our own sun. On another front, she says, the survey suggests that our own sun was once radically more active than it is now. The sun is currently some 4.6 billion years old, and its variations in luminosity during a sunspot cycle are no more than a fraction of a percent. But when it was only 1 billion years old, judging by survey stars of that age, it had ten times as much of its surface covered by sunspots, and its fluctuations in luminosity during the cycle could have been as high as several percent. No one knows how this affected the young earth, but presumably the impact on the primordial climate was large.

At the moment all these observations are being done manually, says Baliunas, which means that they take up an enormous amount of professional time. Before too much longer, however, it should be possible to ease that burden with automation. At the Smithsonian's Whipple Observatory in Arizona, for example, the three robotic telescopes of the Automatic Photoelectric Telescope Service are left unattended on the mountaintop in a building to protect them from wind and rain. Every evening at sundown, an automated weather station on the building checks the environment and, if conditions are favorable, rolls back the roof to let the telescopes measure luminosity variations in a preprogrammed list of stars. In the morning, the roof is closed again and the data sent back to headquarters.

In the future, says Baliunas, she and her colleagues on the HK Project are hoping to implement this robotic observing concept in a new, lightweight 2-meter telescope on Mount Wilson. (The existing 60-inch and its dome, which date from 1908, are considered too heavy and clumsy for entirely automated observing.) The remarkably steady atmosphere and cloudless skies of Mount Wilson continue to make it an excellent site for this kind of work, she points out, even though air pollution and sky glow from nearby Los Angeles have long since ruined it for studies of the distant galaxies and quasars. Indeed, she and her colleagues consider it crucial to keep on observing there, since moving to another site would produce a discontinuity in the survey records that would be hard to correct for.

That continuity has been in doubt since 1984, when the Carnegie Institution of Washington announced that it would withdraw as operator of the observatory. Just this past January, however, the operating responsibility was officially transferred to a new private organization, the Mount Wilson Institute. Thus, says Baliunas, it now appears that the Mount Wilson facilities will be kept open permanently.

■ M. MITCHELL WALDROP

1988 Ties for Warmest Year

The man who last summer said the greenhouse warming is here, James Hansen of the Goddard Institute for Space Studies, also said that, barring an improbable event, 1988 would be the warmest year on record. Well, he was right about 1988, but only barely. A consortium of British climatologists announced at the end of January that the globe's average temperature for 1988 was 0.34°C above that of the 1950–79 reference period. The past year thus noses out 1987, at 0.33°C above the reference, for the honor of warmest year in the 100-year record of instrumentally recorded global temperatures. But it is only a titular honor. "It's above the previous year," says Philip Jones of the University of East Anglia, but considering the inherent errors "it's not any different than the previous year." The year 1988 will have to settle for a tie.

Nineteen-eighty-eight does continue the run of warm years in the 1980s, according to the British group, which is composed of Jones and David Parker of the Meteorological Office in Bracknell and their colleagues. This decade lays claim to the six warmest years in the instrumental record, as analyzed for land by the East Anglia group and for sea surface temperatures by the Met Office group.

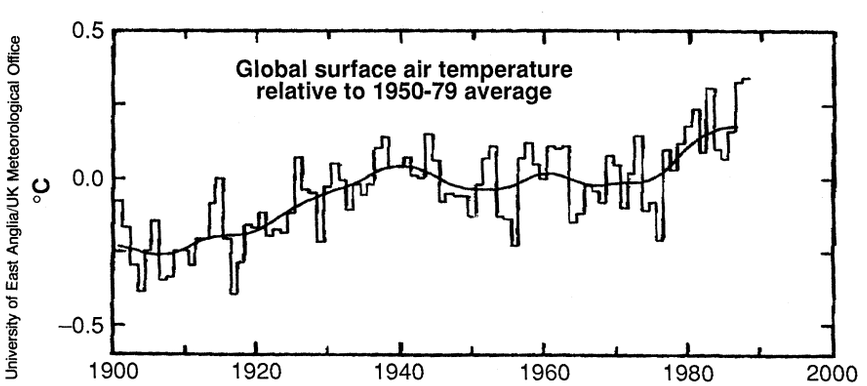
That the year managed even a tie might be taken as a sign of the robustness of the current surge of warming. Hansen's "improbable event" materialized last spring in the form of a sudden cooling of the tropical Pacific Ocean at the end of the 1986–87 El Niño (*Science*, 26 August 1988, p. 1037). It was a strong cooling, or La Niña, and the first major cooling since 1975 even though such coolings had recurred about every 4 years on average during the past century. Nineteen-seventy-five was also, perhaps only incidentally, the beginning of the current surge of global warming. There is an approximate 6-month lag between the beginning of a La Niña and its effect on global temperatures, but 1988 still "shouldn't have been as warm as 1987," says Jones, all else being equal.

The thought that it may be the greenhouse effect that is making all else less than equal is on everyone's mind. The British are still cautious. "It's the multiyear and decadal trends, not the individual years, that are important," says Jones. "While this [trend] is consistent with the theory, it can't be taken as unambiguous proof. We still need more warm years before we can say we've detected an effect."

This year should offer an interesting test. The global temperature was dropping toward the end of last year, especially at low latitudes, as La Niña took effect. And 1989 will likely be a La Niña year from beginning to end. On the assumption that only La Niña will be cooling the globe, Jones "would expect 1989 to be about 0.2°C colder than 1988," or still about 0.15°C above the reference period.

Another warm year in the 80s, in the face of La Niña cooling, would certainly impress climatologists, but it would not convince them. The cautious attitude pervading the climate community can even at times temper Hansen's confidence in his claimed detection of a greenhouse warming in 1988. Writing in the *Journal of Geophysical Research* last August, with seven coauthors, he concluded that "The greenhouse warming should be clearly identifiable in the 1990s." Perhaps in several years, when the next La Niña again tests the robustness of the warming trend, the consensus could shift.

■ RICHARD A. KERR



The warming trend continues. *The century-long global warming of about 0.5°C has had its ups and downs, the latest upturn coming in the mid-1970s.*