

Repeat Photography in Landscape Research

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INTRODUCTION

A repeat photograph, or 'rephotograph' is a photograph specifically made to duplicate selected aspects of another, pre-existing photograph. The new image typically repeats the spatial location of the original, showing the viewer the same scene once again and inviting comparison. But other features of an existing photograph, the lighting or the events depicted, may also be the subject of attempted duplication. The verb 'attempt' is appropriate in this effort, for a photograph made at one time can never be exactly replicated in another. And it is the differences between photographs that make them both compelling and informative when seen together. The result is a photographic diptych that spans an intervening period of time. The photographs act like bookends to the time in between, and the combination raises questions about what is not seen as well as what is seen in either photo. The ability of rephotographs to illustrate change as well as question assumptions about time insures their unique contribution to the medium of photography.

Rephotographs rely on a visual language that is almost universal. The ability to point out and compare differences between photographs spans a very wide range of viewer interests and levels of experience. However, the ability to interpret these differences is not universal; because when two photographs, an original and a rephotograph, are paired together the combination may illustrate change and the passage of time, but neither image can explain the events that led to that change.

Rephotographs have been used by researchers across many fields as tools, documents and objects; how rephotographs are made varies among disciplines, just as what researchers expect from them ranges from documentation of data to poetic expression. Rephotographs can support both empirical and theoretical work; they may also become the subjects of research. From the natural sciences to the fine arts, rephotographs can help examine change and document the passage of time, most commonly in landscapes where the original subject of a photograph can be located and the space revisited.

For example, rephotographs have been used in such wide-reaching projects as studying changes in plant growth and population in the Arizona desert, revisiting the now famous photographs of a major city, exploring the route of a historic intercontinental highway, repeating a collection of vernacular snapshots as a departure point for conceptual art project, and rephotographing the collection of an automobile club as the pathway to a changing urban environment (Hastings and Turner, 1965; Vale and Vale, 1983; Rosier, 2004; Levere, 2005; Kinder and Roth, 2005). These studies span the natural and social sciences, the fine arts, urban planning and land management, to name only a few of the disciplines involved.

Intervening time spans between photographs may be short term, as in the record of plant growth over a few days, or long term, as in monitoring the creeping movement of a glacier (Fagre and McKeon, forthcoming). Common to many disciplines, there has been a need to visualize change, and the overall connection has been to gain a unique perspective on time related to place that is independent of discipline and challenges the observation of any single moment.

While there are common threads in the need for visualizing change, there have been two basic approaches to rephotography. I will describe each approach, based on my extensive experience in rephotography across a variety of projects, with examples of some of the ways rephotography can be used in visual research in a number of fields. I will focus, in particular, on *The Third View Project* (Third View), which attempted to repeat Western American survey photographs dating from the 1860s and 1870s along with a set of rephotographs made of these originals by the Rephotographic Survey Project (RSP). The RSP worked between 1977 and 1979 to precisely repeat the first photographs of the American West made by photographers such as Timothy O'Sullivan, William Henry Jackson, J. K. Hillers and others

(Klett et al., 1984). The project is described on its website as follows:

Third View revisits the sites of historic western American landscape photographs. The project makes new photographs, keeps a field diary of its travels, and collects materials useful in interpreting the scenes, change and the passage of time.

The Third View project began in 1997 and completed fieldwork in the year 2000. Over the course of four years the project revisited 109 historic landscape sites, all subjects of nineteenth-century American western survey photographs. (*The Third View Project*, 2004: Introduction).

The first approach described in this chapter depends on finding the exact location where an original photograph was made, and accurately reoccupying the position and framing of the initial view. This technique is most useful to those wishing to make quantitative measurements from the photographic sets, and they are often used in the natural sciences. But the concepts are also important to those in other fields who wish to create convincing recreations of an original photograph. This is the most commonly used set of techniques and when used with care will deliver photographs that can be molded to a wide range of concerns.

The second approach also involves locating where an original photograph was made, but is less concerned with exact relocation of the original position or frame, and instead focuses on the context surrounding the photograph(s). This technique is useful when the researcher is interested in exploring stories associated with those images and locations: for instance, in noticing what is, or is not included in the photographic view. It is also a method for combining multiple photographs. This may be a better fit for the social sciences and the arts, but is often useful to other fields as well.

These two visual research methods have different purposes, and the techniques used have both virtues and limitations. However, the two approaches are not mutually exclusive since they share a common goal: finding where an existing photograph was made.

AQ1 Kinder and Roth 2005 is under 'Labyrinth Project'. Confirm Re-order as Kinder and Roth (2005) in References

That 'place' becomes the basis for making new photographs.

VANTAGE POINT

One reason photographs are so useful is they originate from a real position in space. Unlike images made 'by hand', such as drawings or paintings, photographs are subject to the laws of physics, chemistry and optics, and it is therefore possible to repeat some of those physical processes in order to create a 'duplicate' image. In place-based photographs, or photographs that depict locations, landscapes, and other scenes that can be reoccupied over long periods of time, the photographer places a camera in a position that is accessible at a later date.

Photographs are formed by a lens projecting an image onto a light-sensitive medium; previously this was photographic film; however, now it is commonly a digital sensor. Thus, the relationship between the lens and the objects before it plays the biggest role in how an image is recorded: The optical properties of lenses resolve and represent the subject in a photograph, but it's where the photographer places the lens in space, or its 'vantage point,' that dictates the resulting composition.

Every photograph has a vantage point, and with the exception of stereo photographs there is only one vantage point per image. This point usually corresponds to a position at or near the diaphragm of the lens and controls how the lens records the objects before it. The vantage point is responsible for the way that three-dimensional space is translated into two dimensions. Thus, in a hypothetical landscape view, the way a rock in the foreground intersects a tree in the middle ground, and how that same tree lines up with a mountain peak in the distance, are all a function of the vantage point chosen by the photographer. If one chooses a different position to place the lens, these relationships will change, if even by a small amount.

Experienced photographers go to great lengths to choose vantage points with care, and for good reason. Failure to consider the vantage point when making a photograph can result in unintended juxtapositions in space. Imagine the portrait of a loved one, taken from a poorly chosen camera position in front of the house, with the unfortunate visual impression of the chimney forever coming out of the subject's head.

There is only one position from which every photograph is made, and that position is dictated by the position of the vantage point. This should not be confused with the focal length of a camera's lens; the choice of long focal length (telephoto) or short focal length (wide angle), affects how much of that vantage point will be included in the photograph. Long focal lengths record less of the scene but enlarge more in the distance; short focal lengths record wider views and describe areas closer to the camera.

APPROACH #1: EXACT RELOCATION OF A VANTAGE POINT

Whether for science or art, then, the job of the rephotographer is to find the vantage point of an original photograph as precisely as possible. And where the purpose is to achieve an accurate evaluation of physical change over time, there is a greater need to precisely duplicate this unique point in the rephotograph. Malde (1973) described how the camera can be used in the same way as a transit when measuring change directly from photographs; the camera is essentially used as an optical surveying instrument. But even studies that have little need for measuring change benefit from accurately repeating a prior vantage point, because the resulting photographs just *look* more alike as repeated images. Carefully relocated vantage points result in photographs that convince viewers they are made from the same place, and encourage greater participation in interpreting the image contents. By eliminating the

variable of where two photographs were made in space, the viewer is free instead to contemplate other differences, such as visible changes between the two views (Klett et al., 1984).

Techniques used for locating vantage points depend on the camera format and materials employed, but the principle is independent of device or medium. Several publications describe methods for accurately reoccupying an existing vantage point (Malde, 1973; Harrison, 1974; Klett et al., 1984; Rogers et al., 1984). In practice, there are two stages to the work. First, the original photograph must be given a general, and then a more specific location: e.g. a photograph taken in the Rocky Mountains in Colorado, and Mt Harvard in particular, and further, the photo shows the east side of the mountain, at a specific drainage, etc. This work is often done before rephotography fieldwork begins, and may require research into any titles or descriptions, comparison to other known photographs, or consulting maps, field records or other documents.

In recent years some researchers have had success using web-based maps and aerial photographs to help locate the positions for landscape photographs. Google Maps, for example, used in combination with oblique views and lighting simulations can help narrow the choices when searching for where photographs were made. The information may provide both direction and approximate distances from known landforms. One recent rephotographic study used high-resolution satellite images not only to identify the landforms seen in an earlier photographic survey but also to make computer-based rephotographs of scenes inaccessible to fieldwork (Hanks et al., forthcoming).

In the next stage of the process the photograph's vantage point is relocated by taking a print of the original image into the field and locating the subject(s) that appeared in that image (and, for anyone who has made rephotographs, this is the exciting part of the work). Using the print as a guide, the observer moves through the space depicted

in the photograph and finds points that are still identifiable from the earlier image. Then, usually through trial and error, the points identified in the view (for example, foreground and background objects) are lined up as in the original, and one quickly learns how moving in different directions affects the way the space looks in the photograph. It tends to be most efficient to locate the vantage points visually by maneuvering the view rather than the camera.

Once the camera has been placed at the chosen vantage point, the choice can be tested and refined. To locate a given vantage point in space, visualize this as movements along a three-point coordinate axis: the photographer may choose to move forwards or backwards, to the left or right, or up or down. After the vantage point is reoccupied as closely as possible without a camera, a lens is chosen to match the original photograph's angle of view and the camera is pointed in the direction to match the original's framing and camera inclination.

At this stage it is possible to quantitatively evaluate the choice of a vantage point more accurately by using measurements made on the surface of photographs (see Figure 6.1) (Harrison, 1974; Klett et al., 2004). There is a virtual demo of this at <http://www.thirdview.org/3v/classroom/index.html>; by following the link to the Rephotography Simulation, a user can walk through the steps of recreating a vantage point and taking measurements between reference points, allowing the user to verify the accuracy of a chosen vantage point through those measurements (Figure 6.1).

Not long ago it was common to make these measurements in the field by using large-format cameras (4 inch $\times$ 5 inch negative size) exposing Polaroid Instant films. To do the work successfully, a 'copy-print' of the original photograph (this term will be used throughout) was carried into the field and measurements taken on the print surface to calculate numeric spatial relationships between objects in the scene. These measurements were then compared to the instant test

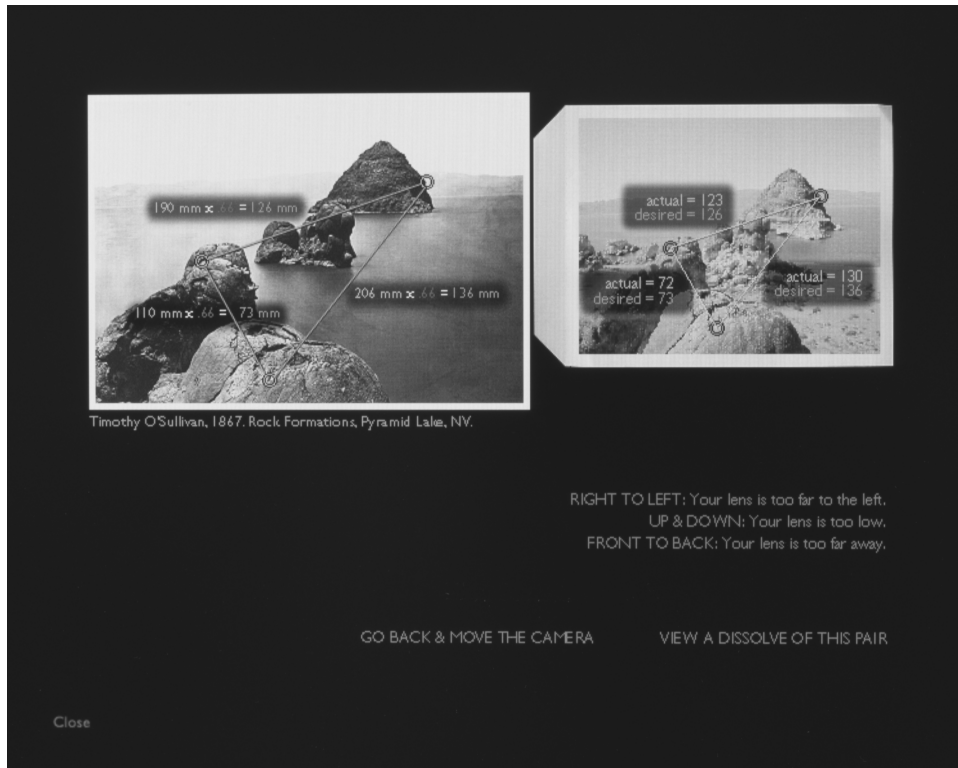


Figure 6.1 A virtual demonstration from the book *Third Views Second Sights: A Rephotographic Survey of the American West* (DVD portion). The viewer interacts with the scene shown (Pyramid Lake, Nevada), attempting to emulate the original photograph shown to the left. A text describes how to align and make a test rephotograph, and the viewer moves the position of a virtual camera along three possible directions, left–right, up–down, forwards–backwards, to line up the scene until it matches the original image on the left. As the camera moves, the simulated view also changes. When a test shot is taken with a click of the computer mouse (shown here), the tutorial demonstrates how the choice of vantage point may be verified by comparing measurements between the original and the test print

prints made at the selected vantage point and adjustments were made in the vantage point until the measurements lined up with the original. Large-format cameras (4 inch × 5 inch negative size) were the instruments of choice because they allowed for recreating any camera movements used by early photographers and most importantly because they provided large negatives with great clarity, and enabled the photographer to use the instant film for feedback while on site. Some variations of large-format instant films

remain, as of this writing, making this method viable, but their continued availability for fieldwork remains in jeopardy.

New techniques using digital cameras are replacing methods based on film, and while necessitating more equipment they also offer greater accuracy. The digital corollary to the method described above involves carrying a portable battery-operated printer into the field along with a digital camera. The photographs made with the digital camera are then printed on site, and the measurements

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described in the technique above are made as before on both the copy-print and digital print.

Another protocol for finding vantage points with precision involves taking a laptop into the field along with the digital camera. The laptop is pre-loaded with a digital copy of the original photograph. A new vantage point is chosen by eye and a trial photograph is made at the chosen vantage point using a camera on a tripod. The image file is downloaded to the laptop, and using image-editing software the new image is overlaid on the original, and made semi-transparent. The two images are scaled to the same size and features are compared. If the new vantage point matches the old, the identifiable features in both images will line up. If the overlap is not close enough, the tripod and camera is moved to a new position to correspond to movements needed to make the two photographs overlap more precisely. The principles of quantitative measurement are then used along with or instead of a trial-and-error method.

The trade-off when using digital technology for rephotographic work is that more equipment is required, costing more money and adding more weight. Power consumption can be a problem in remote locations and laptop screens are often hard to see in daylight. The skill level needed to work some image-editing software requires a steep learning curve. Furthermore, storage of digital image files can be a concern in both the short and long term. In spite of these drawbacks, finding a vantage point using digital techniques is more accurate than earlier techniques using film, and the option of using electronic media offers many new opportunities, some of which will be outlined below.

Regardless of equipment used, any attempt to relocate a pre-existing vantage point has limitations. The accuracy in matching two vantage points becomes greater when more information can be compared between the original and a rephotograph. This is especially true when the original image contains

multiple objects at a variety of distances from the lens. Photographic vantage points that provide clearly identifiable objects or markers in the foreground, middle ground, and background of the photograph are the most accurately reoccupied. Foreground in this case can mean anything close enough to the camera for the photographer to touch, which is especially true when wide-angle lenses are used. Under these circumstances, when information at multiple distances from the camera is reliable, it is often possible to position the lens within centimeters of the original. But if the information is limited or the photographer can only rely on identifying similar distances from the camera, the degree of accuracy will be significantly reduced.

Lighting

Light plays an important role in defining the subject in an image, and another characteristic of photographs is that they are made at unique times of day. The lighting in the original image can be the most obvious indication of the photograph's moment in time, and can be an aid in identifying the vantage point, by matching both the time of day and time of year in which the photograph was made (Malde, 1973; Hoffman and Todd, forthcoming). Lighting defines how three-dimensional objects are rendered in a flat picture plane, and a change in lighting in the rephotograph will change the way a viewer interprets space in the scene.

Together with exact duplication of an earlier vantage point, replicating the lighting is an essential part of accurate rephotographic methods. In landscapes, the angle of the sun above the horizon will be determined by the season, and the lighting in any given location can theoretically be repeated twice a year, once on either side of the closest solstice. For example, the lighting in a photograph made in April, two months before the summer solstice can also be duplicated in August, two months after. But there may be seasonal differences that are important: for example,

photographs made in October may look very different than those in February, even though the lighting matches. The direction of the light in the same landscape scene, east to west, will be determined by the time of day. Depending on the details in the photograph that is being repeated, both the time of day and the time of year may be critical to making a rephotograph.

In summary, accurate place-based rephotography is formulated on the principle that an earlier vantage point can be relocated with precision, regardless of camera type or output. Rephotographs made in this way can be the basis for making quantitative measurements from the photographs; they also convince viewers that the space has been matched. Replication of lighting is also an important part of this method; more than aesthetics, lighting provides viewers with clues to reading space. Together, careful replication of vantage point and lighting duplication provide the best visual evidence for monitoring changes over time through photographs and are an effective approach for projects, across disciplines. A viewer will depend on knowing that the places depicted are the same, and use that knowledge to

gauge how closely the pictures match. Thus, the level of accuracy achieved is an important conceptual as well as physical tool necessary to understanding how to read the photo pairs and in gauging the reliability of the photographic evidence. If the rephotographs are made with consistent quality, viewers will concentrate on interpreting the information the photos provide. If the methods vary in quality and approach, viewers will spend time assessing how the photos were made from different positions rather than interpreting other differences.

Pyramid Lake

An example of this method is shown in Figure 6.2, from the Third View (mentioned earlier). Again, from the Project website:

The project's "rephotographs" were made from the originals' vantage points with as much precision as possible. Every attempt was also made to duplicate the original photographs' lighting conditions, both in time of day and year (*The Third View Project*, 2004: *Introduction*).

The subject is Pyramid Lake, Nevada. In 1867, the original photographer, Timothy



Figure 6.2 An example of two rephotographs made using methods to accurately relocate the vantage point of an original photograph. The first photo was made in 1867 by Timothy O'Sullivan (Rock formations, Pyramid Lake, Nevada; collection of Massachusetts Institute of Technology). The second was made by Mark Klett for the Rephotographic Survey Project in 1979. The process involved photography with a large format camera (4 inch $\times$ 5 inch negative) and instant films. Measurements to verify the choice of vantage point were made comparing details that could be confirmed between photographs. The same process was used again in the second rephotograph made by Mark Klett and Byron Wolfe for Third View in 2000. The three photographs show changes in the water level of the lake, a fluctuation related to human interventions

O'Sullivan, placed his camera in an unusual and isolated position atop a 'tufa' knob, similar to those in the foreground of the photo. The closest subject was less than 10 feet away from his lens, and O'Sullivan's photograph is filled with details that can still be identified, making it an excellent candidate for accurate rephotography. The methods used are described in Klett et al. (1984) and illustrated by the interactive demonstration in *Third Views, Second Sights: a Rephotographic Survey of the American West (DVD)* (Klett et al., 2004; also available at www.thirdview.org).

The rephotograph illustrates a drop of about 65 feet in the lake's water level when compared to the original, and the reasons are not explained by either image. The water coming in to the lake from the Truckee River was diverted, starting in the early twentieth century for irrigation, and the lake level was lowered as a result of water loss. The lake's Native American owners, the Pyramid Lake Indian Reservation, have litigated this loss in intervening years. The Third View photograph, c. 2000, shows the water partially restored to its earlier level.

APPROACH #2: WORKING WITH MULTIPLE PHOTOGRAPHS AND CREATING A CONTEXT FOR THE VIEW

Photography as a medium has only been around since the 1840s, making it a relative newcomer in the history of image representation. But it has also been a prolific provider of images and in the digital era their growing number bears significantly on our perspectives on the world. Given any location on earth, there is bound to be at least one photograph that covers the terrain, if even remotely, as in satellite imagery. In geographic areas hosting large populations the number of existing photographs made at ground level can be staggering. Questions regarding accessibility aside, social networking sites such as

Flickr (www.flickr.com) and Facebook (www.facebook.com) provide examples of thousands of photographs made at the same locations or events and have already been the subject of testing by software makers seeking to develop engines that can sort through massive piles of visual data. Software, such as Microsoft Photosynth (see examples at <http://photosynth.net>) can sift through a large number of photographs, identify common subjects, recognize the spatial relationship of one photograph to another and piece together three-dimensional representations of the larger space based on hundreds and even tens of thousands of photographs (Agarwal et al., 2009).

The process that a software program uses to determine that one photograph is related to another is a form of rephotography done in an automated way; while it can be done by hand and eye as well, it may take much longer. Any individual photograph within a large group may be a candidate for traditional rephotography, but working with multiple photographs and sorting through large pools of images, rather than single pictures, opens up significant new possibilities. Groups of images empower relationships between photographs, invite questions about the context in which they were created, or enable a better examination of how a specific subject has been depicted through imagery. The ability to work with many photographs and edit them for specific reasons has become an important skill in an era when large numbers of photographs are becoming commonplace. The pictures may come from multiple users, commercial media, artists, or even surveillance cameras. But the specific choice of which images to use and how to put them together distinguishes the content of the work and its relevance to an audience. The next section will discuss only a few ideas related to the conventions of rephotography. But while developing technologies will undoubtedly open new possibilities for relating and combining existing photographs to the spaces they come from, it will always be the criteria used in selecting and editing these images that will matter.

Finding photographic resources

The same advances in technology that are changing how rephotographs are made in the field have also affected the way research is conducted with historic photographs. Major collections are being digitized and made accessible on the web, making thousands of pictures available to the public that were previously unknown, and enabling assessment across collections. This is especially significant when researching photographs made from a specific location. For example, many of the existing nineteenth-century survey photographs were spread out over collections nationwide. It wasn't known how many photographs were actually made of any given subject unless one traveled to these individual collections and compared detailed notes. Similar comparisons can now be made in a matter of hours at home by viewing photographs from several digital online collections at the same time. Furthermore, it's often possible to relate photographs to published reports and diaries that describe the photographer's experience or context for the view. One can also examine other photographs made by the same photographer at other locations to understand certain working techniques and personal idiosyncrasies of that photographer.

Most importantly, the availability of World Wide Web access to photographs means an important revision to the workflow linking research and fieldwork: it's now possible to download and bring more photographs into the field and compare these photos to the experience of place – i.e. current geography, environment, location, and so on. Previously this had to be done by visiting photo archives and making or ordering copy-prints of originals, work that was usually expensive and time consuming. The combination often limited the number of photographs taken into the field. By comparison, low-resolution downloads are typically free, and for an increasing number of 'important' photographs, sites like the US Library of Congress (www.loc.gov/pictures/) offer free downloads of high

resolution (100+ megabyte) files. And downloads can sometimes now be made on-site if a connection to the web is possible. Reviewing collections on-site may also reveal the locations of photographs that were previously unknown.

Working with multiple vantage points

Historically, some physical locations have generated more photographs than others. Places that attract photographers or cities with large populations have become focus points for disproportionately large numbers of photographs and are what might be called places of high image density. One example of an image-rich environment is Grand Canyon National Park in Arizona; with over 4 million visitors per year, it is the second most visited national park in the USA (Sullivan, 2007), and an internationally known landscape of the American West.

In the composite photograph shown in Figure 6.3, four photographs made by William Bell in 1872 appear embedded in a larger panorama of the scene near Toroweap Point on the North Rim of the Canyon. The historic photographs occupy their original positions and the contemporary view made at the same location shows the space around the photos. The combined image becomes what has been called a digital 'mashup,' a term that Wikipedia defines as 'a digital media file containing any or all of text, graphics, audio, video, and animation, which recombines and modifies existing digital works to create a derivative work' ('Mashup', 2010). We have similarly described this method as a photographic mash-up, or more formally as the 'embedded rephotograph' approach.

This method is made possible by digital image editing, whereby one photo can be placed over top of another, or made to slightly overlap the other, in a digital composite. What confirms that the photographs occupy the same space is the way the edges of one image merge with the details of the



Figure 6.3 Mark Klett and Byron Wolfe, 2008. At the Canyon's edge: from the foot of the Toroweap to the 'Devil's Anvil' overhang with an upstream view of the Colorado River. A 'nodal point' attachment was used on a tripod to create the underlying wide-angle panorama seen in the right-hand portion of this image of the Grand Canyon near Toroweap. From left to right are four 1872 photographs by William Bell made from the same tripod position and embedded into the underlying panorama (Canyon of Kanab Wash; Walls of the Grand Canyon Looking East, Colorado River; Looking South Across Grand Canyon, Colorado River; all Courtesy National Archives). The left-hand panel positions a fourth photograph made approximately 20 feet north of the others (William Bell, Canyon of Kanab Wash Looking North; Courtesy National Archives). The panel was created at an angle using photo-editing software to visually simulate its position relative to the larger panorama

other (similar to the 'stitch' feature now common on many point-and-shoot cameras). The technique is effective if the photo that is embedded seamlessly connects to the photo that appears to be 'beneath' it in space, and in order for this to happen the two must be made from at or near the same vantage point.

In this case Bell made three of his four photographs from the same position, simply by rotating the camera on its tripod from southeast to northwest. Byron Wolfe and I were able to relocate his tripod position and recreate the three views using the standard rephotographic techniques described in the first section of this text. The vantage points for the three Bell photographs on the right and central part of the composite were nearly identical. The only difference between them was the distance the lens traveled when rotating around his tripod. It was apparent after studying the scene that the tripod itself had not been moved. The resulting panorama shows that Bell, curiously, did not include the river among the photographic panels he made at the scene.

The underlying contemporary view was made by using special software to stitch together 18 separate and detailed photographs of the scene into one large image. These photographs were made from one vantage point, which was judged the average position of Bell's three vantage points and was within inches of where he made his photographs. Unlike a simple rotation around a tripod, the stitched photographs were all made from one point using a 'nodal point' panorama attachment, a tool that attaches to the tripod and allows the camera and lens to rotate around the center of perspective for the lens. When the camera is rotated at this perspective point the resulting photographs can be stitched with great precision using software designed for the purpose. The advantage of using stitched photographs is that they allow extreme enlargement of the image while retaining exceptional detail and clarity. In the past the only way to achieve similar quality was to use professional large-format equipment. Now, image files from any digital camera may be stitched together, though

cameras and lenses using larger image sensors will produce better results.

The left-hand panel of this panorama bears mention. Bell's fourth photograph was not made from the same tripod location as the other three, and the vantage point was instead found approximately 30 feet to the north. In order to link this photograph virtually to the others, we rephotographed the view from its original vantage point, and then in the process of editing the composite placed the panel at what appears to be an angle to the main panorama, suggesting its relation in space to the other panels.

The role of rephotography in developing narrative

An example of an embedded rephotograph from Yosemite National Park, the third most visited national park in the USA with 3.7 million visitors in 2006 (Sullivan, 2007), will address another use of multiple photographs. We quickly found that while Yosemite is itself very large, the photographs that helped make the park famous tend to be clustered closely together (Klett et al., 2005). Historic photographers (discussed further below) were making views of the park's scenery and they often chose the same features as their subjects; as a result, vantage points were sometimes quite close to one another. If one were to plot the vantage points of the best-known scenic photographs on a map of Yosemite, there would be small clusters with great image densities in certain locations, and vast open areas without photographic representation throughout most of the park.

While searching for a vantage point used by one photographer, we sometimes found another vantage point nearby that was used by a second photographer from another era. Sometimes these separate photographers were photographing the same subjects, sometimes their focus was on slightly different subjects in different directions, but their framing of the views might overlap in space.

Sometimes we could actually connect the views of different photographers by walking between the two vantage points. This discovery led to an adaptation of the embedded rephotograph technique and can be seen in the panorama of Lake Tenaya in Figure 6.4.

The panorama at Lake Tenaya connects three historic images to a wider panorama Byron Wolfe and I made at the scene. The large photograph on the left, made by Eadweard Muybridge in 1872, was perhaps the first photograph ever made of the lake. In the center of the panorama, an Ansel Adams photograph, c. 1942, of the rocks and dramatic clouds across the lake, was partially overlaid on an earlier view made by Edward Weston (1937). Each photographer, in separate trips to the lake, managed to choose vantage points that were within 20 feet of one another. Muybridge and Weston, photographing the lake some 65 years apart, were standing less than 2 feet from one another!

We were able to rephotograph each original using conventional techniques, but felt the most important thing to convey about this site was the overlapping nature of the historic photographs. We walked the distance between the three vantage points, but in the end chose one from which to base our own photographs, the widest view with the closest foreground, the vantage point used by Muybridge. Using instant film positives on a 4 inch $\times$ 5 inch view camera, we were able to plot the relationship of the three earlier photographs and create a larger panorama in which all views could be combined into a single image.

Two of the three photographs were displaced from the vantage point we chose (Muybridge's). But the act of laying the historic images on top of our contemporary view covered parts of the new image, making this position error less noticeable. The choice of embedding the historic photos also negated the capacity to compare details between first and second views. The final image composites photographs from all eras into one



Figure 6.4 Mark Klett and Byron Wolfe, *Four views from four times and one shoreline, Lake Tenaya*, 2002. The left inset was taken by Eadweard Muybridge (1872); center top, Ansel Adams (c. 1942); inset center bottom, Edward Weston (1937). The three historical photographs were made within 20 feet of one another over a period of about 70 years. The panorama combines all photographs into one visual composite of time layers analogous to the lithographic layers of a stratigraphic rock. One way to approach rephotography of image-dense landscapes is to map the vantage points into real space. In the scene, photographer Byron Wolfe swats at the high country mosquitoes mentioned in Weston's historical account of the scene. (E. Muybridge, *Mount Hoffman, Sierra Nevada Mountains. From Lake Tenaya. Number 48*, courtesy of the Bancroft Library, University of California, Berkeley, California, USA; A. Adams, *Tenaya Lake, Mount Conness, Yosemite National Park*, courtesy of the Center for Creative Photography, Tucson, Arizona, USA; E. Weston, *Lake Tenaya*, courtesy of the Center for Creative Photography; M. Klett and B. Wolfe)

digital file. The methods used to make this panorama are based on the concept of vantage point, but would not produce an acceptable result if quantitative information were desired when comparing the images. The composite panorama does not replace the usefulness of three more accurately made rephotographs from each original vantage point, but it does a better job of informing how the all the vantage points are related.

The composite loses some capacity for describing physical changes between photographs, but it may gain in other ways, such as an increased potential for narrative with this technique. Here, for example, a personal story accompanies the panorama, told to us by a man who was visiting the lake on the same day we made our rephotographs. Forty years earlier he had camped with his wife in the wooded spot occupied by the trees in Muybridge's photograph. He was reliving that memory when we met him. He had

returned, he said, with Park Service permission to spread her ashes there as she had died of cancer earlier in the year. It was a poignant story of personal loss, and one that added a new layer to our mash-up of images by three famous photographers. In her essay in *Yosemite in Time: Ice Ages, Tree Clocks, Ghost Rivers* (2005), Rebecca Solnit wrote:

Despite all those magnificent lumps of granite, this place is made out of memory, imagination, and desire, which are as tough, if not as slow to change. Scenic splendor must have brought the widower to camp in this place, but personal history is what brought him back, and it's on the return, over the long run, that meaning transforms a place into a ritual site or into home. (Klett et al., 2005)

Our desire for this project was to see Yosemite as a place that photographs had helped shape in the minds of viewers, whether they had been visitors or not, and to revisualize the Park's iconic imagery as a layered mix of

time, cultural representation and personal stories. This particular example also describes a multi-faceted history of photographic representation, bridging a historical divide between the era of exploration and the period of high Modernism. The addition of the widower's story alters this perspective by adding a personal layer to the record. It's a reminder that each time the lake is visited, a new layer may be added to its collective history. Our work also revealed the changes that have occurred to some of Yosemite's natural environments. So for our purposes, both methods of making rephotographs were useful, in combination, on this project, even though the expectations for the results were different for each type of rephotograph. Both involved accurate relocation of vantage points, but one technique was useful in visualizing physical changes; the other, by embedding historic photographs, had clear advantages for reaching the goal of revisualizing the Park's cultural history. The embedded technique opened the visual record to a broad range of interpretations and enabled the addition of different historical and personal narratives. The pictures became less about an exact description of place and change, and more about context for the views.

Summary: rephotography using multiple photographs and creating a context for the view

The second approach involves relocating the vantage point of an original photograph in a manner similar to the first method. Here, the purpose is not to duplicate the original precisely, but rather to expand the context surrounding the two views. Techniques for repeating the original image are less focused on duplicating the original's exact location than with placing either the earlier or newer works in relationship to other photographs and the larger space. Digital techniques allow smaller photographs to be embedded into a larger photograph at or near the same vantage

point, with the effect of showing what surrounds the smaller view. A new panorama made from that vantage point may show a wider angle of view, and may host an embedded original.

Variations include embedding a smaller second view into a larger original photograph, reversing the order of which image, old or new, is embedded; or placing a newly made photograph side-by-side or overlapped with an original photograph to form a continuous scene where the features of one image flow seamlessly into the next. In fact, the exact techniques used may be altered to meet the demands of the situation and not in response to a consistent framework. This approach will only work if the embedded photograph 'fits' seamlessly into the scene, something that requires the vantage points for the two photographs to be the same or nearly the same, and it relies upon digital technologies to edit the resulting composite.

Embedded photographs may connect separate photos from multiple vantage points into one scene or combine photographs made at different times into overlapping layers. It becomes a useful technique to convey narratives and/or stories related to or in support of the view. It is also useful for comparing and contrasting views across time periods.

NEW TECHNIQUES USEFUL FOR VISUALIZING REPHOTOGRAPHS: DIGITAL INTERACTIVE MEDIA AND THE THIRD VIEW PROJECT

The Third View project (1997–2000) attempted to repeat Western American survey photographs dating from the 1860s and 1870s along with a set of rephotographs made of these originals by the Rephotographic Survey Project (RSP). The RSP worked between 1977 and 1979 to precisely repeat the first photographs of the American West made by photographers such as Timothy O'Sullivan, William Henry Jackson, J. K. Hillers and

others (Klett et al., 1984). Essentially, the Third View project's job was to create a second set of rephotographs based on the original survey pictures, but also to reinterpret the ideas and methods developed by the first rephotographic project. The project began on the twentieth anniversary of the RSP and, by design, attempted to address questions raised by limitations of the first project's approaches. The new project field team explored technological advances that made it possible to collect new data in the field, as well as to solve to the problem of displaying multiple rephotographs.

Third View's methodology began with the conventional approach of precisely repeating vantage point and lighting; these were the same methods used to make the first set of rephotographs for the RSP. A view camera was used for the photography, and test shots were made onto instant film just as they were 20 years earlier for the RSP. Measurements were taken between copy-prints and the instant print and then compared to calculate the most accurate placement of the camera (Klett et al., 2004). In the case of discrepancies between first- and second-view vantage points, the Third View images were based on the vantage points of those made by the RSP. Departures from the earlier project and the introduction of new methods came after the precision rephotographs were made. New photographs of the landscape were taken to show the scene surrounding the original vantage point. Video footage recorded the journeys to the field locations and the team's experiences at those locations. Ambient sounds were recorded, and oral history interviews were conducted and recorded with people connected to those sites. Team members' personal photographs, made-for-computer animations and panoramas were added to show what was 'behind the camera' or outside of the picture frame. Contemporary artifacts (not of antique or archaeological value) were also collected at some locations. Each piece was chosen for its relation to the larger whole. The goal was to capture the experiences of the team at that site, and to

provide context for how the rephotographs were made.

Third View was as much interested in the narrative of the journey as it was in adding to the documentation of the West. The project was conceived as an updated version of the traditional Western geographical survey, only rather than exploring unknown territory, the field team re-explored the once open spaces of the West, now transformed into home to millions of inhabitants. Besides physical changes, the project was equally concerned with the evolving perception of place and the shifting mythologies of the West of the imagination, as well as the evolving concerns of documentary photographic practice.

The fieldwork collected a large array of visual and aural documents. These could only be combined by editing the content into some form of an electronic presentation. The project launched the website with many of the less memory-intensive works, but it was not ideal for showing the large volume of content created. The fully edited materials were presented via an interactive DVD that was published and included with a hard-bound book (Klett et al., 2004). Viewers of the DVD were given access to a full range of digital files, including video footage, text, interviews and sound clips, with still images that connect places to events, people and ideas.

In addition, there were several significant changes to the techniques used to view rephotographs themselves. Perhaps the most simple but effective technique used by Third View was a blended overlay of one image dissolving into the next. Photos at each time interval were sized and aligned using photo-editing software, and the images were then placed into a single window and made to dissolve into one another by clicking with the computer mouse. By constantly changing the view from one to the next and back, specific places in each photograph could be compared. This technique was a useful way to see three views together: rather than displaying the rephotographs side by side, this concept took up less space per page. (However, we

also found that it required a greater degree of precision in making the rephotographs. If the new photographs were not remade exactly from the originals' vantage point, or if the lighting was significantly different between photos, the changes between the dissolves became immediately recognizable and distracting).

In addition to the simple dissolve between photographs, project programmer and designer Byron Wolfe created a novel way to compare and view selected parts of the rephotographic sets. By creating a mask that acts like a moveable window, the overlapped

rephotographs also offer a 'Time Reveal' that places a view from one time period on top of another (Figure 6.5). A viewer is able to choose the time period revealed in this moving window (from first, second, or third views) as well as that of the underlying photograph. The window appears to float on top of the photograph beneath it and is moved by grabbing and dragging it across the screen with the computer mouse. The Time Reveal window has proved the project's most dramatic way to visualize time.

Besides the Time Reveal tool, each rephotographic set offers other options for viewers,

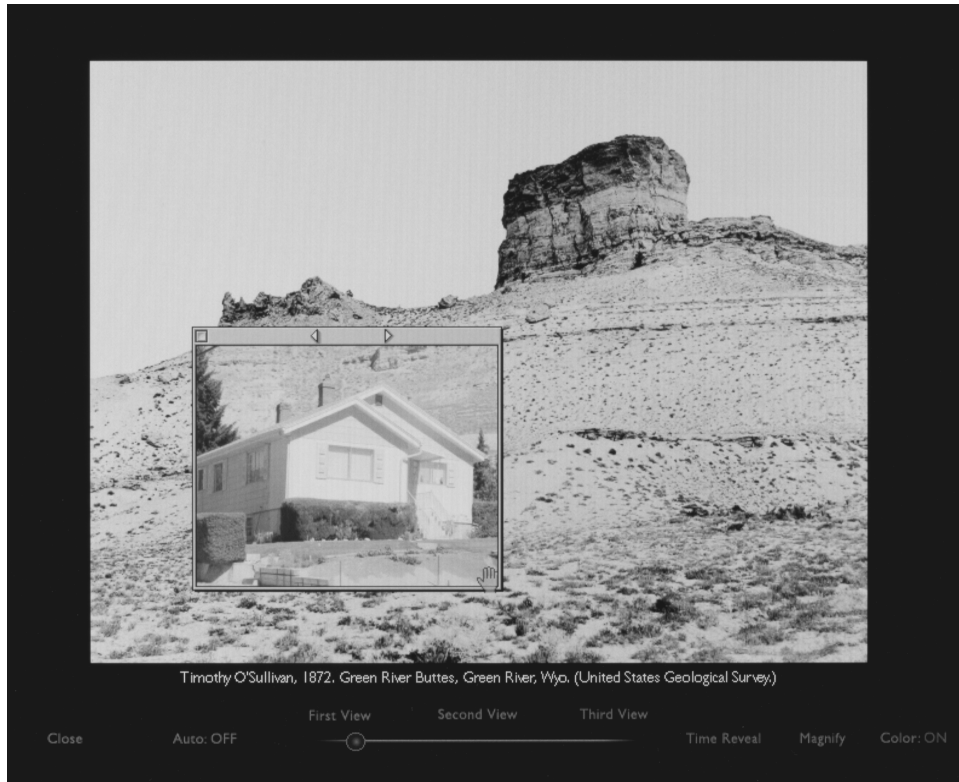


Figure 6.5 The 'Time Reveal' window from the Third View project's interactive DVD. The information taken at one time period may be seen as through a window floating on top of the same location at a different time period. In this case the window shows a house that is part of the rephotograph made in 1997 at Green River, Wyoming, as it appears in the window on top of the scene as originally photographed by Timothy O'Sullivan in 1872. Different time periods may be selected in either the reveal window or base photograph below

including a magnifying glass to enlarge details in each photo. The magnifier helps alleviate one problem with viewing photographs on computer screens: their relative coarseness and lack of fine detail. In order to enable the magnifying glass, we scanned images at twice the normal resolution for screen viewing, and then deployed the magnifier, which accesses the enlarged version of the photograph.

Each rephotograph is displayed in a window with additional controls at the bottom of the screen. One button allows viewers to turn color versions of the photographs on or off. The photos may be seen in monochrome or as full-color versions. Other buttons turn sound recordings on and off where available.

The sound often recorded at sites ranged from ambient noise to recorded interviews.

Each site rephotographed by Third View included a panorama made at the original vantage point. The panoramas are basic versions of embedded rephotographs. The visibility of the historic photographs can be turned off and on using a mouse-controlled switch. The panorama can also be enlarged or reduced in scale, and navigation left or right is possible in the up/down and left/right screen.

Geography was used as the primary navigation interface for the project. A map of the Western states was used to display colored dots that indicate active locations (Figure 6.6).

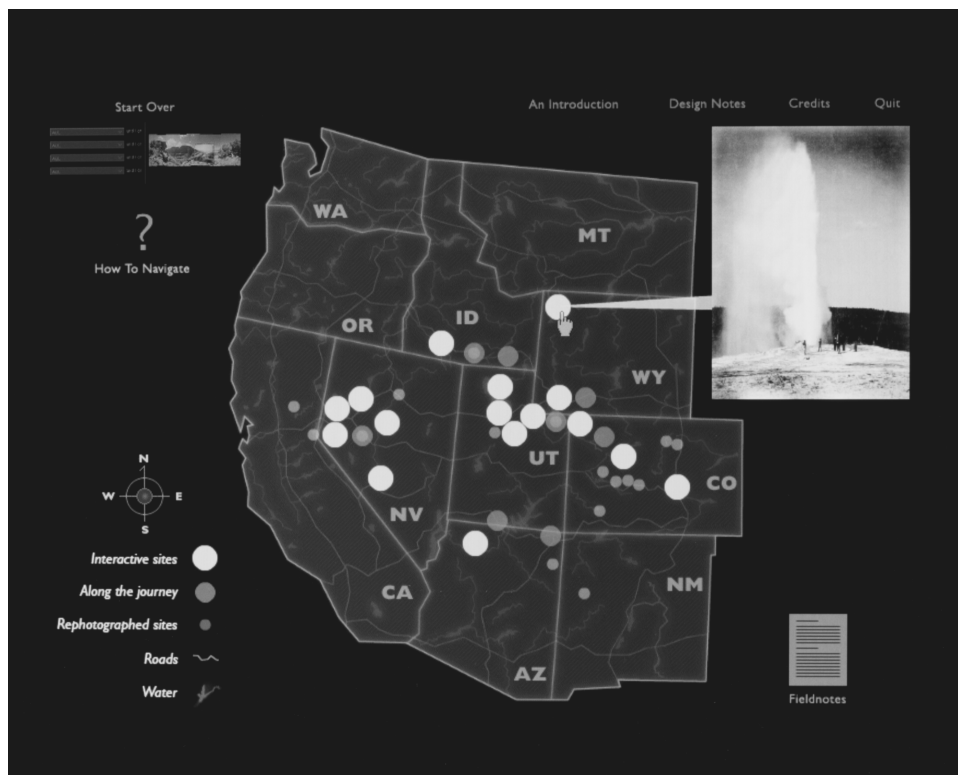


Figure 6.6 The map of the Western states used by the Third View DVD's 'Journey' section is a geographically based navigation device. Rolling over the enlarged colored dots triggers a photograph to appear, and clicking on the dot brings the user to that site location

When rolled over with the computer mouse, these sites reveal photographs that bring viewers to those specific site locations. Some locations contain multiple rephotographs along with other materials. The site locations are displayed as photographs that act as 'hot' buttons to take viewers further into the program. The buttons are aligned in linear fashion, with a slider used as the navigation device to scroll through the choices.

The interface allows viewers access to all the materials the project offers as part of the 'Journey' section of the DVD, and also contains an 'Archive' feature. The database is a selection available upon first opening the disk on the computer. If viewers only wish to research the project's photographs, they can search based on location, title, keywords, photographer and other parameters.

Taken together, the features of the Third View interactive disk represented a new approach to presenting rephotographs. In the meantime, although it wasn't possible to put the more memory-intensive material on a website originally, this has changed due to increases in processing and online access speeds; it is now possible to put most, if not all, of the project's content on the web. While publishing the photographs in this way does not replace the need for printed versions of the work, it significantly increases the exposure and accessibility of the work.

Since the Third View DVD was published in 2004, the software needed to combine media and make interactive programs has changed: that is the nature of digital media, and the actual software used to create the Third View disk is no longer available. New software will allow for improved interactivity between users and the material, but project results depend not upon specific software but on ideas enabled by any new technology. The purpose of Third View's DVD was to challenge the ways geographic change was visualized, and to provide a new context for the historic survey photographs and their sites. The content was meant to withstand the 'bells and whistles' of changing media over time, by emphasizing content and ideas over

technology. To the degree that it succeeded, the content will remain pertinent even when the technology itself is dated.

THE FUTURE WILL BE DIFFERENT, AND THE SAME

Photography has always been a medium in transition and based on changing technologies. In recent years the pace of change has quickened and it can be assumed that the materials and methods for making photographs in general and rephotographs in particular will continue to change along with the medium. But rephotography is based on the principles of how lenses describe and capture space, and these basics have not changed since camera systems were introduced well over a century ago. The fundamentals of choosing vantage points will not change and new technologies will not end the need to gather new information, visualize the world, or discover new perspectives from photographic images.

Content as diverse as text, sound, video and still images can now also be combined, along with rephotographs, to create truly integrated presentations. Interactive approaches using digital technologies enable seemingly incompatible types and formats of data to be collected and used together. Organizing this material presents a new challenge that accentuates content over media type, and emphasizes the experience of the work as a way to discover the work's content. If done well the results can add layers of meaning and accessibility to photographs, extending their audience and reaching across disciplines. Then the old problem that photographs alone cannot explain their histories has found a new solution.

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