Eric Renner

EDITION 4

PINHOLE PHOTOGRAPHY

From Historic Technique to Digital Application

Focal Press

CHAPTER 8

Digital Imaging with Pinholes, Zone Plates, and Alternatives

Techniques vary, art stays the same: it is a transposition of nature at once forceful and sensitive.

—CLAUDE MONET

One of the first homemade digital pinhole images was created by Sam Wang in 1989 (Figure 8.1), which seems like eons ago for digital technology. Sam Wang described his process as follows—actually it was nail hole not a pinhole:

> The nail hole picture was made by using a digitizer on the computer to convert the video signal to digital, so that the color separated images can be manipulated on the computer and combined and printed one color at a time on a computer (digital) printer.
>
> It was crude, but all early digital imaging was crude. Instead of being captured on CCD sensors like today's digital cameras, it was captured as continuous video signal, but translated into digital by a converter. Slower, but same concept.
>
> Makes sense? Look ma, no film! Just electronic bits and bytes. Must be digital.

But that was almost 20 years ago. Presently, many artists are using pinhole and zone plate body caps on their digital single lens reflex cameras. First of all, it's easy to turn a DSLR into a pinhole or zone plate camera! Just about any removable lens digital camera will accept a body cap. All Nikon models take the same cap, as do all the Canon EOS models. It's the Photoshop and printing part of digital photography that has a long learning curve. If you have a digital single lens reflex camera you should only use a "no dust" pinhole or zone plate body cap. "No dust" means that the pinhole or zone plate has been made with a very opaque *black area on film; the pinhole or zone plate area is clear on the film*. A "no dust" pinhole is **not** an open pinhole made with a needle—a place where air and dust could enter your digital camera and end up on the CCD sensors.

If you have dust on the light sensors in your digital camera, it will show up as little dark spots on the final image. The spots will always be in the same place on every image. After you get a pinhole or zone plate body cap and if you notice dust right away on images, it means it was there before. If you are unsure if the spots are dust, make a picture of a white wall by setting the camera on manual (with its lens back on) and make the image with the lens set way out of focus. Then see if the spots still show up in the image. If they do, it's dust!

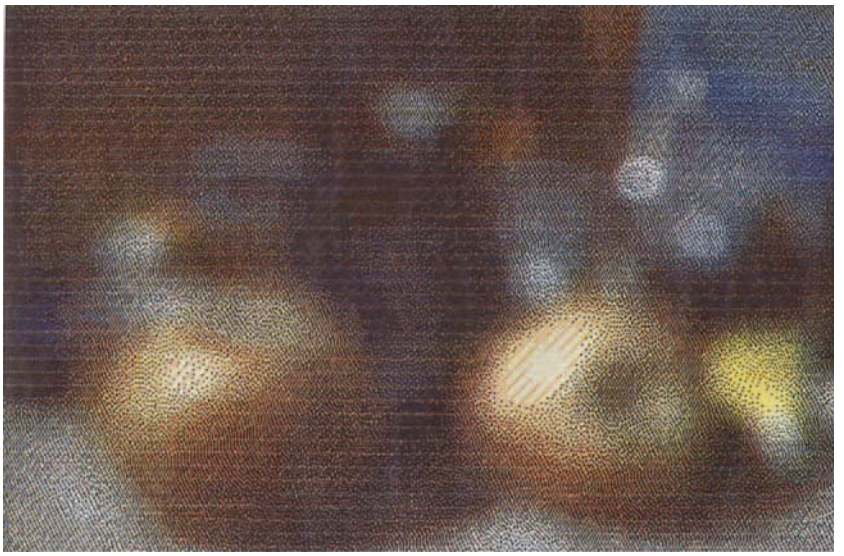

FIGURE 8.1
© Sam Wang, *Untitled Still Life*, 4¼ × 7-inch nail hole color-separated computer print, Macintosh ported to Atari ST, printed on Star, 1989. From the collection at Pinhole Resource.

A little piece of dust or dirt right on the pinhole or zone plate will not show up as a little spot in the image. "No dust" pinhole and zone plate caps should not get wet in the rain.

When changing lenses or changing to a pinhole or zone plate cap, you should **always** hold the camera lens area **toward the ground** so dust doesn't naturally fall into the camera. It's very important to not change lenses in a windy or dusty area.

If you do have dust in your digital camera, you should use one of the wet or dry products recommended by the Website cleaningdigitalcameras.com. You can try a Giotto Rocket Blower (we use that method) and if that does not get all the dust removed, possibly Eclipse cleaning solution will. Care is recommended. Don't use canned air!

"No dust" pinhole and zone plate caps are available from Pinhole Resource.

Making Digital Pinhole and Zone Plate Images

After putting the pinhole or zone plate cap on your camera, set your camera to manual. In the menu, adjust for the lighting condition: tungsten, daylight, and so on.

Set the ISO at a low rating unless you want pixel artifacts in the final image. Try a pinhole image at about 1 second in bright sun. Try a zone plate image at about 1/20th of a second in bright sun. Zone plates work well too, even when imaging in lower unshadowed light than always in bright sun (Figure 8.2) and will still provide a subtle glow at the edge of a contrast break. Because of veiling glare, some zone plate images will lack saturated color as compared to pinhole images. Saturation can be increased in Photoshop.

Check the viewing screen on the back of the camera and either add or decrease the time. The beauty of digital is that you can see how the image looks and you can always delete. Trial and error is the only method and it's the best. Unless you have some other specific reason, you should probably always shoot *raw* files.

Most DSLR cameras such as the Nikon series, Canon EOS series, and Olympus are easy to convert to pinhole or zone plate imaging. If, however, you are using a Minolta Maxxum DSLR with a pinhole or zone plate cap, set your menu to *star*, go to *custom*, and then set it to *Shutter Lock Off*.

Since you can buy DSLR camera bodies without a lens, that makes digital much less expensive, particularly if you only want the camera for pinhole or zone plate imaging.

In 2006, Nancy Spencer and I were invited to China to make images on a photo trek in Qinghai Province, a very rural area that was originally northeastern Tibet. We knew we would be on a little bus accompanied by other artists, probably none of whom did pinhole or zone

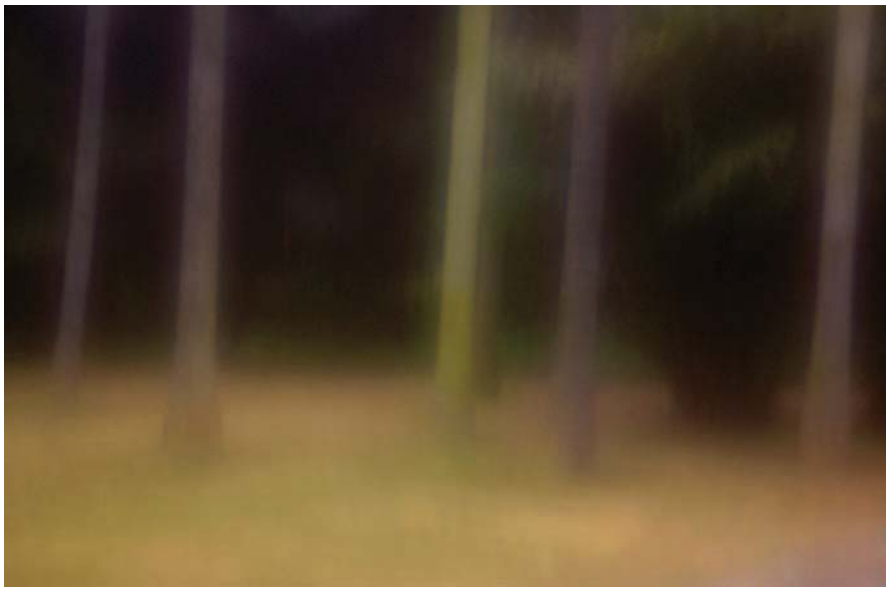

FIGURE 8.2
Nancy Spencer, *Trees*, Shenzhen, China, digital zone plate photograph from a Nikon D50, 2007. From the collection of the photographer.

FIGURE 8.3
Nancy Spencer, *Circumambulating Ancient Woman*, Qinghai Province, China, digital zone plate photograph from a Nikon D50, 2006. From the collection of the photographer.

plate imaging. They would probably be using very high-end digital cameras, which made us realize that if we used film holders, 4 × 5 pinhole cameras, changing bags, and tripods that these traditional methods would be cumbersome and time-consuming—undoubtedly our setup time would be unappreciated by the others. As a result, we opted for digital zone plate imaging. Because zone plates make an image seven times faster than pinhole, we figured that this too would speed things up. It did; we actually blended in with the other photographers and made images (Figures 8.3 and 8.4) as easily as anyone else. At an exhibition in Xining we met up with a large group of commercial photographers who watched how Nancy and I were using our digital cameras. They thought we had forgotten to take the body caps off—where were our lenses? Humbly, they came over to correct us. When we showed them that we actually could get an image to show up on the screen with a body cap on the camera they all were appreciably happy, but puzzled. We showed them the tiny little hole in the body cap—then, they understood and everyone laughed even harder.

Less than a year earlier, Nancy had purchased a Nikon D50 in Beijing. From Beijing we went to an exhibition of our photographs in Pingyao, a small city that is a World Heritage Site. We wanted to put a pinhole onto the body cap of Nancy's new digital camera. Having no drill or

FIGURE 8.4
© Eric Renner, *Face,* Qinghai, China, 16 × 24-inch digital zone plate photograph from a Nikon D50, 2006. From the collection of the photographer.

FIGURE 8.5
© Nancy Spencer, *Black Horse, White Horse*, New Mexico, 16 × 24-inch digital pinhole photograph from a Nikon D50, 2006. From the collection of the photographer.

other tools, we went out on the street. Luckily we found a bike repairman. We showed him the body cap and, using hand language, asked him if he had a hand drill that would put a hole through it. He quickly understood, went into the back of his shop, and came out with a hand drill and just the right size drill bit. He drilled a 3/8-inch hole through the cap. Next we cut a piece of metal from a soda can, took a pushpin, made a pinhole, sanded it somewhat smooth with a nail file, and taped it onto the body cap with black electrical tape that we had brought along. In about 15 minutes we had a working digital *pinhole* camera. of course this physical hole let a small amount of dust into the camera, however, it was the best we could do. A roll of black electrical tape always comes in handy when traveling. Other advice when traveling with a pinhole or zone plate digital camera is to take many extra image cards, extra batteries, a Giotto Rocket Blower, and a good camera bag.

Returning to the United States, Nancy made handheld digital images (Figures 8.5 and 8.6). *Black Horse, White Horse* was one of those surprise images that appear as an enhanced

FIGURE 8.6A
© Nancy Spencer, *Cypresses*, North Carolina, 16 × 24-inch digital pinhole photograph from a Nikon D50, 2006. From the collection of the photographer.

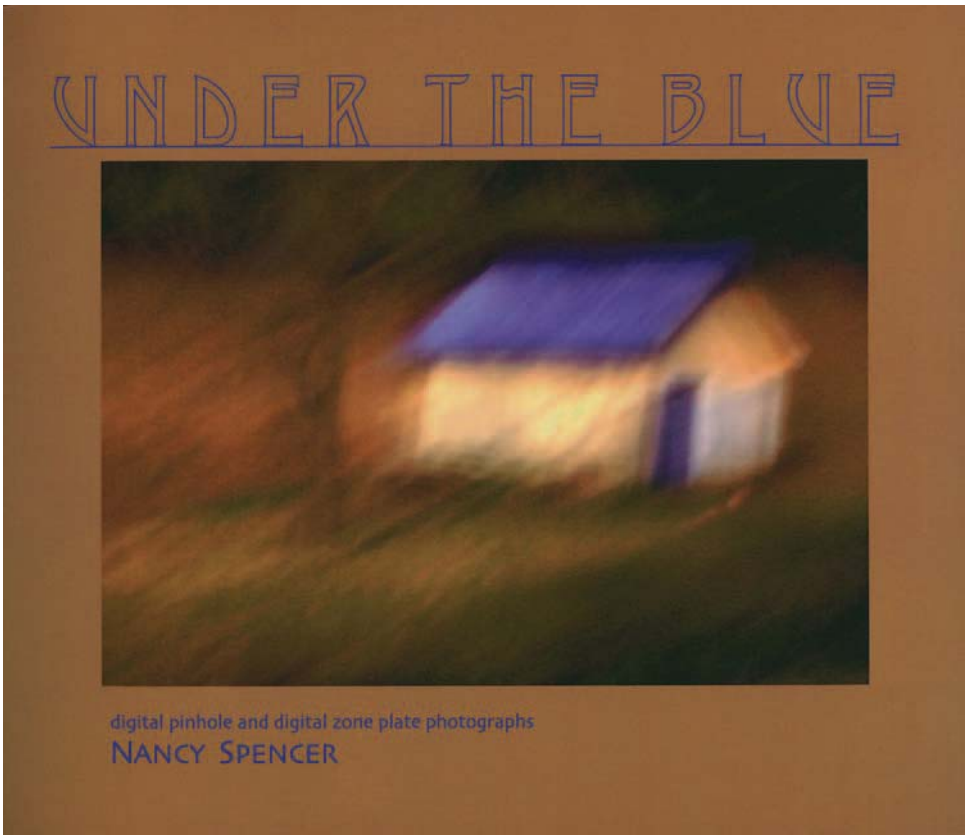

FIGURE 8.6B
© Nancy Spencer, *Under the Blue*, Flying Monkey Press, 2008, cover, digital zone plate photograph.

mishap. Many of Nancy's digital landscape images are in *Under the Blue* (Flying Monkey Press, 2008) (Figure 8.6B).

Thomas Micklin used a "no dust" 0.29-mm pinhole on his Canon 5D to photograph *The Meadows* at Washington Park Arboretum in Seattle (Figure 8.7). The image has a slightly different look and feel than if it had been photographed using a pinhole on a film camera. Using the same "no dust" 0.29-mm pinhole, Micklin added a 25-mm extension tube onto his Canon D5 and photographed *Falling Light* at Madison Falls (Figure 8.8). Because the

FIGURE 8.7
© Thomas Micklin, *The Meadow*, Washington Park Arboretum, 8 × 12-inch digital pinhole photograph from a Canon 5D, 2007. From the collection of the photographer.

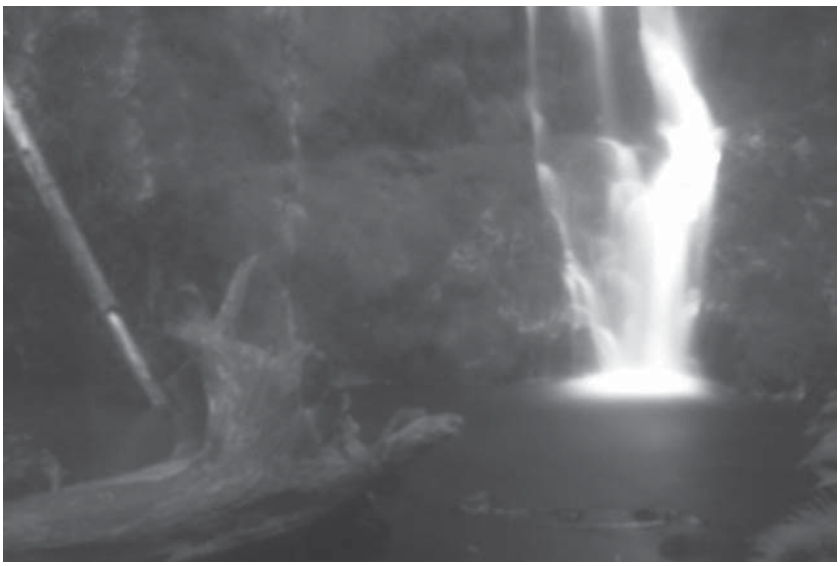

FIGURE 8.8
© Thomas Micklin, *Falling Light*, Madison Falls, 8 × 12-inch digital pinhole photograph from a Canon 5D, 2007. From the collection of the photographer.

pinhole was not optimal for that increased focal length, the image has an even softer look, surprisingly like a zone plate image.

Sam Wang has continued his use of zone plates (Figure 8.9) and in 2006 was instrumental in developing short focal-length zone plates: 45 mm, 38 mm, and even shorter.

Stefano Bandini of Kyoto, Japan, used a Canon EOS 5D with a Kenko pinhole adaptor to make handheld *Nico the Clown* (Figure 8.10). Of the Kenko adaptor available in Japan, Bandini explains:

> The Kenko Adaptor is basically a camera cap which is installed on the camera instead of the lens. It consists of two pieces, one is a threaded circular plate in which the pin hole is drilled. The second one is a ring that is sold with different mount (Canon, Nikon etc.); the threaded part is mounted in the ring and the assembly is mounted in the camera as a lens. It has a focal length of about 50 mm and an f number of 250. The Kenko Adaptor can be seen at http://www.yodobashi.com/enjoy/more/i/cat_13_23_12219283/1233177.html and http://www.yodobashi.com/enjoy/more/i/1219575.html.[1]

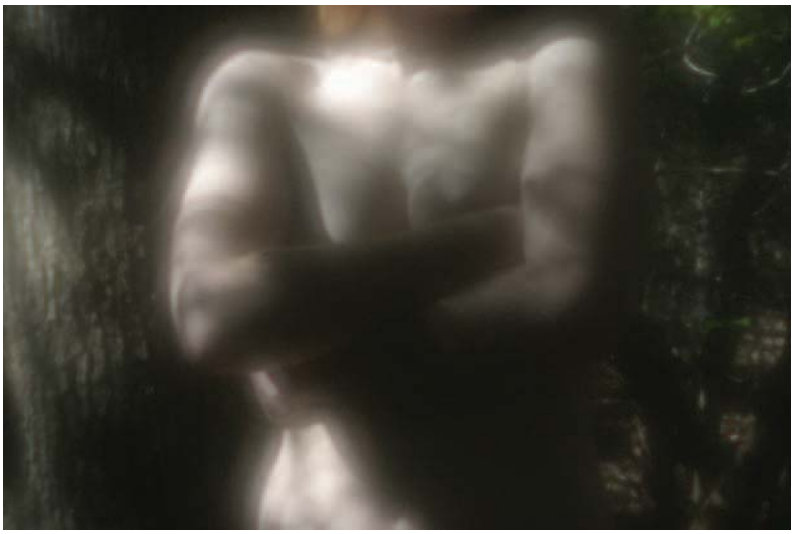

FIGURE 8.9
© Sam Wang, *Encounter in Forest*, 12 × 18-inch digital zone plate image from Canon Rebel, 2003. From the collection of the photographer.

FIGURE 8.10
© Stefano Bandini, *Niko the Clown*, 30 × 20-cm digital pinhole image from Canon EOS 5D with Kenko pinhole adaptor, lighting with a lateral spot and white umbrella and opposite side a reflecting panel, 1600 ISO, 3-second exposure. 2003. From the collection of the photographer.

Digital camera options were explored by Jürgen Königs from Germany, who used an Olympus E500 to create *AB-Seher* (Figure 8.11). He explained:

> I modified a DSLR camera into a pinhole camera by replacing the objective with pinholes of different shapes, zone plates and slot systems. I also used a kind of bellows lens hood to combine positive and negative masked images sections. On the other hand such a digital pinhole camera has some limitations: you can't get wide angle pictures and there is only one image size. The image field is always plane. Multiple exposure isn't possible—and so on. On the other hand you can choose for example between different

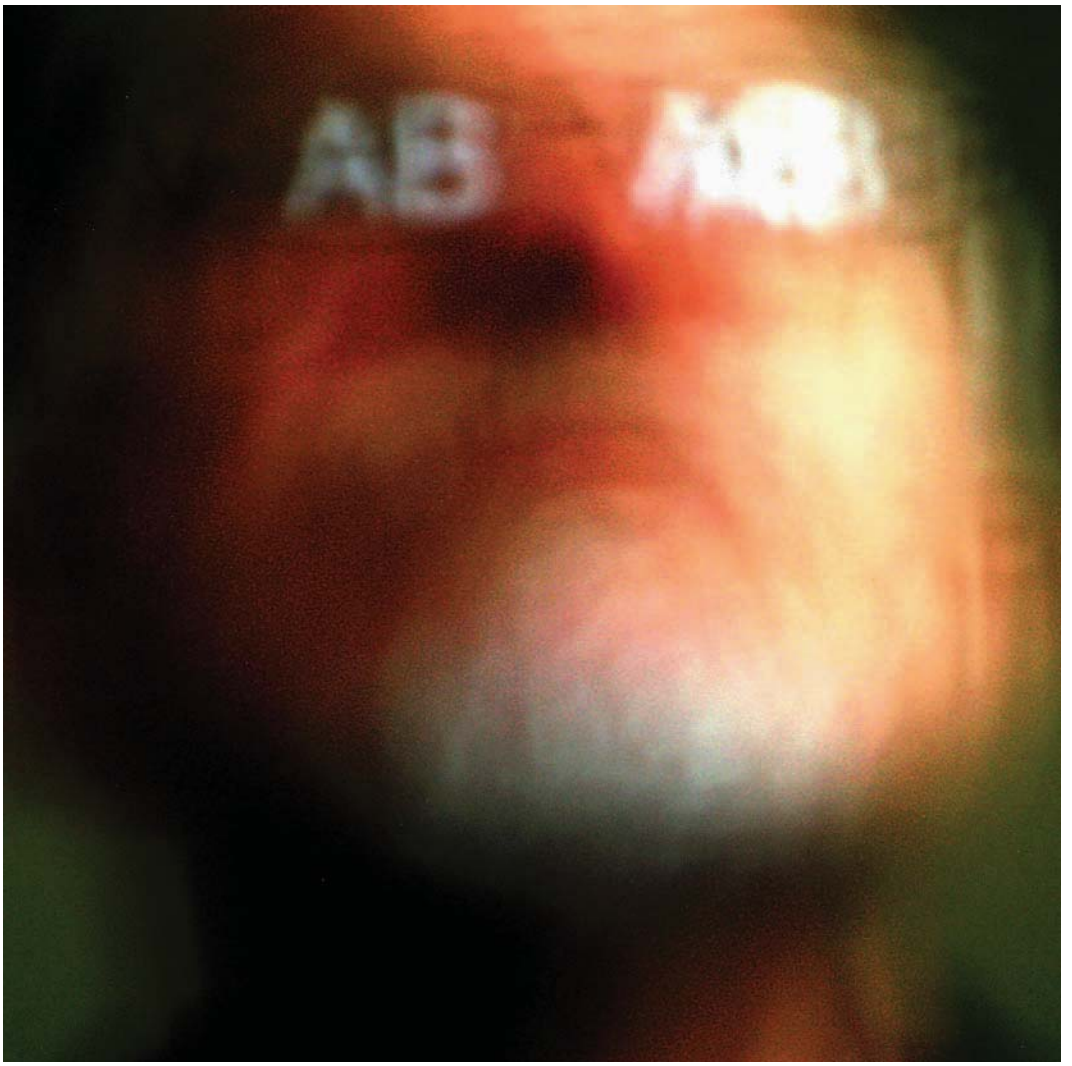

FIGURE 8.11
© Jürgen Königs, *AB-Seher* series *Präfixel*, 2007. From the collection of the photographer.

modes of monochrome or colored picture and of sensitivity. You can use noise reduction or accept or push noise as a means of expression. Furthermore you can control the images immediately.

The picture *AB-Seher* of the *Präfixel* series is made with a letter shaped pinhole. I used the German prefixes (AB-, VOR-, NACH-) each of them differentiating the meaning of the german word 'Bild' (=image).[2]

Pinhole Spy Cameras

Hardly a spy camera, but this 1885 rendition of a pinhole *camera obscura* made with a derby hat suggests imaging discretion (Figure 8.11) and humor (as no one would have known you had a *camera obscura* with you). I guess you were meant to wear the hat on your head until that special magic moment appeared. Then you swiftly got under your oversized black cape, saw the upside down image on translucent paper, traced it, and then put your hat back on your head and continued onward, with no one the wiser.

A digital pinhole camera may someday be manufactured, but only if there is a market for it. However, there are digital pinhole *spy* cameras. . .hmmm? In fact, an overwhelming surfeit of them are on the market. That lipstick sitting on your bureau may just be a camera or the Teddy bear (Figure 8.13) sitting high on a shelf may image your babysitter.

FIGURE 8.12
Derby hat *camera obscura*. In 1885, a simple *camera obscura* was made from a derby hat, translucent paper, and a dark cloth, from *Scientific American*, April 1885. From the collection of Julie Schachter.

FIGURE 8.13
Teddy bear spy camera, one of many objects available commercially as a spy camera.

Jim Moninger from New York used a pinhole spy camera and then wrote about its usefulness in "Pinhole Videography and the Digital Still" in Volume 18#2 of *Pinhole Journal* (2002). The pinhole on his Visiontech VC25P3 spy camera (Figure 8.14a) is less than 1 mm. Moninger stated:

> Pinhole imaging is widely used in the commercial production of state of the art micro-miniature video cameras. Designated "Spy Cameras or Nanny Cams," these are extraordinarily small, relatively low cost, video cameras which have powerful imaging capabilities.
>
> Their tiny size makes them ideal for concealment in ordinary household objects like clocks and books. They're available in both black and white and in color, and deliver the

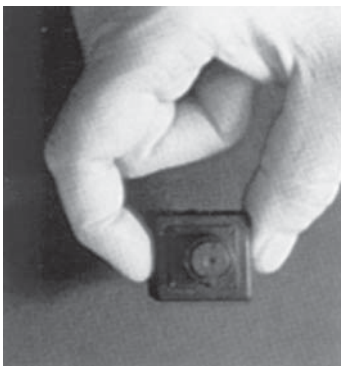

FIGURE 8.14A
© Jim Moninger, pinhole spy camera, 2002. Lens photograph. From the collection of the photographer.

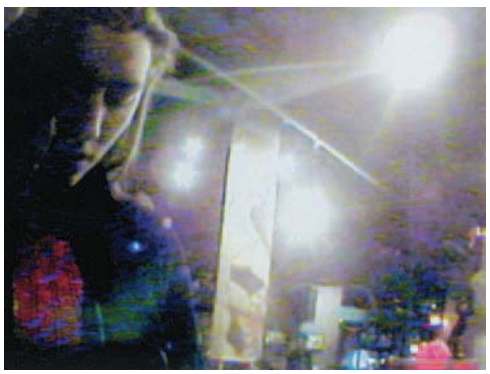

FIGURE 8.14B
© Jim Moninger, *Pinhole Videograph Shot in a Dark Cafe,* 2 × 3-inch pinhole photograph, 2002. From the collection of the photographer.

FIGURE 8.14C
© Jim Moninger, *Intense Man*, 2½ × 3-inch pinhole photograph, 2002. From the collection of the photographer.

same picture quality as VHS camcorders. . . . Many of these devices have glass lenses, but many have a pinhole for primary imaging. Color models cost well under $100.

Art and the Pinhole Videograph

Miniature pinhole video cameras, connected to a conventional camcorder, can be a powerful imaging tool for the artist creating still photographic images. Rather than being limited to art applications in the video medium alone, many of today's camcorders have the ability to capture still photographs from their own tape recordings in a digital form which is readily downloaded to a computer. Images can then be improved with imaging software and printed out on a wide variety of papers with a digital printer. These video/still camera hybrids often feature input jacks which enable them to record the images played back on tape by another camera; for example, the pinhole spy camera. This is the method I've been using to explore the aesthetic potential of this new pinhole technology. I've connected a miniature pinhole video camera to a conventional miniature digital video camcorder. The camcorder records, like a portable VCR, the footage imaged by the pinhole security camera. Later, the tapes are played back and the camcorder is used to extract still images from the moving pictures.

Low Light Pinhole Imaging

Exploring these technological advances has opened the opportunity to expand the vocabulary of pinhole photography into radically new dimensions of creative expression. First: low light. One of the most serious inherent limitations in pinhole work is largely overcome: The dependency on bright light or slow shutter speeds. Very low light images formed by pinhole video cameras are electronically enhanced. It is now possible to shoot with a pinhole camera in extremely dim light, including that of city street light, and at action-stopping shutter speeds. At last, night photography of moving subjects is possible with a pinhole camera.

These tiny video cameras, roughly the size of a sugar cube, contain circuitry which delivers a remarkably accurate exposure down to an incredible .2 Lux level of light. Some even have automatic backlight compensation. The color versions have automatic color correction built in. Although the expanded depth of field of pinholes is reasonably maintained, the cameras focus automatically. Focal lengths are somewhat limited, but some cameras feature a fairly wide angle of view comparable to the 28–35 mm ranges. The technology that allows this is based on the use of electronic components, most often CCDs (Charge Coupled Devices). CCDs function something like the light-sensitive photoelectric cells used in light meters which respond to varying levels of light intensity. Instead of a single area of sensitivity, CCDs contain a host of microscopic photosites which respond to the light intensity of various areas of the image projected to them from the pinhole. The CCD is connected to circuitry which creates an electronic reproduction of the image's light response. This is then recorded on conventional magnetic video tape. Typically, CCD imaging systems contain 320,000–1.3 million photosites. The more photosites and the larger the CCD, the greater the resolution of the image. This is an expression of the clarity and detail of the recorded image. By using additional circuitry, the cameras can amplify dark areas of the scene to compensate for low light conditions. They can also read a backlight situation and adjust the exposure accordingly. Often, they focus by detecting changes in the frequency of the light striking the photosites in various parts of the CCD.

Image Quality Issues

Image quality of spy cameras for VHS movie recording is quite good. However, the quality of "captured" still photo images is very low when measured by conventional photographic standards. Of course, one of the liberating aspects of venturing into pinhole photography is that the soft and low contrast images, the motion blur and camera shake, the flare and other weaknesses have opened up our visual sensibilities to the expressive capabilities of these characteristics. Spy cameras deliver very low resolution and are

practical for only very small prints of reasonable quality at this period in the technology's evolution. In addition to the images being soft and flare-prone, like most pinhole images, video-captured images made with pinhole spy cameras contain video artifacts such as scan lines, jagged edges, and patches of phantom color which appear in various parts of the image.

Image quality of video captures is significantly improved by using Digital Video Camcorders, but it is still very far from the quality that can be expected from film cameras and digital still cameras of high resolution. Capture resolution of digital cameras is listed in terms of 'megapixels,' or one million pixels. Pixels are tiny areas of light and dark (and color, where relevant) which comprise the image. It is convenient to think of pixels as being like the silver metal crystals which form the image on conventional photographic film. The more megapixels, the higher the resolution of the image.

For the work illustrated here, I'm using a SONY TRV900 camcorder capable of only 1.3 megapixels of resolution. This delivers a print of adequate quality for snapshots only to a size of about 4 × 5 inch. By comparison, higher quality 35 mm digital still cameras deliver images comprised of 5 to 6 megapixels, or four times as much clarity and detail than the best consumer grade camcorders. And, although very low light images are now feasible using these cameras, the lower the light level, the lower the quality of the image. The weak link is not the camcorder but the spy camera which is of far lower resolution and creates a lot of visual noise in low light.

Among the images illustrated here is a series made in the New York City subway [Figures 8.14b and 8.14c]. Light conditions there are such that, with an ISO 400 film, exposures at 1/30 range from *f* 1.8 to *f* 4. This low light level is impossible for ordinary pinhole work shot at hand holdable and action-stopping shutter speeds. If the quality is low today, dramatic improvements in both camera types can be expected in the near future.[3]

Digital Printing for Nonsilver Processes

Sarah Van Keuren, author of *A Non-Silver Manual,* has generously contributed detailed information for digital printing with nonsilver processes.

From the perspective of a non-silver printer working in gum bichromate and cyanotype: many imperfect pinhole negatives may be scanned and improved in Photoshop. Barely perceptible shadow details in underexposed pinhole negatives, both paper and film, often appear in scans and can be boosted in Levels or Curves, adding richness to the image.

Working in hand-applied alternative processes requires contact negatives that are the size of the printed image. A small pinhole negative may be scanned at a high enough resolution so that the resized larger negative has a resolution of 300 dpi. Enlarged negatives may be printed on inkjet acetate film or on vellum or lightweight plain paper. (You will obtain a richer inkjet negative if you print in color with the cyan, magenta and yellow cartridges contributing to the info and density of your negatives that will still look monochromatic.)

If your printer does not produce large enough negatives you can tile them together printing one segment of an image at a time and taping them together. Or if you have access to a copy camera you can print out a positive from your computer printer on, say, 8 1/2 by 11 inch paper, and then in the copy camera enlarge onto bigger ortholith film to obtain a negative.

If you are printing from a color negative or positive you might want to change to CMYK mode and print color separation negatives by highlighting one channel at a time and printing a monochromatic (black but in color) negative from it. If you wish to inject color

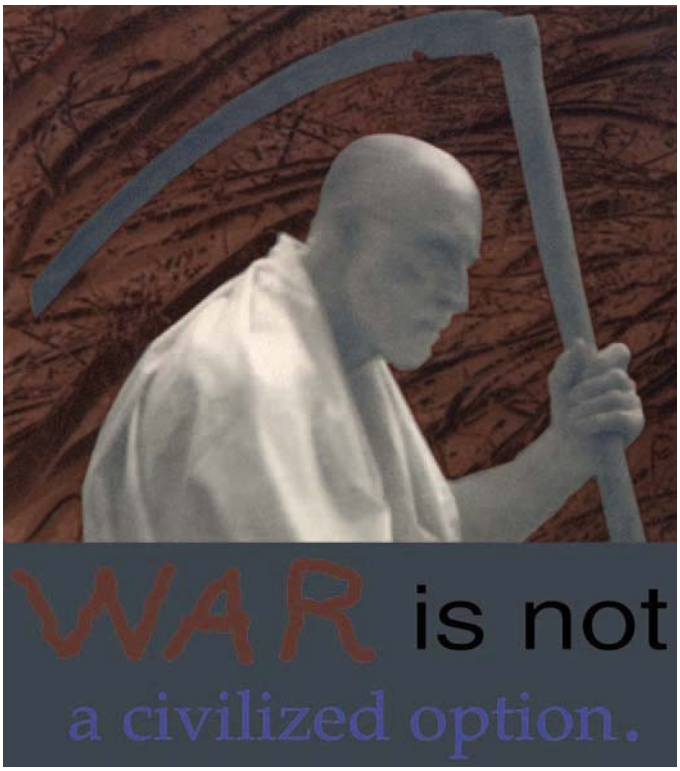

FIGURE 8.15
© Sarah Van Keuren, *War is Not a Civilized Option*, composite pinhole negative and pinhole positive cyanotype and gum bichromate photograph, 2003. From the collection of the photographer.

into a b/w negative you can also switch into CMYK mode and then in the manner of a printmaker, make changes in each separation so that an in-color imager emerges.

Theoretically duotone, tri-tone or quad-tone negatives can be generated in Photoshop from continuous-tone b/w pinhole negatives. In practice I have only generated duotones negatives from enlarged lens negatives. Sometime I would like to compare the look of a Photoshop duotone rendition of a pinhole negative with my old way of printing two layers in gum from a single 8 by 10 inch pinhole negative with a short exposure in a dark color for the shadow details and a subsequent much longer exposure in a lighter color to extend into the highlights.

I save all of my pinhole negatives so that eventually I can scan and compose from them. Certain negatives that may seem empty and a bit dull such as a field with woods in the background can function as stages upon which I place my 'actors' or symbolic elements. Pinhole negatives work especially well in this montaging activity because they have fairly uniform soft resolution rather than being in or out of focus. The effect is painterly.

Another use of the computer when printing from b/w pinhole contact negatives in alternative processes is as a source of accurate nuanced masks [Figure 8.15]. This is especially handy when attempting to produce areas of local color from a b/w pinhole negative. The mask can be feathered and gradated and specified to be of a particular opacity that would be hard to achieve by other means.

Finally, it is useful to be able to produce in advance a positive inkjet proof that roughly approximates to what you are heading towards in your non-silver print.[4]

NOTES

1. Stefano Bandini, personal communication with the author, 4 January 2008.
2. Jürgen Königs, personal communication with the author, 15 August 2007.
3. Jim Moninger, "Pinhole Videography and the Digital Still," *Pinhole Journal*, Vol. 18#2 (2002): 13, 24.
4. Sarah Van Keuren, personal communication with the author, 28 November, 2007.