A HAZARD OF FLOAT WASHING: REGENERATION OF PAPERSIZING

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Abstract: The phenomenom of the development of resistance to wetting of paper after repeated float washings on water is discussed.

Float washing is a traditional means of treating with water the entire surface of a sheet of paper that cannot be safely bathed. Even in this era of cold suction tables, the technique cannot be surpassed in certain cases for ease, economy, and effectiveness. Presumably the process has been discovered independently by many conservators, who observed the natural tendency of many sheets of paper, however wrinkled and even torn, to float on the surface of still water, to be pulled flat by surface tension, and to be washed clean of water-soluble stains.

Float washing is little discussed in the literature; I have found one description of the process in Thomas R. Beaufort's Pictures & How to Clean Them (New York, 1926), pp. 156-159, as a means to clean pastels. More recently, Katherine Eirk published "Musings on the Technique of Float-Washing Paper" in the Washington Conservation Guild Newsletter I (1977), no. 4, p. 4. Her paper, dated 8 Nov. 1976, is a more thorough discussion of the technique, which gives some of the theory behind its mechanism and which mentions some of the inherent hazards.

I wish to report on another hazard which I have encountered in practice and which I have confirmed by some simple experiments. As Eirk notes, "Several repetitions of this procedure (float washing) should result in a paper containing several orders of magnitude fewer water-soluble impurities than formerly,"

and, indeed, practice seems to establish that some stains are removed more thoroughly by several short floats, with the paper allowed to dry between them, than by one long float. However, it has been my experience that in a limited but statistically significant number of cases,the more often the sheet is floated, the less absorbant and the less evenly saturated it becomes.

Even one instance of this could be one too many, of course, because of the unfortunate consequences of uneven wetting. When a sheet wets uniformly, the dissolved stains are wicked to the back of the sheet into the bath, "...until sufficient impurities exude from the paper to bring the bath and paper to equilibrium," again to quote Eirk. However, if the sheet does not wet out uniformly, not only do the less wet areas tend to release less stain into the water than the more wet areas, resulting in mottling, but also the stain-charged liquid in the more wet areas tends to spread sideways through the paper fibers rather than being drawn uniformly to the bac k and to be dammed up at the borders of the wetter areas by the surrounding drier areas, resulting in rings and tide lines.

This is a real hazard, for, in practice, when a paper becomes less and less absorbant after repeated floatings, it does tend to do so irregularly. The nature of the pattern of wetting which develops suggests the cause of the paper's decreased wettability: the pattern on the partially saturated surface reflects mould attack, in that the wet patches are of the size, shape, and distribution that we recognize as foxing, even if little or no foxing was apparent before treatment; or the wet patches conform to mechanical disturbances of the sheet

(creases, abrasions, tears); or deckle or book-page egdes, if present, continue to wet up even when the rest of the sheet does not.

All of these effects suggest that the cause of the developing water-repellancy of the sheet is that the sizing of the paper, where undamaged by mould, accident, or ageing accelerated by disproportionate exposure to air, is regenerated by repeated wetting and drying. If this mechanism occurs, it goes far to explain the subjective opinion held by practically all paper conservators of my acquaintance, that washing old paper greatly restores its luster and "hand," to use a term more usually applied to textiles, --an opinion which runs counter to the expectation of doubting curators, who are concerned that washing dissolves and removes paper's sizing. I emphasize that I refer to water-washing, or floating, only. If additives, such as strongly alkaline buffers, are added to the bath, or if the water is heated, sizing might well be affected.

In order to see whether my empirical observations were correct and to understand the mechanism a little more explicitly, I set up a series of tests with old papers from the Fogg Museum repair papers collection. My criterion for selection was simplicity itself: I chose sheets large enough (at least 6"x10") to guarantee a control sample and samples for several sorts of floats. I cut off a control piece about four inches square from each sheet, and then I floated the rest of each sheet on room-temperature deionized water. If a piece wet out completely and uniformly within a few minutes, it was retained for the project. I obtained twenty-six samples that met this requirement: it seemed easiest to keep track of them by letters, and

in any case we did not have too many large sheets to spare.

Most of the papers appeared to be ledger sheets dating from the 17th-19th centuries. Most were handmade, laid papers; practically all appeared to be rag papers. There were a few more modern papers, all of them apparently of very good quality. I decided not to proceed to any further analysis beyond simple visual inspection until and unless the results of my tests warranted it.

Also, I had recently acquired a large collection of old papers from an artist's estate, mostly fine watercolor papers in their original packaging. From these I chose a full sheet (Imperial) of Whatman paper watermarked 1836, which I was certain would be gelatine sized, presumably with alum hardening, and a sheet of buff-colored MBM Ingres d'Arches paper, which I believed to be rosin/alum sized. These papers had been in dark storage since their manufacture, and they provided large enough pieces to carry out a wider variety of experiments.

From those sheets from which I could spare large pieces, that is, the Whatman 1836 and MBM, plus samples C,F,H,M,O,P,S, and T, which were all ledger sheets of some age, I cut pieces for preliminary light-ageing. This seemed useful as I was fairly certain that all samples, even those which were from unknown sources, had been kept in the dark for substantially their entire existence and thus did not represent the typical condition of print and drawing papers in need of conservation.

Samples for light-ageing were mounted loosely onto rag-board and laid under a south-facing skylight in a non-climate-controled portion of the museum for a period of up to 100 days (Feb.-May). It is worth noting here that all of the papers that I believed to be undyed rag faded, some to pure white,

and that none darkened. British Blue Wool Standards put out at the same time also faded, with Strip #1 fading to pale tan, #2 fading to lighter than the comparative Grey Scale #1, #3 fading to Grey Scale #1, #4 to Grey Scale #4, and #5 fading just perceptibly.

While these were ageing, I proceeded to refloat four more times on deionized water the pieces which had already been floated once. Between each float, the papers were allowed to air-dry thoroughly, at least overnight and usually over a period of several days. At this time, and also prior to the tests, the Fogg Museum climate-control system was being carefully monitored, and so the relative humidity to which the samples were conditioned was 50%, with little variation.

Little significant change in the saturation of the samples was noted after the second float, but by the fifth float it was obvious that, while a majority of the samples continued to wet up as thoroughly and quickly as they had at the beginning, a substantial number of them had developed a marked resistance to wetting out at all. As in the cases of comparable behavior that I had observed during conservation treatments, the patterns of decreased wettability followed those areas of the sheets where the sizing was apparently undamaged by mould, mechanical wear, or accelerated ageing through exposure to the environment.

After five floats, I cut small pieces from each of the control samples and the five-float samples and then dropped the paired samples simultaneously onto water, to observe and time their wetting characteristics (results of this test and other tests and examinations are given in Table I at the conclusion of this report). This operation took place on a

Saturday. I left the pieces floating until Monday, to see if any of the samples that did not wet up over the course of a morning would saturate after two days: none did, nor did any of the saturated pieces sink.

After drying, portions of all samples that had been floating for almost two days were set out to light-age. After sixty days they were floated to observe their wetting characteristics anew. Observations were consistent enough that there seems no need to devote a separate column to them in the accompanying table. Briefly, with only two exceptions, all of the samples wet out completely. If any difference was observable, it was the tendency of the samples that had been floated five times to wet out a little more slowly and unevenly than those than had been floated only once. Some wet so completely that they sank. The two exceptions were both modern papers, N and R; in both cases the one-float sample wet up and the five-float sample did not.

The light-aged samples of the Whatman 1836 and the MBM papers were floated in comparison with control samples. It was immediately apparent that the Whatman 1836 light-aged sample continued to resist wetting up except at points that had apparently been attacked by mould (no stains were visible under casual examination of the dry sample). These mould points had increased significantly in size and numer during the two-and-one-half months under the skylight. The MBM sample, which was presumed to be rosin-sized, wet out immediately and completely, conforming to reports in the literature of the light-sensitivity of rosin/alum sizing (see Julius Grant, Books & Documents: Dating, Permanence and Preservation (London, 1937), pp. 141-142).

The light-aged portions of samples that had shown a strong tendency to resist wetting after five floats were themselves floated four more times, to a total of five after ageing and then floated a sixth time in comparison with pieces from the same sample, not light-aged, that had already been floated five times. Results of these tests (also reported in Table I) were clear-cut: light-ageing seriously damaged and in most cases destroyed the proven capacity of these sheets to develop a resistance to wetting. The single dramatic exception, Sample R, a modern paper, was only partial, in that the sample that was light-aged after one float and then floated five times after light-ageing did wet out, but the sample that was light-aged after five floats and then float washed five more times continued to resist wetting.

As indicated, the Whatman 1836 and MBM samples, which were considerably larger sheets in pristine condition, which resisted saturation even on their first floats, were subjected to a larger variety of tests. Results are reported in Table II at the conclusion of this report; they may be summarized by saying that pre-floating on a water/alcohol mixture seems to affect seriously both papers' capacity, otherwise very strong, to develop further resistence to wetting. Apart from this, the papers' characteristics seem to follow the general patterns noted in the experiments as a whole.

After all these floating tests were concluded, the samples (in particular their sizing) were examined in various ways. Visual examination immediately established that floating had accomplished the usual result desired in conservation treat-

ment: the sheets became lighter, brighter, cooler in hue, more lustrous, and with apparently improved "hand." The most striking change was observed in sample L, which had shown a pale greenish hue before floating. It became a pure, light aqua-blue after treatment; the effect was apparently caused by the removal of a strong yellow component of its pre-treatment color, much as the pallette of an oil painting is apparently altered by the removal of a discolored natural varnish.

Visual examination under ultra-violet light showed that the control and the five-float samples had characteristically different fluorescences. The controls showed a soft yellowish color; the treated samples were more purplish. Samples that had wetted out imperfectly and developed tidelines of dissolved stain showed these patterns of staining very prominently as a golden intensification of the hue of old, untreated papers viewed under ultra-violet light. Areas that had wetted out more thoroughly than the general body of the sample and were differentially lighter by ordinary visual inspection showed a purpler mottling when viewed under ultra-violet light. In general, therefore, the change in fluorescence can be attributed to the loss of the colored, water-soluble ageing products, whose loss is visible under normal viewing conditions as a lightening of the paper and is one of the usual desired results of water treatment. Under ultra-violet light, light-aged but untreated samples of both Whatman 1836 and MBM papers were dramatically changed: both fluoresced an intense purple-brown.

Because of limitations of time, not all samples could be examined by all means, but a selection was made for study by scanning electron microscopy. Two instruments were used, the

first (Cwikscan 100 Field Emission SEM, with the samples carbon coated) for visual examination, and the second (JEOL JSM-35 SEM, with the samples gold-palladium coated) for photography. The Whatman 1836 and MBM papers were studied, and also three papers whose wetting characteristics had remained the same and three whose wetting characteristics had dramatically changed after five floats. In all cases, both the recto and the verso of both control and treated samples were examined, at magnifications of up to 2000x. I had, frankly, expected to be able to detect a coating on fibers of samples which had become resistant to wetting, and that it would have changed in some way as a result of treatment. However, there were no coatings visible on any samples consistent with their behavior and, indeed, even the detection of any coating was a subjective act of faith on almost all samples. Also, there were no significant differences between the recto and the verso of any sample.

SEM x-ray fluorescence analysis, using an energy dispersive detector, was done on various particles observed in the papers under high magnification, in hopes of detecting aluminum and sulphur, indicating alum. Most particles turned out to be adventitious grains caught among the fibers; a large proportion of these contained silicon, and they are presumed to be airborne grit. Two samples, however, had particles which were definitely aligned with the paper fibers themselves and were evidently deposited during the manufacturing process. In both cases, these homogeneous particles were analyzed to contain, exclusively, calcium and sulphur. Dard Hunter (Papermaking, 2nd ed. (New York, 1957), p. 540) reported that gypsum (cal-

cium sulphate) was "used for the first time in Europe as a 'loading' material" in 1823, but I have discovered a 1797 recipè for engraving-paper (Annales de chimie, v. 22, p. 104) which calls for, among other ingredients, alabaster and gypsum, both calcium sulphate compounds. The two samples in question appeared to be 18th-early 19th c. ledger sheets. What makes the discovery interesting in a discussion of floating is that no trace of these calcium/sulphur particles could be found in samples of the same sheets after they had been floated five times.

Several samples, including the Whatman 1836 sheet, which I was certain was coated with a gelatine sizing in good condition, were examined by Fourier transform infra-red spectrometry, in hopes of establishing a method to identify the presence of gelatine sizing with certainty. While all samples gave excellent, well-resolved patterns which matched cellulose standards, the spectra failed to show the presence of protein, either because the protein was in too small quantities or because the cellulose spectra masked the region where protein bands are commonly found.

I then resorted to two standard chemical spot-tests for protein (Feigl and Ninhydrin). I tested the sensitivity of both on finger-smears on filter paper (negative) and rabbit-skin glue (positive), and I discovered in practice that the Ninhydrin test was somewhat more sensitive than the Feigl test but that both gave consistent results, on both control samples and samples that had been floated six times. Most of the papers proved to be protein (gelatine) sized, including the MBM paper

which I had assumed to be rosin/alum sized.

The Raspail test for rosin, carried out on all samples, proved negative on the MBM paper and all others except sample A, an anomalous oriental (?) paper which never ceased wetting up but which gave a positive test for both rosin/alum and gelatine sizing (if that is what the Raspail, Feigl, and Ninhydrin spot-tests prove), and also on two other samples, D and G. D, a modern paper, demonstrated some change after five floats but continued to wet out; G, watermarked 1801 (but maybe later?), became the most water-repellant of all papers in the project after five floats. G gave a negative rpotein test; D was difficult to judge, as it is a dyed paper and the dye color seemed to mask or imitate the pinkish tinge of the protein tests.

Finally, an attempt was made to detect aluminum, as a component of either rosin/alum or alum-hardened gelatine sizing, by elemental analysis using emission spectroscopy. Again, time limited the number of samples that could be examined. Eighteen samples that either continued definitely to wet out or which showed pronounced changes in wetting were selected; the particular pieces chosen were those that had been floated once for almost two days, as the largest amount of sample was available in this class. These samples were ashed and arced, and their spectra correlated with a spectrographically pure iron spectrum under each spectrum. Rough quantitative estimates (major, minor, trace) were made of detected elements (Si, Mn, Fe, Mg, Al, Ca, Na), and the presence of elements of particular interest in this study (aluminum, magnesium, and calcium) are reported, together with positive spot-test results only, on Table I.

Every sample tested contained at least a trace of aluminum (not true of Si, Mn, Mg, or Na), although sample G, which gave a positive test for rosin, showed only a trace: evidently sample G's sizing, which is certainly effective, practically speaking, did not require volumes, comparatively speaking, of alum. Of the eighteen tested papers, the three with "major" aluminum components were A, the oriental (?) paper which gave positive rosin and protein tests yet which continued to wet up, and P and W. These two samples, which gave positive protein tests, also continued to wet up after five floats.

What conclusions, then, can be drawn from these analytical tests, from the experimental results, and from a correlation of these facts with my approximate classification of the papers by type and age? First, and most emphatically, sized papers can develop a pronounced resistance to wetting through repeated treatment by floating. (All three papers which gave negative rosin and protein tests continued to wet up relatively consistently.) Second, the mechanism of this process has not been identified, although alum may be an influencing factor. Third, older papers, that is, those subjectively identified as pre-nineteenth century, were much less likely to develop a resistance to wetting. Fourth, gross over-exposure to light will probably damage or destroy a paper's capacity to develop resistance to wetting. Fifth, and this is incidental to the study, while calcium/sulphur compounds are removed by five floats, neither protein or rosin are; and magnesium, aluminum, and other calcium compounds can remain as "major" components of paper after at least one forty-hour float in deionized water.

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TABLE I

EXPERIMENTAL AND ANALYTICAL RESULTS OF TESTING PAPER SAMPLES FOR THE DEVELOPMENT OF RESISTANCE TO WETTING AFTER REPEATED FLOAT WASHING

Samples are listed in order of increasing development of resistance to wetting. All samples were tested for protein (F = Feigl spot-test, carried out on control samples; N = Ninhydrin spot-test, carried out on five-float samples) and rosin (Raspail spot-test, carried out twice on control samples); only positive results are recorded. Eighteen samples were analysed by emission spectroscopy for the presence of aluminum, magnesium, and calcium; results are given in that order (3 = major, 2 = minor, and 1 = trace finding). Two sorts of light-aged samples were compared to non-light-aged five-float samples, but as a few light-aged samples were lost, results are not absolutely consistent (LA5F = samples which were floated once, light-aged from March 15 to May 15, and then floated five more times; 5FLA5F were samples which were floated six times, light-aged from March 15-May 15, and then floated five more times).

TABLE I

SAMPLE	TYPE: A=antique laid M=modern laid W=wove hm=handmade wm=watermark	PROTEIN	Al / Mg / Ca	ROSIN	WETTING ON SIXTH FLOAT OF CONTROL AND FIVE-FLOAT SAMPLES (March 15, 1982)	WETTING ON SIXTH FLOAT OF FIVE-FLOAT AND LIGHT-AGED FIVE-FLOAT SAMPLES (May 24, 1982)	WETTING OF FIVE-FLOAT AND 45-HOUR ONE-FLOAT SAMPLES
A	(?Chinese?), M, cream, very thin, 19th-20th c.	F+ N+	3 2 2	+	both wet out uniformly and quickly, 5F curls		
B	A, ivory, medium weight, ribbed, hm, 18th c.	F+ N+			both wet out uniformly		
K	A, off-white, medium weight, smooth, 20th c. wm: DARD HUNTER		1 2 3		both wet out uniformly and quickly		
O	A, Dark tan, thin, rough hm, 17th-18th c. wm: HH	F+?	2 1 3		both wet out completely and instantly		
S	A, ivory, light weight, rough, hm, 17th-18th c. wm: A M		1 1 3		both wet out completely and fairly quickly		
W	A, cream, medium-heavy weight, pebbly, Italian 17th-18th c., hm, wm: six-pointed star in circle, surmounted by X	F+ N+	2+ 1 3		both wet out in about 1 minute		
Y	A, cream, medium weight, pebbly, hm, Italian 17th-18th c., wm: six hills in triangular array	F+ N+	2 2 3		both wet out completely and immediately		

SAMPLE	TYPE: A=antique laid M=modern laid W=wove hm=handmade wm=watermark	PROTEIN	Al / Mg / Ca	ROSIN	WETTING ON SIXTH FLOAT OF CONTROL AND FIVE-FLOAT SAMPLES (March 15, 1982)	WETTING ON SIXTH FLOAT OF FIVE-FLOAT AND LIGHT-AGED FIVE-FLOAT SAMPLES (May 24, 1982)	WETTING OF FIVE-FLOAT AND 45-HOUR ONE-FLOAT SAMPLES
C	A, ivory, medium weight, ribbed, hm, Italian 17th-18th c.	N+	1 2 3		c wet out faster than 5F, but both wet out completely		
D	W, tan (dyed), heavy weight, smooth, 20th c.	F+? N+?		+	5F curls much more than c at beginning, but both wet out	5F dry, 5FLA5F wets out irregularly but completely in the end	
T	A, ivory, medium weight, pebbly, hm, 18th c., wm: fleur-de-lys in oval, A M G above, F below	F+?			c wets immediately, 5F mottled but eventually wets out	all wet out completely, but LA5F and 5FLA5F more rapidly	
E	W, tan, thin, rough, machine made, previously light-aged and determined to have some non-rag pulp late 19th c.				5F wets in patches faster that c, but c more completely wet		
F	A, tan, medium-heavy weight, coarse, ribbed, hm, 18th c.	F+ N+			5F wets faster, completely wet in 45 sec., c wet in 4 min.	all wet out completely, but LA5F and 5FLA5F much more rapidly	
H	A, cream, medium weight, coarse, hm, Italian 18th c., wm: eagle in circle surmounted by crown	N+			c and 5F edges saturate immediately, c wet overall in 2½ min., 5F remains dry in pin-prick sized points	5F wets but remains somewhat mottled, LA5F wets completely	
I	A, off-white, light weight, smooth, hm, 20th c.,wm: DARD HUNTER	N+			c mottled-wet in 2 min., completely wet in 9 min.; 5F only mottled-wet overall	5F remains dry-to-mottled, LA5F and 5FLA5F wet out rapidly and completely	45hr wets out; 5F curls at 1st and then ½ wets

SAMPLE	TYPE: A=antique laid M=modern laid W=wove hm=handmade wm=watermark	PROTEIN	Al / Mg / Ca	ROSIN	WETTING ON SIXTH FLOAT OF CONTROL AND FIVE-FLOAT SAMPLES (March 15, 1982)	WETTING ON SIXTH FLOAT OF FIVE-FLOAT AND LIGHT-AGED FIVE-FLOAT SAMPLES (May 24, 1982)	WETTING OF FIVE-FLOAT AND 45-HOUR ONE-FLOAT SAMPLES
M	A, tan, medium weight, ribbed, hm, 18th-early 19th c.	F+ N+	2 3 3		c wets out, 5F mottled after 2½ min.	5F wets in two minutes, LA5F wets immediately	
P	A, cream, medium weight, ribbed, hm., Italian? 18th c. ledger paper	F+? N+	3 2 3		both wet out slowly and irregularly; c wet in 8 min., 5F a few points unsaturated		
X	A, off-white (very soiled), light weight, pebbly, hm, 18th c.	N+			c wets out immediately, 5F a little more slowly and remains mottled	5F mottles, LA5F and 5FLA5F wet out immediately	
Z	A, tan,m medium weight, ribbed, hm, 18th-early 19th c. ledger paper	F+ N+	2 2 3		c wets out in 1 min., 5F remains mottled after 1 hr.	all samples wet out, LA5F and 5FLA a little laster	
J	W, cream, thin, slick, hm, wm: JWHATMAN / 1937	N+			5F begins to wet a bit faster but in the end only c wets completely	5F mottled, LA5F and 5FLA5F wet out completely, 5FLA5F a little faster	
L	M, pale blue-green (dyed) light weight, ribbed, hm, very early 19th c., wm: L & C with balance scales	N+	1 1 3		c completely wet in 5 minutes, 5F barely wet except in foxed areas	5F dry, LA5F and 5FLA5F wet	45hr ½ wet 5F dry
R	M, tan (dyed), medium weight, smooth, mould made?, 20th c., wm:1449	F+ N+	1 - 1		c wet immediately at edges and uniformly ½ wet in general; 5F only slightly mottled after 2 days	5F dry, LA5F wets out immediately, 5FLA5F dry	45hr wet, 5F dry

SAMPLE	TYPE: A=antique laid M=modern laid W=wove hm=handmade wm=watermark	PROTEIN	Al / Mg / Ca	ROSIN	WETTING ON SIXTH FLOAT OF CONTROL AND FIVE-FLOAT SAMPLES (March 15, 1982)	WETTING ON SIXTH FLOAT OF FIVE-FLOAT AND LIGHT-AGED FIVE-FLOAT SAMPLES (May 24, 1982)	WETTING OF FIVE-FLOAT AND 45-HOUR ONE-FLOAT SAMPLES
U	A, ivory, thin, hm, late 18th-early 19th c., wm: L & ...	F+? N+	2 1+ 1		c wets out in a mottled pattern, completely wet in 2 min., 5F not even mottled in 2 min., wets up in pin-prick spots only after two days	5F mottled, LA5F wet	45hr and 5F mottled-wet and wet out in foxing only
V	A, cream, thin, ribbed, hm, late 18th-early 19th c. ledger paper	N+?	2 1+ 3		c foxing wets out immediately (no foxing apparent on 5F); c wet out in 2 min., 5F wets only at edges after 2 days	5F dry, LA5F wet	45hr and 5F both dry
Q	M, off-white, medium weight, smooth, hm, early 19th c. ledger paper	F+ N+?	1 1 2		c wet completely after 5 min., 5 wet only at edges after 2 days		45hr wet; 5F wet at edge and dry otherwise
N	M, buff (dyed), light weight, grainy, machine made, 20th c.	N+	1 2 2		very slow wetting; c eventually ½ wet, with pin-prick points saturated overall, 5F does not wet	5F dry, LA5F wets immediately, 5FLA5F wets more slowly, but completely also	45hr ½ wet; 5F dry
G	W, off-white, thin, smooth, wm: 1801 / L & P Co.		1 2 3	+	c wet in 2 minutes, 5F completely unsaturated, with no mottling	5F dry, LA5F half-wet (relatively uniform), 5FLA5F wet	both dry
Wh 1836	W, medium weight, smooth wm: JWHATMAN / 1836	F+ N+			wets only at edges and in foxing pattern even in c; later floats become more water resistant	see separate table	see separate table
MBM	M, buff (dyed), light weight, early 20th c., wm: MBM(FRANCE)/INGRES D'ARCHES						

TABLE II

COMPARISON OF FLOAT-WASHING CHARACTERISTICS
OF WHATMAN 1836 AND MBM WATERMARKED PAPERS

Control and pre-treated samples of Whatman 1836 and MBM papers were floated simultaneously on deionized water and compared. Their pre-treatments are here indicated by codes; each pre-treatments is separated by a slash from the next for each sample. Codes: ETOH = one float on a water:ethyl alcohol solution (2:1); H20= one float on deionized water; 60°= one float on deionized water heated to 60°C; 5F = five floats on deionized water. Thus, a pre-treatment of one float on water followed by a float on a 2:1 water/ethyl alcohol mixture followed by another float on water is written: H20 / ETOH / H20. Most of these tests were run twice. Results were consistent; though the extent of foxing patterns varied, their character and habits of wetting remained generally comparable for the same tests.

	Whatman 1836	MBM
control	foxing (medium size spots) ½ wet, rest dry	very slight, uniform wetting
light-aged (Mar.3-May 15)	foxing (larger, more scattered spots) fully wet, rest dry	wets out immediately, sinks
light-aged / 5F	fully wet, gross, sacttered foxing; rest dry	uniformly wet
1F	fine, scattered foxing; rest dry	dry
5F	dry	dry
ETOH	somewhat wet, esp. in foxing	wets out
H20 / ETOH	pin-point foxing wet, rest dry	fine foxing wet, the rest mottled-wet
H20 / ETOH / H20	n.d.	gross foxing wet, rest dry
60° / H20	1/2 to 3/4 wet in gross foxing attern, rest dry	wet in gross foxing pattern, rest dry