APPENDIX

TO

A DISSERTATION ON

AN INTERNSHIP IN THE CONSERVATION OF PAPER

by

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Auckland

New Zealand

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1. INTRODUCTION

This appendix is written at the request of the panel of examiners who assessed my dissertation on an internship in the conservation of works of art on paper which I undertook at the Auckland City Art Gallery under the supervision of Mr Edward Kulka, senior conservator. It is a critical analysis of the conservation processes described in my dissertation. In particular I have been asked to comment on the suitability of the treatment afforded the woodcuts by Albrecht Durer.

An evaluation of the conservation of works of art must be made with regard to the objectives of the institution owning them as well as to the responsibilities of the conservator. At the Auckland City Art Gallery these objectives are to collect, record, conserve, study and display visual and plastic works of art for the enjoyment and information of the public. The responsibility for the fulfilment of these objectives rests with the director and curators. To assist them in their task they call upon the advice and special services of the conservators.

At the request of the curator, the conservator is expected (a) to restore the works of art to a condition suitable for display to the public, and (b) to ensure

their long-term preservation so that they will be available for display and study for as long a time as possible.

In order to have a work of art put in a suitable condition for display, the curator will generally request the removal of dirt and extraneous materials, the reduction of stains and discolouration, the mending of tears and losses, and the flattening of creases. This is because he considers such damage contrary to the artist's intention.

It is the responsibility of the conservator to examine each work of art thoroughly, to record the condition, and to recommend to the curator possible courses of treatment. He should never recommend, or carry out, any treatment which is likely to endanger the work. A work of art could be endangered if (a) its life is likely to be shortened, (b) the artist's intention is altered or distorted, or (c) any information it contains regarding its purpose or history is lost. The conservator should avoid using any materials or persuing any treatment which might have a deleterious effect on the object or which would be irreversible. He should never undertake any treatment the outcome of which is uncertain.

During my internship my supervisor instructed me to carry out a number of procedures the outcome of which I considered to be uncertain, but which he considered to

be safe and beneficial to the objects. The procedures involved the use of calcium hydroxide, exposure to sunlight, and the use of calcium hypochlorite in the treatment of certain types of works of art on paper, including the Durer woodcuts, and also the use of cyclohexylamine carbonate as a non-aqueous deacidification agent. I expressed my reservations and asked my supervisor to explain why he considered the treatments to be safe. Having discussed them I deferred to his greater experience and authority and carried out the treatments as he directed.

In the following sections I shall discuss the advantages and disadvantages of these treatments, give my supervisor's reasons for using them, and express my opinion of how I believe they could have been done. I will then examine the treatment of the Durer woodcuts in greater detail.

2. DEACIDIFICATION WITH CALCIUM HYDROXIDE

In my dissertation I described the deacidification of works of art on paper with aqueous solutions of calcium hydroxide. Calcium hydroxide is an effective deacidification agent because it has the capacity to neutralise both strong and weak acids owing to its high alkalinity. Because it is applied in an aqueous solution acidic degradation products are washed out of the paper. As the paper dries insoluble calcium carbonate is formed which acts as a buffer to neutralise any further acidity to which the

paper may be exposed. Another advantage is that calcium hydroxide solution is easy to prepare.

However, calcium hydroxide may affect certain papers and media because of its high alkalinity (about pH 11). Paper which contains groundwood turns yellow when it is immersed in calcium hydroxide solution. This is an indication that oxidation is taking place in the paper as the result of its exposure to high alkalinity.[1] It is also known that paper degraded by oxidation is susceptible to hydrolysis in highly alkaline conditions.[2] Potential causes of the oxidation of paper include chemical bleaching, prolonged exposure to light and natural ageing. In addition to contributing to the degradation of paper in certain circumstances, calcium hydroxide may alter the colour of dyes, pigments and inks which are sensitive to changes in pH.

One of the problems associated with the use of calcium hydroxide solution is that a scum is formed on the surface when it is exposed to the air. This becomes deposited on the object being treated. It was my supervisor's practice to wash the scum off the object with running water. However, he agreed that some objects were too delicate to treat in this way. I suggested to him that the formation of scum could be prevented by placing a sheet of polyester film on the surface of the liquid to isolate it from the air. He replied that he was aware

of this practice. His reason for not using polyester film at that time was that he was sun bleaching works of art while they were immersed in deacidification solution and he was concerned that the film might cause the solution to overheat. In my opinion it is definitely advisable to use polyester film in order to prevent the problem of scum being deposited on the objects. I believe that there are several methods of controlling the temperature of the solution if this is found to be necessary. One method is using a cooled deacidification solution. Another method is that of standing the tray containing the deacidification solution in a larger tray containing iced water.

During my internship no attempt was made to identify paper which might contain groundwood in order to refrain from treating it with calcium hydroxide. This was because my supervisor concurred with the opinion expressed by Margaret Hey in her article on the washing and aqueous deacidification of paper[3] that calcium hydroxide does not damage paper which contains groundwood and that it is better to deacidify paper containing groundwood with calcium hydroxide than not to treat it at all. Hey said that although paper treated with calcium hydroxide is darker initially, on ageing it retains its colour better than paper which has not been treated at all. It was my supervisor's opinion that the amount of discolouration resulting from the treatment with calcium hydroxide of

paper containing only a small percentage of groundwood impurities would be negligible and would be outweighed by the beneficial results of the treatment. Three of the drawings I treated with calcium hydroxide were on twentieth century art paper and might have contained groundwood. (Case studies 13 and 18, and Object No.22.) These appear to have been improved as the result of the treatment.

In my dissertation I stated that four watercolours were treated by saturation with calcium hydroxide solution. Two of these treatments were carried out by Mr Kulka with my assistance (Objects No. 33 and 108), and the other two I treated myself at his direction (Case studies 12 and 17). I discussed with my supervisor the possible problems associated with treating watercolours by aqueous methods and with calcium hydroxide in particular.

The problems likely to occur are (a) the dissolving of pigment or binder by the deacidification solution or by the mixture of water and iso-propanol used to wet out the paper before treatment, (b) the redistribution of pigment particles during treatment, (c) the formation of a surface deposit by the deacidifier, and (d) the alteration of pigment colours by chemical reaction with the deacidifier.[4] The latter is likely to result from the reaction of the highly alkaline calcium hydroxide

solution with organic colours which are inherently acidic.[5] It was Mr Kulka's belief that by following his treatment procedure all these problems could be avoided.

The colours were first tested for solubility in the solutions to be used. If they were found to be insoluble the paper was then sprayed on both sides, first with a mixture of iso-propanol and water and afterwards with calcium hydroxide solution. The work was then placed face up on a pad of blotting paper which was also saturated with deacidification solution. The aim was to wash the paper by capillary action. By this process acidic degradation products are drawn into the blotting paper. In addition, because the watercolour is not immersed in solution, redistribution of pigment particles by moving liquid is avoided. The watercolour was lightly sprayed with deacidification solution from time to time to replace moisture which had evaporated and to cool it. Mr Kulka attempted to lessen the amount of calcium carbonate deposit forming on the surface of the work by diluting the saturated calcium hydroxide solution with two or three parts of water. No attempt was made to remove the deposit by washing or brushing because of the danger of disturbing pigment particles.

Mr Kulka considered that the colours of pigments would not be affected by the high alkalinity of the deacidification solution. This is because he had tested

watercolour samples in calcium hydroxide solution and had observed no colour changes, even in organic colours.

As the result of treating the watercolours there was some reduction of discolouration and foxing stains in the paper. However, I am strongly of the opinion that the front of a watercolour painting should not be treated with any type of aqueous solution as it involves an unacceptable risk of damage for the reasons I have stated previously. Moreover, no spot testing for the solubility of paint or its susceptibility to alkalinity can predict with certainty what is likely to happen when the whole object is treated.

I deacidified two ink drawings (Objects No. 22 and 107) with calcium hydroxide. They were tested before treatment to find out if they would be affected by the solution. The results of the tests were negative and the treatment successful. A graphite drawing (Case study 14) had an ink inscription dating from the nineteenth century. The inscription was tested with the deacidification solution for a few minutes and no reaction was observed. However, after treatment the inscription was paler. In my opinion it was probably iron gall ink which is inherently acidic and susceptible to alteration in alkaline conditions. The initial test took only a few minutes. This clearly indicates that a longer testing time is required, if necessary for as long as the intended treatment.

Where the use of calcium hydroxide might cause problems associated with high alkalinity, magnesium bicarbonate should be considered as an alternative aqueous deacidification agent because the solution is less alkaline.

3. SUN BLEACHING

It was Mr Kulka's practice to bleach works of art on paper by exposing them to sunlight while immersed in or sprayed with calcium hydroxide solution. He based his procedures on those recommended by Keiko Mizushima Keyes[6] with certain modifications. Keyes used water with some magnesium bicarbonate solution added, firstly to make it slightly alkaline and, secondly, because the presence of magnesium ions will deactivate the catalytic action of metal impurities which would hasten the degradation of cellulose by the oxidative bleaching process. Mr Kulka used a third or quarter saturated solution of calcium hydroxide. His object was to carry out several tasks at the same time: washing, deacidification, sun bleaching, and the removal of backings and other extraneous materials.

During the time of my internship, Mr Kulka did not carry out any initial washing procedure as distinct from deacidification. Later he and I carried out experiments and observed that washing in water followed by deacidification is a more effective procedure for cleaning paper.

Keyes, besides sun bleaching works of art on paper by immersion, described the use of a 'moistening sandwich' to treat objects which are too delicate for immersion. Blotting paper is slightly moistened and the object sprayed and placed on it. A medium weight sheet of polyester film is placed on the surface to prevent the evaporation of moisture. As has been described, Mr Kulka used a similar procedure but with calcium hydroxide solution instead of water mixed with magnesium bicarbonate.

Keyes said that paper with a high lignin content should not be sun bleached as it tends to darken rather than lighten. Also, light causes the lignin to decompose and therefore degrades the paper. Mr Kulka thought that, because of the short exposure time, the effect would be negligible. Keyes also said that it would be a good policy to avoid sun bleaching paper containing alum rosin size, although she thought it uncertain that it would be appreciably affected because of the short exposure time required. Mr Kulka thought there would be no adverse effect.

I expressed to Mr Kulka my particular concern about the sun bleaching of watercolours because of the possibility of fading. He considered that the risk was negligible because of the short time of exposure to sunlight. I also expressed concern about the long immersion or saturation time (about four hours) required to carry out the treatment. I was anxious that the chances of paint

or ink dissolving might be increased by the long soaking. I have already expressed an opinion that solubility tests cannot predict with certainty what might happen. I was concerned that the chances of weak paper disrupting or disintergrating would also be increased. Mr Kulka said that he had not experienced any of these problems.

From an examination of the objects treated by my supervisor and me it would appear that sun bleaching is an effective method of reducing discolouration. In particular, foxing stains are considerably reduced and in some cases disappear altogether.

My considered opinion, however, is that the sun bleaching of works of art on paper while immersed in or saturated with an aqueous solution should be undertaken only after very careful thought, adequate analysis and testing of the object, and with extreme caution, for the following reasons: (a) Papers made before the nineteenth century may decompose during immersion because they are softer than modern papers and may have areas of weakness due to poor pressing. They may also be unable to withstand treatment due to weaknesses caused by long exposure to light, natural ageing or chemical bleaching by previous conservators. (b) Papers made in the nineteenth and twentieth centuries could contain lignin, alum rosin size or other additives which may be affected by sunlight. (c) If the image is of ink or watercolour it could be affected by the long immersion or fade as the result of

exposure to sunlight.

4. STAIN REDUCTION WITH CHEMICALS

During the period of my internship only six works of art on paper were treated for the reduction of stains with chemicals. They had been previously sun bleached, but it was decided that as the stains and discolouration were not sufficiently reduced they be further bleached with chemicals. Five objects, including four Durer woodcuts, were treated with calcium hypochlorite. The other, a Whistler etching, was treated with hydrogen peroxide. Details of the treatment of the Durer woodcuts are discussed in Section 6.

The etching by J M Whistler (Case study 22) was very highly degraded, badly stained and discoloured as the result of direct contact with a wooden backing, and exposure to light over a period of fifty to one hundred years. It was privately owned and I accepted the responsibility for treatment having first warned the owner of the risks involved owing to its advanced state of degradation.

I first deacidified and sun bleached it following my supervisor's standard procedure. The object was not harmed by the treatment and much discolouring matter was washed out of the paper. However, as it was still highly stained I decided to bleach it with hydrogen peroxide. This resulted in some slight damage to the image in an

area where the paper was weakest. The damage can be attributed to a combination of three factors. Firstly, the paper was very weak; secondly, deacidification with calcium hydroxide had given it a pH of 9.5; and, thirdly, the hydrogen peroxide rapidly decomposed in the highly alkaline conditions, thus producing an excess of bubbles which disrupted the paper where it was weakest. I was able to inpaint the small area of damage and restore the work to an exhibitable condition.

5. NON-AQUEOUS DEACIDIFICATION

During my internship I was asked to deacidify a highly degraded document (Object No. 104) with vapour phase deacidification paper (cyclohexylamine carbonate). I thought this unsatisfactory for the following reasons: Cyclohexylamine carbonate is volatile and does not provide long-term protection for paper. Also, it has been observed to darken paper and is carcinogenic. Because of the latter, I wore protective clothing and carried out the treatment in the fume cupboard, I sealed the object tightly inside two plastic bags together with the vapour phase deacidification paper and a pad of thick blotting paper, and left it for two weeks. The pH of the blotting paper was measured before and after treatment because it was not possible to test the pH of the actual document to monitor the effect of the treatment. Measurements were taken on a number of locations on the blotting paper and the results averaged out. The pH of the blotting paper

before treatment was 7.3; immediately after treatment it was 9.7; thirty-two days later it was 8.6; and after 140 days it had reverted to 7.3. These observations are consistent with the contention that cyclohexylamine carbonate is not of lasting benefit to paper and should not be used as a deacidifier.

Another highly degraded work I was asked to deacidify (Case study 24) was treated with a commercial preparation of methyl magnesium carbonate (PHizz). As methyl magnesium carbonate, because of its high alkalinity, may affect certain papers and media, including casein, which was the medium of the work in question, the object was treated by spraying the back. The treatment was, however, unsuccessful because it caused the paper to cockle. The object was relaxed with calcium hydroxide solution and then pressed.

6. THE DURER WOODCUTS

During my internship I assisted my supervisor in the examination and treatment of seven woodcuts by Albrecht Durer (Objects Nos. 1 - 7: Case studies 1 - 5). They were part of a collection of prints which had been recently acquired by the gallery.

As new acquisitions the woodcuts were sent to the conservation department in order that (a) a record of their appearance, composition and condition could be made; (b) they could be prepared for exhibition; and (c) any

treatment for their long-term preservation could be carried out. I was given the task of examining them and recording their composition and condition. I prepared written reports, drew diagrams and took photographs.

The woodcuts date from about 1500. They were all printed in black ink on handmade paper. Full details of the condition of the woodcuts, with the exception of Objects No. 2 and 7 are set out in my dissertation. The condition of Object No. 2 (St. Leopold) was similar to that of Object No. 1 (Case study 1). Object No. 7 (Seige of a Fortress) was composed of two separate pieces of paper. It had been folded at some time in the past and had torn along the folds. However, the tears had been repaired and the paper had been flattened before it had been acquired by the gallery. The paper was slightly discoloured but the creases were discernible because of ingrained dirt.

The curator of prints and drawings requested the removal of backings and other extraneous materials, the repair of tears, the flattening of creases and the reduction of discolouration in order to make the woodcuts suitable for exhibition. He and Mr Kulka agreed that the damage and degradation were not part of Durer's intention and that they interfered with the aesthetic integrity of the works. It was decided that the works should be treated to remove stains and discolouration provided that this could be done without harming them.

Six of the woodcuts (Objects No. 1 to 6) were treated by immersion in one-third saturated calcium hydroxide solution and simultaneous exposure to sunlight for four hours. The objectives of this treatment were to remove the backings, hinges, fragments of paper and glue, to deacidify the paper, and to reduce stains and discolouration concurrently. It was considered that the paper was probably acidic because discolouration and foxing are usually an indication of this. Tests were not made to determine the pH because it had been decided to treat the paper anyway.

I discussed with my supervisor the possible dangers of treating the Durer woodcuts by this method. My first question was whether or not the paper could withstand immersion in an aqueous solution for several hours without disintegrating. There is a possibility that antique handmade papers like that of the Durers could pulp or delaminate in water, as I mentioned earlier. Mr Kulka said he anticipated no problem because of his experience in treating similar paper. It was his practice, however, to inspect continuously works of art on paper undergoing treatment to ensure that no damage was being done. The second question was whether the woodcuts would be affected by the calcium hydroxide solution. The possibility must be considered that the paper could be susceptible to alkaline hydrolysis due to oxidation. Consideration has also to be given as to whether or not the highly alkaline deacidifier will affect the image. In the case of the

Durer woodcuts the ink was probably bound with an acidic drying oil such as linseed oil. Mr Kulka, drawing on his previous experience anticipated no problems associated with the use of calcium hydroxide. Because the paper was made before the nineteenth century, it was considered safe to sunbleach it.

After the aforementioned treatment all the works appeared to be much cleaner. However, the stains on Objects No. 3, 4, 5 and 6 (Case studies 2, 3, 4 and 5) were still considered to be disfiguring. Object No. 3 (Case study 2) was still orange in colour. My supervisor decided to further bleach these four woodcuts with calcium hypochlorite.

This involved: the wetting of the paper by immersion in a fifty percent aqueous iso-propanol solution to facilitate the penetration of the paper by the calcium hypochlorite solution; bleaching by immersion in a one percent calcium hypochlorite solution; washing in several water baths to stop the bleaching action and to remove the hypochlorite; immersion in a five percent acetic acid solution for five minutes to destroy residual hypochlorite; washing again in several water baths to remove the acid; and finally, a further deacidification by immersion in a half saturated calcium hydroxide solution to ensure the total neutralization of the paper and to buffer it. Each woodcut underwent about two hours of aqueous treatment in addition to the original four hours deacidification.

An essential consideration in the treatment of paper with calcium hypochlorite is preventing the pH of the solution dropping below 9.5. Below this level hypochlorous acid becomes available and will damage the cellulose. The cellulose will also oxidise and become vulnerable to hydrolysis.

Calcium hypochlorite bleaching treatment was regarded by Mr Kulka as the most appropriate method of further reducing the stains. The method is recommended by Margaret Hey.[7]

Among the disadvantages associated with the use of calcium hypochlorite are that it is an inherently unstable compound which will deteriorate in storage; bubbles may occur during the bleaching process which may damage the object; the solution may affect paper and media because of its high alkalinity; and stain reversion may occur in the course of time.

As the result of treatment with calcium hypochlorite stains and discolouration were reduced and, although they were not completely removed, the treatment was regarded as successful.

To complete the treatment, tears were repaired on the six woodcuts.

Object No. 7 was not treated except to remove old hinges, because aqueous treatment would most certainly have undone the previous repairs and there was a risk that the tears would have lengthened.

There are a number of questions which should be considered regarding the treatment of the Durer woodcuts. They are:

(a) Was the treatment necessary for aesthetic reasons?
In my opinion it was. The woodcuts are works of art and aesthetic considerations are important. Discolouration, stains and creases in the paper detracted from the appearance of the works.

(b) Was treatment necessary for the long term preservation of the woodcuts?
This is uncertain. The paper was deacidified as part of the treatment to reduce stains, but it is not known if this was necessary to neutralise excess acidity likely to harm the paper as the pH was not taken at the outset. The paper was assumed to be acidic because of stains and discolouration. On the other hand, the fact that it was not brittle and had survived for almost 500 years may have indicated that the paper was in a stable condition. If there was sufficient reason to believe that the paper was excessively acidic, deacidification for long term preservation would have been advisable.

(c) Was the treatment likely to have endangered the woodcuts?
In my opinion there was an element of risk. However, the woodcuts were not damaged by the treatment carried out. If I had to treat other sixteenth century prints, I would not repeat the same treatment given to the Durers. This is because it is not certain that the paper could

withstand several hours immersion in aqueous solutions and because it is not certain that the paper would not be damaged by calcium hydroxide or calcium hypochlorite solutions. I would consider using magnesium bicarbonate as the deacidification agent and sun bleaching the prints using the 'moistening sandwich' technique advocated by Keiko M Keyes. I would be wary of bleaching with hydrogen peroxide because of the risk of bubbles damaging the paper.

7. INSCRIPTIONS AND ARCHIVAL DOCUMENTS

A work of art will be damaged if any information it contains regarding its purpose or history is lost. It would be wrong to remove inscriptions put on it by the artist. However, in certain circumstances it may be permissible to remove inscriptions added by someone else where they detract from the appearance of the object. For example, it may be permissible to remove a nineteenth century collector's stamp from a sixteenth century print. The decision to do so should not be taken lightly, however, as the stamp may be part of the evidence which authenticates the object. Another circumstance is when a later inscription impedes the carrying out of the beneficial treatment of the object.

In my dissertation I reported the removal of the water soluble component of an ink inscription on the back of a watercolour (Case study 12) in order that the latter could

be treated with an aqueous solution. I consider this action justified because the inscription was not written by the original artist and because it remains legible. (I have discussed elsewhere the inadvisability of treating watercolours with aqueous solutions.)

In my discussions on the treatment of works of art on paper, I have not mentioned archival documents, which are essentially historical records. Aesthetic considerations do not have the same weight when deciding whether or not to treat such items.

An archival document has been defined as: 'A document which is to be kept permanently, in as near as possible its original form, for the evidence which it might afford both in itself and within its context'[8]. Historical and archival documents can, of course, include prints, drawings and watercolours. The information they contain may be considered more important than the aesthetic considerations. The decision as to which factor is the more important rests with the owner or the curator.

8. CONCLUSIONS

I said at the beginning that a conservator should avoid using materials or persuing any treatment which might have a deleterious effect on the object. In practice there is always an element of risk involved in any conservation treatment undertaken. The conservator should assess the extent of the risk and inform the owner or

curator. The risk should be balanced against the benefits derived from the treatment. In the case of works of art the benefits are those of putting it in a condition suitable for display and ensuring its long-term preservation. If a work of art is only slightly damaged the risk should be minimal. If, however, the work of art is so degraded that it can no longer fulfil its function of being exhibited, the conservator should be prepared to exert his best endeavours within the limits of his professional competence and facilities to restore it to a more acceptable state. The decision to treat the work of art should be a joint one between the conservator and the owner or curator.

In the course of this evaluation of the treatment of works of art on paper carried out during my internship I have, bearing in mind what I was taught at Canberra, expressed doubts about some of Mr Kulka's procedures. However, none of the treatments he performed damaged the works of art, and he carried them out with what he believed was a minimum of risk in the light of his training, reading and practical conservation experience. I hold Mr Kulka in high regard. He has listened with patience to suggestions I have made with respect to treatment and has responded positively.

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