

The Eclipse

We then met and decided how to get to the eclipse site. I had a lot of equipment to set up so I needed to get there sooner than the rest of the group. I went in the advance team with Vic & Jen Winter, David & Wendee Levy, Bob Shambora, and some other folks I don't know. We drove in a tracked vehicle that belongs to the Indians, a slow vehicle that took an hour to make the trip. I would describe my mood as one of cautious optimism. The locals described the weather as "exceptional". The sky was absolutely fantastically clear so we were essentially guaranteed to see the eclipse. Or so I thought...



Packed into the tracked vehicle going to the eclipse site.



Above: Eclipse chasers spread out across the ice.

Upon arriving at the site there was a problem, South wasn't where it was when Jen surveyed the site in February. A large rise would block our view of the eclipse. Don't ask me what happened because I don't know. To come all this way, spend all this money, have perfect weather, and miss the eclipse because of a snow bank would not do.

Below: Our immediate group set up away from the ice ridge.



The Indians had towed a container full of equipment out here and could not move it. Jen's radio was out of range of base camp so we couldn't do anything to try to coordinate a move to a new site. We could not move south or west due to crevasses. Some of the Japanese started to try to climb the snow bank to the south and we had to send Chris Jackson our mountaineering guide after them. East was no better as far as crevasses. So that left north, we started hiking that way in the hope that as we got further from the ridge we would see over it better. We arrived at a suitable place only about 30 minutes before totality. My GPS read 70d 52' 12.8" S, 11d 25' 57.0" E.

There was no time left to set up all of the equipment I had brought, so I had to prioritize and set up whatever I could. It was so bone-chillingly cold that batteries and cameras were dying left and right. Put a fresh battery in and it's dead within minutes. My fancy Meade LXD55 tracking mount decided it was in the northern hemisphere and refused to track the sun in the correct direction. I couldn't fix it because I couldn't make out the display in the bright surroundings. Oh well. At this point I wished I hadn't gone on that scenic flight until tomorrow. It would have given me more time to prep my equipment.

Standing next to me (to my right) was David & Wendee Levy, next to them was Jen & Vic Winter, then Bob Shambora, Karen Mendenhall, and finally Jim Huddle. To my left were Charles Simpson, Casper Badenhorst, and perhaps a few more people. We made sure to stand line-abreast so as not to get in each other's way.

The seeing was absolutely terrible, on the order of several arcminutes. Extinction was about two stops (25% of the Sun's light was making it through the atmosphere, a really large amount and a testament to the extremely clean air here). David Levy spotted shadow bands around 10 minutes before totality, an exceptional amount of time. This is the first time I have ever seen shadow bands. They looked like a shadow of smoke. We could see the Moon's shadow coming in



The Moon covers all but a slim crescent of the Sun. Note how the lower tip is clipped by the ridge.

The approaching shadow is visible to the left in the sky.





Second contact diamond ring. Colors are real, as I remember them.

can see him just left of the sun. This is the second contact diamond ring, you can see some red prominences and whitish corona. I have corrected the color to remove the reddening that comes from the low solar altitude, to better show the prominences. The ridge was still high enough to block part of the sun.

Just after second contact we could see some nice prominences. The wind was so strong that it shook my sturdy mount and blurred many of my images. The sharpest photos I have come from my video camera, as shown at right. This image is an average of the 30 best frames in two seconds of video. I used a JVC JY-HD10U hidedef video camera (set to SD mode: 852x480x60fps progressive), with a 3X Kenko teleconverter, and Registax software to select and average frames. Then curves, saturation, and resize in Photoshop.



TOTALITY! False color view of prominences and corona.

Totality was wonderful, I concentrated on observing visually while working cameras with the back of my mind. My binoculars were out of focus and I had a hard time adjusting them because of the cold. Looking around, I did not see any aurora. There was some spatial variation in sky brightness but nothing I would consider aurora. I could only see two radii of corona. The corona was orange or brown near the horizon, changing to a greenish tinge up higher.

well to the left of the Sun. The anti-solar shadow was huge and black all the way to the horizon, I wish I could have gotten a picture of that (the camera died due to cold).

As totality approached I blindly took pictures with my cameras, hoping to get something. Because we had backed up from the designated observing site there was someone in my field of view. You

The image below is a highly processed composite of four images that's intended to be a more artistic representation of what the eclipse felt like. I have increased the color saturation slightly to better show the green thru red corona colors, otherwise the image is truthful. In the processed image the coronal streamers and polar brushes really come out. The person in the photo is the Japanese painter and illustrator Kagaya (<http://www.kagayastudio.com/>). He was set up directly in front of me. I didn't notice him before the eclipse because of the intense sunlight, so it was a complete accident that he was in my photo. At left is his "freight bag", a large soft suitcase in which we placed our cold weather gear, tripods, and so forth. Next to that is a collapsible chair, with his sleeping bag laying on it. At the moment of this photo he was leaning over to take a picture with his camera. I am very happy that Kagaya was in my photo, it makes the composition much more interesting.

Composite image of totality attempts to recreate the view seen by the eye.



I could tell the eclipse was coming to an end, because some prominences popped out from behind the Moon at the left edge. This video capture (using the same method as the video image earlier) was taken just before the eclipse ended at third contact. The eclipse took place about 15 minutes after local midnight, so the Sun was rising during totality. In this



More prominences signal that the end of totality is near.

photo you can see how more of the corona was visible than at second contact (compare the distance between the “points” where the horizon meets the Sun: they are now closer than in the photo above).

All too soon the eclipse ended and the Sun peeked out from behind the moon. The third contact diamond ring is below, you can still see a hint of corona around the left guy. Totality had lasted 1 minute, 18 seconds. Shadow bands again were visible for 10 minutes after totality. We were absolutely elated, we had done it! We (well, several hundred of us)

became the first people to see a total solar eclipse from Antarctica. A whole continent, 6 billion people in the world, and we were the first ones. Amazing! This also marks the first time I’ve seen the midnight sun, as the eclipse was just after midnight local time.

It wasn’t until now that I began to realize just how cold it was here. Someone’s thermometer was reading -11F (-24C), and the winds were blowing at 10-15mph (15-25kph), so the “feels like” windchill was -35F (-37C). By far this is the coldest place I have ever been. People that had taken their gloves off for just a couple of minutes were now regretting that, they were now within minutes of getting frostbite. Luckily Jen & Vic planned ahead and had chemical handwarmers to pass out.

Above us we could now see the NHK’s special jet that broadcasted the eclipse back to Japan and the Discovery Channel. As I packed up my equipment (pretty much everything had died from the cold, no point in sticking around), David made a call in to the Discovery Channel for a live interview and related his descriptions with schoolboy giddiness.



Third contact diamond ring, corona is just barely visible.

David Levy is interviewed by the Discovery Channel via satellite phone.



Before leaving I took a few moments to stop and just soak in the place. To borrow Astronaut Buzz Aldrin's words, it was a place of magnificent desolation, as barren and inhospitable as the Moon he walked on 34 years ago. I really feel like an astronaut. Our mission started with training, progressed to space suit fit checks (cold weather clothing), aborted liftoffs (weather delays), finally a real liftoff (the Russian cargo flight), a landing, and a successful fulfillment of our mission. Would

there be a tickertape parade when I returned home to San Diego? Of course not, what was I thinking. As I stood there on the ice I was overcome, I tried to express my feelings to those around me but I couldn't find the words. "Unbelievable" was what came to mind. This place was simply unbelievable. As I looked north and followed my long shadow up to the horizon I noticed that the horizon seemed to stretch forever (see photo at left). In the dry pristine air we were seeing perhaps a hundred miles, all the way to the distant ice-covered ocean. I just could not believe where I was.



Karen (in yellow) and Vic (in red) after totality.

Our shadows stretch toward the horizon and ice-covered ocean.



I got a cup of too-hot chicken noodle soup and climbed back into the tractor that had brought me here. We began the long journey back to base camp. The adrenaline was wearing off and it seemed like a very long ride. Actually it WAS a long ride, because something broke down on the way back and we had to wait a while for it to be fixed. I passed the time by flipping through my pictures of the eclipse and was overjoyed at the results I had gotten. We got into camp very late, I crawled straight into my sleeping bag. I was so very cold, I hadn't warmed back up from the eclipse site. Later in the night someone set up a blast heater and it got a little bit better. At some points in the night I wasn't sure if I was hot or cold. I think that's a bad sign. There was a struggle among the folks in the shed: some wanted the heat on, others thought it was TOO hot and didn't like the six foot flames the heater occasionally spewed! I felt like I was sleeping on a bed of ice. Actually I WAS sleeping on a bed of ice, there was only a tarp, the cot, and a sleeping bag between me the thousand-foot-thick sheet of ice.

Casualties of the Cold: What Worked and What Didn't

Much of my equipment had problems in the extreme cold. Here's how it stacked up:

Canon G1 digicam – Battery died 1-2 minutes before totality due to cold. No time to change battery.

Canon 10D DSLR – No problems.

Canon D60 DSLR – Color LCD display quit working at coldest temps.

JVC JY-HD10U hodef video camera – No problems.

Kestrel 4000 Wind/Weather meter – Clock screwed up when temperature fell below -20c.

Suunto Vector watch – No problems.

Meade LXD55 mount – Lost memory, screen too dim/sluggish to use.

Sony TR2A laptop – No problems. Kept battery inside coat when not using.

Homebuilt Controller – Clock malfunctioned (Murphy's Law at work: the only component not rated for subzero temperatures was the clock).

Creating the Totality Composite

The signature image of my trip to Antarctica is a composite photo showing the Sun during totality, with a fellow eclipse chaser superimposed on the Sun (see front cover or page 64). This image was intended to convey the feeling of the eclipse, the emotions it evoked, rather than be a strict scientifically precise representation. I guess I succeeded in evoking emotions, because I have gotten a phenomenal reaction to it: everything from "it's a Photoshopped fake" to "I love it, how can I buy a print". To the doubters: this is a real image, I was really there and that's what it really looked like. Interestingly, people who have never seen a total solar eclipse think it's fake, while people who HAVE seen a total eclipse (particularly those with me in Antarctica) think I got the image exactly right! The image was the Astronomy Picture of the Day on December 8th, 2003, was CNN.com's Space Scene of the week starting December 17th, 2003, and appeared in Sky & Telescope's April 2004 issue. My website got half a million hits during December 2003.

This sidebar shows how the image was made, and how it differs from reality. Let me start by saying that the image is a composite of four photos. The Sun's corona (the diffuse halo with streamers that reach outward) has an incredible range of brightness. Near the Sun it's very bright, as bright as a full Moon, and it then tapers down quickly into the twilight around it. No camera (except some one-of-a-kind hideously expensive scientific cameras) can capture this range of brightness in a single exposure, so multiple exposures are required to capture the full range of brightness. The conventional wisdom with film cameras is to take exposures one stop apart. The superior quality of a low-noise digital SLR camera allows that to be expanded to three or four stops.

On the next page are two photos of my equipment setup, taken during testing at home before the eclipse. It is substantially similar to the setup I used so successfully in Australia. Yes, I took this entire kit to Antarctica!



*I tested equipment at home before leaving for the eclipse.
The lower SLR is a 10D with a 90mm F/13.9 Mak-Cass scope.*

So the plan was to take a series of exposures three stops apart, plus some shots around second and third contact to see the prominences. To accomplish this I built a standalone controller box, which had been preprogrammed with a script of exposures for four of my seven cameras. The controller is the square silver box with a 4x4 keypad. Now, I have a rule for the minutes before total eclipses: if a piece of equipment doesn't work on the first try, give it a second try, if it fails again then CHUCK IT! So as it turned out, the extremely cold weather at the eclipse site caused the controller to malfunction (I believe either batteries or the clock were the culprit), and I ended up doing the exposure sequence by hand. I wanted to focus on observing the eclipse rather than fuddling with cameras, so during totality I mindlessly moved the exposure control on my cameras back and forth while pushing the shutter buttons. See the previous sidebar on page 67 for a camera-by-camera account of how things performed (or didn't). Anyway, the result was a bunch of blurred or underexposed or overexposed photos with only a handful of usable images. Luckily the good ones were in the right ranges to do a composite. Below are the four images that went into the composite, presented exactly as they came out of the camera.





Above (four images): These are the raw, straight-out-of-the-camera images that went into my now-famous composite image of totality. Exposure times were 2sec, 1/10sec, 0.5sec, and 6sec. Lens: Canon 100-400mm F/4.5-5.6L IS at 400mm F/8. Camera: Canon D60 DSLR, ISO 100.

The images above have incorrect color, because the camera's auto white balance system was fooled by the strange environment. Notice how the colors shift from image to image. None of the images have colors that match what I remember.

The first step in creating the composite was to convert the RAW camera images into 16bit linear TIFF files. These files preserve the raw data from the camera, have fixed white balance, and have a nearly linear relationship between true brightness and pixel value. I chose the 1/10s, 0.5s, and 6s exposures for the coronal composite. I normalized the pixel values into intensity by dividing each pixel value by the image exposure time. The images were then blended together by masking out the overexposed and underexposed regions in each image and stacking them. Then a radial gradient intensity filter was applied to compensate for the range of brightness in the corona. The result is this image:



Step 1: Blended stack of 1/10, 0.5, and 6 second exposures.

I couldn't get the radial gradient quite right, the middle corona is too bright. In reality the corona drops off in brightness like the earlier raw images, so this was a compromise to keep things within the range of consumer computer monitors. The gradient has

the unpleasant side effect of making the Moon jet black. This is incorrect, that area should be roughly the same color as the surrounding sky. There is no easy way of fixing this, and in truth it actually mimics the behavior of the eye: things appear darker when they're next to a bright object. The bright inner corona makes the Moon appear darker than it really is.

Now the image above has a big problem in that the colors are wrong. They're close, but they're not what I remember. So I used Photoshop to slightly alter the balance and saturation of the colors. This is where I depart from reality slightly: the image at right has colors that are more saturated than they were in real life. I did this to add to the excitement of the image. It's a subtle change (compare with image above) but I think it was necessary. I also rotated and cropped the image, and painted out the bright blue artifact at the 8 o'clock position on the Sun. This artifact came about because the person in the photo moved between the exposures.

Next I performed some radial blur sharpening in Photoshop, a standard technique used in eclipse images. This makes the coronal streamers slightly more defined. (Middle right)

The radial gradient algorithm doesn't know about the ground, so the ground near the Sun is darkened as if there was visible corona there. That's a defect that needs to be corrected by superimposing the ground without a radial gradient filter. I chose to superimpose (see lower right) a different image than the one used for the outer corona, because as you can see in the fourth raw image the person is kneeling and it's not apparent there is a person there.

After getting this far into the processing I felt that the image was a little too dark and moody, when our emotion was much more one of joy and celebration, so I upped the brightness a little. The final image then was cropped.

The image isn't perfect, but overall I'm pleased with it. I can't wait until the 2005 eclipse so that I can give it another try.

Step 2: Color correct, rotate, crop, paint.



Step 3: Radial blur (emphasize streamers).



Step 4: overlay foreground.

