Chapter 14

To the Ends of the Earth

In This Chapter

- The 7-minute total eclipses occur every 18 years 11⅓ days, most recently in Hawaii and Mexico
- European eclipses are popular sights
- Recent American eclipses have been only annular or partial
- African eclipses link the Sun with safaris
- The Australian outback can give clear skies

Eclipses are seen by three kinds of people:

- Scientists who travel to see them
- Tourists who specialize in traveling to eclipses
- People who are lucky enough to live along the eclipse path already

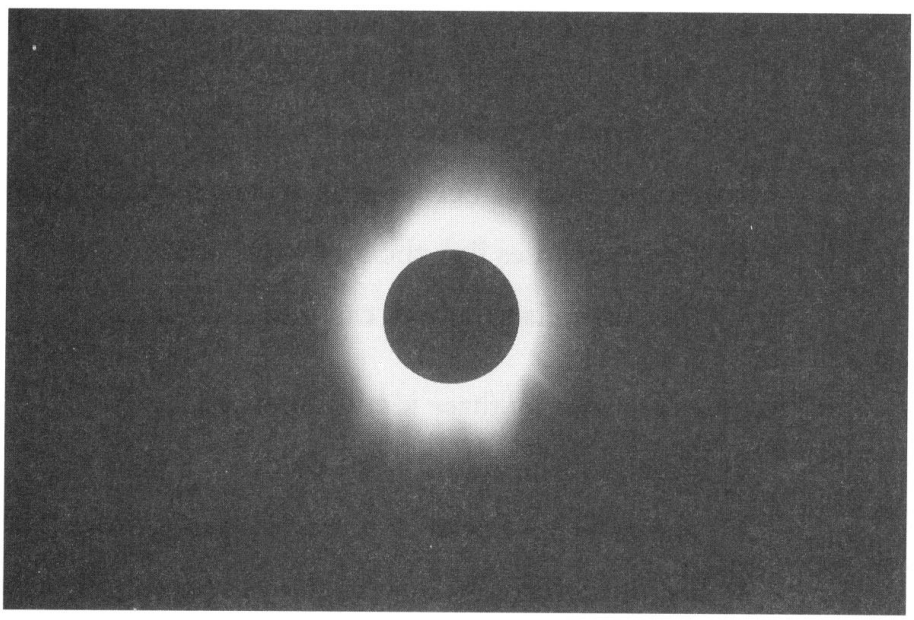
No total solar eclipses have crossed the continental United States since 1979, although there have been a couple of annular ones, plus a largely cloudy total eclipse in Hawaii.

As Long as Can Be

As we already discussed, at intervals of every 18 years 11⅓ days, the longest total eclipse in a saros interval appears. Most recently, the path of the July 11, 1991, eclipse crossed Hawaii and then traversed the Pacific Ocean to hit North America at Baja California. Totality proceeded over Mexico City and down to South America.

Solar Scribblings

The previous 7-minute eclipse to the 1991 event crossed Africa. The peak duration was in the Sahara desert north of Timbuktu, the contemporary remnant of a historically glorious city in Mali. I traveled there in advance of the eclipse to see if we could handle the logistics, but we decided eventually to observe the eclipse from Kenya, where totality was shorter but weather predictions and logistics were better.



The eclipsed Sun in the sky during the 1973 eclipse. Viewing conditions were best in Kenya, where this picture was taken, although the eclipse totality exceeded 7 minutes in the Sahara.

(Jay M. Pasachoff, Williams College Expedition)

Predictions of weather are made long in advance—not real weather predictions, but actually statistical evaluations of past cloudiness. In this case, the predictions called for a 90 percent chance of seeing the eclipse both in Hawaii, with 3 minutes of totality, and in Baja California, with almost 7 minutes of totality.

I opted for taking my team of students and colleagues to Hawaii, since we wouldn't have to go through the logistical bother of taking our equipment through customs. We were willing to sacrifice some minutes of totality for what we thought were better logistics. We were located at sea level.

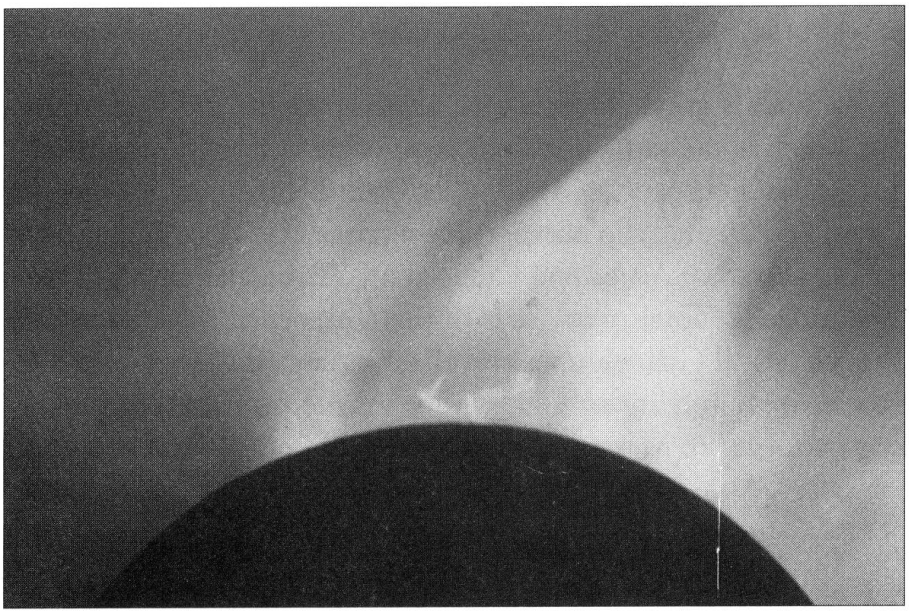
Other scientists were using the major observatory on top of Mauna Kea, the volcano that was visible from our site. Some of the world's largest telescopes are there.

But a Pacific storm came up, not to mention volcanic dust blowing from the eruption of Mt. Pinatubo in the Philippines, which had started not long before. The eclipse was in the early morning in Hawaii. The day of the eclipse dawned cloudy and then cleared overhead. The question was which would happen first: the clouds dispersing or the Sun rising over the cloud rim into clear sky. Unfortunately for my site, the clouds won. We didn't see totality, which was a tremendous disappointment. But by 8 A.M., the sky had cleared and we could see the final partial phases. In the weather records of Hawaii, the day will be marked down as "clear."

On top of Mauna Kea, at 14,000 feet of altitude, the scientists did better, but barely. Clouds from the storm were rising even to the top of the mountain, and it looked as though the telescope domes would have to be shut to protect the telescopes from moisture. But the clouds held off long enough for observations to be made. The most successful were by a team led by Serge Koutchmy of the Institut d'Astrophysique in Paris. He used the Canada-France-Hawaii Telescope to get exceedingly high-resolution images of the corona, and he even detected some changes during the three minutes of totality.

Fun Sun Facts

People who travel to eclipses are often called "eclipse chasers," but I don't like that term; as we have seen, eclipses move too fast to keep up with. I've never chased an eclipse; the eclipses always catch up with me. I prefer the term umbraphile—or no special word at all.



A high-resolution image of the corona taken at the Mauna Kea Observatory during the total solar eclipse of 1991.

(Serge Koutchmy, et al.)

In Baja California, the eclipse took place almost directly overhead. The temperature was very high, but the day was largely clear. Cabo San Lucas, the resort city where most people were housed, was in the path of totality but wasn't central. People who stayed there were successful. But some of the people who made the trek to the center line were clouded out. Still, on the whole, the Baja sites were clear.

The eclipse proceeded to cross Mexico City, with its almost 20 million inhabitants, in clear weather. Perhaps as many saw this total solar eclipse as any other in history.

Rooting for Extreme Cold

The total eclipse of March 9, 1997, crossed only remote and cold terrain in northern Mongolia and Siberia. Still, the hope that we would have cold and clear weather led some of us to tackle the trip.

A special chartered train took us north from Ulan Bator, the capital of Mongolia. We went north about six hours, viewing the conical housing called yurts alongside the train tracks. But the clear, cold weather we had hoped for didn't materialize. It had actually been 50°F in Ulan Bator, and it was close to freezing at the eclipse site instead of –20°F. It actually snowed, and we tried to view the eclipse through the snow. Fortunately, the cloud cover was thin, and we got at least a glimpse of the corona, though not a good one.

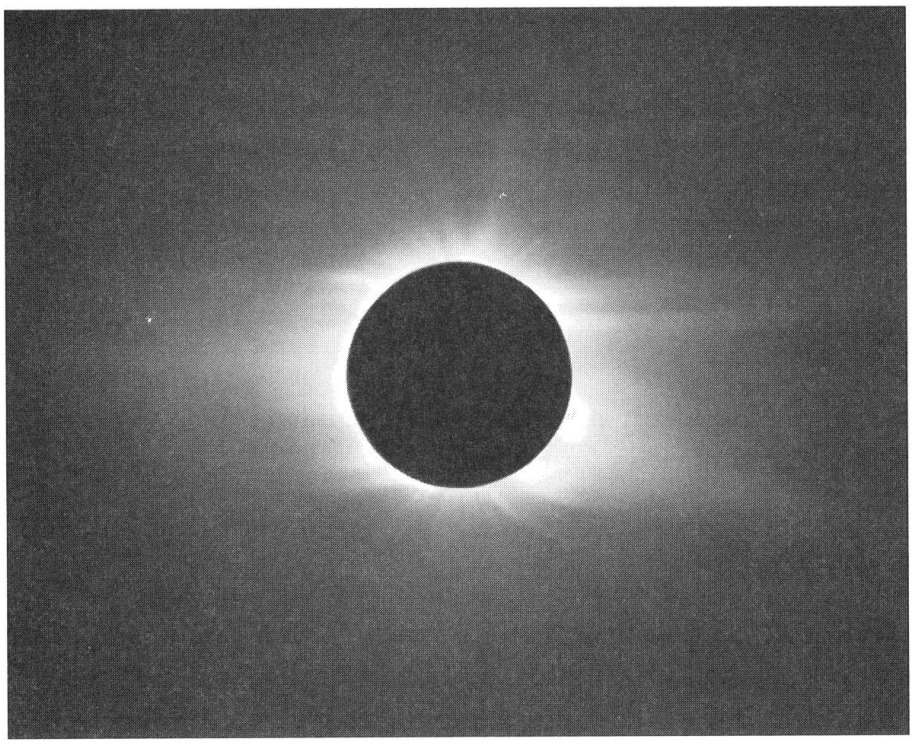
Farther north, it was indeed clear and cold in Siberia. A Russian team was successful there in observing the eclipse.

Caribbean Sun

An eclipse in the Caribbean sounds good. After all, we want to see the Sun instead of clouds during the eclipse, which is the same goal that most tourists have during their vacations. The path of totality on February 26, 1998, went over the northern Galapagos Islands, the southern border of Panama, the northernmost parts of Colombia and Venezuela, and then over the islands of Aruba and Curaçao off Venezuela's coast. These islands are part of the Netherlands. Totality on parts of them exceeded three minutes. Later in the path, the French island Guadeloupe, as well Antigua and Montserrat, all in the West Indies, saw the eclipse. Totality on Guadeloupe ranged from zero through three minutes, depending on location. Many cruise ships also came into the path of totality.

A steady wind of at least 20 knots blows over Aruba, which we discovered to be a desert island. We spent a lot of our time building windbreaks, though we did get our equipment set up on the roof of a hotel.

We had largely clear weather, but about two hours before the eclipse, the sky clouded up completely! Fortunately, it then quickly cleared, and there were clouds in the sky for us during totality, but not in the direction of the Sun. Most other eclipse viewers also saw the spectacle.



The totally eclipsed Sun, viewed from Aruba during the total eclipse of 1998.

(Jay M. Pasachoff, Williams College Expedition, and Wendy Carlos)

Eclipses in Europe

The hundreds of millions of people living in Europe enjoyed the total solar eclipse of August 11, 1999. The peak of the eclipse occurred in Romania, a few hundred miles northwest of Bucharest. But the duration of totality was fairly flat over Europe, not changing very much from two minutes.

The weather forecasts indicated little chance of seeing the eclipse in Cornwall, England, where it was almost certainly going to be cloudy. Still, some diehard British tourists insisted on staying there. The weather was predicted to be spottier across Western Europe, with better weather in Eastern Europe, and that was the case. After southern England, the eclipse crossed parts of France, Belgium, Luxembourg, Germany, Austria, Hungary, Yugoslavia, Romania, and Bulgaria. The people who saw the eclipse in Germany, for example, saw it through holes in the clouds, sometimes dodging rainstorms.

I took my own scientific group of staff and students to Ramnicu Valcea, Romania, right at the point of maximum eclipse—in both duration and height in the sky. We

spent about 10 days onsite getting our ton of equipment ready and aligned to track the Sun. We observed the eclipse in completely clear sky.

The eclipse proceeded over Bulgaria and to the Black Sea. Many eclipse tourists saw the event from Turkey, where it was very clear. Totality continued along its path to northern Iraq and to Iran, where the skies were also completely clear. It concluded in Pakistan and India.

At midnight following the eclipse, at our site in Romania, the bad weather reached us from the west, and a terrible windstorm tore apart the housing for our equipment, which had largely, but not entirely, been disassembled. So we had success, but only by about 12 hours.

Recent American Eclipses

Though no total eclipses have crossed any part of the U.S. mainland since 1979, two annular eclipses provided interesting views for millions.

1984 Annular Eclipse in the South

The 1984 eclipse was predicted to be annular, but just barely. The Moon was to cover 99.9 percent of the Sun, so we hoped to glimpse a bit of corona. I set up equipment in Virginia, ready for the event. But the days preceding the eclipse were cloudy and were getting worse.

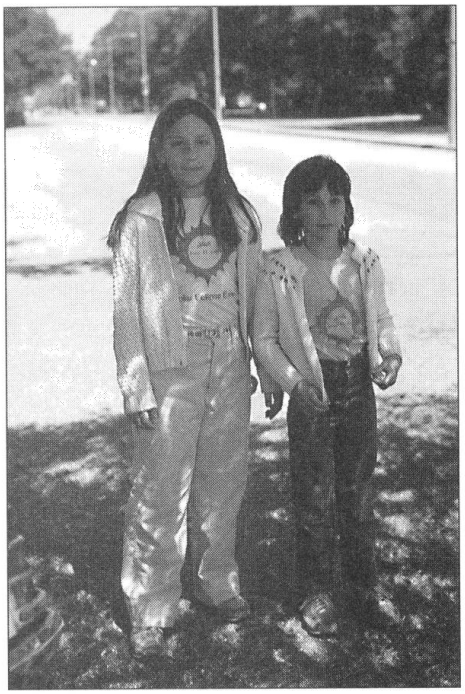
Sun Safety

I lectured at a school in Williamsburg, Virginia, and was shocked and dismayed to find that the school board wasn't going to let the students out to see the eclipse, for fear of eye damage. We tried reasoning with the principal, and the teachers were on our side, but we didn't win. At least it turned cloudy there, so the students didn't miss anything they might have seen.

But had the day been clear, the students would have learned later that day that many people had seen the eclipse safely. They probably would have trusted their teachers and public officials less when, in later months or years, they issued warnings about other things—drunk driving and so on. The net loss by preventing students from seeing eclipses safely is possibly tremendous.

The night before totality, I decided that optimism is good but that realism has to win. My family and I set out to fly to New Orleans, and we intercepted friends from New

York who were about to fly to Virginia. Early in the morning, we drove up into the band of annularity, which included Picayune, Mississippi. We drove to the town square, to get the pretty steeple of a church in our views, and even found another eclipse tourist there already.



Pinhole crescents on my children during the partial phases of the annular eclipse of 1984, viewed from Picayune, Mississippi.

(Jay M. Pasachoff)

The day was perfectly clear, and the Moon indeed almost entirely covered the Sun. But even that 0.1 percent made the sky too bright to see the corona. At another location, *Sky & Telescope* editor Dennis di Cicco used an ingenious method of covering up one side of the Sun with a filter, in order to photograph a bit of innermost corona on the other side.

1994 Annular Eclipse Crossing Diagonally

The 1994 annular eclipse swept across the United States from southwest to northeast. I went to New Hampshire to see it. It was a quiet expedition—my wife, a few friends, a TV satellite truck from a Boston channel, and me. We could see the street fair going on in Boston.

We knew in advance that a big annulus would remain; the Moon was simply too small in the sky to cover the Sun. We could see the eclipse well when looking through our solar filters, but it was always too bright to look at directly or to make the sky dark.

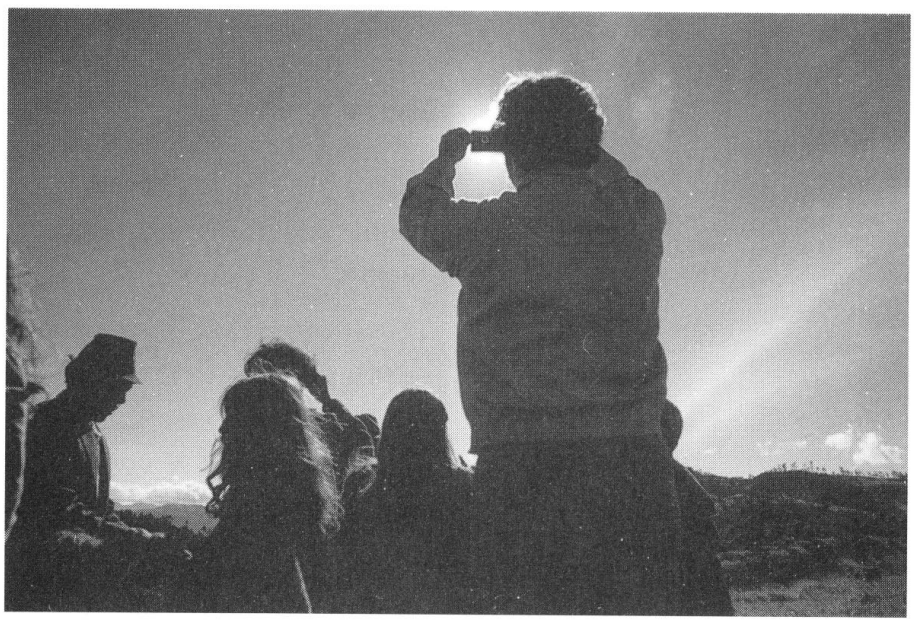
Sun Safety

For an annular eclipse, it never becomes safe to look without special filters.

Solar Scribblings

I had hoped to see lots of pinhole images of solar crescents on the ground simply by standing under trees. But on May 10, 1994, although the leaves were out in Boston, they hadn't yet emerged by the time we got a bit farther north. So, the trees were bare in Sunapee, New Hampshire, and there were no pinhole images on the ground, except for the ones we made by holding up punctured pieces of cardboard.

The annular eclipse of 1974, viewed through a solar filter.



Partial Eclipses

Although there have been no recent American total eclipses, partial phases from two annular eclipses reached much of the United States. I viewed the annular eclipse of December 14, 2001, from Costa Rica, and the annular eclipse of June 10, 2002, from Puerto Vallarta, Mexico. In both cases, the penumbra reached the United States, making a partial eclipse for people in it.

Eclipses and Elephants

A recent pair of eclipses gave tourists views of the Sun and of fascinating animals, as well as giving professionals a chance to make scientific totality studies.

2001 in Southern Africa

On June 21, 2001, a total solar eclipse started in the Atlantic Ocean off the coast of Uruguay, reached its peak in the Atlantic west of Angola, and crossed southern Africa. Observers were stationed at various places across Africa.

Because of the decades-long civil war now settled in Angola, few tourists went there, even though it had the longest totality on land, over four minutes. The French scientist Serge Koutchmy did make his base there.

Most tourists and scientists were in Zambia or Zimbabwe. My own group was in Lusaka, the capital of Zambia, where we set up our equipment on top of a hotel and on the university grounds. The weather was gorgeous, and we even knew a day or more in advance that there would be no clouds across southern Africa. For our three minutes of totality, the corona was fairly round, showing the traits of the maximum of the solar-activity cycle.

Solar Scribblings

Tourists loved the African eclipse in part because it gave them a chance to see animals in the game parks in addition to seeing the beautiful eclipse. A general goal was to see the big five: lions, elephants, giraffes, hippos, and Cape buffalo. My team saw them all in Chobe National Park in Botswana after the eclipse.

2002 in Southern Africa

The December 4, 2002, eclipse peaked over the ocean between Africa and Australia, but nobody could reach that spot. Before noon, it crossed southern Africa, though on a slightly different track than the previous year's eclipse. In particular, it went south of Zambia, sending most tourists to Zimbabwe or South Africa.

This eclipse differed from the previous one in that it was now the rainy season in southern Africa. Therefore, the weather statistics were much less favorable: only about two-thirds chance of seeing totality. And this is what actually occurred. It was largely cloudy, but there were holes in the clouds through which many people saw totality. However, Kruger Park the big South African game preserve/National Park, was cloudy.

Outback Eclipse

Far past the peak of the December 4, 2002, eclipse, near sunset, the path of totality reached Australia. I chose to intercept it at Ceduna, a town on the coast of South

Australia. The Sun was only 9° above the horizon (less than the height of a fist held at the end of your outstretched arm), but farther inland it would be even lower. My team of 11 Williams College students and colleagues reached this location over a week in advance, after a 900-km ride west of Adelaide.

We had beautiful, clear weather for most of the time we were there, but the day before the eclipse, things turned cloudy. Eclipse day itself was totally cloudy until about two hours before the event. Then some holes appeared, and we had more hope of seeing the eclipse.

The weather statistics were about the same in Australia as they had been in Africa: about a two-thirds chance of seeing totality. It turned out that many of the 20,000 or so people in and around Ceduna—swelling the normal population of about 3,500—saw the eclipse through a big hole in the clouds. Inland, with the Sun even lower on the horizon, the weather was entirely clear and people had excellent views.

The Least You Need to Know

- Eclipses that approach seven minutes in duration are highly desirable.
- The last such long eclipse occurred in 1991 in Mexico.
- There haven't been total eclipses over the U.S. mainland since 1979.
- The annular eclipses of 1984 and 1994 were visible in the United States.
- Tourists in 2001 and 2002 combined eclipses with animal safaris.