INFORMAL OBSERVATIONS ON "LEATHER-BURN," ACIDITY, AND LEATHER LUBRICANTS

By Tom Conroy *

All book conservators know that leather turn-ins discolor or "burn" books' endpapers, and that the amount of "leather-burn" varies with the leather, the paper, and the age of the book. We all have our favorite examples; mine is a magnificent Oxford Lectern Bible bound by Roger Powell in full green Chieftain goat with doublures formed by the bare, waxed oak of the boards, and with white free endpapers. The leather has burned the endpapers brown, the oak has burned them slightly less with the wood grain reflected in the burn, and I cannot decide whether I deplore the echoed pattern as damage more than I admire its beauty.[1]

Although leather-burn is a phenomenon well-known to benchworkers, it has rarely been mentioned in print, and there seems to have been no systematic study of it. The following comments are meant to promote observation, thought, and research. They are not systematic or rigorous, and should in no way be considered completed research.

The problem of leather's tendency to attack paper is distinct from that of its own permanence. Severe leather-burn is often seen in perfectly sound bindings. Doves full leather bindings on Doves Press books are convenient examples because they are comparatively common and comparatively uniform. Their leather remains in superb condition after eighty or ninety years, with no sign of red rot and little mechanical damage despite the fact that the leather is (by modern standards) pared rather thin. There is, however, always severe leather-burn from the turn-ins; this damage is blatant because the Doves Bindery's chaste white endpapers do not disguise the burn, as do the marbled endpapers used by most hand binders of the period. Another convenient example of the distinction between a leather's inherant soundness and its aggressiveness is found in native-tanned Nigerian goat, which is esteemed the most permanent of currently available vegetable-tanned leathers. It is also, to my observation, by far the most aggressive; and the turn-ins of a binding in native Niger less than twenty years old will often have caused stains the color of strong tea. It is my impression that native Niger is even more aggressive than Oasis, which is re-tanned from it;

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1). Bound in 1960; now in the Bancroft Library, University of California at Berkeley. Powell tooled small gold stars on the free endpapers; this decorative touch, together with his closeness to woodworkers and his own knowledge of wood, suggests to me that he may have anticipated and sought to highlight the reflected pattern.

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this is relevant because Oasis is considered the less permanent of the two. There also seem to be examples of the reverse situation, where the leather is impermanent but not highly aggressive.

For a book conservator, damage caused by aggressive leather should be a greater worry than leather's own impermanence. Discolored endpapers are a cosmetic problem, but they are also a symptom: when ends stained over the turn-ins are lifted with water one finds that the stained area is extremely weak, as one might expect. Visible damage to the endpapers suggests similar damage, including mechanical weakening, to the folds of the sections where they touch the leather of tight-back, leather-lined, or unlined loose-hollow bindings. Such damage is often found when tight-back bindings are pulled, although the damage caused by poor hide glue complicates the analysis of these bindings. Leather is essential for a moving tight back but is superfluous for a hollow back. Thus the aggressiveness of leather becomes a major factor in the choice of correct rebacking and rebinding structures, in the choice of flyleaves and linings for barrier as well as mechanical properties, and in adhesive choice since some binders say that PVA blocks leather-burn.[2]

An obvious cause of leather-burn is the inherent acidity of all leather and tawed skin, and it is tempting to accept acid migration as the sole cause.[3] I suspect, though, that fat-liquors and other tanners' lubricants also play a role, maybe the primary role with some leathers. The following notes will focus on tanners' lubricants because the dangers of oil migration from dressings and other restorers' lubricants are well-known and avoidable. However, observed damage from careless dressing should be kept in mind while considering leather-burn.

Modern alum-tawed skins may offer an example of the dangers of oil migration. Tawed skin is highly favored by conservators, largely for

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2). John Dean, for instance, uses PVA to put down endpapers for this reason; and he says that leather bindings done this way several decades ago have not yet developed trouble (personal communication 1987). Louise Genest-Cote uses PVA to laminate onlay-thickness leather to Japanese tissue for concertinas in exposed-spine design bindings, with the same rationale (personal communication 1989).

3). In this paper I have avoided the causal term "acid migration", which many would use for the discoloration, since it prejudges the question of cause; I have used the symptomatic "leather-burn" since it is non-causal, or at least is causal in so crudely metaphoric a way that no one will take it that literal flames are involved.

In recent years "acid migration" as the single cause of staining has been challenged as inadequate, even where the gross source of damage is aggressive paper or board. Vincent Daniels has suggested that migration stains on paper are caused by induced oxidation by gaseous materials, including "hydrogen sulphide, organic acids, aldehydes, peroxides and various free radicals." See: "The Discolouration of Paper on Ageing." The Paper Conservator 12 (1988), p. 97.

I have also heard the term "tannin migration", especially for stains caused by leather touching paper during floods. Tannin migration, however, would not explain the aggressiveness of modern alum-tawed skins. Dr. Daniels tells me he has seen dye migration from dyed leathers, another complication (letter 25/1/1991).

its inherent permanence and durability but also because tawed turn-ins four centuries old and more rarely burn paper as do tanned turn-ins of the same age.[4] Unfortunately, tawed skin used in the last twenty years is said on the grapevine to have already burned endpapers; and at the AIC Annual Meeting in 1987 a slide was shown of burn from the laced-in thongs of a recent limp vellum binding.[5] Of various changes known to have been made in the manufacture of tawed skin, the most pertinent is "the substituting of a non-ionic oil for egg yolk for a variety of reasons such as greasiness, varied colours, inconsistancy of oiling and smell."[6] It is conceivable that the new oil has introduced a source of degradation not present in egg yolk or other traditional lubricants.

Full-leather Doves bindings may again give evidence. When the book was printed on vellum, as was normal for part of each Doves edition, vellum ends were used; and even these have been slightly stained by the leather of the turn-ins (although the stain is less than that seen on paper ends). It is hard to imagine leather acid enough to attack vellum, yet sound in itself; but it is easy to imagine sound leather oily enough for the oil to migrate into vellum and there discolor. This example also suggests that leather-burn may involve benign discoloration of the oil itself in addition to discoloration due to the degradation of the paper.

A highly subjective impression of mine may be used to broaden the

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4). Jesse Munn mentions immunity from oil migration as an advantage of lab-tawed skin over tanned leather, together with various mechanical properties. See: "Alum Tawing Goat and Calf Vellum--- Current Experiments." Guild of Book Workers Journal 22:2 (Spring/Summer 1984), p. 17.

5). The slide was shown by Bruce Levy, although it does not appear in the printed version of his talk: "The restoration rebinding of Speculum Naturale by Vincent of Beauvais..." Book and Paper Group Annual 6 (1987), p. 79-84. Mr. Levy informs me: "I don't really know much about the stain or burn at this stage. I did a wet-surface pH reading on the burn area, the adjacent area of the same page, and the unaffected inner text pages. I received a reading that was for me indicative that the stain, at least so far, hasn't altered the pH reading (surface). All readings were less than .5 difference... The book in the slide was bound during the last 8 years I think." (letter dated 1/1/88).

6). George Barlee. "Alum Tawed Leathers: A Reappraisal." Bookbinder 1 (1987), p. 19. For binders, accustomed since the turn of the century to a high regard for tawed skin, it may be confusing that Barlee's reappraisal is in favor of tawing.

I am indebted to Christopher Clarkson for first suggesting to me that the lubricant in tawed skin was a potential source of trouble; he repeated a comment made by Ronald Reed. When I first circulated a rough draft of this article in 1987 I knew no published statement that modern lubricants had been substituted for egg yolk; substitution was hypothesized on the basis of the cost of eggs, and it was, in a grim way, gratifying to have the guess confirmed.

Other changes in tawing, not persuasive as causes of leather-burn, include the modern time-lag in salt between flaying and unhairing; the use of chemical bates instead of dung; the use of aluminum sulfate instead of potassium or ammonium aluminum sulfate (the latter two were rarely distinguished before the nineteenth century); and the drumming of skins to speed up manufacture. It is perhaps worth considering the possibility that egg yolks, which have been used on their own for oil tannage, acted as more than lubricant and gave traditional tawed skin a mixed oil-and-mineral tannage rather than an all-mineral tannage.

implications. It seems to me that the color of leather-burned paper is different from that of paper damaged by inherent vice; it quickly grows far darker in tone than paper left to itself, darker even than century-old newsprint, and is perhaps a richer, less grey and less yellow brown. Though paper left alone rarely takes on the rich, dark brown of leather-burn, a similar color does occur at the gutter margins of books where excess leather dressing has been wicked up by cracks in the spine and spread along the gutter by the sewing thread. Yet although discolored oil in the gutter does weaken paper, the paper often retains enough working strength and flexibility to remain quite usable; paper darkened to such a degree by inherent vice would be as weak and brittle as a mummy's bones. Again we may suspect that the oil itself has discolored, in addition to discoloration due to degradation of the paper.

As was mentioned, native-dressed Niger is particularly apt to cause leather-burn; and binders who work with it comment often on its tendency to oiliness.[7] This can be so serious that paper touching native Niger sometimes will pick up wet-oil stains in just weeks or months.[8] Wet-oil stains demand treatment urgently, since at first they can be lifted with solvents but later they will become brittle and may resist removal save by bleaching. It may be objected to my hypothesis of oil migration as one cause of leather-burn that no wet-oil stain is seen in most cases, which might imply that no oil has moved. However, oil migration from printing ink does occur, and without causing wet-oil stains.[9] Perhaps

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7). Malcolm Lamb gives a "Typical analysis of [native Niger] leather" containing "Grease 11.4%". The lubricant is groundnut (peanut) oil. See: "The Hausa Tanners of Northern Nigeria." The New Bookbinder 1 (1981), p. 61-2. For comparison, at the 1984 FAIC Leather Refresher Course, Pieter Hallebeek said that "New leather commonly has a fat content of 2-10%", and recommended an optimum 5% fat content for old leather; Sonja Fogle quoted D.H. Tuck as giving "typical extractable fat values from 3-20%." These figures are too few to confirm the greasiness of native Niger, but they are consistent with it. Hallebeek also said: "There may be a connection between age and fat content, with the oldest leathers having the least amount of bound fat. The values obtained for old leather are usually 1-2% of the weight of the sample... The values given by Tuck refer only to new leather. Chemically, old leather can no longer bind fats as it once could." See: Recent Advances in Leather Conservation (Washington: FAIC, 1985), p. 22-3. The loss of fat to old leathers is at least consistent with the thesis of this paper, and I believe supports it since forced-out fats must presumably go somewhere.

8). Linda Ogden has told me of one exceptional shipment of native-dressed skins received by the Library of Congress in the early 1970s. Books bound with them developed stained turn-ins in a very short time--- weeks or months. Several skins which she bought from the same shipment transferred distinct wet-oil stains to wrapping paper in contact with them (personal contact 1991). Bruce Levy has told me of a similar case at HRHRC in the middle 1980s (personal contact 1991).

9). Cheap non-drying oils adulterating boiled linseed or walnut oil in printing ink can cause both offset and halo browning. Vincent Daniels describes an offset image from printing ink "analysed by Mr. R. White of the National Gallery, who found that the brown stained areas had 'moderate amounts of non-drying fats', whilst the less badly stained areas contained smaller quantities." (Daniels op. cit. p. 95). The parallel to my thesis of oil migration from leather is obvious.

the concentration of oil is low enough that no wet stain forms; acid migration too presupposes that moisture can move without a high enough concentration to form a wet-water mark.

A final point: leather-burn seems to develop faster and farther on absorbent paper than on hard-sized paper. I have a sample card obtained from one tanner around 1983; the card itself is slick coated stock, and the leather samples had stained through to its reverse within five years. However, in books bound in the year I got the card, with leather from the same tanner, common colored endpapers are not yet stained over the turn-ins. Coated stock thus seems more apt to develop leather-burn, and I think this is because the clay coating is quite absorbent.[10] Samples tipped to the boards in two books on leather deterioration from 1905 may offer the same lesson: in Hulme and Wyndom's Leather for Libraries,[11] the samples have burned many pages into the thick, fluffy esparto paper of the text block; in the Society of Arts' Report of the Committee on Leather for Bookbinding,[12] on harder-sized, more calendered paper, the damage to the text block is much less. The greater susceptibility of absorbent paper could be explained as well by acid migration as by oil migration; but there is a practical consequence. On a thesis of acid alone one might choose heavily buffered paper for endpapers, linings, or loose barrier sheets, hoping to neutralize the migrating acids. However, on a thesis of oil migration, heavily buffered barriers are not to be advised since they are (like other heavily filled and coated papers) quite absorbent, and therefore they would speed up migration without

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10). Vincent Daniels informs me: "I don't agree that heavily buffered paper ought to cockle more than other types of paper. One method of reducing hygroexpansivity of paper is to use fillers." (letter dated 25/1/1991). It is, however, common at the bench to have problems with cockling, warping, and distortion of coated and buffered papers, particularly after tipping or other local application of paste. Furthermore, finely-divided powders have long been used for absorbing liquids. An old method of removing fat stains from books, for instance, was to cover the stain with French chalk and then iron it with a hot polishing iron; see Zaehnsdorf's Art of Bookbinding (London: George Bell, 1890) p. 164, and many other manuals. This method would work only if chalk were more absorbent than paper. The conflict between Dr. Daniels' comment and bench experience leaves me somewhat at a loss.

Shannon Zachary suggests that the apparent conflict may be the result of the different nature and mechanisms of full-sheet expansion/contraction, contrasted with distortions caused by localized wetting. Also involved may be the differing effects of absorption by the fibers, which is anisotropic and causes greater expansion across the grain, contrasted with absorption by finely divided powder, which clearly must be equal in all three directions. Or perhaps an ad hoc explanation is enough: coated and buffered papers may just tend to be slack-sized.

11). London: The Sound Leather Committee of The Library Association. Copy examined at Stanford University Library.

12). Ed. by Viscount Cobham and Sir Henry Trueman Wood. London: George Bell and Sons for The Society of Arts. At least 5 copies seen (University of California at Berkeley; San Francisco Public Library Special and Circulating Collections; Capricornus; Edith Diehl's copy in the Guild of Book Workers Library). Some of the samples are usually missing.

preventing the deterioration. This may offer a partial explanation of why heavily-buffered loose barrier sheets often seem ineffective. In consequence I would suggest that "permanent/durable" paper be avoided in endpapers, spine linings, and perhaps in flyleaves; instead, a less absorbent unfilled paper, possibly hard-sized with gelatine by the binder, should be used.[13]

The substance of these remarks has been to suggest that there is a real danger of attack on paper by leather which is sound in itself; that tanners' lubricants as well as the acidity of leather are implicated in the attack; that some lubricants are worse than others; that absorbent papers are more at risk than hard-sized papers; but that the loss of working strength in the paper is less than one would expect considering the depth of color reached. I don't mean these observations to discourage unduly the use of leather in binding: all covering materials have their dangers,[14] and the speculative nature of many of my remarks makes them an unwise basis for immediate modifications of working practice. My intent is to bring the problems of leather-burn vividly before conservators and scientists; and, I hope, to induce them to give some extra observation, thought, and research to the matter.

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13). Modern marbled papers, especially American ones, often have powdery, weakly stuck colors; when used for endpapers it is best to gelatine-size them anyway, to consolidate the colors. Modern papers sized with (hydrophobic) alkyl ketene dimers may offer less of a barrier to oils than do traditional papers sized with (hydrophilic, oil-resistant) gelatine; see John R. Hubbard, "Animal Glues" in: Handbook of Adhesives, ed. Irving Skeist (New York: Reinhold, 1962), p. 117.

14). Vellum, for instance, is considered an exceptionally desirable covering by many conservators; but I have used vellum that was (imperceptibly) greasy on its flesh side only, and caused wet-oil stains where the turn-ins lay over the endpapers of a limp vellum binding; the oil even wicked into paper lying beyond the turn-ins, which is how I became aware of it.