

Public Education in Developing Countries on the Occasions of Eclipses

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Abstract. Total solar eclipses will cross southern Africa on June 21, 2001, and on December 4, 2002. Most of Africa will see partial phases. The total phase of the 2001 eclipse will be visible from parts of Angola, Zambia, Zimbabwe, Mozambique and Madagascar. The total phase of the 2002 eclipse will be visible from parts of Angola, Botswana, Zimbabwe, South Africa and Mozambique. Public education must be undertaken to tell the people how to look at the eclipse safely. We can take advantage of having the attention of the people and of news media to teach about not only eclipses but also the rest of astronomy. I am Chair of a "Public Education at Eclipses" subcommission of IAU Commission 46 on the Teaching of Astronomy, and we are able to advise educators and others about materials, procedures and information releases.

Though science does not usually make it to the front pages of newspapers, total solar eclipses bring widespread attention. People are eager to find out about the Sun being visibly extinguished in the midst of the day, and are often frightened both about the sun itself and about the possibility of their being injured. Much confusion abounds, in the developed and the developing countries alike, about how hazardous solar eclipses are and about how to view them. The Working Group on Eclipses of the solar commissions of the International Astronomical Union runs a Web site,

http://www.williams.edu/astronomy/IAU_eclipses,
at which we have many links to information about observing eclipses safely in addition to information about eclipse expeditions and maps. Commission 46 on Education and Development in Astronomy has a Program Group on the educational opportunities given to astronomy educators and scientists when a country's attention is drawn to science through the occasion of an eclipse. I have the honor of being Chair of each.

For those in the path of totality, people usually don't understand the difference between totality and a partial phase. I liken the difference to (1) going on the Underground in London to the Covent Garden tube stop, and then returning home immediately, and (2) buying a ticket and going inside to hear La Traviata. In both cases, you can say "I have been to the opera," but only in the second

case have you had the full benefit. At the 1998 eclipse in Aruba, I was able to appear on television in advance to try to explain when and why people should look at totality, but nobody really believed in advance how dramatic the onset of totality would be and therefore how easy it would be to tell when you could look safely without filters.

Without a clear understanding of the difference between totality and partiality, people living near the band of totality do not understand why they should bother to travel to see the total eclipse. Further, many people mistakenly think that there are extra rays during an eclipse, and therefore that it is hazardous to watch. Actually, there is less of everything during each part of an eclipse, and it is only that you are more tempted to watch the partial phases than you are to stare at the Sun today that could lead to any eye damage.

During the total phase of an eclipse (Figure 1), which occurs somewhere on Earth about every 18 months, the Moon entirely covers the surface of the Sun that is visible every day. Then the bright sunlight doesn't hit the Earth's atmosphere to make the sky blue, and the Sun is aloft in a dark sky in the middle of the day. Without the blue sky, we can then see the faint corona of light that always surrounds the Sun but that is normally overwhelmed.

People don't realize in advance how dramatic the overall change in the atmosphere around you is. For that reason, watching an eclipse on television misses most of the effect, which includes the rapid darkening of the sky in the last few minutes before totality, the drop in temperature, the eerie sharpening of shadows, and the change in the color balance of the incident light. The actual phenomenon of the Moon going in front of the Sun is almost less spectacular than these other effects.

The band of totality is only 100 km or 200 km wide, and the people within that band usually see about 90 minutes of partial phases before totality and a similar length of partial phases afterwards. So we must discuss both partial phases and totality.

Further, the partial phases are seen in a very wide area to the sides of the band of totality. Whole continents or equivalently large areas are included (Figure 2). The August 11, 1999, total solar eclipse crossed from Western Europe over Hungary, Romania, and Bulgaria, which benefitted from the arrival of many tourists for the event, as did Turkey, further along the path.

The next total solar eclipses, on June 21, 2001, and on December 4, 2002, both cross southern Africa. For the 2001 eclipse, most of Brazil sees a partial eclipse as does all of Africa from the Sahara to the south (Figure 3). For the 2002 eclipse, most of Africa again sees a partial eclipse. In this latter case, the partial phases are also visible from the western two-thirds of Australia, with totality itself visible at sunset from a narrow band that comes inland in the middle of Australia's southern coast (Figure 4).

It is thus important to mount education programs throughout Africa, Brazil, and Australia on what an eclipse is, what the difference is between partial and total phases, and how to observe an eclipse safely. I discuss how to observe eclipses and when they occur in my observing guide (Pasachoff, 2000).

It is important to educate the people correctly about the benefits and hazards of observing solar eclipses. All too often, the people become scared by overzealous warnings about eclipse hazards. When they later hear that they

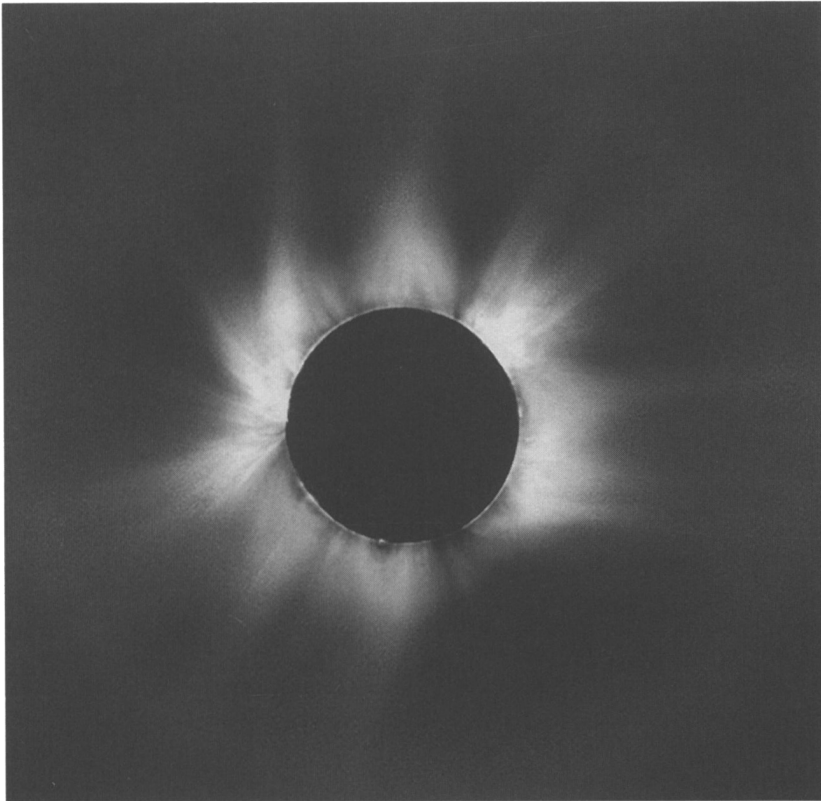


Figure 1. The Corona on the day of the 1999 Eclipse (Williams College photograph).

were not given correct information by groups of ophthalmologists or by the government, for example, they may be less inclined to accept even the correct warnings that may be given later on how to prevent the transmission of AIDS, for example (Pasachoff, 1996).

The easiest way to observe an eclipse safely, while still being outdoors to benefit from the overall experience, is to make and use a pinhole camera. To do so merely requires punching a hole a few millimeters across in a piece of paper, cardboard, or foil. Then you hold the material with the hole overhead and look away from the Sun, at the image projected on another surface, usually a piece of paper. Since you are looking away from the Sun, it is completely safe to do so.

To view the partial phases many people manage to obtain solar filters from one of many suppliers, often for a cost of only about \$1. I am sorry to see the recent trend of making solar filters in the shapes of eyeglasses, since then people tend to keep them on and to stare at the Sun for a long time. Though if the eyeglasses are of proper optical density and are unscratched and untorn, it is safe to look through them for long periods, I always only glance at the partial phases for a second or two and then look away. In any case, the partial phases

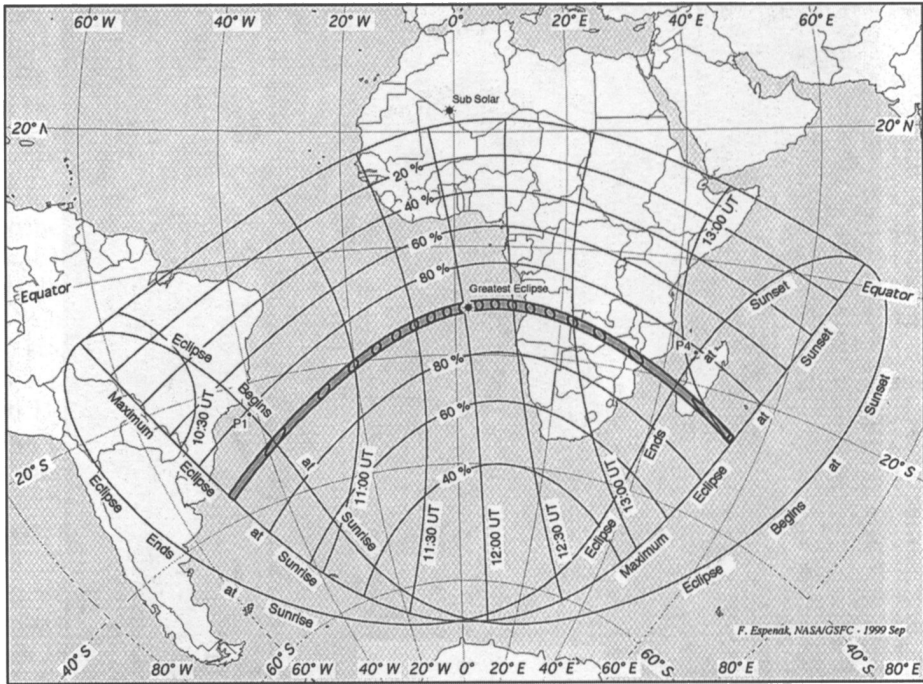


Figure 2. Path of the eclipse of 2001, June 21.

change slowly, so there is no need to stare. I often cut the two halves of the eyeglasses apart, making two separate filters for two different people. Welders' glass in dark shades, No. 13, No. 14, or No. 15, are also satisfactory.

Old-fashioned methods are less encouraged. Smoked glass can be of uneven quality and the smoking can be wiped off, which would make it hazardous. Fogged and developed black-and-white film can make good filters, but some newer black-and-white films don't incorporate silver and so are unsafe. Color films, no matter how dark they look, are never safe, since they don't incorporate silver and so don't absorb enough in the infrared. Photographic neutral-density filters, such as the Kodak Wratten filters, are unsafe for the same reason. Some CDs or CD-ROMs have enough reflective coating of the correct type on them to make filters, but not all. And we have heard of people looking up through the hole instead of through the shiny reflective part of the CD. Similarly, though X-ray photographic film, when fogged in light and then developed to full density, can make a satisfactory filter, we have heard of people looking up through the almost-transparent part of someone's X-ray where the bones reduce the photographic density, which defeats the point of using the filter.

Still, the glory of the eclipse is worth seeing, and we should be encouraging people to watch even partial phases, with proper filters, and totality whenever possible, for which no filter is necessary or useful. And we should take advantage of interviews on radio and television or in the newspapers to demonstrate to the public how science works. My own team's scientific results are discussed in part at <http://www.williams.edu/astronomy/eclipse>. It is interesting that we can

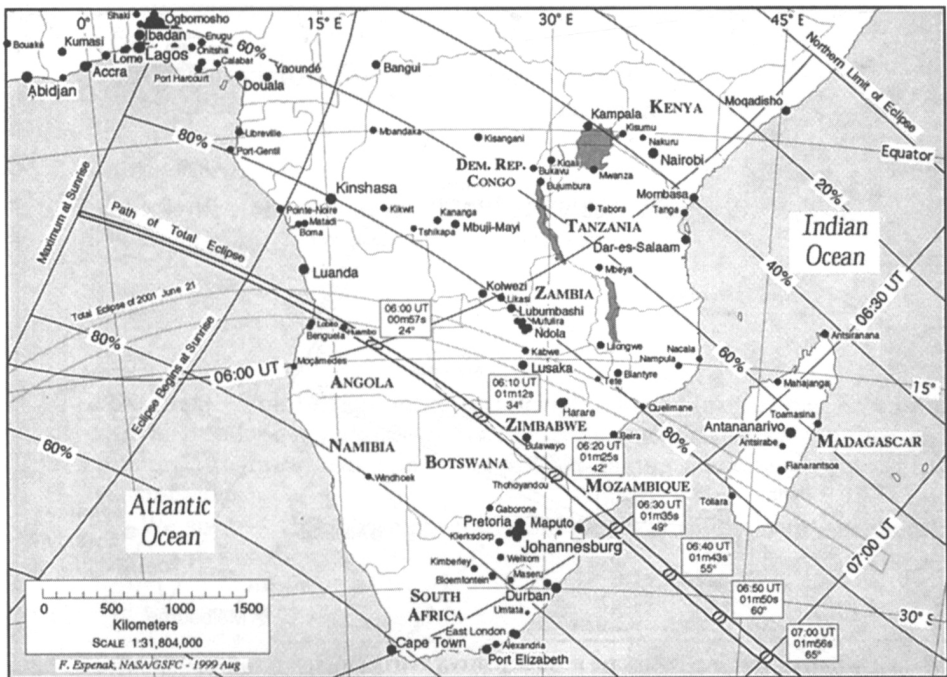


Figure 3. Path of the eclipse of 2002, December 4, in Africa.

predict eclipses and their locations for thousands of years in advance, and that we can use our observations to understand how the Sun shines. People all over the world benefit from the demonstrations of the methods of science, and at the times of eclipses, we have a special platform to demonstrate astronomy.

Acknowledgments. My most recent expeditions were funded in large part by grants from NASA in the Guest Investigator Program for SOHO (EIT): NRA-98-03-SEC-051; from the National Science Foundation's Atmospheric Sciences Division: ATM-9812408 and ATM-0000545; and by the Committee for Research and Exploration of the National Geographic Society: 6449-99, as well as by support from the Science Center of Williams College and the Brandt and Milham Funds.

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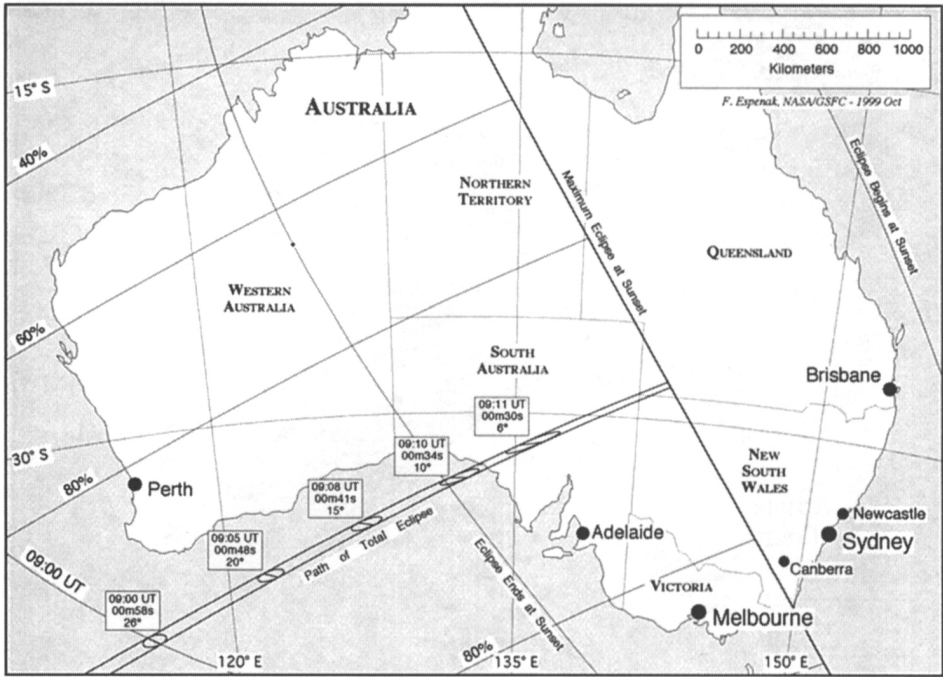


Figure 4. The eclipse of 2002, December 4, in Australia

Discussion

Podmore referred to his poster (see p. 364-5) and added that a new book had just appeared, edited by Aisling Irwin, entitled *Africa and Madagascar: Total Eclipse 2001 and 2002* (published by Bradt Publishing ISBN 184162 015 7) and that the Astronomical Society of Southern Africa will hold a three-day symposium in Harare, just before the eclipse of 21 June, 2001.

Much discussion centred on bad advice about eclipse watching. Ratnatunga had been in Curaçao in 1998 and the tourist authorities were very proud that they had advised the public to watch the eclipse on TV. No-one seemed to be aware that the total phase could be quite safely looked at without protection – and so people missed the glory of a total eclipse. Dworetzky recounted similar stories from the U.K. in 1999, although the Royal College of Ophthalmic Surgeons found not one case of eye damage from proper use of filters.

Torres-Peimbert said that the 1991 eclipse in México provided much public exposure for astronomers on TV and in the newspapers. Even during totality, TV commentators discouraged people from watching directly. Rosenzweig said that in 1998 in Venezuela cooperation of government officials was needed to go to remote sites. The Universidad de Los Andes developed educational materials especially for distribution in schools. Astronomers also visited schools personally. This strongly motivated people to watch the eclipse. The materials are offered to Zambia for the forthcoming eclipse.