STUDY ON THE PAPER SUPPORT OF A POSSIBLE RENOIR PASTEL

HISTORIC-TECHNICAL AND CHEMICAL INVESTIGATIONS

december 2002

TABLE OF CONTENTS

Summary 3
Introduction 3
General description of the pastel 3
Provenance 3
The pastel 4
Renoir's studies for the Great Bathers of 1887 4
Description of the paper 5
Physical description 5
Chemical description of the fibre layer 6
Chemical description of the coating 6
Layer structure of the pastel 6
Determination of the type of paper 7
Make up of the pastel paper 8
Production date of the paper 8
Arguments based on the chemical composition 8
Arguments based on the make up 9
Source of the paper 10
Renoir and transfer paper 10
First period: 1879-1884 10
Second period: the 1890s and early twentieth century 11
Other graphic printing papers used by Renoir 11
Impressionists and transfer paper 12
Conclusions 12
Acknowledgements 13

Appendix
I: *Illustrations* 14
II: *Technical data* 19
III: *Renoir's treatment of paper in the studies for the Great Bathers* 25
IV: *Sources on transfer paper and paper making* 26
V: *Research reports by Wagner, Corrigan and McCrone* 28

Summary

This report describes a multidisciplinary study into the paper support of a pastel that could be the work of Pierre-Auguste Renoir. The authenticity of the pastel, however, has been questioned. Paper historical, technical and chemical investigations have indicated that the pastel support consists of a special, late nineteenth century type of transfer paper. These transfer papers, as well as other related papers from the graphic industries, were available to, and used by Renoir and other impressionists in that period. The results of the present research project may offer a useful contribution to the authentication of the pastel.

Introduction

The Koninklijke Bibliotheek (KB) Paperhistorical Department was requested to study the paper of a pastel, tentatively attributed to Pierre-Auguste Renoir by the present owner, G. Kitchen, New York. With the restrictions in mind that paper analysis can only be part of the process of authentication, it was decided to start an investigation. A. Kardinaal, paper historian, Amsterdam, already involved in a joint study on the quality of nineteenth century paper, agreed to set up a research project in co-operation with H.J. Porck, curator of the KB Paperhistorical Department. The objectives of the project included the determination of the type of paper, its date of production and its relationship with the paper of authenticated drawings by Renoir or other impressionists.

General description of the pastel

Provenance

The pastel has been in the collection of Mr and Mrs Charles Wolf, France, up to 1960 when the collection was sold. A small plaque from this period contains the following text:

Une 'Etude' pour: Les Baigneuses
Pastel Par Pierre-Auguste Renoir
1841-1919

We also have a ticket with the name of Charles Wolf printed and in typescript added 'collection of Mr and Mrs'. Probably one of Wolf's business cards was used for the purpose. The ticket is attached to the backing of the frame in which the present owner acquired the pastel. The paper of the ticket is strongly discoloured, which cannot have been caused by the cardboard to which it is now attached. One explanation is an earlier backing, which was highly acidic. If this deduction is correct, the discoloration of the ticket is an indication that the pastel has been in the possession of Charles Wolf for a fairly long time. This is confirmed by the typographic style of the ticket, which points to the 1930s, but this of course does not exclude a later use.
Before this period the pastel must have been in an environment where it incurred the damage it now shows: earlier research for instance established restoration of the border area, which may indicate that the pastel was stored without proper protection. [1]

[1] Report Wagner, see Appendix V.

The pastel (Appendix I, ill. 1)

Dimensions of the pastel are: 71 x 55 cm. The technique is rubbed pastel. For a general description of the technical aspects and the pigments we refer to the report by Wagner and the data from the XRF-tests performed by McCrone. [2]
The pastel in question is intimately connected with a study by Renoir for his painting 'Les Grandes Baigneuses' (Appendix I, ill. 2). This study is now in the collection of the Musée d'Orsay. The study in the Musée d'Orsay is larger than the investigated pastel - 108 x 162 cm - and consists of three main figures[3]. Yet the two bathers that are on both drawings are practically congruent, in spite of the different dimensions, which is evident from comparison by means of copies on transparent sheets; also in the background there are several congruent details. On the other hand the investigated pastel is strikingly different in the way the figures are coloured, in the media used and in the overall structure of the background. At some places changes and corrections have been made into the pastel: for instance, the left hand of the seated bather has been redrawn.
The fact that the background is structured around the composition of the two women, gives the impression that the investigated pastel was intended as an independent work of art. This interpretation is confirmed by the presence of a contour line, probably drawn by means of an eraser, around the composition.[4] Important from the point of the investigation into the paper support is that the colour of the paper surface is clearly an integral part of the drawing background.

Renoir's studies for the Great Bathers of 1887

The drawing fits into a series of studies for the painting 'Les Grandes Baigneuses', exhibited for the first time at the Galerie Georges Petit in 1887. Renoir made a great number of studies for this painting, five of which represent the whole composition.[5] At first sight the investigated pastel seems the only drawing with just the left half of the composition, but this is not so: the last study of the complete group of bathers has been cut in two by Renoir himself (both halves are signed) and finished in different techniques.[6] The two halves should therefore be regarded as two drawings. Obviously Renoir felt the need to work on the left and right halves of the composition separately. The investigated pastel would however be the only composition study for the Great Bathers with all the colours filled in.
There may be a relation between the investigated pastel and the authenticated composition studies in the way the image is 'cut off'. To elaborate upon this would lead beyond the scope of the present study. As the question involves Renoir's handling of paper, the discovered data are given in Appendix III.

---

[2] See Appendix V.
[3] These measurements are provided by the Departement des Arts Graphiques of the Louvre.
[4] We owe this insight into the nature of the contour line to A. Stijnman from the Netherlands Institute for Cultural Heritage (ICN), Amsterdam. Former interpretation considered the contour line as damage caused by board or glass lying on the paper. A similarly constructed shape seems to be visible on a reproduction of a pastel by Degas. See J. Sutherland Boggs, A. Maheux, *Degas pastels*, 1992, p. 23.
[5] A survey of these studies is given by B. Ehrlich White, *The Bathers of 1887 and Renoir's Anti-Impressionism,* in: *The Art Bulletin*, 1973. White dates the drawing from the Musée d'Orsay 1901-1903 and connects it directly to a remake of the Great Bathers painting from 1903. This is rejected by Ch. Riopelle, *The Great Bathers,* 1990. There are more group studies of bathers but these do not yet represent the final composition.
[6] It is visible that the two halves belonged once to a single drawing because the foot of the reclining bather has been cut in the middle.

The date and order of the various studies for the Great Bathers are important if we want to establish whether the paper of the investigated pastel could have been from the same period. From the literature it appears that Renoir studied the individual figures and the composition of the Great Bathers painting during a fairly long period.[7] There is no consensus on the exact period: 1882 or 1884 till the beginning of 1887. The composition studies would have been done towards the end of that period. However, according to information from the Departement des Arts Graphiques of the Louvre, the composition study now in the Musée d'Orsay dates from 1881-1882. An early date for this study might be based upon the possibility that Renoir started work on the painting, but abandoned it in order to study the composition again. [8] Taking into account that the paper may have been in stock for some time, this means that the paper of our pastel, if authentic, should date from the middle 1870s till the middle 1880s as the most likely period. A later period cannot however be completely excluded.[9]

Description of the paper[10]

Physical description of the paper

On the basis of visual observation and direct measurements we can give the following description of the paper:

- Surface: a coating is clearly visible on one side of the paper. In spite of this coating, the fibre structure of the paper under the coating is still noticeable. Creases are visible on the surface; these are in line, which may mean that the paper has been kept on a (thin) roll.
- Smoothness: the fibre layer as well as the coating is very smooth; both must have been glazed.
- Colour: the coating is off white, the paper itself is yellowish or chamois. No discoloration is evident.[11]
- Backing: traces of brown coloured board are present on the verso of the paper.
- Dimensions: the paper has been cut by hand from a larger sheet. This can be seen from the somewhat irregular cutting edge of the paper. The paper as it is now has a common format, also in use for transfer paper: the dimensions are practically the paper format 'jésus' (ca. 72 x 55 cm). As the rectangular contour line is well within the limits of the paper, it is not likely that the artist has slightly trimmed the paper to adjust the dimensions of the composition. The original sheet must haven been considerably larger. This may indicate that a larger sheet or roll of paper has been cut into sheets of standard format by hand.

---

[7] F. Daulte, *Auguste Renoir*, München, 1972, gives 1882; White, op. cit., 1884; Riopelle, op. cit., 1884.

[8] This can be concluded from the fact that the drawing now in the Musée d'Orsay shows a strong resemblance to a remake of the Great Bathers dated 1903, while at the same time it is drawn in the style Renoir used in the 1880s. Explanation for this is that the painting from 1903 had been started in the 1880s, then abandoned and finally finished in 1903 when Renoir was asked by Vollard to make a copy of the 1887 painting. The 1903 painting could therefore be placed in the series of studies for the final painting of 1886-1887 after the d'Orsay drawing and the investigated pastel. This leaves room for the supposition that the d'Orsay study and the investigated pastel were made shortly after 1882. See J. Meier-Graeffe, *Auguste Renoir*, 1911, p. 122; Ch. Riopelle, op. cit.

[9] The episode of the 1903 remake (see note 8) may alert us also to the possibility that Renoir has been asked at a certain date after 1887 for a pastel based upon his 1887 painting.

[10] This chapter is based on the research performed at the Netherlands Institute for Cultural Heritage (ICN), Amsterdam, the Proost & Brandt Paper Laboratory, Diemen, and by R. Gerritsen, Amsterdam. See Appendix II.

[11] If the backing of the original frame (see chapter 'General description of the pastel', paragraph 'Provenance') has been acidic, then it did not visibly attack the paper of the pastel.

Chemical description of the fibre layer

The paper is unsized. It consists primarily of bleached sulphite pulp. Though the pulp has been bleached, the paper is neither white, nor in our opinion, discoloured. Therefore we assume that a yellow dye-stuff has been added to the pulp. Dying in a light tone required bleached pulp. How the paper has been tinted cannot be decided; chrome yellow, rust yellow (iron oxide) or synthetic dyes were all used to give paper a yellowish colour. In sized paper the resin and alum act as mordants; for the investigated paper, chromium and iron compounds may have been used as mordant, which could explain the somewhat higher amount of chrome in the paper.

Chemical description of the coating

A particular point of interest during the investigation has been the possibility of a photographic print under the pastel. On the basis of the chemical composition of paper and pastel this hypothesis must be rejected: a photographic print would show itself by the presence of certain elements in the photographic image, especially silver, chromium (for the carbon process) and iron (for the cyanotype process). In fact, there is a complete lack of silver and the presence of just a small amount of chromium compared to a carbon print, tested for reference. None of the chromium is however in the gelatine layer where it should be in case of a photographic image. Finally the cyanotype or blueprint process is based on the light sensitivity of iron salts. Again there is no iron present in the coating. Preparing the paper with a solution of iron salts would also have given the coating a dirty grey colour, which is not present at the places where the pigments disappeared.[12] Finally, investigation by infrared reflectography and on the light table showed no divergence from the pastel drawing. [13] This would have been expected if a photographic or other type of print was present under the pastel.

Layer structure of the pastel

In summary the overall layer structure of paper and pastel is as follows:

- pastel layer: a single layer of pigment; gypsum and chalk uniformly dispersed on the surface area; lithopone unevenly dispersed

- coating: gelatine and starch; some calcium present (about 20 ppm) but no other metals

- paper fibres: china clay present as filler; no sizing

Relative thickness fibre layer : coating ca. 20 : 1.

[12] G. Fritz, *Handbuch der Lithographie*, 1902.
[13] Report Corrigan, see Appendix V.

Determination of the type of paper

All properties of the investigated paper point to one single type: transfer paper. This kind of paper has been developed during the nineteenth century in order to make lithographs without having to draw on the stone itself. An equally important impulse came from the printing industry: drawings made on transfer paper could be transferred to a zinc plate that was then etched into a relief sufficient for letterpress printing. One of the names for this technique was gillotage after the inventor Firmin Gillot. Transfer paper was also used in the printing industry to transfer an image from one printing form to another (stone to stone, plate to stone).
Most nineteenth century instructions for the making of transfer paper are based upon the addition of a coating to an ordinary type of paper. The essential ingredients of the coating are mostly gelatine and starch or flour. Sometimes a filler is added. The coating has to be soluble, the fibre layer absorbent and therefore not or slightly sized. The paper of the investigated pastel is clearly indicated by the description in Lemerciers handbook of lithography of *'papier sans colle ordinaire avec encollage d'un seule côte'* [unsized paper with a coating on one side].[14]
We can determine the paper more precisely as autographic paper for pen, brush and tusche drawings. The term authographic paper, in French 'papier autographique', refers more specifically to paper upon which an original drawing was made for whatever final purpose, as opposed to paper for the transport of images between printing surfaces (in French: 'papier à report'). Two variants of autographic transfer paper existed from the 1870s on: a paper with a smooth coating, as the one used for the pastel, and a paper for crayon drawing, with a thick coating containing a filler and often an embossed texture, for instance an aquatint corn, in the coating. The fibre layer of most transfer papers was probably rather thin, but especially so when the paper was intended for transport from one printing surface to another; then China paper was often used. The fibre layer of autographic papers had to be thicker and stronger in order to allow the manipulations of the artist; it also had to be smooth for pen drawing. The properties of the paper support of the pastel are in agreement with these prerequisites.
Transfer paper could be home made by the artist or printer, using any kind of suitable paper. However, we don't believe many artists took the trouble of preparing the paper themselves. In our case the smoothness of the coating must have required a press. Therefore as far as the coating is concerned, the paper could have been made in a printing establishment for its own use or be produced for the market.
Transfer paper was manufactured for the market by a limited number of firms. These were often also major printing establishments. In France the lithographic printing firms of Lemercier and Clot are known producers. For the German market we find only four factories mentioned around 1900: Angerer & Göschl from Vienna, Klimsch & Co, Krebs and Schaeuffelen.[15] At least two of these, Angerer & Göschl and Klimsch were also illustration printers. As far as the producers of transfer papers did not have their own paper making facilities, they probably made the coating themselves and may have acquired the fibre layer directly from the paper factory. This allowed them to make special demands in regard to the paper properties on the basis of their specific experience and needs.
The fibre layer of the investigated pastel is most likely such a raw paper especially made for the production of transfer paper, because the only other type of unsized paper that could have been acquired on the market was printing paper; the paper under examination is definitely not of the latter kind. In the technical literature on paper making we found no evidence that uncoated transfer paper could be acquired through the general paper trade, though some

[14] A. Lemercier, *La lithographie francaise de 1796 à 1896*, 1896.
[15] F. Hesse, *Die Chromolithographie*, 1906, p. 32-33.

indications suggest that such a paper was sold in France by suppliers of lithographic articles[16]. The most likely interpretation of the paper of the investigated pastel seems to be that it was produced for the market by a paper factory or another kind of paper producer.

Make up of the pastel paper

In order to distinguish the two sides of the paper for the convenience of the user the coating of transfer paper was often provided with a colour. This seems to have been in particular the case with autographic paper, so much so that in France it was simply called 'papier jaune'. The fact that all recipes for transfer paper prescribe the addition of colouring materials to the coating, points to the use of white paper as a support: a coating containing starch paste or a white filler would be perfectly visible on a tinted paper. This is confirmed by the fact that the still extant transfer papers of Joseph Pennell in the Library of Congress all have a white paper as basis.[17] The pastel paper is therefore atypical in the sense that the colour is added to the pulp, not to the coating. A possible explanation of this apparent anomaly can be put forward.
The particular make up of the investigated paper may be explained by the requirements made upon transfer paper in the 1880s. In this period the gillotage process was further developed by Charles Gillot, son of Firmin: besides the direct transfer of images from paper to zinc, the indirect transfer by means of photography - photo-gillotage or photo-etching - now became a commercial option. Indirect, photographic transfer, from paper gave a better reproduction but required that a drawing be made on a flat, white paper. A special paper was created for this purpose again by Charles Gillot, 'papier procédé' or scratchboard, a kind of Bristol board with a white coating. Though we do not have positive evidence, it does seem logical however that in the early period of photo-gillotage transfer paper has been used for the purpose. Basically what was needed was a paper with a white coating, that is transfer paper with a coating not 'spoiled' by a colouring substance. The required stiffness could simply be achieved by attaching board to the paper; fixing a temporary board to transfer paper was in any case advisable, when it was used for drawing. Even after the development of 'papier procédé' it might have been useful to have a paper that was suitable for both kinds of gillotage as they were usually done by one and the same firm. We presume that the pastel paper belongs to this category of transfer paper. The yellow colour of the fibre layer can then be explained by the fact that under the specific circumstances, the only way to mark the right side of the paper for drawing, was by tinting the pulp.

Production date of the paper.

Appearance and chemical composition of the paper taken together, point to an early production date in the last decades of the nineteenth century.

Arguments based on the chemical composition

An important point in dating the paper of the pastel is the chemical composition of the fibre material. The presence of sulphite pulp gives an earliest production date of ca. 1880. The fact

[16] Advertisement by Ch. Lorilleux et Cie added to the Bulletin de l'Imprimerie, february 1895: 'Papier mat, préparé pour reports' and 'papier mat sans colle pour reports'. The interpretation is uncertain because 'sans colle' could also mean: without internal sizing, as in the earlier quotation 'papier sans colle avec encollage d'un seule côte', but the price difference suggest that the 'papier sans colle' was a considerably less elaborate paper: 6 Fr versus 1 Fr 75 c.
[17] Personal communication, L. Stiber Morenus, Library of Congress, Washington.

that the pulp has been bleached may present another opportunity for dating the paper. The most common, in some countries almost universal, method of bleaching in the early twentieth century was by means of bleaching powder (calcium hypochlorite). In this case, however, we would expect the presence of calcium in the fibre layer of the paper. When paper fibres swell in water, as during the paper production stage, they adsorb a certain amount of soluble material. In addition, because of the electronegative character of cellulose, positively charged particles, like calcium-ions, will be bound to the paper. The lack of calcium in the pastel paper, as demonstrated in the performed tests (Appendix II), indicates another bleaching method, viz. chlorine gas. Chlorine gas was used in the early days of cellulose production, until the 1890s, but was abandoned because too much fibre was lost in the process. [18]

Arguments based on the make up

The colour of the fibre layer of the pastel support was very fashionable for certain kinds of late nineteenth century paper; it was especially typical for drawing paper. This type of paper was called 'papier bulle' in French. We find a similar tone in the paper of various drawings by Renoir, described as 'papier beige', or 'buff paper'.
A second argument for a late nineteenth century production date based on the make up of the paper has already been discussed in the preceding chapter on the determination of the type of paper: the fact that the fibre layer is coloured in stead of the coating, is best explainable by the particular circumstances in the 1880s.
The overall impression of the pastel support is that it consists of an ordinary paper to which a coating has been added. In this it has an old fashioned appearance. Modern, factory made transfer papers which we have observed, show a more uniform make up and a higher glaze than the paper of the pastel. In reconstructing the design of late nineteenth and early twentieth century transfer paper, we are hampered by the lack of extant papers. Transfer paper was usually destroyed during the transfer process. On the other hand we expect that the usual uniformity of industrial products of a period will also be apparent in the case of transfer paper.
The modern 'design' of transfer paper dates back from at least the beginning of the twentieth century. A sample of autographic paper from the firm of Klimsch & Co[19] appeared to be a thin, very smooth paper with a greyish coating. This type of colouring for the coating was perhaps also typical at the time, because we find it again in samples of a special kind of transfer paper, 'Steinpapier', from the firm Angerer & Göschl. [20]
The modern look of (German) transfer paper seems to have been quite stable: in the sample book (1937) of the Aschaffenburger Buntpapier Fabrik from the collection of the Koninklijke Bibliotheek, The Hague, we found very thin, highly glazed and white coated transfer paper both for the purpose of "Umdruck" (transfer from one printing surface to another) and for autography or original drawing. It was also present on the Anglo-Saxon market, where it was called Berlin paper.

---

[18] From our study of the technical literature we conclude that the only alternative to bleaching powder in the first half of the twentieth century, natrium hypochlorite, produced by electrolysis of common salt, was never used extensively in the paper industry. The spread of electrolyte bleaching was prohibited by the high costs of electricity and salt. The most important change in the bleaching process was the introduction of liquid chlorine, which however was used by paper makers to produce their own bleaching powder.
[19] 'Autographische Papier für Federzeichnungen'. The sample is added to G. Fritz, *Handbuch der Lithographie*, 1902.
[20] Personal communication, F. Schmidt, Deutsche Bücherei, Leipzig.

Source of the paper

It is not likely that the artist would have been in possession of transfer paper unless he worked as a lithographer or had access to a printing establishment where these papers were in stock. If the artist wanted to reach a special effect, other smooth white papers, with or without coating would have been available, though perhaps not yet in the early 1880s. We must therefore conclude that the choice for the particular transfer paper used was based both on availability and artistic purpose.
The state of the paper may indicate that a printing shop has been the source. Transfer paper came usually in sheets in the paper trade. We have indications that the paper has been kept on a roll and cut to (standard) size (see the chapter on the description of the paper, first paragraph). This seems to point to a printing shop as the source of the paper for the artist.
Whether as a lithographer or through connections with other users of transfer paper, the artist would also have had access to other papers from the graphic industry. Suppliers of lithographic materials had various kinds of transfer paper in stock, among them very thin papers like China paper and thin western 'papier pelure'. Uncoated China paper, used for printing (proofs; chine collé), was also sold. [21] In short, if the artist had access to transfer paper, he would also have had access to a wide range of other special papers.

Renoir and transfer paper

After the determination of the type of paper, the dating and tracing of the source, the final step is establishing whether the investigated paper is of a kind used more often by Renoir. In comparing the paper to those of authenticated drawings by Renoir, we do not want to limit ourselves to the particular type of paper which may have been chosen for the occasion only because of its role in the background of the pastel. Another way to link the investigated paper to Renoir, is looking for other papers, intended for lithographic use and for other graphic printing applications, but adopted by Renoir for the purpose of drawing paper.

First period: 1879-1884

The gillotage reproductions of the drawings Renoir made in 1879 and 1883-1884 for the journal La Vie Moderne and for l'Impressioniste indicate that he had access to and worked on transfer paper during that period. A signature on one of the reproductions tells us that the firm of Gillot translated Renoir's drawings in relief, and therefore this firm is likely to be the source of the paper for the original drawings. Study of the reproductions in La Vie Moderne shows furthermore that Renoir used papers with at least two different types of surface: a smooth paper without any surface structure and a grained paper.[22] The method of producing the relief

---

[21] For the range of papers sold for lithography, see the journal *l 'Imprimerie* and the advertisement of Lorieux in the *Bulletin de l'Imprimerie,* 1896. On China paper, see: P. Jenkins, *India proof prints*, in: *The Paper Conservator*, 1990.

[22] We also have Renoir's own words to attest to the type of paper he used: '..they made us draw on a kind of paper which we had to scrape in order to produce the whites. I could never learn to use it properly.' A. Vollard, *La vie et l'oeuvre de Pierre-Auguste Renoir*, Paris, 1919. Renoir may refer both to transfer paper with an embossed pattern or to 'papier procédé' (described above in the paragraph on the make up of the pastel paper, chapter 'Determination of the type of paper'), a board that could have a pattern (stripes, points, a grain structure or whatever) embossed in or printed over its coated surface. By going more or less lightly over the embossed structure, grey tones were produced; firmer scratching of these parts resulted in white areas. In case of a printed pattern whites and grey tones could be produced in a similar manner by scraping away the pattern completely or partially. The grey tones could then be reproduced by gillotage in relief print as they consisted of separate

block (printing form) might have been a direct transfer from paper to zinc or an indirect transfer by way of a photographic negative. As some of the original drawings that Renoir made in 1883 are still in existence[23], photo-gillotage was probably used in that period for the transfer process in stead of direct transfer from the paper: in the case of direct transfer the image is usually destroyed together with the coating. Another clue for photo-gillotage is that one of the reproductions is larger than Renoir's original drawing.
As far as direct gillotage was adopted, Renoir must have drawn on transfer paper, but also for the photo-gillotages Renoir did not use the special board, 'papier procédé', that was developed for this purpose: in some reproductions we observed indications of the use of frottage to give the paper an additional structure. This of course presupposes that in these instances the paper must have been fairly thin.
In all cases that the original drawing is no longer extant, this drawing was most probably made on autographic paper and directly transferred to zinc. Also in case of photo-gillotage, transfer paper may have been used, as already indicated earlier; this paper, if supplied with an uncoloured coating, would have provided the white surface needed for photographic reproduction. Regrettably we did not yet have the opportunity for a direct study of the drawings which still exist.

Second period: the 1890s and early twentieth century

In the 1890s Renoir produced a series of lithographs. He took part in all the major albums published in those years. In at least one case, Le Chapeau Epinglé, it is explicitly stated that Renoir made the original drawing on transfer paper.[24] This seems to have been Renoir's usual way of working. Rather than drawing directly on stone, he was contented 'to throw a drawing on transfer paper' and leave the rest up to the printer. [25]

Other graphic printing papers used by Renoir

The above indicates that Renoir could have acquired the transfer paper used for the pastel through his contacts with the printer of La Vie Moderne. In order to test this hypothesis we have started comparing the paper of the investigated pastel with that of authenticated Renoir drawings. The intention is not only to establish whether Renoir has used the particular type of transfer paper more often, but also whether he has used other, related papers from the graphic printing industry.
Up to this point it can be said that Renoir did use a paper that may originally have been intended for lithographic printing for one of his studies for the Grandes Baigneuses. This became clear after examination of the three studies for the Great Bathers that are now in possession of the Musée d'Orsay but kept in de Departement des Arts Graphiques of the Louvre. Of these studies, a large drawing of the left seated bather (1 x 0.72 m) is on a very thin paper. Because the drawing is framed, the possibility of investigation is limited. However, the thinness of the paper is evident from the fact that the structure of the cloth, to

---

elements (before the introduction of screens, grey tones could of course not be directly printed in relief). A good explanation on the different surface patterns and how they were used, is presented in: J. Adeline, *Arts de reproduction vulgarisé*, 1894.

[23] J. Rewald, *Renoir drawings,* 1946.

[24] F. Carey and A. Griffiths, *From Manet to Toulouse Lautrec. French lithographs 1860-1890. Catalogue of an exhibition at the Department of Prints and Drawings in the British Museum,* 1978, p. 71.

[25] C. Roger-Marx, *Les lithographies de Renoir*, Monte Carlo, 1951. Quoted in: P. Gilmour, *Cher monsieur Clot ... Auguste Clot and his role as colour lithographer,* in: P. Gilmour (ed.), *Lasting impressions. Lithography as art,* London, 1988.

which it has been attached, is visible from the recto. It is also apparent from the wrinkles and folds in the paper due to careless mounting to the cloth. The colour of the paper is brown.[26]
This paper can be interpreted as China paper as was used in printing establishments for proofs and for certain kind of transfer papers. It cannot be excluded that the paper of the Bathers study is a very thin western paper, 'papier pelure', but here too we must look at lithographic printing for its original purpose (it might be a kind of transfer paper or have been intended for the preparation of transfer paper).
Renoir also used a thin paper of the 'papier bulle' type for another of his studies for the Great Bathers. This paper is generally described as a page from a sketchbook. The thickness of the paper is on estimation that of the investigated paper. In this case, the paper is discoloured except for an area around the borders, that has probably been covered by a frame.[27] Originally the sheet must have had a light yellow tone. There is a general resemblance to the paper of the investigated pastel. We might even suppose that the 'sketchbook' paper was also connected to lithographic printing just as the paper used for the Bathers study mentioned above, but this can neither be proven nor refuted at the moment.
The paper of the great composition study closest to the investigated pastel (see chapter on the general description of the pastel) is now brown of the same tone as the aforementioned; the original colour will also have been a more light tone. It could very well be the same paper as the 'sketchbook' paper, but too little is visible to give more than an impression.

Impressionists and transfer paper

When one takes a broader view and looks at the papers used by Renoir's contemporaries and fellow impressionist, it becomes clear that they did use on occasion similar papers as the one we have investigated. For instance, Degas made a monotype on ivory paper. Particularly interesting is the practice of Monet to use 'papier procédé' or scratchboard on a number of occasions. In case crayon is used, as for Monet's "Two men fishing" (Fogg Museum), this choice was more logical than for pastel, as the paper was developed for this kind of medium. A number of drawings by other impressionists were also done on coated paper possibly with the intention to have a reproduction made of their paintings for catalogues and the like. As a type of paper, scratchboard is of course closely related to transfer paper; in fact we wonder if it could be distinguished visually from transfer paper attached to board, as we presume our investigated paper once has been. [28]

Conclusions

Our findings have demonstrated convincingly that the paper used for the investigated pastel is transfer paper. The determination of the production date is based partly on the direct evidence of the chemical composition and the colour of the paper, partly on an interpretation of the visual characteristics of the paper and a reconstruction of nineteenth century transfer paper that was produced for the market. Of course the latter arguments have a much larger margin of uncertainty than the former. However, taking all the evidence together, a production date for the paper before 1900 or even earlier is by far the most likely.

---

[26] 'Papier blanc entoilé', according to the information on the website of the Agence Photographique de la Réunion des Musées Nationaux.
[27] Louvre, no. 89DE3578/RF 28657: Feuilles d'Etudes; études de Baigneuses.
[28] J. Meder, *The mastery of drawing*, volume I, 1978. Translated by W. Ames, p. 146 en 147; idem, volume II, plate 251 and 257.

If we accept the conclusions on the date of the paper as late nineteenth century, it must also be regarded likely that the pastel was made during that period. In the process of transferring the image from the transfer paper to another support, the paper or its coating was usually destroyed. In principle, the paper produced subsequently disappeared in use. Besides, transfer paper has no special features why some of it should be kept, like the fine Whatman papers. Therefore, a stock of nineteenth century transfer paper in the twentieth century is unlikely.
We must, on the same premise, also conclude that the pastel has been made in France. The picture is closely related to the large drawing now owned by the Musée d'Orsay, in the Louvre since 1947 and before that in possession of French private collectors. No reproduction was available before 1903. [29]
The artist has used a sort of paper that is not really suited to hold the pigment particles of a pastel. The choice of paper seems to be determined by the wish to create a certain effect, but also by availability. The artist who made the pastel was either personally active as a lithographer or had contacts with lithographic printers or other firms where transfer paper was in use.
This image fits Renoir. We know that he has worked on transfer paper, both for the purpose of gillotage and for lithography. From our limited study of authenticated Renoir drawings we also know that for at least one Great Bathers study Renoir used an unorthodox paper of a similar source as the transfer paper of the investigated pastel. Renoir was not the only impressionist artist to have used papers intended for the production of prints and illustrations. From the perspective of nineteenth century drawing practice, the use of transfer paper by Renoir would certainly not be exceptional.

Acknowledgements

Various specialists and research institutions have contributed to this study. H. Porck, curator of the Paperhistorical Department of the Koninklijke Bibliotheek, The Hague, was closely involved in the whole project. P. Hallebeek has led the research at the Netherlands Institute for Cultural Heritage (ICN), Amsterdam; A. Stijnman analyzed the drawing. G. Calkoen, Proost & Brandt Paper Laboratory, Diemen, performed fibre analyses and allowed us to use her laboratory; R. Gerritsen, Amsterdam, conducted the infrared reflectography. Important information, comments and other forms of assistance were provided by the following persons and institutions: J. de Zoete, Museum Johan Enschedé, Haarlem; L. Stiber Morenus, Library of Congress, Washington; E. van der Grijn, paper historian; F. Schmidt, Deutsche Bücherei, Leipzig; U. de Goede and E. Löffler, Rijksbureau voor Kunsthistorische Documentatie, The Hague; G. Bowen and M. Stewart, Fogg Art Museum, Harvard University, Cambridge; R-J. te Rijdt, Rijksmuseum, Amsterdam; N. Lingbeek and B. van Velzen, paperconservators; C. Waldthausen, photoconservator; Departement des Arts Graphiques, the Louvre, Paris; the librarians of the Library of the Amsterdam University and the Van Gogh Museum, Amsterdam.

[29] Probably the first printed reproduction of one the studies for the Great Bathers was published in the catalogue for the sale of the Arsène Alexandre collection. This reproduction is shown in Appendix I, Ill. 3, and further discussed in Appendix III.

APPENDIX I: Illustrations

1. The investigated pastel
2. Study for the painting 'Les Grandes Baigneuses' from the collection of the Musée d'Orsay
3. Illustration from the catalogue for the sale of the Arsène Alexandre Collection, 1903
4. The approximate spots where the XRF-tests have been done by McCrone (ciphers in squares) and the Netherlands Institute for Cultural Heritage (ciphers)

Illustration 1. The investigated pastel

Illustration 2. Study for the painting 'Les Grandes Baigneuses' from the collection of the Musée d'Orsay

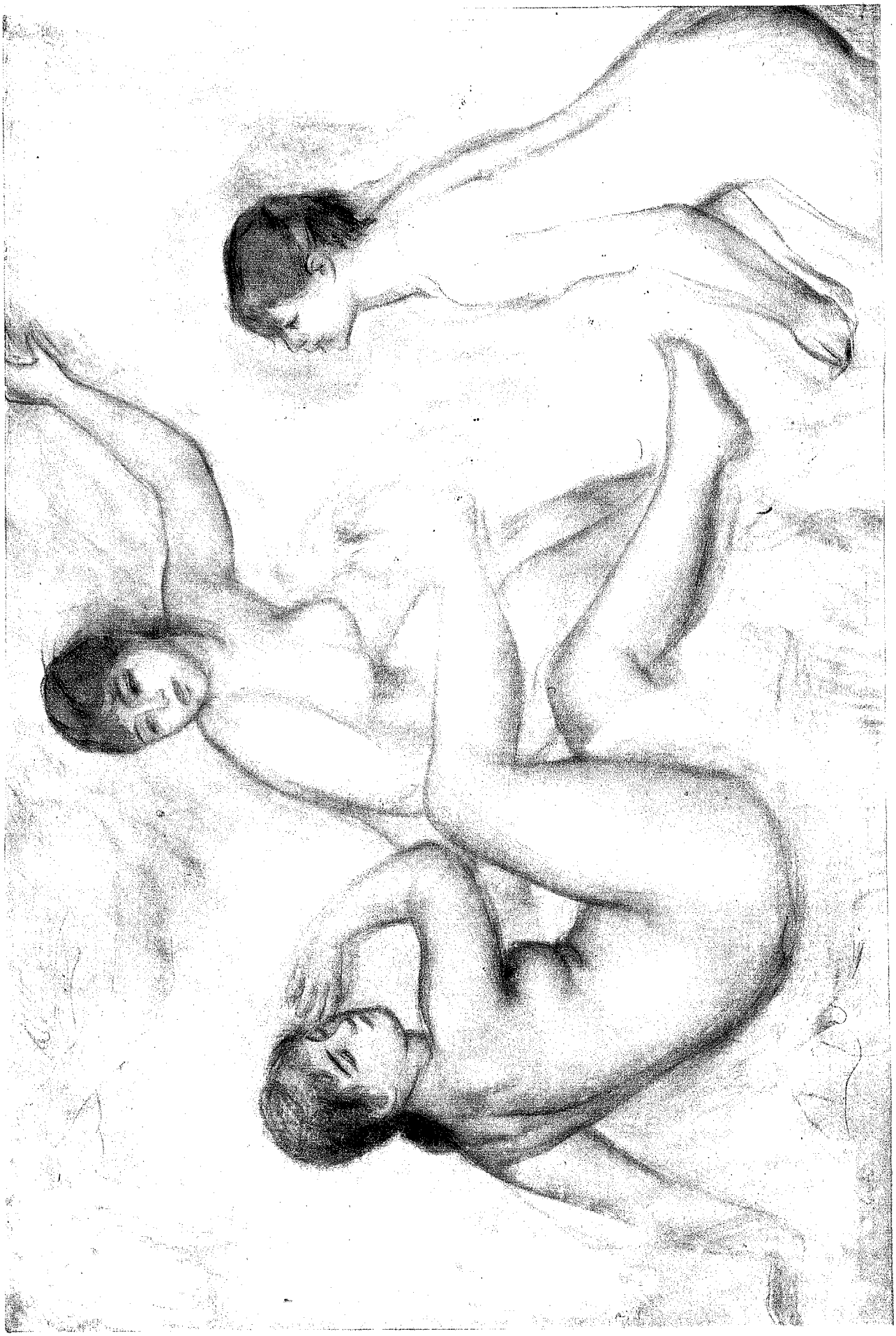


Illustration 3. Illustration from the catalogue for the sale of the Arsène Alexandre Collection, 1903

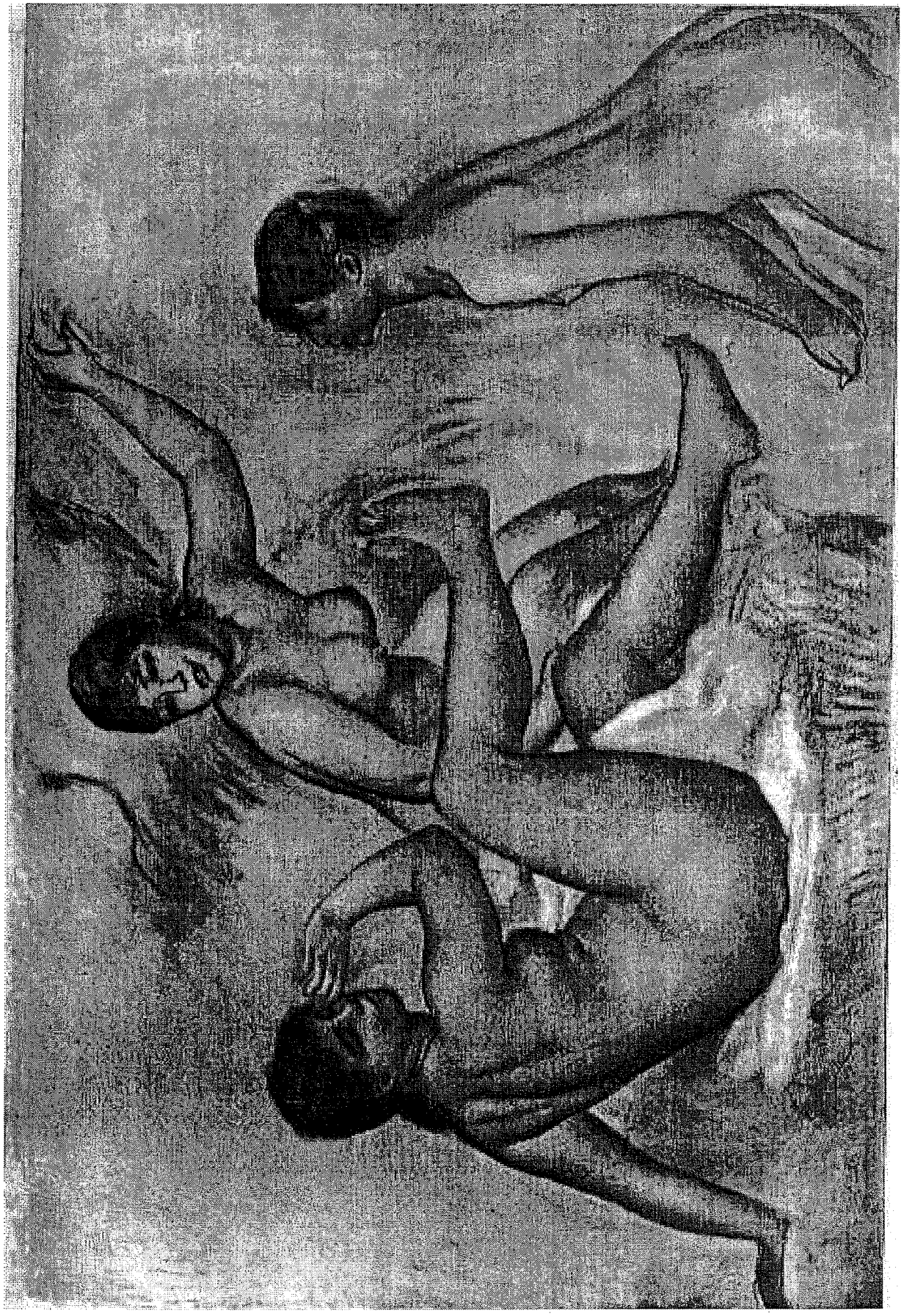
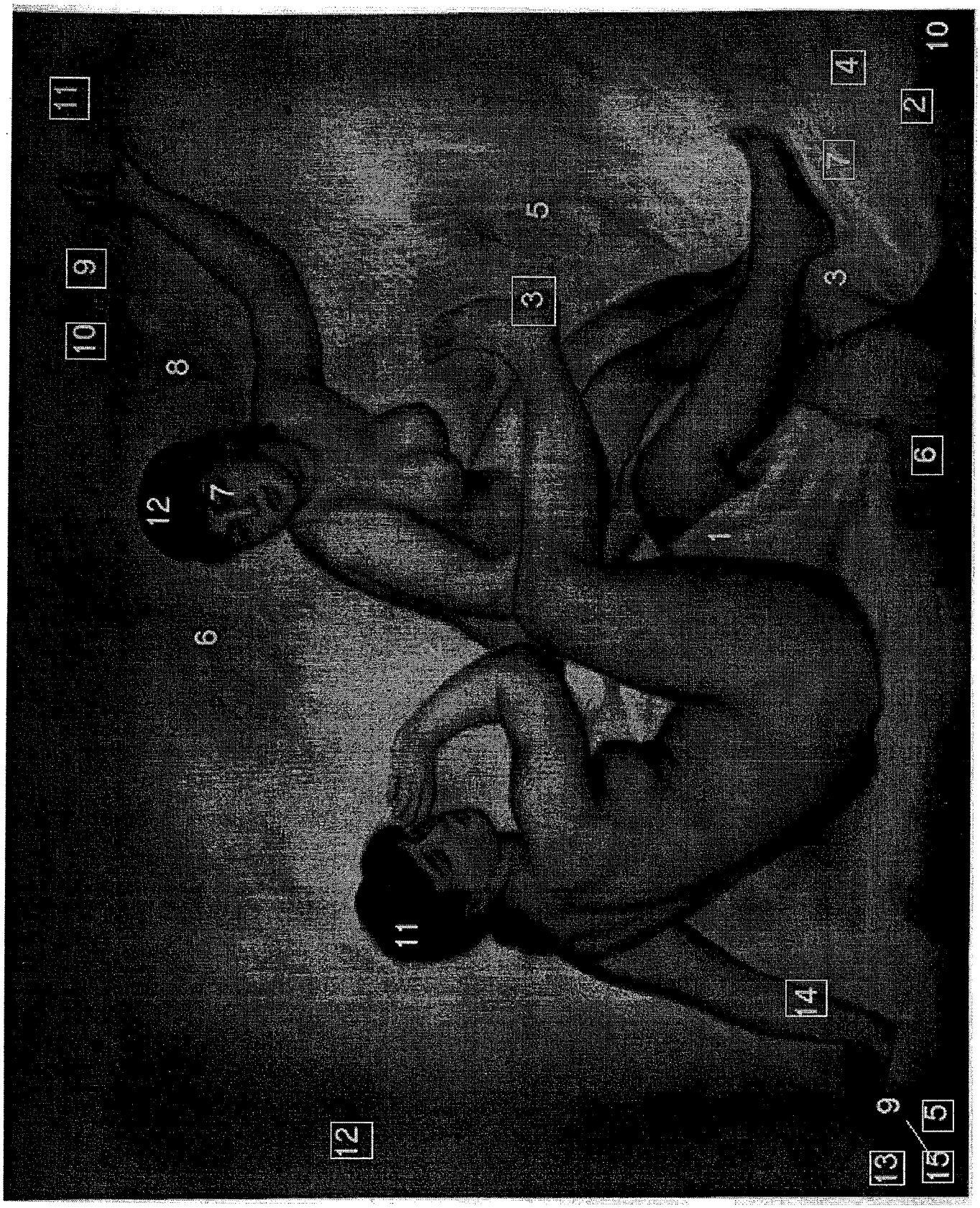


Illustration 4. The approximate spots where the XRF-tests have been done by McCrone (ciphers in squares) and the Netherlands Institute for Cultural Heritage (ciphers)



APPENDIX II: Technical data

General

Research took place at the Netherlands Institute for Cultural Heritage (ICN), Amsterdam, and at the Proost & Brandt Paper Laboratory, Diemen. The paper has been investigated by direct observation, partly aided by enlargement up to 50x and various types of light under different angles (Docucentre, Proost & Brandt), as well as by means of electron microscopy (SEM-EDX, ICN). To investigate the chemical composition different spectrometric techniques have been used. The presence of a number of elements in the paper, that were regarded as relevant, has been established by X-ray fluorescence spectrometry (XRF) at the ICN; the locations on the pastel where the XRF-tests were performed are indicarted in Appendix I, ill. 4; the results of the measurements are presented below (p. 21-24). As the X-rays penetrate the pastel completely, the XRF technique is not informative with respect to the layer in which the various detected elements are located: the pastel layer, the coating, or the fibre layer. For this reason, the precise position of a number of elements was determined by SEM-EDX, scanning electron microscopy combined with X-ray spectrometry.
The coating appeared to consist of a single layer under the electron microscope. Infrared spectrometry (FTIR, ICN) showed the coating to be a mixture of gelatine and starch; the presence of starch was confirmed by means of a spottest using potassium iodide reagens. Liquid chromatography (HPLC, ICN) also confirmed the presence of gelatine as well as the absence of resin. Finally gas chromatography-mass spectrometry (GC-MS, ICN) pointed to the absence of glycerine.
By means of the XRF and SEM-EDX tests conclusive evidence was obtained for the absence of a photographic print under the pastel, as has been described in detail above (chapter 'Description of the paper', paragraph 'Chemical description of the coating'). Infrared reflectography, performed by R. Gerritsen, Amsterdam, as well as investigation on the light table, also excluded the presence of an underlying photograhic or other type of print.
Fibre analysis has been done in an earlier stage by Integrated Paper Services and during the present stage at the Proost & Brandt Paper Laboratory.

Physical characteristics of the paper

(i) the paper support of the pastel measures 55.4 x 71 cm.
(ii) the paper is machine made and is glazed.
(iii) the paper is fairly thin: 0.24 mm (mean value of 4 measurements with hand micrometer; range: 0.15-0.3); measurements with the electron microscope on two places give 0.1 mm on the average for the fibre layer.
(iv) the paper is coated on one side.
(v) the paper is yellowish, but does not seem to be discoloured; the coating is off white.
(vi) the paper is sensitive to humidity; and has a tendency to curl along the short side; this points to a gelatine coating on one side of the paper.

The coating

(i) the coating is very smooth, of an off white colour and somewhat shiny on the edge of the paper.
(ii) the coating is very thin: 0.01 mm (SEM).
(iii) there are creases in the coated side of the paper.

(iv) Electron microscopy, FTIR, HPLC and a spottest on starch showed that:
- on top of the paper fibers there is only one closed layer, the coating of the paper.
- on top of the coating are the more separately distributed pigment particles.
- the coating consists of a mixture of gelatine and starch.

(v) SEM-EDX showed the absence of a filler in the coating.

(vi) GC-MS pointed at the absence of glycerine (sometimes used to keep transfer paper moist).

(vii) XRF testresults as far as the possibility of a photographic print under the pigment layer is concerned: silver is completely absent from the paper, chromium is present in a smaller amount than in a tested carbon print (20-30 ppm versus 240 ppm), but in a larger amount than in ordinary drawing and printing paper (5-10 ppm); SEM-EDX proved the absence of chromium as well as iron from the gelatine coating.

Fibre composition

The paper is produced from bleached sulphite pulp. The board that was once attached to the paper consists of mechanical wood pulp, unbleached sulphite pulp and old paper.

Chemical composition of the paper

(i) from the fibre research it appeared that the paper pulp has been bleached; this is also indicated by the large amount of sulphur in the paper, which may point to an incomplete washing of the pulp to remove cooking and bleaching products.

(ii) XRF showed the presence of the elements silicium and aluminium; SEM-EDX proved them to be only present in the fibre layer of the paper, indicating that china clay has been used as a paper filler.

(iii) there are several indications that the paper has no internal sizing:
- tests showed no detectable amount of resin.
- there is no potassium in the paper, therefore no alum.
- in view of the quantities of aluminium and silicium in the paper, the aluminium must be completely bound to the silicium, excluding the presence of aluminium sulphate in the paper.

(iv) gypsum (calcium sulphate), chalk (calcium carbonate) and lithopone are part of the pastel but not of the paper or its coating.

(v) the chromium content of the pastel layer is ca. twice as large compared to the fiber layer; the same distribution was found for iron.

XRF analysis of references (drawing paper, carbon print) and the pastel performed at the Netherlands Institute for Cultural Heritage (ICN), Amsterdam

REFERENCE PAPERS

DRAWING PAPER	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Fe	Pb	Ba
1. Drawing paper 1	+++	+++	-	+	+	+	+	T	T	+		-
2. Drawing paper 2	++	+++	-	++	+	+	+	-	-	+		-
3. Drawing paper 3	+	+	+	+	++	+	+	-	-	+	T	-

CARBON PRINT	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Fe	Pb	Ba
1. PRINT 1	T	-	-	++	++	+	+	+	+++	+	T	+++
2. PRINT 2 (POSSIBLE)	+	-	-	+	++	+	+	-	-	+	-	-
3. PRINT 3 (POSSIBLE)	T	-	T	+	++	-	+	-	-	+	-	-

+++ Main compound
++ Additional compound
+ Minor amount
T Trace
- Not present
nm Not measured

PASTEL

Place	Al	Si	P	S	Cl	K	Ca	Ti	Cr	Fe	Ag	Au	Pt	Br	Pb	Ba
1.	++	++	-	+++	+	-	+++	+	+	+	-	-	-	-	-	++
2.	++	++	-	+++	+	-	+++	-	+	+	-	-	-	-	-	++
3.	T	-	+	++	+	-	++	T	T	T	-	-	-	-	-	++
4.	++	++	-	+++	+	-	+++	T	+	T	-	-	-	-	-	+
5.	++	++	-	+++	+	-	+++	T	+	T	-	-	-	-	-	++
6.	++	++	-	++	+	-	+++	T	+	T	-	-	-	-	T	+
7.	+	+	+	++	+	-	+++	T	+	T	-	-	-	-	-	T
8.	++	++	-	+++	+	-	+++	T	+	T	-	-	-	-	-	++
9.	nm	nm	nm	nm	nm	nm	+++	T	+	T	-	-	-	-	-	+
10.	nm	nm	nm	nm	nm	nm	+++	T	+	T	-	-	-	-	-	T
11.	nm	nm	nm	nm	nm	nm	+++	T	+	T	-	-	-	-	-	T
12.	nm	nm	nm	nm	nm	nm	+++	T	+	T	-	-	-	-	-	+

+++ Main compound
++ Additional compound
+ Minor amount
T Trace
- Not present
nm Not measured

- The elements silver, gold, platinum and bromium are not quantitatively measured, but only qualitatively; present or not present.
- In none of the measured places one or more of the above-mentioned elements is positively identified.
- The element iron is in all the measured places identified in slightly changing quantities, but always in the same order ca. 30-40 ppm. No connection is established between the measured quantity of iron and lighter and darker places on the pastel.
- The chromium content in all the measured places is ca. 20-30 ppm. Also in this case no connection is established between the quantity of chromium and lighter and darker places on the pastel.
- Aluminium is identified in all measured places, evenly distributed over the surface of the pastel.
- Potassium is not identified.
- Lithopone (barium sulphate and zinc oxide) is in changing quantities upon the paper of the pastel present.
- Calcium sulphate (gypsum) is in all the measured places identified in the same quantity upon the paper of the pastel.
- Calcium carbonate is in all the measured places identified in the same quantity upon the paper of the pastel.
- When the measured amount of chromium originates from a photographic chromium salt in a layer of gelatine, this salt could not be potassium dichromate (potassium is not present) but should be sodium or ammonium dichromate (very rare). Because of the fact that the amount of chromium in the paper from the pastel is higher than the trace amount to be expected in paper and the amount of chromium to be expected in a carbon print is not known, the chromium content of three carbon prints, one real and two possible is examined.

- The chromium content of a standard type of paper could be: 5-10 ppm.
- the chromium content in all the measured places on the paper of the pastel is: 20-30 ppm
- the measured chromium content in a carbon print is: 240 ppm. (average value of three measured places on the surface).

Conclusion: There is no indication of the presence of a carbon print under the pastel, the slightly enhanced amount of chromium is probably to be attributed to pollution from one or more pigments or paper additives. From the measured carbon prints only the first one is a real carbon print, the two other ones are no carbon prints.

RESULTS OF THE XRF MEASUREMENTS

Drawing paper1/Ref

AL	12350.604	PPM	+/- 658.9901
SI	18830.881	PPM	+/- 358.8288
P	N D		
S	490.209	PPM	+/- 52.1933
CL	1264.959	PPM	+/- 95.3244
K	1307.863	PPM	+/- 41.2107
CA	725.820	PPM	+/- 26.9838
TI	27.692	PPM	+/- 7.4192
CR	11.013	PPM	+/- 4.5131
MN	21.525	PPM	+/- 3.6076
FE	290.912	PPM	+/- 5.5575
CO	12.496	PPM	+/- 2.7684
NI	N D		
CU	N D		
ZN	2.763	PPM	+/- 1.3879
AS	2.944	PPM	+/- 0.9444
PB	N D		
BA	N D		
C	96.465	DIFF	

Drawing paper, thin 2/Ref

AL	7194.073	PPM	+/- 590.9428
SI	13612.151	PPM	+/- 314.5457
P	N D		
S	1067.586	PPM	+/- 57.8966
CL	1021.237	PPM	+/- 92.3803
K	1103.008	PPM	+/- 36.2814
CA	300.768	PPM	+/- 20.3318
TI	7.051	PPM	+/- 6.6840
CR	5.700	PPM	+/- 4.4722
MN	19.876	PPM	+/- 3.5257
FE	209.112	PPM	+/- 4.8735
CO	11.073	PPM	+/- 2.6669
NI	2.610	PPM	+/- 1.8882
CU	5.356	PPM	+/- 1.7748
ZN	7.220	PPM	+/- 1.5217
AS	N D		
PB	3.342	PPM	+/- 2.4717
BA	N D		
C	97.543	DIFF	

Drawing paper 3/Ref

AL	619.512	PPM	+/- 284.1135
SI	235.479	PPM	+/- 125.9738
P	438.680	PPM	+/- 89.2042
S	421.829	PPM	+/- 47.4845
CL	1613.802	PPM	+/- 88.9206
K	50.350	PPM	+/- 17.6653
CA	180.471	PPM	+/- 13.3466
TI	N D		
CR	8.200	PPM	+/- 4.0598
MN	8.982	PPM	+/- 3.1863
FE	27.299	PPM	+/- 2.9523
CO	5.128	PPM	+/- 2.1585
NI	N D		
CU	2.089	PPM	+/- 1.7057
ZN	7.652	PPM	+/- 1.4116
AS	1.927	PPM	+/- 1.1668
PB	16.255	PPM	+/- 2.6823
BA	N D		
C	99.636	DIFF	

Carbon print 1 - real/ref

AL	503.929	PPM	+/- 420.8019
SI	N D		
P	N D		
S	4578.906	PPM	+/- 104.1809
CL	2740.219	PPM	+/- 116.8358
K	241.951	PPM	+/- 27.9550
CA	470.211	PPM	+/- 24.4827
TI	315.340	PPM	+/- 42.1726
CR	231.151	PPM	+/- 10.5838
MN	6.226	PPM	+/- 6.0610
FE	128.796	PPM	+/- 4.9149
CO	16.857	PPM	+/- 3.4080
NI	1.599	PPM	+/- 2.6776
CU	6.443	PPM	+/- 2.7046
ZN	9.646	PPM	+/- 2.3311
AS	1.600	PPM	+/- 2.2288
PB	38.615	PPM	+/- 5.0849
BA	8197.529	PPM	+/- 99.3667
C	98.251	DIFF	

Carbon print - possible/Ref

AL	1881.920	PPM	+/- 353.0286
SI	N D		
P	N D		
S	2433.290	PPM	+/- 74.8059
CL	1695.754	PPM	+/- 97.0427
K	64.856	PPM	+/- 19.5640
CA	443.274	PPM	+/- 18.6478
TI	N D		
CR	7.009	PPM	+/- 4.1210
MN	10.362	PPM	+/- 3.4038
FE	70.234	PPM	+/- 3.5037
CO	0.490	PPM	+/- 2.3789
NI	N D		
CU	8.793	PPM	+/- 1.7602
ZN	5.574	PPM	+/- 1.5009
AS	1.947	PPM	+/- 1.1300
PB	1.201	PPM	+/- 2.6917
BA	11.738	PPM	+/- 15.1810
C	99.336	DIFF	

Carbon print - possible/Ref

AL	324.729	PPM	+/- 270.8703
SI	90.656	PPM	+/- 120.3152
P	508.834	PPM	+/- 88.6834
S	412.652	PPM	+/- 49.9003
CL	1747.916	PPM	+/- 86.7339
K	N D		
CA	417.744	PPM	+/- 16.7354
TI	0.135	PPM	+/- 4.8956
CR	4.600	PPM	+/- 3.2532
MN	7.103	PPM	+/- 2.6775
FE	46.963	PPM	+/- 2.7160
CO	3.512	PPM	+/- 1.9242
NI	N D		
CU	0.877	PPM	+/- 1.4480
ZN	2.930	PPM	+/- 1.2212
AS	0.811	PPM	+/- 0.9646
PB	5.528	PPM	+/- 2.2532
BA	2.966	PPM	+/- 12.7757
C	99.642	DIFF	

RENOIR/1

AL	652.172	PPM	+/- 362.1518
SI	1209.371	PPM	+/- 169.1845
P	N D		
S	4368.676	PPM	+/- 88.6450
CL	352.781	PPM	+/- 88.9942
K	N D		
CA	745.869	PPM	+/- 21.7594
TI	31.151	PPM	+/- 9.4779
CR	30.522	PPM	+/- 3.6331
MN	N D		
FE	29.033	PPM	+/- 2.3443
CO	N D		
NI	N D		
CU	N D		
ZN	113.924	PPM	+/- 2.0223
AS	N D		
PB	2.171	PPM	+/- 1.5708
BA	382.264	PPM	+/- 22.9632
C	99.207	DIFF	

RENOIR/2

AL	1632.835	PPM	+/- 488.7677
SI	1401.125	PPM	+/- 206.7499
P	N D		
S	3706.286	PPM	+/- 96.4716
CL	805.447	PPM	+/- 101.3261
K	N D		
CA	1493.288	PPM	+/- 34.9688
TI	N D		
CR	22.835	PPM	+/- 4.9968
MN	N D		
FE	55.954	PPM	+/- 3.6528
CO	N D		
NI	N D		
CU	5.446	PPM	+/- 2.1667
ZN	12.114	PPM	+/- 1.9982
AS	4.193	PPM	+/- 1.6105
PB	N D		
BA	70.649	PPM	+/- 19.5786
C	99.078	DIFF	

RENOIR/3

AL	102.901	PPM	+/- 252.9069
SI	N D		
P	380.239	PPM	+/- 88.7576
S	975.936	PPM	+/- 51.1325
CL	619.538	PPM	+/- 74.5080
K	N D		
CA	298.396	PPM	+/- 14.0919
TI	8.600	PPM	+/- 5.3854
CR	6.028	PPM	+/- 2.5860
MN	7.808	PPM	+/- 1.8620
FE	16.272	PPM	+/- 1.7182
CO	N D		
NI	N D		
CU	1.319	PPM	+/- 0.7893
ZN	27.476	PPM	+/- 1.0334
AS	N D		
PB	1.606	PPM	+/- 1.0803
BA	88.641	PPM	+/- 13.4910
C	99.746	DIFF	

RENOIR/4

AL	983.067	PPM	+/- 357.5269
SI	715.843	PPM	+/- 163.2635
P	N D		
S	4416.831	PPM	+/- 89.8787
CL	457.799	PPM	+/- 93.3270
K	N D		
CA	1317.899	PPM	+/- 28.5963
TI	13.146	PPM	+/- 6.7041
CR	21.922	PPM	+/- 3.8973
MN	5.271	PPM	+/- 2.8297
FE	22.059	PPM	+/- 2.5062
CO	N D		
NI	N D		
CU	2.667	PPM	+/- 1.3003
ZN	28.002	PPM	+/- 1.3565
AS	N D		
PB	3.993	PPM	+/- 1.8443
BA	57.053	PPM	+/- 17.3712
C	99.195	DIFF	

RENOIR/5

AL	1209.113	PPM	+/- 420.9531
SI	1488.111	PPM	+/- 191.9278
P	N D		
S	4325.328	PPM	+/- 92.5493
CL	1039.143	PPM	+/- 102.0219
K	N D		
CA	1669.062	PPM	+/- 33.0278
TI	20.469	PPM	+/- 8.9683
CR	29.697	PPM	+/- 4.8824
MN	5.474	PPM	+/- 3.6356
FE	27.763	PPM	+/- 3.2072
CO	N D		
NI	N D		
CU	6.048	PPM	+/- 1.7153
ZN	50.694	PPM	+/- 1.9046
AS	N D		
PB	3.369	PPM	+/- 2.5905
BA	192.354	PPM	+/- 22.2401
C	98.993	DIFF	

RENOIR/6

AL	1025.370	PPM	+/- 399.8325
SI	1018.561	PPM	+/- 176.4170
P	N D		
S	1749.062	PPM	+/- 71.8262
CL	722.523	PPM	+/- 88.6378
K	N D		
CA	1205.053	PPM	+/- 30.4952
TI	11.154	PPM	+/- 6.9511
CR	20.612	PPM	+/- 4.2865
MN	5.835	PPM	+/- 3.3732
FE	29.024	PPM	+/- 3.0656
CO	N D		
NI	N D		
CU	N D		
ZN	9.925	PPM	+/- 1.6767
AS	3.793	PPM	+/- 1.4288
PB	9.074	PPM	+/- 3.3795
BA	40.221	PPM	+/- 18.1775
C	99.415	DIFF	

RENOIR/7

AL	464.835	PPM	+/- 321.8091
SI	375.517	PPM	+/- 146.8264
P	377.845	PPM	+/- 106.0481
S	1812.769	PPM	+/- 64.7834
CL	934.965	PPM	+/- 88.3917
K	N D		
CA	786.532	PPM	+/- 21.6489
TI	7.290	PPM	+/- 5.8002
CR	22.394	PPM	+/- 3.7919
MN	15.878	PPM	+/- 2.9006
FE	55.295	PPM	+/- 2.8755
CO	N D		
NI	N D		
CU	2.708	PPM	+/- 1.2697
ZN	5.298	PPM	+/- 1.1079
AS	1.677	PPM	+/- 0.7955
PB	4.199	PPM	+/- 1.8709
BA	36.510	PPM	+/- 15.0148
C	99.509	DIFF	

RENOIR/8

AL	870.427	PPM	+/- 358.5210
SI	1315.175	PPM	+/- 170.0966
P	N D		
S	2515.094	PPM	+/- 73.8133
CL	808.410	PPM	+/- 89.3519
K	N D		
CA	1613.268	PPM	+/- 30.8556
TI	50.981	PPM	+/- 7.7853
CR	19.273	PPM	+/- 3.5731
MN	8.462	PPM	+/- 2.6034
FE	31.582	PPM	+/- 2.4256
CO	N D		
NI	N D		
CU	N D		
ZN	16.449	PPM	+/- 1.0912
AS	2.487	PPM	+/- 0.6951
PB	3.528	PPM	+/- 1.6646
BA	155.776	PPM	+/- 20.0789
C	99.259	DIFF	

RENOIR/9

CA	319.746	PPM	+/- 13.1133
TI	22.534	PPM	+/- 4.2397
CR	29.784	PPM	+/- 3.4045
MN	7.427	PPM	+/- 2.7310
FE	31.386	PPM	+/- 2.8710
CO	N D		
NI	N D		
CU	4.999	PPM	+/- 1.4596
ZN	10.145	PPM	+/- 1.2614
AS	2.365	PPM	+/- 0.9370
PB	6.344	PPM	+/- 2.2092
BA	8.434	PPM	+/- 11.4842
C	99.935	DIFF	

RENOIR/10

CA	280.165	PPM	+/- 16.3774
TI	N D		
CR	9.877	PPM	+/- 3.4182
MN	21.471	PPM	+/- 2.9029
FE	34.446	PPM	+/- 3.3736
CO	4.227	PPM	+/- 2.1227
NI	2.371	PPM	+/- 1.7618
CU	7.100	PPM	+/- 1.6926
ZN	13.496	PPM	+/- 1.5045
AS	N D		
PB	5.876	PPM	+/- 2.9956
BA	36.232	PPM	+/- 13.8040
C	99.940	DIFF	

RENOIR/11

CA	175.106	PPM	+/- 10.3053
TI	7.140	PPM	+/- 3.7021
CR	10.862	PPM	+/- 2.7415
MN	21.063	PPM	+/- 2.2946
FE	22.065	PPM	+/- 2.6561
CO	3.123	PPM	+/- 1.4909
NI	N D		
CU	N D		
ZN	1.626	PPM	+/- 0.8682
AS	1.601	PPM	+/- 0.6541
PB	3.964	PPM	+/- 1.5326
BA	N D		
C	99.962	DIFF	

RENOIR/12

CA	189.152	PPM	+/- 12.6178
TI	N D		
CR	9.867	PPM	+/- 3.1442
MN	17.818	PPM	+/- 2.7198
FE	39.769	PPM	+/- 2.8648
CO	3.117	PPM	+/- 1.8644
NI	N D		
CU	2.646	PPM	+/- 1.4518
ZN	4.597	PPM	+/- 1.2738
AS	3.349	PPM	+/- 1.0767
PB	N D		
BA	1.379	PPM	+/- 12.3066
C	99.967	DIFF	

APPENDIX III: Renoir's treatment of paper in the studies for the Great Bathers

It has been mentioned earlier in this report that the final composition study for the Great Bathers painting has been cut in two halves by Renoir himself (chapter on the general description of the pastel, final paragraph). When the two separate drawings are placed together, it is evident that the half with two bathers (now in the Fogg Museum) has lost a stripe of paper of about 15 cm at the bottom, and the half with the lonely splashing bather a similar stripe at the top. One can conclude that this has been done by Renoir to change the dimensions of the two halves of the drawing. It is not unusual that an artist changed the exact proportions of a drawing by adding small stripes of paper. Obviously, the opposite could also have happened: changing a drawing by cutting off smaller or larger stripes. Renoir's treatment of his last study for the Great Bathers is an example of this practice.
The relevancy for the present study is in the relation between the contour line on the investigated pastel and the way the drawing is cut off in the various authenticated works by Renoir. It is to be noted that on a total of five composition studies by Renoir, two have a contour line. Also there is an evident similarity between the way the contour line in the pastel cuts off the picture and the way this is done by the border of the paper in two other studies by Renoir: the one in the Wadsworth Athenaeum and the great composition study of the Musée d'Orsay. In the Wadsworth study it is the left hand of the foreground bather, in the d'Orsay study (Appendix I, ill. 2) the left hand of the central bather that are cut off in similar ways. All this seems to indicate identical choices on the final dimensions of the composition. But as far as the study from the Musée d'Orsay is concerned there is a complication.
We have a reproduction of this drawing, published in 1903, in which the drawing is larger: in particular the left hand of the central bather is complete.[30] This is confirmed by the dimensions provided in 1903: 112 x 167 cm, in stead of 108 x 162 cm (d'Orsay). The drawing is presently framed and part of the drawing could be hidden by the frame, but this would be very strange. The record in the database at the Departement des Arts Graphiques of the Louvre, where the drawing is kept, gives no indication of what might have happened. Therefore we must at least consider the possibility that the drawing has been trimmed.
As it is very unlikely that any collector would have cut away part of a genuine Renoir drawing, Renoir himself may have trimmed the drawing when he still owned it. The reproduction of 1903 was made according to the 'procédé Georges Petit', a primitive type of heliogravure. This Georges Petit was the famous gallery owner, who doubled as publisher of prints and inventor. He was also the one who sold the d'Orsay drawing in 1903, as well as the painting of the Grandes Baigneuses in 1887. It is therefore very likely that the photographic negative, that was the basis of the reproduction of 1903, was already in the archives of the Galeries George Petit. It could very well date from the 1880s when the drawing was made. After that date Renoir may have reconsidered the composition and its exact proportions, a reconsideration that led to a trimming of the drawing.[31] If this is correct, Renoir's handling of the d'Orsay drawing would be a clear indication of his doubts on the final dimensions of the composition, a doubt that is suggestive of the contour line in the investigated pastel.

---

[30] Appendix I, ill. 3. Catalogue for the sale of the art collection of Arsène Alexandre, 1903. This catalogue is present in the Rijksbureau voor Kunsthistorische Documentatie, The Hague.
[31] It would be interesting to explore whether there is a relation between the 1903 reproduction, or another print from the negative that was the basis for it, and the last painting of the Bathers (1903) which is clearly based on the Louvre study. It is known that at this time Renoir had no access to the painting of the Bathers from 1887, and possibly neither to his final composition studies and the Louvre version. He may have used the reproduction as basis.

APPENDIX IV: Sources on transfer paper and paper making

- Sources on transfer paper

Adeline, J., *Les arts de la réproduction vulgarisé*, 1894.
Adeline, J., *Lexique des termes d'art,* 1884.
Andes, L.A., *Papierspezialitäten: praktische Anleitung zur Herstellung von den Verschiedensten Zwecken dienenden Papierfabrikaten, wie Pergamentpapiere, Abziehpapiere etc etc,* 1896.
Andes, L.A., *The treatment of paper for special purposes: a practical introduction etc etc*, 1907, and Idem,1923 (2nd. ed., rev. and enh.).
Antheasian, G.Z., *The Tamarind book of lithography: art and techniques*, 1971.
Bulletin de l'Imprimerie (journal), 1896 -
Duchatel, E., *Traité de lithographie artistique,* 1893.
Fielding, *The art of engraving*, 1844.
Fritz, G., *Handbuch der Lithographie und des Steindrucks*, 1902.
Hammann, J.M.H, *Des arts graphiques destinés à multiplier par l'impression*, 1857.
Harrap, C., *Transferring*, 1912.
Haynié, J., *Der lithographische Umdruck nach dem heutigen Stand dieser Technik,* 1900.
Hesse, F., *Die Chromolithographie mit besonderer berücksichtigung der modernen, auf photographischer Grundlage beruhende Verfahren und der Technik des Aluminiumdrucks,* 1906.
Kampmann, C., *Die graphischen Künste,* 3., vermehrte und verbess. Aufl., 1906 [1898].
Lemercier, A., *La lithographie francaise de 1796 à 1896 et les arts qui s'y rattachent. Manuel pratique s'adressant aux artistes et aux imprimeurs par Alfred Lemercier, artiste et imprimeur lithographe, premier president de la Société des Artistes Lithigraphes Francais, neveu et associé de R. J. Lemercier officier de la Légion d'Honneur et fondateur de la célèbre imprimerie de ce nom etc .... publié sous le patronage de la Maison Lorilleux et C*ie , 1896.
Lexicon des gesamten Buchwesen's, (herausgegeben von Karl Löffler und Joachim Kirchner, unter mitwirkung von Wilhelm Olbrich), 1937, Band III.
L'Imprimerie (journal), 1876-
Motteroz, *Eassai sur les gravures chimiques en relief*, 1871, and Idem, 1888.
Nouveau Larousse Illustré.
Rhodes, H.J., *The art of lithography*, 1922 [first impression 1914?].
Seymour, A., *Practical lithography,* 1903.
Trivick, H.H., *Autolithography: the technique*, 1960.
Trompetter, H., *Handleiding voor de chromo-lithograpfie*, 1924.
Trompetter, H., *Handleiding voor de chromo-lithografie en photo-lithografie*, 1939.
Valenta, E., *Das Papier: seine Herstellung, Eigenschaften, Verwendung in den graphischen Drucktechniken, Pruefung usw*, 2. verm. Und verb. Auflage, 1922.
Valette, A., *Manuel pratique de la lithographie,* 1894 [1891?].
Villon, A.M., *Nouveau manuel complet du dessinateur et de l'imprimeur lithographe: traitant de toutes les operations lithographiques sur pierre et sur zinc de l'autographie, des reports, de la gravure, de l'autographie, de la chromolithographie, de la photolithographie, de la phototypie et de tous les procedes connus jusqu'a ce jour pour reproduire les ecritures et les dessins au moyen de la pierre, du zinc etc.*, 1891.

- Sources on paper making

Clapperton, R.H. and Henderson, W., *Modern paper-making*, London, 1929.
Cross, G.F. and Bevan, E.J., *A text-book of paper-making. Fifth edition*, 1936.
Grant, J., *A laboratory handbook of pulp and paper manufacture*, London, 1942.
Grant, J., *Wood pulp and allied products,* London, 1947.
Hoffmann, C., *Praktisches Handbuch der Papier-Fabrikation*, 1891-1897.
Hoffmann, C., *Traité pratique de la fabrication du papier*, 1877.
Hoffmann, C., *Traité pratique de la fabrication du papier. 3ieme partie: collage, charge coloration des pates a papier,* 1926.
Keim, K., *Das Papier*, 1956.
Kirchner, E., *Das Papier. I. Teil. Geschichte der Papierindustrie und Allgemeines über Papier. II. Teil. Rohstofflehre*, 1896-1897. *III. Teil. Halbstofflehre*, 1907.
Müller, F., *Die Papierfabrikation und deren Maschinen. I. Band: Die Roh- und Halbstoffe sowie das Ganzzeug*, 1926.
Olmer, G., *Du papier mecanique et de ses apprets dans les diverses impressions,* 1882.
Opfermann, E. and Hochberger, E., *Technik und Praxis der Papierfabrikation. Band III. Die Bleiche des Zellstoffs,* Berlin, 1935.
Os, J.A. van, *Warenkennis en technologie*, deel I, 1956.
Possanner von Ehrenthal, B., *Die Papierfabrikation*, Leipzig, 1913.
Possanner von Ehrenthal, B., *Lehrbuch der chemischen Technologie des Papieres,* Leipzig, 1923.
Puget, P., *La fabrication du papier*, Paris, 1923.
Schubert, M., *Die Praxis der Papierfabrikation. Dritte vermehrte und verbesserte Auflage von Dr Ing E. H. Ernst Müller*, 1922.
Sutermeister, E., *Chemistry of pulp and papermaking*, 1920.
Sutermeister, E., *Chemistry of pulp and paper making*, 1941.

APPENDIX V: Research reports by Wagner, Corrigan and McCrone

Before the present research was undertaken the pastel has been investigated by A.B. Wagner (New York), C. Corrigan (Paris), and McCrone Associates (Westmont). Their reports, in case of McCrone a summarising table, are presented below (p. 29-30).
The investigation of McCrone was done by means of X-ray spectrometry. Small samples of material were taken from the surface of the pastel, mainly in the fringe areas. Two samples were taken from one of the main figures: one at right foot of the sitting bather (sample 3) and one from her left arm (sample 14) (see Appendix I, ill. 4).
On the basis of the test results the following pigments were found to be present: chrome yellow, zinc yellow, umber=iron earth, vermilion, ultramarine, Prussian blue, bone black, charcoal black (probably), lithopone, whiting, calcium sulphate and clay.
The research at the Netherlands Institute for Cultural Heritage (ICN) showed lithopone to be unevenly, gypsum (calcium sulphate) and chalk (calcium carbonate) to be evenly dispersed in the pigment layer of the pastel.
In the fringe area of the pastel some titanium dioxide was found. The tests at the Netherlands Institute for cultural Heritage (ICN), performed over the whole body of the pastel (see Appendix I, ill. 4), did not confirm the presence of titanium. This confirms the earlier conclusion already drawn from the McCrone research, that the titanium dioxide was added during later restoration and not part of the pigments used by the artist.

ARNOLD B. WAGNER

STUDIO / LAB
CONSERVATION AND *RESTORATION* OF FINE WORKS OF ART
150 WEST 28th ST. NEW YORK. NY. 10001-6103. tel/fax. (212) 633-6094
www ARNWAGNER@AOL.com

Mr. Greg Kitchen
34 West 28th Street
New York New York, 10001

April 5, 1993

Re:Pastel Rendering In Glazed Frame Two Female Nude Figures Signed Renoir measuring 22 3/4" x 27 3/4"

The following is my physical assessment of the above:

Upon examination, both visual and microscopic, we found the art to be a pastel rendering on textured paper in a style consistent with the apunte´ (or preliminary sketch) technique reminiscent of the work of the artist, Augustus Renoir.

This drawing utilized primarily umber, sanguine, Prussian blue and Prussian blue in a light tone, white, and finally black. The bottom most layers seem to be a bluish wash or watercolor and we see that the the initial drawing of the figures outlines were faintly established with this. We see this because we see an indication of a outline of the third models left elbow and backside in the blue.

Being that this color has a slight sheen, we assume that the artist may have fixed this stage.

The artist then established his large graduated value transitions of mass and flatness after establishing thin faint outline by rubbing with a stump,chamois or with pinkie finger. Highlights of white and black were then restated to re-establish the salient aspects of hair, face and boundaries of form.

Spontaneity is evident, consistent with that of an apunte´in the changing of positioning of the pinkie of the left most hand .

It is evident from the documentation of the final rendering of this pose that this was an idea sketch or apunte´ being that one of the hands were kept in the final and one was changed.

The paper and its "Naugahyde" tooth surface was made possible from scraping technique that is indicative with artist sketches has been documented. The paper originally had pulp board glued to the back, but has subsequently been removed for conservation / restoration purposes.

A large off square shape is evident and off to the right is in the background which seems to be connected with either the placement of a mat, but most likely a sheet of glass that was flat stacked leaving the edges unprotected to wear, dust or contamination which is evident with the darkening of peripheral areas of the background which could be consistent with retouching by a latter hand.

There is a crude erasure or removal of light blue background on extreme right which is consistent with a study by the artist obliterating the third model right, and to test the sharpness of his erasure or stump placement .

A current framing anomaly with corrugated verso caused losses due to static vibration which transferred itself in the form of vertical corduroy stripes to the center of glazed verso.

Professional Associate
American Institute for the Conservation of Artistic and Historic Works

CAROLINE CORRIGAN
Diplomée de l'Institut Français de Restauration des Oeuvres d'Art
Habilitée par le service de restauration des Musées de France
RESTAURATION DE DESSINS

Paris, le 23 novembre 2000

GREG KITCHEN
34 WEST 28 Th STREET
NEW YORK NEW YORK 10001

OBSERVATION ON A DRAWING FROM RENOIR

Representing two naked women sitting
Size : 55,4 cm x 71 cm

Paper : coated paper, smooth surface, in a good state -
the back shows residues of an ancient backing on a mounting board.

Drawing technique : Rubbed pastel, no underlying marks of print could be seen under magnifying lenses (x10 , MANTIS MAGNIFIER) ,
In somme parts overlining with black pencil (hairs, eyes) and brown pencil for some parts of the contour of the body.

Remarks: left, right and upper sides present a darker shade, probably caused by an ancient mounting board overlapping the drawing.

C.CORRIGAN

51 rue des Partants, 75020 Paris - Tel: 01 47 97 00 99

#	Color	Vertical Location	Horizontal Location	Pigments Present
1	Paper, glue, backing	Bottom	Right	[redacted] sulfite; mostly softwood bleached sulfite with some hardwood bleached sulfite
2	White	1.75" FB	6" FR	Lithopone Clay Bone black Titanium dioxide white (traces)
3	Red-orange (heel)	13.5" FB	6" FR	Calcium sulfate Whiting Iron earth (umber) Lithopone Clay
4	Purple	4.75" FB	4.75" FR	Whiting Lithopone Ultramarine Iron earth Vermilion Clay
5	Black (signature)	Bottom	Left	Bone black Whiting Titanium dioxide white (probably anatase) Lithopone Calcium sulfate Zinc yellow
6	Black (grass)	Bottom	12" FR	Whiting Bone black Lithopone Titanium dioxide white (traces)
7	Blue-gray (foot)	8" FB	11.5" FR	Whiting Lithopone Charcoal black (probably)
8	Loose particle			Wood particle (artifact)
9	Blue in sky	4" FT	8" FR	Whiting Calcium sulfate Prussian blue Charcoal black (probably) Clay
10	White #2	4" FT	7.5" FR	Calcium sulfate Zinc oxide
11	Brown	1.75" FT	4" FR	Iron earth Whiting Lithopone Clay Titanium dioxide white Bone black
12	Yellow	8.25" FT	1.5" FL	Whiting Iron earth Clay
13	Green Gray	3.75" FB	4.5" FB	Titanium dioxide white (anatase) Whiting Bone black Chrome yellow Ultramarine blue Clay Iron earth
14	Flesh	3" FB	13.75" FB	Whiting Iron earth Lithopone Clay
15	Gray	1.75" FB	2.5" FL	Calcium Sulfate Whiting Lithopone Bone black Zinc yellow Iron earth (umber) Clay
16	Scrapings from glass			Sodium chloride Lithopone Iron earth Whiting
17	From tape from glass			Not analyzed
18	Fibers from mat board			Cellulose fibers Clay Sodium chloride
19	Tape from mat board			Carbon Chlorine Titanium dioxide Calcium carbonate