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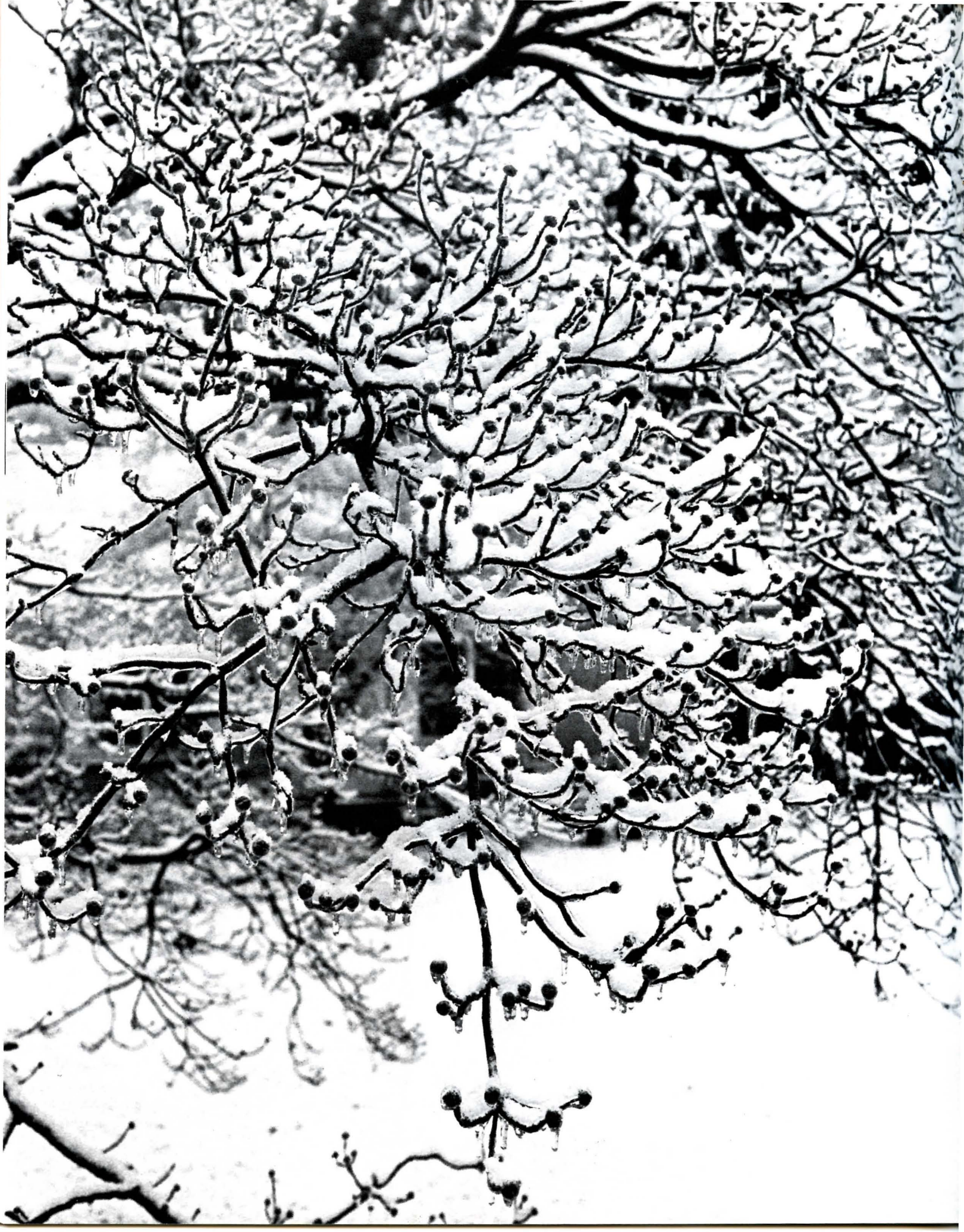


Some scientists speculate that our past two winters show that South Carolina and the rest of the nation are rapidly approaching a doomsday ice age. Here is evidence that the last two years were only short term fluctuations and that milder weather will soon return.

Climatic Change...the Case for South Carolina

©by John F. Sanders

Last year meteorologist Reid Bryson said, "There is a very important climate change going on right now, and if the trend continues, it will affect the whole human occupation of the earth - like a half billion people starving."

In a 1974 report, the Central Intelligence Agency stated that "leaders in climatology and economics are in agreement that a climatic change is taking place, and it has already caused major economic problems throughout the world."

But former U. S. Secretary of Agriculture Earl Butz has voiced the opinion that such statements are at best without scientific basis and are at worst apocalyptic nonsense.

British climatologist C. E. P. Brooks, borrowing a line from Rudyard Kipling, once noted that "there are at least nine and sixty ways of constructing a theory of climatic change." There seem to be at least that many theories about the weather which we might expect over the next hundred or thousand years.

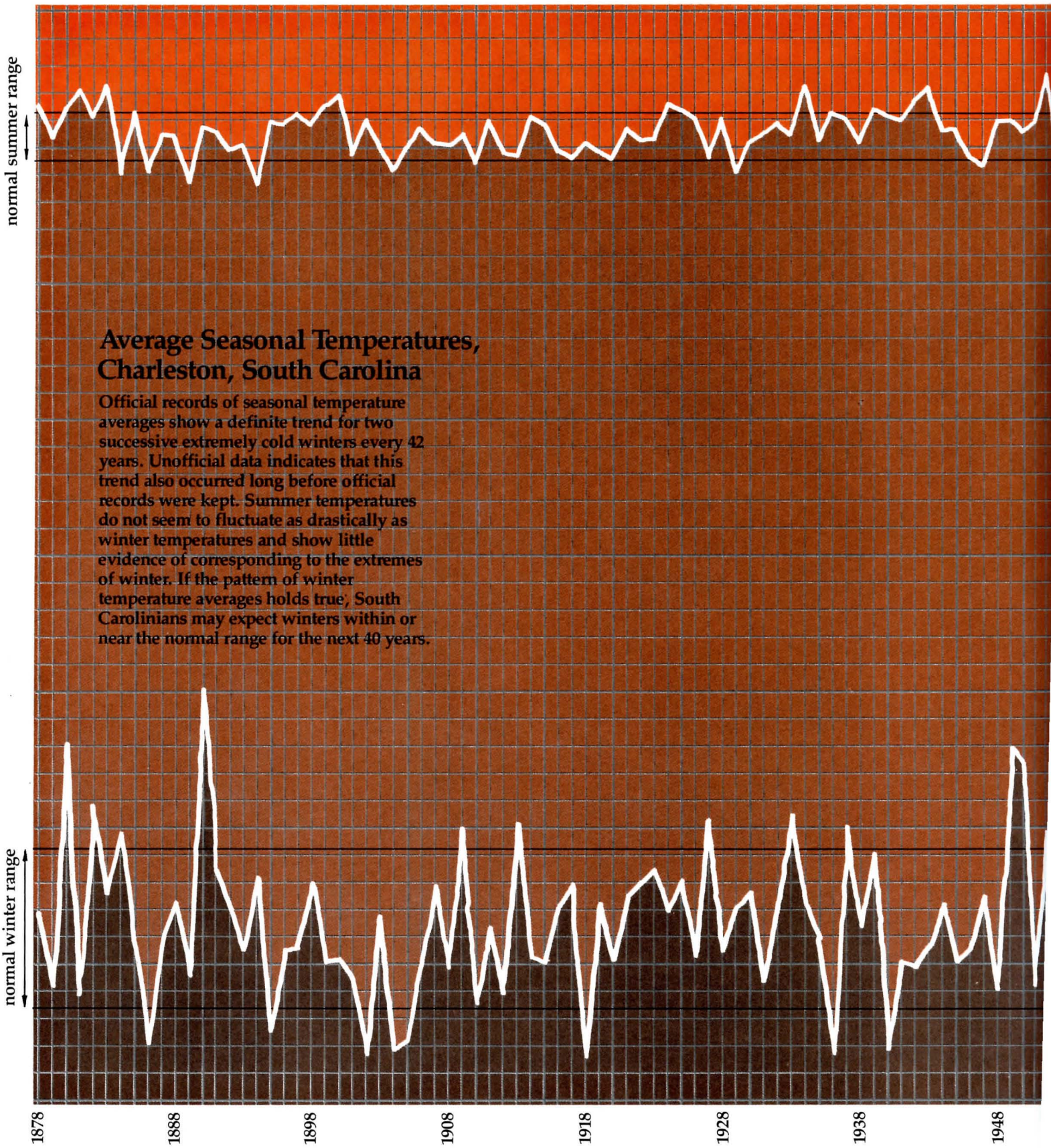
One way to resolve such controversy would be to examine our meteorological records. Instrumental records are extremely limited and at best only cover less than 300 years continuously and then only a few small European cities. Climatic variations which occurred prior to the development of instruments must be inferred from historical evidence and from the geological records of natural phenomena which are, in some way, linked to climate.

Samples of ocean sediments and ancient soils are two of the ways in which scientists may determine information about past sea surface temperatures, ocean floor temperatures, the volume of ice that existed during a particular time, air temperature and precipitation. Geological evidence from these and other sources depicts a past world significantly different from the present.

Climatic variations may occur on a time scale ranging from a season to millions of years, but, during the last billion years, the prevailing large scale climate has been as much as 18°F warmer than our present weather, with an almost complete absence of polar ice. Three major ice ages interrupted this warm condition. Then, approximately 50 million years ago, a gradual cooling trend started which culminated about two million years ago in the arrival of a fourth major ice age characterized by a sequence of perhaps 20 major glacial-interglacial oscillations.

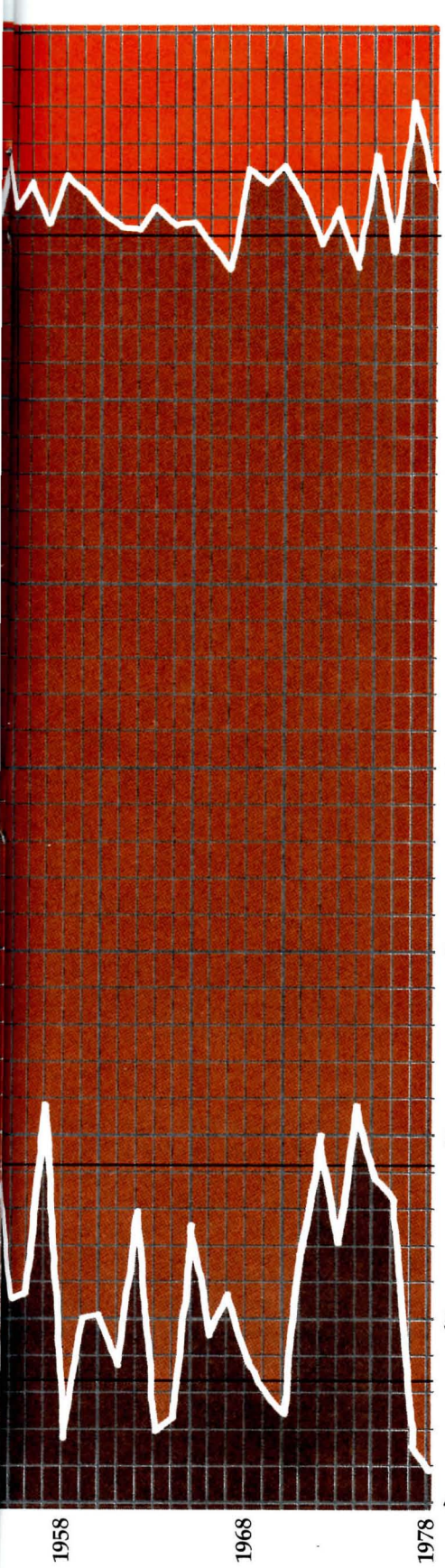
The peak of the last glacial episode recurred 17,000 to 18,000 years ago, when an ice sheet over a mile thick covered the northern and middle latitudes of North America as far south as New York. From this time through the present, the earth has been in an interglacial period.

The winter of 1976-77 brought record cold to many regions of the United States, including South Carolina. That



Average Seasonal Temperatures, Charleston, South Carolina

Official records of seasonal temperature averages show a definite trend for two successive extremely cold winters every 42 years. Unofficial data indicates that this trend also occurred long before official records were kept. Summer temperatures do not seem to fluctuate as drastically as winter temperatures and show little evidence of corresponding to the extremes of winter. If the pattern of winter temperature averages holds true, South Carolinians may expect winters within or near the normal range for the next 40 years.



following summer was warm and dry and many of us watched helplessly as corn fields withered beneath a merciless sun. Then the coldest winter in over a century enshrouded the state, chillingly penetrating our lives with discomfort and inconvenience. Some individuals and tradespeople experienced considerable economic loss due to these extremes of weather. Is our weather really changing, or does a fluctuation from the average conditions normally occur?

Between 1900 and 1940 a very marked rise in annual temperature occurred. This corresponds to the general trend of increasing temperatures experienced globally during this time period. The average temperature increased over the continents of the Northern Hemisphere by almost 1.5°F. This trend reversed itself between 1940 and 1970 as the average hemispherical temperature cooled by 1°F, with the decreases even greater in the higher latitudes. Such variations in temperature also occur within South Carolina.

With only one exception, the annual temperatures for Charleston are warmer than those for Columbia which, in turn, are warmer than the annual temperatures for Greenville. Western location and higher elevation are key factors which contribute to Greenville's lower temperatures and the influence of the Atlantic Ocean greatly modifies the environmental conditions in Charleston by helping to warm the winters and smoothing seasonal extremes.

Dominating the temperature records for all three locations are the extremely high annual temperatures of the 1930s. High temperatures and low rainfall for several years created hardships for the farmers of this agricultural state. Money had to be spent to buy additional seed as the weather conditions often made replantings necessary. Crop yields were sometimes reduced significantly due to the lack of rainfall.

Another period of unusually warm and dry weather occurred in the late forties through the mid-fifties. The warm weather of the mid-1950s turned cool by 1958 and in the 1960s sea ice began to form along the coast of Iceland after an absence of over 40 years. The recession of glaciers in Alaska and Scandinavia slowed markedly while alpine glaciers in Switzerland began to advance again.

In Great Britain, climatologist Hubert Lamb observed a shortening of the growing season by 9 to 10 days since the warmest decades, 1930s-40s. The growing seasons in the Soviet Union are now estimated to be 10 to 14 days shorter than in the forties. The growing seasons here, though varying from year to year, have not changed significantly.

Annual temperatures began to increase again in the 1970s. Since the mid-seventies annual temperatures have appeared fairly warm, but beneath those figures are two of the coldest winters ever recorded in South Carolina.

If we look at seasonal rather than annual temperatures we can better appreciate the severity of our recent winters and summers. The winter seasons exhibit much more variability of temperature. A normal range of the summer temperature variations is about 2°F, while the range for the winter temperature variations is 6°F.

The seasonal records also help to indicate how deceptive an annual average temperature can be. When viewed from the record of the annual temperatures, 1899 appears to be an "average" year for Columbia. But that year folks in the Sandhills experienced a fairly cool winter and a hot summer. In 1937, the annual temperature for Greenville also represents an "average" year. Yet both the winter and summer were warm while the spring and autumn were cool transitional seasons.

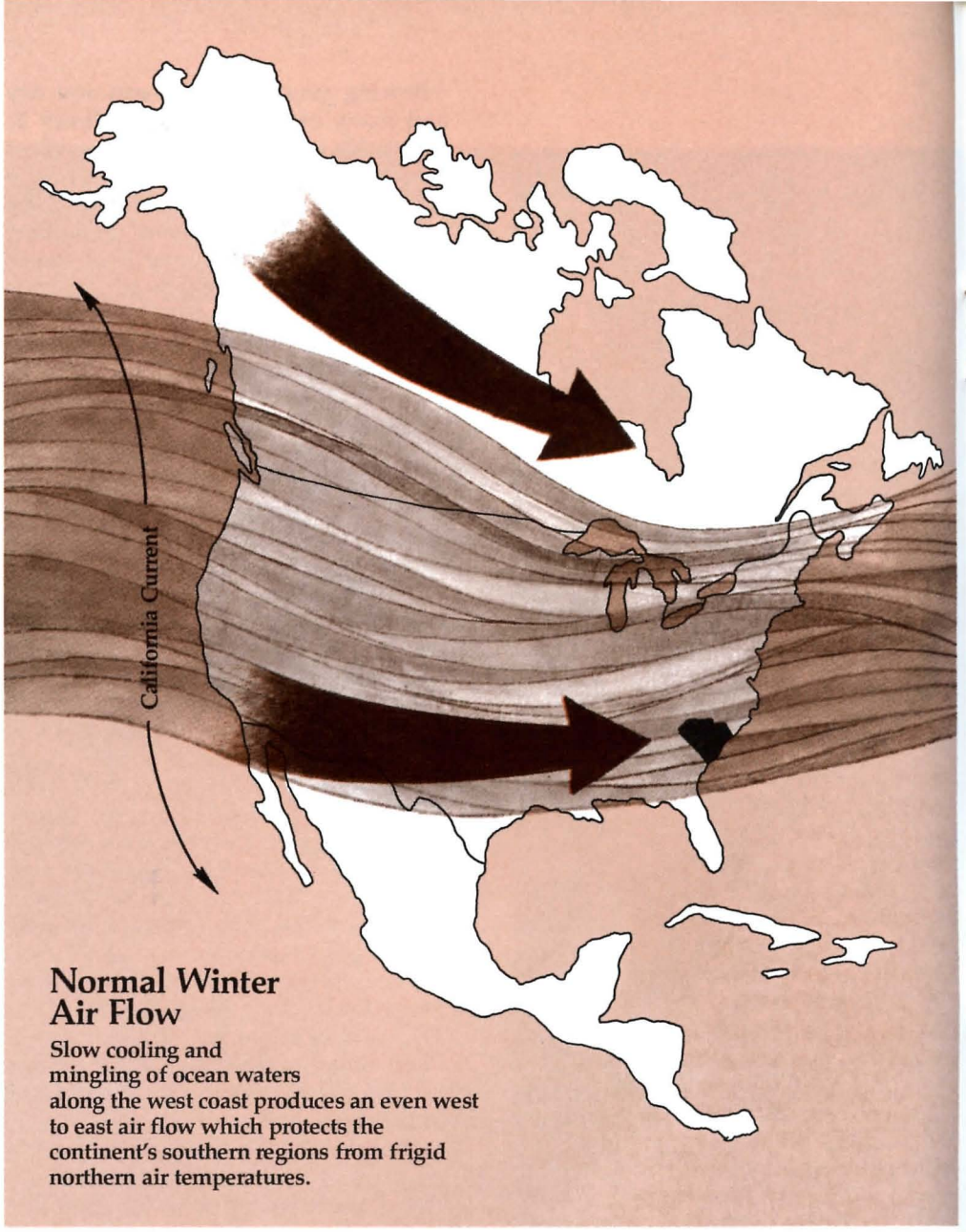
South Carolinians experienced very cold winters from 1899 to 1905 and they shoveled a considerable amount of snow in the 1910s. In February of 1912 an unusually heavy snowstorm in the eastern Carolinas buried Smith's Mill under 18 inches. Just two years later in February, 1914, snow again blanketed the state and a record 18 inches fell in less than 24 hours at Society Hill.

Winter temperatures began to increase, and by 1932 record seasonal temperatures were set in Greenville and Columbia. With the exception of 1936 and 1940, winter seasons remained fairly warm until 1958.

The warmth of the 1948-49 and 1949-50 winters caused premature and rapid development in fruit trees. A similar situation developed in 1955 and similarly, a late freeze crippled the peach farmer. On March 26-27, 1955, an unprecedented cold wave swept across the state, leaving in its wake seriously injured garden vegetables, grazing and commercial truck crops. The damage incurred in fruit and nut crops was virtually complete; the combined tonnage

Normal and Temporary Atmospheric Circulation

Under normal conditions, warm Pacific waters cool gradually as they meet the cool southward flowing California Current. This sets up a fairly even zonal west to east flow of air currents. For unknown reasons, Pacific waters have been warmer during the past two winters causing a greater difference in temperatures between the sea waters and those of the California Current. This rapid change in water temperatures has created a twisting meridional effect in air currents.



Normal Winter Air Flow

Slow cooling and mingling of ocean waters along the west coast produces an even west to east air flow which protects the continent's southern regions from frigid northern air temperatures.

harvested in 1955 was less than 2 percent of the 1954 production. The estimated loss by peach growers alone was in excess of $10 million.

Temperatures really took a dive in 1958 and the cold continued in the winter of the 1960s when four major snow storms hit South Carolina! Eight states were left paralyzed after a storm in March, 1960. Landrum received 10 inches of snowfall in less than 24 hours during a January, 1965 storm, and all previous records were broken when 28.9 inches covered Caesar's Head during February 15-16, 1969.

Extreme cold can directly affect the productivity of our farms, forests and fisheries. In South Carolina estuaries and offshore waters, temperatures lower than 45°F for an extended time period can decimate the populations of overwintering white shrimp. In December, 1962, water temperatures dropped to 41.5°F for several days. The catch of white shrimp that fall (September-December 1963) was the lowest ever recorded—only 183,000 pounds. This is equivalent to a very slim 7 percent of the average fall catch taken during 1965-1974! Another cold winter occurred in 1964, with water temperatures hovering in the low forties for eight consecutive days. The fall catch of white shrimp was somewhat better than in 1963, but still only 487,000 pounds.

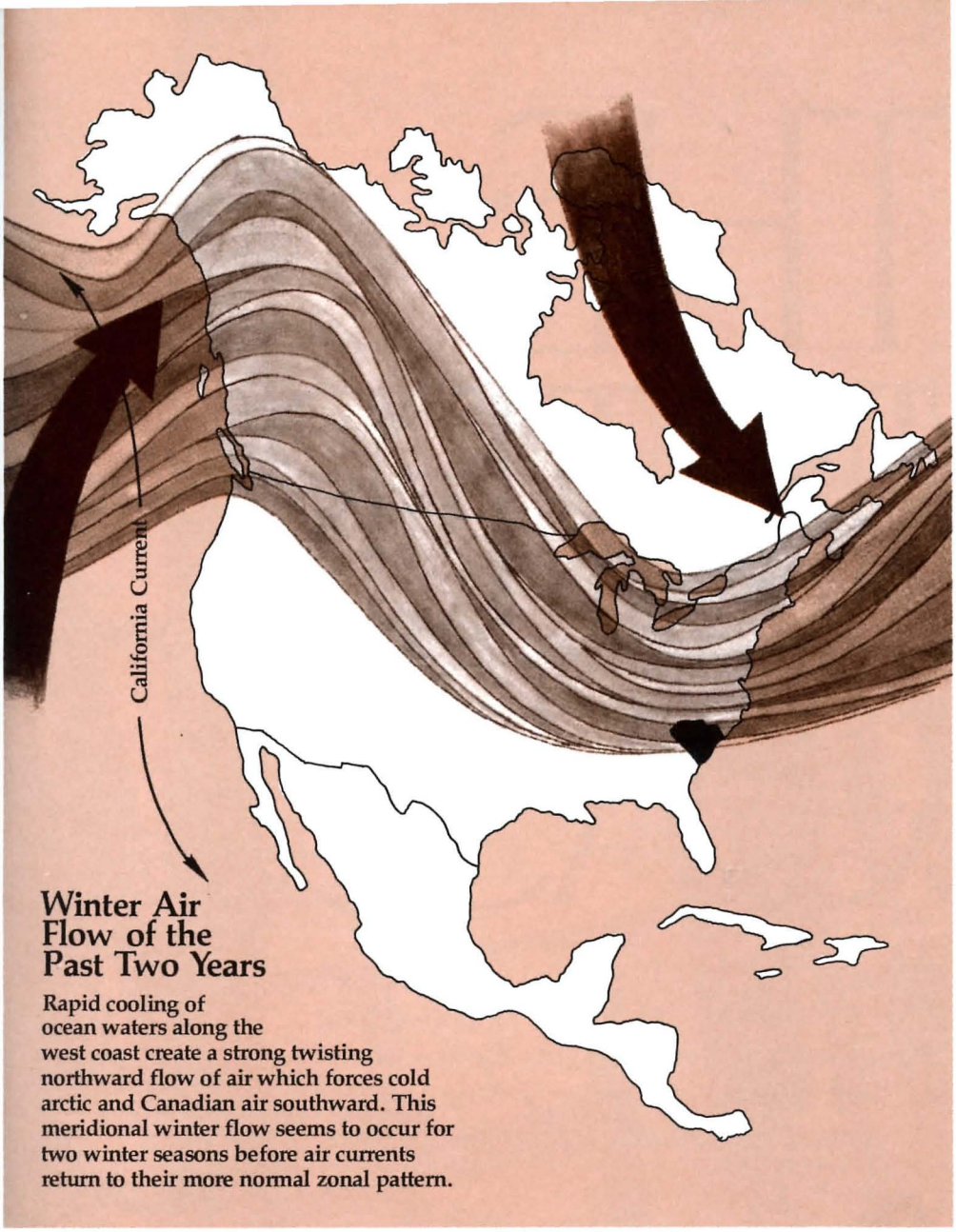
A warming trend seemed to occur after 1970, but this trend was a short term oscillation as temperatures dropped to new lows during the past two winters. The winter of 1977-78 stands as a record low winter temperature for Columbia and as the official record low for Charleston (though unofficially both the winters of 1855-56 and 1758-59 were colder for Charleston). For Greenville, 1904-05 remains as the coldest winter season on record.

The winter of 1977-78 was the coldest winter in over a century for several locations in South Carolina but it was warm in comparison to the winters of 1902, 1904, 1905, and 1909 in Greenville. The average temperature there during the winter of 1905 was a chilling 35.4°F.

There have been few years in which extremely cold winter seasons occurred consecutively. Statewide, those years were 1904 and 1905, 1963 and 1964, 1969 and 1970, 1977 and 1978, six of these extreme winters took place in the last 15 years. In planning for the future, we must watch the weather closely.

Climatic variations can have tremendous impact upon food and fiber crop yields, livestock production, forest productivity, fishery yields, diseases and pests, land and water resources, energy production, distribution and use, transportation and communications and public health. Temperature and rainfall variations play an important role in agricultural and forest productivity. Atmospheric fluctuations also affect marine life, with repercussions felt by our fishermen.

Because climate has a profound influence on the amount of power generation required, an early awareness of the impact of climatic fluctuations on power generation is important. An extremely



Winter Air Flow of the Past Two Years

Rapid cooling of ocean waters along the west coast create a strong twisting northward flow of air which forces cold arctic and Canadian air southward. This meridional winter flow seems to occur for two winter seasons before air currents return to their more normal zonal pattern.

cold winter for which preparation was not made would induce gas and oil shortages for our region.

Land and water resources are especially vulnerable to damage during periods of extended drought or periods of excessive rainfall, which develop most often during the summer months.

"The most widespread and disastrous drought in the history of South Carolina prevailed from January and November, 1925," Columbia meteorologist John Purvis reminisced about that summer. "I was only five years old, but I remember it well. Everything turned brown. Conditions were just miserable." An old meteorological report observes that, "all vegetation deteriorated incident to the drought, large numbers of forest trees died and forest fires became more numerous, even in the swamp regions. Many streams were the lowest of record, with hydro-electric power correspondingly reduced, and scarcity of water in the interior resulted in considerable premature marketing of livestock."

The 1950s presented South Carolinians with several extremely warm and rather dry summers. One of the driest and warmest years on record for several locations in the state was 1954. The summer drought, in tandem with damage from Hurricane Hazel in October, produced economic losses in excess of $100 million.

We watched with great concern last summer as our lakes began to dry up and crops withered in the fields. Farmers in 27 counties applied for federal emergency disaster relief, estimating crop losses at $143,422,000! Seventy percent of the livestock producers in the state applied for aid. The estimated reductions in stock were 60,850 head of cattle, 22,000 swine, and one million chickens.

Although rainfall amounts for the 1977 summer appeared near the average, periods of dry weather were extended. Yet, by many meteorological standards the summer of 1977 was not very severe. The losses which were incurred point out that, as man's technology advances, his vulnerabilty to minor climatic fluctuations seems to increase.

There are several important atmospheric variables, but temperature and precipitation are the conditions most easily observed and recorded. Rainfall can be extremely important, and heavy rains can damage personal property, affect water quality and impair transportation and communications systems. Occasionally, deaths occur due to heavy flooding. South Carolina is also subject to severe wind storms, especially from tornadoes and hurricanes, which can destroy a person's livelihood. At present, we must be content in the knowledge that our state is moderate in both these conditions. Records over the past years show only a few exceptions from our normal summer climate which is ideal for crop production and winters are normally much milder than those in more northern states.

Our climate, and that of the rest of the northern hemisphere, has been out of the ordinary during the last few years with extreme cold during the winter months and drought during the summer. But there is not enough evidence to indicate a drastic permanent climatic change. Rather, it would seem from past annual and seasonal records of temperature and precipitation that the past two years are only peaks in a fluctuating cycle occurring normally in an interglacial period of tens of thousands of years, hardly the evidence needed to predict an impending doomsday with our world frozen over in glacial ice.

Our earth's climate is not static, it has changed tremendously in the past and will change in the future. But for now, maintenance of atmospheric research programs in conjunction with a weather-informed public are the vital elements needed to preserve our daily lifestyles from these occasional dips and peaks of weather.