculations about the influence of climate on evolution and human existence are likely to be disappointed.

As Ronald Pearson, a University of Liverpool zoologist, shows in **Climate and Evolution** (Academic Press, 1978), most researchers fasten on discrete cases, such as documenting the adaptation of *Cepaea nemoralis* (a species of snail) to different environments by changing its coloration.

Generally, it seems, every bit of new evidence about, say, the extinction of the woolly mammoth toward the end of the Quaternary Succession (the period beginning 2.5 million years ago and ending 10,000 years ago) spawns a new theory without necessarily eliminating several competing older ones.

Nevertheless, the discussion is often fascinating. The woolly mammoth was just one of scores of species of "megafauna"—sabre-toothed tigers, giant baboons and pigs, the 20-foot tall North American sloth, and beavers as large as bears—that perished in a surprisingly

short period of time beginning about 60,000 years ago. Deepening the mystery is the fact that the oversized mammals survived a whole series of Ice Ages, only to die off as the world's climate was again warming and stabilizing.

In conference papers, learned articles, and books such as **Pleistocene Extinctions: The Search for a Cause** (Yale, 1967), edited by P. S. Martin and H. E. Wright, Jr., scientists have offered several new explanations.

For his part, paleontologist John Guilday suggested that the Earth's post-Ice Age warming expanded southern deserts and northern forests, squeezing many animal species into diminishing grasslands. The smaller mammals, requiring less food, were better suited to survival in the new environment; only those megafauna that experienced evolutionary "dwarfing" (e.g., the bison) were able to survive.

But there were objections to this theory. For example, it was known that many of the later extinct species had been able to extend their range *beyond* the retreating grasslands.

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Other theories were proposed. Diseases bred among animal species isolated by glaciers during the Ice Age may have been unleashed as the planet warmed; a sudden warming could have turned vast areas of the world into deadly bogs that entrapped large mammals; or perhaps "racial senility" rendered entire species unable to adapt to climatic change. Finally, during the late 1960s, some scientists, pointing to fossil evidence that prehistoric man had slaughtered thousands of animals at a time in mass hunts, argued that humans were largely responsible for the relatively swift extinctions.

Today, as Windsor Chorlton notes in his popular account, **Ice Ages** (Time-Life Books, 1983), the "hunter" theory has few proponents. Scientists now generally agree that man may have speeded the demise of the megafauna, but that a changing climate and a variety of other factors (e.g., changing sea levels) appear to have been the chief causes. *How* climate may have helped kill the megafauna, however, remains a matter of intense debate.

The same caution and strict attention to case studies that characterize current research on climate's influence on evolution carry over to most serious investigations of its impact on human history.

The classic work on climatology is Hubert H. Lamb's two-volume **Climate Present, Past and Future** (Methuen, 1977). In his more recent **Weather, Climate and Human Affairs** (Routledge, 1988), Lamb chides historians for ignoring the effects of climate, and allows himself some passing observations about the subtlety of climate's influence. He notes, for example, that architecture seems to be affected by changes in climate. The abnormally dry weather of the 1930s and '40s encouraged the building of flat-roofed houses in England—a fashion, Lamb adds, that the present owners of these leaky-roofed dwellings no doubt regret.

As Theodore K. Rabb writes in **Climate and History: Studies in Interdisciplinary History** (Princeton, 1981), however, historians have not yet developed techniques to gauge climate's effects on human history with any accuracy—except, perhaps, in a few localized cases where climate changed rapidly.

Climate and History: Studies in Past Climates and their Impact on Man (Cambridge, 1985), edited by T. M. L. Wigley, M. J. Ingram, and G. Farmer, provides a scholarly overview of work in the field. Essays include "Climate and Popular Unrest in Late Medieval Castile," "The Economics of Extinction in Norse Greenland," and "The Historical Climatology of Africa."

Historian Emmanuel Le Roy Ladurie's **Times of Feast, Times of Famine: A**

History of Climate Since the Year 1000 (Doubleday, 1971), despite its grand title, is chiefly of interest to scholars exploring methodologies for reconstructing past climates.

The Last Great Subsistence Crisis in the Western World (Johns Hopkins, 1977), by John D. Post, is one historian's ambitious attempt to trace the effects of a single climatic drama: the eruption in 1815 of Indonesia's Mount Tambora, whose ash and gases shut off sunlight and cooled the Northern Hemisphere. The result: crop failures and bread riots throughout Europe. Among the other consequences, according to Post, were a surge of emigration to the New World—and an outbreak of anti-Semitism in southern Germany. Ultimately, he says, "it is not difficult to believe that [climate-induced] economic crisis and social unrest fused with political conservatism to foreclose the emerging liberal ideas of 1815."

Scholars seem to agree that studies of such isolated episodes and their effects are relatively easy work. The greater hazards of more wide-ranging, speculative history are illustrated by the search of climatologists Reid A. Bryson and Thomas J. Murray for past **Climates of Hunger** (Univ. of Wis., 1977). Apparently caught up in a mid-1970s anxiety about the slow onset of a new Ice Age, to which they attributed severe droughts in the Sahel region of Africa, the authors consulted history for precedents. They argued that Mycenae and several other ancient societies had perished because of droughts—produced chiefly by global cooling, exacerbated by the practices of farmers and herders.

They warned of a possible repetition in the future: "Our conclusion is that the net effect of man's burning of fossil fuels, his slash-and-burn agriculture, and his other activities that produce both carbon dioxide and dust, is to *reduce* temperatures" (emphasis added).

Today, of course, most scientists take a contrary view. Their findings and recommendations pour forth in such publications as **Developing Policies for Responding to Climatic Change** (World Meteorological Organization, 1988); **A Matter of Degrees: The Potential for Controlling the Greenhouse Effect** (World Resources Institute, 1987), by Irving M. Mintzer; and **Present State of Knowledge of the Upper Atmosphere 1988: An Assessment Report** (National Aeronautics and Space Administration, 1988). For the layman, the proceedings of various congressional hearings, such as **The National Climate Program Act and Global Climate Change** (Government Printing Office, 1988), provide some of the most accessible guides to current research and prognostications.

The study of climate is still in its youth. It lacks a grand theory. Without much fanfare, scores of scientists and other researchers, in America and abroad, are trying to devise more rigorous approaches to the investigation of the globe's changing climate and its impact on man.