trade winds in Mauritius during March and April may foreshadow the Indian summer-monsoon rainfall.

To synoptic climatologists a fundamental question is how climatic fluctuation results from a change in circulation types. Sung Euii Moon's paper on climatic change in Korea and Masatoshi M. Yoshino's paper on regionality of climatic change in monsoon Asia provide valuable insights on this problem. In all tropical countries rainfall has been found to be the most important factor in the determination of rice yields. In an analysis of the data from 1960 to 1975, Minoru Tanaka noted that India and Bangladesh, where rainfall was highly variable, had the greatest fluctuation in rice yields. There was also a tendency for bad or good harvests to occur simultaneously in most countries in monsoon Asia.

In an excellent article, H. van Keulon presented a framework for a complicated model that incorporated temperature, radiation, and nitrogen to estimate photosynthetic and respiration rates of rice plants during successive stages of crop development as well as the partitioning of dry matter within the plants. Such a model would be useful to compare yield potential in the absence of water deficit for different areas in different seasons. It could also be used by the agronomist as a guide to select the best variety for a specific climatic zone. Unfortunately much basic experimental data needed for such a model are still lacking.

In Japan drought is not a serious problem except in the western part of Kyushu. Most of the articles discuss frost damage, wind damage, and the adverse effect of low temperature on photosynthesis. Various agronomic practices that serve to prevent or to lessen the damage are described in some detail. Perhaps the most interesting paper to geographers is the one by Koichiro Takahashi and Junkichi Nemoto. They found a good correlation between the mean annual temperatures and the rice yields in Japan for the period 1886 to 1974. On the average a 1°C decrease of temperature corresponded to a yield loss of between 20 and 30 percent. This in turn was reflected in the historical records of population fluctuation.

Like most symposium volumes, this book lacks continuity and uniformity of presentation. The overall contribution by the contributors, however, is certainly more substantive than in similar symposia. The volume is recommended for libraries or for a large group of research workers interested in the subject, but not for individuals.—JEN-HU CHANG

ICE AGES: Solving the Mystery. By JOHN IMBRIE and KATHERINE PALMER IMBRIE. 224 pp.; maps, diagrs., ills., bibliogr., index. Short Hills, N.J.: Enslow Publishers, 1979. $12.95. 9 x 6 inches.

Since the early 1970s research on glacial climates has profited greatly from systematic study and synthetic evaluation of the many deep-sea cores that had been removed during the previous two decades from the floors of the world oceans by several oceanographic teams. Much of this earlier exploration had been done out by the Lamont-Doherty Geological Observatory of Columbia University, and a second phase, follow-up analysis, was organized by an offshoot of the Lamont group, particularly by J. D. Hays and John Imbrie, the latter a paleontologist specializing in oceanic microfossils. A National Science Foundation project named CLIMAP was formed in 1971 to coordinate related research efforts at different institutions, in order to reconstruct the history of the North Pacific and North Atlantic oceans during the last 700,000 years. This goal was later expanded to map the surface of the earth during the last Pleistocene glacial and to measure the glacial-interglacial climatic cycles. Probably the most expensive, nonstrategic project ever funded in the natural or social sciences, some $6.6 million were expended between 1971 and 1977.

Much was accomplished. Existing techniques of oxygen isotopic measurement were systematically applied to allow detailed delineation of the glacial-interglacial record preserved in deep-sea sediments. These data were then correlated with older Czechoslovakian work that had established a remarkably similar record of continental deposits in loess and paleosol horizons, both types of sequence now dated within a geomagnetic framework. Next a synoptic map of North Atlantic ocean-surface temperatures, at the height of the last glacial cycle, circa 18,000 years ago, was prepared. Finally an overly ambitious map of world glacial climates was published.

"Ice Ages" attempts to place the achievement of CLIMAP in historical perspective by developing the nineteenth-century background of glacial geology, the earliest astronomical efforts to explain former continental glaciation, and the impact of a Yugoslav astronomer's radiation curve. Milutin Milankovitch first published in 1920 curves of latitudinal isolation changes related to three variable earth-orbital parameters: the angle of the ecliptic, the precession of the equinoxes, and the eccentricity of the orbit. These periodicities do not change total solar radiation received by the earth, but they affect the degree of continentality, the latitudinal distribution of radiation, and the hemispheric contrasts. The next fifty years saw countless circular arguments to date glacial-interglacial cycles by various, tenuous paleoclimatic interpretations of the radiation curve and thence to explain the succession of ice ages already causally linked in this way. Only with the advent of radiometric and geomagnetic dating was it possible to provide an independent temporal frame for the glacial cycles. By 1968 distinct correlations were evident between climatic changes—with a wavelength of several tens of thousands of years (x.10^4 yrs.)—and recalculations of the Milankovitch curve. CLIMAP refined the correlation by spectral analyses in 1976, without establishing the necessary causal linkages in terms of global radiation budgets and general atmospheric dynamics. What the radiation curve has so far also failed to produce are mechanisms for longer-term trends (x.10^5 yrs.) and for the critical, shorter-term perturbations (x.10^3 yrs.) equally evident in the deep-sea and continental records.

As a book, "Ice Ages" is fascinating for the earlier history but becomes self-conscious, pompous, and subjective in presentation of recent research events. For example, we read that "Professor Robley K. Matthews of Brown University boarded a plane for the tiny Caribbean island of Grenada. His fellow passengers were looking forward to a holiday in the sun, but for Matthews this trip was all business." Earlier CLIMAP papers allow the surmise that the dramatic close of the book should have been yet another prediction of an impending new glaciation, as forecast by the radiation curve. Recent, unequivocal evidence for a major warming during the twenty-first century, due to the build-up of atmospheric carbon dioxide from burning of fossil fuel and terrestrial biota, seems to have prompted some poorly disguised, last minute revisions: we are now lead to believe that glaciation has been postponed for 2000 years, with a super-interglacial more immediately ahead. Somehow, I feel uncomfortable when science, autobiography, and elements for mass appeal are all blended into a single mix. There is indeed room for a history of intellectual ideas and for confrontation with the motivations that drive scientists to explore new frontiers. But "Ice Ages" fails to capture any fascinating personalities, and the intellectual plane seems plastic rather than cosmic.—KARL W. BUTZER

AMOSKEAG: Life and Work in an American Factory City. By TAMARA K. HAREVEN and RANDOLPH LANGENBACH. xiii and 397 pp.; ills. New York: Pantheon Books, 1978. $15.00. 9½ x 6½ inches.

In 1837 a group of Boston entrepreneurs bought 15,000 acres of land along the Merrimack River in south-central New Hampshire. The plot surrounded a series of falls and rapids known as Amoskeag. On this site was to rise the city of Manchester, named after the great industrial city in Lancashire and modeled after the growing and prosperous textile town of Lowell, Massachusetts, thirty miles downstream. The industrial complex around the Amoskeag Falls was the quintessence of the nineteenth-century mill town. Long rows of red-brick mills of three, four, or five storeys were laid out along the river, separated by a double set of power canals. The open area between the mills was known as "the Millyard." Brick tenements were built nearby