Aerial Photography for the Archivist: from World War I to Sherman Fairchild

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Coming upon an oversized print of a vertical aerial photograph is a mystifying and fascinating experience. Archivists are used to viewing and handling photographs taken in the studio or on the street, particularly analog techniques and processes. An aerial print presents questions of how were they created from the shutter in motion to the final print and what were they used for. If the archivist knows nothing about the creation and application of early modern aerial surveys, they cannot correctly process them or work with novice researchers on how to use them. This paper seeks to unravel the mystery of aerial photography by reviewing World War I aerial cameras and Sherman Fairchild's innovations and then explore the challenges aerial photography presents to archives.

World War I was, in many ways, an innovator in aerial camera technology. Up until then, the cameras used were based on terrestrial technology. The critical need for aerial military intelligence on enemy activity made it quickly apparent that those cameras were insufficient for high altitude reconnaissance and land surveys (McCabe & Padley, 2019). The cameras developed over the war were attempts to compensate for plane speed, altitude, and atmospheric conditions.

Germany, France, and Britain waged a photographic aerial battle with the recent combination of planes and cameras. Germany was the first to adopt surveillance and land surveying early in the war. Subsequently, a downed German Zeppelin kicked off France's adoption of a photographic division in its army air corp. Cochrane (1995) describes their De Ram camera as a "fully automatic, motor-driven, glass-plate camera that weighed 100 pounds…[and] their [film] magazines were heavy and difficult to handle″ (p. 34). She goes on to write that the glass plates were fragile (Cochrane, 1995). Cochrane does not say whether they were then useless, but broken plates would have been an expensive risk in terms of materials, time, and fuel. Camera weight would also be a problem that persisted throughout the war on all sides. The

British "L" camera had other drawbacks, predominately a short focal length that took poor shots at high altitudes (Cochrane, 1995), and plane speed and vibration were other factors that affected image clarity (McCabe & Padley, 2019). Limited camera technology aside, Britain had "produced…6.5 million aerial images during the last year" by the end of the war, and Germany had mapped 450 miles of the Western Front using 2,000 cameras (Cosgrove & Fox, 2010, p. 37). These are numbers that were unheard of before the war, if not impossible to achieve.

The United States' foray into military photography came toward the end of the war. Without cameras of their own, the new Photographic Division of the American Expeditionary Forces (AEF) adopted the British "L" and French De Ram cameras. Frustrated by the limitations of the cameras, the lack of U.S. innovation, and the AEF's slowness to grasp the utility of aerial reconnaissance, Chief of Air Photography Edward Steichen accelerated not only training and print production—at one point the "photo sections achieved an output of 10,000 prints in one day" (Hardesty, 2013, p. 21)— but also the research and development of military aerial cameras (Cochrane, 1995; Hardesty, 2013).

The result was the Folmer Automatic Camera, commonly known as the K-1. It would kick off the K-series that became the standard in army and naval use. K-1 took both oblique and vertical photographs and had the capacity to take 100 exposures with dimensions of 18 x 24 cm. It also featured color filters to counter the effects of atmospheric haze (Cochrane, 1995). Nevertheless, like its predecessors, the K-1 had significant problems: the between-the-lens shutter was slow, underexposing the film, and frequently jammed; high altitude static-electricity fogged the film; and the spacing mechanism wasted exposures due to the problem of increasing diameter on the take-up-spool with each revolution of the winder "so that a 100-exposure roll of

film yielded only seventy-seven photographs" (Cochrane, 1995, pg. 35). Twenty-two-year-old camera enthusiast Sherman Fairchild proposed solutions to these problems.

Fairchild was a critical figure in the development of modern aerial photography, because as journalist Churm (1986) explains, "Fairchild's work is a baseline against which more recent aerials are compared to track geological and urban changes on the ground…" (para. 7). His cameras were cutting edge, as was the scope of their use. One of the most prolific and influential innovators in aerial photography, Fairchild created entire businesses around aerial photography, from successive advances in camera technology, photogrammetry and mapping, and aircraft design.

In 1918-1919, Fairchild began his career by re-tooling the K-1 with an improved between-the-lens shutter design that was faster, lighter, and jammed less. The new shutter became part of the K-2, released just after the war had ended (Cochrane, 1995). In 1921, Fairchild shipped the Fairchild Automatic Aerial Camera (Model A), where it was renamed the K-3. He followed that with the K-3a, which added metadata to each exposure, reworked the F-1 to be lighter weight and handheld, and then introduced the K-6 and K-7 for high altitude reconnaissance (Sanders, 1944). These were by no means the end of Fairchild's cameras; the Fairchild Corporation produced well over 30 cameras, including the Lunar Mapping Camera used in the Apollo 15, 16, and 17 missions.

In 1923, Fairchild founded the second arm of his aerial photography enterprise, Fairchild Aerial Survey, Inc. (FAS). The initial goal of FAS was to prove the scope of what Fairchild's cameras could do beyond military use. The results of the FAS 1921 Manhattan aerial survey succeeded in generating a broad demand for oblique and vertical surveys in urban planning, geological exploration and oil discovery, timber surveys, and aerial analysis of ecological

changes. Two major commissions included a large-scale survey of the Los Angeles region as part of its urban planning and a survey of the Great Plains for the Soil Conservation Service in response to the catastrophic Dust Bowl. Cosgrove and Fox (2010) write, "To undertake his aerial survey…Fairchild built the largest aerial camera ever constructed, a 300-pound instrument that, when flown at 23,000 feet, could capture 225 square miles per exposure" (p. 49).

Prints from these surveys were created from photomosaic maps. During survey flights, hundreds of overlapping negatives were shot and then cut and pieced into a continuous map used to make contact prints. Another FAS innovation was the use of aerial photographs in creating topographical maps using a stereoplanigraph (Doyle, 1980). To oversimplify, this massive piece of equipment was a combination of stereoscopic viewer and plotter, with which the operator could plot land elevations from aerial photographs.

This quick overview of WWI cameras and Sherman Fairchild's work offers the briefest glimpse into the history and evolution of aerial photography. However, that glimpse makes it easier to identify prints and negatives and assist researchers in using them. Additionally, the objects' unique properties are essential reasons for digitizing them.

Understanding the cameras and the applications of aerial photography is helpful for more accurately identifying and processing prints and negatives. To the untrained eye, the origin of a negative may not be immediately apparent—metadata was not added to the film until the K-3a—but the size and quality of the image and film will reveal a lot. Atmospheric haze, fog, and image blurriness can indicate the type of camera, its lens, and the era of the photograph. For example, if the photograph's origin is unknown, the image is reasonably sharp, and electro-static fogging is present, it is unlikely to be the British 'L.' Electro-static fogging occurred at higher altitudes, whereas the British 'L' camera had a short focal length and was therefore predominately

used at lower altitudes. Finally, the intended use of a survey of landscape dominated by orchards or urban areas may not be readily apparent. Knowing the intended use behind the images assists in writing better finding aids and cataloging images, which in turn, assists researchers in accurately finding the appropriate survey.

Technical knowledge of aerial photography is invaluable at the reference desk. It provides insight into the traits of negatives and prints and their subjects, including scale and measurements, orientation, and capture technique. Images from aerial surveys, in particular, are confusing to read because each shot overlaps by about two to two-and-a-half inches and has specific orientations, typically north-south (UC Santa Cruz Library, 2017). The Fairchild T-2 four-lens camera creates unique prints called 'rectified prints,' intended to correct inherent height distortions caused by the aircraft's movements (Doyle, 1980; Jablonski, 2004). The prints do not make sense out of context, which makes them difficult to read and identify. Additionally, prints intended to be read stereoscopically use a specific vertical viewer that requires hand aligning the prints (UC Santa Cruz Library, 2017).

The fragility of aerial photographs and their value in many research disciplines present a strong argument for digitization. The volatility and fragility of nitrate negatives prevent researchers from manipulating images, such as piecing together a mosaic. As described, negatives from surveys were once cut and reconstructed to create a seamless image, an unthinkable prospect for preservation. Whereas tiff files of negatives allow researchers to reconstruct the mosaics and then digitally layer different surveys to compare changes in the landscape or urban development. Digital surrogates allow better comparisons of analog mosaics with more recent digital surveys.

Prints and mosaics also present problems for digitization. A mosaic pieced together with tape is not a candidate for scanning because often the tape has poorly aged, obscuring the image beneath (J. Jablonski, personal communication, September 10, 2021). The same holds for deteriorating nitrate negatives. In this case, it is worth looking for surveys from competing companies. Often, they flew overlapping missions within a few years of each other and captured similar information.

Up until World War I, aerial photography consisted of an obsessive exploration of putting cameras in the sky and developing a clear print. The results of these experiments are as easy or challenging to work with as terrestrial photographs. That quickly changed when war broke out in 1914, and it changed again through the work of Sherman Fairchild. The new aerial cameras were far more complex, as were their photographs. Understanding their technical aspects and the context in which they were used is critical for photography archivists who work with them.

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