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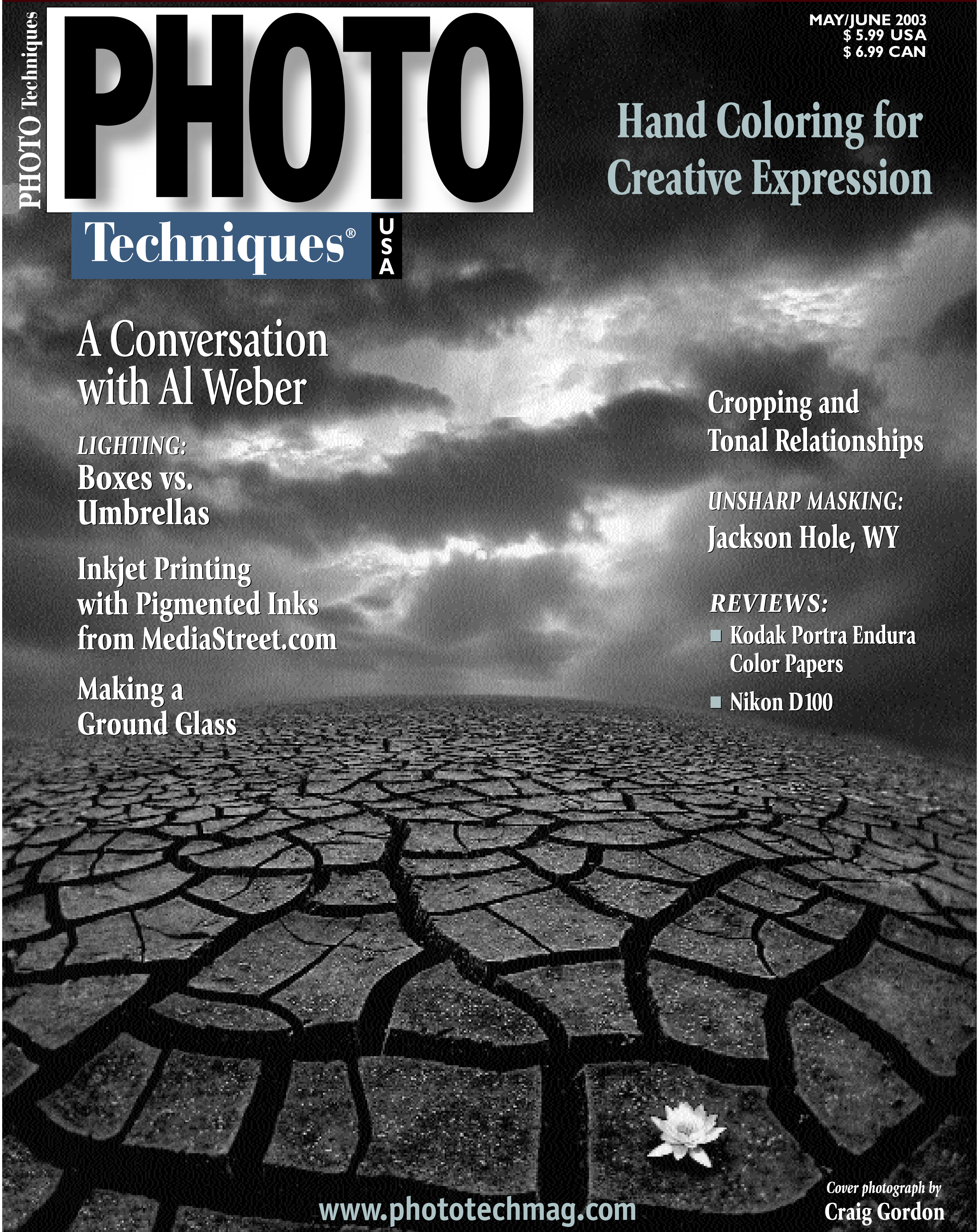

Hand Coloring for Creative Expression

A Conversation with Al Weber

LIGHTING:
Boxes vs. Umbrellas

Inkjet Printing with Pigmented Inks from MediaStreet.com

Making a Ground Glass

Cropping and Tonal Relationships

UNSHARP MASKING:
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- Kodak Portra Endura Color Papers
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The Joy of
Digital Printing

by **Mark Dubovoy**

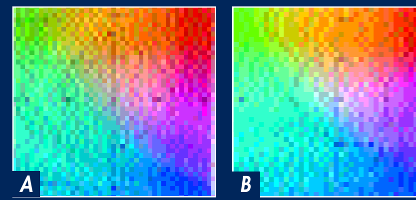


Figure 1. *These diagrams compare the color gamut of a print produced with* ***A****, Enhanced Generations inks on Royal Renaissance paper versus,* ***B****, a Lightjet print on Fuji Crystal Archive paper. It is obvious from the diagram that the color gamut of the inkjet print is wider.*

Often, I'm asked how to best capture an image and digitally produce a quality print from that image. More often than not, however, I've found this relatively innocent photography question is posed to engage me in a deep discussion about "traditional" vs. "digital."

Perhaps it's time to step back and examine the topic more objectively.

Digital systems and photography

A digital system is defined as a group of elements, where each element can exist in one of only two available states. A few familiar examples of these states include:

- Magnetic states (up or down) as in a computer disk drive or a computer tape.
- Holes (or no holes) on a surface, like pits in a CD or DVD.
- Electric current states (current or no current), such as inside a microprocessor.
- Electric charge states (charge or no charge) as in a CCD.

If we look at conventional film and photographic paper, we see that both materials contain chemical compounds (usually silver halides) that produce an array of light-sensitive grains. Each grain essentially exists in only two chemical states: the original state, and a different state, which is produced after exposure to light. Therefore, both conventional film and photographic papers are by definition, digital systems.

To those who engage in the tireless "traditional" vs. "digital" debate, I say, from its inception, photography always has been digital. This is true for capture, as well as printing. Film, by its very nature, is a digital capture system; conventional photographic papers, too, by their very nature, are digital (printing) systems. To my knowledge, non-digital photography has never existed.

Digital workflow

Now that we've established that photography is—and always has been—digital, we can take a more objective look at different printing methods.

Let's look at the typical workflow for making a fine art print (black-and-white or color) on conventional (silver halide) photographic materials. For simplicity and consistency, assume that we are starting with a film negative. Many times, the photographer wants to change the contrast on the film; in other words, modify the film curve. This is done by altering the "normal" development time and/or by the specific chemistry used. Once the film is processed, the negative is placed on the enlarger and the enlarger is focused on a sheet of paper. The highlight exposure is determined using test strips, while the level for the shadows is determined by experimenting with different contrast papers and/or different contrast filters. Determining the global paper contrast is equivalent to a second set of curve adjustments.

The next steps involve using physical tools like masks, dodging tools, and cards with cutouts or holes (to select specific print areas to apply desired changes without affecting other print areas). These local changes in selected areas include density changes (dodging and burning), contrast changes (selectively applying bleaches and reducers, using different variable contrast filters, using contrast masks, etc.), and color changes or adjustments (color filters in selected areas). Some printers also use unsharp masks to produce sharper prints with more discernible detail in local areas. This usually necessitates a final set of adjustments to levels and curves.

At the end of the process, unwanted objects are retouched out, wanted objects are retouched for enhancement, and dust or scratches are removed.

Thus, the workflow for a conventional print is:

1. Modify the film curve.
2. Determine highlight and shadow levels.
3. Subsequent curve modifications as needed.
4. Select local areas to be modified further.
5. Apply changes in density, contrast and/or color to selected areas.
6. Sharpen the print using unsharp masks or other tools.
7. Determine and apply final levels and curves adjustments.
8. Retouch.

A second look at this workflow reveals it is basically identical to the typical workflow in Photoshop.

This further proves not only that photography always has been digital, but also that photographers have been practicing Photoshop methodology for more than a century. Many of the great masters, like Ansel Adams, were experts at Photoshop many decades before the software ever existed.

The transition

The transition photography is experiencing is between using mechanical and chemical means to perform key tasks, and now performing these tasks electronically. When used properly, electronic tools can be extremely effective. However, just as a good computer with good word processing software doesn't guarantee that someone can write a good book, having a great computer, printer and scanner does not guarantee good prints. As with any tool, it's the artist's skill that determines the ultimate quality of the product.

Digital print options

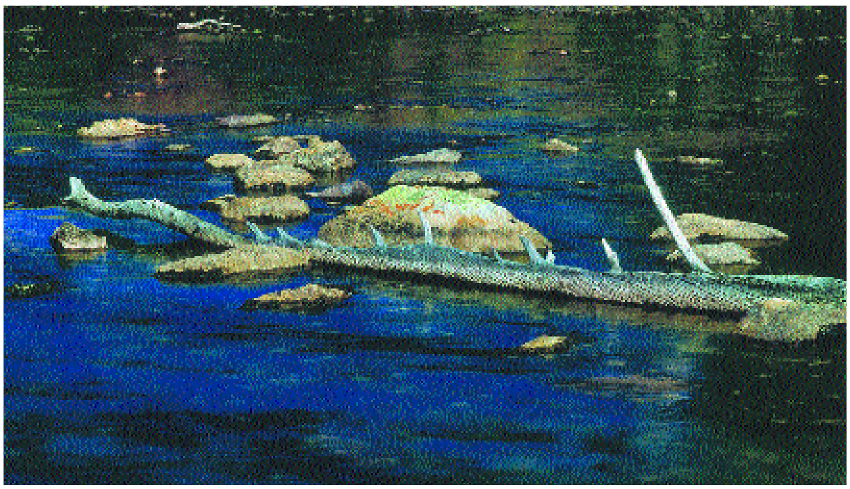
These are exciting times in photography. Today, a photographer is faced with an unprecedented number of choices in terms of different types of (digital) prints: carbon pigment, platinum, silver gelatin, Ilfochrome, Lightjet, inkjet, etc. I view each printing method as a different media. In painting, we have watercolor, acrylic and oil paintings, as well as ink drawings; likewise, in photography we have many different kinds of prints. Since each type of print has its own look and feel, part of the printing method selection process should include a subjective judgment on the look and feel of specific materials.

In my first two articles (*PT*, July/Aug '02 and Nov/Dec '02), we examined carbon pigment prints. In this article, we'll discuss prints made with inkjet printers. Although I'll concentrate on color printing, all the basic principles apply equally to black-and-white.

Inkjet prints

Regarding nomenclature, many artists and art dealers don't like the term "inkjet." They prefer the term "Gicleé," a French word that denotes something that is sprayed. Unfortunately, "gicleé" is too generic a term. It refers to many things, including a male cat spraying to mark its territory.

For lack of a better term, I'll use "inkjet" for the remainder of this article. Most inkjet printing today is done using Epson printers. Roland and Kodak, among others, also produce very high quality printers, but their market share is very small.



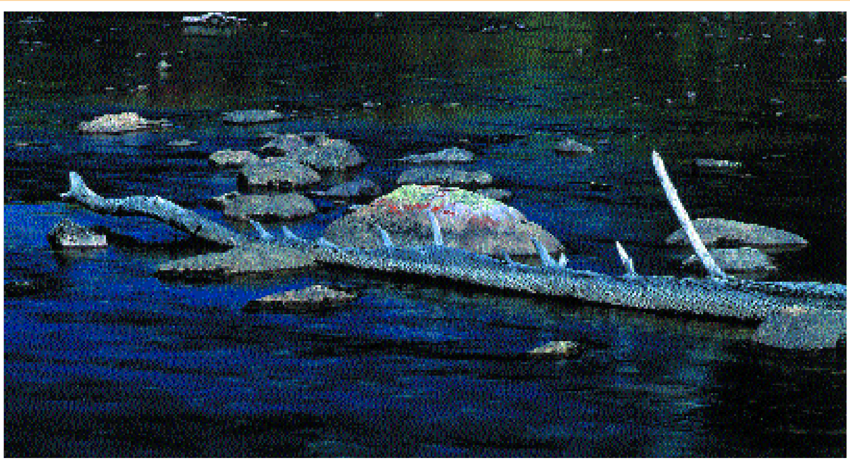


Figure 2. *These photographs were taken with a 4×5-inch Linhof Technika 2000 camera at sunrise in Wyoming. After the Fujichrome Provia 100 original was scanned, a pigmented inkjet and a Lightjet print were produced. The final materials were Enhanced Generations inks/Royal Renaissance paper for the inkjet print (top) and Fuji Crystal Archive (bottom) for the Lightjet print. Notice how the brightness range of the inkjet print is much better than the Lightjet print. Also, notice the superior color gamut of the inkjet print; the Lightjet print looks somewhat muted, lacks brilliance and misses a significant range of tones in the water when compared with the Inkjet print.*

Pigmented inks

Early in the life cycle of inkjet prints, the inks tended to fade extremely quickly. One could see significant changes in just a few months under display conditions. Dye-based inks also were prone to color shifting, and were very sensitive to ozone, humidity and temperature changes.

Most photo quality inkjet printers rely on a piezo element as the critical component in their printing head. Earlier attempts to produce a pigmented ink for this piezo-head technology failed because the pigment particles were too big to pass through the spray nozzles. Early pigmented inks had severe limitations in terms of restricted color gamut and clogging of print heads.

The first breakthrough came from MediaStreet (www.mediastreet.com), a small, independent company in New York. MediaStreet developed a pigmented ink with a gamut comparable to dye-based ink, and a pigmented particle size that ranged from 0.15–0.17 microns. (Epson's nozzle openings are about 25 microns).

Pigmented inks are not water-soluble. Unlike dye-based inks, these inks are highly resistant to fading and color shifts. Also, pigmented inks are not adversely affected by inkjet "coated" media. While uncoated media cannot produce really sharp prints, coated media significantly erode the longevity of dye-based inks.

About two years after MediaStreet introduced their pigmented "Generations Inks," Epson came out with DuraBright Ink for their Desktop 1270 printer, their first "archival" attempt. Unfortunately, most prints using this ink shifted to orange within hours. Epson recalled these inks.

Epson's next attempt was the pigmented inks first introduced with the 2000P, then the 7500 and 9500 Pro units. To pass the large pigment molecules through the nozzles, Epson used "micro-encapsulation" technology, the equivalent of putting a wrapper around the pigment. The wrapper squeezes the molecule to a size small enough to go through the nozzles. When the wrapped molecule hits the paper after passing through the nozzles, the wrapper breaks, and the pigment either gets embedded in the coating on the paper, or combines with the coating. Epson is very secretive about the details of the process. The only limitations of this pigment set are a somewhat reduced color gamut (versus dye-based inks) and the fact that the colors appear different when viewed under different light sources (metamerism).

Epson's third attempt at pigmented inks is the current UltraBright ink set for the 2200 desktop and 7600 and 9600 Pro printers. They've introduced a seventh cartridge—light black—to minimize metamerism. This ink set produces much better black-and-white prints. A new yellow produces a much better color gamut than previous Epson inks, but at the cost of significantly shorter life. Epson's claims on the longevity (archivability) of their prints have dropped from 200 years to "up to 80 years framed under glass," as long as the image is printed on their most archival matching paper. For comparison, Generations Inks have been tested and rated by The Wilhelm Research Institute at "beyond 100 years."

For black-and-white, there are several other alternative ink sets, most notably Jon Cone's specialized "Piezography" inks (www.inkjetmall.com). These require specialized software and drivers for the printer.

I should emphasize in the strongest terms that a long-lasting, good color gamut inkjet print is a marriage between the ink and the print media. The ink and the paper (or other media) benefit from a careful scientific match. That's why—commercial considerations aside—manufacturers recommend specific combinations of ink and media, and specify very different longevity for different combinations. You can try other combinations, but be aware that the longevity characteristics of such combinations are not known.

The dollar factor

Recently I did an interesting survey of the typical price-per-gallon of several well-known items in the San Francisco Bay area:

Premium Gas	$2.39 per gallon
Diet Snapple 16 oz ($1.29)	$10.32 per gallon
Lipton Ice Tea 16 oz ($1.19)	$9.52 per gallon
Gatorade 20 oz ($1.59)	$10.17 per gallon
Ocean Spray 16 oz ($1.25)	$10.00 per gallon
Brake Fluid 12 oz ($3.15)	$33.60 per gallon
Vick's Nyquil 6 oz ($8.35)	$178.13 per gallon
Pepto Bismol 4 oz ($3.85)	$123.20 per gallon
Liquid Paper 0.7 oz ($1.39)	$254.17 per gallon
Scope 1.5 oz ($0.99)	$84.48 per gallon
Evian water 9 oz ($1.49)	$21.19 per gallon

Now, compare this to pigmented inks. The lowest price I found on the Web for Epson Ultrachrome inks for the 7600/9600 printers is $58.50 per cartridge. Each cartridge contains 110ml of ink. Since a gallon is equivalent to 3,785ml, the price of Epson UltraChrome inks is a whopping $14,090 per gallon set of seven inks!

Clearly at more than $14,000 per gallon set, the inks are a huge profit margin item, which might explain why Epson fiercely defends its market share in this area. Perhaps this also provides a clue why Epson changes the cartridge's physical shape and installs a microchip to try to lock out third-party ink providers from marketing cheaper and/or better inks with each subsequent generation of printers. The third-party developers eventually do break the code in the chip, and manufacture compatible cartridges until the next printer generation is introduced; then the cat-and-mouse game begins again.

Personal choice

After spending a fair amount of time experimenting, I've settled on an Epson model 9000 printer, a proven workhorse that allows me to make prints up to 44 inches wide by any length. My choice of inks and media is Enhanced Generations inks and Hahnemuhle's Royal Renaissance heavyweight (309 gsm) paper. Both products are supplied by MediaStreet. This paper-and-ink combination can be used on the 7500, 9500 and 2000P printers.

My choice is based on the following:

1. A very wide color gamut. In fact, the color gamut is significantly better than a Lightjet print on Fuji Crystal Archive paper (Figure 1). This difference can easily be seen in my landscape photographs (Figure 2).
2. The brightness range is superior and very pleasing to the eye.
3. The color saturation is better than Epson Ultrachrome ink.
4. The amount of metamerism is smaller than with any other combination I've tried.
5. According to tests conducted by Henry Wilhelm, the life expectancy of prints using this combination is more than 100 years, much better than that for Fuji Crystal Archive (60 years), Ilfochrome (29 years) or Epson's "up to 80 years."
6. The look and feel of the Royal Renaissance paper is, in my opinion, the best in its class.

In black-and-white, I have yet to see an inkjet print that looks as good as a traditional silver gelatin or platinum/palladium fine print. In color, however, a good pigmented inkjet print can be noticeably better than that produced with conventional light-sensitive materials. I also prefer the look and feel of a fine-art rag paper to that of traditional color light-sensitive papers.

Conclusion

Starting with large-format negatives, I'm able to make 40×50-inch pigmented inkjet prints of stunning quality and permanence. The inkjet technology allows me to produce much larger prints in my studio than I could in my conventional darkroom. It also allows me to produce smaller prints of very high quality as a much less expensive and far less laborious alternative to carbon pigment prints. In terms of quality, look and feel, I prefer pigmented inkjet prints to Lighjet or Ilfochrome prints. As a bonus, these prints are expected to last much longer under display than conventional color prints.

Finally, the consistency from print-to-print is outstanding, as long as not too much time elapses between printing sessions. Contrary to popular belief, I've found that printers and/or ink cartridges do change over time. For precise work, it's necessary to produce a new printer profile regularly. I encourage those doing precise work with inkjet printers to acquire the appropriate profiling hardware and software. I don't believe canned profiles (or even a custom profile) are accurate enough to produce top quality work over extended periods of time.

I feel privileged and excited to live in a time when we are able to use such sophisticated and wonderful technology to produce prints of a quality that was almost unthinkable a few years ago. ■

Mark Dubovoy specializes in large format color landscape, mostly on the West Coast. He is an expert printer who utilizes traditional and digital methods, as well as non-conventional processes and materials. His photographs can be found at the San Francisco Museum of Modern Art and the National Museum of Contemporary Art in Mexico City. He has a Ph.D. in physics from Berkeley.