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POLAROID VECTOGRAPHS

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Abstract

Vectographs are photomechanical stereo images developed by the Polaroid Corporation in the 1940s. Each monochrome print or transparency is a set of polarizing images, created by the reaction of iodine on oriented polyvinyl alcohol film and viewed with special polarized lenses. The process was embraced by the ophthalmology field for vision testing and by the US military during World War II for use with aerial photography and technical illustrations. A few stereo photographers produced Vectographs as an artistic endeavor, primarily through the 1980s.

The Polaroid Corporation Records at Harvard Business School's Baker Library contains thousands of Vectographs, intermediate negatives, film samples, prototypes, and accompanying documentation. Some Vectographs in the collection remained in pristine condition while others had suffered from catastrophic deterioration, prompting the need for a condition survey and material testing. Ultimately the data was used to formulate a preservation strategy for the collection. This paper will discuss the manufacture, history, deterioration, and preservation of stereo Vectographs.

General description

As reflective prints or transparencies, Vectographs look like shiny double images on a plastic base. (See figure 1.) Monochrome or "black and white" images have a tonality that ranges from cool blue to warm brown, sometimes even on the same print. Color Vectographs have a full range of cyan, magenta, and yellow dyes. Reflective prints invariably have a metallic paint or laminate on the verso. Sizes can vary between standard lantern slide sizes to 12 x 14 inches, with 6 x 9 inches being the most common size.

Figure 1. Recto and verso of *Stereo Fly* printed by Stereo Optical, 2008.

Vectographs are images that rely on the properties of polarized light to create a three-dimensional effect. Instead of light being scattered in all directions, light is channeled in one plane, or polarized, as it passes through a Vectograph. One image of the Vectograph is polarized in one direction. The second image is polarized 90° to the first. Special glasses have polarized filters, with each lens polarized at 90° to each other. The effect is that each eye sees a slightly different image which is combined by the brain into a three dimensional scene. (See figure 2.)

A more exact explanation was given by John Dennis in a 1981 volume of *Stereo World* and is quoted here, maintaining the emphasis he placed on particular words.

> Instead of *being* polarized in a projector, Vectograph images *are* the polarizers – rather than looking at polarized images, you are looking at "imaged polarizers". Using the right eye as an example, with regular polarized projection the right eye viewer filter extinguishes the entire left image and lets only the right image through, as it is polarized at the same axis as the filter. With a Vectograph, the right eye image is on the side of the Vectograph film that is at a *crossed* axis to the right eye filter. The image's dark tones are thus *created*, varying with the degree of polarization. Light tones or white areas are seen because they *aren't* polarized and light comes straight through (or reflects off the aluminized backing of the print). Any dark tones comprising the *left* image aren't seen through the right eye filter because they are polarized at the same axis and no contrast is created. The crossed axes of the *two* images create the imperfect image seen when the Vectograph is viewed without filters.

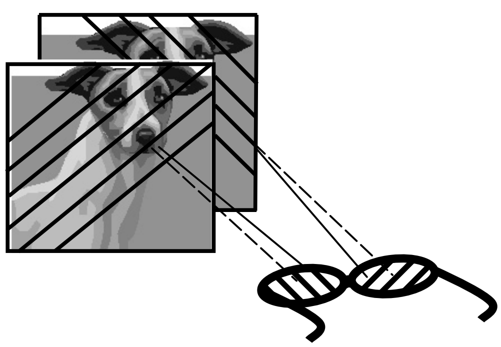


Figure 2. Each image is polarized at 90° to each other. Tones are created through the degree of polarization as seen through the polarized glasses. The two images are combined in the brain, resulting in the perception of a three dimensional image.

Composition and Structure

The film used as the Vectograph substrate is a composite material. First a film of polyvinyl alcohol is stretched to between four and six times its length, resulting in an alignment of the molecules, which allows the film to polarize light. The polarizing film is then laminated to each side of a core made of cellulose triacetate or cellulose acetate butyrate. (See figure 3.)

Once printed, the top is coated with a protective lacquer while the bottom is coated with aluminum paint. The aluminum paint is necessary in order to reflect the light in a way that keeps the polarization intact. A white background would scatter the light and ruin the effect.

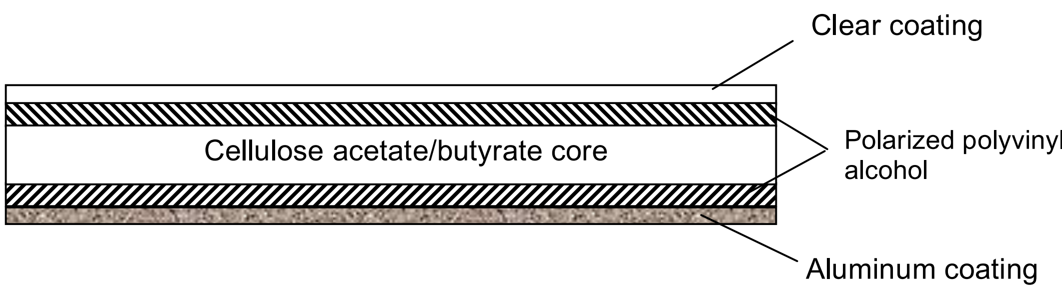


Figure 3. Cross section of Vectograph reflective print.

If a Vectograph is intended to be a transparency instead of a print, the aluminum paint is omitted and the back also gets a clear protective coating. Newer Vectographs use laminates instead of coatings. When a transparency is projected, the screen must have a silver surface in the same way that the prints have aluminum backings.

Manufacture

In order to make a simple monochrome Vectograph of a subject or scene, the photographer must begin by taking a right and left negative, usually with a stereo camera. Then a gelatin relief matrix is made for each negative using a wash-off relief film. The thicker areas of the gelatin will hold more of the so-called ink and will correspond to the darker areas of the finished Vectograph. The matrices are taped in registration and soaked in an iodine solution. The Vectograph film is placed between the matrices and run between rollers. (See figure 4.)

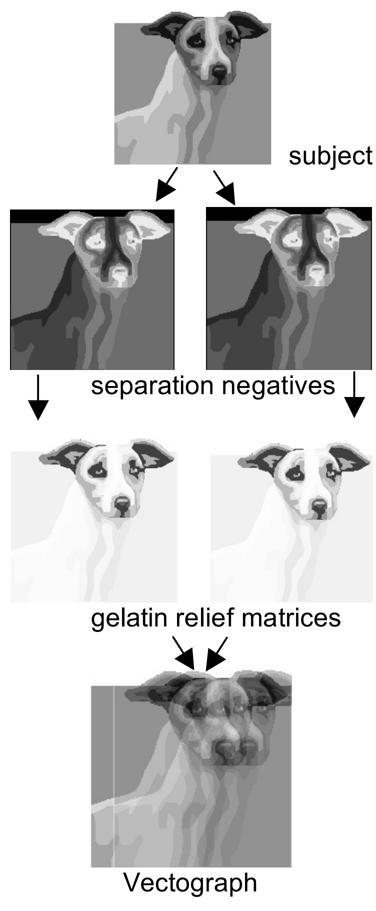


Figure 4. Vectograph production

The Vectograph is proportionally more polarized in the darker areas, where the iodine has reacted with the polyvinyl alcohol. As mentioned above, the double image seen without the glasses is where the two images are crossed axes. With glasses, the darks of each image are actually *created* as they are viewed through the cross axes of the corresponding eye filter. The resulting viewed image is not a dyed image *per se*, but instead is rendered in terms of percentage of polarization.

As described above, a simple monochrome Vectograph required four additional pieces of film in the process. Color Vectographs are significantly more complicated, requiring up to fourteen separate pieces of film to make a single Vectograph. The photographer would need two color positives or negatives, six separation negatives – cyan, magenta and yellow for each eye – and six gelatin matrices – one for each separation negative. The photographer would then need to print the three sets of color matrices in perfect registration, a technically exacting procedure.

History

During the 1930s, the idea of using polarized filters for stereoscopic projection was well known. Edwin Land's companies – first Land-Wheelwright Laboratories, then Polaroid Corporation in 1937 – specialized in perfecting the manufacture and promoting the use of polarizing filters. In 1938, a Czechoslovakian inventor named Josef Mahler suggested to Land that instead of using polarizing filters, the image itself could be the polarizer. Land immediately hired Mahler to head the Vectograph research team at Polaroid.

Material from the Polaroid Corporation Records at Harvard Business School's Baker Library Historical Collections illustrates how quickly the Vectograph process evolved. The first Vectograph demonstration made by Mahler appears as two small squares of opaque plastic film with pinpricks outlining a cube shape on one and a three-dimensional diamond shape on the other. The objects do not resemble Vectographs as we know them but the inscription on the original sleeve is in Mahler's handwriting: "Very first Vectograph made for Mr. Land. The first test. January 1938."

A year later Mahler used polyvinyl alcohol as the polarizing layers, enabling the refinement of the process to occur at a rapid pace. The example dated March 23, 1939, has no discernable image but the object does have some beginning characteristics of a true Vectograph. The polyvinyl alcohol layer is secured onto an aluminum-painted paper with black tape, indicating the discovery of the need for a reflective back surface. A Vectograph made just two weeks later also has aluminum-painted paper crudely taped together with black tape but the cockled sheet of polyvinyl alcohol clearly shows an image of a sculpture. The process had progressed enough during 1939 that Edwin Land was able to give a very successful Vectograph lantern slide presentation to the Optical Society of America in December of that year.

During WWII, Polaroid – as its name implies – had a number of products utilizing polarized film. Vectographs were used by the US military for machinery training and aerial photographs. Vectographs worked particularly well for aerial photographs because they enabled the viewers to experience the topography of the land. The National Archives and Records Administration has aerial photographs of the Normandy beaches that were used in the planning of the D-day invasion.

Polaroid set up a Vectograph training facility in Cambridge, Massachusetts where over 1500 military personnel were instructed. Polaroid supplied complete Vectograph kits that were about the size of a foot locker. There were even instructions for how to adjust the solutions if sea water was used.

Vectographs made with two very different images were called comparison Vectographs. Such Vectographs would not have been viewed with polarized glasses but with a viewer that alternated from one filter to the other, letting the observer see first one image then the other. Inventive servicemen were purported to have made "disroboscopes" – Vectographs which featured a woman with and without clothes. Polaroid used a less risqué Vectograph of a bikini-clad "Glare Girl" for marketing purposes. Samples dating from the 1960s in the Polaroid Corporation Records also include comparison Vectographs of John F. Kennedy on one side and Barry Goldwater on the other.

Polaroid promoted the use of Vectographs for scientific purposes, including graphs, x-rays and photomicrographs. They also saw the potential for Vectographs in studying sculpture. Land worked with Smith College professor Clarence Kennedy who used Vectographs to teach art history. Kennedy, a respected photographer in his own right, made numerous Vectographs of sculpture at the Boston Museum of Fine Arts.

The first color Vectograph was made in 1939, the same year that monochrome Vectography was perfected. This first color Vectograph is an image of a couple walking down a lane, holding hands. The object is comprised of three sheets taped together but more closely resembles a red-green anaglyph image than a true color Vectograph. One of Mahler's samples from May 1940 presents two young boys with a much sharper and more naturalistic color image, demonstrating the tremendous progress made in the dye diffusion process.

During the late 1940s and 50s, Polaroid perfected color Vectography and tried to develop a viable process of making Vectograph motion pictures. However at that time, Polaroid began investing its resources in the development of instant photography.

By far the greatest use of Vectographs has been in the field of ophthalmology where they are used to test for binocular vision. A monochrome Vectograph of a fly on a sugarcube, supposedly taken at Polaroid's military training facility, can easily be considered the single most-viewed image in the history of stereo photography. (See figure1.) Over the last 50 years, uncounted millions of people, particularly children, have seen *Stereo Fly* during eye exams. The viewer is asked to grab the fly's wings. How far the viewer holds his fingers over the Vectograph reveals how well his binocular vision is working. For some patients with imperfect binocular vision, Vectographs then are used therapeutically as part of a vision therapy regimen. Stereo Optical and Vision Assessment Corporation continue to be major producers of Vectographs for vision testing and training, making a range of hand-printed Vectograph prints and transparencies, including *Stereo Fly.*

While never a mainstream process, artistic Vectographs are considered collectable by enthusiasts of stereo photography who deem them optically more enjoyable than the common red-green anaglyphs. During the 1980s Stereo Optical was one of the foremost printers for collectable Vectographs. Collectable Vectographs printed at Stereo Optical should each bear a set of stamped numbers on the verso to indicate the date of printing. For example, the number 103087 stands for October 30, 1987.

Limited edition Vectographs were occasionally printed by Stereo Optical but packaged and marketed through Reel 3-D Enterprises. Instructions printed on the Reel 3-D Vectograph holder for the Steve Aubrey print *City Escape* wisely suggests that the customer should "keep it in a cool, dry place, away from direct sunlight" so that "…it will bring many decades of 3-D enjoyment."

Polaroid Corporation Records

In 2006, Harvard Business School's Baker Library acquired the Polaroid Archives. The mandate of Baker Library Collections is to collect and preserve material that can be used in the research and teaching of business history and theory. Since Polaroid was an exceptionally innovative and successful international corporation, headquartered just down the road from Harvard University, its archives are rich in business history. In addition to business records and legal documents, the large archive contains marketing material, patents, research and development documents, prototypes, and product samples. Timothy Mahoney, the manuscript librarian processing the Polaroid Corporation Records, as it is now called, estimates that there are nearly 4,000 linear feet of material, taking up nearly ¾ of a mile of shelving.

There were 139 boxes of material in the collection that had been identified as pertaining to Vectographs. The material was brought to the attention of the Weissman Preservation Center because some items were clearly deteriorating and the staff at Baker Library needed a preservation plan.

Initial inspection revealed an array of objects: complete Vectographs in presentation albums or mats, uncut samples of varying quality, prototypes, separation negatives and relief matrices. Some were in pristine condition while others had catastrophically deteriorated, making them unusable. Many Vectographs exhibited imperfections that were not immediately identifiable as deterioration or as processing flaws, making research into Vectograph production and deterioration a necessary component to a condition survey.

At one time, Polaroid kept important prototypes and samples of their products in what they called the Polaroid Museum, which was part of the larger Polaroid Archives. A significant number of Vectograph materials from the Polaroid Museum have original enclosures with specific inscriptions indicating production details, including date, creator, and processing variations. Some enclosures were even signed and witnessed. Any preservation plan would have to include the retention of these original enclosures with the accompanying photographic materials.

The collection also contained many complete sets of color Vectograph materials, including the completed Vectographs and all separation positives, separation negatives, and matrices for left eye and right eye, all well labeled in folders as received from Polaroid. Meanwhile, other boxes contained what looks like a random assortment of unlabeled and currently unidentifiable materials.

Survey

The initial assessment helped the library staff and conservator understand the scope of a preservation survey and agree on the goals. The goals of the survey were identified as follows:

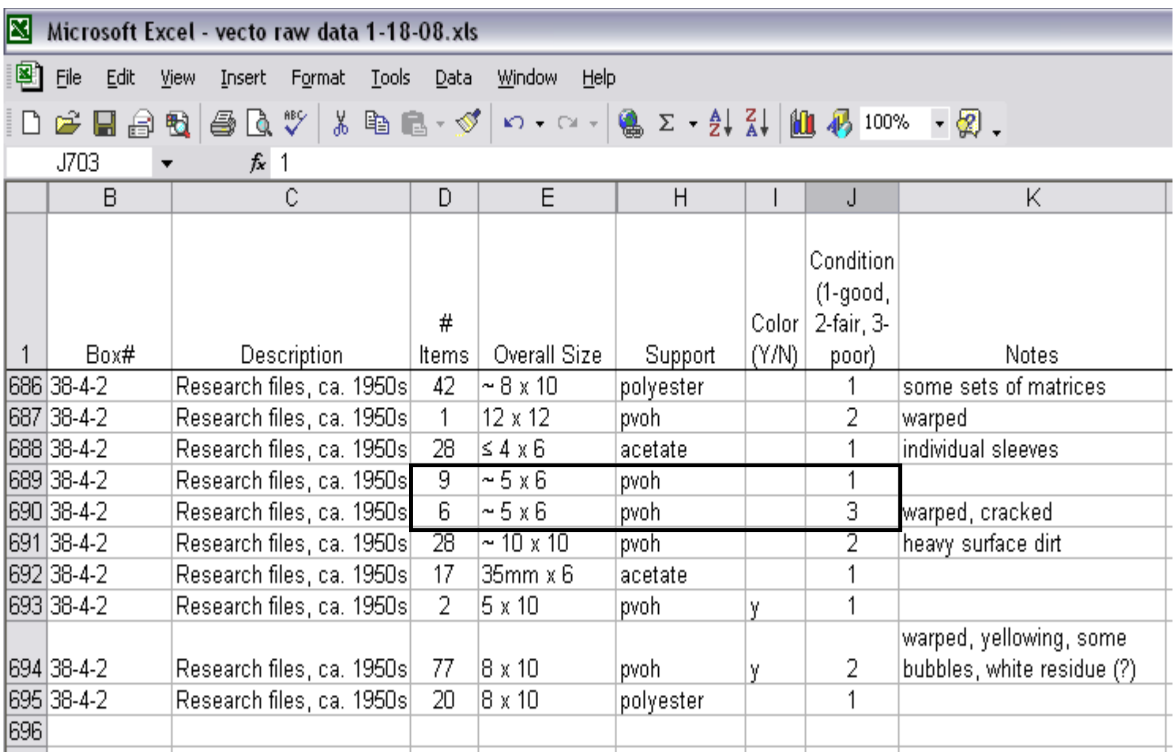
- *Assess overall condition*. How pervasive was the deterioration? Since the materials were recently received by Baker Library and would be stored in very good environmental conditions from that point on, it was considered to be the right time to get a baseline of the health of the collection.
- *Determine specific deterioration characteristics*. Because there are no known comparable collections of Vectographs in the world, Vectograph deterioration was an unstudied phenomenon. Do the relative conditions of segments of the collection provide clues to the deterioration process?
- *Note items too deteriorated to use*. If library staff decide in the future to deaccession select unusable Vectographs that are not part of a set or do not have historical significance, the survey should identify possible candidates.
- *Identify types of plastics.* When possible, this was done through standard means, such as context, edge printing, notch codes and polarizing filters. It was discovered through the course of the survey that polyvinyl alcohol has a cloudy blue appearance when seen through polarizing filters.
- *Develop housing and storage plan*. It was decided early on that frozen storage would be necessary for the long-term storage of the Vectographs and related acetate material. The survey was designed to help calculate how much space would be needed.
- *Determine preservation priorities*. The survey would help identify areas of the collection where rehousing efforts should begin and where additional analysis was needed.

It was clear that the survey design needed to be detailed enough to provide item counts that could be sorted by size to aid in the housing plan, as well as be sorted by condition in order to determine the stability of the Vectographs, identify preservation priorities, and recommend items for possible deaccession. An item-level survey was ruled out because there were several thousand items, most with no specific identifier such as a number or title.

Therefore, a simple Excel spreadsheet was used to perform a box-level survey. For each box, items were broken down into *categories* based on size, material composition and condition, which enabled the data to be sorted in a number of ways. See figure 5 below for data collected for a typical box. Due to the excessive offgassing of the cellulose acetate and cellulose acetate butyrate, the survey was conducted in a fume hood located on-site at Baker Library. The time spent assessing each box ranged from ten to forty-five minutes, depending on the uniformity of the material. The survey and data analysis took a total of 105 hours over a span of twelve months and was performed by a single conservator.

Each item was briefly assessed for overall condition. Again, since the individual items were not numbered, it was not possible to record the condition of particular items. Instead, within each box, items of the same size and material were grouped according to a condition scale of 1-3. Level 1 indicated good condition, even if there was some minor damage. Level 2 indicated fair condition, meaning there was damage/deterioration but the item was still usable. For example, a warped Vectograph with good image would be considered level 2. Level 3 indicated poor condition that made the photograph unusable. A number of level 3 items that are unusable have been marked for recommended deaccessioning.

During the course of the survey, measurements in inches were recorded on the spreadsheet. Later during data analysis, the measurements were rounded up to standard housing sizes when possible with the exception of the Vectographs whose most common size was 6x9 inches. On the spreadsheet, the collection items were grouped into a set number of standard sizes so that the approximate number of enclosures and boxes could be estimated.


Microsoft Excel - vecto raw data 1-18-08.xls

File Edit View Insert Format Tools Data Window Help

J703 fx 1

	B	C	D	E	H	I	J	K
1	Box#	Description	# Items	Overall Size	Support	Color (Y/N)	Condition (1-good, 2-fair, 3-poor)	Notes
686	38-4-2	Research files, ca. 1950s	42	~ 8 x 10	polyester		1	some sets of matrices
687	38-4-2	Research files, ca. 1950s	1	12 x 12	pvoh		2	warped
688	38-4-2	Research files, ca. 1950s	28	≤ 4 x 6	acetate		1	individual sleeves
689	38-4-2	Research files, ca. 1950s	9	~ 5 x 6	pvoh		1	
690	38-4-2	Research files, ca. 1950s	6	~ 5 x 6	pvoh		3	warped, cracked
691	38-4-2	Research files, ca. 1950s	28	~ 10 x 10	pvoh		2	heavy surface dirt
692	38-4-2	Research files, ca. 1950s	17	35mm x 6	acetate		1	
693	38-4-2	Research files, ca. 1950s	2	5 x 10	pvoh	y	1	
694	38-4-2	Research files, ca. 1950s	77	8 x 10	pvoh	y	2	warped, yellowing, some bubbles, white residue (?)
695	38-4-2	Research files, ca. 1950s	20	8 x 10	polyester		1	
696								

Figure 5. Data recorded for a single box. Note fifteen 5x6 Vectographs were separated into two categories because some were in good condition, others in poor condition. After the survey was complete, sizes were rounded up to standard housing supply sizes, eg. 5x6 became 5x7. The designation "pvoh" was a shorthand label for Vectographs. The support would have also contained a cellulose acetate or cellulose acetate/butyrate core. Examples of unsupported pvoh were found in the collection and subsequently identified in the notes field.

Survey Results and Deterioration Observations

The survey results indicated that there are approximately 4,600 Vectographs and almost 7,000 negatives, matrices, and other film items in the Polaroid Corporation Records. It also revealed that the deterioration was not as pervasive as had been feared. 82% of the Vectographs were identified as being in good or fair condition. The 18% considered to be severely deteriorated were characterized by any or all of the following: fine cracking or crizzling of the polyvinyl alcohol layers, image dissolution, and acetate warping and channeling. The major deterioration types are described below.

Deterioration of the cellulose acetate or acetate butyrate core. Many Vectographs had the appearance of severely channeled acetate film, with the Vectograph becoming very brittle and puffing up to around a half-inch thick. It is well known that deteriorated cellulose acetate has a characteristic odor of acetic acid or vinegar. Deteriorated cellulose acetate butyrate releases butyric acid which has a strong rancid odor. Acetic acid and butyric acid released as off-gassing can speed the deterioration of adjacent material but it is unclear to what extent this mechanism played in the deterioration of this collection. Many of the deteriorated Vectographs were found in groups, many of which were likely to have been made from the same stock material at the same time. Occasionally a catastrophically deteriorated Vectograph was in close contact with another Vectograph in fair or good condition, with seemingly little adverse interaction.

Figure 6. Top: white crystalline deposit barely visible at arrow, October 2007. Bottom: same Vectograph in December 2008. Polaroid Corporation Records, Baker Library.

In other instances, Vectographs clearly suffered from some autocatalytic reaction when housed in enclosed spaces such as between glass as lantern slides or in plastic (including polyester or Mylar®) sleeves. Vectographs that had been housed in polyester sleeves by Polaroid Corporation during the 1990s were in various stages of deterioration and often had white crystalline deposits on the surface of the prints. Prior to the survey, one Vectograph that remained in a polyester sleeve was observed to have such a small bloom (~ 2mm x 2mm) of white crystalline material. Within fourteen months, the Vectograph was completely channeled and unusable. (See figure 6.) With this in mind, Vectographs in polyester sleeves were targeted as a priority for rehousing into paper sleeves during the rehousing phase due to the potential rapidity of the decay.

A sample of white crystalline deposit was analyzed by pyrolysis gas chromatography mass spectroscopy (GCMS) at Harvard Art Museum's Straus Center for Conservation and Technical Studies. Senior Conservation Scientist Narayan Khandekar indicated that the accretions were phthalate plasticizers that had migrated to the surface but could not freely evaporate because of the polyester sleeve. As with cellulose acetate negatives, removal of plasticizers results in embrittlement and shrinking of the plastic support.

Figure 7. Delamination of polyvinyl alcohol layers in color Vectograph. Polaroid Corporation Records, Baker Library.

Adhesion problems. In some Vectographs, the aluminum paint used on the back of reflectance prints is poorly adhered, causing blisters and flaking. In other cases, particularly with color Vectographs, the polyvinyl alcohol layers have delaminated from the acetate core. (See figure 7.) In discussions with contemporary Vectograph makers, layer delamination is occasionally seen immediately during processing, indicating an original flaw with the material. Less frequently, delamination occurs as the acetate or acetate/butyrate core shrinks.

Image and polyvinyl alcohol deterioration. Image deterioration is difficult to classify because flaws in the original processing can mimic image fading or staining. Since many of the Vectographs in the Polaroid Corporation Records represent the early development of the process, it is unclear if the samples were retained because they were flawed and hence were instructive to the manufacturer. While iodine formulations and other modifications were designed for warmer or cooler toned images, it is unlikely that two tones in the same Vectograph would have been created intentionally because both sides would have been inked at once with the same batch of solution. When one image of a Vectograph is warmer than the other, it is possibly due to some failure (or absence) of coating on one side to protect the polyvinyl alcohol from oxidation. Local spots or stains may be the result of deterioration or may be processing flaws. For example, Vectograph makers report that a trapped air bubble during printing will result in an area with no image while a piece of dust or debris will result in a dark spot.

Figure 8. Magnified detail of image deterioration. U.S. NavyTraining Kit. Polaroid Corporation Records, Baker Library.

Some Vectographs in the collection exhibited a feathering or ghosting around the image, accompanied by fine cracks. (See figure 8.) This may be a precursor to a total dissolution of the image layer into a brown and white mass, as Vectographs with both types of deterioration were often found in close proximity, particularly in the U.S. Navy Training Kit booklets. (See figure 9.) There were several copies of specific Training Kits and severe deterioration was noted on exactly the same Vectographs in each of the booklets, indicating that particular prints were made in a batch and all suffered from the same improper processing or inherent material flaw. Often, completely deteriorated Vectographs were in the same display pocket, back-to-back with one in very good condition.

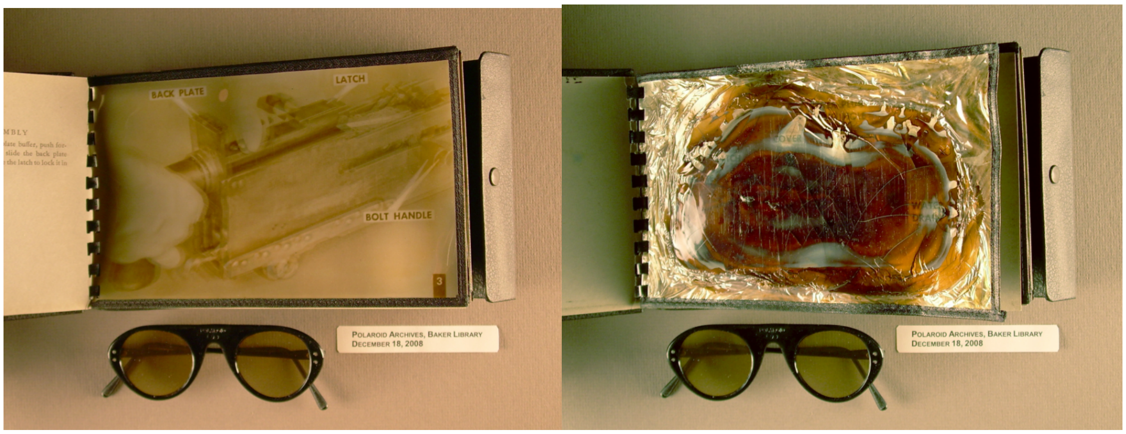


Figure 9. Left: Vectograph in very good condition. Right: Catastrophically deteriorated Vectograph in same booklet as one on the left. U.S. Navy Training Kit. Polaroid Corporation Records, Baker Library.

Very infrequently, a series of diagonal, parallel hash marks can be seen in the polyvinyl alcohol layer. The hash marks are clear in color and sometimes intersect at a 90º angle. They appear to be following the direction of polarization. Observations from workers at Stereo Optical indicate that the lines appear immediately when a Vectograph has been left too long in the so-called fixer solution of hot boric acid. No research on the mechanism of Vectograph image deterioration has been found.

Preservation Plan: Rehousing and Cold Storage

The deterioration of the Vectographs cannot be reversed. However, as with other photographic materials, the rate of deterioration can be slowed down through storage at low temperatures. Cold or frozen (less than 32ºF) storage requires some caution. Plastics are often brittle at low temperatures and pressure-sensitive tapes can fail. Additionally, strict acclimation protocols must be followed when removing items from cold storage before they can be handled by staff or researchers. The collection was packed into a 74 cubic foot, So-Low lab and pharmacy freezer, set for 0°F. It was necessary to purchase additional shelves to accommodate the most efficient packing of the freezer.

Commercial freezers can have high and fluctuating relative humidity, therefore proper packaging is crucial. Packaging of the Vectograph material in the Polaroid Corporation Records first involved acclimatization of the rehoused collection in the Baker Library Collections climate controlled stacks (60°F, 35%RH). Boxes were then double-wrapped in 0.004” thick polyethylene (LDPE film) because many boxes were odd sizes and did not fit into heavy-duty zip bags. The polyethylene used has an operating range specified to be -60 to 150°F. The polypropylene carton-sealing tape (3M #375) was selected for its ability to withstand freezing temperatures up to -30°F if applied at temperatures between 55 and 120°F.

Cobalt salt-based RH indicator cards are not calibrated to work in freezing temperatures. Therefore, acting on advice from conservator Constance McCabe, cover sheets were fabricated and affixed on the cards showing the proper scales for reading at both room temperature and at 0°F. (See figure 10.) For each box, two RH indicator cards were placed in visible locations under the plastic for easy monitoring by library staff. One card was placed just below the outer layer of plastic. If the outer plastic becomes compromised, the first card will reflect the change in humidity. Library staff are then instructed to look at the second RH indicator card to see if the inner layer of plastic wrap continued to protect the contents of the box in spite of the breach to the outer layer. Library staff will continue to monitor the cards on a regular basis and acclimate and re-wrap boxes when necessary.

%RH
Read top of blue
between blue & pink
at correct temperature

75°F		0°F
10		X
20		X
30		X
40		10
50		20
60		30
70		40
80		50
90		60
100		70

Read here
for freezer

Figure 10. Temperature conversion template for RH indicator card.

Due to the complications cold storage can bring to item retrieval, the finding aid for the Vectographs was made to be sufficiently detailed without item-level processing. Two boxes were assembled to contain a representative sample of Vectograph processes, types and products. Although still stored in frozen storage, the boxes are intended to serve the research needs of all but the most specialized researchers and limit the number of boxes that must be retrieved from the freezer. For the most part, the other boxes were packed predominately by size in order to maximize the most efficient use of space within the freezer.

As with all photographic materials, high quality, lignin-free storage materials were specified. Buffered paper enclosures and boxes were used for rehousing. Where possible, enclosures that have passed the Photographic Activity Test (PAT) were used. The PAT is designed to ensure that the enclosures will not cause fading or staining of photographic materials over time. However, some sizes or types of enclosures were not available with the PAT designation. In those cases, high quality buffered material that would be suitable for use with paper-based collections were used.

Some Vectographs and associated material were kept in their original enclosures because the enclosures had significant inscriptions identifying the item, date, creator, and signature of the creator as well as signature of a witness, making the enclosure a document in its own right. Other original enclosures, such as office file folders, were also retained if the enclosure was in good condition and could physically support the photographs. The acidic nature of the original enclosures was less of a concern because it was clear that the collection would be stored in frozen storage. The primary concerns were that the items were physically protected and that each Vectograph had its own enclosure. These concerns were balanced against the need to keep the collection from expanding too much so that it could fit in the freezer. Some techniques for achieving these goals were as follows:

- When possible, items were housed with items of like size in order to minimize the size box needed. Groups of items that were clearly meant to be part of a set were kept together, with the largest applicable size enclosure predominating. For the most part, the order of original material did not need to be maintained. The archivist maintained documentation that could intellectually reconstruct the original box contents.
- Vertical storage was used for most items less than 8-1/2 x 11 inches.
- Only Vectographs were given individual enclosures. Other material was organized into folders, with interleaving or paper-weight subfolders as necessary.
- Since most Vectographs measured 6 x 9 inches, standard archival enclosures were not available. In order to save room in the freezer, 8x10 archival sleeves were trimmed to make paper “L-sleeves” measuring 6x10 inches. Custom clamshell boxes – called Microclimates™ boxes from Custom Manufacturing Incorporated (CMI) – were then made to accommodate these groups of Vectographs.
- Original enclosures were photocopied and discarded when the inscriptions were deemed to have informational value but not inherent value, like those signed and witnessed.
- A small number of Vectographs were warped so they nested together. To save space these were kept together without individual enclosures.
- Custom spacers or frames made of archival corrugated board were made to protect curled or warped items.

In order to rehouse over 12,000 items, two technicians worked a combined total of 152 hours, spread out over six months. Planning for cold storage and the manuscript librarian’s work on refining the intellectual control spanned an additional six months, with packaging for the freezer taking three additional days.

Conclusion

Vectographs are images that rely on the properties of polarized light to create a three-dimensional effect. The Vectograph material in the Polaroid Corporation Records at Harvard Business School’s Baker Library has the potential to be a valuable resource for researchers. Not only are Vectographs unique in the history of photography, the development and marketing of this innovative product sheds light on the Polaroid Corporation’s internal workings, wartime contributions, relationship with the motion picture industry and more.

Unfortunately, the Vectographs are made with inherently unstable materials, requiring close attention to their long term storage. The polyvinyl alcohol layers and cellulose acetate or cellulose acetate/butyrate core can be vulnerable to deterioration, such as loss of plasticizer, particularly when kept in an enclosed environment like plastic sleeves. The deterioration of Vectographs cannot be reversed but can be slowed through storage in a cool, dry environment with proper housing materials.

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Weissman Preservation Center, Harvard University Library

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The Collection of Historical Scientific Instruments at Harvard University

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