# *Through the Looking-Glass:* *Hans Danuser's "Last Analog Photograph"*

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Analog photography is layered in many ways. Some of these layers occur, so to speak, "in front" of the photograph and some occur "behind" it. Up front we encounter the image. It has meaning upon meaning, altered slightly by installation, viewer, lighting, and caption. Behind the image and less visible are a series of material layers made of silver bromide suspended in gelatine, optical brightener, paper, and so on. The material layers and the layers of meaning in the image are inextricably linked.

Like Lewis Carroll's fabled Looking-Glass, on one side of the photograph is the image of the world as it appears to be. To Alice, it was the image of her sitting room. Once she stepped through the glass, she arrived in a world governed by different laws. To climb to the middle of the garden, Alice had to set off determinedly in the opposite direction, on a trail "more like a corkscrew than a path." The material side of analog photography is also governed differently, not by foreground, background, and middle ground, but by lattice structures, electron traps, and Frenkel defects. Here the book of nature is written in another language; the chemical language of the latent image $e^- + Ag_i^+ \rightarrow Ag_i^0$.

Carroll was the pen-name for Charles Dodgson, a mathematics tutor at Christ Church, Oxford, and a prolific Victorian photographer.[1] Each collodion negative Dodgson prepared was an exacting affair, and he was well versed in the upside-down and back-to-front camera image, as well as in the oft-recalcitrant chemistry of handmade analog photography. We forget that behind photographic images are materials and the people that prepare those materials. We forget, too, that all the decisions they make in the preparation of those materials affect the image that we eventually see. All too often, though, it is the image that is privileged at the expense of a more material understanding.

In *The Last Analog Photograph*, Hans Danuser has set out to examine the photographic image and to highlight its material nature, by delving deeply into its structures and unpicking the threads from which photographic images are made. Like the first photographic experimentalists in the 1830s and 1840s, nature is his inspiration. The project is rooted in a larger, overarching investigation of the complexities of *Erosion*. Through all three parts runs a strong narrative about the relationship of photographic material to its resulting images. Before *Erosion* though, Danuser brought the color of monochrome photography to the surface of ice in the *Frozen Embryo* series. The light and dark distortions of ice are at once familiar and strange. Black ice, white ice, and gray ice emerge from the crystalline structures of photography and evoke the inner symmetry of ice crystals. The lattice structure of salt crystals (also silver salts) and the crystalline structure of ice created a dialog in constant motion. It was a dialog about structure as well as about impermanence. Land ought to be so much more fixed, but Danuser shows us that it too is in a constant state of transformation. The first part of *Erosion* consists of photographic slates of silver bromide baryta paper supporting an image of the eroded, anthracite-laced slate sand. In this metamorphic landscape, silver bromide (AgBr) with its cool, bluish grays not only represented the tonal values present in the slate, it also reflected its subtle coloring. He found, in the layered landscape of the Alps in Switzerland and the slate hills of Wales, a natural target mimicked perfectly by the chemistry of analog photography. It was, as photographic inventor William Henry Fox Talbot put it in 1839, "Nature magnified by Herself."[2] Early writing on photography is redolent with similar language that posited photography as the mechanical conduit for natural imaging. Talbot's image of nature was likely a reference to the similarity of the forms that left their mark on the paper, rather

than the chemical reactions that led to the image. He wrote of an uninhibited enjoyment of the wonder of natural imaging. In the case of *Erosion* and its third part, *The Last Analog Photograph*, nature is also wondrously magnified. More importantly, it is also colored.

In 1896, Charles Cros, the French poet and photographic inventor, described colors as essences with three dimensions.[3] No better description could characterize the colors of the photographs made for *The Last Analog Photograph* project. They have a physical and metaphorical depth that is tangible and lasting. Not content with limiting his investigation of such an extraordinary coincidence of chemistry and landscape to Switzerland, and the palette provided by eroded slate, Danuser set his sights on a new landscape, exchanging eroding ground for the fluid and ever-changing landscape of the desert.[4] In choosing sand as his muse, Danuser invokes not only a *Landscape in Motion*, as the series is subtitled, but also the fragility of a single moment of organization of material grains of sand and silver. The phenomenon of desert movements extends across the world but it is also intensely local. As it moves, it drives change before and behind it. Houses are slowly covered over, people relocate, dunes change shape, deserts expand, geological borders are redrawn. Deserts are both natural and man-made, evolving in a complex series of events that in the past have been natural, but in the present are more likely to be the result of climate change or land misuse. "Desertification" is a relatively new word describing the intricate, centuries-old transformation of semi-arid landscapes into deserts. Slowly, slowly the sand inches in between and then over the top of greener vegetation until the landscape inexorably changes to the colors of sand.

The complexity of photographic layers is an apt analogy for the complexity of the desert. Natural forces that order sand into sculpted dunes are evoked by the moment in which silver particles coalesce in image formation. If bromide chemistry could mimic not only slate, as it did in *Erosion*, but also the shifting perception of colors as light strikes those formations, surely it could also achieve such a singular correlation with the dunes of the Gobi desert? To achieve such a correlation, Danuser and a team of scientists at the ETH Zurich would have to turn a century of commercial photographic paper production on its head, and reinvent analog photography one layer at a time.

Creating the last analog photograph is very much like creating the first. The experimental process is fraught with uncertainty; expensive, time-consuming, and often fruitless. Almost any combination of materials seems possible. Danuser at least could lean on the knowledge of 180 years of chemical manipulation. The first inventors had no such support. Talbot's 1839 and 1840 notebooks suggest the kind of profusion of possibilities in the absence of such knowledge: hydriodate of zinc, bromide zinc, bismuth, gum benjamin and chloride silver, sublimed muriate ammonia washed with nitrate of silver and dipped in water saturated with nitrate potash, a pasty mass of chloride or bromide silver pressed between hot copper plates, milk or cream for opalescence—the list is both long and unexpected.[5] Sir John Herschel and Mary Somerville, also working in the 1840s and 1850s, extracted colors from flowers to create light-sensitive papers on which they performed hundreds of experiments.[6] Here, the upside-down and inside-out world of botany and chemistry prevailed. Robert Hunt, another early experimental chemist, warned colleagues, "[t]he color of a flower is by no means always, or usually, that which its expressed juice imparts…" For instance, red damask roses gave "a dark slate blue" and red poppies a "rich and most beautiful blue color."[7] Sometimes, to achieve the most natural colors, they needed to head in the opposite direction. For all the precision of Danuser's original idea for *The Last Analog Photograph*—to create a photographic paper that mimics the color of sand—nature has her own agenda.

To find a chemical substance that would color bromide paper according to the artist's wishes, and render a photographic image as well as a photographically natural color, Danuser and Professor Reinhard Nesper, working alongside a team of enthusiastic scientists, had to follow a path parallel to that of the original inventors.[8] Knowledge that had been kept secret under patent protection for nearly a century needed to be utilized once more. Turning what was essentially bulk-manufactured commercial paper back into individual handmade photographic surfaces required the precision of a laboratory chemist [Fig. 1 photo of Hans in lab coat with panama hat, leaning over tray]. The back-to-front natural reactions had to be made to yield predictable, and replicable, results. The only way to begin was with trial and error. Some combinations resulted in dead ends, while others showed promise. Certain metal salts were more reliable than others. Long before the results could be translated into a clear set of rules about combinations and colors, there was a more speculative phase [Figure 2. Experiments on glass and paper laid out on paper towels]. Each layer of the process is important. The paper is one element, the chemistry another, the brightening layer yet another. Each layer was trialled separately, and then carefully combined. These trials, and even some of the errors, elicited repeated exclamations of wonder: dark red! colorless! The experiments were not just a mechanism for making a certain kind of photographic paper. They were a vehicle for rediscovering wonder in this strange world of photochemistry. Wonder is also an ever-present emotion in Herschel's and Talbot's notebooks of the 1840s. The snippets of paper produced in their experiments are coded and sequenced symmetrically [Figure 3, the trestle table with results laid out according to an organized structure]. They evoke the orderly natural history catalogues of the eighteenth century and imply a seductive sort of mastery over the chemical world.

The "Last Analog Photographs" that resulted from these trials are a delicate tightrope walk of light sensitivity, practicality, and durability. While this balancing act has always been present in photography, Danuser brings it to the surface, making this conflict as present as the image. It is perhaps presence that marks out the differences between these photographs and what Lyle Rexer has called "the antiquarian avant-garde."[9] In the more alchemical works of that period, the reactions of photographic chemistry are the subject of the photographs. Here the subject is still the ice, the slate, and the desert. *The Last Analog Photograph* is not a project steeped in nostalgia about analog photographic chemistry. At its heart is still the image. That differential focus turns the photographs from a chemical discussion into a dialog about how we see. Perhaps it is a dialog that has only become possible in the digital age.

The moving landscape at the heart of *Erosion* and its last part, *The Last Analog Photograph*, asks difficult questions about how we see analog photographs in our digital age. Photography is also a shifting landscape here. One that reminds us that vision, like the landscape, is not fixed. Walking in front of the triptych *Desert Storm*, the grains gather up into images and dissolve back into grains [Figure 4. *Desert Storm* or a reference to the plate number]. A ridge of a dune becomes visible, then melts away on either side into a sea of sand. The color of the image shifts in the changing light, mirroring the unstable foundation of a dune. At times, the lustrous baryta exerts enough force to be seen as the image, and at times it retreats into the image. It is as if the land-

Hans Danuser in Rafael Buess's
darkroom in Bern

Samples of paint on glass supports in the Laboratory
of Inorganic Chemistry at ETH Zürich

Samples of paint on paper supports in the studio



scape is emitting its own light and forming its own colors. The effect has something to do with the subject matter and viewing distance, and something to do with the structure of the paper.

The effect is in part the result of the baryta layer, scattering light back through the silver bromide particles. Baryta, which is commonly called barium sulphate but often also includes strontium sulphate in photographic papers, has been used as a coating for photographic papers since Juan Laurent and José Martínez-Sánchez offered their Leptographic photographic paper for sale in 1866.[10] Not only does it whiten the paper much better than Talbot's suggested milk or cream, it also scatters light. The scattering of light effects color changes in most photographic materials, and the works in *The Last Analog Photograph* are no different. While the base colors of gray-brown, orange-brown, and yellow set parameters for the color change, they do not limit it in any way. A change in the quality of the light or the angle of viewing elicits shifts from blue to red to orange, and sometimes toward a neutral brown monochrome. This effect most often stems from reflected light, which acts very differently from transmitted light. Digital images have their own materiality, and part of it is fixed in the light source. That light source is more constant than daylight, and fixed at a certain angle. It is evenly distributed and lacks the variability of reflected light. The startling homogeneity of the constant light source once elicited astounded reactions from crowds in lantern demonstrations. Now it dazzles the eye to the point of fatigue.

What makes one photographic way of seeing "normal"? In the nineteenth century, photographic materials were more sensitive to the blue, violet, and ultraviolet end of the spectrum. Yellow was represented in the same dark gray as green. Red looked darker than blue. After the introduction of panchromatic film, a correlation between monochrome gray scales and the world around us became naturalized. Advertising convinced audiences that this was so. Analog photography of the 1970s was predictable. When Danuser made the series *In Vivo*, photographic materials were reliable and for the most part predictable in their reactions to light situations. These photographic materials were the result of half a century of commercial film research and production by firms like Ilford, Kodak, and Agfa. Each new film cost each company years of work and hundreds of thousands of euros to develop. Each embodied this delicate balance of resolution, light sensitivity, and predictability. In spite of these standardized reactions, created for a commercial market, Danuser noticed peculiarities surrounding the color of ice when rendered in monochrome film. The warmer the ice was, the blacker it appeared on film. From these observations emerged the *Frozen Embryo* series. White ice, black ice, and ice in shades of gray demonstrate how present the commercial photographic chemistry was in the images. Attention shifts from the image to the colors, and back to the image—it is never still.

In this shifting landscape of perception, Danuser has given us a new way of seeing color. The variation of color and color perception was perhaps most famously elicited in Goethe's theory of colored shadows. In *Zür Fahrbenlehre*, he argues against Newton, who conceived of shadows as merely the absence of color. Goethe's argument turned the vision of shadow from an absence into an opportunity. He saw the possibility of shadows and their constantly changing colors. Danuser renders a similar service to light. *The Last Analog Photograph* invites us to see light through the eyes of photography, and to conceive of monochrome analog photography as subtly and pervasively colored. It requires time and patience and a certain amount of diligent observation. Experiencing the desert requires a similarly patient attiude. At first, the scrubby browns seem to indicate the absence of green. In time, though, the browns distinguish themselves from one an-

other, transforming into a rich kingdom of color that lacks for nothing. By using the color of sand as a guide for the chemical experiments, Danuser invites us to contemplate what a true image of sand might look like.

To find the true image, it is necessary to look at a single spot from many different angles, or to examine it many times from the same angle. A single photograph usually opens up only one fixed perspective, but Danuser's images require to be examined from multiple angles. In spite of their description as "monochrome,", the images are not all one color. Repeated viewing of the photographs throws up a cloud here and a cloud there, and perhaps the ridge of a dune. One photograph is a bit orange, the other nearly gray with a yellow cast. Horizontal but without a horizon, the photographs urge us to contemplate the colors of land in the absence of sky. Comparisons to Turner's fantastic mergers of sea and sky abound in both the colors and the images. Turner's pair of paintings *Shade and Darkness—The Evening of the Deluge* and *Light and Colour (Goethe's Theory)—The Morning after the Deluge—Moses Writing the Book of Genesis* are visual testament to Turner's interest in color theories and the broader scientific dialogs about light, light sensitivity, and perception that interested so many in the middle of the nineteenth century.[11] Danuser's photographs go a step further by merging the image with the material. The grains of silver and grains of sand create a new dialog that not only concerns the image, but also shapes it. It makes it impossible to consider the images without considering the materials.

How do these structures form the perfect image of our imagination, of the lens through which we see the world? *The Last Analog Photograph* is an installation of living, moving things fixed in a photographic image. Like the dunes, which are in constant motion, the audience moves, changing the way the light reflects off the photographic surface, setting the materials in motion as well. It is a landscape of infinite possibilities. Deserts are laid out on maps but are constantly reshaping their borders. Color is also a shifting target, infusing the monochromatic emulsion. That there is color in monochromatic photography is one clear conclusion to draw. These photographs also extend the bounds of photographic representation, and transform it into something wholly new.

In *The Last Analog Photograph*, photography's layers are brought to the surface and merged into an image that is both material and ephemeral. The particular connection that photography has with the light that initiates the latent image is normally hidden, and taken to be a necessarily invisible part of how photography works. We are supposed to look past the photography toward the image it depicts, but this series makes us question that very action. It makes us aware that we are looking through a looking-glass into a land with wholly different physical and chemical rules. Each photograph calls into question not only *what* we see, but *how* we see it. Our vision becomes the sum of the possibilities of a particular moment, captured during an era in which we can contemplate analog photochemistry as a historical, but hardly irrelevant object.



1
See Roger Taylor and Edward Wakeling, *Lewis Carroll Photographer: The Princeton University Library Albums* (Princeton: Princeton University Press, 2002).

2
William Henry Fox Talbot, Notebook P, in Larry Schaaf, *Records of the Dawn of Photography: Talbot's Notebooks P & Q* (Cambridge: Cambridge University Press, 1996), 35, March [3]–April 5 1839.

3
Charles Cros, 'Solution générale du problème de la photographie des couleurs' [1896], in *Oeuvres Complètes* (Paris: Gallimard, 1970), 499. As translated by Kim Timby in 'Colour, Photography and Stereoscopy: Parallel Histories,' *History of Photography* 29:2 (2005), 183–96: 183.

4
Hans Danuser photographed the movements of the desert in North America in Arizona and New Mexico, in North Africa in the Islamic Republic of Mauritania and journeying from Morocco to Egypt, and in Asia in Outer Mongolia and North China.

5
See entries throughout Notebooks P and Q in Schaaf, *Records of the Dawn*.

6
See the papers of Mary Somerville at the Bodleian Library in Oxford (MSSW-13), and an extract of a letter communicated by Sir J. Herschel, published in *Philosophical Transactions of the Royal Society of London*, Pt. II for 1846 (London: 1846).

7
Robert Hunt, *Researches on Light in its Chemical Relations: Embracing a consideration on all the photographic processes* (London: 1844), section 334: 193.

8
Development of the project *Hans Danuser—The Last Analog Photograph* at the Institute of Inorganic Chemistry, ETH Zurich with Prof. Reinhard Nesper, Max Broszio, Matthias Herrmann, Florian Wächter, Dipan Kundu et al. as part of the image series *Hans Danuser—Landscape in Motion* (2007–2017), part three of the *Erosion* project.

9
Lyle Rexer, *Photography's Antiquarian Avant-Garde: The New Wave in Old Processes* (New York: Harry Abrams, 2002).

10
John Hannavy, 'Printing Out Paper,' in John Hannavy ed., *Encyclopedia of Nineteenth Century Photography* (New York: Routledge, 2008), 1175.

11
See for instance Martin Kemp, "Turner's Trinity," in *Visualizations: The Nature Book of Art and Science* (Oxford: Oxford University Press, 2004), 56–57.

I

V

VIII

XXII

# THE LAST ANALOG PHOTOGRAPH

A1

A2



A3

A4

A5

A6



A7

A8

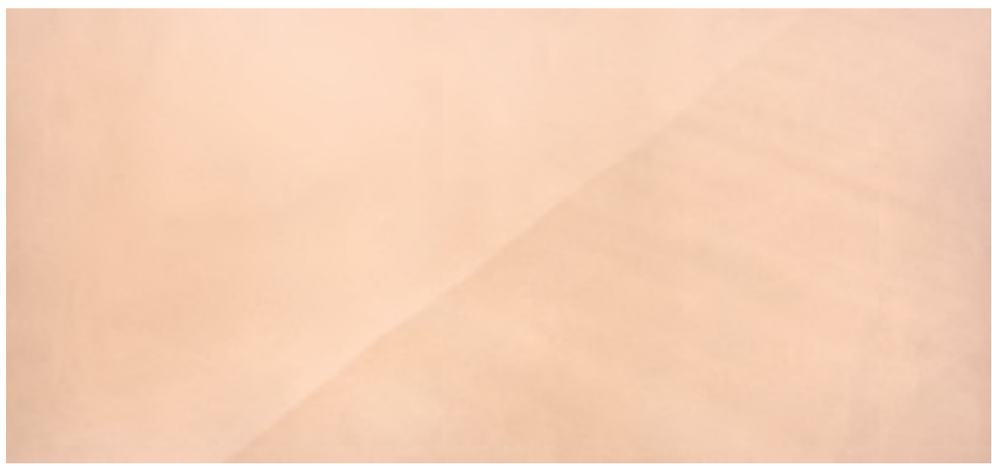
C1

C2



C3

C4



J1

J2



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A9

Hans Danuser

# Darkrooms of Photography

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