



Article: MICKEY, DONALD, GOOFY & PLUTO WHAT'S BREAKING UP THAT OLD GANG OF MINE?: A QUANTITATIVE LOOK AT THE "CEL" ART CREATED FOR WALT DISNEY'S ANIMATED FILMS AND ITS DETERIORATION PROCESS

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MICKEY, DONALD, GOOFY & PLUTO

WHAT'S BREAKING UP THAT OLD GANG OF MINE?

A QUANTITATIVE LOOK AT THE "CEL" ART CREATED FOR WALT DISNEY'S ANIMATED FILMS
AND ITS DETERIORATION PROCESS

RON BARBAGALLO

FORWARD

This writing reflects some of the work my company "Animation Art Conservation" has uncovered caring for these "cel" paintings over the past seven years. I concentrate, as my work frequently does, on the feature films. When asked to write this paper I knew there would be difficulties. Most art conservation involves the care of artwork that is in the public domain; animation "cel" art is not and as such presents some problems. Even with the proprietary reasons aside, records were not always kept and many answers are still unknown. Often my work reminds me of a jigsaw puzzle with many pieces still left to be fit into place. With that in mind, offered is an introduction into the origins, processes and conservation of Walt Disney "cel" art.

An-i-ma-tion Cel (An'ə mā'shən Sel), n., 1. a line drawing on the face of a registered sheet of cellulose acetate which has been flatly colored on the reverse side with paint; cel art is used to create sequential images which are photographed against watercolor backgrounds to give the illusion of movement in animated films.

THE BIRTH OF CEL ART

In 1906, J. Stuart Blackton filmed a series of chalk drawings on a blackboard and called his work "Humorous Phases of Funny Faces." Emile Cohl followed in 1908 and created a series of drawings with white pencil on black paper for use in his film "Drame Chez Les Fantochez." In April of 1911, Winsor McCay, an American Cartoonist, debuted "Little Nemo," a work which involved four thousand pencil drawings on paper and took over 4 years to finish.

A system for producing animation artwork had started to develop by the time McCay premiered "Gertie the Dinosaur" in Chicago on February 23rd, 1914. Drawings were done with india ink on rice paper which was translucent enough for tracing. Progressive stages of character animation were drawn with pencil and inked onto blank sheets. Afterwards, simplistic outlined backgrounds were carefully copied by hand onto each sheet used in the sequence.

John Randolph Bray, a New York City newspaper cartoonist turned his hand towards animation in the early 1910's and through a series of patented improvements helped bring about the development of "cel" art. Released in 1913, "Colonel Heeza Liar in Africa," was Bray's second film and is generally considered the first commercial cartoon. It not only established the cartoon series but also made use of preprinted backgrounds on sheets of translucent paper with specific sections blanked out for character animation. An animator could overlay an additional sheet to draw in whatever actions the scene needed. Both sheets were composited by back lighting them together as they were photographed. This advancement in animation art production would remove character animation from the scenic background and onto a separate sheet.

Bray's next contribution was brought to be patented in July of 1914 and was approved on November 9th, 1915. It involved the use of gray toned paints which were applied to the reverse side of the translucent paper drawings. The addition of a gray scale gave the characters dimension and added a sense of local color to the film. Today, animation production still utilizes this method of tones and

RON BARBAGALLO
ANIMATION ART CONSERVATION

values. While its origins are here in black and white, the use of a gray scale as a local color became the basis of the color theory used at the Walt Disney Studio.

On December 19th, 1914 Animation Cel Art was born when Earl Hurd, another former newspaper cartoonist turned animator, took these advancements one very crucial step further when he submitted his patent application which read "I believe I am the first to employ a transparent sheet or a plurality of transparent sheets in conjunction with a background which is photographed there through upon the negative film." With this development, character animation had now become paintings on clear sheets of cellulose acetate. Simple line drawing backgrounds would now evolve into large detailed watercolor paintings upon which characters could now move freely about.

Bray and Hurd united later in 1914 and formed the "Bray - Hurd Processing Company." Their patented innovations, developed to save time and money, also led to the creation of the "Animation Cel." Every animation studio producing cartoon shorts by using hand painted art on cellulose acetate paid them a royalty. Their approach was used for decades and later became the foundation for the production of Walt Disney Cel Art.

THE ROLE OF CEL ART IN THE ANIMATION PROCESS

After the story for an animated film is established by a Director and Writer, various artists are brought in to assist the writing team in visualizing their text. "Inspirational sketches," "story sketches" and "scenic layout" are roughed out and presented at "Storyboard" meetings to be approved or discarded. An "Art Director" is chosen to establish a visual style for the project. At this point, "Character Model Artists" are brought in to design the look of the characters. Articulated three dimensional sculptures called "Maquettes" and pencil drawings later composited onto photostatic paper called "Model Sheets" serve as character

studies displaying various expressions and poses. A vocal track is recorded and accurately timed out so the animators can match the dialogue spoken with the drawings they are about to make.

"Key Animators" start by creating drawings on registered bond paper establishing the character in the main action poses required by the scene. After the "Key" drawings are completed, an assistant animator called an "In-Between" will connect these "Extreme" drawings by finishing the missing sections of pencil animation. A "Clean Up" artist further refines the lines of these drawings and writes detailed instructions on the paper to be used by the "Inkers" and "Opaquers" as a guide for creating "cel" art. Backgrounds are conceived as pencil layouts and later realized as detailed watercolor paintings.

A "Paint Chemist" has mixed a specialized paint medium which will adhere to clear uncoated cellulose acetate sheets, the most common surface used for the execution of this artwork. A "Colorist" has worked along side the "Art Director" to create thousands of premixed shades of color which will be used like a paint by number palette by the "Inkers" and "Opaquers."

"Inkers" have the responsibility of tracing the lines of finished animation drawings onto the face of a sheet of cellulose acetate with the use of a "Crow Quill" pen. Once a "cel" drawing is traced and the paint is dry, the sheet is turned over. Then an "Opaquer" paints in each section of the figure one color at a time. Great care is taken to stay within the lines. When dry, these "Cel" drawings - paintings are registered in succession to painted backgrounds and photographed by a "Camera Operator" on an "Animation Camera Stand" at a predetermined number of frames per "Cel."

Once principal photography is completed, their role in the motion picture process is over. "Cel" art was often washed clean for reuse, discarded, taken home by employees, given as gifts or sold. Their long term survival was never intended.

MICKY, DONALD, GOOFY & PLUTO WHAT'S BREAKING UP THAT OLD GANG OF MINE?

WHAT TYPES OF INKS AND PAINTS WERE USED AND HOW WERE THEY APPLIED?

Different kinds of commercial and proprietary paints were used over the past 70 years by the Walt Disney Studio to create the lines drawn on the front of the acetate which are called "inking" and the flat fields of color painted on the reverse side which are called "opaquing." The paint manufactured at the studio was based on a watercolor gouache recipe. It evolved over the years and was modified to suit each new type of acetate the studio used. There are 3 general components to a gouache recipe; they are: pigment for color, precipitated chalk and a gum arabic based gum solution. Proportions of these ingredients vary from pigment to pigment.

Drawings are traced onto registered sheets of acetate with the use of a "crow quill" pen which etches a line right into the surface of the "cel" sheet leaving a routed area for the paint to nest. Although the line work is called "inking" rarely is it accomplished with the use of an ink. Colored "ink" lines are made with the same paint used to make "opaquing." In 1958 during the production of "SLEEPING BEAUTY" the Disney Studio experimented with a small section of animation of "Prince Phillip" by using "xerography" as a means to photocopy the animator's pencil line drawings to acetate. To give the new xerographic "cel" art a fuller more traditional look, selected colored lines called "self ink lines" were drawn in later by hand. The Disney Studio continued to use xerography to transfer animation pencil drawings onto acetate up until 1989 for "THE LITTLE MERMAID," the last complete Disney feature to use of xerography for creating the line work of "cel" art.

The "opaqued" areas, most of which are applied on the reverse side, are painted in a heavy coat with a watercolor brush. Although the colors in animation art appear perfectly flat to the human eye, subtle mottling occurs within each colored section. The more pigments used to resolve a color the greater the incidence of mottling. The next time you are watching "LADY AND THE TRAMP" (1955), look carefully and you will notice

the fields of color mottle as "Tramp" walks across the screen. Not only does the color mottle significantly from one area of a flat field to another but color on the top side of a paint layer is not the same color as on the bottom. The pigments settle differently within the very paint layer.

On July 31st, 1939 EMILIO BIANCHI started his career at Disney as a Chemist in the Paint Lab. Emilio began by mixing gouache paints and in time became the Paint Lab Supervisor until he retired in 1978. On occasion he worked elsewhere at Disney as a Tech Research Assistant and in the Process Lab. In his absence, STEVE MC AVOY headed the Paint Lab from 1946 on through 1948 and again in 1954.

EMILIO BIANCHI's humectant heavy gouache recipe is hygroscopic and responds directly to changes in temperature and humidity. The vehicle for its adhesion to the acetate is simply the paint layer's ability to retain moisture. The moisture content in the paint layer expands and contracts as the humidity and temperature rises and falls. This repeated activity can contribute to the opaqued paint layer shifting out of registration with the inked lines on the top side of the "cel."

The recipe for "BAMBI" (1942) is considerably drier and applied thinner than the paint which was used for "PETER PAN" (1953). A significant change in paint chemistry occurs between the productions of "CINDERELLA" (1950) and "ALICE IN WONDERLAND" (1951). This paint is moist and applied with a heavier coat. The steady use of this recipe continues until "THE GREAT MOUSE DETECTIVE" (1986). "OLIVER AND COMPANY" (1988) marks the first time "Cel Vinyl" paints were made at the studio but soon its manufacture was abandoned for paints bought from local vendors. "Cel Vinyl" paints were used to create "cel" art for the productions of "WHO'S AFRAID OF ROGER RABBIT?" (1988) (whose "cel" art was made in England) and for "THE LITTLE MERMAID" (1989). A proprietary computer generated coloring system was developed for translating animation pencil drawings into color

RON BARBAGALLO
ANIMATION ART CONSERVATION

and was used for "THE RESCUERS DOWN UNDER" (1990). This marks the first time a complete Disney animated motion picture was colored by computer. Its use has continued with each subsequent animated feature film the studio has released. The making of "cels" as production art has been discontinued with the exception of Disney Television which still employs the traditional use of xerographic line transfer and cel vinyl paints on registered tri-acetate sheets.

To test the stability of the paint mediums currently used in animation production, I ran a series of temperature and humidity tests on the complete line of "Cartoon Colour Regular Color" (a gum based) paint on a full sheet of aged tri-acetate from Walt Disney's 1959 production "SLEEPING BEAUTY" and on the complete line of "Cartoon Colour's Cel Vinyl" (a "vinyl acrylic copolymer") paint on two sheets of aged tri-acetate from MGM's 1966 production "HOW THE GRINCH STOLE CHRISTMAS." It is likely that the pigments used in both paints from this company are identical. The binders are different and have very different properties for long term adhesion. I found the "Cel Vinyl" paint fared relatively well while the "Regular Color" paint displayed consistent signs of separation shortly after application which progressively worsened over time.

I had a series of Ir Spectras run on the current Cartoon Colour "Regular Color" transparent base and on a sample of Disney gum base taken from the 3 Cherubs from "THE PASTORAL SUITE" from Walt Disney's 1940's feature film "FANTASIA." While both the old Disney and the Cartoon Colour "Regular Color" paint formulas both appear to be gum based, they are not identical and I have found do not possess the same abilities for adhesion.

WHAT TYPES OF CELLULOSE ACETATES WERE USED AND WHEN?

The types of acetates used in animation production parallel those which were used in still photography and motion picture films with one

exception; "cel" acetates do not contain any kind of photographic coatings. However, it is acetate and does experience the same states of deterioration. An acid contained in acetate acts as catalyst producing a self destructive agent which is accelerated by its exposure to high humidity and high temperature.

Records were not kept at the Disney Studio indicating when or what film base was used. Some things have been uncovered from direct examination. The condition of the surviving acetate surfaces vary dramatically from one sheet to another even when the sheets are from the same consecutive sequence from the same motion picture. This includes uneven sheet shrinkage, rippling, curling, discoloration, leaking plasticizers and the paint layer's ability to adhere to the acetate's surface due to any of these kinds of deterioration.

Film shorts and features before 1939 made use of uncoated film sheets of CELLULOSE NITRATE. This includes all of "SNOW WHITE AND THE SEVEN DWARFS" (1938) and portions of "PINOCCHIO" (1940) and "FANTASIA" (1940). For the most part "cel" art created on cellulose nitrate has aged well. The opaqued paint layer adheres to the substrate of nitrate film base better than it has to di-acetate or tri-acetate and is less affected overall by the shrinkage and curvature developing in the sheet. Frequently "cel" sheets appear discolored with a clouded or amber hue. Incidents of rippling are found at the exterior edges of the "cel" sheet even when the "cel" has been pressed flat and covered from light with mat board for years. Severely deteriorated nitrate can have fractures in the "cel" sheets along with a kind of alligator-like network of fissures which can lead to the sheet's further fracturing into separate pieces. Cellulose nitrate "cels" can be brittle and quite sensitive to the slightest amount of pressure.

Somewhere during the production of "THE SORCERER'S APPRENTICE" sequence in "FANTASIA" (1940) there appears to be a switch to a new film surface. Judging from the kind of deterioration I have seen, it is likely they moved

MICKEY, DONALD, GOOFY & PLUTO
WHAT'S BREAKING UP THAT OLD GANG OF MINE?

onto CELLULOSE DI-ACETATE. The acetates from the war years are inconsistent but as a rule have not yellowed as much. They can be just as brittle, do tend to curl up at the edges and seem thinner than the nitrate sheets which were used for "SNOW WHITE AND THE SEVEN DWARFS" (1938). Particularly apparent are the significant amounts of sheet shrinkage. A "cel" trimmed around the outline of a character and glued to a watercolor background will often show a mucilage glue stain around the outer area of the trimmed "cel" where the acetate shrank away. It is not uncommon for an image which is 6 inches tall to lose 3/8 of an inch during a 40 year period. Sheet shrinkage of this nature makes long term paint adhesion difficult. While it is certain that there was a switch to a different acetate, I do not note a distinct change in paint chemistry during the period from "SNOW WHITE AND THE SEVEN DWARFS" (1938) and "SALUDOS AMIGOS" (1943), so it would seem likely that the paint formulas were not adjusted to suit the change of acetate.

I have observed consistent groups of deterioration types and a variety of acetate thicknesses which have led me to believe that it is possible several kinds of acetates were used throughout the 1940's. Sometime around 1944 there seems to be yet another change of film base used by the Disney Studio. The acetate from "THE THREE CABALLEROS" (1945) seems to be thicker and tends to show signs of deterioration more in keeping with what I have observed in known tri-acetate sheets from the mid 1950's. However, since Kodak introduced tri-acetate in 1948, this must be another kind of acetate possibly that of CELLULOSE ACETATE BUTYRATE.

TRI-ACETATE "cel" sheets from the 1950's show a consistent variety of deterioration usually within twenty years of manufacture. Sheet shrinkage in tri-acetate usually results in a flat "cel" sheet becoming curved, warped or rippled to varying degrees. When an area of paint is forced off from this kind of shrinkage, it does not leave the kind of traces of paint behind which are found on

nitrate "cels." At times some of the more brilliant pigments have been known to leave a slight stain on the acetate surface upon separation. Full or even trimmed cel sheets tend to develop a convex or concave curvature to them. Paint layers which extend to the edge of the acetate tend to crack as the acetate sheet curves up or down. Tri-acetate from this period can also appear almost wet from a build up of oily plasticizers leaking to the surface of the sheet which in severe cases can contribute to the paint layer's separation from the acetate.

HOW HAS THE AGING PROCESS AFFECTED
CEL ART?

The majority of the surviving "cel" art we have today left the studio through one of a variety of Disney Art Programs. There was a time, after the Courvoisier Galleries went bankrupt in 1946 and before Disneyland opened on July 17th, 1955, when there was no official source for the sale of Disney "cel" art. The quality of the paints, the type of acetate used for its support, how the "cel" art was prepared for the marketplace and the environment where the art was kept all factor into its life expectancy.

THE COURVOISIER GALLERIES
133 Geary Street
San Francisco, California

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1938 - 1946

Under the direction of HELEN NERBOVIG at the Walt Disney Studio, 20 artists from the animation department prepared for sale over 13,000 "cel" setups from "SNOW WHITE AND THE SEVEN DWARFS" (1938) and a variety of short subjects. The opaqued paint layer of the "cels" were coated with lacquer, trimmed around the exterior of the character and attached with a mucilage glue to a specially prepared presentation watercolor or wood veneer background. Even full "cel" sheets were glued to backgrounds. The lacquer coating on the opaqued paint layer did a fair job keeping the

RON BARBAGALLO
ANIMATION ART CONSERVATION

paint adhered to the nitrate even as the sheet curved with age. After many years, only minor areas of paint separation in the opaquing are common.

Preparing "cel" setups in this manner became too costly and time consuming for the studio. So, in April of 1939 ROY DISNEY turned that responsibility over to THE COURVOISIER GALLERIES directly. "Cels" were still lacquered, trimmed and glued to a variety of surfaces even master production backgrounds. A good deal more were laminated together as full or trimmed "cel" sheets with jagged edges. The solvent used for lamination melded the individual sheets together. It did not have the same affect on the acetate behind the opaqued paint layer which in time pulled away as gases caused the acetate sheet to expand outward. In extreme cases, I have seen trimmed "cels" from "DUMBO" (1941) shrink so much that the acetate curled up like a cannoli shell and paint layer fractured into dozens of pieces.

THE DISNEYLAND ART CORNER
Main Street U.S.A., Disneyland
Anaheim, California

—◆—
1955 - 1973

When Disneyland opened in 1955, there was a small souvenir shop on Main Street where a saleswoman named ELDA HIATT sold trimmed "cel" sheets which were stapled with or without a paper "litho" reproduction background onto inexpensive mat board and covered with a thin white mat. A metallic label identifying the artwork as having been used in a Walt Disney film was placed the back side of the mat board. They were originally sold between \$1.25 - \$5.25. "Cels" left Anaheim, California and found their way onto the wall of children's rooms and soon into desk draws, cardboard boxes and then into attics, basements and garages where they stayed for decades. These storage environments revealed a lot about the affects of high or low humidity and temperature. A "cel" setup from "LADY AND THE TRAMP" (1955) kept in a moist environment typically

displays areas where the opaqued paint layer actively spreads outward and becomes embedded into the mat board. The acetate's deterioration is accelerated by the high humidity which results in the sheet shrinking and rippling. The once flat surface of the acetate has a new geography with peaks raising 1/4 inch or more.

"Cels" which remain firmly pressed against a Disneyland Art Corner backing board run the risk of the opaqued paint layer becoming embedded into the board. Further incidents of paint cracking occur as the board, the paint layer and the acetate expand and contract at different rates. In the past there have been a good amount of amateur preservation treatments, like the coating the back side of the "cel" art with clear nail polish or rubber cement. So called "remedies" like these have only led to further deterioration of the acetate and paint layer.

Paint separation of the gouache layer remained a problem for animation art for years. The main function of "cel" art at this time was still its use in animation production so this was not a great issue. Interest in Disney "cel" art started to expand by the time Walt Disney World opened in Lake Buena Vista, Florida in October of 1971 with prices approaching \$100.00.

THE WALT DISNEY ART PROGRAM
The Preferred Galleries
of Disney Art Editions, Inc.

—◆—
1974 to Present

In the 1974, the Disney Company, through "A Division of Consumer Products," expanded the way they sold "cel" art by forming an art program for galleries in North America. With this new way of retailing artwork came the need for a commercial way to insure the paint layer from separating and falling off. In December of 1981, full "cel" sheets were laminated with MACTAC on at least one side with the use of a LAMINEX machine set between 250° - 275° Fahrenheit. This type of lamination continued steadily for the next ten years.

MICKEY, DONALD, GOOFY & PLUTO WHAT'S BREAKING UP THAT OLD GANG OF MINE?

Although thoroughly tested at the time, in some isolated cases, problems have already started to arise. I examined a "cel" of "Baloo" from 1967's "THE JUNGLE BOOK" which was laminated with using this process in 1986. Within 3 years, the laminate on both sides pulled away from the "cel" sheet with the art taking with it a majority of the paint layer. The adhesive had completely penetrated the opaqued paint layer on through to the acetate's surface. The sections of clear acetate were not bonded as was previously the case when "cels" were laminated in the very late 1930's and early 1940's. The solvent in the glue used by MACTAC slowly transferred the xerographic lines right off the acetate and into the adhesion layer. Once completely separated, all that remains beside the majority of the Disney Seal is about 50% of the xerographic lines. Lamination of this sort was completely discontinued at Disney sometime around 1991.

WHAT TYPES OF RESTORATION AND CONSERVATION SERVICES ARE AVAILABLE?

During the course of commercial animation production the opaqued paint layers of many "cels" would become separated and fall off sometimes right as they were being photographed. They were sent back to the "Ink and Paint Department" where they could be re-opaqued. Production schedules and the intermediate nature of the artwork made this practice common. Originally most restoration of this artwork took this very same approach. Smaller animation studios made use of their stock colors and staff inkers and opaquers and set up in the industry an acceptance for this method of restoration. While the stock colors might not even be close, this type of restoration provided an inexpensive way of refinishing damaged art for sale. The problem is that this approach gives no thought at all to the merit the original paint had for creating the images which were put forth before the camera lens as the motion picture was filmed. Historic areas of paint which could otherwise could be saved are routinely discarded.

Regarding the original paint layer as significant, I started out by developing ways to partially repair "cel" art by selectively treating the damaged areas. I am aware that is an over simplification. The purpose of this writing is to introduce some of the issues involved with the conservation of this art form on a technical and ethical level. This text serves as an armature on which to put forth a future work. Different paint binders and different pigments experience different kinds of deterioration. The type of acetates, how they aged and how critical their state of deterioration all need to be considered. Inpainting has its limitations both commercially and technically as water retentive paint media run the risk of migrating into the surviving paint layer and further accelerating the deterioration of the acetate. A true guide for the conservation of "cel" art would have to be very specific and would require more space than I have here. It would have to take into account the materials used at the various studios at the time of each production, the manner in which the various art programs prepared the art for sale and the state of deterioration which is present.

On December 8th, 1984 in New York City, Christie's East held an auction of Disney animation art from the collection of John Basmajiam. Prices reached well into the thousands. This event propelled "cel" art from its short lived role in film production and placed it into the arena of Fine Art where the longevity of its materials would become a point of greater concern. It is the goal of my company, "Animation Art Conservation" through its continued research and material testing to assist the animation community in making this transition.

In closing, I would like to dedicate this writing in memory of Emilio Bianchi. I did not get to meet the late great Disney paint chemist but I do have the privilege of handling his work on a daily basis. He treaded unknown territory with little recognition and solved the complicated task of

RON BARBAGALLO
ANIMATION ART CONSERVATION

coming up with a paint formula which could adhere to acetate over a long period of time with such surprising consistency.

With appreciation, this paper is in recognition of the expertise of Emilio Bianchi.

This article reflects the research and observations of the author and is only intended for general informational use. The years indicated next to a motion picture title represent the year the film was released; in some cases "cel" art would have been produced well in advance of the release date. None of the contents of this article either in complete form or edited form may be reproduced, stored in a retrieval system or transmitted in any form or by means electronic, mechanical, photocopy or otherwise without prior written permission of the author.

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A Conservancy dedicated to the partial repair of Classic Animation Art whose clients include many of the authorized galleries in the Walt Disney and Warner Brothers Art Programs.

On March 4th, 1995 at 11am at The National Gallery of Art in Washington D.C., Ron Barbagallo presented this paper in an adapted form to an international assembly of curators, conservators and research scientists at the 1995 American Institute for Conservation Photographic Materials Group Winter Meeting sponsored by the National Gallery of Art, the Circle of the National Gallery of Art and the National Geographic Society.

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Page five, paragraph two, sentence three:

Adelstein, P.Z.. "PIONEERS OF PHOTOGRAPHY"