THE POLAROID PRESERVATION PROJECT

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Author's Declaration Page

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Abstract

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The Polaroid Preservation Project was born from a fascination with 20th-century photographic materials, primarily instant photography. This thesis addresses preservation considerations for Polaroid photographs created in the last half of the twentieth century. My research references the *Fade Resistance Collection,* a collection of over 3500 instant photos collected by artist Zun Lee of African American families held by the Art Gallery of Ontario (AGO) in Toronto, Canada. This collection, recently acquired by the museum, is scheduled to be exhibited, providing a touchstone for strategies around identifying, storing, preserving, and exhibiting these unique photographic objects. The thesis is broken down into four parts; 1) Background History; 2) Composition of Polaroid Instant Photographs; 3) Deterioration of Polaroid Photographs; 4) Housing, Storage and Display of Polaroid Photographs. Additionally, I will be publishing a website that will serve as a platform for my research and help provide better access for researchers and others.

Acknowledgements

My sincerest thanks to my first reader, Professor Robert Burley, who, without his help and motivation, this project would not have gained any steam or traction. This thesis was born out of a Model 150 Land camera thrust into my hands and asked to figure it out and make it work. Well over a year later, this project has transformed from an interest in instant photography into a somewhat all-consuming passion that will ultimately continue once this portion of my schooling is completed.

Thank you as well to second reader and AGO Curator, Photography, Sophie Hackett, who has been a guide throughout this project and has provided me with support and access to the AGO's collection of instant photographs. Special thanks to FPPCM faculty Professor Marta Braun, and Associate Program Director Thierry Gervais, who have provided me with guidance and counsel throughout the program and have helped me shape this thesis into what it is today.

I want to thank Holly Pruner for her constant support and frequent text edits, without which this project would have indeed suffered. I'd also like to thank Noah Henderson, whose shared passion for instant photography has been a tremendous motivator. My warmest thanks are also extended to my parents, who have provided me with the work ethic and worldview that has gotten me as far as I have.

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1. Introduction

Photography in the 21st century has been redefined by digital imaging technologies, while the analogue photographic processes that shaped the photographic industry of the 20th-century have become increasingly scarce and therefore expensive to acquire. Former photographic giants like Kodak, Agfa, Polaroid, Ferrania, and Konica, among many others, were unable to compete with digital photography. They were sluggish and unresponsive as digital imaging products took hold of the consumer market— billion-dollar companies bleeding themselves dry as they failed to adapt. While film is still available many of the companies once responsible for making it have disappeared, and the ones that remain do so at a greatly diminished capacity. With this comes a profoundly tragic loss of information: a major pitfall of 20th-century photography is that much of the innovation and the science behind it is locked behind patents held by large corporations that are struggling to survive or have filed for bankruptcy. Individuals wishing to create many 19th-century photographic processes can simply access the published texts and recipes left behind by inventors and/or the enthusiastic practitioners that followed. All that is required are the ingredients along with a little time and patience. With most commercially manufactured 20th century materials and processes, the individual enters a maze of locked doors which prevent access to information, materials, tools and technologies.

Polaroid is one of the companies that could not weather the digital storm that arrived with the new Millennium. Formed initially as a polarizing filter manufacturer in 1932, Polaroid would

become better-known as the company that invented instant photography, becoming synonymous with it. Founder Edwin Land and his company would be responsible for one of the most significant leaps forward in the photographic industry during the 20th century, to be surpassed only by digital photography in the latter half of the century. With the technology debuting in the winter of 1948, Polaroid would become entrenched in the photographic industry for decades to come, with consumers and professionals all over the world drawn to this new mode of photography.

Polaroids are the 20th-century version of the photography's first iteration, the daguerreotype, a seemingly magical process that took society by storm. With a few exceptions, this photographic process created one-off photographs instantly eliminating the onerous wait times for darkroom processing and printing. Initially, a roll film, which held the negative and positive portions on separate rolls, would be sandwiched together by a series of rollers, causing a pod of chemicals to burst and develop the image inside the camera system. This process would be refined into what is known as pack film, or more commonly known as peel-apart. The peel-apart format would then be further refined into integral film. With the peel-apart variants, the film's negative portion would be stripped away from the print once it had fully developed. By contrast, Polaroid's final and most advanced integral film format kept this layer within itself, neutralizing development through a series of chemical layers housed within the photograph package.

Instant photography, in many ways, became synonymous with vernacular photography, simply because the products were so easy to use. They were first marketed to consumers—with the promise of creating tangible renderings of life's significant moments in a mere sixty seconds. The popularity of the medium on both a consumer and professional level speaks to its widespread appeal. *Fade Resistance Collection*, created by artist Zun Lee, now housed at the Art Gallery of Ontario (AGO) is just one example of a large culturally-significant photographic collection, primarily comprised of Polaroid's instant prints. Created as personal objects to be treasured and loved, these Polaroids not only provide an overview of the evolution of instant photography processes but also present a full range of preservation and conservation issues specific to this type of photographic object.

The *Fade Resistance Collection* held in the AGO's photography collection is an essential component of this thesis project. Composed of some 3500 instant photographs, with the large majority being of the integral film format (Type SX-70) this collection was used as a case study for instant photographic material deterioration. Artist Zun Lee collected orphaned photographs depicting African American life from the 1950s to the 1990s. This collection showcases vibrant narratives that are often overlooked: family depictions that document Black life and love outside the white gaze. This collection presents personal stories made by African American families that have been rarely seen and serves as a visual record to counter stereotypical portrayals of African Americans in the mainstream media in the 20th century. The AGO has continued its drive to shift the narrative of photography with a "maximum openness too engaging with the relationship of

photographs to broad social, political, and cultural forces over time."[1] With that said, the collection is composed of fragile photographic objects. In the coming year, the *Fade Resistance Collection* will be exhibited at the AGO and may tour to additional venues. Finding a balance between the needs of display and the needs of the physical objects themselves is a point of tension in this project.

The project's scope was initially defined as a preservation plan for peel-apart instant photographic materials, as this medium has recently obsolesced. But as the pandemic limited my access to valuable information, I had widened the scope of the project to incorporate the integral film variants of Polaroid photographs. The Polaroid Corporation, like many of its contemporaries from the 20th-century, was notoriously secretive. Hiding information about the composition and stability of its photographic processes. This decision was a prudent business strategy but from a cultural heritage perspective, this decision created a vacuum of knowledge after the company's collapse in 2008.

My initial plan was to research the general composition of instant photographs, finding the exact chemical and physical composition of Polaroid's instant pictures. This approach was successful to a certain degree, but I soon discovered many of the resources were locked behind paywalls or stored in inaccessible library reference sections. During the pandemic, libraries suspended all activities related to digitization requests. One such example is the Baker Library at Harvard University that houses the entire corporate archive of the Polaroid Corporation. Included

[1] Hackett Sophie. "Encounters in the Museum: The Experience of Photographic Objects." Essay. In Thierry Gervais, Ed. *The "Public" Life of Photographs*. Toronto, Canada: Ryerson Image Centre, 2016. 234-263

in the archive is the correspondence between Vivian Walworth, the chair of the Image Stability Committee, and the staff of technical advisors who worked under her. These reports are still pending digitization, some six months after my request was made. To follow this up, I attempted to contact surviving members of the committee without success.

I continued to follow bibliographic information to locate the remainder of my resources for the research component of this thesis. This provided the most helpful information that was generally available to me. By doing this, I have aggregated a bibliography that covers composition, film identification, deterioration and conservation recommendations. My survey of these sources revealed that the current status of conservation strategies appears outdated, and through my informal survey of professionals in the field of collections conservation, I discovered that research and preservation projects pertaining to Polaroid materials are far and few between.

My thesis will focus primarily on Polaroid's peel-apart format, as this is the format that has most recently been rendered obsolete. Since these formats suffer routinely from inferior light fading stability, and most types of this film do not produce a usable negative, these prints should be displayed with caution. With this in mind, I will create recommendations for both the housing and long-term storage of these photographs, as well as how best to present them for exhibition. This work includes accurately dating and identifying the specific film types from production codes on the versos of various instant prints, and researching the chemical formulas used in these prints to help understand how they are deteriorating. Pack film is unique in its materiality and understanding these exclusive characteristics are crucial to the long-term preservation of these

photographic objects. After the Polaroid Corporation's demise in 2006, peel-apart film's sole remaining producer was Fujifilm. In 2016, Fujifilm also announced that it would cease production and begin to decommission the machinery required to produce this film. This announcement brought with it the impetus to develop a comprehensive preservation plan for the presentation and long-term storage of this format.

In addition to this thesis, I have created a website to provide better access for researchers and others interested in the long-term storage and preservation of Polaroid's instant photographic processes. This website contains multiple image galleries, with examples from *The Fade Resistance Collection* and my collection. These images highlight both the process and forms of deterioration that is common among Polaroids. The website also includes a brief history of the Polaroid Corporation, a guide for identifying film type and year of manufacture. There is a small video gallery that provides concise and instructional videos on exposing and finishing of instant photographs as well. My aim with this website is to create a dialogue with its users and allow for user participation by sourcing examples to fill in any missing examples.

The following will be an overview of the available conservation research pertaining to Polaroids and other instant photographic processes. Through direct consultation with conservators, chemists, photographers and curators this thesis will strive to provide a guide for collections managers and the general public to adequately care for and preserve instant photographs.

2. Literature Survey

This literary survey addresses the published sources that deal with conservation and preservation issues related to Polaroid instant photographs, specifically problems associated with the pack and integral film formats. I understood from the outset that this survey would prove difficult for two reasons: first, there is a dearth of published sources about this subject and secondly, many of the available sources are somewhat suspect because they were produced by the Polaroid Corporation who naturally wanted to present only best-case scenarios about their products. Adding to these problems, much of the technical knowledge related to Polaroid products is either locked away in inaccessible libraries and archives - or it lives in the minds of former Polaroid employees. When the company was dissolved in 2008 many of the internal documents were discarded and as of this date none of the former employees have been motivated to write about the chemical and/or physical nature of Polaroid photographs. Starting in the 1990's independent researchers and museum conservators began to address the stability problems of Polaroid photographs because by this time, these types of objects were collected by major museums. In the latter half of the 20th century there were innumerable artists who had been drawn to the unique character of these materials and had employed them throughout their careers. Major figures such as Andy Warhol, Chuck Close, David Hockney and Robert Mapplethorpe each produced significant works of art that had both monetary and cultural value. However, the subject of Polaroid materials and their preservation remains a mystery to many experts in the field and it would appear there is still much work to be done. While this paper focuses on the preservation issues related to Polaroid materials it was important to establish the

significance of these photographs through corporate histories of Polaroid and the place of the images in contemporary visual culture.

2.1 Corporate History and Related information

The First Thirty Years: A Chronology of Polaroid Photographic Products details the company's first thirty years from a technological perspective.[2] This publication is helpful as the most significant technological advancements in instant photography happened within this period. Of note in this publication is the emphasis on the camera equipment and the side-by-side evolution of instant camera and film. Additionally, this publication confirms date ranges for certain instant films that have been incorrectly applied to specific films in other resources. *Instant Photographic Systems*) provides an update to some of the information previously published by the Polaroid Corporation.[3] While this publication was intended as a sales brochure, it still holds relevant technical data about available film and camera equipment at this stage in the company's history. John Wolbarst's *Pictures in a Minute* is an early iteration of a commercial user's guide to Polaroid photographs.[4] This guide provides little technical information on the film but is remarkably useful in understanding how to expose and finish instant photographic products. This text focuses on the roll film types, which today is the least accessible form of instant photographs.

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[2] Polaroid Corporation . *The First Thirty Years : A Chronology of Polaroid Photographic Products*. Cambridge , MA: Polaroid Corporation, 1978.

[3] Polaroid Corporation . *Instant Photographic Systems* . Boston, MA: Polaroid Corporation, 1982.

[4] Wolbarst, John. *Pictures in a Minute*. New York, NY: Blanchard Press, 1960.

Instant: The Story of Polaroid is a remarkable text on the rise and fall of the Polaroid Corporation and provides insight into the working life of the leader of the company Edwin Land.[5] This text serves as the most comprehensive and digestible history of the company. Bonanos goes into great detail about the company's early years and highlights the creation and eventual release of instant film in 1948. While the text provides a fascinating but somewhat nostalgic read, Bonanos does continue to perpetuate some of the false talking points of the Polaroid Corporation concerning the long-term stability of Polaroids. *The Collapse of Polaroid – 4 Reasons Why Polaroid Failed and What We Can Learn* provides a brief but illuminating examination of the business and strategy failings of the company that defined instant photography.[6] Gaudet's analysis of the company's failings generally echoes much of the agreed-upon causes of the company's bankruptcy but serves as another source to help illustrate the company's history.

The Polaroid Image as Photo-Object provides an excellent perspective on the cultural significance of Polaroid photographs as art objects.[7] Buse discusses the Polaroid photograph as a physical object and how its physical materiality manifests itself in the digital realm. Polaroids exist within a frame, and when scanned, this frame is carried forward to perpetuate the

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[5] Bonanos, Christopher. *Instant: the Story of Polaroid*. New York, NY: Princeton Architectural Press, 2012.

[6] Gaudet, Charles. “The Collapse of Polaroid – 4 Reasons Why Polaroid Failed and What We Can Learn " Predictable Profits.” Predictable Profits, October 8, 2020. https://predictableprofits.com/the-collapse-of-polaroid-4-reasons-why-polaroid-failed-and-what-we-can-learn/.

[7] Buse, Peter. “The Polaroid Image as Photo-Object.” *Journal of Visual Culture* 9, no. 2 (2010): 189–207. https://doi.org/10.1177/1470412910372754.

materiality closely associated with instant photography. This provides a useful theoretical foundation while approaching collections of Polaroids in the context of preservation. This is especially important when considering the avenues of display both physically and digitally.

The Polaroid Book by Barbara Hitchcock features a wide range of Polaroid work by major figures in the 20th century art world it additionally provides an insider's view of the company's history and its corporate ethos from the perspective of the curator of the extensive Polaroid Collection.[8] This includes its support of visual artists and photographers working with Polaroid materials over the many years. This text also features a full chapter on the evolution and design of the innovative camera systems essential to the instant photographic process.

2.2 Deterioration

Ansel Adams's book *Polaroid Land Photography* was written as an in-depth guide to Polaroid image production.[9] Of note is Adams's insistence that users of this format understand the many technical considerations that need to be applied, with a degree of nuance, in order to achieve long-lasting images (e.g. adequate print coating, toning of images in conventional photographic print toners). Constance McCabe's chapter "Coatings on Polaroid Prints" in *Coatings on Photographs Materials, Techniques, and Conservation* provides tremendous insight

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[8] Hitchcock, Barbara. *The Polaroid Book*. Taschen, 2005.

[9] Adams, Ansel, and Robert Baker. *POLAROID LAND PHOTOGRAPHY*. BOSTON: NEW YORK GRAPHIC SOCIETY, 1978.

into one of the primary considerations when preserving Polaroid photographs from the 1950s to the 1970s: the incorrect application of the print coater.[10] Early on in development, it was noted that Polaroids suffered from severe fading of the image surface and significant yellowing in areas inadequately coated in the Polaroid coating solution, this deterioration was due to residual developing chemistry left on the print surface. As noted by Adams and McCabe, the incorrect coating of prints is one of the most common conservation issues facing black and white peel-apart film from this era. The final sections of The Library of Illinois website "Preservation Self-assessment Program" deal with the damage inherent to and affected upon black and white Polaroid processes.[11]

The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures by Henry Wilhelm and Carole Bower focuses on photographic stability in relation to other types of colour processes.[12] Wilhelm and Bower discovered that unlike the traditional and more commonly used Type C colour prints, the dyes in Polaroid colour prints are considered stable. Compared to other instant formats, the peel-apart variant has superior stability in dark storage, due to the stripping of the negative after development; however, these prints suffer from poorer light fading. *Storing, Handling, and Preserving Polaroid Photographs,* published by the Polaroid Corporation, discusses the issues

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[10] Mesquit, Teresa, and Barbara Lemmen. “Coatings on Polaroid Prints.” Essay. In *Coatings on Photographs: Materials, Techniques, and Conservation*, edited by Constance McCabe, 180–99. Washington (D.C.), D.C: Photographic Materials Group, American Institute for Conservation of Historic and Artistic Works, 2005.

[11] Preservation Self-Assessment Program.” Preservation Self-Assessment Program (PSAP) | Instant B&W Photographs. Accessed April 22, 2020. https://psap.library.illinois.edu/advanced-help/photo-instant-bw.

[12] Wilhelm, Henry, and Carol Brower. *The Permanence and Care of Color Photographs Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures*. Grinnell, IA: Preservation publishing company, 1993.

that affect Polaroid products produced from 1948 to 1983, when the book was published.[13] The original Polacolor film tended to fade noticeably after they were exposed to bright light for a moderate period of time. In 2013, photo conservator Sylvie Pénichon, published her research on 20th century colour photographic processes in *Twentieth-Century Color Photographs*: *Identification and Care*.[14] In a chapter addressing instant photographs she states, "dye diffusion prints have moderate dark stability and poor light stability [however] print stability was constantly improved after the first colour instant prints were introduced in 1963. Peel-apart prints are susceptible to fingerprints and surface abrasions, larger prints are easily creased." When exposed to atmospheric sulfur dioxide and moisture the dyes can shift. An online resource created by the Image Permanence Institute, The Graphics Atlas outlines aspects of physical deterioration such as colour shifts, fading, and disfiguration of the print such as curling and cracking.[15] This resource also has photographic examples where the viewer can navigate the print's surface, examining the decay types.

2.3 Visual identification

Having visual examples is essential to understanding and familiarizing oneself with the various types of preservation issues discussed above. Examples are also very important references for dating Polaroid photographs. Due to the short production run, examples of the

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[13] Duffy, Pamela, ed. *Storing, Handling and Preserving Polaroid Photographs: a Guide*. Boston Mass., MA: Focal Press, 1983.

[14] Pénichon Sylvie. "Dye Diffusion Process." Essay. In *Twentieth-Century Color Photographs: Identification and Care*, 232–73. Los Angeles, CA: Getty Conservation Institute, 2013.

[15] "Identification." Graphics Atlas: Identification. Accessed April 22, 2020. http://www.graphicsatlas.org/identification/?process_id=91#objectview.

original sepia film (Type 40,1948-50) are rare, but Harvard University's Baker Library has an online exhibition *At the Intersection of Science and Art* with high-quality examples available.[16] *Coatings on Photographs Materials, Techniques, and Conservation* has a timeline of every black and white instant format that Polaroid produced, and relevant, high-quality visual identification examples.[17] The Graphics Atlas created by The *Image Permanence Institute* at the Rochester Institute of Technology provides general information on identifying photographic objects.[18] It has two categories for instant images: diffusion transfers, or black and white peel-apart photos, and a second category for dye diffusion transfers, the colour format of peel-apart film. Unfortunately, the examples are quite limited, with their website only showcasing four images total.

2.4 Chemical Composition

The chapter "Coatings on Polaroid Prints" in *Coatings on Photographs Materials, Techniques, and Conservation* proved to be invaluable to my research.[19] The chemical composition of instant photographs is discussed, detailing how the image is produced by the migration of unexposed silver halides from the negative to the positive. It also provides an analysis of the coatings applied to the image surface of the positive portion, which is where most

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[16] www.shadyhillstudios.com, Shady Hill Studios -. "Baker Library Historical Collections." Polaroid: At The Intersection of Science & Art: Edwin H. Land and the Polaroid Corporation - Harvard Business School. Accessed December 5, 2020. https://www.library.hbs.edu/hc/polaroid/.

[17] Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

[18] Graphics Atlas,"Identification."

[19] Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

conservation issues arise in black and white peel-apart prints. Ansel Adams's book *Polaroid Land Photography* was written as an in-depth guide to Polaroid image production.[20] As an artist and technician, Adams's attention to detail is readily apparent in this text, with extensive research put into creating the best possible image on this film format. This publication deals only with the film formats available at the date of publication. As such, some of the information is dated or outright obsolete. The appendices are among the most valuable portions of the book, detailing film testing procedures and the chemical formulas that would have been used.

The "Dye Diffusion Processes" chapter of conservator Sylvie Pénichon's *Twentieth-Century Color Photographs*: *Identification and Care* provides an extensive overview of colour instant photographs, concerning itself mostly with Polaroids, but the text features some information about dye diffusion images manufactured by Kodak and Fuji as well.[21] The chapter goes into great detail about the films' physical construction, highlighting how the different coloured layers of emulsion were made illustrated with diagrams. This chapter analyzes the successive developments of the colour instant process, from the initial release of Polacolor, to SX-70, Polacolor 2, Polaroid 20x24, and lastly, Polacolor ER, Time Zero and the 600 and Spectra systems. These later types of film represent the last significant changes to the film's dye composition before the company's steady decline. *The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures*

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[20] Adams and Baker, *POLAROID LAND PHOTOGRAPHY*.

[21] Pénichon,"Dye Diffusion Processes," 232–73.

by Henry Wilhelm presents data on Polaroid photographic stability in relation to other types of colour processes.[22] The text is a scientific analysis of colour photographs, and as such, the author has spent many hours testing photographs for long-term stability through accelerated aging. The text compares the light fading stability of instant colour film against its colour contemporaries, such as Fujicolor and Ektacolor, produced by Fujifilm and Kodak, respectively.

2.5 Storage and preservation

Twentieth-Century Color Photographs: *Identification and Care* (1st edition 2013) chapter "Dye Diffusion Processes" by Sylvie Pénichon offers basic preservation and storage recommendations.[23] Pénichon's guidelines for storage aim to prevent dye diffusion print fading and deterioration— both are easily accelerated by high humidity and heat. Peel-apart materials fare better in the dark since the negative and chemicals are discarded after the completion of processing. *Storing, Handling, and Preserving Polaroid Photographs: The Polaroid Corporation Guide* this book was published from data compiled by the Image stability committee of Polaroid.[24] This guide is the first and only publication from Polaroid that addresses the storage and safe handling of their instant products. This guide should be approached with some skepticism as the company had a vested interest in making their products appear to be long lasting.

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[22] Wilhelm and Brower, *The Permanence and Care of Color Photographs*.

[23] Pénichon,"Dye Diffusion Processes," 232–73.

[24] Duffy, Storing, Handling and Preserving Polaroid Photographs.

Coatings on Photographs Materials, Techniques, and Conservation offers the same preservation suggestions and guidelines that can be found in both Pénichon's book and Polaroid's own *Storing, Handling, and Preserving Polaroid Photographs*.[25] Where this text differs is that it offers practical conservation treatments that a trained conservator may undertake in a museum or lab setting, such as the overcoating, recoating, retouching, and separation of stuck together prints, as well as image surface cleaning. These approaches only work with film types that require the application of a print coater, and therefore can only be used to treat black and white types of peel-apart film.

A Guide to the Preventive Conservation of Photograph Collections (2003) by Bertrand Lavédrine does not directly reference Polaroid's specific storage or conservation needs but instead focuses on blanket preventative treatments and techniques for photographs.[26] Many of the general recommendations and best practices apply to instant photographs and are immensely useful when formulating a thesis around the preservation of these images.

2.6 Display

Coatings on Photographs, *Twentieth Century Color,* and the *Storage and Handling Guide* from Polaroid all offer some suggestions for displaying instant photographs.[27] Most of the

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[25]Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

[26] Lavédrine Bertrand, Jean-Paul Gandolfo, and Sharon Grevet. *A Guide to the Preventive Conservation of Photograph Collections*. Los Angeles, CA: The Getty Conservation Institute, 2003.

[27]Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

suggestions concern the framing and matting of the objects with archival-quality supplies, acid-free tapes, board, and mounting tissue. As noted by Bower and Wilhelm, the display of these objects should be approached with caution. Pénichon notes in her chapter on instant photographs that dye diffusion prints should be exposed to no more than 12,000 lux-hours annually with a maximum illumination of 50 lux. Most instant processes did not create a usable negative after development save for the Type 55 or 665 variants of the black and white film types. This lack of reproducibility poses a problem for institutions with substantial Polaroid photograph collections. Most of the literature surrounding instant photos suggests making duplicates, on the same film type, so that you can preserve one and show the other. Unfortunately, this practice is not a viable option now as the remaining stocks of Fuji's peel-apart film expired in 2018, and have become absurdly expensive, starting at around $125 for a single pack of 10 exposures. This, coupled with the fact that chromogenic printing has also obsolesced, leaves a new and exciting avenue of exploration: the digital reproduction of instant photographs, and eventual output as inkjet prints. The long term light stability of instant photographs makes display a huge challenge for collections managers and curators. Digital facsimiles that reference both the process and photograph will be imperative as this medium continues to deteriorate.

3. History of Polaroid Corporation

The history of the Polaroid Corporation is in itself the history of instant photography, the conception of which is widely attributed to the eagerness of Edwin Land's daughter to see, more immediately than was possible, the photograph that her father had taken of her during a vacation in 1943.[28] The story goes that her excitement and quest for immediacy was the impetus for Land to create one of the most groundbreaking innovations in 20th-century photography that would be eclipsed only by digital photography at the end of the century. It's during this summer vacation in Santa Fe that Land flushed out the general mechanics of a system that could produce instant photographs; he even met with his patent lawyer to have everything written down.[29]

By late 1944, Land had already begun producing images with the system he had devised.[30] While they were of poor image quality, the instant process was continually refined. As the war began to wind down, the Polaroid Corporation needed to find a way to keep the company afloat once the government contracts for polarizing filters, goggles and other 3D viewing systems began to dwindle. As such, the Polaroid Corporation reallocated resources and personnel towards research and development. In 1946, with the additional help of new scientists and personnel like Meroë Marston Morse and Doxie Muller, both of whom would continue to be massive forces in the company for years to come, the development team was creating weekly test

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[28] "Edwin Land and Instant Photography." American Chemical Society. Accessed April 27, 2021.https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/land-instant-photography.html.

[29] Bonanos, *Instant: the Story of Polaroid*.

[30] Shady Hill Studios,"Baker Library Historical Collections."

images that were both stable and sharp.[31] The photos were varying degrees of yellow to reddish-brown, due to the amount of silver molecules they were able to retain within the negative and the film was orthochromatic. The devised process created a photograph without using a conventional darkroom or printing facilities: the positive, negative, and chemistry needed to develop the image are all contained within the camera. This method's first iterations involved a two-step process for producing images; a negative and positive held on separate rolls, with a chemistry packet attached to the paper positive side.[32] After exposure, the picture was pulled through a series of rollers that sandwiched these separate parts together, crushing the chemistry packet, spreading the chemical agents across the surfaces of the two parts and initiating development. After approximately one minute, depending on the ambient temperature and the developing image's progress, the negative would then be separated from the paper. This initial method was called roll film.[33]

Land presented his new system to the Optical Society of America in 1947 at a conference held at the Hotel Pennsylvania in New York City.[34] Using an 8x10 View camera modified to take a roll film back. Land took a self-portrait and then removed the film from the camera and placed it in a processing rig set up on an adjacent table.[35]The film was sandwiched together with a positive receiving sheet and a pod of chemistry. A minute later, Land peeled the life-size portrait

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[31] Bonanos, *Instant: the Story of Polaroid.*

[32] Wolbarst, *Pictures in a Minute*.

[33] Ibid

[34] Bonanos, *Instant: the Story of Polaroid.*

[35] Ibid

of his face apart to the amazement of the crowd. Instant film had been revealed to the public, and it was a roaring success, with Land and his crew taking dozens of portraits for the attendees at the presentation. By 1948, Polaroid was ready to hit the market as a film and camera manufacturer; in November of that year, a sales team took fifty-six cameras and film to the Jordan Marsh department store in Boston. By the end of the day, the cameras had sold out, far outperforming Polaroid's sales expectations, who had figured the cameras would sell out no sooner than Christmas.[36] The camera that had its debut that day was called the Model 95, a far cry from the more advanced instant cameras that would follow. The Model 95 was reminiscent of the previous century's folding plate cameras, and it was heavy, weighing approximately four pounds.[37] Still, the camera sold rapidly as there was an appetite for this new photographic system's instant gratification. By the end of its run in 1953, the Model 95 had sold 900,000 units, far exceeding Land's initial estimated 50,000 a year.[38]

The first film that Polaroid debuted was the Type 40, available from 1948-1950.[39] It was an orthochromatic sepia-toned film, later replaced by an orthochromatic black and white film, Type 41. This black and white film type quickly ran into an issue that would plague Polaroid's black and white peel-apart prints until the 1970s.[40] The photographs were incredibly unstable and would fade due to air pollutants and humidity, and the image surface was susceptible to

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[36] Ibid

[37] Polaroid Corporation,*The First Thirty Years.*

[38] Bonanos, *Instant: the Story of Polaroid.*

[39] Polaroid Corporation,*The First Thirty Years.*

[40] Mesquit and Lemmen, “Coatings on Polaroid Prints,”180–99.

smudging from rough handling. This rapid fading necessitated developing what would be commonly referred to as Polaroid's "print coater": an alcohol and resin-based polymer spread over the image surface with a wadded-up piece of cotton held in place by a plastic handle.[41] This tool was messy and cumbersome to use but provided adequate protection from contaminants and gave the final print a slightly glossy finish. Type 42 was a panchromatic 200 ISO film, which, remarkably, remained in production from 1955-1992, highlighting the success that these early cameras achieved and their staying power despite being replaced by more straightforward and easier-to-use models throughout the decades.[42] Polaroid consistently innovated and enhanced their films, with film types released and others discontinued with each research and development department's advancement.

All the while, in the background of these early developments, a team had been tasked with realizing Land's dream of instant colour photographs, finally achieved in 1963.[43] Polaroid released two different versions of their new colour film, type 48 and 108. Type 48 was a roll film, the standard to-date, whereas 108 was a different breed, falling into the category of what would come to be known as pack film or peel-apart film.[44] Although identical in chemical composition, pack film differed in how the film was held within the camera and subsequently sandwiched together. Pack film would be an instant success, and its compact design allowed the

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[41] Ibid

[42] Kuhn, Martin. The Land List. Accessed May 18, 2021. http://www.landlist.ch/landlist/landhome.htm.

[43]Pénichon,“Dye Diffusion Processes,” 232–73.

[44] Ibid

company to produce lightweight and portable consumer cameras that were appealing to all demographics. It didn't hurt that Polaroid had hired a crack-marketing consulting team in lockstep with consumer trends.[45]

Nine years later, 1972, Polaroid would release an actual one-step instant photographic process: you pressed the button, and, for the first time, the camera did the rest. This new system, the SX-70, was Land's dream of instant photography come true. The SX-70 was a massive advancement in the photographic industry. The negative and positive were contained within a sealed integral unit, and the mess and packaging associated with the peel-apart film were gone.[46] In this system, the negative is exposed through the positive layers, and the positive is viewed through the same surface. The SX-70 would prove to be massively influential and be used by thousands of consumers and artists, with some notable names, like Andy Warhol, André Kertész, Walker Evans being huge proponents of this new and novel little camera system and film. When someone mentions instant film, it is commonly referred to as a Polaroid.

It wasn't long before Polaroid had its imitators. Both Kodak and Fuji began to develop instant photographic systems during this same era, with Kodak running afoul of Polaroid in spectacular fashion.[47] Early on developing its instant products, Polaroid had outsourced the negative component of its film to Eastman Kodak. With the release of the SX-70, Polaroid

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[45] Bonanos, *Instant: the Story of Polaroid.*

[46] Polaroid Corporation, *The First Thirty Years.*

[47] Rowbotham, Cassandra. "'Polaroid versus Kodak': The Battle for Instant Photography." Ryerson Archives & Special Collections, August 21, 2013. https://library.ryerson.ca/asc/2013/08/kodak-versus-polaroid-the-battle-for-instant-photography-2/.

developed a new way to couple dyes together, shifting towards in-house manufacturing of its negative by 1975.[48] During this time, Kodak had been secretly developing their own peel-apart films, but with the debut of the new SX-70 technology, they quickly scrapped this project and began working on an integral system called the PR-10, released in 1976. Kodak's integral film differed from Polaroids, as they were "exposed through the back of the film and viewed on the opposite side."[49] Polaroid quickly slapped Kodak with a lawsuit nonetheless, claiming patent infringement. The ensuing court battles would last some ten years and end with Kodak paying Polaroid just under a billion dollars in damages. In 1981, Fuji released its instant film, the FI-10, which was structurally similar to Kodak's PR-10, and even worked in Kodak's cameras.[50] Fuji managed to avoid Polaroid's ire by keeping their product in the eastern market and by partnering with Polaroid in diversifying its portfolio with access to electronics, floppy disks, and audio recording storage solutions.[51]

By the early 80s, Polaroid was starting to get into financial trouble, and the slow decline of the company was becoming apparent.[52] Some say it was the departure of Land from the company at the end of the 70s that secured the decline, while others say it was corporate inflexibility and lack of innovation. Some blame the failed Polavision project, an instant motion picture film that had been Land's pet project before his departure, and still others claim the nail

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[48] Bonanos, *Instant: the Story of Polaroid.*

[49] Ibid

[50] Pénichon,"Dye Diffusion Processes," 232–73.

[51] Bonanos, *Instant: the Story of Polaroid.*

[52] Ibid

in the coffin was digital photography.[53] What is certain is that Polaroid's death was the result of a thousand cuts, gradually drawing down the company's profits until it was no longer sustainable. By the early 90s, the company had shrunk from 200,000 employees in 1978 down to only 5000.[54] In hindsight, it is easy to point to solutions that could have potentially saved the company from insolvency, yet none of this was clear at the time. Polaroid was working on both inkjet printing and digital imaging during this period of decline. These two innovations alone would have been enough to save the company during the digital revolution at the end of the century. Yet these products weren't perfect, and that didn't fit with the working ethos left by the Edwin Land era. For Polaroid, it was less about being first; they had already done that with their instant films. One of the most pressing issues facing Polaroid at this time was consumer disinterest. A customer would buy the camera and shoot a couple of packs, and then the camera would sit on a shelf. Keeping the consumer coming back had been a problem for a while, and the solution had always been to invent a new and exciting product to drum up interest again. Sadly, this was only a short-lived solution and by the early 90s, Polaroid was producing essentially the same product in different sizes or with colourful borders.[55]

What would come over the next couple of decades and into the 2000s is a series of corporate executives who tried to bail out the company with, for the most part, little success. Eventually, Polaroid would be taken over by Tom Petters, a ruthless corporate raider, who, with

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[53] Gaudet, “The Collapse of Polaroid.”

[54] Bonanos, *Instant: the Story of Polaroid.*

[55] Gaudet, “The Collapse of Polaroid.”

little attachment to the company that had started the instant film revolution, began to sell the land that housed the factories and scrap the machinery to turn a profit.[56] Ironically enough, the market for instant film had begun to stabilize around this time, to the point that the 10-year supply of film created before shuttering the factories sold out in less than 5 years. Making more was out of the question— the chemicals, machinery, and technical skills had been lost, and the doors were shut for good. The company's remaining assets would be sold off, a holding corporation would retain the name, the corporate archive would be given to Harvard University.

While this was the end of the road for the Boston-based Polaroid Corporation, in 2010, something equally ambitious grew in its place: The Impossible Project restarted production of the integral film at the only remaining factory in the Netherlands. Led by a group of recently retired Polaroid employees and enthusiasts, they reengineered the integral SX-70, 600 and Spectra film types. This was a mammoth undertaking and resulted in a product that deviated substantially from Edwin Land's original Polaroid. These new film types are compatible with the original Polaroid integral cameras, and should be viewed largely as a success. Since 2010, they have been consistently refining the chemistry and gaining colour accuracy. As of 2021, they were able to secure the original Polaroid namesake, going from the Impossible Project, to Polaroid Originals, and finally, just Polaroid. However, it should be noted that while the instant photographic materials manufactured by The Impossible Project appear very similar to those

[56] Bonanos, *Instant: the Story of Polaroid.*

produced by the Polaroid Corp in the latter half of the twentieth century, they are dramatically different in terms of their chemical make-up and stability. As a result, the recommendations outlined for the preservation of instant photographs in this paper do not apply to these materials.

4. Chemical Composition of Instant Photographic Materials

The key to understanding the needs of instant photographic collections is understanding these materials' physical and chemical composition. Instant photographs come in various shapes and sizes and use a variety of camera platforms for exposure. For a detailed list of film types, see APPENDIX 1. Still, the fundamental process is generally the same across the different film types regardless of manufacturer or brand. Instant photographs are created through a process called diffusion transfer. Initially, this process was used as a photocopying technique and adapted and improved upon for use within a camera system by Polaroid.

The initial diffusion transfer process involves two sheets of paper, one coated with a light-sensitive gelatin emulsion and the other coated with a gelatin layer with an imaging fixing solution contained within it. Generally, this would be sodium thiosulfate or an ordinary fixer. In order to create a photocopy, the original is reflected onto the light-sensitive coated paper creating a negative. This negative is developed in an alkaline solution, hardening the gelatin layers between the image and non-image areas. This sheet is then pressed and rolled against the specially coated sheet to create a positive image. The images created with this process were of low quality, and they could only produce bi-tonal images and were unable to render continuous tones in the same manner as traditional photographic films and papers .[57]

[57] “Preservation Self-Assessment Program.” Preservation Self-Assessment Program (PSAP) | Office Printing and Reprography, n.d. https://psap.library.illinois.edu/collection-id-guide/officeprintcopy#diffusiontransfer.

Edwin Land took the process described above, adapting and refining it to be used within a camera system to eject a dry finished print directly from the camera. A significant obstacle that needed to be overcome to create this system, was retaining the chemistry within the camera, alongside the negative and positive portions of the film. A pod system was devised to house a viscous reagent that would be ruptured when the two parts would contact each after the negative was exposed to light. The two halves were then pulled through a series of rollers where the pod attached to the negative portion would rupture and spread the chemistry across the image surface. The reagent would develop the negative part of the film. Light-exposed insoluble silver would remain in the negative portion. The mobile silver halides would migrate to the positive receiving sheet, which would create an inverse of the negative resulting in a positive image.[58]

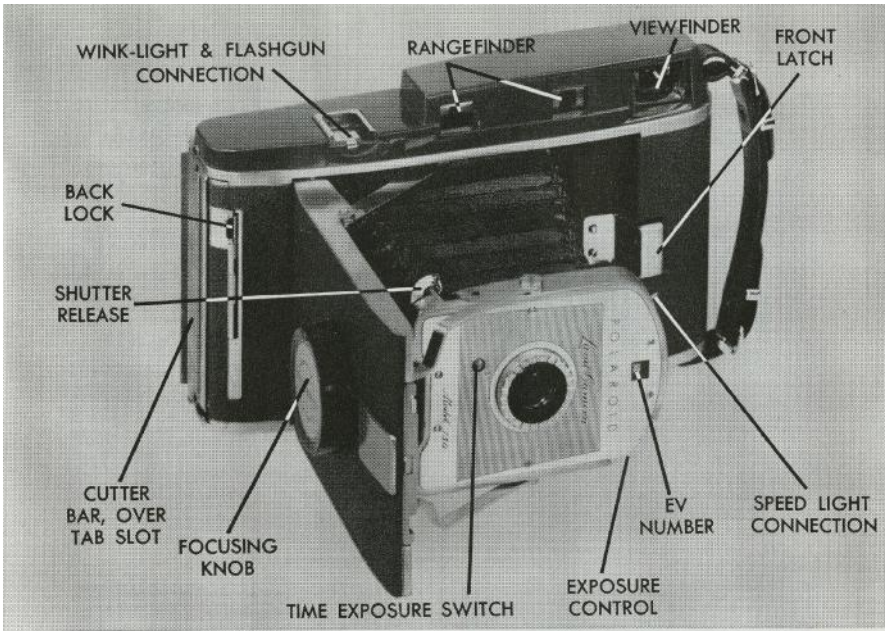

Fig.1 Polaroid Model 150, one of the earliest Instant film Cameras.
Pictures in a Minute, John Wolbarst 1960

[58] Graphics Atlas,"Identification."

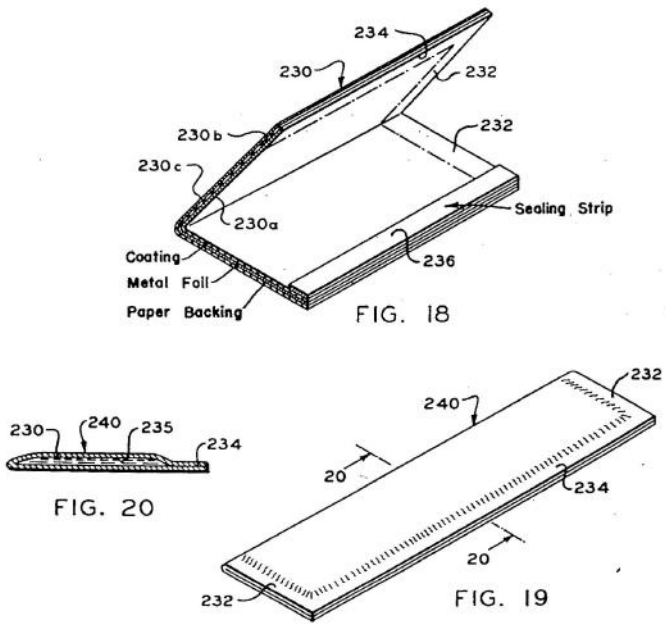

Fig.2 Patent illustration showing a typical pod structure (U.S Patent 2,543,181)

The crucial element of Polaroid's success was the pod of reagent without which the majority of instant photographic processes would not be possible. The sealed pod is designed to be impermeable to moisture and oxygen. Still, the seal on the pod's front is designed to rupture evenly and consistently every time, spreading 0.01ml/ cm2 of chemistry.[59] Creating a laminated "sandwich" between both the negative and positive portions, incorrect amounts of chemistry will result in processing malfunctions; too little or too much, and the two sides will not properly adhere to each other as they are pulled through the rollers.[60] The pod must also be made of materials that will not react with the alkaline reagents contained within the pod. The reagents within the pod must also be viscous to properly spread and hold the two layers together during processing. In order to achieve the required viscosity level, polymeric thickening agents such as carboxymethyl

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[59] Sturge, Walworth, Shepp, Neblette, and Mervis , . “Instant Photography and Related Reprographic Processes.” 181–225. Sturge, John M., Vivian K Walworth, Allan Shepp, C. B. Neblette, Stanley H Mervis , and Vivian K Walworth. “Instant Photography and Related Reprographic Processes.” Essay. In *Imaging Processes and Materials*, 181–225. New York, NY: Van Nostrand Reinhold, 1989.

[60] Ibid

cellulose, hydroxyethylcellulose, or polymeric oximes are added.[61] These specific compounds were chosen due to their weight, allowing small amounts of the mixture to be present while still performing their intended function. The pod processing system is the most common form of instant photograph processing. The peel-apart and integral print formats and the Polavision and 35mm instant film formats all utilize some form of pod processing.[62]

The two main categories of instant film that this thesis is concerned with are the peel-apart and integral variants. These two categories contain both colour and black and white versions using different chemical reagents and pod systems. The first instant photographs were produced using a camera system similar to the folding large format roll cameras that looked similar to traditional film cameras used at the turn of the twentieth century. The first film that accompanied these cameras was a roll film released in 1948 called type 40, a sepia-toned film.[63] The camera had space for two separate rolls, one containing the negative and the positive portion with the attached pod of reagents. Roll films can be identified from a few key characteristics. In general, roll films, regardless of size, will have the film type, frame number, and manufacturing code located on the verso of the image.[64] The sole exception is the type 46 film as it produced transparencies instead of prints; deckled edges will also be present. Before 1958, the 3¼ x4¼ in films will have deckled edges on all four sides.[65]

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[61] Ibid

[62] Ibid

[63] Adams and Baker, *POLAROID LAND PHOTOGRAPHY*.

[64] Kuhn, The Land List.

[65] Ibid

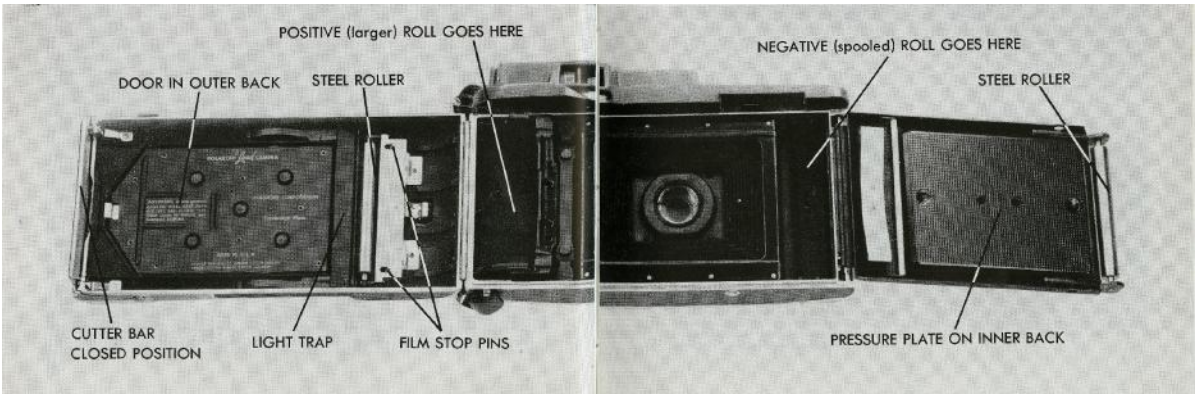

Fig.3 interior of a roll film camera.
Pictures in a Minute, John Wolbarst 1960

The diffusion transfer processes devised by Polaroid are closely related to conventional photographic processing. The Polaroid process lacking the traditional processing baths required a coating solution to stabilize the print surface.[66] In 1950 Polaroid would release their first black and white print film (type 41). It was noted to quickly yellow and fade when exposed to oxygen for a short period—prompting the development of the coating solution that would be common for all black and white polaroid prints until a "coaterless" print format was introduced in 1970.[67] The coating solution would remain in use with some film types after this date. As noted in the patent filed by Edwin Land from February 1954, the two main functions of this coating solution are to wash and protect silver-based images.[68]

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[66] Adams and Baker, *POLAROID LAND PHOTOGRAPHY*.

[67] Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

[68] Land , Edwin, and Milton G Mattapan . METHODS FOR WASHING AND PROTECTING PHOTOGRAPHIC SILVER IMAGES, issued June 4, 1957.

The application of the coating solution neutralizes the remaining processing solution left on the print surface after stripping away the negative portion.[69] Additionally, once dried to the surface of the image, the coating solution protects from physical damage, with the added benefit of increasing the maximum density and tonal range by permeating the image surface.[70] The coating acts as a physical and chemical barrier to moisture and airborne pollutants, helping seal the silver inside the image, and protects against atmospheric sulphides. The chemical composition of the coating solution most commonly used is unclear. In general, the recipes share

Fig. 4 Unknown Photographer, 8.3 x 10.8.Type 41 (1957) roll film photograph with deckled edges. (Personal collection)

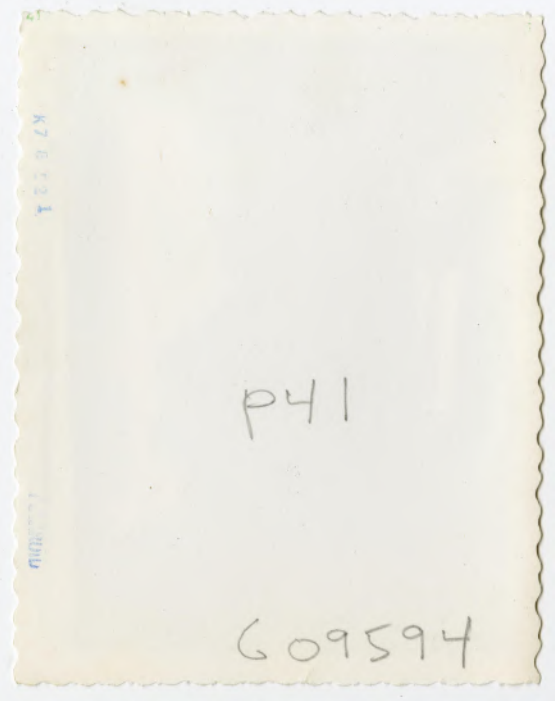

Fig. 5 Unknown Photographer, 8.3 x 10.8.Type 41 Verso (1957) roll film photograph with deckled edges. (Personal Collection)

a common ingredient. According to Teresa Mesquit and Barbara Lemmen, "The film-forming component of the coating is a water-insoluble organic polymer having polar groups. It is

[69] Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

[70] Ibid

probably a vinyl pyridine polymer or co-polymer in which vinyl pyridine is the characteristic ingredient."[71] Consulting Patent # 3533,789 shows nine different recipes for the coating solution with the most common ingredient between the recipes being a poly-(ethylene/maleic anhydride) compound commercially produced by Monsanto Chemical Co under the name DX-840-11.[72]This chemical comes in either a liquid or powdered form and quantities vary depending on the recipe.

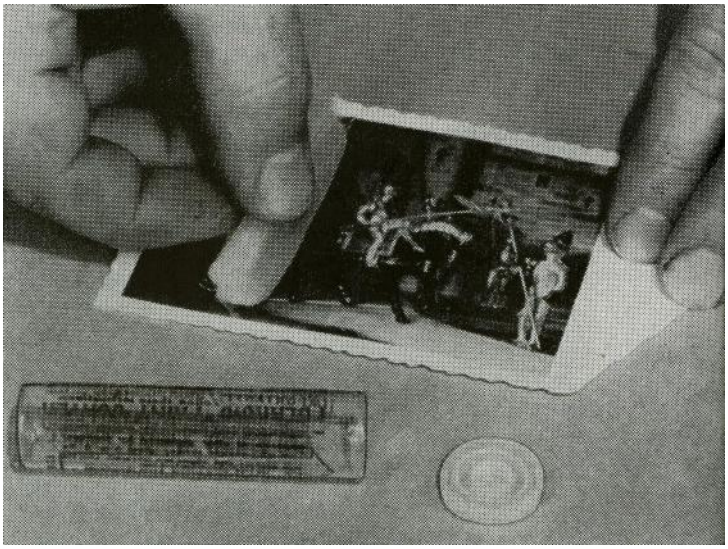

Fig. 6 Demonstration of the coating solution.
Pictures in a Minute, John Wolbarst 1960

[71]Ibid

[72] Land , Edwin, and Milton G Mattapan . METHODS FOR WASHING AND PROTECTING PHOTOGRAPHIC SILVER IMAGES, issued June 4, 1957.

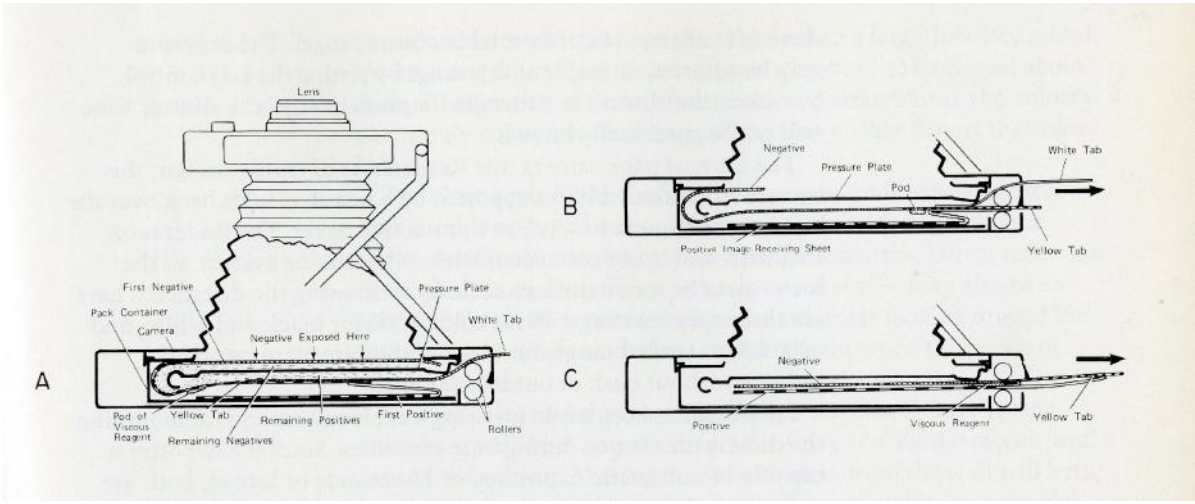

Fig. 7 internal diagram of pack film exposure.
Polaroid Land Photography, Ansel Adams, Robert Baker 1978

In 1963 the pack film format would be released: "The pack consists of eight film units, each made up of the same elements present in other Polaroid films-negative, receiving sheet (which becomes the print), and reagent (developing chemicals in a sealed pod)."[73] Pack film simplified the exposure system and held the film in an accordion-style package within the camera. Once the negative portion of the film was exposed to light, the photographer would first pull a small tab which would draw the negative and positive into contact with each other. A second tab would be pulled, beginning the development processes as the two portions were drawn through a series of rollers that ruptured the pod. Depending on film type, the process could take anywhere from 15 seconds to a full minute for the colour film variants.[74] Pack film can be identified by its straight borders on all four sides, and in general on the verso will be a manufacturing code at the bottom that can be deciphered to read film type, date of production and factory. On the top right corner will also be frame numbers, until near the end of production when the frame numbers are moved next to the manufacturing code.

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[73] Adams and Baker, *POLAROID LAND PHOTOGRAPHY*.

[74] Ibid

Fig. 8 Alexander Arslanyan 8.3 x 10.8.(2020)
Polacolor Type 669 Verso showing placement
of frame number and manufacturing code
(Personal Collection)

Colour instant photography was a watershed moment in the history of photography and one of the most significant leaps forward since the introduction of Kodachrome. Debuting alongside the release of pack-film, Polacolor would prove to be wildly popular. Colour instant processes are based on the subtractive colour principle, "which is the production of colour by absorption or subtraction of the three primary colours, red, green and blue, from white light. The three subtractive colours are yellow, magenta and cyan; they absorb or subtract blue, green and red light, respectively and are sometimes named after the colour they absorb. The subtractive system is used in most colour photographic processes."[75]

[75] Pénichon,"Dye Diffusion Processes," 232–73.

Fig.9 Unknown photographer, [Pamela & Mauricee Noel, Age 4 Months], 1976. Colour instant photograph (Type 108), 10.8 x 8.3 cm. Purchase, with funds donated by Martha LA McCain, 2018. © Art Gallery of Ontario 2018/770

Incorporating colour into the diffusion process faced several obstacles, chief among them was selecting suitable dyes. H.G Rogers, a scientist at the Polaroid Corporation, would suggest a dye developer concept.[76] "The dye-developer process functions by the transfer of an ionized compound called a dye-developer to a receiver, i.e. a layer which insolubilizes the dye-developer for the formation of a coloured image."[77] Like its black and white counterparts, the new colour film was composed of a negative and positive sheet and a pod of viscous reagents. "In the negative, yellow, magenta and cyan dye developers were coated in separate layers beneath the blue-green and red sensitized silver halide emulsions layers, respectively. During processing, the

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[76] Idelson, Martin. "Chemistry of Metallized Dyes." *Journal of The Society of Photographic Science and Technology of Japan* 47 (November 6, 1984): 421–31.

[77] Theys, Ronald D., and George Sosnovsky. "Chemistry and Processes of Color Photography." *Chemical Reviews* 97, no. 1 (1997): 83–132. https://doi.org/10.1021/cr941191p.

dye developers were oxidized by exposed silver halide in each emulsion layer. The oxidized dye developers were immobilized in proportion to the degree of exposure and development of the silver halide, while the unreacted dye developers were free to diffuse through the layers of the negative onto the image-receiving sheet."[78]

The initial dyes proposed by Rogers were two azo and one anthraquinone dyes. The two azo dyes would be yellow and magenta, and the anthraquinone cyan.[79] This combination of dyes would prove challenging to alter, and the chemical composition of Polacolor would remain the same until 1972.[80] It was noted that the dyes chosen for Polacolor needed improvement in both colour rendering and light stability, and a program was started to replace these dyes with metal complex dyes. Interest in metal complex dyes had been around for some time by this point but faced a few challenges. Renowned for their light stability and the number of colours they could render, they, unfortunately, did not produce sufficiently bright enough dyes.[81]The selection of new metallized dyes was centred around 6 requirements : "1) the colour must be consistent with subtractive colour synthesis, 2) it must be stable to the alkaline reducing processing medium, 3) it must not interfere with silver halide photography, 4) it must not react with gelatin, 5) it must perform in the photographic process, 6) and it should be stable to light in the image."[82] Two metalized dyes were selected to replace the magenta and yellow, the magenta composed of a

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[78] Pénichon,"Dye Diffusion Processes," 232–73.

[79] Idelson, "Chemistry of Metallized Dyes," 421–31.

[80] Ibid

[81] Ibid

[82] Ibid

mixture of chromium, cobalt, nickel and copper. The yellow is composed of carbon hydroxide, nickel and chromium, this dye was much simpler to create than the magenta. The cyan is a copper phthalocyanine. For detailed chemical analysis of these dyes and a breakdown of the science needed to develop these dyes, Martin Idelson's paper *Chemistry of Metallized Dyes* is an excellent place to start.[83]

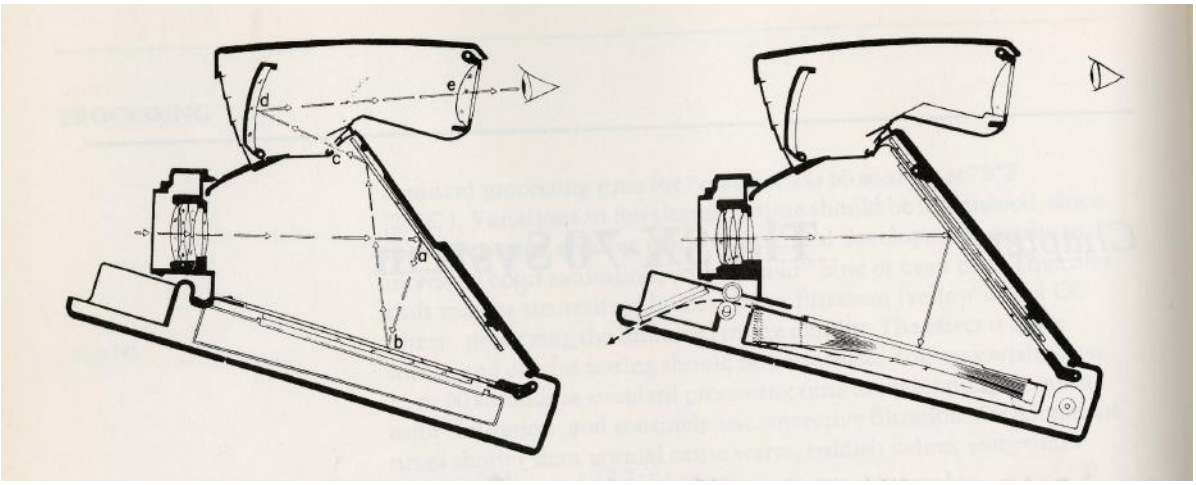

Fig.10 Diagram of an SX-70 Camera detail from Polaroid Land Photography, Ansel Adams and Robert Baker 1978.

The same dyes used in Polacolor 2 were also incorporated into the new SX-70 film system.[84] The SX-70 film format was a revolutionary development in instant photography, and the print format would be synonymous with instant photography in general.[85] This new system utilized a compact folding single-lens reflex camera envisioned to be pocketable. While the completed SX-70 was slightly larger than Land had imagined, the sleek design of these new

[83] Ibid

[84] Pénichon,"Dye Diffusion Processes," 232–73.

[85] Bonanos, *Instant: the Story of Polaroid.*

chrome and leather cameras allowed for an ease of use and portability that had been lacking with the pack-film cameras.[86] Unlike pack or roll film, SX-70 cameras ejected a print that contained both the negative and positive within a polyester housing. When the photo was ejected, the pod of reagents was ruptured, spreading between the negative and positive layers.[87] " Instantaneously forming a new layer of white pigment, water and opacifying dyes that protected the still light-sensitive negative so that processing could take place in daylight."[88] The opacifying layer was one of the critical requirements for success when designing integral film formats. For a successful opacifying layer, the dye needed to be stable in caustic solutions. It can change from coloured to colourless, protect the entire image surface from light and be photographically inert. A phthalein dye was chosen for its ability to change colour based on differing levels of Ph.[89] The process of diffusion dye transfers is the same between peel apart and integral, but the reagents within the integral films need to be neutralized as the two portions are not separated as with the peel-apart variants.[90] This was accomplished by a polymeric acid layer located above the image receiving layer. When the reagents encountered this layer, they were immobilized, and the Ph levels were neutralized.[91]

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[86] Ibid

[87] Pénichon,"Dye Diffusion Processes," 232–73.

[88] Ibid

[89] Idelson, Martin. "Sx-70: A Unique System of Dyes." *Dyes and Pigments* 3, no. 2-3 (1982): 191–201. https://doi.org/10.1016/0143-7208(82)80022-3.

[90] Pénichon,"Dye Diffusion Processes," 232–73.

[91] Ibid

The general composition of the instant film products issued by the Polaroid Corporation would largely stay the same throughout production, with changes coming in dye composition and emulsions. The pod, negative and positive receiving layer, would remain the building blocks for all new Polaroid film products. Each new change was done to increase image stability and colour rendering. Polaroid would introduce many different formats of films within the many years of production within the peel-apart and integral families. For the peel-apart lines, there were 4x5, 8x10, 20x24, and even 40x80in. These formats would use alterations of the pod process, but the chemistry and function are the same. The integral format would also have new introductions; following the success of the SX-70, Polaroid would introduce the Type 600 and Spectra film format.[92] The physical and chemical composition of Polaroid's instant processes is of concern: dye stability, image quality, print deterioration and damage are inherent to the print medium. Having a firm grasp of the technical process and science that went into producing these formats is imperative as understanding how's these products were created will give insight into how they deteriorate.

Fig. 11 Unknown photographer, [Thelma 53 Taken by Judy], 1978. Colour instant print (Polaroid SX-70), 10.8 x 8.8 cm. Purchase, with funds donated by Martha LA McCain, 2018. © Art Gallery of Ontario 2018/3551

[92] Kuhn, The Land List.

5. Deterioration and Conservation Issues

Fig.13 Unknown Photographer 8.3 x 10.8 (1957) Type 41 Showing localized deterioration due to inadequate levels of coating,Polaroid Roll Photograph, (Personal collection.)

In 1950, Polaroid's black and white photographs faced several issues regarding the degradation of the image surface. Once exposed to air and light, the image surface would quickly yellow and fade.[93] This process would begin almost immediately unless an intervening treatment was employed. The solution created was the Polaroid "print coater," a somewhat messy and laborious process that introduced some obstacles to the one-step photographic process. Once the print was processed and separated from the negative, the photographer would apply the coating solution, which accompanied the roll of film in either a glass or plastic tube.[94] After flattening the print the photographer would apply even and overlapping strokes of the solution across the print surface.[95] In his correspondence with Polaroid and his book on instant photography, Ansel Adams noted the necessity of coating prints immediately after exposure.[96] He

[93] Mesquit and Lemmen, "Coatings on Polaroid Prints,"180–99.

[94] Wolbarst, *Pictures in a Minute*.

[95] Ibid

[96] Adams and Baker, *POLAROID LAND PHOTOGRAPHY*.

also expressed concern over the drying time of the coating solution and the possibility of airborne debris drying into the coating solution and image surface.

The print coater was necessitated by the physical characteristics of diffusion transfer prints, as the black and white photos "formed the silver image in a thin silica receiving layer coated over a waterproof layer."[97] Due to the position of the image layer within the receiving layer, stabilization compounds could not be placed below the image surface. A stabilization compound needed to be applied to the image surface as the layer was penetrable from the outer surface.[98] In 1970 just before the release of Polacolor 2 and the SX-70, Polaroid introduced a new "coaterless" black and white film that needed no treatment after exposure.[99] Unlike the previous versions of films this new coaterless film contained the image silver within a layer of regenerated cellulose, which protected against both surface abrasion and atmospheric attack.[100] Additionally, the developing agents were altered with colourless inert oxidation products, and the silver halide solvents were sulphur-free.[101] Finally, a polymeric acid layer was added to reduce Ph levels and improve overall image stability. The coaterless prints are more resistant to physical

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[97] Sturge, Walworth, Shepp, Neblette, and Mervis ,"Instant Photography and Related Reprographic Processes." 181–225.

[98] Ibid

[99] Kuhn, The Land List.

[100] Sturge, Walworth, Shepp, Neblette, and Mervis , "Instant Photography and Related Reprographic Processes." 181–225.

[101] Ibid

abrasion but slightly less resistant to long-term attack by atmospheric pollutants.[102] Polaroid would continue to produce coater and coaterless prints until the end of their manufacturing run.

Fig.12 Unknown Photographer 8.3 x 10.8 (1950)Type 41 Verso showcasing significant image deterioration, Polaroid Roll Photograph, (Personal collection.)

Coated prints have several issues associated with their care and long-term storage. Once coated, the photographs are incredibly stable and resistant to atmospheric contamination.[103] On the other hand, the physical application of the coating solution is the source of many of the conservation issues associated with this print film type. Coating issues are common and the inadequate or uneven coating creates image loss over time as the prints sit in storage. Photos with inconsistent coating solutions produce localized yellowing and image loss resulting in yellow streaking across the image surface. The nature of the coating solution also creates preservation challenges. While the solution is drying, the print surface is incredibly tacky to touch and this means dirt and dust can settle into the coating or contact with another print can cause the two prints to stick together.

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[102] Ibid

[103] Ibid

Throughout its history, Polaroid introduced thirty separate types of films that required coating after processing.[104] There has been little progress in the field of conservation research on these print formats. The most concise information comes from Teresa Mesquit and Barbara Lemmen. Together with testing, consultation of Polaroid company staff, and available research at the time of publication have produced the most up-to-date conservation recommendations which will be further explored in the following chapter.

Colour peel-apart film was developed and released as a "coaterless" film in 1963, avoiding the messy final step that the black and white films needed[105]. Unfortunately, the very nature of instant processes leads them to be somewhat more unstable than their chromogenic counterparts. The chemical action on the image surface is of concern as these prints are not treated or washed after processing.[106] Polaroid made steps to rectify this by incorporating polymeric acid layers that interact with timing layers to reduce the Ph levels, effectively ending the transfer process and stabilizing the image."[107] An important consideration with all dye images is the ability of the dyes to withstand prolonged exposure to light, particularly light that extends into the ultraviolet region; The metallized dyes used in SX-70 and Polaroid's later films have outstanding light stability as well as excellent dark stability[108]." While the dyes within Polaroid

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[104] Kuhn, The Land List.

[105] Pénichon,"Dye Diffusion Processes," 232–73.

[106] Sturge, Walworth, Shepp, Neblette, and Mervis , "Instant Photography and Related Reprographic Processes." 181–225.

[107] Ibid

[108] Ibid

instant photographs are incredibly stable on their own, their incorporation into instant film products leads to image instability, despite the claims otherwise.

Henry Wilhelm's research into these print formats' long-term stability challenges the claims from Polaroid.[109] "Polaroid peel-apart instant prints have inferior light fading stability compared with chromogenic colour papers such as Fujicolor and Ektacolor."[110] While the peel-apart variants of instant films suffer from light fading, they fare much better in dark storage than integral film formats. The negative portion is stripped away after development, reducing any chance of chemical action. Due to the evolution of peel-apart films and the subsequent changes in the composition of dyes, different eras of the film will shift and fade at different rates depending on exposure to light.[111] Polacolor prints tend to fade noticeably under bright light, even for short periods. Polacolor 2, on the other hand, has more excellent light stability from the incorporation of metallized dyes. Still, due to different fading rates for each dye, the images will exhibit noticeable colour balance shifts.[112] Polacolor ER's dyes were altered again to improve light fastness, but no data is currently available on their light stability.

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[109] Wilhelm and Brower, *The Permanence and Care of Color Photographs.*

[110] Ibid

[111] Pénichon,"Dye Diffusion Processes," 232–73.

[112] Ibid

Integral formats of instant film face more deterioration than their peel-apart counterparts, mainly because they retain their negative and processing chemicals.[113] Over time in room temperature dark storage, integral film formats will develop a yellowish stain on the image surface, shifting the colour balance considerably. "This stain is produced by slow migration of non-image dyes and other chemical constituents residing in the lower layers of the tightly sealed Polaroid package."[114] As mentioned earlier, the dyes used in Polaroid photographs are incredibly stable. The stain occurs due to the storage of the films themselves. Room temperature dark storage will produce this yellowish stain in a relatively short period, sometimes within months.[115]

All formats of Polaroid's integral film suffer from the development of the yellowish stain. This includes the Type 600, Spectra, SX-70, Captiva and Pocket films. Additionally, early SX-70 prints from the 70s are subject to catastrophic cracking of the image-receiving layer below the transparent print cover sheet. This cracking is partly due to rapidly shifting levels of humidity. By the 1980s, Polaroid had satisfactorily resolved the cracking issue.[116]

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[113] Wilhelm and Brower, *The Permanence and Care of Color Photographs.*

[114] Ibid

[115] Ibid

[116] Ibid

The fragile and unique nature of Polaroid prints requires special preservation considerations for storage and exhibition. Polaroid's colour formats suffer from long-term room temperature storage (degrees 70F and above) and suffer under display. The black and white variants suffer under atmospheric contamination unless adequately coated in the Polaroid brand coating. As of 2008, this coating solution has been discontinued as the Polaroid Corporation dissolved into bankruptcy. The new Polaroid born from the Impossible Project has no plans to remake this formula, nor does it have the patents. Steps need to be taken to safeguard collections composed of instant photographs. The following chapter will explore solutions for display, housing, and storage and address what can be done to address the preservation issue related to the coating solution.

6. Housing, Storage and Display

As mentioned in the previous chapter, the nature of Polaroid's instant prints makes them generally unsuitable for any long-term display. As they also suffer in long-term dark storage at room temperature, approaching storage, display and housing these collections takes some time and preparation. Like conventionally processed photographs, Polaroids face the same threat from atmospheric pollutants. Pollutants that can affect the image surface are "oxides of sulphur and nitrogen, chlorine, peroxide, hydrogen sulphide, ozone, vapour of ammonia, automobile exhaust fumes, and fumes given off by paints, varnishes, solvents, bleach and cleaning agents."[117] Integral films fare better to these airborne pollutants as the image surface is contained beneath a polyester layer. Puncturing or trimming the housing of integral prints will lead to the eventual destruction of the image as this will open the image surface to attack from the aforementioned contaminants.[118] Due to the nature and widespread use of Polaroid's integral film formats, it is common to see integral films suffering from damage associated with handling ie, creasing, tape and adhesive damage, and delamination of the integral package,. It is not uncommon to see integral Polaroids trimmed or with puncture marks from being pinned to surfaces. This damage is also associated with artists who work with integral formats, manipulating the image surface or transferring the image layer to other supports.[119]

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[117] Pénichon,"Dye Diffusion Processes," 232–73.

[118] Ibid

[119] Deane, R.J.H. "NOTES ON THE ARCHIVAL SUITABILITY OF SOME CONTEMPORARY PHOTOGRAPHIC MATERIALS." *ICCM Bulletin* 5, no. 2 (1979): 41–44. https://doi.org/10.1179/iccm.1979.5.2.004.

Fig.14 Unknown photographer, [From Joey to my one and only love Donna Moeriand],1986. Colour instant print (Polaroid SX-70), 10.8 x 8.8 cm. Purchase, with funds donated by Martha LA McCain, 2018. © Art Gallery of Ontario 2018/50

Contact with inadequate housing materials and physical damage all destroy dye diffusion or instant photographs. Therefore, the first step in creating a storage plan for instant pictures is to find material suitable for close contact with the image surface. Housing materials should not be high in acidity or alkaline compounds, and the general Ph of the material should fall somewhere between 7.0 to 8.5.[120] In the 1980s, Polaroid released a guide for storing and displaying their photographs, supplying a list of safe materials for contact with instant pictures. "Storage materials made of acid-free paper or card, cellulose acetate, polyethylene, polyester sheeting and sleeves, aluminium, stainless steel, materials coated with baked enamel, glass, porcelain, acrylic plastics."[121] For the most part, this list is still accurate by today's conservation standards, except for cellulose acetate, as this polymer is no longer recommended.[122]

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[120] Duffy, Storing, Handling and Preserving Polaroid Photographs.

[121] Ibid

[122] Lavédrine ,Gandolfo, and Monod, *A Guide to the Preventative Conservation of Photograph Collections*.

The highest recommended material for close contact with photographic collections is uncoated polyester.[123] As in "dark storage", a polyester sheet is believed to be more stable than even the best quality 100% cotton fibre paper; polyester will probably last as long as any type of photograph in existence. Extensive experience with it as a film base coupled with accelerated ageing tests indicates that polyester is essentially non-reactive with black and white and colour images, even under extreme temperature and humidity conditions."[124] Polyester additionally has a low permeability to gasses, adding protection against the effects of atmospheric pollutants and using polyester sheeting as an interleaving sheet can help prevent contamination from low quality paper or poorly processed photographs. Uncoated polyester is ideal for enclosures and products like DuPont Mylar or ICI Melinex 516 are photographically safe.[125]

Fading and discoloration of colour instant photographs is accelerated by high humidity and heat. Polaroid recommends storage temperatures of 60-70F or 16-21C, with a relative humidity of 30-50% and no more than a 4 degree variance in temperature.[126] As noted earlier though, room temperature dark storage will lead to a yellowish stain to develop in the integral variants of the film, this temperature guide line appears to be somewhat faulty. It is noted in the Polaroid guide that cold storage should only be employed when the refrigeration unit has the ability to control humidity variances to a strict degree.[127] Consulting the data aggregated by

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123 Wilhelm and Brower, *The Permanence and Care of Color Photographs*.

124 Ibid

125 Ibid

126 Duffy, Storing, Handling and Preserving Polaroid Photographs.

127 Ibid

Henry Wilhelm shows sobering numbers when concerning the long-term storage of Polaroid photographs. Polaroids will see a 20% loss of the least stable image dye in roughly 3 to 6 years in room temperature storage regardless of film type.[128] The integral formats fall in line at around three years for severe and irreversible image loss. Polaroid's longest-lasting products, the peel-apart variants, also exhibit colour balance changes in remarkably short periods averaging two months in dark storage before a 0.10 d-min colour imbalance.[129]

When approaching the display of instant photographs the conditions in the exhibition need to be closely monitored and controlled as these photographs are unique and irreplaceable. Prints should be monitored closely for colour changes before, during and after exhibitions and should not be submitted to more than 12,000 lux hours annually at no more than 50 lux of illumination.[130] Consulting Wilhelm's accelerated testing on all available film at the time, all of Polaroid's products averaged 2.7 years of display time before noticeable shifts in colour balance regardless if the prints were covered with regular glass, or a UF-3 ultraviolet filter.[131] These numbers were aggregated from a pool of freshly exposed Polaroids with accurate colour rendering and density. These numbers, unfortunately, do not provide information for collections composed of already deteriorating instant photographs. Still, if there is already a perceptible shift in the colour balance, these prints should only be shown in the most controlled environments.

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[128] Wilhelm and Brower, *The Permanence and Care of Color Photographs.*

[129] Ibid

[130] Pénichon,"Dye Diffusion Processes," 232–73.

[131] Wilhelm and Brower, *The Permanence and Care of Color Photographs.*

The same caution towards display and storage applies to the black and white versions of instant film, and it can be expected that black and white instant photographs will deteriorate under the same conditions as their colour counterparts. This deterioration, though, will be at a slower rate due to the picture containing no dyes. As mentioned before, the Polaroid coating solution is key to prolonging the lifespan of coater peel-apart photographs. Based on testing at the Getty Conservation Institute, coated peel-apart pictures were shown to have a lightfastness rating of ISO Blue Wool #3.[132] In areas with no coating or inadequate application of the coating to have an ISO Blue Wool #2.[133] The coated areas exhibited a lightfastness that was ten times greater than that of the uncoated areas. With that in mind, the ISO Blue Wool scale indicated that these prints are still highly fragile coated or not, as the scale is from one to eight, one being the lowest and eight the highest.[134]

As mentioned in the previous chapter, the coating solution has been discontinued since 2008. The current conservation recommendations for coater instant photographs have been rendered futile as the current treatments are centered around removing and reapplying coating solutions or an overcoat of the solution on top of the previously applied area.[135] The conservation community must develop new coating solutions to preserve these vulnerable and precious

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[132] Mesquit and Lemmen, “Coatings on Polaroid Prints,”180–99.

[133] Ibid

[134] *Colour Fastness to Light: Daylight (ISO 105-B01: 2014)*. Geneva : International Standard , 2014.

[135] Mesquit and Lemmen, “Coatings on Polaroid Prints,”180–99.

photographs. Consulting the patent # 3533789 from the Polaroid Corporation provides nine different recipes for synthesizing a coating solution that appears to create small batch quantities that would be ideal for conservators needing to treat coater photographs.[136] The most common ingredient listed in all recipes is a DX-840-11 resin that Monsanto Chemical Co manufactured. It appears that this chemical is no longer produced by them but can be found for sale from Sigma-Aldrich under its chemical name Poly-ethylene/ maleic anhydride.[137] All the chemicals in these recipes are readily available for purchase and obtained from most chemical manufacturers.

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[136] Land, Edwin, and Mereo M Morse. PROCESS OF WASHING AND PROTECTING A DIFFUSION TRANSFER PHOTOGRAPHIC SILVER PRINT , issued October 13, 1970.

[137] "Polyethylene-Graft-Maleic Anhydride." Polyethylene-graft-maleic anhydride - maleic copolymer, maleated copolymer. Accessed June 14, 2021. https://www.sigmaaldrich.com

Conclusion :

As heritage institutions begin acquiring more and more vernacular photographs, museum collections will invariably draw Polaroids into their holdings in larger numbers. While the ubiquity of Polaroids made them a favourite of the consumer, many artists built prolific careers centred around these materials. As we progress through the 21st century, the availability of knowledge once retained by the employees of Polaroid and other 20th-century photographic manufacturers will continue to disappear. It's for this reason, I undertook this project to understand and preserve instant photographs. Kodak and Fujifilm both produced instant pictures based on the patents and research developed by Polaroid. From an examination of the Fade Resistance Collection at the AGO, it is apparent that the collection includes examples of Kodak's PR-10 instant photographs alongside Polaroid products. The recommendations presented in this thesis also apply to the Kodak and Fuji offerings. Kodak instant products deteriorate more severely than those of Polaroid, as they were rushed to market and corners were cut in regarding research in too long term dye stability.

The research into the conservation of instant photographs has been challenging. Most of the literature written on the conservation of photographs lumps instant photographs in with other analog print formats. This misidentification leads to damage of instant photographic collections as they ultimately have different preservation needs. Polaroid photographs deserve consideration in the broader scope of photographic preservation. Much of the information I have compiled was from the previous century when the Polaroid corporation was still manufacturing. These resources tend to recommend that any physical degradation can be remedied by recreating these

instant photographs on newer instant film— sadly, this isn't possible anymore. It's necessary to find ways to digitally create facsimiles that reference both the image and the process. Polaroid photographs are unique objects and, like the daguerreotype and other early photographic techniques, are heavily entrenched in the family setting. Collections that contain Polaroids should be given extra consideration from the conservation, collections management and curatorial standpoints.

The Polaroid Preservation Website will host the recommendations and information compiled in this thesis. Initially, this website will feature a downloadable link to my thesis paper. Still, in time I will take the data gathered within and condense it into guides that collections managers and the public can easily engage with. While this is the end of the project within the scope of my Master's program, I intend to continue this research into Polaroid preservation, with an eye to the future, with the eventual goal being to assess the long term stability of new instant products from Fujifilm and the Impossible Project (now Polaroid). For a small sample of the website please see APPENDIX II.

APPENDIX I

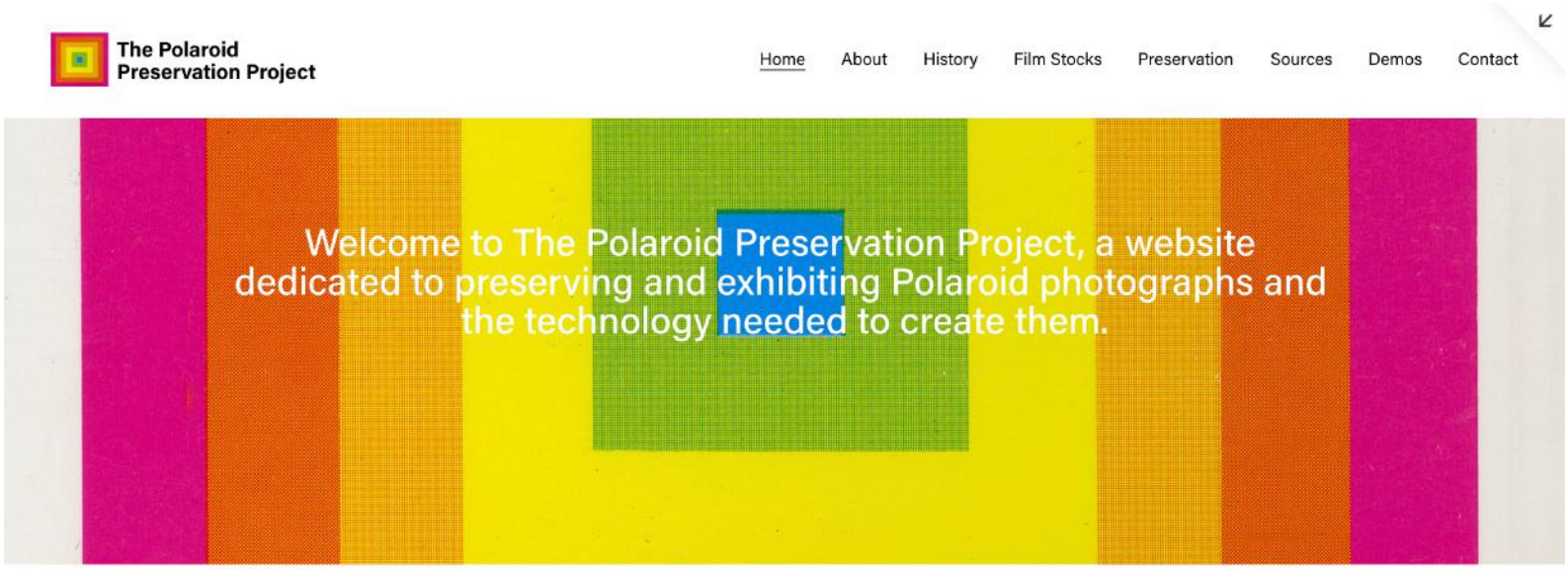
Film Type	Format	Introduced	Discontinued	Notes
Type 40	3 1/4 x 4 1/4	1948	1950	Sepia
Type 41	3 1/4 x 4 1/4	1950	1959	Orthochromatic
Type 31	2 1/2 x 3 1/4	1954	1958	Orthochromatic
Type 42	3 1/4 x 4 1/4	1955	1992	Panchromatic
Type 32	2 1/2 x 3 1/4	1955	1979	Panchromatic
Type 43	3 1/4 x 4 1/4	1955	1958	Panchromatic
Type 44	3 1/4 x 4 1/4	1956	1963	Panchromatic
Type 46	2 1/4 x 2 1/4	1957	1964	Transparency
Type 46L	3 1/4 x 4	1957	1983	Transparency
Type 47	3 1/4 x 4 1/4	1959	1992	Panchromatic
Type 37	2 1/2 x 3 1/4	1959	1979	Panchromatic
Type 146L	3 1/4 x 4	1961	1983	Transparency
Type 410	3 1/4 x 4 1/4	1961	1978	For high speed recording
Type 413	3 1/4 x 4 1/4	1964	1969	Infrared
Type 48	3 1/4 x 4 1/4	1963	1976	Colour
Type 38	2 1/2 x 3 1/4	1963	1969	Colour
Type 20/20c	2 1/2 x 3 1/4	1965	1979	Panchromatic

Film Type	Format	Introduced	Discontinued	Notes
		Polacolor		
Type 58	4 1/8 x 5 1/8	1963	1976	Sheet film
Type 108	3 1/4 x 4 1/4	1963	1975	Replaced by Polacolor 2
Type 88	3 1/4 x 3 3/8	1971	1976	Replaced by Polacolor 2
		Polacolor 2		
Type 108	3 1/4 x 4 1/4	1975	1980	Replaced by Polacolor ER
Type 58	4 1/8 x 5 1/8	1976	1981	Replaced by Type 59
Type 88	3 1/4 x 3 3/8	1976	1980	Replaced by Polacolor ER
Type 668	3 1/4 x 4 1/4	1977	1981	Replaced by Type 669
Type 808	8 1/2 x 10 3/4	1977	1981	Sheet film
		Polacolor ER		
Type 59	4 x 5	1980	2008	Replaced Type 58
Type 88	3 1/4 x 3 3/8	1980	2006	
Type 108	3 1/4 x 4 1/4	1980	2001	Replaced by Type 669
Type 559/s	4 1/8 x 5 1/8	1981	1992	For film holder 550
Type 809	8 x 10	1963	1969	Replaced 808
Type 669	3 1/4 x 4 1/4	1982	2008	Replaced Type 668
Type 64	4 1/8 x 5 1/8	198?	2008	Tungsten balanced
Polacolor Pro 64	3 1/4 x 4 1/4	198?	2008	Tungsten balanced

Film Type	Format	Introduced	Discontinued	Notes
Type 107	3 1/4 x 4 1/4	1963	2000	
Type 107C	3 1/4 x 4 1/4	1978	199?	"coaterless" version of 107
Type 105	3 1/4 x 4 1/4	1974	1977	P/N named changed to 665
Type 084	3 1/4 x 4 1/4	1977	2002	Professional use
Type 665	3 1/4 x 4 1/4	1977	2006	P/N
Type 612	3 1/4 x 4 1/4	1981	1998	oscilloscope recording film
Type 667	3 1/4 x 4 1/4	1977	2008	"coaterless" version of 107
Type 611	3 1/4 x 4 1/4	1979	2008	Low contrast 3000 ISO
Type 664	3 1/4 x 4 1/4	????	????	Medium contrast 100 ISO
Type 672	3 1/4 x 4 1/4	????	????	Medium contrast 400 ISO
Type 84	3 1/4 x 3 3/8	2003	2006	ISO 100 Similar to 664
Type 85	3 1/4 x 3 3/8	2003	2005	ISO 80 P/N
Type 87	3 1/4 x 3 3/8	1974	2006	ISO 3000

Film Type	Format	Introduced	Discontinued	Notes
SX-70	3 1/8 x 3 1/8	1972	1980	ISO 150
SX-70 Time Zero	3 1/8 x 3 1/8	198?	2006	ISO 150
Type 778	3 1/8 x 3 1/8	1981	2006	Professional version SX-70
Type 708	3 1/8 x 3 1/8	1981	2006	No battery version of 778
Type 600	3 1/8 x 3 1/8	1981	199?	600 ISO/Called 780 or 788
Type 600 Plus	3 1/8 x 3 1/8	1988	1992	used Spectra emulsion
Type 600 Plus HD	3 1/8 x 3 1/8	1992	2006	Replaced Type 600
600 Platinum	3 1/8 x 3 1/8	1997	2006	Colour improvements
Type 779	3 1/8 x 3 1/8	1980?	2006	Professional 600
Spectra	3 5/8 x 2 7/8	1986	199?	600 ISO
Type 990	3 5/8 x 2 7/8	1986	2008	Professional Version
Spectra Platinum	3 5/8 x 2 7/8	1991	1998	Improved colour
Spectra HD	3 5/8 x 2 7/8	1992	199?	Improved version
Type 700	3 5/8 x 2 7/8	1998	2006	asian market name
Spectra HD Gold	3 5/8 x 2 7/8	1998	2006	grid overlay for scientific use

APPENDIX II


The Polaroid
Preservation Project
Home
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Demos
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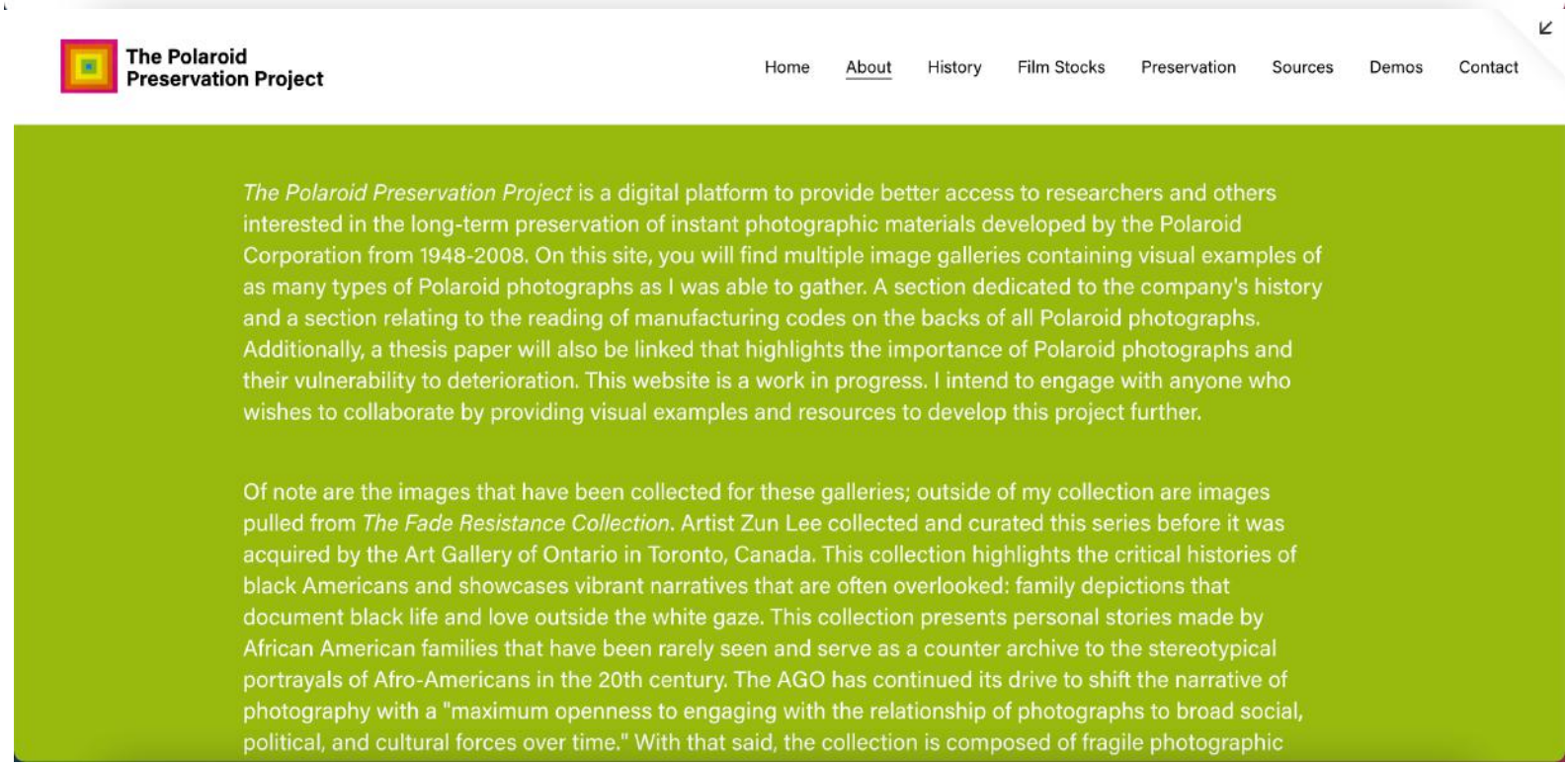
Welcome to The Polaroid Preservation Project, a website dedicated to preserving and exhibiting Polaroid photographs and the technology needed to create them.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The Polaroid Preservation Project is a digital platform to provide better access to researchers and others interested in the long-term preservation of instant photographic materials developed by the Polaroid Corporation from 1948-2008. On this site, you will find multiple image galleries containing visual examples of as many types of Polaroid photographs as I was able to gather. A section dedicated to the company's history and a section relating to the reading of manufacturing codes on the backs of all Polaroid photographs. Additionally, a thesis paper will also be linked that highlights the importance of Polaroid photographs and their vulnerability to deterioration. This website is a work in progress. I intend to engage with anyone who wishes to collaborate by providing visual examples and resources to develop this project further.
Of note are the images that have been collected for these galleries; outside of my collection are images pulled from *The Fade Resistance Collection*. Artist Zun Lee collected and curated this series before it was acquired by the Art Gallery of Ontario in Toronto, Canada. This collection highlights the critical histories of black Americans and showcases vibrant narratives that are often overlooked: family depictions that document black life and love outside the white gaze. This collection presents personal stories made by African American families that have been rarely seen and serve as a counter archive to the stereotypical portrayals of Afro-Americans in the 20th century. The AGO has continued its drive to shift the narrative of photography with a "maximum openness to engaging with the relationship of photographs to broad social, political, and cultural forces over time." With that said, the collection is composed of fragile photographic

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A brief history of the Polaroid company from its inception to its decline.

Inception

Polaroid's history is in itself the history of instant photography. Its inception is widely attributed to founder Edwin Land's daughter's eagerness to see, more immediately than was possible at the time, the photograph that her father had taken of her during a vacation in 1943. The story goes that her excitement and quest for immediacy was the impetus for Land to create one of the most groundbreaking innovations in 20th-century photography that would be eclipsed only by digital photography at the end of the century. It's during this summer vacation in Santa Fe that Land flushed out the general mechanics of a system that could produce instant photographs; he even met with his patent lawyer to have everything written down.

Early days

By late 1944, Land had already begun producing images with the system he had devised. While they were of poor image quality, the instant process was continually refined. As the war began to wind down, the Polaroid Corporation needed to find a way to keep the company afloat once the government contracts for polarizing filters, goggles and bomb sites began to dwindle. As such, the Polaroid Corporation reallocated resources and personnel towards research and development. In 1946, with the additional help of new scientists and personnel like Meroë Marston Morse and Doxie Muller, both of whom would continue to be massive forces in the company for years to come, the development team was creating weekly test images that were

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Here's what you need to know about roll film.

The first commercially available instant photographs were produced using two separate rolls, one containing the negative portion and the other with the positive, which would be sandwiched together as they passed through a series of rollers within the camera rupturing a pod of chemicals. Released by Polaroid in 1948, Type 40 was an orthochromatic sepia-toned film that produced prints 3¼ x 4¼in in size. Type 40 would subsequently be replaced in 1950 by a true black and white film, Type 41. Sometime after its release, consumers noticed that these new prints suffered heavily from fading, prompting Polaroid's team to create a viscous polymer that neutralized the chemical reagents and provided a barrier from environmental hazards affecting the print surface. This print coater would be necessary for all black and white polaroid photographs until 1970, when a coater-less version of the black and white process was developed. There are three film versions within the roll film umbrella, series 20, 30, and 40. These films differ in size and utilize different camera systems for exposure, but generally, the emulsions and development are the same. For example, types 37 and 47 are identical, differing only in size. Roll films were widely used and the black and white versions would remain in production until the early 1990s.

Examples below:



Type 20

- 1965-1970
- ISO 3000
- Panchromatic
- 2 ½ x 3¼ in

The Swinger 20-series films are sort of a hybrid design. The packaging is similar to the 30- and 40-series roll films, but the film is designed to develop outside the camera like the 100/660- and 80-series pack films. Other than that, Type 20 is similar to Type 37 film.

Kuhn, Martin. The Land List. Accessed May 18, 2021. http://www.landlist.ch/landlist/landhome.htm.

Unknown Photographer, around 1960s. Black and White instant print (Type 20),6.3 x 8.3.cm. Personal Collection.

Unknown Photographer, around 1960s. Black and White instant print (Type 20),6.3 x 8.3.cm. Personal Collection.

An identification resource for Polaroid photographs.

Follow along with our guide to uncover dates of production as well as other identifying characteristics.

Roll Film

Think you might have some roll film on your hands?

Get started

Integral Film

Maybe you're dealing with integral film instead.

Find out

Pack Film

Coming soon!

Click here

Verso layout

The information found on the verso of roll film generally follows a set layout. The ink used for these markings changes over time, with some examples exhibiting red frame number markings and black text, or green frame numbers and film types and blue text.

On the top left side of the verso will be the film type (i.e. Type 40, 41, 42, etc.).

Directly below this will be the manufacturing code with a letter prefix denoting the month of production.

Following this will be the brand name.

In the top right corner will be the frame number ranging from 1-8.

Roll films will come in three different sizes, but for the most part share the same emulsions and paper bases, one notable type of film is the type 46, 46L and 146 which created black and white transparencies instead of a positive image on a paper support. Examples of these are rare.

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