"Photographs of Lightning": The Intersection of Research and Creation in Leo Daft's Photographs of Electric Sparks

Tara Allen-Flanagan

En 1875, la revue *The Photographic Times* a publié quatre photographies stéréographiques de courants électriques prises par l'inventeur et photographe Leo Daft. Une lettre écrite par Daft, expliquant comment il a produit les images et invitant les lecteurs à le contacter s'ils souhaitaient emprunter les matériaux nécessaires pour créer les leurs, a été incluse à côté de ces images qui représentaient des lignes blanches d'électricité sur fond noir. Le pouvoir actinique des étincelles électriques de Daft, ou leur capacité à provoquer les réactions photochimiques qui permettent de réaliser des photographies, fait que les sujets des photographies sont aussi leurs conditions d'existence. Ce texte soutient que les photographies d'étincelles électriques, et la publication ultérieure de leur création, démontrent comment Daft laisse des traces perceptibles de la recherche-création au sein de son travail et de sa diffusion. Soulignons que pour un sous-ensemble d'intellectuels occidentaux multidisciplinaires, qui ont travaillé côte à côte à la fin du XIX^e^ siècle, les frontières entre la photographie, la science et l'art étaient floues.

Tara Allen-Flanagan is an independent scholar based in Toronto. — tara.allen-flanagan@mail.mcgill.ca

In 1875, US-based photography journal *The Photographic Times* published a letter by inventor Leo Daft (1843–1922) that included instructions on how to both create and photograph electric currents. The journal's full title, *The Photographic Times: An Illustrated Monthly Magazine Devoted to The Interests of Artistic And Scientific Photography*, neatly encapsulates the breadth of Daft's letter. These four engravings, black-and-white reproductions of Daft's photographs of white lines of electricity on a black background, were published alongside the article |**fig. 1**|.[1] While the engravings serve as useful illustrations of the experimental process that Daft outlines in his letter, they are also two-dimensional reproductions of images that were intended to be viewed in three dimensions. As Daft explains, the intended results of his instructions are "stereoscopic views," or stereographs. Stereographic images are achieved by placing two images of the same scene, taken from slightly different angles, side by side on a single surface. When viewed through a stereoscope, a device that isolates the vision of each eye such that each sees only one of the two images, the images appear to overlap, creating the illusion of what appears to be a single, three-dimensional image. By inviting readers to create their own stereographic images, Daft communicated that his photographic process bore, like any worthy experiment, reproducible results. With the right method and equipment, any reader could observe short-lived sparks whose actinic light, capable of causing photochemical reactions, leaves its marks on a chemically treated plate.

Daft's foray into photography was a manifestation of both his practical interest in electricity and his desire to replicate a community-based artistic mode practiced by his idols: the European inventors and electrical engineers who gained fame in the early nineteenth century. Daft's photographs of electric sparks and his subsequent publication of his methods demonstrate how, to a subset of Western intellectuals who worked alongside one another in the late nineteenth century, the boundaries between photography, science, and art were blurred. Daft's process, existing at the intersection of what we might now categorize as the separate disciplines of scientific research and artistic creation, did not result in an object that he considered to be an artwork or in the patenting of an invention. Given that the medium of photography has historically resisted categorization as either art or science, Daft's images reflect the holistic integration of

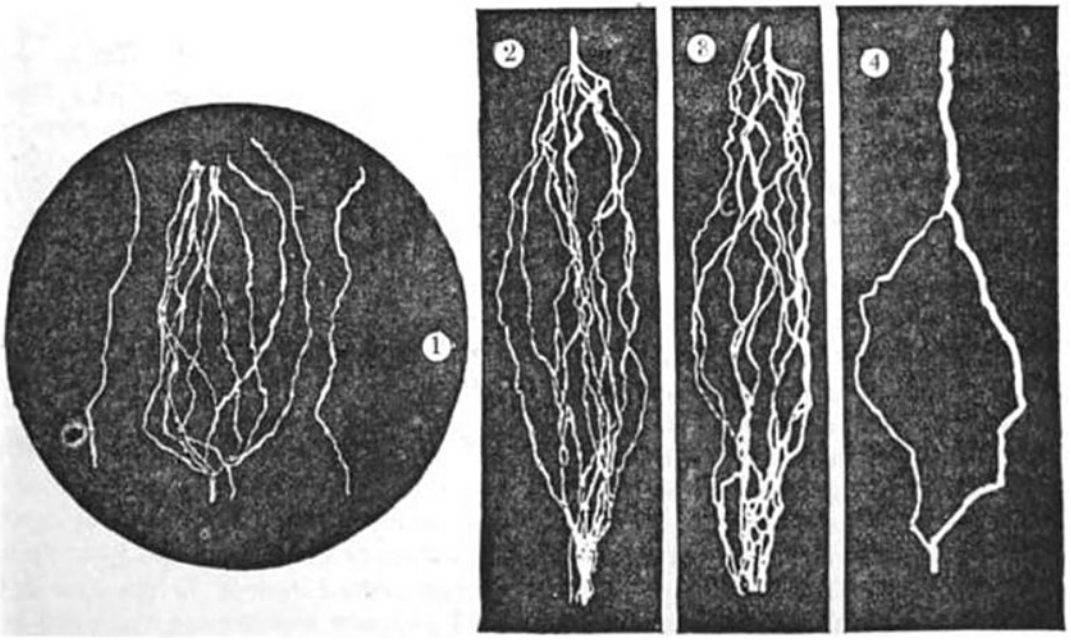

Figure 1. Engraving of Leo Daft's electric spark photographs. Reproduced from Leo Daft, "Photographing Electric Sparks," *The Photographic Times*, August 1, 1875.

research and artistic production. Although the journal's title recognizes art and science to be separate domains, the work presented throughout reveals the constant entanglement of these ostensibly separate fields. Daft's work exemplifies this entanglement and, I suggest, can be considered an act of research-creation.

Owen Chapman and Kim Sawchuk define research-creation as the "intent to 'reveal' new things (i.e., the exploration of the boundaries of what can be created through research, as research) that unites research-creation with other forms of scholarly research [...]."[2] When considered within the context of research-creation, Daft's letter, which details a research process that seeks to experiment with the boundaries of photography as a medium through the production of artwork, serves as an example of the use of research-creation methods during the Second Industrial Revolution. Daft's process can be considered an act of creation-as-research, per Chapman and Sawchuk's definition of the subcategory of research-creation as one that considers the process of research itself to be the end goal, with the artistic output being a key facet of the process' results.[3] While the publication of new processes for producing photographs of electric sparks was one material result of Daft's experimental process, the stereoscopic images he created and their intended viewing method in a stereoscope evince the importance of artistic output within this process. The images would not exist without the research Daft conducted to create them, and yet they stand on their own as art objects regardless of the context of their production. Nevertheless, the process and the art are intrinsically linked through both medium and subject matter.

1. Leo Daft, "Photographing Electric Sparks," *The Photographic Times* 5, no. 56 (August 1, 1875): 193.
2. Owen B. Chapman and Kim Sawchuk, "Research-Creation: Intervention, Analysis and 'Family Resemblances,'" *Canadian Journal of Communication* 37, no. 1 (2012): 20.
3. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis and 'Family Resemblances,'" 19.

Photography, at the time that Daft was engaged with it, was not considered either a purely scientific or artistic discipline; an article in the same issue of *The Photographic Times* that Daft's was published in describes how photography was not included with the fine art or the machinery in the preparations for the International Centennial Exhibition of 1876 in Philadelphia and calls upon individual photographers to submit their work so that they may "elevate [their] art."[4] Jonathan Crary, in his 1990 book *Techniques of the Observer*, discusses the use of optical devices that alter human ways of seeing, the stereoscope in particular. He challenges the notion that scientific imagery produced in the late nineteenth century with optical devices was intentionally objective and devoid of creative vision: "Rather than stressing the separation between art and science in the nineteenth century, it is important to see how they were both a part of a single interlocking field of knowledge and practice."[5] If research-creation has recently arisen as a critical framework that supports the pedagogical integration of artistic production and academic research, Daft's work effectively demonstrates the productivity of its historical precedent.[6] Daft's photographs of electric sparks and accompanying letter published in *The Photographic Times* point to his position as both researcher and creator. Analyzing his work through the lens of research-creation, I suggest that the "artistic" and "scientific" facts of Daft's process are inextricable.

Daft, who during his lifetime worked as a commercial photographer and an electrical engineer, produced art that was informed by the way science operated at the time; that is, his experiment was not evidence of a new discovery, but a template that served to teach others how to recreate natural phenomena themselves. In effect, his "artistic" and "scientific" processes were intrinsically linked to the point where one could not exist without the other. While he could have taken photographs of electric sparks and published them all the same, he pushed his endeavour further, blurring the lines between science and spectacle to create a three-dimensional view of electricity. Daft's dedication to capturing, via photography, and recreating, via stereography, the "actual track of the electric fluid" resulted in a set of images that seek to recreate the moment in which they were created.

Leo Daft's Photography Studio

Daft lived during an era in the history of modern science that saw a boom in patenting and the monetization of inventions. Born in 1843 in Birmingham, England, Daft was exposed to the notion of professional engineering and invention from an early age. His father, Thomas Barnabas Daft, was a civil engineer who pursued inventing and patenting as a full-time career.[7] Noticing his son's early interest in engineering and technical design, Thomas B. Daft hired Leo Daft as a draftsman and illustrator when he was sixteen years old. Thomas B. Daft's professional interest in scientific research provided his son with the tools and connections necessary to begin his own career in engineering. Leo Daft was acquainted with his father's friends, such as the early contributor to the telegraph, Cromwell Fleetwood Varley (1828–1883)

4. The article, written by an unknown author in a flippant tone, notes that photography had been excluded from the fine art display in Memorial Hall because it "has been crowded out because of the imperious demands of her older sisters," suggesting a familial relationship between photography and older forms of art while also acknowledging that photography has not yet achieved the same categorization. See Unknown, "Photography at the Centennial Exhibition," *The Photographic Times* 5, no. 56 (August 1, 1875): 185.

5. Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, MA: The MIT Press, 1990), 9.

6. Natalie Loveless, "Introduction: Art in the Expanded Field," in *How to Make Art at the End of the World: A Manifesto for Research-Creation* (Durham, NC: Duke University Press, 2019), 3.

7. Unknown, "Obituary. Thomas Barnabas Daft, 1816–1878," *Minutes of the Proceedings of the Institution of Civil Engineers* 55 (1879): 329.

Figure 2. Leo Daft's photography studio, 1911 reproduction of an 1877 albumen print. In the possession of the author.

and engineer William Pole (1814–1900). With Pole, Leo Daft studied civil engineering at University College, London.[8] In London, Daft met engineer Sir William Siemens (1823–1883), who loaned him a forty-cell battery and other assorted electrical apparatuses to experiment with.[9] The early relationships that Daft made in London continued to provide him with material and intellectual benefits throughout his career.

In 1866, Daft emigrated to New York in search of electrical engineering work. Finding scarce employment opportunities, Daft opened a photography studio in Troy, New York in 1873. According to an 1876 advertisement in the *Lansingburgh Gazette*, Daft specialized in "Landscape Work. Machine Copying, and every branch of photography."[10] From 1873 to 1878, Daft specialized in commercial photography.[11] Little is known about Daft's time working as a professional photographer; nevertheless, an later reproduction of an 1877 photograph of the interior of his studio reveals a small room, with a modest selection of portraits and landscape images displayed in ornate frames |**fig. 2**|.

While Thomas B. Daft and Leo Daft had wide-ranging connections among prominent English scholars and inventors, their scientific interests were not solely academic; they also sought to patent ideas to make a living. Christine MacLeod identifies three broad categories of people who filed patents near the end of the nineteenth century: the amateur inventor, who dabbled in technological invention as a hobby; the professional inventor, who invented for a living; and the businessman, who was a tradesman prepared to actually use the patent to further their business interests.[12] MacLeod notes that the professional inventor's zenith in England began during the early nineteenth century and led to the creation of an "invention industry" wherein men could earn a living through patenting.[13] Thomas B. Daft, who took out twenty-eight patents between 1839 and 1877 in his own name and many more while working for various manufacturers and engineering firms, fits squarely into the category of the professional inventor.[14]

In Thomas B. Daft's era, London was a hub for scientific research. In a letter sent to Leo Daft in 1871, two years before his son began working as a professional photographer in Troy, Thomas B. Daft reveals himself to be caught in an endless cycle of inventing, patenting, and selling. He equates patenting with income, and describes how the patenting of his latest invention might allow him to retire early, travel to see his children, and potentially settle down alongside his son in America: "I want to accomplish leather webbing by self acting machinery, and if I do succeed it may be a good thing, not to say a great thing for the rest of my days…. If we obtain an American Patent, it is just possible that we may meet before next year is out."[15] Thomas B. Daft worked for years in the pursuit of a self-acting machine that, as Steve Edwards states in reference to the concept of a self-acting machine more generally, reflects the Victorian ideal of a mechanical device that "sets production free from the hindrance of the working class and, in the process, unleashes the possibility of a frenzy of making."[16] The Victorian self-acting ideal that Thomas B. Daft worked towards, however, belied the capitalist

8. Unknown, "Leo Daft: An Electric Railway Pioneer," *Cassier's Magazine*, July 1901.

9. Unknown, "A Biographical Sketch of a Distinguished Electrician," *The Electrical World*, March 30, 1889, 1.

10. The full advertisement reads as follows: "LEO DAFT. (Successor to J. M. Capper,) Landscape Work. Machine Copying, And Every Branch of PHOTOGRAPHY. Cor. Grand Division & 4th Sts., TROY, N.Y." Leo Daft, "Advertisement," *Lansingburgh Gazette*, April 22, 1876, 2.

11. He is recorded as having sold a photograph of Mohawk Valley, over seven feet wide, for $300. See "A Biographical Sketch of a Distinguished Electrician," 2.

12. Christine MacLeod, *Inventing the Industrial Revolution: The English Patent System, 1660–1800* (Cambridge, UK: Cambridge University Press, 1988), 79.

13. MacLeod, *Inventing the Industrial Revolution*, 79.

14. Unknown, "Obituary. Thomas Barnabas Daft, 1816–1878," 329. See also Thomas Barnabas Daft, "Correspondence from Thomas Barnabas Daft to Leo Daft," December 3, 1871, in the author's possession.

15. Thomas Barnabas Daft, "Correspondence from Thomas Barnabas Daft to Leo Daft," December 3, 1871.

16. Steve Edwards, *The Making of English Photography: Allegories* (University Park: Pennsylvania State University Press, 2006), 42.

systems put in place that favored the businessman over the manufacturer. He wrote, "I work, if anything, harder than ever and yet don't get on—it seems as if you cannot in that you go in for some great company & most of them are more or less swindlers."[17] Ultimately, Thomas B. Daft did not patent this "self-acting machinery," and he remained in London until his passing in late 1878. While Thomas B. Daft's struggles to make ends meet as a professional inventor may have influenced his son's refusal to pursue inventing as a full-time career in England, his death seemed to have served as a catalyst for his son's own interest in filing patents.

Leo Daft's emigration from England to America coincided with the beginnings of American inventors self-proclaiming the United States to be a society driven by invention. In her book, *The Early American Daguerreotype*, Sarah Kate Gillespie tracks the arrival of the daguerreotype in America and the claiming of the photographic process as an American one: "The idea of inventiveness as a national trait was immediately applied to the daguerreotype. Though it was not an American invention, within ten years of its arrival to the United States it was called 'the American process.'"[18] Thomas B. Daft clearly felt this shift, as he wrote to Leo Daft in March of 1876, "I quite feel with you that America is the coming country."[19] Narratives of American progress and scientific intellect mirror those propagated by Leo Daft's English idols, and yet, in the United States, were based in a more explicitly capitalist and voyeuristic setting.

Following the death of his father, Leo Daft shut down his photography studio and, less than two months later, filed his first US patent. The patent, entitled "Camera-Screen Attachments," specified a design for a device that allowed the screen of the camera to be opened and closed by an electro-magnet without intervention from the photographer. According to Daft, this camera-screen attachment hid the screen from the subject of a portrait, thereby eliminating anxieties about being photographed and allowing their features to remain natural:

> In taking pictures of persons it is desirable that during the time of exposure such persons shall be kept free from all anxiety; but in the ordinary process of taking such pictures many persons become nervous at the moment they see that the exposure begins, and their features assume a strained look. By my attachment…the person whose picture is taken remains entirely unconscious of the time of exposure, so that perfect pictures are obtained even from very nervous persons.[20]

One can imagine that Daft conceived of and created a prototype for his camera-screen attachment while working in his photography studio, where he undoubtedly had to photograph no shortage of "very nervous persons." This photography patent, which solved an issue likely only noticeable to those who regularly sat for or took photographs, highlights Daft's early interest in improving upon existing modes of production.

As a business owner, Daft's interest in mitigating the potentially stressful nature of sitting for one's portrait was informed by a desire to please his clients, both by rendering their time at his studio more comfortable and ensuring that their photographic likenesses came out satisfactorily,

17. Thomas Barnabas Daft, "Correspondence from Thomas Barnabas Daft to Leo Daft," March 14, 1876, in the author's possession.

18. Sarah Kate Gillespie, *The Early American Daguerreotype: Cross-Currents in Art and Technology* (Cambridge, MA: The MIT Press, 2016), 136.

19. Thomas Barnabas Daft, "Correspondence from Thomas Barnabas Daft to Leo Daft," March 14, 1876.

20. Leo Daft, 1879, Camera-Screen Attachments. US Patent 221,670, filed January 22, 1879 and issued November 18, 1879.

unmarred by the "strained look" of anxiety. In the specifications for his patent, Daft surmises that the visible camera screen is what causes sitters to become nervous and ruin a "perfect" picture. This technical hypothesis is at odds with the persistent human anxiety around being photographed, which has always plagued and continues to vex photographers, their subjects, and art historians. Felix Nadar, writing in 1854, describes the apprehensive attitude many people—including those he deems "our most brilliant intellects"—held towards photography; he cites Honoré de Balzac's belief that bodies are made of "ghostlike" layers of images and that, because matter could not be created from nothingness, taking a photograph of someone removed one of those layers and thus a part of their life.[21] Roland Barthes, in his seminal 1980 book *Camera Lucida*, claimed that posing for a picture involves acknowledging one's own mortality, insofar as a photograph depicts a version of oneself that, in being of a moment invariably past, is seen no longer to exist.[22] Daft's patent explicitly attempts to alleviate this quandary by obscuring the moment of exposure through mechanical intervention. Daft's invention did not solve the issue of the portrait sitter's awareness—Barthes found the experience of being photographed in the 1970s just as nerve-wracking as Daft imagined his sitters felt in the 1870s—yet it demonstrates his interest in producing idealized photographs.[23]

Daft worked with electricity in various forms since his childhood; in 1863, at twenty-one years old, he showcased an early prototype of an electric motor and other "electrical experiments" to a group of friends in his home.[24] This research culminated in an invention that granted him some public recognition: in 1883, he patented an early electric tram system and installed electrified trolley systems in a few cities across the north-eastern United States.[25] Due to his later success as an inventor and engineer, Daft's interest in photography was dismissed by biographers as a break from, rather than a continuation of, his interest in electricity. The author of an 1885 article on New York tram propulsion systems notes that Daft's "scientific tastes led him to the extremely fascinating, though not profitable occupation of photography until 1880, when he turned his attention to his first love—electricity."[26] This removal of photography from Daft's interest in electricity continues today. Joseph J. Cunningham, in his article "Forgotten Pioneer: Leo Daft and the Excelsior Power Company," lists photography as one job among many: "[Daft] worked in a variety of jobs and fields that included a steam locomotive engineering, drafting, photography, and, finally, electric lighting and propulsion."[27] Cunningham, like many of Daft's biographers, considers photography to be a break from, rather than a facet of, Daft's interest in the potential of electricity. As evidenced by his electric spark photographs and their accompanying description, however, Daft's foray into photography was not a deviation from his lifelong interest in electricity; rather, his stereographs of electric sparks reveal a deep interest in the multitude of ways in which electricity could be produced, harnessed, and used to power both locomotion and photographic traces.

21. Felix Nadar, Gaspard Felix Tournachon, and Thomas Repensek, "My Life as a Photographer," *October* 5 (1978): 9, https://doi.org/10.2307/778642.

22. Roland Barthes, *Camera Lucida: Reflections on Photography* (1980), trans. Richard Howard (New York: Hill and Wang, 1981), 14.

23. Daft, Camera-Screen Attachments.

24. "A Biographical Sketch of a Distinguished Electrician," 2.

25. Leo Daft, 1883, Electric Locomotive. US Patent 283,759, filed September 6, 1882 and issued August 28, 1883.

26. B.H. Horgan, "Electricity Versus Steam: The New Systems of Electric Locomotion to be Tried in New York," *Olean Herald*, July 18, 1885, 8.

27. Joseph J. Cunningham, "Forgotten Pioneer: Leo Daft and the Excelsior Power Company," *IEEE Power & Energy Magazine* (July/August 2018): 108.

Just as Daft emulated his idols by studying electricity and engineering, he also followed in his precedents' footsteps by experimenting with the photographic process. Daft was not the first person to use the light discharge of electric sparks to create photographs. In 1851, British photographer William Henry Fox Talbot (1800–1877) used the light emitted by a spark held within a Leyden jar to illuminate a spinning disk of paper with the goal of capturing a clear, still image of a moving object. While the resulting (and ultimately unsuccessful) image is lost, the experiment itself is perhaps the earliest known instance of someone taking a photograph by the light of an electric spark. To term Talbot's experiment a "first" in a linear series of photographic discoveries would, per Chitra Ramalingam, belie the sheer variety of separate scientific interests and collaborators that led to its creation, as well as Talbot's failure to consistently repeat his experiment.[28] Daft, like Talbot, was interested in using electricity to showcase motion. However, where Talbot used electric sparks as a light source to illuminate a separate object, Daft's focus was on the sparks themselves.

Two of Daft's stereographs of electric currents are held by the New York Public Library. One of the two images in *[Horizontal] Electric Current* was reproduced in *The Photographic Times* as an engraving, albeit flipped and rotated |**fig. 3**|. On the back of the card, Daft's oval trade stamp is visible on a pink background. Daft shares his methodology for photographing electric sparks in detail, with the stated intention of the article being to have others reproduce his effects. In providing instructions on how to recreate his experiments, Daft also informs viewers how to create works of art. Although Daft's textual approach reflected the scientific conventions of the reproducible experiment, the products of this experiment had an uncertain status. In sharing them with a photography community, Daft clearly understood his images to be more than just the incidental documents of a chiefly scientific endeavour. His photographs of electric sparks were displayed, not in his studio, but as engravings in a newspaper whose readership consisted of professional US-based photographers.

As the readership of *The Photographic Times* would have already had a thorough knowledge of popular photography techniques, Daft's instructions are geared towards an informed reader, who is assumed to have access to a camera, developers, and who knows how to create a stereograph. Most of his letter addresses the matter of creating viable, actinic electric currents that will make their mark on prepared plates. Daft pays considerable attention to the treatment of light in the photographic process, as the subject of the image was the very light source that would expose the camera plate. He mentions his use of a Holtz machine, defined in 1877 as a machine that produces static electricity by way of induction.[29] Daft writes that, before running the Holtz machine that produces bursts of static electricity, one must turn off the lights in the room, remove the camera cap, and turn the crank of the machine to create sparks. He notes that the best stereoscopic images are created when the Holtz machine is oriented to produce vertical electric sparks, presumably because they most readily trick the human eye

28. Chitra Ramalingam, "'The Most Transitory of Things': Talbot and the Science of Instantaneous Vision," in *William Henry Fox Talbot: Beyond Photography*, ed. Mirjam Brusius, Katrina Dean, and Chitra Ramalingam (New Haven: Yale Center for British Art, 2013), 263.

29. Elihu Thomson, "Cylinder Holtz Machine," *Journal of the Franklin Institute* 103, no. 3 (1877): 207, doi:10.1016/0016-0032(77)90657-3.

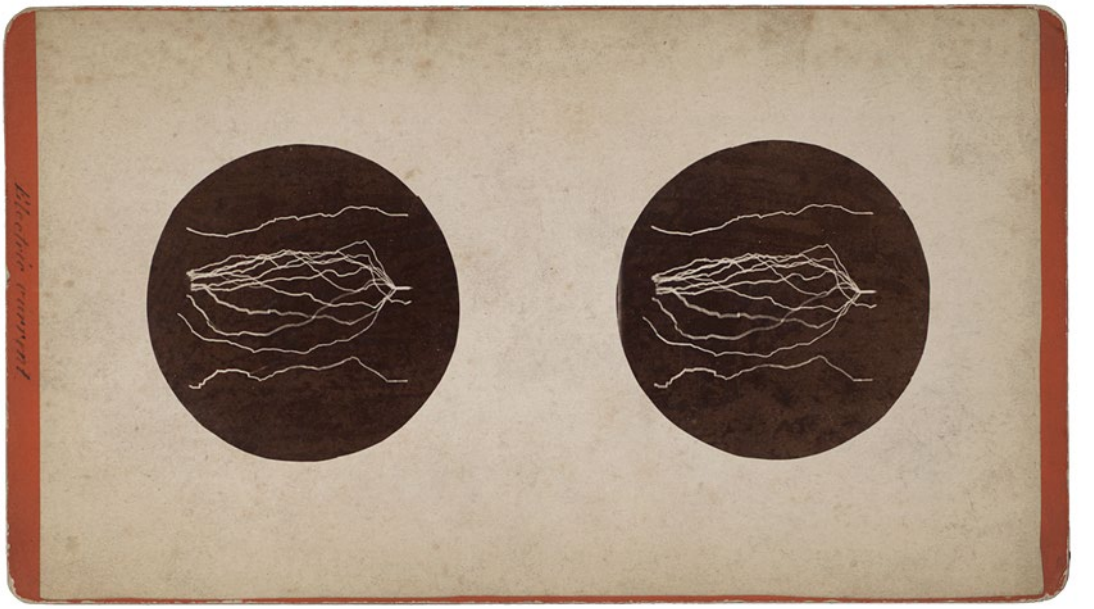

Figure 3. Leo Daft, "[Horizontal] Electric Current," ca. 1870–1875. Albumen print. New York City, The Miriam and Ira D. Wallach Division of Art, Prints and Photographs, New York Public Library. Photo: New York Public Library Digital Collections.

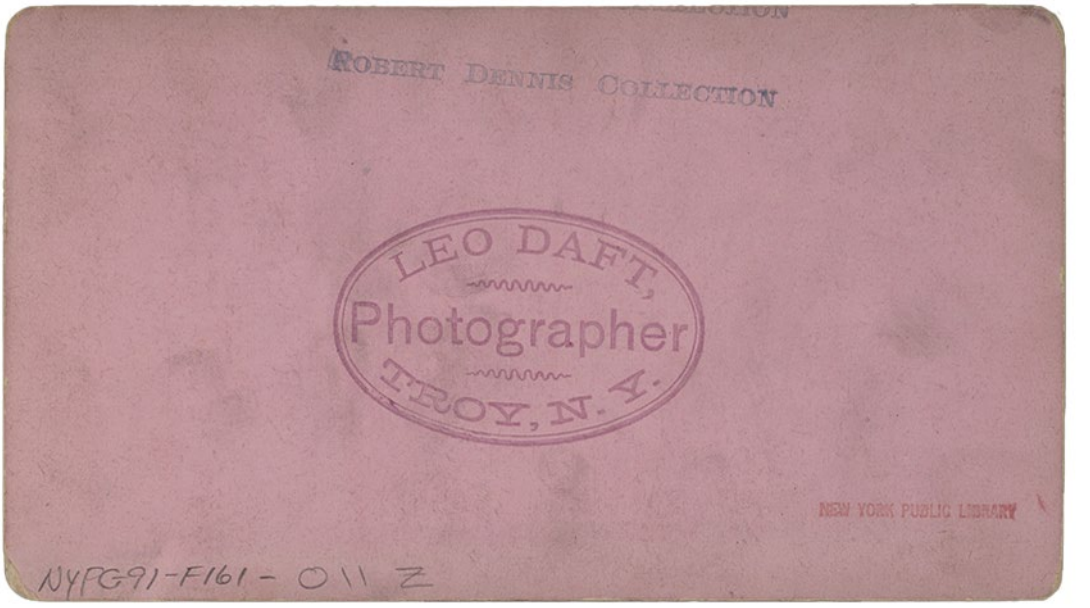

Figure 4. Leo Daft, "[Horizontal] Electric Current," ca. 1870–1875. Albumen print. New York City, The Miriam and Ira D. Wallach Division of Art, Prints and Photographs, New York Public Library. Photo: New York Public Library Digital Collections.

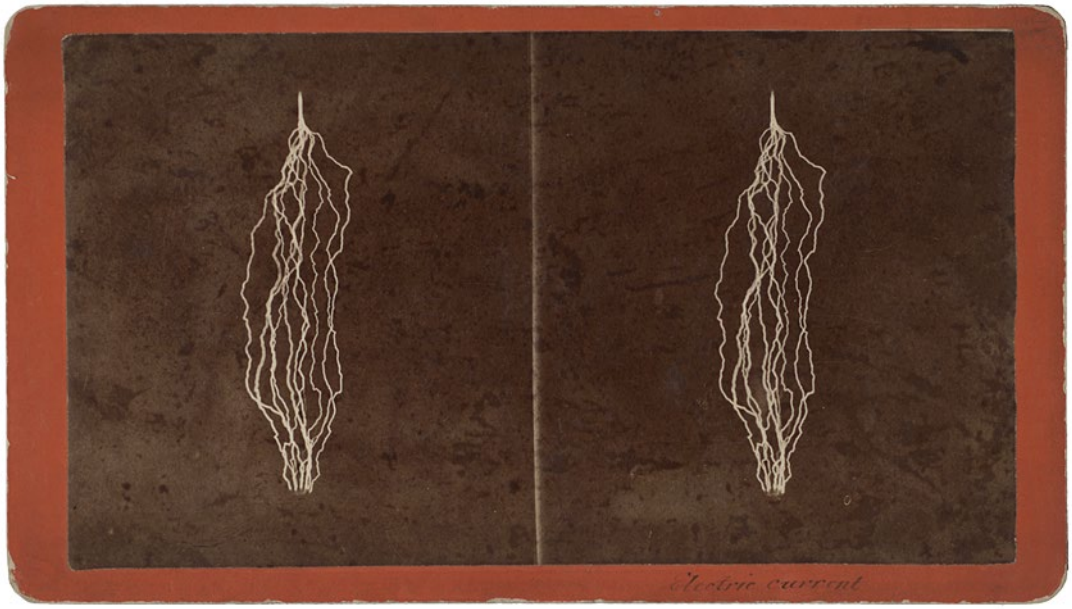

Figure 5. Leo Daft, "[Vertical] Electric Current," ca. 1870–1875. Albumen print. New York City, The Miriam and Ira D. Wallach Division of Art, Prints and Photographs, New York Public Library. Photo: New York Public Library Digital Collections.

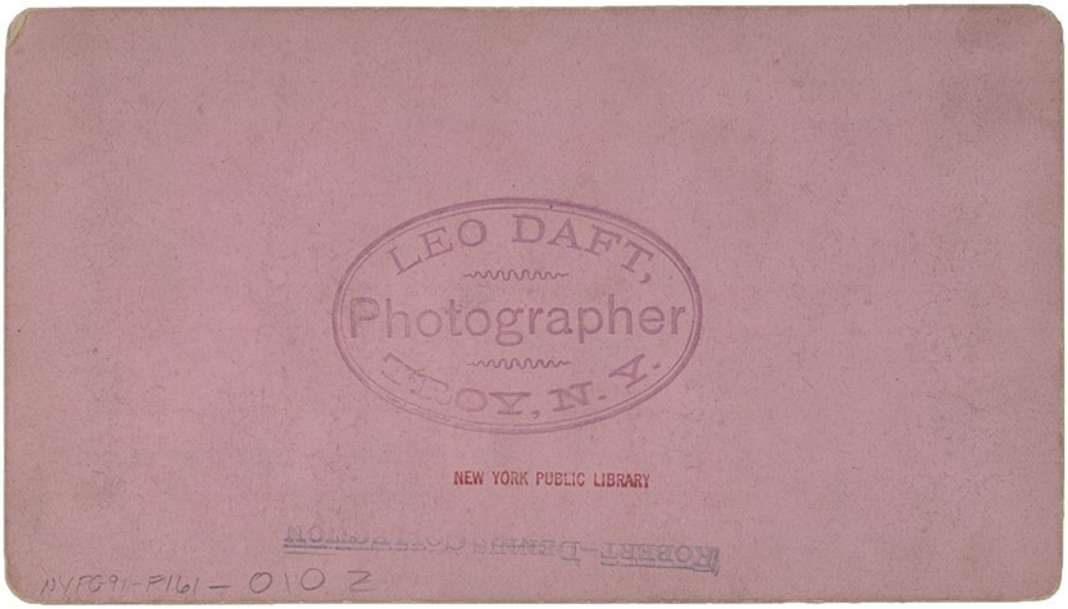

Figure 6. Leo Daft, "[Vertical] Electric Current," ca. 1870–1875. Albumen print. New York City, The Miriam and Ira D. Wallach Division of Art, Prints and Photographs, New York Public Library. Photo: New York Public Library Digital Collections.

into seeing depth: "In making stereoscopic views, the machine should be arranged so that the discharge takes place *vertically*; this brings all the line into the strongest stereoscopic vision."[30] Here, Daft reveals that, in producing electric sparks, he is most interested in capturing images that will produce the most interesting three-dimensional image when viewed through a stereoscope. When placed in a stereoscope, multiple sparks that were created over a short period of time and layered over the same plate are viewed as a single current, a manufactured moment in time.

By photographing sparks of electricity and displaying them in three dimensions, Daft emphasized the creative power of electricity. Stereographs saw massive popularity in the late nineteenth century for their ability to suggest three-dimensionality. According to Crary, it was the effect of depth rather than the subject of the stereographs themselves that kept viewers engaged with the medium: "…what the observer produced, again and again, was the effortless transformation of the dreary parallel images of flat stereo cards into a tantalizing apparition of depth."[31] Charles Wheatstone (1802–1875), whose calculations on Daft cites in his letter, had created a stereoscope in 1838 to assist with his experiments on vision, yet the stereoscopic image only gained in popularity when Louis-Jules Duboscq (1817–1886) demonstrated the use of stereographic daguerreotypes with a stereoscope at the great exhibition in 1851.[32] While Wheatstone used his stereoscope to further his electrical and optical experiments, Duboscq capitalized on the stereographic image's propensity to function as an immersive viewing experience.[33] Janice Schimmelman observes that stereographs gained popularity in America in the 1850s because they allowed viewers to "armchair travel" when viewing landscapes, the most common and popular subject of the stereograph, with a stereoscope.[34]

Displayed as flat images, Daft's two stereographs only showcase one facet of his artistic experiment. Each individual stereograph card features two separate photographs of the same electric current taken at slightly different angles. In *[Horizontal] Electric Current*, ten lines of electricity are visible in each circular photograph, displayed horizontally, and two of the ten lines are not grouped in at the ends with the others. The two images are placed side by side on a beige card with a red border and rounded edges. In *[Vertical] Electric Current* |**fig. 5**|, ten separate streams of electric current are joined together at the top of the image before separating into undulating lines and rejoining near the bottom. These images are larger and square in shape, placed next to each other with no space between the inner sides of both photographs. The red card background is visible along the edges of the images, with the words "Electric current" handwritten on the bottom right. The backs are stamped with Daft's studio logo |**figs. 4 and 6**|. The New York Public Library dates the cards to 1870 and 1875, based on the knowledge that Daft's photography studio in Troy was only open between 1873 and 1878. Given that the publication of the article includes a reproduction of one of the two images in Figure 3, it can be surmised that these images were produced between 1873 and 1875.

30. Daft, "Photographing Electric Sparks," 193.
31. Crary, *Techniques of the Observer*, 132.
32. Schimmelman, *The Tintype in America*, 1856–1880, 16.
33. For more on the calculations that Daft refers to, see Charles Wheatstone, "An Account of Some Experiments to Measure the Velocity of Electricity and the Duration of Electric Light," *Philosophical Transactions of the Royal Society of London* 124 (1834): 583–91.
34. Schimmelman, *The Tintype in America*, 1856–1880, 16.

These images are not products of a single exposure, but multiple different sparks that left their mark on a single plate. It is thus not entirely accurate for Daft to claim that his images are "instantaneous," as the flash of the electric current lasts for only "one millionth of a second."[35] While the exposure process was close to instant, the final photographs showcase multiple different electric sparks. He observes that on a dry day, the hand-cranked Holtz machine can produce "about six discharges per minute" and that one can "stop at any number of sparks [they] please to have on one plate."[36] Daft's stereographs, which each feature ten separate sparks, would have each taken well over a minute to produce. If a reader follows his instructions, producing as many sparks as they see fit, the process could be much shorter or longer in duration. Daft's stereographic images are thus both instantaneous, in that each spark captured on the plate only existed for a short period, and meticulous, in that each plate contains multiple instances of these instantaneous sparks. Furthermore, Daft's use of the stereograph results in the creation of two nearly identical images of the same spark; the two images that make up one stereograph are an impression of the same electric sparks. The two photo plates would have been placed side by side and thus captured the sparks from slightly different angles.

The experiment at play, here, is revealed to be a creative one. Daft assumes that his readers will have a basic understanding of electricity and the tools required to create it. What he does not assume, and what he spends his letter describing, is how to manipulate electricity to create renderings that are pleasing to the eye. Despite the scientific nature of his process, Daft's attention to aesthetics can be observed when he discusses the risk of attempting to use a larger coated surface: "really the only delicate point to be observed is just how far the coated surface can be increased without losing the beautiful effect of the wiry impulse surrounded by its aureola."[37] The only potential mishap, according to Daft, is that the natural beauty of the electric spark is lost. His focus is on capturing the unusual moments, like the divided spark seen on the rightmost engraving in his letter; he notes that this one is the "most remarkable example of a divided spark I ever saw."[38] The unique nature of this spark suggests a desire to catalogue a new phenomenon, a particularly fine representation of an unusual occurrence, that leads him to suggest to viewers that, should they recreate his images, they stop producing sparks once a divided one is captured. This control over the process, as well as Daft's intentionality when making visually pleasing images, highlight the importance that process played in his experimentation. Like his portraits, Daft's carefully constructed images of electric sparks were artificially influenced to appear natural. The Holtz machine that produced the sparks is not visible in the final images. Only that sparks that the machine produced are seen, leaving viewers to wonder about the mode of their creation. Crary argues that photography supplanted stereoscopy as the preferred method of viewing images in the nineteenth century due to the photograph's ability to obstruct its own mode of production: "But photography had already abolished the inseparability of observer and

35. Daft, "Photographing Electric Sparks," 193.
36. Daft, "Photographing Electric Sparks," 193.
37. Daft, "Photographing Electric Sparks," 193.
38. Daft, "Photographing Electric Sparks," 194.

camera obscura, bound together by a single point of view, and made the new camera an apparatus fundamentally independent of the spectator, yet which masqueraded as a transparent and incorporeal intermediary between observer and world."[39] Daft's photographs enact this "masquerade" by disguising their mode of production whereas his article, by contrast, describes it in depth. In both his portraits and his photographs of sparks, Daft hid the mechanism leading the image to be produced to obtain visually pleasing results.

Daft's focus on capturing the beauty of the electric sparks, and his description of the repetitive process taken to create his photographs, reflects the nature of the scientific process during the second industrial revolution. In the late nineteenth century, the broad field of natural science was less standardized than it is today. While the concept of a scientific method came into use in the 1870s, it was not associated with a consistent meaning until the early twentieth century. It was around the mid-nineteenth century that the mainstream scientific inductive reasoning philosophy of Francis Bacon (1561–1626), which promoted the practice of generalizing based on specificities, began to be challenged by proponents of a more nature-based, observational science.[40] Daft's creative process sought to amalgamate, rather than eliminate, irregularities. In reference to the accompanying images, Daft notes:

> At the positive pole sparks usually start from one point on the ball, but I have purposefully selected two groups (in Figs. 1 and 3) where an exception occurs; at the negative, the discharge is always erratic. Fig. 2 represents the average form of a group, and will be repeated ninety times in a hundred; the others may be regarded as curiosities even by a veteran photographer of lighting.[41]

The photographs that Daft sent to *The Photographic Times* were not mere examples of spark photography, however, as he notes that three out of the four feature rare exceptions to the norm, where each current begins and ends at the two electric poles of the Holtz machine. As Lorraine Daston and Peter Galison explore in the introduction to *Objectivity*, Western scientists shifted from their prior focus on regularity and reproducing ideal results towards capturing imperfect, irregular phenomena.[42] Daft's photographs exist at the intersection of the methodical, repetitive, and symmetry-bent angle of earlier schools of thought, while his interest in capturing unusual sparks trends towards the objective view that was adopted near the turn of the nineteenth century. Even though the sparks he photographs may be unusual, they are nevertheless repeated twice; the two ever-so-slightly differing images on each stereograph form an imperfect symmetry that emphasizes the process that made them.

Invention as Research-Creation

Daft's photographs are remarkable not because they stand at the intersection of scientific research and artistic production, but because they cannot be separated into distinct categories of art *or* science. In their influential paper on the concept, Chapman and Sawchuk state that research-creation

39. Crary, *Techniques of the Observer*, 136.

40. Daniel P. Thurs, "Scientific Methods," in *Wrestling with Nature: From Omens to Science*, ed. Peter Harrison, Ronald L. Numbers, and Michael H. Shank (Chicago: University of Chicago Press, 2022), 308, 315–320.

41. Daft, "Photographing Electric Sparks," 194.

42. Lorraine Daston and Peter Galison, *Objectivity* (New York: Zone Books, 2007), 15.

"describes a conglomerate of approaches and activities that incorporate creative processes and involve the production of artistic works in the context of academic programs."[43] They emphasize the practice as a radical break from traditional academic standards, newly valuing creative output and experimentation as much as conventional research methodologies. While the methodological category of research-creation among scholars of social sciences and humanities only emerged in the late twentieth century, the broad grouping of creative research practices that the term represents long precede their naming as such. Chapman and Sawchuk, writing in 2012, assert: "Research-creation is not so much a 'new' method as it is a 'newly recognized' academic practice that has gained ground in the past ten years."[44] In situating Daft's photographs and letter within the context of research-creation, I want to use Daft's practice to make a case for the historical use of research-creation. If, today, the framework of research-creation allows academics to combine "conventional research" methods and "creative" methods in spaces where disciplinary boundaries would not otherwise permit this, I want to consider how this practice has precedent in earlier eras of intellectual output and suggest that the notion of research-creation might allow for the charting of a tradition in the industrial era.

Research-creation, which I argue is central to the inventive process, is not necessarily a new break in traditional knowledge systems but has precedents in experimental modes of knowledge and art production that thrived during the second industrial revolution. Chapman and Sawchuk group research-creation into four subcategories: research-for-creation, wherein knowledge and resources are gathered prior to the creation of an artwork; research-from-creation, wherein research questions and data are generated from artistic production; creative presentations of research, which sees an artistic production incorporated into the otherwise relatively standardized format of academic presentations; and creation as research, which sees the act of research itself incorporated into an artistic practice and vice versa.[45] These authors note that these categories are not necessarily distinct by deferring to Wittgenstein's concept of "family resemblances," which suggests rather than insists upon groupings.[46] Of the four categories proposed, creation-as-research is the category that best describes Daft's practice, and perhaps the practices of similar late nineteenth-century inventors.

Per Chapman and Sawchuck, creation-as-research emphasises the research component of the research-creation process: "Research is more or less the end goal in this instance, although the 'results' produced also include the creative production that is entailed, as both a tracing-out and culminating expression of the research process."[47] They note that, as the most complicated of the four subcategories, this one most readily examines and experiments with technology that is often discussed theoretically; creation-as-research "is a form of directed exploration through creative processes that includes experimentation, but also analysis, critique, and a profound engagement with theory and questions of method."[48] While Daft's photographs can be formally analyzed as art objects, the process behind

43. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis, and 'Family Resemblances,'" 13.

44. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis, and 'Family Resemblances,'" 6.

45. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis, and 'Family Resemblances,'" 19.

46. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis, and 'Family Resemblances,'" 14. In their 2015 follow-up article, Chapman and Sawchuk emphasize that these categories were not meant to be rigid suggestions but preliminary guidelines to be critiqued and expanded. See Owen Chapman and Kim Sawchuk, "Creation-as-Research: Critical Making in Complex Environments," *RACAR: revue d'art canadienne / Canadian Art Review* 40, no. 1 (2015): 49–52.

47. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis, and 'Family Resemblances,'" 19.

48. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis, and 'Family Resemblances,'" 19.

their creation provides both the context for their existence and an explanation of their subject matter to the extent that trying to separate the artworks from the research that created them is difficult. Likewise, the instructions Daft provides in his letter can be read and followed without reference to the finished photographs, but much of his discussion centres around how his images showcase the desired aesthetic affects they demonstrate. Nevertheless, the research process takes precedent over the artwork produced within the letter, as the images are published primarily for the purpose of illustration. It is this generative quality of Daft's work that aligns it with the category of creation-as-research over other categories that prioritize artistic output over generative research.

Daft's academic experience was very different from the experiences of students today. Nevertheless, as stated previously, he only gained access to the connections and materials necessary to complete his experiments because of his time studying at University College London. His academic output did not come in the form of a thesis project, but in his continued engagement with academics and academia throughout his years as an inventor. Just as Daft wrote down his methods in print, explaining the research process that led to the creation of his photographs, the research-creation process necessitates the sharing of the process of creation.

Artist and scholar Nathalie Loveless describes the driving force that led her towards research-creation as a paradox at the centre of her artistic creation: "the more I gravitated toward conceptual and feminist art practice, the more theory and history I needed."[49] Key to her development of both was institutional support from two different schools that provided the educational resources necessary to combine her two complementary disciplines. Like Chapman and Sawchuk, Loveless situates research-creation within the Canadian context. More specifically, provincial and federal funding bodies and the social sciences and humanities departments at universities. Research-creation, according to Loveless, is a term that arose in Quebec universities in the late 1980s; other variations of the term, including practice-based research and practice-led research, are used in the UK.[50] The research-creation projects that Sawchuk and Chapman describe—notably their description of Chapman's thesis on soundscapes—echo the process of experimentation, participation, creation, and diffusion that Daft shares in his letter to *The Photographic Times*. Key, here, is the engagement with the objects of study. In Chapman's case this is sound production; in Daft's case it is photography. Invention, here, is a form of creation-as-research that incorporates trial and error. What Daft's images highlight is that aesthetics are not antithetical to science. The images are to be admired and viewed for both the moments of their creation and the beauty of the created effect itself.

Looking, Motion, and Flatness

The illusion of depth and movement that lay viewers appreciated as an artistic experience was the same feature of the stereographic image that appealed to researchers. Robert J. Silverman, in his article on the

49. Loveless, "Introduction: Art in the Expanded Field," 3.
50. Loveless, "Introduction: Art in the Expanded Field," 5.

stereoscope, explains that Sir David Brewster (1781–1868), who invented the stereoscopic camera, was opposed to placing the two stereographic images at distances that caused the human eye to see oddly-sized images. Yet, he praised the artistic input of the photographer when deciding how to angle a shot.[51] Some photographers believed that the stereoscope improved upon human vision, as it surpassed the natural world's ability to showcase the minutiae of its three dimensionality. While Talbot understood photography as the direct inscription of nature onto a supporting medium, the stereographic image paired the authentic representation of nature with the illusion of depth and the solidity of dimensionality.[52]

The process of using the stereoscope to view stereographic images serves as a counterpoint to the argument that early scientific photographers aimed to use the camera as a faithful reflection of reality. By taking two separate photographs of the same subject at slightly different angles, and then tricking the eyes into viewing them at the same time using the stereoscope, photographers created an illusion of realistic depth that was inherently artificial. What was not artificial, however, was the faithful reflection of light on a plate. As Daston and Galison note, late-nineteenth-century scientists promoted photography as an apt medium for capturing images of unusual occurrences whose veracity was in question.[53] Photography became increasingly associated with unaltered reproduction and indexical faithfulness, an ironic juxtaposition with Daft's multiple-spark images that highlight human intervention to operate the Holtz machine.

The subjects of Daft's photographs, these exceptional examples of electricity, were also their mode of production; the research process creates the art object. Daft's prints, when viewed through a stereoscope, present a view of electricity that would not be seen when doing electrical experiments. He could have reproduced a static imprint of a single electric spark on a photographic plate, akin to the images of multiple currents published in *The Photographic Times* in their two-dimensionality. Instead, he adopted a technology of photographic display that reflected a creative process: the repetitive, rigorous mode of the scientific method combined with the artistic freedom of allowing for moments of surprise in the form of unusual spark patterns. By capturing multiple sparks on a single plate and displaying them as stereographs, Daft invited viewers to consider an artificial manifestation of a multiplicity of currents that move too quickly to be properly admired by the human eye. Daft notes that these spark photographs were meant to be viewed through a stereoscope to create the illusion of seeing electricity in motion: the moment in which each spark was produced is brought to life, reanimating the moments of the photograph's capture.

While Talbot argued that the production of images was the result of natural processes rather than human intervention, Brewster argued that the process of taking a photograph was artless, but the resulting photographs were not.[54] According to Brewster, researchers used cameras as tools to produce or aid in experiments that resulted in unique, important creations: photographs. Edwards argues that the use of photography by early scientists

51. Robert J. Silverman, "The Stereoscope and Photographic Depiction in the 19th Century," *Technology and Culture* 34, no. 4 (1993): 753.

52. Silverman, "The Stereoscope and Photographic Depiction in the 19th Century," 735.

53. Daston and Galison, *Objectivity*, 135.

54. Edwards, *The Making of English Photography*, 58.

and inventors reveals their fascination not only with the mechanisms of the process, but with the beauty of the reproductive process: "The fascination with fidelity and exact transcription conveys something of the mesmerizing qualities attributed to the copy in the initial phase of photography."[55] This interest can be likened to the scientific method's emphasis on repetition of processes to achieve replicable results.[56]

Invention as Research-Creation: Magic and Self-Acting Machines

In reproducing Daft's images in two-dimensional print and without their stereographic duplicates, the "wonderful" effect of lightning appearing before one's eyes is lost. The inherent flatness of the photograph, as a two-dimensional image on a sheet of metal, paper, or other flat material, shuts down any possibility that the image being looked at is a real scene. Readers understood that recreating Daft's work by personally undertaking his experimental process was the only way of fulfilling the goals of his photographic project. Instead of just admiring the results, readers could enact the process themselves. Only in doing so could they achieve the meaningful result: an image that documented the dynamic process itself.

While Daft's photographs were thus firmly rooted in ideas of scientific experimentation, his narrative also appears to diverge from the ostensible standards of science. He does not simply share the steps he followed to make the photographs reproduced in print, but also the steps he followed that resulted in undesirable, or even surprising, results. This is most apparent in his use of language that suggests diverted paths, repetition, and experimentation: he will "generally watch for divided sparks," "the bunch of sparks in the centre shows the form generally assumed," "at the positive pole the sparks usually start from one point at the ball."[57] Daft's vocabulary is decidedly non-specific; he does not promise outcomes, but describes ways in which his experiments vary from attempt to attempt. This language is reminiscent of the emphasis Chapman and Sawchuk place on the role of "intuition and 'feeling'" in research-creation, ideas decidedly removed from common conceptions of scientific experimentation, which nonetheless pervade Daft's letter.[58]

The goal of bringing intuition into the realm of scientific research, replicable processes, and historical precedent may be the rehabilitation of a notion that was already incorporated into science. Daft's research is not concerned with inventing a new process, which he does not claim to do; instead, Daft's interest lies in producing in the most "beautiful effect" that he can using the tools and methods available to him. He was a prolific inventor, but he did not patent this process. His letter and the accompanying photographs are the results of his experimentation, with his eye now turned to induction coils.[59] Although the results of this subsequent experimentation were not published, one can surmise that he would consider his photographs and his letter to be the results of his electric spark photography in and of themselves. These objects are the result of experimental play, of researching modes of creation and creating research objects as a result.

55. Edwards, *The Making of English Photography*, 59.

56. Daston and Galison, *Objectivity*, 135. Daston and Galison note, for example, that scientific drawings were continued to be used in literature following the invention of photography because of the technical difficulty of producing photographs in the late nineteenth century.

57. Daft, "Photographing Electric Sparks," 193.

58. Chapman and Sawchuk, "Research-Creation: Intervention, Analysis and 'Family Resemblances,'" 12.

59. Daft, "Photographing Electric Sparks," 194.

Daft was not a wizard who harnessed nature for his own inventions, nor were the more prominent individuals who dabbled in both photography and electricity. However, the language used in articles about him and other inventors suggests that their work was a process of otherworldly intervention rather than materialist and capitalist efforts whose interest in furthering science was entangled with a desire to live comfortably and receive recognition from their peers. The knowledge that Daft's photographs were the result of human intervention in nature's mechanics seems only to have intensified the myth of the supernatural genius inventor instead of quelling it. Morus explains this phenomenon succinctly as the result of the self-fashioning researcher of electricity, whose guise as a "man of science" was a basis of expression based on romanticized notions of generations of gentlemen scientists past: "They shaped the ways in which electricity could be seen and understood by providing appropriate contexts through which the imponderable fluid could be approached and assimilated into culture. They thus had an important role to play in defining what counted as experiment. They also defined the experimenter."[60] The introduction to the article in *The Photographic Times*, which served as the point of departure for this paper, ends by stating that readers are about to experience a "description of [Daft's] modus operandi in chaining the lightning to his will."[61] This language is reminiscent of popular depictions of Benjamin Franklin, the namesake for one of Daft's trolleys, whose discovery that lightning is electrical has been the subject of numerous artworks and articles. Curiously, the article in *The Photographic Times* extols Daft's magic capabilities while at the same time inviting him to reveal his methods—asking the magician to reveal his secrets.

The title of Daft's article in *The Photographic Times* perhaps summarizes the ways in which the stereographic image appealed to both scientists and viewers. While the article is titled "Photographing Electric Sparks," the editor suggests that the images should be called "Photographs of Lightning."[63] In a 1908 article published after his invention of the electric tram in the Washington Post, Daft is described in such an exaggerated fashion that the author almost seems to be mocking him. The article, titled "The Latest 'Wizard' Has Secrets Which Not Even the Government Can Share," provides a short profile on Oscar Wiederhold, a man who manufactures light fixtures for the American government and whose interest in electricity was entirely financial. However, before Weiderhold is introduced as a "wizard" of electricity, Daft is named as a precluding figure: "The first 'wizard' we had in New Jersey was Leo Daft, builder of an electric car that drove all other electric cars into innocuous desuetude. The second wizard was Tom Edison, whose electric lights now illuminate the world."[64] To contemporary viewers, Daft's trolleys lack the original magic that struck audiences during the nineteenth century when they sped through the streets of America.[65] What does contain an element of magic, of illusion and trickery, are his representations of electric sparks that move before the eye.

Daft's experimental photographs continue to invite further research. In 2016, an anonymous user of the New York Public Library's Digital Collections

60. Iwan Rhys Morus, Frankenstein's *Children: Electricity, Exhibition, and Experiment in Early Nineteenth-Century London* (Princeton, New Jersey: Princeton University Press, 1998), 5.

61. Daft, "Photographing Electric Sparks," 192.

62. For more on depictions of Benjamin Franklin see Phillip Dray, *Stealing God's Thunder: Benjamin Franklin's Lightning Rod and the Invention of America* (New York: Random House, 2005).

63. Daft, "Photographing Electric Sparks," 192.

64. Unknown, "THE LATEST 'WIZARD,'" *The Washington Post* (1877–1922), August 23, 1908.

65. Doug Most, *The Race Underground: Boston, New York, and the Incredible Rivalry that BuiltAmerica's First Subway* (London: St. Martin's Press, 2014), 78.

created renderings of one of Daft's photographs that attempt to build upon the stereoscopic effect by depicting the sparks in motion: the leftmost through the use of red and blue, or anaglyph, 3D;[66] in 2020, another turned both images into a GIF.[67]

Most biographical narratives of Leo Daft begin in 1881, two years after he abandoned his photography business. His creation of the Daft Electric Company, invention and implementation of an electric trolley system, and continued engagement with electricity are facets of his life that conform to the existing narratives of the capitalist, scientific American inventor that have been well documented in other articles. However, as explored in this paper, the short period of time during which he was thought to have abandoned his work in electricity produced what is perhaps his most interesting work of all: a series of stereographic images of electric sparks whose three-dimensional motion challenged the notion that photography aimed only to capture the real. ¶

ACKNOWLEDGEMENTS This article was made possible by the family archive created by my grandmother, Kay Flanagan, herself the second-great granddaughter of Leo Daft. I would also like to thank Hana Nikčević for her helpful edits and invaluable input on the intersection between research-creation and Daft's work.

66. "Electric Current. 1870?-1905?," *Stereogranimator*, http://stereo.nypl.org/view/42898.

67. "Electric Current. 1870?-1905?," *Stereogranimator*, http://stereo.nypl.org/view/96877.