

THE CONSERVATION TREATMENT OF AUDUBON'S BIRDS OF AMERICA VOL. I

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ABSTRACT:

The conservation treatment of Audubon's Birds of America, Vol. I, containing 109 water-coloured engravings is described. Of special interest was the protective coating of the image areas with methyl cellulose prior to washing and deacidification. Because the grain of the Whatman paper runs horizontally instead of vertically in the book, many of the prints were damaged by the turning of the leaves. The book was not rebound, but instead each print was encapsulated in a Mylar envelope and stored in a Solander box. A special storage case was constructed for the binding.

On April 2, 1852 the Library Committee of the Legislative Library at Fredericton, New Brunswick authorized the purchase of the four volumes of Audubon's Ornithology from Little & Brown of Boston, Massachusetts at the cost of \$800¹. It is one of the five sets of Audubon's Birds of America in Canada², and is one of the most handsomely bound of all the existing Audubon Folios in the world. At the present, 134 complete sets of the Audubon are known to exist in North America and abroad³. Some sets have been broken up and sold as single prints. Ten are known to have been destroyed by fire and war. There are probably at least 70,000 prints from the original edition still in existence.³

John James Audubon (1785?-1851) published the so-called Double

Elephant Folio edition of Birds of America between the years 1827 and 1838. He had previously traveled through North America studying, drawing and painting the birds in their natural environment, in life-sized and life-like poses. In 1826 he went to Scotland and England to arrange for the publication of his drawings. William Home Lizars, a prominent engraver of Edinburgh, executed the first ten copper plate engravings, printed them and directed his water-colourists in their hand-colouring. The remaining 425 plates were executed, printed and coloured by R. Havell and Son of London. Only the treatment of Vol. I (109 prints) is dealt with in this paper.

PRELIMINARY INSPECTION AND TESTING

The books were printed on J. Whatman handmade wove paper. This is a heavy paper (about 10 mils) and each sheet is water-marked with either "J. Whatman" or "T.J. Whatman Turkey Mill", plus the date which ranged from 1825 to 1838.⁴ The major conservation problems stem from the chemical nature of the wove Whatman paper. Testing with the Barrow Kit⁵ indicated a high content of alum in the paper. The alum would have contributed to the low pH of the paper (pH 4-4.1 by flat-head surface electrode). An important physical feature of the book leaves is that the grain of the paper runs horizontally instead of vertically (parallel with the fore edge). As a consequence of this wrong grain direction, the leaves do not open properly; i.e., they fail to arch as each leaf is turned from left to right, and instead tend to break along the binding margin as pressure is applied (Figure No. 1). Also, the method of sewing used (individual prints were whip-stitched into sections of

four leaves) precludes the opening to the binding gutter. This type of sewing, plus the wrong grain direction, has resulted in the breakage of many of the leaves as they were forced open, especially at the beginning and ending of the book. An additional problem was that Volumes I (the volume conserved containing 109 prints) had been lined along the three edges on the verso side of each leaf with linen tape. The foxing on this particular volume was minimal.⁶ In some instances the image had transferred to the back of the preceding leaf; this is especially noticeable in the large dark-coloured images. It is not clear whether this transfer is due to acid migration or to actual pigment colour transfer. However, the colours of the image areas have retained a freshness and brilliance.

Although there was some slight fading of the leather of the front board, the leather was in exceptionally good condition. The gold tooling was expertly done by J. Wright*, a prominent London binder of the 1850's, and remains in an excellent state of preservation with little flaking and with exceptional brilliance (Figure No. 2).

THE CONSERVATION TREATMENT

Taking the Book Down: After the photographic documentation of the binding and of each individual print, the bookblock was removed from its binding. The backbone of the bookblock was heavily lined with cartridge

* The name "J. Wright" is stamped on the lower border design on the front cover.

paper. This was gradually removed by applying coats of wheat starch paste which slowly softened the paper and old adhesive. Eventually the hardened animal glue of the backbone was gently removed with a bone folder. The removal of the glue and cartridge paper revealed the sewing of the book block: groups of four leaves which had been whip-stitched to form a signature. Each signature was then sewn around sunken cords. The first group of about five signatures and the last group had been oversewn to strengthen these areas of the bookblock. The sunken cords had been cut at the shoulder of the bookblock so that there were no slips to lace into the boards (Figure No. 3). The binding was in fact a case-binding. The lack of slips, the whip-stitching which prevented any leaf opening to the gutter, the heavily lined-up backbone, plus the over-sewing constituted weaknesses in the binding structure and had led to a weakening of the physical properties of the book.

The sewing threads were cut with a sharp scalpel and then with the use of a bamboo spatula each leaf (print) was gently raised and removed one by one from the bookblock. This for the most part was done without any breakage or tearing except for those leaves which were already broken along the gutter (due to the wrong grain direction) and for the exceptional leaf where the original animal glue had crept between the signatures when the back bone was glued up.

Dry-Cleaning: Considerable surface dirt was removed by using erasing powders in the form of "Skum-X" and "Opaline Pads". "Pink Pearl" erasers were used to remove more resistant dirt. Care was taken to remove

all eraser particles from the prints after the cleaning was completed.

Taking Samples of the Water-colour Pigments: The four volumes of the Audubon were printed and hand-watercoloured between 1827 and 1838, a period of eleven years. Historically this is an interesting period in the development and use of certain pigments. Windsor and Newton Co. was founded in 1832.* The Firm introduced zinc oxide (Chinese White) in 1834.** It was felt that the analysis of the pigments would be a contribution to our knowledge of the history of the use and development of pigments, especially if the analysis could eventually cover the entire period of eleven years. It was decided to take samples of 38 of the pigments used in the Audubon. The minute samples were removed by a sharp scalpel under a microscope. The pigments were transferred from the scalpel point using glass fibres which had been dipped into silicone grease. The fibres were then placed into small glass vials and sent to Analytical Research Services, at C.C.I. in Ottawa, where they were studied and identified by the use of light microscopy and x-ray diffraction and x-ray energy spectrometry used in conjunction with scanning electron microscopy.

Testing for Solubility of Image Colours and Glazes: All of the image colours were tested for their solubility in water. A drop of distilled water was placed on a specific colour, allowed to stand for about thirty seconds and then a small square of blotter (1" square) was pressed

* Marjorie B. Cohn, Wash & Gouche (pub. by the Center for Conservation and Technical Studies, Fogg Art Museum) p. 12.

**Ibid. p. 13.

against the moistened area. The blotter surface was examined to determine whether or not there had been a colour transfer. Forty three of the 109 prints had one or more colours which were soluble in H_2O . Some colours were only slightly soluble, e.g., Plate XV, "Blue Yellow-back Warbler" - the pink and yellow were only slightly soluble as were the reds of Plate 47, "Ruby Throated Humming Bird". In other prints the colours were highly soluble, e.g., all of the dark colours in Plate 31, "White-headed Eagle", and the blues of Plate 36, "Stanley Hawk". Plate I, "Wild Turkey" contained green, brown and red pigments that were only faintly soluble. The colours were tested with H_2O only. Some of the prints had been glazed with a varnish-like substance. These glazed areas were also tested. The water had no effect on them and did not dull them in any way.

Fixing the Images: Because several of the image colours were soluble in water, it was decided to fix these and, as a precaution, all of the image colours with 10% methyl cellulose in water. This was applied to the front surface of the image area evenly with a soft-bristled oriental brush and allowed to dry overnight (Figure No. 4). When dry, the fixed surface had a slight sheen. The purpose of the methyl cellulose coating was to prevent any bleeding or running of the water-colour pigments during immersion in water or in the deacidification bath.

Washing: As a preliminary to washing, the linen tape was mechanically removed by peeling it off dry. Each Audubon print was then supported on a sheet of "Reemay", sprayed off with distilled water and then placed in a large sink for washing. The prints were washed in groups of five in

constantly changing luke-warm water for forty-five minutes. The washing not only removed additional dirt but also made possible the removal of the residual linen tape adhesive. The remaining animal glue on the back edge of each plate was softened and could be removed by the use of a bamboo spatula and soft brush. After washing, the prints were removed from the sink, still on their Reemay support (Figure No. 5) and placed image side up on terry cloth. The excess moisture of the image surface was blotted dry with sheets of chromatography paper. The prints were then allowed to air dry.

Deacidification: The prints were then immersed in a solution of magnesium bicarbonate for fifty minutes. The solution was made up by suspending magnesium carbonate powder in water (8.5 grams per litre of distilled water). Carbon dioxide (CO_2) was vigorously bubbled through this suspension for 2 hours. Testing of the solution with the Taylor Hardness Kit⁷ indicated that approximately 8 g/l magnesium carbonate were being dissolved. The prints were deacidified in groups of five, each group in a fresh solution of 25 liters of magnesium bicarbonate solution. These were removed and dried in the same manner as the washed prints. It is to be noted that on drying there was no apparent trace of the methyl cellulose on the paper surface, and the glazes were left unaffected. In the case of the prints where there was a possible problem of bleeding of specific colours, these were deacidified with Wei T'o Solution No. 2*,

* Methanol and Trichlorotrifluorethane, the organic solvents used in Wei T'o Solution, dissolve the deacidification agent, magnesium methyl carbonate (a mixture of magnesium methoxide and carbon dioxide).

applying the Wei T'o solution with a Devilbiss spray gun using a stream of CO₂ gas as a propellant. This solution was applied to both the front and back sides of the prints. Before the prints were completely dry, they were placed between blotters and placed in a large press and pressed lightly overnight. Prior to pressing, in order to secure the engraving impressions, the exact area of the plate impression was traced and then cut-outs were made of the same thickness of paper and inserted in the depressed areas to preserve the impressions. The final pH, measured with a flat-head surface electrode, ranged between 8.5-9.1. Although the fixitive was applied only to the front surface of the image area it is the opinion of the author that washing occurred from the back side and that the deacidification solution easily entered the paper from the rear. During the washing and deacidification there was obviously some softening of colours, although no bleeding of colours was detected. During blotting there was no transfer of colours to the blotting paper with one exception - Plate 31, White-headed Eagle. Upon blotting with chromatography paper there was faint transfer to the blotting paper of some of the darker colours.

Mending: All mending was done with Sekishu oriental paper using wheat starch paste as an adhesive. The Sekishu paper was torn into long strips by the use of a water brush to ensure long fibres. A strip of oriental paper was applied to the verso of the fore edge of each print. The mending of small tears was done with the assistance of a tacking iron, applying this at a low heat to the mend through a sheet of Reemay. Because of the weakness and many tears and losses of the Turkey plate (Plate No. 1),

it was backed overall with Sekishu oriental paper. This was done without any use of heat.

Encapsulation: After consultation with the Librarian of the Legislative Library, it was decided not to incorporate the 109 prints back into the binding since the Whatman paper would not withstand turning of the pages without consequent breakage. It was therefore decided to insert each print into a 7 mil polyester (Mylar) envelope. The two sheets of Mylar that formed the envelope were held together on the left vertical edge by a strip of 3M #415 Double-side Tape. These Mylar enveloped prints were then stored in two large Solander boxes which were lined with Harumi acid-free paper (Figure No. 6). Because of the weight of the prints and the Solander boxes, they were supported by a piece of 3/4 inch plywood lined with acid-free gray board the size of the Solander box.

Treatment of the Binding: The final procedure was the treatment of the binding. The first step was to remove the paper lining of the boards. The corners of the binding (which showed considerable wear) were lifted and the heavy millboard corners injected with polyvinyl acetate emulsion using a hypodermic needle. This was done to strengthen the boards. New leather was applied to the corners and wheat starch paste was used to adhere the original leather down into place over the new. The spine was then reinforced by lifting the leather along the spine and head cap areas and then pasting in a strip of leather which was the same length of the spine but about an inch wider than the spine width. Finally, the spine was lined with acid-free paper and new paste-downs were applied. The leather was treated with

potassium lactate, allowed to dry for 24 hours, and then a lanolin and neats foot oil leather dressing was introduced. When this had dried the binding was buffed up with soft terry cloth. A special storage box was constructed in which the binding could be stored flat, face up.

MATERIALS

Wheat starch paste is available in a dry powder from Talas, division of Technical Library Service, 104 Fifth Avenue, New York, NY 10011 U.S.A. (212) 675-0718.

Skum-X (Dietzgen) Drawing Cleaning Powder is available from Wallack's Art & Drafting Supplies, 231 Bank Street, Ottawa, Ontario.

Opaline Pads (containing ground up eraser material) is manufactured by Durasol Drug and Chemical Co., 325 Marginal Street, East Borden, MA 02128 U.S.A.; it is available from Talas.

Pink Pearl Eraser is manufactured in Canada by Eberhard Faber (Canada) Ltd., Acton Vale, Québec, Division of Dixon Pencil Co. Ltd.; it is available from Wallack's.

Reemay is a polyester fabric with a spun-bonded structure. It is manufactured by DuPont of Canada Ltd., Box 660, Montréal, Québec H3L 2V1 (514) 861-3861. Talas is now stocking a substitute, Hollytex 3221.

Methyl Cellulose-M-282, laboratory grade, 1500 centipose viscosity is available from Fisher Scientific Co. Ltd., 2660 Southvale Crescent, Ottawa, Ontario.

Wei T'o Solution #2 is manufactured by Wei T'o Associates, Inc., 224 Early Street, Box 352, Park Forest, IL 60466 U.S.A.

Devilbiss Spray Gun is available from Devilbiss (Canada) Ltd., Barrie, Ontario.

Sealactor Tacking Iron is available from 115 V.A.C. Seal Inc., Derby, CT U.S.A.

Sekishu, Japanese handmade paper, is available from AIKO's Art Materials Import, 714 North Wabash Avenue, Chicago, IL 60611 U.S.A.; it is also available from Talas.

Mylar (7 mil, type D, super clear, uncoated) is available from DuPont of Canada Ltd., Films Department, Box 660, Montréal, Québec.

Double-sided Tape (#415) by 3M is a transparent double-sided tape on a polyester carrier. It is available from Carr McLean Co., Toronto and is a product of 3M Canada Ltd., London, Ontario.

Solander Boxes are available from Mr. Perry Goodin Fine Bindings, 264 Holmwood Avenue, Ottawa, Ontario K1S 2P9.

Jade #403 is a polyvinylacetate emulsion which is available from Talas.

Potassium lactate is available from Talas.

Talas Leather Dressing (40% anhydrous lanolin and 60% neatsfoot oil) is mixed and sold by Talas.

NOTES AND REFERENCES

1. Maurice P. Boone and Donald B. Gammon, "The Audubon Mystery" Atlantic Advocate, March, 1959.
2. The five sets are:
Library of Parliament, Ottawa, Ontario
Laval University Library, Québec City, Québec
Wood Library of Ornithology, McGill University, Montréal, Québec
Legislative Library, Fredericton, New Brunswick
Fine Art Department, Metropolitan Toronto Library, Toronto, Ontario.
3. Fries, Waldemar H., The Double Elephant Folio: The Story of Audubon's Birds of America (Chicago: American Library Association, 1973) p. 196.
4. Ibid. p. 387.
5. The Barrow Kit is a commercial product containing spot-testing materials for paper. It may be used for the testing for the presence of alum and is available from W.J. Barrow Research Laboratory, Inc., Richmond, Virginia.
6. Carolyn Horton remarks that considerable foxing is often present in the plates, especially in those sets which have been kept in a hot and humid climate. A discussion of this may be found in: Horton, Carolyn, "Conservation Problems of Audubon's Birds of America", Guild of Book Workers Journal, vol. XV, nos. 1-3, 1976-77, p. 18.
7. The Taylor Kit is a commercial product used for quick determinations of dissolved magnesium (Mg) levels. It is available from Taylor Chemicals, Inc., 7300 York Road, Baltimore, MD 21204 U.S.A.

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PHOTOGRAPHS

- Figure No. 1: Showing the buckling of the leaves and their failure to arch as they are turned.
- Figure No. 2: Detail of gold tooling.
- Figure No. 3: Detail of sewing structure.
- Figure No. 4: Treating image with methyl-cellulose.
- Figure No. 5: Removing turkey print from washing bath supported by Reemay.
- Figure No. 6: Turkey print in mylar sleeve in solander box.

REVIEWERS COMMENTS

1. Comment: Strongly disagree with use of fixative over entire image area, especially since impression given that not all pigments were fugitive.

Answer: It is true that not all colours were fugitive from my testing. Only 43 of the 109 plates had one or more soluble colours. Some colours displayed only the slightest solubility. However, since the prints were to be exposed to a washing of 45 minutes and a deacidification bath of 50 minutes, it seemed the prudent thing to fix the entire image as a safeguard against any loss of colour.

2. Comment: How much colour are you losing?

Answer: a) In testing for solubility, some pigments were highly soluble.
b) After washing and deacidification, no noticeable loss of colour. This was verified by comparing the before and after photographs of each print.

3. Comment: Methyl-cellulose swells in aqueous treatments and so must be at least partially removed during procedure. If you cannot see the methyl cellulose on surface of object after treatment where do you think it has gone? Into the paper or removed in aqueous treatment.

Answer: Methy cellulose is soluble in H₂O and I think that most or much of it would have swollen in aqueous media and been removed into bath. A small amount, I think, would have remained inbedded in the paper fibres. This is a guess and would have to be scientifically verified.

4. Comment: Will the residues (if they are in the paper) cause the image areas to react to moisture differently than non-image areas?

Answer: It would depend on the amount of methylcellulose remaining in the paper. Again I think that the amount remaining is so slight that there would be no appreciable difference. The Whatman paper was originally sized with gelatine and the paper appears to be in a healthy condition size-wise. The pigments were added to the paper after it had been sized. So already there is a difference in the way the image area and non-image area would react to moisture. It is possible, and this is conjecture, that by sizing the image area, i.e., fixing with methylcellulose, the image areas and non-image areas would react to moisture with greater similarity than before.