

Reflections on Photography & Art – 8

*Paradigm Shift:
The Transition from Chemical to Digital Photography*



*The Ghost and his assistants, Canyonlands National Park.
Digitally manipulated scanned film photograph, 1993.*

by

Alain Briot

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1-Introduction

In 1963 Thomas Kuhn published *The Structure of Scientific Revolutions* in which he introduced the concept of *paradigm shifts*. In his book, Kuhn argues that scientific advancements do not happen gradually. Rather, they happen through revolutions spaced apart by periods of relative calm. The revolutions that Kuhn describes represent periods during which one worldview is replaced by another worldview. Periods of relative calm represent times when the current worldview is left unchallenged. These changes in worldviews are what Kuhn calls *paradigm shifts*.

Kuhn's breakthrough description of the way scientific revolutions take place has found uses in fields other than science. In fact, the expression *paradigm shift* has come to define not just scientific revolutions but also radical changes in our way of thinking regarding specific fields of human activity.

Examples of paradigm shifts in science include:

- The Copernican revolution, during which people went from believing that the earth is at the center of the universe to believing that the sun is at the center of the solar system
- Darwin's theory of evolution replacing previous theories of inherited characteristics
- Quantum mechanics replacing classical mechanics
- Plate tectonics as explanation for global geological changes
- Pasteur's discovery that infectious diseases are not carried into the body from birth but external living organisms that find their way into the human body.

Examples of paradigm shifts outside of science include:

- DNA analysis replacing previous methods of identification
- Absolute monarchies replaced by democratic governments
- Specific inventions that transformed our relationship with the world such as the wheel, the airplane, the personal computer, etc.
- The use of an essay structure based on the purpose of the writer rather than on the 3-paragraphs theme (introduction, body and conclusion), a paradigm shift I personally experienced during my rhetoric studies and while teaching English at the university level in the early to mid-1990s.

2-The chemical to digital photography paradigm shift

The recent widespread dissemination of digital photography has resulted in a still-ongoing, global transition from chemical to digital photography. In turn this transition has caused a *paradigm shift* in the field of photography.

This shift is characterized by the following characteristics and consequences:

- changes in the way we capture photographs
- changes in the way we process photographs
- changes in the way we print photographs
- changes in the way we look at photographs

In this essay I want to detail the exact nature of these changes as well as their implications. While many, if not all the conclusions that I have reached can be applied to the entire field of photography, my personal expertise is in fine art landscape photography. I will start my analysis by looking at the first 3 changes in the list above, then turn to number four in order to reach a number of general conclusions about what this paradigm shift means on a societal level. My goal when looking at number 4 will be to outline the changes that this paradigm shift has brought to the way we look, approach and perceive landscape photographs.

In this essay we will also see that the paradigm shift I describe is far from being completed. This should not come as a surprise. The presence of a paradigm shift can be outlined far before its implementation is complete. I will, therefore, in the course of this essay, point to areas where either this shift is not complete, or areas in which the previous paradigm continues to be used or to dominant. In many ways, we will see that a paradoxical and at times ironical situation has developed, a situation in which digital tools are offered along with features designed on the basis of the chemical-photography paradigm. We will also see that some areas of photography are embracing the new paradigm faster than other.

As you read this essay you may find yourself saying, "There is no point going into all of that, I already know it." As a photographer either working with or knowledgeable about digital photography, this is bound to be the case and I expect it. Take it easy. The point I am making is really in the conclusions that I reach throughout and particularly at the end of this essay, when I look at how photography is changing globally. I could have done away with listing each specific change on my way to these conclusions, but doing so would have made this essay accessible only to those that are intimately familiar with the differences between chemical and digital photography. I did not want this essay to be written solely for an audience of photographers. Rather, I wanted it to be accessible to a larger audience who is not intimately familiar with the changes I outline.

I also wanted to provide a comprehensive list of the various changes that took place in the transition from chemical to digital photograph because, to my knowledge, such an essay has not been written. As I previously said, I attempted to make this list as exhaustive as possible. However, if you find an item I forgot, kindly let me know and I will add it to the list.

It also needs to be said that most, if not all, of the many entries pertaining to individual changes could be turned into full-fledged essays. I do believe that this is the case and that, should one be so inclined, it can certainly be done. Personally, while I have done so for a number of entries

which I believe to be particularly important, or which I find to be of extremely high interest to my readers, I certainly do not plan to write extended essays on each item listed in this essay. Doing so would be paramount to writing a dissertation, an endeavor that, while definitely worthwhile, is not my goal at this time.

These preambles having been addressed, let us take, without further ado, an actual look at the matter at hand: the exact nature of the chemical to digital photography paradigm shift.

3 - Changes in how we capture photographs

Digital photography has revolutionized how we capture photographs. Digital photography allows us to bypass many of the limitations imposed by film by dramatically lowering the cost of taking photographs, allowing a precise way to visualize exposure and evaluate photographs in the field, permitting ISO changes at any time, and allowing images to be captured at different quality levels, i.e. RAW or various levels of jpeg compression. A digital camera is also a digital light meter and a visualizing tool that can be also used when working with film cameras.

These changes in what digital cameras can do has in turn brought changes to the relationship between camera, image resolution and print size. These changes, which are most noticeable at the grass root level, have in turn affected camera manufacturers. Some important new features are being introduced unevenly, and some film-based camera companies, which are either not moving to digital or moving to digital inefficiently, are seeing their sales tremendously reduced, or are being forced out of business altogether.

Many of the limitations imposed by film are now gone

Chemical photography required that photographs be captured on film. This implied that the film itself played a major role in the eventual appearance of the image. The film, in a way, became an irreversible element of the image's final appearance. At one extreme, an image captured on black and white film could never become a color image unless colors were hand-painted onto the photographic print. At the other extreme, a color cast, or a contrast increase caused by the film, had to be corrected in the darkroom, a process that was difficult and required either expert knowledge and having your own darkroom, or employing the service of an expert printer. Because both options were out of reach of most amateur photographers, fine art print quality remained the avatar of professionals.

Digital cameras capture images on digital sensors, and while it can be said that there are variations between sensors regarding color and contrast, these variations are far smaller than variations in film type. This is especially true when images are captured in Raw format, because Raw images exist in a single channel file that is later interpreted by the raw converter in various ways. This interpretation -or raw file conversion as it is called- can be controlled by the photographer to a large extent.

Image capture costs are lower

The cost of capturing digital photographs is far lower than the cost of capturing film photographs. With film, the cost of taking of photo is the cost of the film plus processing. With digital the cost of taking a photo is the cost of the storage medium. In-camera storage, on various card media, is endlessly reusable and hence can be considered part of the cost of the camera. The actual cost of digital capture is the cost of the final storage media, which most

commonly is either CDs, DVDs or hard disc storage. Film plus development today for 2 rolls of 36 transparencies, for a total of 72 images, costs roughly \$20 (\$5 per film plus \$5 per development, for a cost per photo of about 30 cents. 72 digital photographs taken with a camera such as the Canon 20 D, which is currently a mainstream 35mm digital camera, can easily fit on a CD, which costs less than \$1, for a cost roughly of 2 cents per photo. This makes the cost of digital about one fifteenth of film photography (2 cents times 15 = 30 cents) when only consumables are taken into consideration.



Silverton, Colorado. Polaroid Type 52 original, 1983
Arca Swiss 4x5, Rodenstock 210mm

In pre-paradigm shift times, the closest one could come to the immediacy of digital capture was to use Polaroid film. In an enthusiastic approach, which may have been a precursor of things to come, I loved it so much that during my first visit to the American Southwest, visit that lasted 6 months, Polaroid type 52 was the only film I used.

Equipment costs are higher

The cost of digital cameras is many times what film cameras used to cost. Furthermore, digital cameras need to be replaced every two years or so as the resolution and other technical aspects of digital cameras continue to improve.

Professionals can offset the higher cost of digital cameras through tax deductions and savings in film and development. But for amateurs the cost of photography as a hobby has never been so high. This is true also if one looks at other equipment that until now has had a similar life span as digital cameras such as wide format printers, RIPs, computers and monitors and more. As I

often say “it used to be that a Leica was expensive.” Now, many of us long for the days when one could have one of the best cameras in the world for about \$2000.

Exposure and captured images can be visualized in the field

Calculating exposure with film has always been challenging, even for the best trained practitioners working with the finest light meters, because of the impossibility to actually see the actual results of a specific exposure in the field. With film, seeing the final image can only be done after the film has been developed, something that, in regards to landscape photography, has to wait until the photographer can take his films to a lab, something that can take days, weeks or months.

With digital the actual results of a specific exposure can be seen in the field, seconds after taking the photographs, on the LCD screen built into all digital cameras. Furthermore, the exposure used to create each specific image can be studied by looking at the exposure histogram, which is stored along with each digital capture.

This has revolutionized how photographs are taken. Prior to digital capture, photographers either had to implicitly trust the accuracy of the light meter built into their camera, or use a separate hand-held light meter, usually a spot meter, to calculate the exposure themselves. Now, one usually starts by taking an exposure at the settings recommended by the camera, using aperture priority usually for landscape photography, especially when a tripod is used, or using the camera in manual mode. Then, after reviewing the image on the LCD screen and studying the histogram, one either increases or decreases the exposure as needed. If the photograph is exposed spot-on by the camera, which does happen, then no further action is necessary and one is free to move on to the next shot. If the image is either over or underexposed, the exposure is adjusted until the histogram is not clipped at either end. If the contrast exceeds the density range of the camera, two images are taken, one exposed for the shadows and one for the highlights, then merged into a single photograph in Photoshop or other image processing software.

The way photographs are exposed has changed radically

It is highly recommended that photographs be exposed to the right of the histogram in order to take advantage of the larger amount of data captured by the sensor as the amount of exposure increases. Digital information is captured in bits of data, and bits increase in quantity proportionally with exposure. As exposure increases, so does the amount of data captured.

Technically, less information is captured in shadow than in highlight areas because shadow areas receive less exposure than highlight areas. However, when little information is recorded, defects such as noise and lines are maximized. To get the finest image quality, it is therefore necessary to overexpose the image as much as possible without clipping the highlights, or to record the image in several captures. To this end the histogram is shifted to the right as far as possible, effectively overexposing the image. The proper exposure is established during raw conversion by reducing the exposure (effectively darkening the photograph) in the raw converter.

This is a radical departure from how film photographs were exposed. With film the goal was to place each area of the image (often called Zones after the Zone System) precisely where we wanted them to be on the print or the transparency. Overexposing made printing far more difficult, if not impossible altogether, because the non-linear nature of film meant that there was

a toe and a shoulder at each end of the film curve. The toe, at the bottom of the curve, meant that a certain amount of exposure was necessary before shadow areas started to be recorded. The shoulder, at the top of the curve, meant that additional exposure resulted in removing details from highlights.

More and more photographs are being taken

The fifteen-to-one reduction of the per-photograph cost has resulted in a huge increase in the quantity of photographs taken, increase which will continue to grow for years to come as more and more people embrace digital photography and break free from the previous paradigm which stated that photographs are expensive.

A digital light meter with histogram and LCD preview is in our future

At this time the only way to have a light meter with a histogram function and an LCD preview of the scene to be photographed is to purchase a digital camera. I am sure this is going to change, and that sooner or later a light meter manufacturer, such as Gossen, Sekonic, Pentax, etc is going to manufacture a “digital” light meter.

This situation means that if you shoot film you may very well own a digital camera that you are not using to take photographs. Indeed, the advantages of being able to visualize the image in the field, and of studying the histogram, are so significant as to warrant the expense. But again, since your digital light meter is also capable of taking photographs, why not do so? And if you are going to do so, it makes sense to carry a top of the line digital camera to maximize the quality of your digital captures.

This situation has become quite frequent with 4x5 photographers who often carry a 35mm DSLR along with their 4x5 system. The combination of the two formats makes complete sense provided the facts I outlined above. Combining medium format digital and 4x5 might also make sense, but the added weight and price are a deterrent at the time. It will be interesting to see how this situation evolves.

ISO freedom is a reality

With film cameras the ISO was set for the current film loaded in the camera. If one wished to use a faster or a slower film, one had to either wait until the film was completely exposed or change the film in mid-roll. Neither option was practical and most photographers used only one specific film speed, or occasionally two, one for most photographs and one when extra speed was needed or when shooting handheld was necessary. For landscape photography this most often meant using one film with an ISO of 50 to 100 and another with an ISO of 200 to 400.

Digital cameras changed this approach dramatically by offering “*on the fly*” ISO changing capabilities. By simply adjusting the ISO setting in the camera, the light sensibility of the sensor is either increased or decreased. Metaphorically, it is as if changing the ISO setting on a film camera actually changed the type of film loaded in the camera. While in the past doing so was a mistake, it is now a reality. Getting used to this new reality requires that one moves away from the chemical-based paradigm and embraces the new digital paradigm.

The consequences of this change are significant. First, ISO setting has become the third variable in regards to exposure control after shutter speed and aperture. One can, for example, raise the

ISO by one stop in order to be able to close the lens down one more stop. When the goal is to get the maximum depth of field possible, being able to do so makes all the difference.

Interestingly, many digital camera manufacturers continue to use the same approach to ISO setting when it comes to which functions and buttons have to be used on the camera. Since setting the ISO was done relatively rarely on film cameras, these functions did not have to be the easiest to access. In fact, it was to the user's advantage that the buttons, or custom functions used, were somewhat hard to access. Changing the ISO inadvertently on a film camera meant either underexposing or overexposing all the images on a roll. Therefore, making the ISO settings difficult to reach made changing the ISO accidentally less likely.

However, now that we are changing ISO settings much more often, these settings need to be very easily accessible. However, most of the time this is not the case. Here too we see that the previous paradigm is still at work, influencing camera manufacturers to continue doing things the way they were done before.

The relationship between cameras, image quality and maximum print size is changing

When I wrote my comparative essay between the Canon 1DsMk2 and 4x5 scanned film, essay available on my site in case you have not read it, I received numerous emails asking me why I "chucked" 4x5 (I didn't), lowered myself to the level of rank amateurs (I didn't either as we will see, not to talk about the discriminative aspect of this remark towards non-professionals) or again why I "joined the dark side" (I metaphor which had to be explained to me due to my lack of familiarity with *Star Wars*).

These comments took me by surprise, and prior to writing the essay you are reading I wrote three unpublished essays in which I tried to explain this sudden unleashing of anger on the part of a certain audience. Interestingly, another segment of my audience was perfectly fine with my decision to use both 4x5 and full-frame 35mm digital, so much so that they were delighted to read this same essay.

I now realize that the response I received was due to the paradigm shift I am in the process of describing. In the world of film photography, there is no good reason for a 4x5 photographer to start using 35mm. The differences in quality between 35mm and 4x5 are immediately noticeable in prints larger than 8x10, and some will say that 8x10 shows a difference already. Grain, lower resolution, even scan quality for those who use scanned film, are all affected by the smaller format.

Not so with digital. With a high quality sensor, such as the one used in the 1Dsmk2, and more so with sensors used in medium format digital backs, sensor size does not affect the quality of the image the same way as film size does. First, the quality of a digitally captured image is higher to start with than that of scanned film.

Second, the maximum print size that can be made from a digital file is nearly one format larger with digital cameras than for similar format film-cameras. What this means is a camera such as the Canon1DsMk2 is capable of medium format quality and a medium format digital back, such as the just-released Phase one P45, is capable of 4x5 quality. As the resolution of digital sensors continues to increase, I expect that the current difference of one camera format between film and digital will increase even further, to perhaps two film sizes.

Third, digital images can be easily stitched together, bypassing the limitation imposed by the sensor. For example, it is common for full-frame DSLR users to use a tilt-shift lens in order to take 3 photographs --one shifted to the right, one dead center and one shifted to the left-- and later merge them seamlessly in Photoshop to obtain a file twice the size of the original resolution of the sensor.

Fourth, the quality of a digital file is not solely determined by the digital sensor. It is also determined by the quality of the raw processing software. As raw processors continue to improve, the quality of the information extracted from raw files can be expected to increase as well.



Waterfall and Pine Tree, Yellowstone.
Polaroid Type 52 original, 1983

Lenses have become the limiting factor with high end digital backs

Digital cameras have reach such high resolution levels that lenses have become the limiting factor. On the low end, some lenses can simply not be used because digital sensors reveal defects that film couldn't show. On the high end, even the best lenses see their resolution capabilities pushed to the limit by digital backs whose ability to capture detail goes beyond the lens'

resolution. New lenses have to be introduced to remedy this situation, something which, at this time, is not happening yet, except for Schneider's large format Digital lens series.

Raw or Jpeg: different image quality for different needs

Film offered one and only one image quality, and that was the quality of the film loaded in the camera. If you wanted a different quality you had to use a different film.

Digital cameras offer different image quality by simply changing the type of file that is saved to the flash card. Raw provides the highest quality level, at the cost of increased storage space, while jpegs reduce storage space, at the cost of image quality. But, another advantage is brought when jpegs are used: images are accessible right away because raw conversion is done in the camera at the time the image is captured. This makes the image available immediately, thereby saving time by bypassing the need to do raw conversion by hand.

Important digital camera features are being introduced unevenly

The change from chemical to digital photography has caused a certain lack of order in the way new features specific to digital cameras are being introduced. For example, at this time live histograms, a feature desirable for both pros and amateurs alike, are available only on digicams. At this time no DSLR features a live histogram.

The same situation is present with real-time LCD preview, a preview that works like a video camera, showing an image, which isn't fixed, but rather moves as the camera moves, showing the scene in front of the lens as the camera is being repositioned. Other desirable features, or accessories, are simply not available at all. For example, a digital light meter, such as the one I described in my *How to Calculate the Best Exposure* essay a couple of years ago, is still not available.

Similarly, an accessory that I personally consider extremely useful if it existed, would be an LCD (or other display) screen with a built in hood that could be mounted on the flash shoe of a digital camera and connected to the video out port of the camera, in order to show an image larger and brighter than the size of the built in LCD. Such a screen, which might measure 4"x6" for example, would greatly help visualize small details in a composition, thereby affording the 35mm or medium format user one of the main advantages of 4x5 cameras, i.e. a very large viewfinder.

A grass root level change

Something has to be said about how many people, at this time in the history of digital photography, are using digicams versus how many are using 35mm digital versus how many are using medium format digital or 4x5 digital. In short, the numbers shrink dramatically as the size of the sensor increases. Digicams is the category with the largest number of users (cell phone cams included), by far, showing that, if we look at just the number of users, currently the chemical to digital paradigm shift is taking place on what can be described as "a grass root level".

The next category, and the one used by serious amateurs and professionals, is 35mm digital. Medium format digital is the third category, but represents only a very small fraction of digital landscape image captures while 4x5 digital, the 4th and last category, is practiced by such a small number that these practitioners virtually know each other by name. The fact that only one company currently produces a 4x5 digital back is testimony to the small size of this market.

Significant changes and disappearances among industry-leading brands are taking place

The shift from film to digital has created new opportunities for camera and photography accessory manufacturers. While some existing brands have thrived because of this change, others have struggled while new brands have surfaced. The reason behind the success of certain brand and the failure of others is their ability to adapt quickly to the changes in both the technology and the marketplace, as well as to the new expectations of customers. Without going into details about specific companies, brands that are able to make the correct changes and decisions, brands that are able to adapt to the new paradigm, thrive, while brands that are unable to do so either loose market shares, are forced out of business or end up being bought by one of the successful brand. Finally new companies are being created from scratch to fill the needs of the new paradigm.

4 - Changes in the way we process photographic images

The changes brought by this paradigm shift have affected the way we process photographs just as much the way we take photographs. The most important change is how Raw files have made it a necessity for photographers to use a computer. However, other very important changes include the near-demise of the chemical photo lab, the shortened delay between taking a photograph and looking at the resulting image, the emergence of the *Master File* concept and of the *digital wallet*, the necessity to learn digital image processing and color management, and the possibility to make virtually any change we may desire to a photograph. Let's take a closer look at these changes:

Photographers must be able to use a computer and need to master image processing software and color management

Virtually no photographer can afford to ignore digital, and to work on digital images photographers need to know how to use a computer. They must also acquire the necessary equipment and software, learn how to use it, and keep their equipment up to date in a quickly changing environment.

Because Raw files only contain “tagged” information about color balance, photographers must learn how to properly color-balance their images, a task which previously was usually handled by the lab. In this regard, experience and color knowledge are key to creating quality conversions.

This is not an easy task. So much so that digital processing quality increasingly separates amateur from professionals. While the tools and the training are readily available, one must constantly invest time and money to learn how to use the latest tools and techniques. I personally believe that the amount of knowledge required for creating world-class photographic images able to compete in the marketplace is increasing every year. I will return to this issue in the conclusion of this essay



Man and Sun
Digitally altered film scan, 1993

In pre-digital times creating this type of image would have been only possible as a painting. In post-paradigm shift time, doing so is entirely possible starting from a scanned film photograph.

The image above was created in 1993 from a scanned film photograph of a rock art panel in Dinosaur National Park on a Macintosh Quadra 840av running Photoshop 2.5

Raw files have revolutionized how we approach a latent image

With a Raw file the user can manipulate the data and try to extract accurate color information over a wide dynamic range. While in pre-digital days what most photographers using color films did was take the picture and let the photo lab develop our film, we now have to process the raw files ourselves, as well as adjust contrast, sharpness and multiple other variables. Certainly, one can shoot jpegs and bypass image processing. However, for fine art purposes, Raw files guarantee a superior result.

Raw converters have replaced film development in turning a latent photograph into an image we can view and print.

While film provided a relatively small number of options in regards to color, saturation and contrast, raw conversion and image optimization programs offer endless variations regarding color and contrast changes. Similarly, improvements that were challenging to make in the darkroom are now routine in the digital world.

When the controls over color, contrast, noise, and even image correction are considered, the raw converter becomes, in effect, many things at once:

- It is part of the camera, in the sense that it can change the very structure of the image such as removing distortion, chromatic aberration, vigneting, etc.
- It is part of the “film development” process in the sense that it can change the color balance and contrast of the film, and at the same time go much further than film developing ever could such as turning a color photo into a black and white image.
- It is part of the post processing, or optimization process of the image, being able to perform functions such as curve adjustments, leveling, cropping, sharpening, noise removal and more.
- It is part of the image filing process, because the latest Raw converters are also image cataloging systems, providing keyword searching, and the possibility to create web galleries and slide shows.
- It is a complete solution. The most recent Raw converters also allow printing from within the converter, making the converting software the only software we need if its capabilities are satisfying to us. These capabilities may still show some limitations but these are bound to be reduced, if not eliminated altogether, in the near future.

We no longer need the services of a photo-lab to develop our film

For those of us who sent their film out to be developed, labs are no longer needed since we now open jpeg files right out of the camera, or “develop” our raw files ourselves. For those who developed their films themselves, there is no longer a need to have a darkroom and to stock darkroom supplies (developer, fixer, etc). Personally, I sold all my darkroom equipment and supplies in 1996. I never looked back. I haven’t met a single photographer who has done this and regretted it. I’m sure there may be some, but they must be part of a very small group.

What is interesting in this regard is the attempt, on the part of a few companies, to act as “raw-developing labs” i.e. digital “labs” to which you send your raw files and which convert them and ship them back to you. While there may be a need for this service on the part of individuals or companies who need an extraordinary number of Raw file conversions, it is unlikely to be a service needed by professional photographers on a day to day basis the way chemical labs were necessary. The reason being that we can do conversions ourselves, and that the time “saved” by having someone else doing far outweighs the time wasted shipping raw files and waiting for their return, not to talk about the fact that by doing so we are giving away control over the appearance and quality of the raw conversion, control which is one of the main advantages of shooting digital.

The delay between taking a photograph and viewing the image has been radically reduced
With film, the delay between taking a photograph in the field and viewing the resulting negative or transparency usually took days if not weeks, depending on how soon we could get the films to the lab. With digital, for photographers working in the field, this delay varies from a few minutes, if a computer is used to process the raw files in the field, to a few days if the photographer prefers to process the raw files back in his studio. For photographers shooting a

camera tethered to a computer, such as is necessary with a scanning back, this delay is nil. The image is available as it captured by the camera, in real time.

A new concept has appeared: the *Master File*

With digital, image optimization and printing are now done in two separate steps. With chemical, after film development, printing and optimization were done simultaneously.

With darkroom work, the first time a negative or transparency was printed, a “printing recipe” was put together. The goal of this recipe was to outline all the steps necessary to create a fine print. These steps included dodging, burning, masking, color control, development times, and much more.

Once the recipe was put together, all the steps called for by the recipe had to be “re-enacted” each and every time a print was made from this specific negative or transparency.

With digital all the optimization steps are done to the original image then saved to what has come to be called the “master file.” Any changes to the image can be saved, and, if using Photoshop, many changes can be saved as layers that can be modified later on. This master file is a copy of the image file that has been optimized so as to create a fine print. This optimization is done once and once only. The only reason why it may be modified is if the photographer decides to make changes based on a new vision for the image.



Trees on Ice. Upper Peninsula, Michigan
Digitally superimposed scanned film photographs, 1993

Once this master file is completed, the steps that were followed to create it never have to be followed again. Prints are made from this file by simply sending it to the printer. The same file can be printed an infinite number of times. As long as the printer, profile, inks, papers and other variables remain the same, the prints will all be the same.

What is interesting is that the quick pace at which digital technology changes makes this last requirement –keeping all the variables the same- the biggest challenge since, at this time, software and hardware change every year or every two years.

The processing possibilities offered by digital image processing are virtually endless

New processing possibilities are offered by digital capture when it comes to image processing and optimization. Without going into a comprehensive list of all the controls available via software, we can simply say that nearly all the defects introduced by film can be fixed and that just about every parameter of a photograph can be controlled.

While Photoshop was and still is the *ubiquitous* image processing software, it may not remain so forever.

Raw conversion software is now increasingly becoming a complete solution, offering not only raw conversion but also image optimization, image cataloging and printing. On the Adobe front, Lightroom is offered as an alternative to Photoshop for photographers who do not need the full-fledged Photoshop image processing capabilities. On the competitor's front, Apple is offering Aperture as an alternative choice to Lightroom.

Yet other companies, such as Lightzone, are offering image-processing software that is aimed at replacing Photoshop by providing a different approach to digital image processing. Lightzone embraces the digital photography paradigm 100% by applying the Zone System to digital photography. The creators of Lightzone accurately realized that this cannot be done during exposure because a digital image needs to be “exposed to the right,” meaning overexposed, regardless of which zones we want to place the different luminance areas in the image on. Therefore, Lightzone implemented zone placement during or after raw processing, depending on whether one works in Lightzone on a Raw file or a previously converted tiff file.

The *digital wallet* offers an entirely new way to store and view images in the field

The advent of the digital wallet makes raw processing in the field a secondary necessity if all one wants is get a general idea of the image. Such devices act as virtual lightboxes, allowing photographers to see the images they took without the need to do any conversion or processing. They have become virtually indispensable for landscape photographers, thereby creating an entire new need.

The digital wallet also brings together photographs, songs, videos and other images in the same storage device. While these different mediums remain separate, they are now stored and retrieved using the same devices.

5 - Changes in the way we print photographs

How we print photographs has changed just as much as how we process photographs. Among these changes we find the demise of the chemical lab, the need to learn a new craft, the possibility to print on demand, and more. Let's take a closer look:

We no longer need the services of a photo lab or of a master printer to print our work

With digital we can print our work ourselves. But with this new freedom comes the necessity of acquiring the necessary equipment as well as learning how to become a master printer. In the previous paradigm we could rely on the knowledge, training, expertise and experience of someone else that we would pay to print our work. Now, we must have this expertise, experience, knowledge and training ourselves. And if we don't our print quality risks to suffer greatly and be under par.

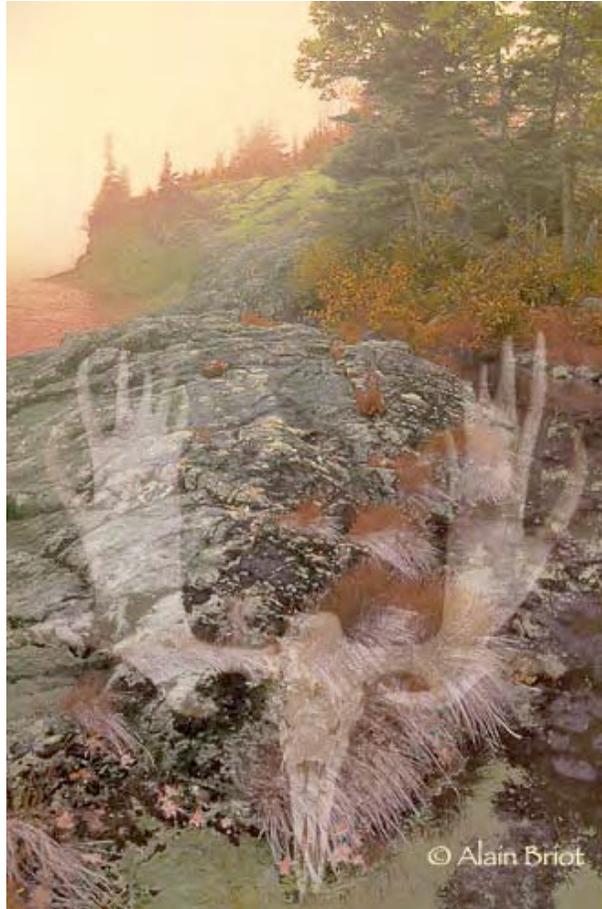
Opportunities for learning the craft are greater than they have ever been

The good news is that there have never been more opportunities to learn the craft, through online tutorials, books and workshops. Both individual photographers and companies producing digital software and equipment offer these learning opportunities.

With darkroom printing, the companies that provided darkroom instruments and supplies offered little in the way of teaching how to use their products past the instructions included with their products. Study had to be done either on your own or under the guidance of a master. While there were a lot of learning materials available in regards to black and white printing, far less materials were available for color printing, especially for printing transparencies on Cibachrome paper. This was even more so when it came to advanced Cibachrome printing, which made use of color and contrast film masks, and of custom built enlarging light sources. The only source I could personally find, in the way of books, was a tutorial written by Bob Pace. Other options were slim, but included one on one consulting with specific photographers for example. I suppose that workshops were offered as well, although I did not come across them. I could not have afforded either workshops or consulting anyway. A book was as much as I could afford at the time.

We can free our bathroom, closet, spare bedroom or garage from darkroom equipment

We no longer need a home darkroom since we print our photographs ourselves digitally. However, we do need a space to install computers, monitors, printers and the many other tools required for digital photography. This means that we still need a dedicated room, or space, to do digital photography. However, we no longer have to black out the windows or pollute the air with chemicals. An extraction fan is no longer a health requirement for photographers printing their work at home! On the other hand, the necessity of having a home-darkroom in order to practice photography as a hobby has been lifted, making embracing the hobby that much easier.



Moose and Isle Royale, vertical version. Isle Royale National Park, Michigan
Digital collage from scanned film photographs, 1994

Soft proofing has become reality.

In Photoshop, as well as in other image processing software packages, we can visualize the final print before actually making the print as long as we use a calibrated monitor, accurate profiles and the proper software setup.

Profiling has become extremely important

Profiling is the act of calibrating a device so that it gives a predictable and calibrated output or display. Custom profiling is often necessary to get the best results from printers, scanners, monitors and digital capture devices. Without using either custom or high-quality profiles, good results are virtually impossible to obtain.

We no longer have to print quantities to save money.

Unlike chemical printing by a commercial lab, which had to be done in quantity in order to get a lower cost per print, photographers can now print one print at a time for the exact same cost per print. In the case of limited editions, prints can be one or a few at a time, reducing or eliminating the need for inventory and storage.

Photographers selling their work can print one or two copies of a new image to “test the market” or see what the public reaction to this new image is, and then decide to make a longer run or not. We can print only as much as we need instead of printing large quantities to get volume pricing.

Printing can be done partially unattended

This is of particular interest in the case of large print runs, or when printing large print sizes. Instead of having to monitor the development of the print, photographers can load the necessary paper in the printer, launch the print job, and go do something else, only checking on the progress of the print job occasionally.

Many more photographers now print their own work themselves

This for the reasons listed above, but also because printers are now relatively affordable. At the onset of digital printing, the sole fine art printer available was the Iris Printer, which cost about \$100,000. Today, printers able to produce the same quality and print sizes, such as the Epson 9800, cost about \$5000, 5% of the cost of an Iris printer.

Digital papers able to recreate the look and feel of chemical papers are now available

For a long time digital printing papers were not able to recreate the look and feel of chemical papers. This is now over with the introduction of papers such as Cranes Museo Fine Art, and Hahnemuhle DFA. Those papers are just about indistinguishable from their chemical relatives. For photographers who prefer other surfaces, a wide variety of digital papers are available.

We no longer have to limit ourselves to photo-quality papers

Photographers can print on cotton-based papers, watercolor papers, canvas as well as a large variety of substrates. This opens the doors to a world of creativity, options and testing for those interested in printing their photographs on new papers.

6 - Changes in the way we look at photographs

As we can see, the changes brought to the field of photography by digital photography are numerous. I tried to keep the lists above simple, but they still got quite long. Plus, I am sure that I forgot a few things here and there. If I did, as I mentioned previously, let me know what else I should add.

At any rate, the goal of this essay is not to stand as a treatise listing each and every change brought by the chemical to digital photography paradigm shift. Instead, the goal of this essay is to demonstrate that a paradigm shift has occurred in the field of photography and that this paradigm shift can be described as “the change from chemical to digital photography.”

The other goal of this essay is to address what this change means to us. Paradigm shifts take place in numerous ways at the practice level. However, on a society-wide level their impact is perceived in much more general terms.

Let me try and reach some conclusions about how the chemical to digital paradigm shift is impacting us as a society. To do this I will look at the 4th category listed at the beginning of this essay *changes in the way we look at photographs*. This 4th category addresses photography from the perspective of the audience rather than from the perspective of the practitioners. And in doing so it allows us to move from the specific to the general in regards to our exploration of this paradigm shift.



Moose Skull, Isle Royale National Park, Michigan
Digitally manipulated scanned film photograph, 1994

The number of photographs taken is at an all time high.

35mm film drastically increased the number of photograph taken because 36 images could be exposed on a roll of film. Digital capture leaves the numbers reached by 35mm film in the dust, by removing the cost factor associated with taking photographs. The cost of taking a digital photograph is essentially the cost of purchasing a digital camera and the required accessories (such as flash cards). Afterwards, the only added cost is the cost of storage, as I described previously. This means that, in effect, the more photographs you take with a given digital camera, the least each photograph costs you. This is very much the same as calculating the cost-per-mile of your car insurance policy: the more miles you drive, the lower this cost is. The same calculation now applies to photography because the consumables are virtually nil unless one prints their photographs (more on this below).

The number of photographs printed is at an all time low

The staggering number of photographs being taken, and the fact that it is no longer necessary to print a photograph to see it (we can look at it on computer monitors, PDA's, digital wallets, cell phones, etc.) means that only a small percentage of images taken is actually printed.

In comparison, in the film-based paradigm nearly all images were printed. Only transparencies, which were mainly used by professionals, were not printed regularly. Back then, the majority of photographs were taken on print film, and, as the name implies, these photographs were all printed.

Digital capture has brought the cost of photographs at an all-time low

See previous entries for details

Digital cameras and backs have brought the cost of new cameras at an all-time high

See previous entries for details

The average quality of photographic prints has gone up.

There is little doubt in my mind that a higher print quality is possible with digital, and that on average we are seeing an increase in print quality. However, this notion is hotly contested by photographers who continue to work with film and hasn't embraced the paradigm shift. This position is however seeing a drop in the number of those who embraced it originally.

Print quality increasingly separates amateurs from professional

While digital print quality is as I said higher on average than chemical print quality, we are also seeing that there is a very large swing between the print quality obtained by amateurs, or un-trained digital photographers, and the quality obtained by master digital printers.

In this regard, we see an increase in the number of people who expect a "push button" solution to generating high quality images and who are disappointed when they realize such an "easy button" is nowhere to be found.

Similarly, a relatively large percentage of digital photographers believe that just about anything can be fixed in Photoshop, and that with sufficient skills, a master Photoshop user can turn any photograph into a winner. This attitude is responsible, in part and not in whole, for the lower quality results obtained by some photographers.

The public perception of digital images as "manipulated" is changing

At first digital photography was rejected as a manipulation of the image. Today, the "manipulation" of photographic images is increasingly expected and accepted. The term "manipulation" is increasingly being seen as a derogatory term by a growing number of photographers and audience alike, and being replaced by "enhancement," "personal expression," "optimization," or other terms that emphasize artistic intent rather than deceit.

However, the subject of "manipulation" and its implications for the photographic profession as a whole, and for Fine Art landscape photography specifically, needs to be further addressed. I will do so in the next essay in this series, which is titled "Just say Yes." As always with my essays, stay tuned for this matter is "a suivre."

Part of the general public is also starting to realize that film photographs were also “manipulated” and that fine art photographs are not straight prints from the original negative or transparency. The same public understands that a number of changes, which can be easily done in Photoshop, such as increasing the saturation or changing the color and contrast of an image, are eerily similar to the changes that could be made in the darkroom when printing black and white or color photographs.

Similarly, the public is also becoming aware that the films themselves made some of these changes, without the need for the photographer to actually step in and make changes himself. Films such as Velvia, which was introduced in the mid-1980’s, became popular because of their ability to increase the color saturation and the contrast of natural scenery. Since colors in nature are often low in saturation, these films allowed those who used it to give a unique look to their work by creating, in camera, colors that were difficult, if not literally impossible, to find in nature.

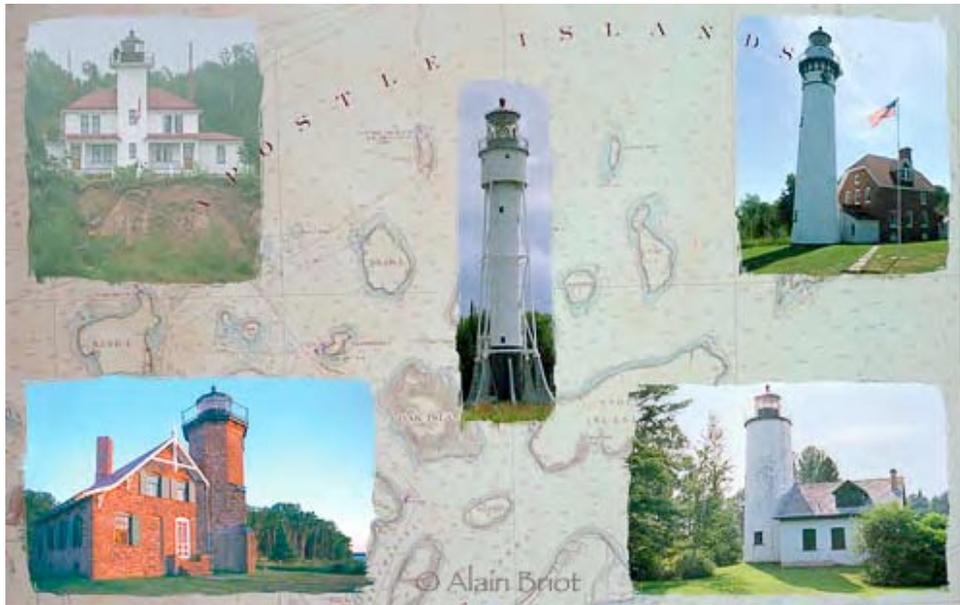
In short, while photographs continue to be perceived as the most realistic form of visual representation available to us, a move away from the blind belief that photographs represent reality is taking place. The general public growing knowledge of how photographs are created and printed generates this change of perception. In turn, this change is resulting in a more widespread acceptance of digital photographs.

Magazines and publications have profoundly altered how images submissions are made

Image submissions are now nearly entirely done with digital files and often these files are emailed to publishers, reviewers and other interested parties, thereby dramatically reducing the difficulty of a submission and the risk of losing an irreplaceable original. Many submissions can be done over the web, following email exchanges, often without phone contact between the two parties.

The fear that the audience will perceive a digital photograph as a fake continues to motivate a number of photography magazines to refuse submissions consisting of digital photographs, either film scans or digital captures. However, virtually all magazines now use a digital workflow for offset printing, requiring them to digitize film photographs before the magazine goes to press.

This dual approach, consisting of refusing digital submissions while using a digital workflow to print books, magazines and other publications, presents a dichotomy which the audience is relatively unaware of, essentially because offset printing is a rather obscure field. Yet, in effect it means that all new publications that use photographs are making use of digital photographs, and that these photographs have been digitally modified to adjust color and contrast, at the very least, so that the photographs looks their best (hopefully) on the printed page.



Apostle Islands Lighthouses. Apostle Islands National Lakeshore, Wisconsin
Composite collage from 6 scanned film photographs, 1994

7 – Conclusion

The chemical to digital paradigm shift has resulted in nothing short of a photographic revolution, a revolution characterized by the many different aspects I discussed in this essay. In concluding, I want to look at global changes that do not specifically fit in these categories, changes that affect how we approach photography as professionals and as members of our society.

The internet has revolutionized our access to photographic knowledge

Before the widespread use of the worldwide web and of email, it was often quite difficult to find where to buy specific equipment. It was also equally difficult to research specific image processes or techniques. In short, photographic knowledge was, to a large extent, elusive and often in the hands of professionals not necessarily willing to share it with others.

Today, since anyone with a computer and an internet connection has access to the web and to email, the flow of information is both freer and more intense than in “pre-net” days. Furthermore, at this time just about every company having something to do with photography has a web site where they provide information about their products and services. Finally, most photographers have a web site where they provide information about themselves and their work as well as galleries of images.

As a result, the internet has radically changed our access to all types of knowledge, and, specific to this essay, to photographic knowledge. If the information you are looking for is available somewhere on the web (and it most likely is,) finding out where is as easy as doing a Google (or other engine) search. In this regard the Internet has become what I like to call *the great equalizer*. No matter who you are, where you are, what contacts you have, or how much experience you

have, this information is equally available to everyone at the same cost, which is often for free or at a relatively minor expense.

The dissemination of photographs is at an all time high

On any given day I receive anywhere from 10 to hundreds of photographs from friends, students, photographers interested in sharing their work, customers asking for a specific print, newsletter subscriptions, and even from spammers. I have entire folders filled with them. This could never have occurred in pre-internet days. The cost of printing images was far too high to allow it. In comparison, sending photographs over email is free. The only cost is that of a web access subscription.

Similarly, the publishing of a photograph on a web site is equally free. The only cost is the operational cost of having a web site. The result is the proliferation of photographs being shared and published over the internet.

The theft of photographs and the number of copyright infringements is at an all time high

There is nothing easier than taking possession of a photograph on the web: simply drag it to your desktop and you are done. In what can be called the modern approach to clipping images out of magazines, web surfers collect folders full of photographs that aren't theirs. While this does constitute copyright infringement (it is a form of copy because you retain a unique and different copy of the image on your computer) it is generally accepted as benign and commonplace, as well as a way to keep a record of what one likes or is interested in. What is more serious is the use of these photographs for various purposes, usually onto the web somewhere, since they are sized for this medium. Illegal print uses are less common since web sizes allow only postage-stamp size images at printing resolution.

At any rate, copyright infringement, or outright theft of images, is both something photographers are understandably concerned with and something that needs to be addressed by taking the necessary steps to insure protection. However, it is also important to realize that only partial protection is possible.

New opportunities for emerging photographers have been opened by the chemical to digital paradigm shift

Opportunities for selling photographs and for gaining exposure have been opened by the new technologies and by the Internet. These opportunities are often as easy to take advantage of as building a web site, or buying a digital camera, a computer, image processing software and a photo-quality printer.

However, the same easiness is available to all, resulting in increasingly high competition for web traffic. While building a basic web site can be accomplished in a matter of hours, it often takes years of efforts to build traffic to a level that can generate regular substantial sales. The web also presents serious obstacles to selling fine art photographs successfully, such as the lack of the physical product for potential buyers to interact with. Another significant hurdle is the multitude of computer monitors used by web surfers, each of these monitors potentially showing your photographs with inaccurate colors, contrast or color balance.

When it comes to selling photographs in venues other than the web --such as art shows, galleries, or stores-- the dramatic increase in photographers using these venues to sell their work is resulting in a never-before seen level of competition. The number of new photographers entering the market is staggering, and so far has been reaching new highs each year.

It is easy to say, and to some extent relatively accurate, that all one needs to get started in this business is a camera and a printer. It is also easy to say that everyone is a photographer. I should say “photographer” because while these photographers certainly have pictures for sale, they are still beginners when it comes to expressing a personal vision (we will come back to this later in a few paragraphs). They are also amateurs when it comes to running a business and marketing their work.

Nevertheless, these opportunities are real, and for those who know how to take advantage of them, and who are not afraid to work hard, new openings are available, openings which did not exist in pre-paradigm shift times.

To remain at the cutting edge of the paradigm shift master photographers must invest a significant amount of their time and income keeping up with new hardware, software and techniques.

This is the first of three areas, which, in my opinion, are increasingly separating amateurs from professionals.

Digital photography is an emerging and rapidly changing field, a field in which to remain at the cutting edge one must stay informed of the latest developments. Equipment and software need to be updated regularly, either yearly or every two years at the most, and sometimes more frequently than that. The field is anything but static, and this constant change in turn demands constant attention on the part of photographers. Things are changing very rapidly and the only way to remain competitive is to keep learning.

The ability to keep up with new technology and techniques requires a serious commitment of time and money. In my view it is one of the three main areas that increasingly separate amateurs from professionals. In my experience, it is not uncommon for amateurs to get the latest equipment and software when deciding to “make the jump” to digital photography, only to let this equipment age without being replaced as time goes by and as they realize that the change is happening on a constant basis, and that they are not willing to devote the necessary resources to follow this constant change.

Exacting knowledge, proficiency and experience in digital imaging and color management is the second area that separates master photographers from amateurs besides equipment.

As digital imaging technology becomes more and more refined, obtaining better and better results means pushing the envelope ever further. To do so, extremely fine knowledge of areas such as color theory and management, printing, image optimization and the like are necessary. Why? Because it is through knowledge of these areas that small but significant gains in image quality can be achieved.

A focus on vision and personal style, rather than on technical proficiency alone, is the third area that separates master photographers from less-achieved photographers

A number of photographers are able to avoid the constant testing shortcoming that I just outlined. Those photographers are able and willing to continuously invest time and money to test and acquire new equipment, as well as continue to learn in order to stay current with the constant changes in techniques and equipment.

At the same time these photographers are able to engage in creative work and produce fresh and never-before-seen images. Those individuals are usually professionals, due to the amount of time required by such a demanding schedule. However, we also find in this category a few non-professionals. Note that by “non professionals” I mean individuals making a living from sources other than photography.

These photographers find themselves in the enviable position of keeping up with the constant change while being able to do creative work. Because equipment can be acquired by anyone, provided that the proper funds are available, and because knowledge is now freely available as described before, provided sufficient time is available, creativity is quickly becoming the element that denotes the highest level of achievement. Because creativity brings with it a uniqueness that separates creative photographers from others, it in turn brings with it a competitive advantage. While it can be said that this has always been the case, as indeed it has, I believe this is more so today than ever.



Mesquite Sand Dunes at Sunrise, Death Valley National Park.
99% desaturated Canon 1DsMk2 digital capture, 2006.

The rapid change in technology, and the constant introduction of new products and solutions, brings with it the risk that photographers end up spending most of their time testing these new products and little time creating original images.

I see numerous web sites, and numerous portfolios, in which just about each photograph is created with a different camera, or processed with a different converter, or makes use of a different optimizing technique, or again is printed on a different printer. While it can be said that this fosters creativity and prevents photographers from being stuck in a rut, it can also be said that it fosters attention on technique and equipment rather than on vision and inspiration. Inspiration, in this instance, is at risk of being fostered purely by the constant desire to explore the capabilities of new cameras, new software, new printers and new techniques. In short, creativity, which stems from being inspired by a vision for one's work, currently often stems from being "inspired" to test new equipment.

While some creative work, no doubt, comes out of this situation, much comes out which is aimed at little else besides understanding the capabilities of the equipment. In other words, the motivation of the photographer is not to express a specific message, or a message at all, but rather to see what the resolving power of sensor x might be, or how x compares to y (x and y being cameras, lenses, sensors, printers, computers, raw converters, processor speed and so on), or again how much faster x can do the job than y.

Certainly, testing is a necessity, and as I mentioned before one needs to keep up with the technology in order to remain competitive. But one also has to be aware that testing is not an end in itself, and that eventually the equipment is here to serve our creative impulses and our vision, not to provide an excuse for constant testing. We therefore need to schedule time, if nothing else, for non-testing purposes, time that is 100% devoted to creating images that follow our vision, regardless of how x compares to y, or of how much better, or how much more resolution, or density range, or whatever, x possesses.

In closing, I want to remind you of my invitation to email me items of this paradigm shift that I may have forgot to list here. As I said, I tried to make this list (or series of lists) as extensive as possible. However, it is most likely I forgot something, or several things. In this case, just let me know. I also invite you to share your views of this paradigm shift, if you like. I regularly publish essays, or responses written by students and readers, on my website, and yours can be next. I look forward to hearing from you.

Alain Briot
Arizona