Error Theory

By

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A thesis submitted to

the Faculty of the Graduate School

of the University of Colorado

in partial fulfillment of the requirement for

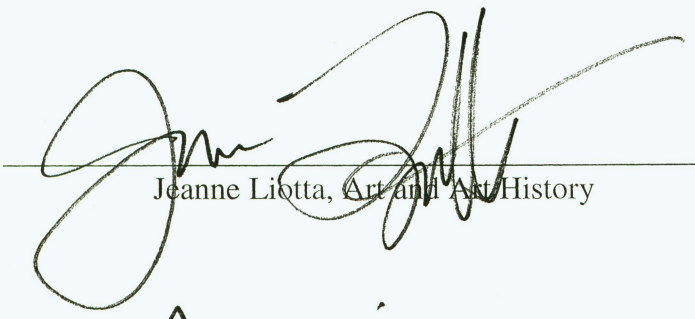
the degree of

Master of Fine Arts

Department of Art and Art History

2014

This thesis entitled:
Error Theory
Written by Mark Banzhoff
has been approved for the Department of Art and Art History



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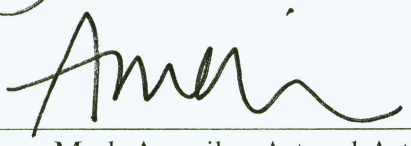

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Date April, 25, 2014

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Abstract

Banzhoff, Mark (M.F.A., Art and Art History)
"Error Theory"
Thesis directed by Professor Jeanne Liotta

Error Theory is a series of images, three of which are being displayed at the CU Art Museum from April 4 to April 17, 2014. This work was created for the MFA 2014 Spring Thesis Exhibition and with the support of professors Jeanne Liotta, Mark Amerika, and Michael Theodore.

The purpose of Error Theory is to explore the link between technology and humanity. In particular, I examine technology's ability to glitch and fail as evidence of the link between the two. Through the circuit-bending of digital cameras and sampling the extraneous data that results, I have created images that are outside of the intended function of the cameras and which demonstrate that when traditional rules are abandoned, errors in a system can open new possibilities outside of the original constructs of a system. In doing so, the images invite the viewers to reexamine traditional notions of "errors" and "mistakes," both in relation to technology and humanity, to which technology is inextricably linked.

By critically reflecting on errors, technology, and Error Theory images' place in the current dialogue on digital photography, I present a new dimension to the digital image paradigm.

Contents

Error Theory

The presence of glitches and errors in technology show that technology is humanity's offspring. Just as errors lead to discoveries in humanity, errors in technology have led to the creation of my Error Theory images.

My series of digital images contained under the title Error Theory are composed by sampling extraneous pieces of data, usually unwanted data from digital cameras, and re-contextualizing the resulting images into a new media aesthetic.[1] When these errors are magnified intentionally, they also magnify the function of a system. By freeing the pixel matrix from interpreting data from the outside world and letting the device instead produce vivid color fields and patterns, these images illustrate that bypassing the intended function of the device allow it to function in a way that surpasses the original system's capabilities.

When I use an early digital camera as a circuit bending platform to create Error Theory images, I am disregarding every possible governing law or rule set forth by the manufacturers of the device, as well as the system's governing principles--primarily the signal path of the circuit board. If I were to consult with the people who made this device, they would likely advise me to not use this methodology, as it falls outside of the device's intended use. However, when I usurp the creators' rules and guidelines, I am able to produce imagery that is far removed from what the camera was intended to record. Thus, I have utilized the apparatus to outwit the camera's rigidity and smuggled human intentions into its program that are not predicted by it.[2]

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[1] See Appendix A.

[2] Flusser, Vilém. Towards a Philosophy of Photograph, 80. London: Reaktion Books Ltd., 1983. ("This was the intention of the foregoing study, and in the course of it a few answers have come to light. First, one can outwit the camera's rigidity. Second, one can smuggle human intentions into its

Error Theory is this concept of utilizing an apparatus in an unintended way to create imagery that simultaneously demonstrates the link between technology and humanity and shows the potential that is revealed when breaking outside of the established norms.

Glitches and errors in technology exemplify the humanity from which technology comes. In my experience, the "errors" or "failings" of humanity are not always negative, particularly when viewed outside of society's constructs of what is "good" and "bad." Sometimes a person's flaw can in fact be an asset or something that makes them unique or beautiful to another person. With my Error Theory images, I have sought to demonstrate this phenomenon through technology and to show that when traditional rules are abandoned, an error can in fact open new possibilities not contemplated by the constructs of the original system.

Error Theory therefore brings into question the very definition of the word error: a deviation from accuracy or correctness; a mistake.[3] Words and the meanings of words predispose us to think and act automatically in certain ways.[4] Error Theory posits that this negative definition does not always hold true once an error is moved outside the traditional systems of regulation -- be it the rules for how a camera is supposed to function or societal norms. Therefore, I have embraced the terms "glitch" and "error" in this thesis to demonstrate that they are not necessarily the negative things often connoted through their use and that a different perspective can change

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program that are not predicted by it. Third, one can force the camera to create the unpredictable, the improbable, and the informative. . . .")

[3] Dictionary.com; last visited November 30, 2013.

[4] McLuhan, Marshall and Fiore, Quentin. The Medium is the Massage, 8. Berkeley: Gingko Press, 1967.

their meanings. Indeed, in some artistic circles "glitch" has already been adopted as a positive term without the negative connotations.

Outside of the rules for how a camera is intended to function, according to its manual, the possibilities expand exponentially and an error is no longer necessarily a mistake. Instead, the glitches open a world of discovery of new imagery to both the creator and viewer of the images. Likewise, flaws in humans may lead to possibilities that would otherwise not be able to occur. Error Theory demonstrates that errors, both in humanity and technology, can be celebrated and valued in their own right, rather than hidden or denigrated as negative.

I. Glitches

The "errors" involved in my Error Theory images are glitches in a digital camera system. A glitch is an error in a system that is specifically designed to avoid it. Maybe this engineering irony is what gives my Error Theory images their theoretical potency. The word "glitch" literally means a defect or malfunction in a machine or plan.[5] Its use was popularized during the advent of the U.S. space program, and it is believed to have originally come from the German word "glitschen," meaning to slip, slide.[6] It possibly entered into the English language through the Yiddish term "glitsh," meaning slippery area.[7] In many ways, the etymological meaning of the word is more appropriate when used to describe Error Theory images. In these images, a glitch is actually an elegant, albeit accidental, "slip" over the boundary of the closed system, rather than a "defect."

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[5] Dictionary.com, last visited November 29, 2013.
[6] Ibid.
[7] Ibid.

The glitches in my Error Theory images demonstrate the potential in all things when the limitations of a system are less finite. The "slips" in Error Theory images show that there is potential for all systems to expand beyond their designed intent. The fact that these images were created through a "glitch" is a reminder that limitations can be surpassed and that the possibilities for imagery from digital cameras are not finite and predetermined.

II. Technology & Humanity

When I think of the errors contained in glitch images, I am reminded of people. It has long been said that cameras are simulations of thought and simulate human thought processes.[8] The presence of glitches in a camera's system shows that cameras are linked to the humanity from which they came. Through their ability to glitch, these devices retain some of the errors from the system of the human brain which created them.

A camera or computer is like the vast network of nerve cells in the brain.[9] Millions of small computational units give rise to an artificial network that can be compared to the conscious mind.[10] Likewise, electric circuitry has been called an extension of the central nervous system.[11] The great British mathematician Alan Turing posited that the brain could be simulated by a machine, and Turing said he wanted to "build a brain."[12] By this Turing meant a computer-like machine. Turing did not mean that the components of his machine would resemble the physical

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[8] Flusser (1983), 67. ("That is because apparatuses are simulations of thought, playthings that play at 'thinking', and they simulate human thought processes . . . .").
[9] Hodges, Andrew. Alan Turing: The Enigma, xi. Princeton: Princeton University Press, 2012.
[10] Ibid. at xi.
[11] McLuhan and Fiore (1967), 40.
[12] Hodges (2012), 209, 420.

components of the brain; he simply meant that it could store words, pictures, and skills in some definite way.[13]

Turing contemplated many questions relevant to Error Theory, including: Could machines give rise to thinking and feeling or even decision-making? Could a machine make a mistake? Could a machine come up with ideas that had not been programed into it in advance? Could creativity emerge from a set of fixed rules?[14] Though in many ways these questions reflected troubles in Turing's own life, they raise similar questions to those presented by Error Theory. Perhaps most relevant is the question of whether creativity can emerge from a set of fixed rules.

In his paper *Natural Wonders*, Turing analyzed what humans and machines had in common. Notably, however, he rejected the notion of creating machines with non-intellectual human characteristics, such as the shape of the body. He thought such an undertaking would be futile and akin to the unpleasant quality of artificial flowers.[15] Instead, Turing envisioned machines that would simulate humans by developing skills above what they are taught or intended to do. Turing described the potential of a machine altering its own instructions and getting the results of the type desired when the machine was first set up, but in a much more efficient manner.[16] In this way, the machine would take actions not foreseen when its original instructions were put in --"like a pupil who had learnt much from his master, but had added much more by his own work."[17] As discussed herein, my Error Theory images encapsulate many of the same issues considered by Turing. To create these images, I have caused

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[13] Ibid. at 292.
[14] Ibid. at xi-xii.
[15] Ibid. at 420.
[16] Ibid. at 359.
[17] Ibid.

glitches that allow the camera to take actions not foreseen or condoned by its original creators, and thus have taken on the human-like quality of a pupil who has expanded beyond that originally taught by his or her teacher.

In addition to expanding the camera beyond its possibilities as Turing contemplated machines could do, a comparison can also be drawn between glitches and mental illnesses. Mental illness can "short circuit" the normal operations and functions of the mind. However, the minds of those who are perceived as having disabilities are often actually capable of something greater than a normal functioning brain--such as the genius found in people with autism. [18] They are able to peer outside of a normally closed system and illuminate the presence of simulacra upon the cave wall.

Like a human mind, a pixel matrix is a "closed system" intended to function in a certain way. The pixel matrix of the camera sensor is a grid of squares. Each square's information is dictated by the image processing chip. Altering its circuit board (as discussed in detail below) allows the camera to create images that are abstractions of the information the camera was attempting to produce as a pixel matrix. This new arrangement of pixels occurs when different pathways are created upon the circuit board.

Glitch images demonstrate how the camera system works--and that it is a human construct and it has limitations. Turing noted that a key distinction between humans and machines is that machines are expected to be infallible.[19] Glitch images, however, demonstrate and embrace the failings and errors of an "infallible" system as

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[18] Szalavitz, Maia. *What Genius and Autism Have in Common*, Time, July 10, 2012.
[19] Hodges (2012), 361.

an expression of art and a symbol of breaking outside of the intended system of the apparatus. By intentionally introducing errors and mistakes physically into the circuitry by way of physically altering the circuit path, I am able to force the digital camera to produce images that show us more accurately its potential for generating images, above and beyond its traditional and intended use, to get inside the "black box" of the camera that is normally not available to the photographer.[20] Without causing glitches in the system, we would have remained oblivious to its additional capabilities.

In this way, glitch images are reminiscent of Brian Ferneyhough's *Cassandra's Dream Song*, a composition that was made intentionally so difficult that it could not be reproduced without errors, and therefore it also could not be produced identically every time it was performed. Thus, the mistakes of the musicians become part of the performance and become a positive element in creating a unique show every time. Glitch images too embrace the errors of a physical camera system and use them to create unique pieces that cannot be precisely replicated.

III. Methodology

A. Circuit Bending

My glitch/Error Theory images are generated by a technique commonly referred to as circuit bending. Circuit bending is a process of making alterations to a circuit board--in my particular case, the circuit board of early digital cameras. I purchase older digital cameras, usually on eBay, for typically no more than twenty to thirty dollars. I open them up just enough to gain access to their circuit boards. Then, using no diagrams or technical charts, I apply changes to the linear network. When I

[20] Flusser (1983), 27.

alter the pathways of the circuit board, electricity will follow the new course, resulting in an image that differs each time, based on the electricity's new path.

I have no technical training in regards to the circuit boards of a digital camera, but I view this as a benefit. McLuhan and Fiore discussed how Michael Faraday, a man with little education or formal training, is "celebrated as an experimenter who discovered the induction of electricity."[21] It was Faraday's ignorance of mathematics that contributed to his inspiration and compelled him to develop a simple, nonmathematical concept when looking for an explanation of electrical and magnetic phenomena. His fantastic intuition and independence and "originality of mind" that allowed him to discover the answer.[22] Likewise, I find my lack of electrical engineering -- particularly with digital camera circuit boards -- to be an advantage in this situation. Approaching circuit-bending cameras from an artistic, rather than technical, perspective allows me to use the circuit board not as a mathematical or engineering equation, but as an experimental ground to be explored with "originality of mind."

I have cultivated a preference for a certain era of digital cameras like any connoisseur would. Glitch images do not require the use of the latest model. In fact, it is older, virtually obsolete, less efficient digital cameras that create the best glitch images. I prefer to use older cameras from the early 2000's, as the circuit boards are much larger and easier to read and understand what is going on.

Each camera is different and each make and model has its own aesthetic and ease of use when circuit bending, but a few variables remain constant in cameras of

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[21] Ibid., 92.
[22] Ibid.

this vintage. There is usually a circuit-processing chip, which is easy to spot. There is also a chip that digitizes the information coming in from the lens, converting the light from the lens into data for a matrix that we commonly call an image. I can usually get results from cameras by shorting the connection to the lens chip. The lens chip is usually connected to the main board via a small connector. I can create these glitch images by making alterations to the connection or routing the signal from the lens to points on the main board or the image processing chip which has small clip like connectors that make for easy connections.

Opening up a camera is like performing a minute form of digital surgery, and it is often devastating to the device. My survival rate is very low. Before the camera moves on to "camera heaven," I can usually get as many as 50 images out of the device. Since I do not really know the schematics of the circuit, I am likely to fry it in one way or another within a few hours.

B. Voltage

In effect, the image is created by the differing path of electrons that results from my circuit bending. Electricity itself is still not fully understood. Most of the world subscribes to electron theory, but it is still only theory.[23] It is therefore impossible to explain precisely what occurs with circuit bending.[24] However, under the theories as they are understood today, voltage is the "desire" or "motive" of electrons to move through a circuit.[25] Kenn Amdahl analogizes the phenomenon of voltage to a group of "Greenies" (electrons) who hear the music from a party of a

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[23] Amdahl, Kenn. There Are No Electrons: Electronics for Earthlings, 1. Broomfield: Clearwater Publishing, Inc., 1991.
[24] Ibid.
[25] Ibid. at 26.

group of girls and really want to go join the party.[26] "Whether we can get to the party or not, voltage is how bad we want to go," the Greenie says.[27] Thus, when a camera is "short-circuited" through circuit bending, the electrons are able to pursue their "need-to-party" and move through the circuit in a new way to reach their goal.[28] It is the voltage of the electrons moving through the altered circuits that creates my glitch images. We are able to "see" the voltage as expressed in the system of a pixel matrix of an early digital camera.

The re-routing of the circuit's signal path allows for a more diverse arrangement of pixels than would be possible in the camera's normal function. The complexity of colors and saturation is increased as well as the diversity between pixels. Circuit-bending the camera seems to allow for increased pixelation, because there is no longer a need to recreate gradients or shaded values from the natural world. When the pixel matrix is overridden by voltage, as described above, it is no longer governed by sensible data to create analogs of the environment in which its shutter was activated. Instead, it is a fingerprint of the voltage as applied through a pixel matrix and how electrons react in this particular altered system.

In a way, every image I take is the same. It is a permutation of voltage in a pixel matrix when applied to an image-processing chip. But the variations of voltage are incredibly rich. There is seemingly endless possibility to be explored. There are so many variables deciding the outcome that the game, for me, contains an infinite number of possibilities and variations. It is color, in a space, arranged by electricity.

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[26] Ibid. at 25-26.
[27] Ibid. at 26.
[28] Ibid. at 25.

C. Capture Function

The capture function of the camera has always been a critical element in the creation of images with a camera, and Error Theory images are no different. The camera's ability to freeze a glitch in motion is an important part of why my images look the way they do. Often times with circuit bending, the image captured and the image on the LCD display are quite different, though the pixel matrix on the LCD display is generally a good indicator of what the image will look like. This imagery is, however, always in a state of flux as soon as the circuit's pathway is altered. As soon as leads are applied to the circuit board, the image-processing chip sets off on a continuous glitch in motion. A vertical or horizontal bias is established. The pixels begin to breathe colors and move in ways that seem to be more than what the LCD can express, as they ultimately appear different in the captured image than what may be visible on the LCD display.

Luckily for my process, the camera's design is already set up to capture the glitches into a still image. The camera is able to net these extremely fast, electron butterflies into a still image. When you "freeze" the glitch with the capture function, the glitch is captured in a way that was not fully visible on the LCD screen, both because the circuit bending process has altered the information it receives and also because the glitches are evidently changing too rapidly for the read out to keep up with. The capture function is what makes this ethereal process visible and tangible. When viewing the final captured image, it becomes evident that the LCD's refresh rate simply does not keep up with the constant change in electrons.

The capture function, however, is able to capture the glitches in a way that is analogous to capturing a bolt of lightning with a photograph. The glitch that was previously too fast to really be seen on the LCD display has been made visible in a permanent image through the capture function. In this way, there is a revelation of how electrons are functioning in the image, even if only on an intuitive level. That is what the viewer is experiencing within these Error Theory images. A fingerprint of electrons captured by this process like fish in the net of a pixel matrix.

Thus, this work is a collaboration with the universe and an expression of electricity. It has been said that electric circuitry confers a "mythic dimension" on our ordinary actions.[29] These images show electricity in a form that we can deeply digest. Humans are visual creatures; seeing is our way of understanding. This process is a way of visualizing the majesty of electricity when applied to a system.

IV. Error Theory's Place Amongst Other Contemporary Artists

Elements of other contemporary artists' work resonate with features of Error Theory images in various ways, though none are completely identical. My process is somewhat analogous to the software glitch process of pixel-sorting used by artists such as Kim Asendorf.[30] Asendorf uses software to re-arrange pixel information and produce glitch images that are similar in aesthetic to my images.[31] His process of distorting is often called data bending. My process of hardware glitch/circuit-bending is a different form of glitch, though, because it is making alterations to the physical device itself and creating the image on that level, rather than using the pre-set paradigm for the camera and then altering the resulting images later. My images are

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[29] McLuhan and Fiore (1967), 114.
[30] Asendorf, Kim. Kim Asendorf, available at http:// http://kimasendorf.com/about/README.
[31] See Appendix B, fig. 1.

created at the source (the camera), rather than from digital information that is manipulated later on a computer.

My work could also be compared to that of glitch artist Phillip Stearns. Stearns also circuit bends cameras, but to a different end.[32] The resulting work of his circuit bending is to create glitch textiles.[33] His work thus explores the intersection of digital art and textile design.[34] In this way, Stearns is almost attempting to create an analog of glitch images by bringing them back into the tactile world as textiles. By printing my images, I am in some ways attempting to do the same thing. However, glitches remain ephemeral, and it is only through the capture function, as discussed above, that I am able to create something permanent that can be displayed in a gallery.

Error Theory images also bear similarities to Mark Rothko's "multiforms." These pieces bear similarities to Error Theory images in their large, square forms, bold colors, linear elements, and abstraction.[35] But whereas Rothko's work was created with intention on a canvas, my Error Theory images are created with randomness through circuit bending a camera and digital media.

There is a significant element of randomness and experimentation with my Error Theory images. Other artists, particularly musicians, have similar elements of randomness and chance in their works. For example, the composer John Cage frequently utilized randomness in his pieces. In some compositions, he would apply the *I Ching* (an ancient Chinese text) chance procedures to other existing music,

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[32] See Appendix B, fig. 2.
[33] See Appendix B, fig. 2; Stearns, Phillip. Bio, available at http://phillipstearns.wordpress.com/.
[34] Ibid.
[35] See Appendix B, fig. 3.

sometimes through quite complicated algorithms.[36] In other works, Cage simply provided instructions to the performer, rather than fully noted music, or, as with his composition *Musicircus* (1967), simply invited the performers to assemble and play together.[37]

Brian Ferneyhough's *Cassandra's Dream Song*, also utilized elements of chance and randomness. Because the piece is so difficult to perform, the musicians unavoidably make mistakes in its performance. This creates a unique performance each time. Ferneyhough stated that he intended the performance of *Cassandra's Dream Song* to be "not precisely definable in advance," and chance and randomness ultimately define the piece each time it is performed. [38]

With my Error Theory images, I utilize the chance and randomness of electricity and, more specifically, the randomness of electrons, as I manipulate the circuits in a digital camera. Voltage is by nature unpredictable in circuit bending because the variables within the circuit are constantly changing.[39] Sometimes my actions result in the camera turning off, producing a black image, or producing an image that is unreadable by the computer. But sometimes, the reconfigured circuit is able to produce images that reveal a world of imagery that was not even possible or contemplated when using the apparatus in it's intended way. Error Theory images

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[36] Cage, John. *Autobiographical Statement* (1990), available at http://johncage.org/autobiographical_statement.html (last visited Mar. 8, 2014).
[37] "The idea of this composition is nothing more than an invitation to any number of musicians willing to perform simultaneously anything or in any way they desire." Cage, John. *Original Notes to Musicircus*, available at http://johncage.org/pp/John-Cage-Work-Detail.cfm?work_ID=273 (last visited Mar. 8, 2014).
[38] Ferneyhough, Brian. *Cassandra's Dream Song Programme Note* (1970), available at http://www.editionpeters.com/resources/0001/stock/pdf/cassandra_'s_dream_song.pdf (last visited March 2, 2014).
[39] Amdahl (1991).

create unpredictable images, much like the unpredictable works of *Cassandra's Dream Song* and *Musicircus*.

V. Errors & Discovery

Error is the basis for all discoveries. Nature itself functions through the trial and error of natural selection. Different biological traits become more or less common in a species' population based on their success or failure in promoting reproductive success.[40] If this were not the case, we would never have seen the duck-billed platypus, the dodo bird, or a myriad of other odd creatures. Likewise, trial and error in other forms also leads to discoveries of new combinations or new ways of expressing or arranging information. For example, jazz music combines what might have been thought of previously as errors into new award-winning arrangements. Without errors, there would be no such discoveries. The "system," whether it be the part of the brain that controls motor skills or the pixel matrix in a digital camera, would remain a closed, uncreative system without errors.

Glitch art puts the "raw material" of glitches, errors, and bugs to creative use.[41] Perfect copies are "abandoned in favor of errors, glitches become aestheticized, mistakes and accidents are recuperated for art under the conditions of signal processing."[42] The glitch images that I am creating show the camera's real potential. They show the colors the camera can truly express. They show the sensor's ability to abstract from the world. They show how voltage and light can be expressed in a pixel matrix. Cameras can do so many things once high-jacked that they could never dream of doing when functioning as intended.

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[40] Darwin, C.R. On the Origin of Species (1859).
[41] Krapp, Peter. Noise Channels, 53. Minneapolis: University of Minnesota Press, 2011.
[42] Ibid.

There is a general standard about how things should look and behave, and this standard holds true for technological devices. For many people, rationality has a connotation of uniformity and connectiveness.[43] Because of this, circuit bending to create glitch images is usurping the normal function and is by its nature working against the established system. It shows that systems are not as closed and finite as we perceive them to be. Sometimes, it shows the power that revolution can have when introduced in a system. It is like I am performing a kind of detournemout on the city streets of a circuit board. Altering the flow of traffic. Re-routing electricity to new alleyways. The electricity is used to produce results that were never intended in the closed loop of the original system.

Errors can provide escape from the stagnant flow of a device's circuit board. Re-wiring the circuit board allows one to hijack the functions of the device. It allows one to make the device do things, like express the full potential of its color index in a cluster of pixels, even though the signal coming from the lens did not tell it to do so. It is like electrons are on board a train and with a pair of alligator clips I can make the train take a completely new route.

VI. The Symbolism of Glitch Images

Hacking a physical system is a mode of usurping the constructed power that system has over your behavior. As noted by Peter Krapp, access to concealed knowledge is possible only in breaking the illusion that positions this object outside discourse.[44] If you tell someone indirectly how to use a device by designing a closed system, you are essentially controlling their behavior. It is no different when a

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[43] McLuhan and Fiore (1967), 45.
[44] Krapp, Peter. Noise Channels, 42. Minneapolis: University of Minnesota Press, 2011.

corrupt government gives the "decision" between two equally corrupt candidates. Either path will work for the purposes of the government system. Control of the system in this context is an illusion. A simple switch that can alter the train tracks into the station and make one feel as if they have done something, but in actuality all parameters have been constructed by the designers of the system, and all control is within the system's design of switches, levers, potentiometers, and buttons.

My method of using the device to create glitch images is a philosophical statement that the camera system and the system in which we live is far too constraining, both for the purposes of generating an image and for any pre-programmed methodology. I am all for the use of presets and knobs and buttons at times, but I have come to a new awareness of how the system and I work in collaboration with one another, and that the variables that I am actually able to control are quite limited. When circuit bending a device or overthrowing any system, you are able to use more of a system's variables than previously available. While normally the only options available to the photograph are to adjust the shutter speed, aperture, and a few other options, through circuit-bending, I open the system up to numerous other variables that introduce randomness and chance into the images. Just as *Cassandra's Dream Song* invites randomness and chance into the composition with every performance, I have introduced chance and randomness into the circuit boards of a digital camera to create my Error Theory images. The result cannot be predicted in advance.

Part of making a consumer product involves limiting these variables to a conceivable, controllable amount, and that has value and merit, but opening that

system, or hacking into it allows you to explore more of the variables and the system's greater potential. This allows the system to do exponentially more than it was ever designed to do. My method of generating images is a statement that sometimes limitations that seem finite and insurmountable are actually just speed bumps. With the right approach, these "speed bumps" are quite simple to exceed.

VII. Relation of Error Theory to the Current Digital Image Paradigm

A. Error Theory as the Next Step in the Digital Age

As Fred Ritchin said, "We have entered the digital age. And the digital age has entered us. We are no longer the same people we once were. For better and for worse."[45] Since the digital era of manipulation of photographs came to be in 1982 with *National Geographic*'s modified image of the pyramids of Giza, images have been manipulated and modified in increasingly new ways.[46] What some posit began as a news media tactic of altering photographs can also be seen as inspiring new, yet unrealized, potentials.[47]

Error Theory images are one such newly realized potential. They are a form of the new imaging strategies that will emerge from the digital revolution that can transcend many of analog photography's limitations.[48] Glitch images go a step further though from regular digital images. They demonstrate a new way of using digital photograph as a form of technology and art. In this way, Glitch images are the "evolving medium hidden inside [photograph] as in a Trojan horse."[49] Glitch images take the world of the internal technology of the camera and transform it into external

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[45] Ritchin, Fred. After Photography, 9. New York: W.W. Norton Company Ltd., 2009.
[46] Ibid. at 41
[47] Ibid at 30.
[48] Ibid. at 11.
[49] Ibid. at 15.

images. These digital images transform these inner workings at the heart of digital photography into the art itself. It is not the digital images themselves that are altered with Error Theory, as with Kim Asendorf's images, but rather the camera itself is altered to permit a new flow of electricity that creates these new images.

B. Error Theory Images are Free From the "Flood of Redundancy"

At their core, images are complex connotative symbols that provide space for interpretation.[50] The "technical image" is one produced by an apparatus.[51] With my Error Theory images, however, the fear that technical images liberate their receivers by magic from the necessity of thinking conceptually,[52] or that as new technologies come into play, people are less and less convinced of the importance of self-expression,[53] is absent. This is because glitch images do in fact require conceptual thought. They are not replicating an image that can also be seen with the naked eye, and thus require some additional conceptual thought beyond simple image recognition.

Flusser described how the apparatuses or tools of cameras tear objects from the natural world in order to bring them to the place where the human being is.[54] By contrast, glitch images do the opposite, and bring into the realm of possibility images and objects that are normally only internal to the camera, never before revealed to the natural world. Glitch images also break through the barriers of the "habit" and familiarity of photographs.[55] Glitch images are not familiar or redundant in the same

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[50] Flusser (1983), 8.
[51] Ibid. at 14.
[52] Ibid. at 17,
[53] McLuhan and Fiore (1967), 123,
[54] Flusser (1983), 23.
[55] Ibid. at 65.

way traditional photographs are, like a tourist attraction that has been photographed millions of times, but instead cause the brain to think in new and engaging ways. Glitch images contain a vast number of permutations but their mode of generating images is not tied to the redundancy of recreation from the natural world. They are "informative" images that oppose the "flood of redundancy."[56] Each glitch image is unique and virtually impossible to replicate.

Flusser long ago recognized experimental photographers are consciously attempting to create unpredictable information, i.e. to release themselves from the camera, and to place within the image something that is not in its program.[57] Glitch images are part of this imagery by their attempt to create unpredictable, unique images.[58] Glitch images also embrace and reflect the shift of power linked to rapid development of science and technology, both literally and figuratively.[59]

C. Error Theory's Role in a Changing Dialogue

Glitch images are part of digital photography's "emerging imagery" that will help people to understand the universe through strategies that were relatively inaccessible to analog photography, including multiple temporal and special perspectives.[60] "The new photograph will be read and understood differently as people comprehend that it does not descend from the same representational logic of either analog photograph or of painting that preceded it."[61] Error Theory images take this paradigm a step further. They are so markedly different from the prior

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[56] Ibid.
[57] Ibid. at 81.
[58] Ibid. at 82.
[59] Ziarek, Krzysztof. The Force of Art, 61. Redwood City: Stanford University Press 2004.
[60] Ritchin (2009), 144.
[61] Ibid.

representations of analog and even digital photography, people will be forced to analyze and contemplate their meanings.[62]

Contemporary art is indeed in a transitional stage, no longer capable or willing to play the old aesthetic and cultural roles assigned to it and yet uncertain, even confused, about its place in the technoworld of the twenty-first century.[63] Error Theory is a part of this evolution of contemporary art, simultaneously embracing and bridging the worlds of art and technology. Error Theory glitch images are not limited to the traditional constraints of digital photography, and in fact break through those barriers and limitations.

Khlebnikov's "inversions of technicity into artistic forcework" are symptomatic of a larger twentieth-century artistic phenomenon known as radical, experimental, or avant-garde aesthetics.[64] Such art is not merely a rebellion against worn-out aesthetic and literary conventions, but rather "constitute a response to the parallel phenomenon of an increasing mathematization of being in modernity."[65] This work finds its expression more powerful in the underlying determination of being as intrinsically 'informatizable': the modern tele-electronic incarnation of 'essence' as information.[66] In this paradigm, however, glitch art stands out as unique, as it cannot simply be made into a blueprint that is orderable.[67] Glitch art represents disorder within an otherwise organized system of capturing data.

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[62] Ziarek (2004), 20.
[63] Ibid. at 5.
[64] Ibid. at 75.
[65] Ibid.
[66] Ibid.
[67] Ibid.

D. Error Theory and the Future of Digital Images

Though many scholars have spent significant time predicting the future of digital photography, the glitch image is not a concept that has been heavily analyzed. For example, though Ritchin did imagine a world where photographs are created through so-algorithms, his algorithms were meant to capture different photographers' skills in creating photographs, not the underlying algorithms and "0s" and "1s" that created the technological code for the image.[68] Ritchin also contemplated more of digital photography's potential for manipulation and inaccuracy of images, along with its potential for more accuracy through different perspectives and the ability to link to other images. He did not, however, contemplate Error Theory glitch images' use of digital cameras and circuit bending as a new method of creating imagery.

Some, such as Ziarek, have questioned whether, despite the massive technological and social changes brought about by the computer industry and their increasing relevance for future, whether the artistic ferment of the early-twentieth-century avant-gardes is again possible.[69] I posit that glitch art is different. Glitch images, while related to technicity and computer technology, are unique in that their link to technology is not as web art or increased web interactivity.[70] Rather, glitch images are created through the essence of technology itself. Technology is not simply a means of dissemination, or the method of creation. Glitch images are an expression of technology itself.

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[68] Ritchin (2009), 173-74.
[69] Ziarek (2004), 190.
[70] Ibid. at 193-94.

VII. Conclusion

The presence of glitches and errors in technology show that technology is humanity's offspring. Just as errors lead to discoveries in humanity, errors in technology have led to the creation of my Error Theory images.

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APPENDIX A

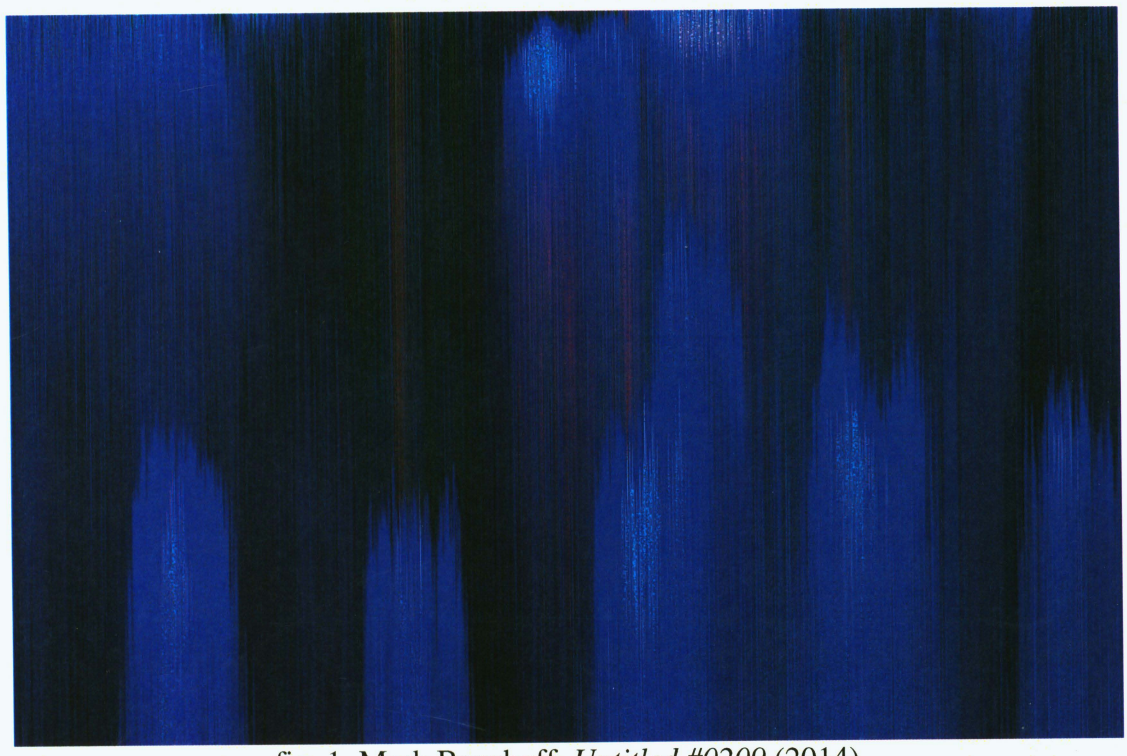


fig. 1. Mark Banzhoff, *Untitled #0209* (2014).

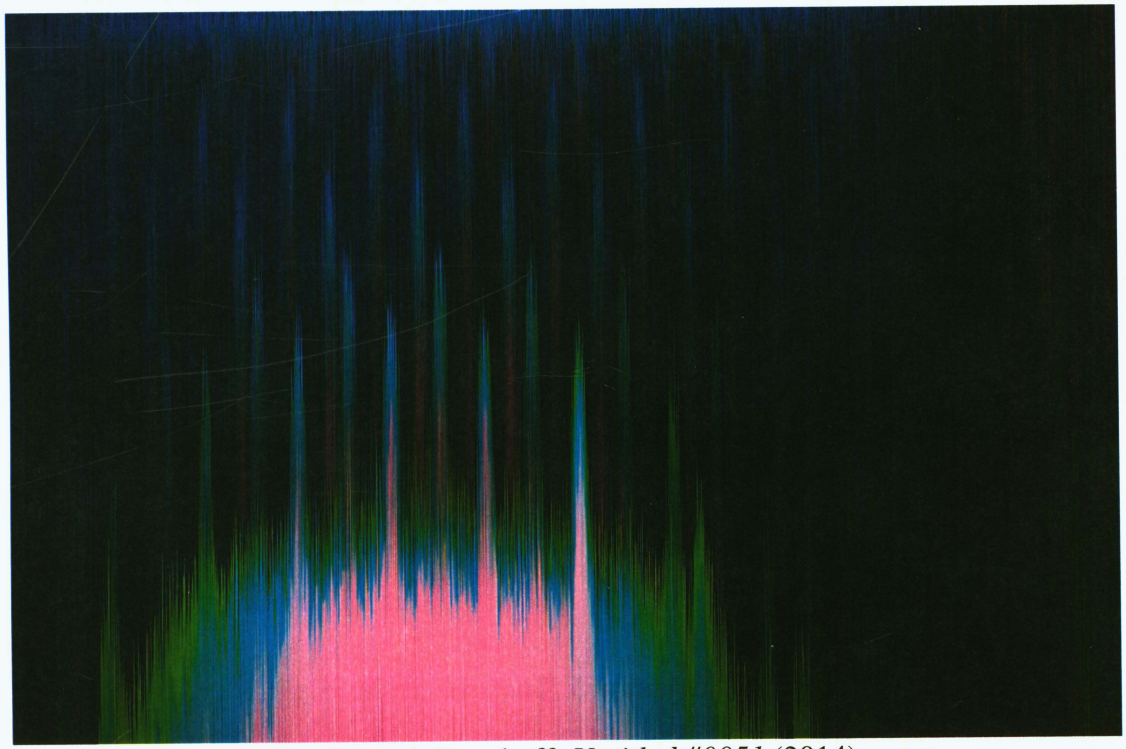


fig. 2. Mark Banzhoff, *Untitled #0051* (2014).

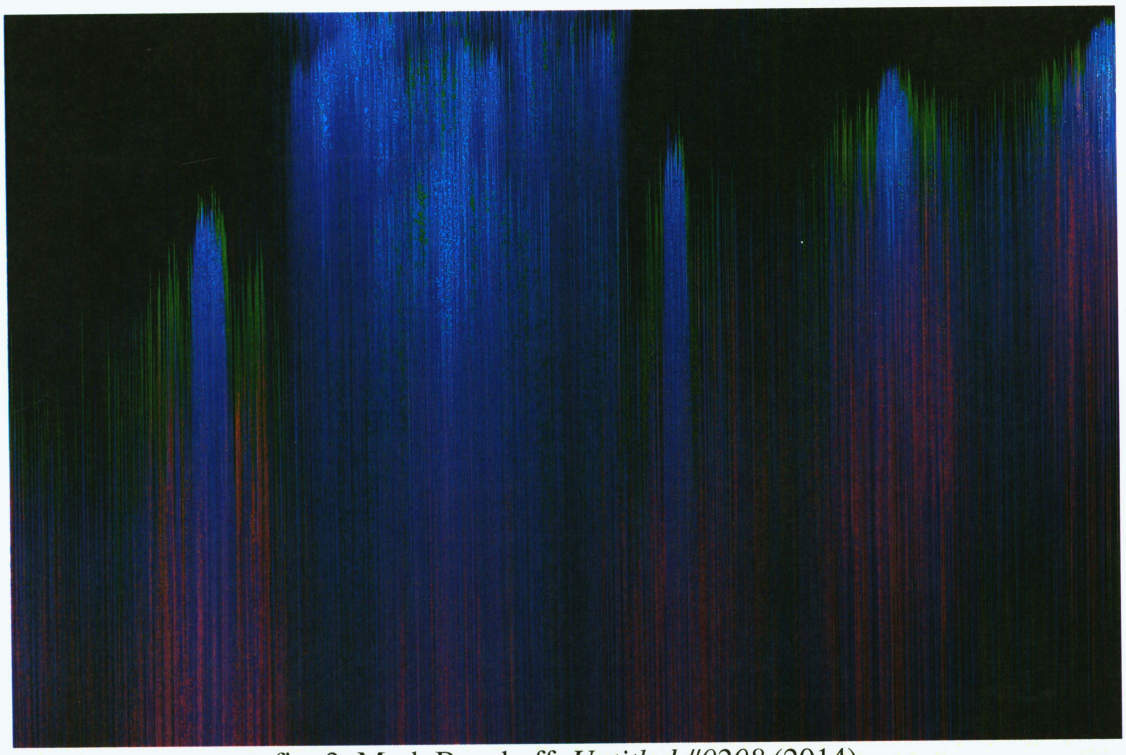


fig. 3. Mark Banzhoff, *Untitled #0208* (2014).

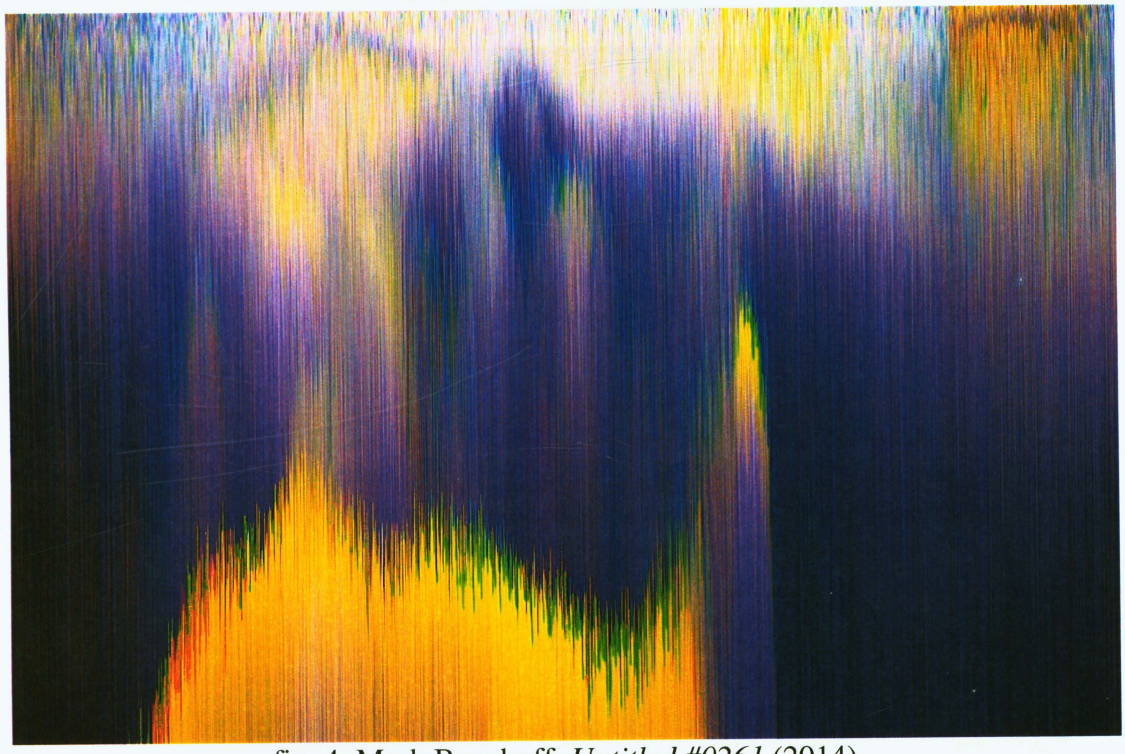


fig. 4. Mark Banzhoff, *Untitled #0261* (2014).

fig. 5. Mark Banzhoff, *Untitled #2481* (2014).

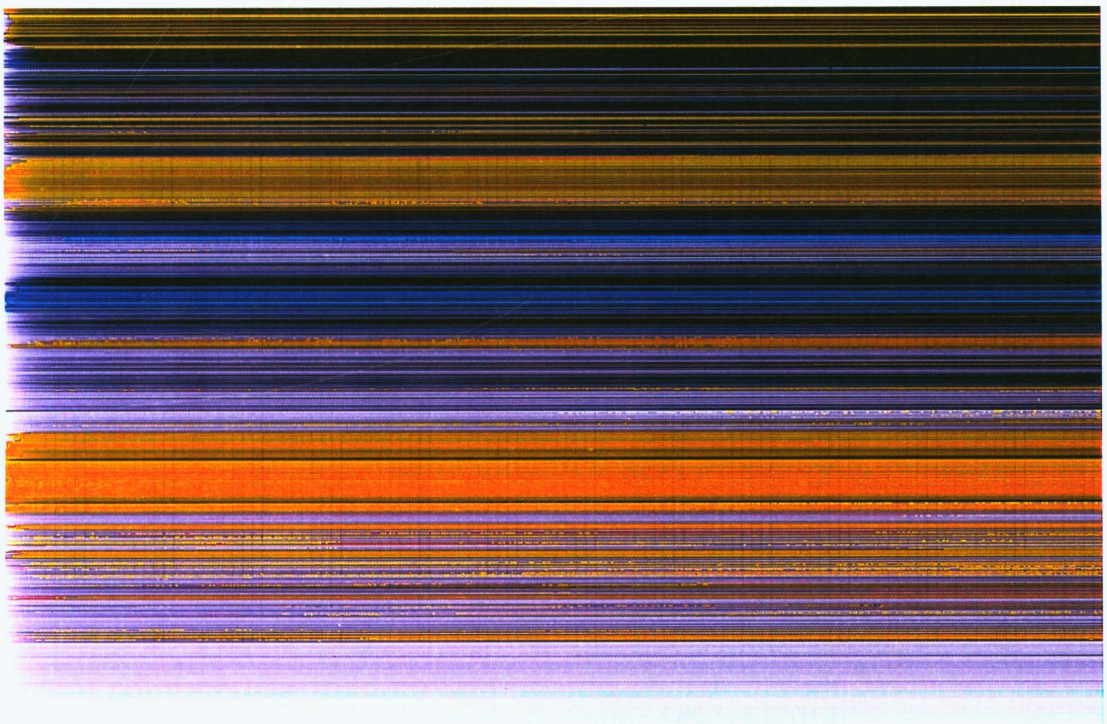


fig. 6. Mark Banzhoff, *Untitled #9214* (2014).

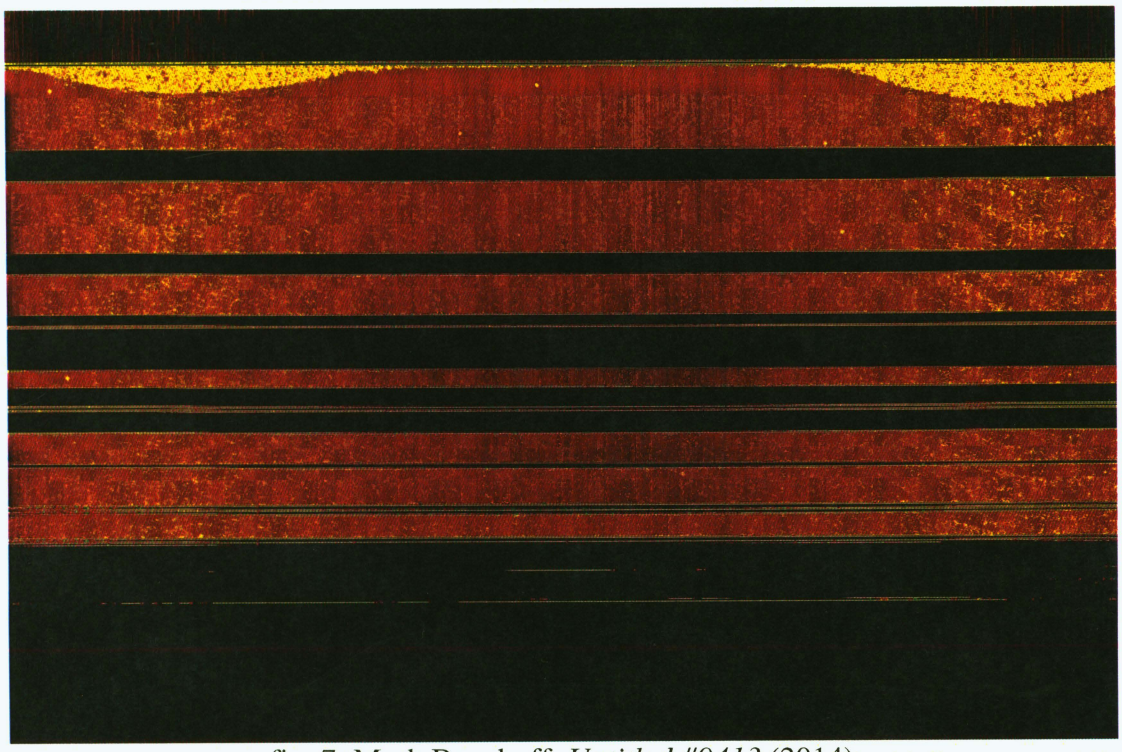


fig. 7. Mark Banzhoff, *Untitled #9413* (2014).

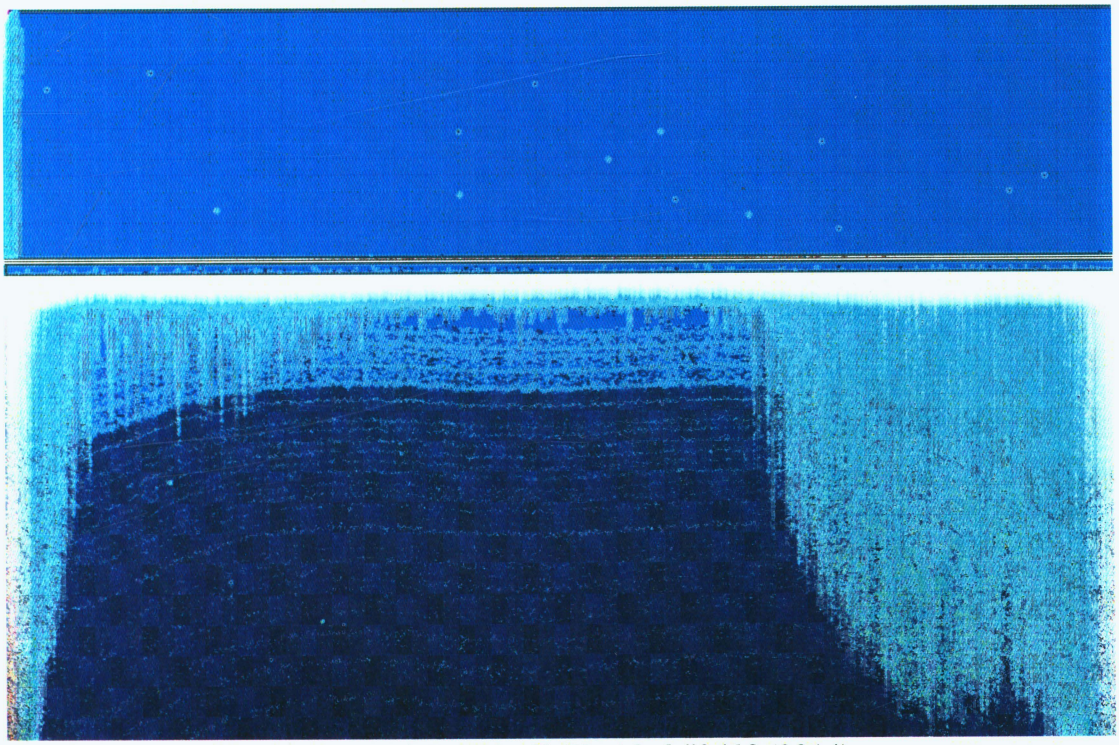


fig. 8. Mark Banzhoff, *Untitled #9418* (2014).

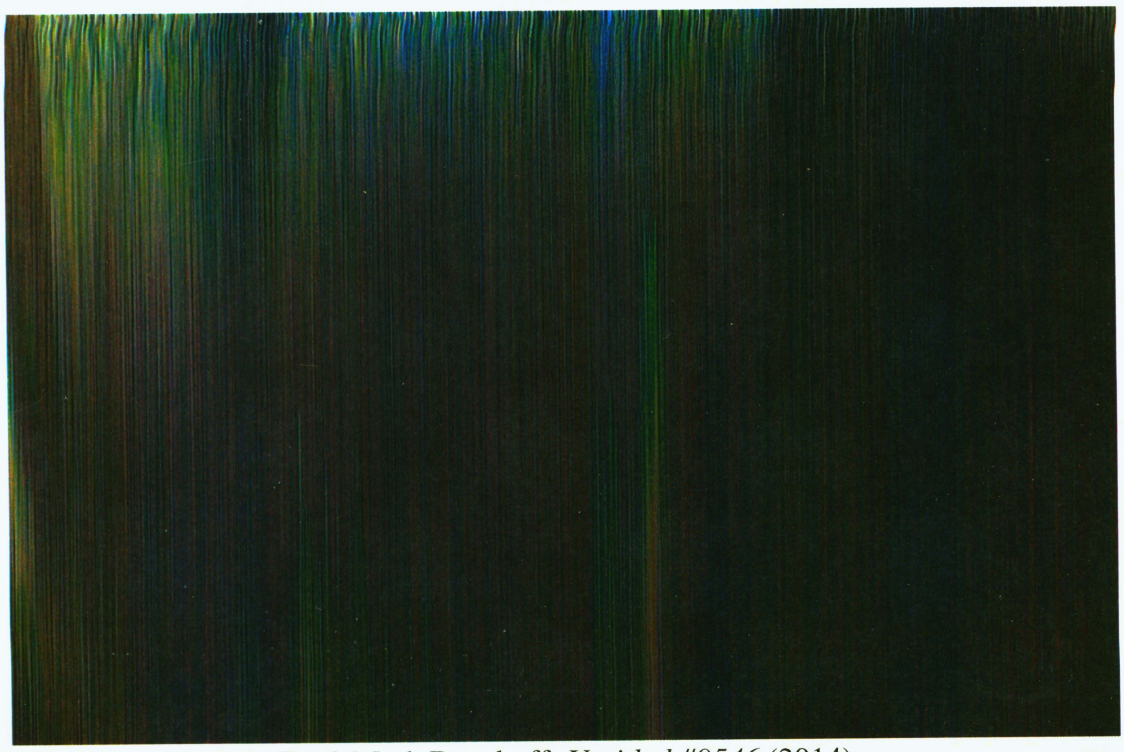


fig. 9 Mark Banzhoff, *Untitled #9546* (2014).

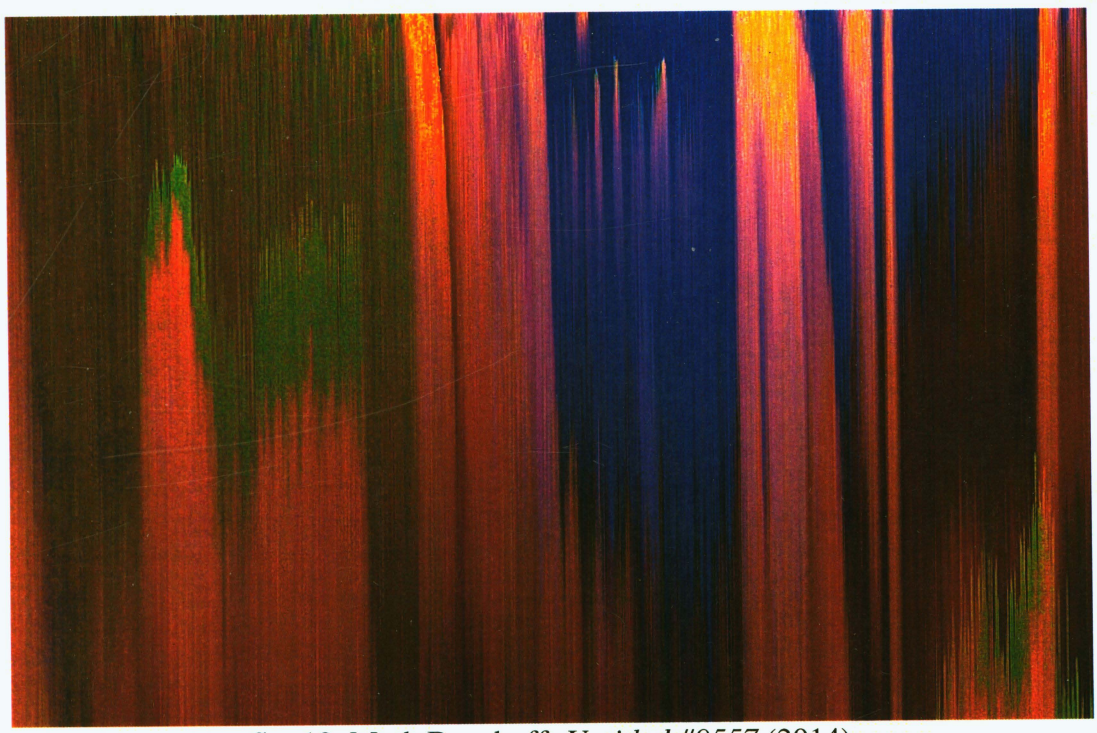
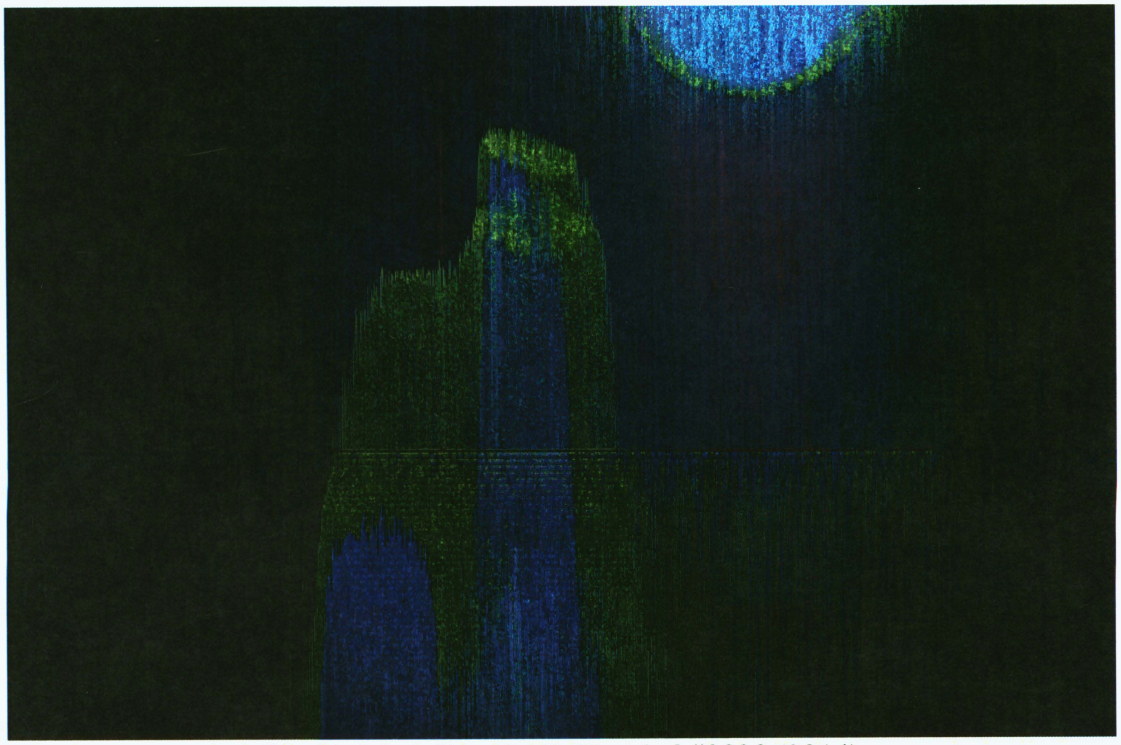


fig. 10. Mark Banzhoff, *Untitled #9557* (2014).



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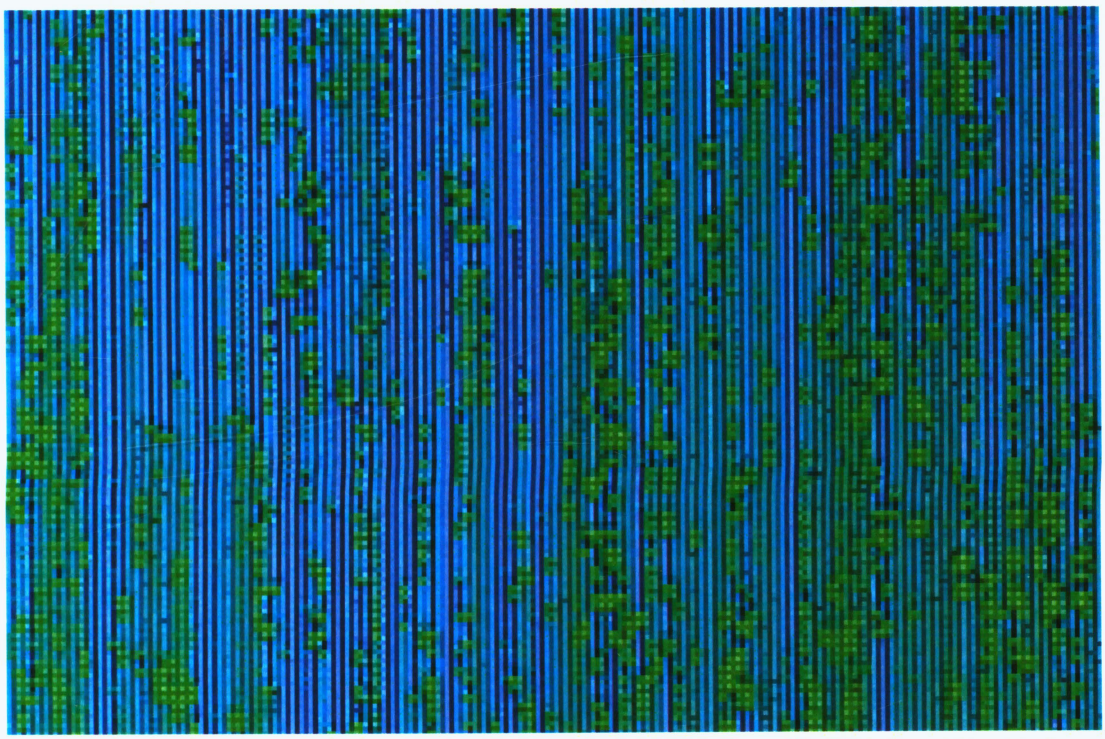

fig. 12. Mark Banzhoff, *Untitled #9992(Detail)* (2014).

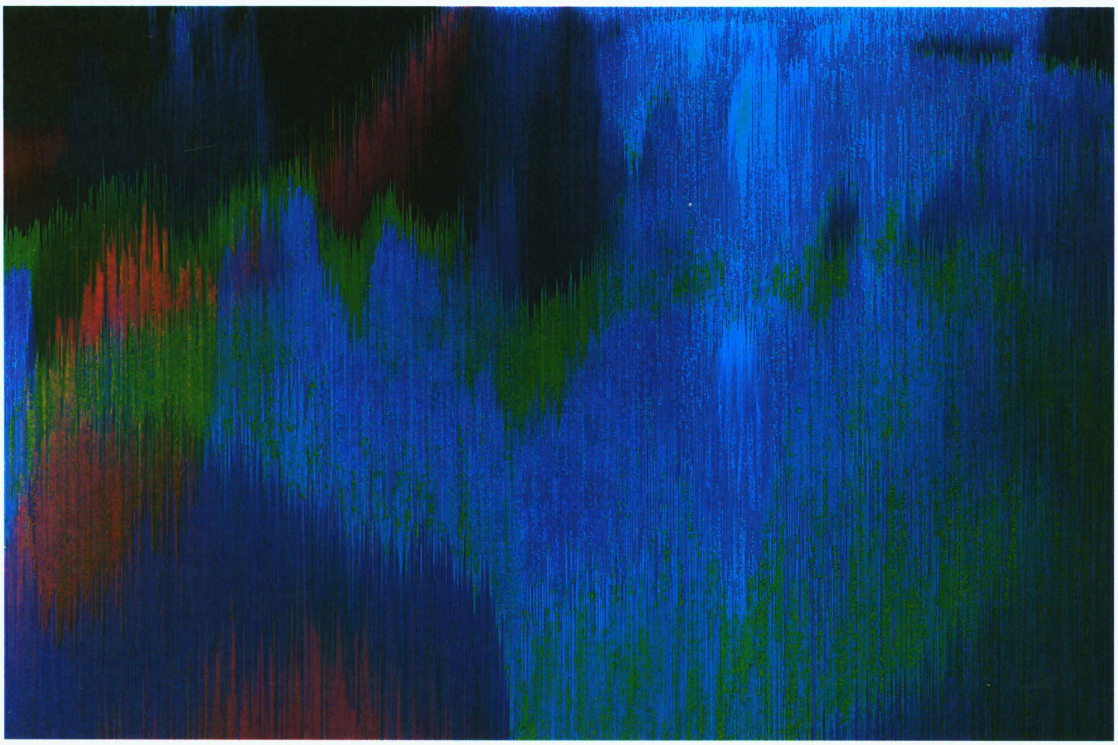

fig. 13. Mark Banzhoff, *Untitled #9992* (2014).

APPENDIX B

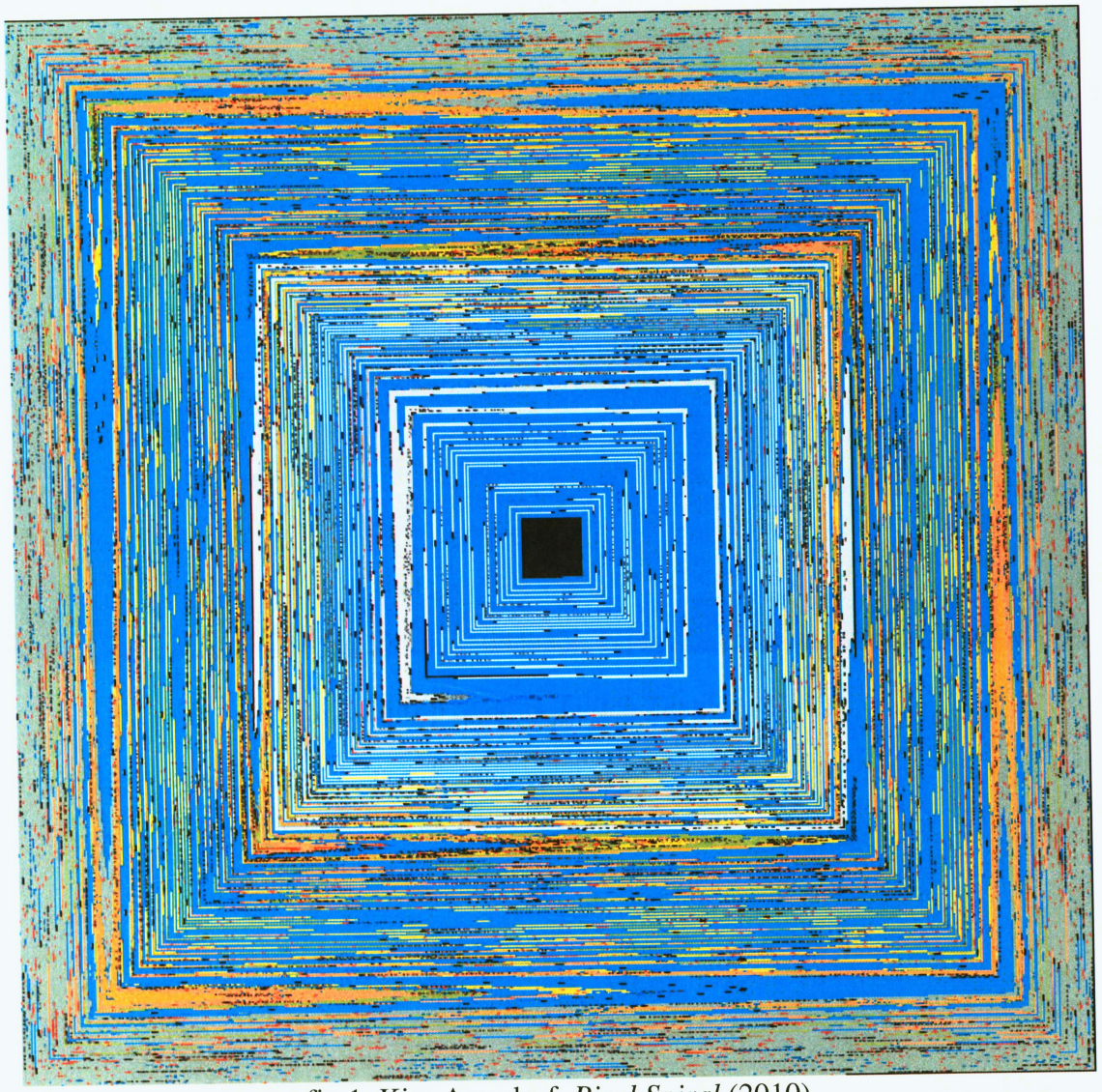

fig.1. Kim Asendorf, *Pixel Spiral* (2010).

fig. 2. Phillip Stearns, *Glitch Textiles* (2012).

fig. 3. Mark Rothko, *Untitled (Violet, Black, Orange, Yellow on White and Red)* (1949).