Teygeler, R. and H. Porck (1995), Technical Analysis and Conservation of a Bark Manuscript in the Dutch Royal Library. In: *The Paper Conservator* 1995 (19). pp.55-62

Technical Analysis and Conservation of a Bark Manuscript in the Dutch Royal Library

Introduction

The Paper Historical Collection of the Dutch Royal Library, the National Library of the Netherlands in The Hague, includes amongst its collections forty sheets of a manuscript written on tree bark (KB:I.A.4.). The manuscript, folded in a concertina, measures 194 x 134 mm. It was acquired by auction for the collection in 1970 and was at that time classified as written in Rencong script [1]. When it was re-examined in 1991 it was thought to be a *Pustaha*, a Batak divination book (fig.1).

The manuscript came to the Library as seven separately folded parts, although it is thought they were one time joined. It had no boards and was in poor condition suffering from extensive surface dirt, tears, and in places the bark was delaminating (fig.2). To make the manuscript safe to handle it was decided it should be repaired. Before any treatment could begin, we needed to know more about the origin of the manuscript and better understand its chemical and physical character. A project was initiated to verify the origin by analyzing the text, and to provide a thorough technical examination of the manuscript. On basis of these results a strategy for conservation was established.

The *Pustaha* is the divination book of the Batak people who occupy the northern part of Sumatra, Indonesia[2]. The earliest known *Pustaha* is dated 1764 but it is assumed the Batak produced books well before that time. In contrast to other Indonesian manuscripts which are usually legal, historical, or literary texts, the *Pustaha* include the subjects of magic, divination and medicine. The fact that these particular books are written on folded tree bark and are extensively illustrated at the same time, is considered unique to Indonesia and Asia. *Pustaha* are made, used and compiled by the Batak medicinemen. The inner bark of the Aquilaria is used for writing.

To prepare the material for writing the surface of the dried bark is first brushed with rice water or rice starch. The text is written with a pen made of little sticks, found in the horsehair-like fibres of the stem of the sugarpalm. The illustrations are done in red ink, sometimes in yellow and the text is always written in black. The primary constituent of the black ink is a tarry substance obtained by precipitating the smoke of smouldering (resinous) wood, mostly the *Garcinia Mangostana*, against a knife, a sword or a potsherd. Often the bark shows evidence of blind ruling, done with a bamboo ruler and a bamboo knife.

Sizes of *Pustaha* vary greatly. Examples are known to range from 5 x 6 cm to as large as 28 x 42 cm. When extended, the bark sheet of the largest book measures almost 16 meters. The binding is simple: one single barkleaf is folded in a concertina, usually covered with wooden boards glued at the beginning and at the end of the bark. These boards come in several colours, most often black and brown, and are decorated in many different ways. Usually the front board is carved while the back board is left smooth. A carrying string is soemtimes attached to the boards. Straps and carrying string are generally made of bamboo or rattan. At the end of the last century most of the Batak were converted to Christianity, now only a poor substitute of *Pustaha* are produced in tourist centres[3].

The origin of the manuscript was assumed to be Batak. To confirm this, we sought the advice of one of the few scholars with expertise in this field who was able to undertake textual analysis[4]. On the basis of his investigation the Batak origin of the manuscript was clearly identified and at the same time several interesting features of the text were revealed. The manuscript, written fifteen lines per sheet, includes two different texts, although it is thought to belong to one book, as all the sheets are the same size. The fact that the manuscript is in two different hands is not considered at all unusual. Four parts (KB:A.I.4/AI-III and KB:A.I.4/BIII) are characteristic of a Toba-Batak *Pustaha*, yet the language also shows influences of both Mandailing- and Simalungun-language[5]. The contents include a long sequence of exorcisms and magical curses directed against Tuan Sorba di Banuwa (ancestor) and 'Head of a large Village'.

The text of the remaining three parts (KB: A.I.4/BI-BII and KB:A.I.4/AIV) contains the spelling of Karo-Batak yet also makes use of non-Karo words, which indicates the text is similar to an original from the Toba region[6].

Linguistic evidence suggests it was influenced by the languages of the Simalungun and of the east-coast Malay: one spell even starts with the Islamic 'Bismallah'[7]. But most of the paragraphs in these parts contain pure Batak elements such as the eight *panggorda*, the astrological powers of Hindu origin. Other Batak elements such as the *pangalomuk*, which are ways of favouring and the *katatakut*, which are ways of scaring these powers. The absence of blind ruling on these three parts of bark is considered unusual. The text is written carelessly with a thick pen, which makes it difficult to read.

Improving the legibility of the text

The extensively discoloured margins obscured much of the text (fig.3). To improve the legibility we considered several infrared (IR) and ultraviolet (UV) techniques often used for this purpose[8]. To learn which techniques were most suitable, a number of experiments were made with UV reflectography, UV fluorescence photography, IR reflectography and IR photography. IR techniques were considered preferable, given UV radiation is known to cause photochemical degradation depending on the duration and the intensity of exposure[9].

Since the cause of discoloration was unknown, it was unclear to what extent UV and IR radiation would improve the legibility of the text. Experiments showed that UV fluorescence photography only slightly improved the legibility of the text and only revealed the damaged areas of the *Pustaha* (fig.4). Tests with UV reflectography had a surprisingly different effect; only the blind ruling was visible and the characters disappeared completely (fig.5). In the case of IR reflectography the image was indirectly registered by means of an IR videocamera, and the image was then photographed from the screen. The quality of the photograph taken this way was unacceptable. The overall image was much too vague and some of the characters were difficult to recognize.

The IR photography tests produced the best results (fig.6). The illegible parts of the text, even in the margins, were clear. IR techniques are relatively easy to use with a good single lens camera fitted with an auxiliary infrared focusing mark, a filter, infrared film, and two halogen lamps[10]. From the results of our experiments the Optical Technique Department at the Royal Library was able to produce excellent, ligible, IR photographs of the *Pustaha*.

Identification of tree bark

It has generally been assumed that the bark to make *Pustaha* is peeled from the Aquilaria malaccensis tree. To confirm this assumption, a small fragment was microscopically examined at the Rijksherbarium, Leiden University. Transverse and longitudinal sections were stained with a mixture of safranine and haematoxylin. Microscopic features indicated the *Pustaha* bark to originate from trees of the Thymelaeaceae, the family to which the genus Aquilaria belongs. Detailed comparisons were made with bark sections of authenticated Aquilaria samples from the Rijksherbarium reference collection. In the radial longitudinal section dark-staining thick-walled fibres alternate with thin-walled parenchyma cells. Some of the latter contain large and elongate solitary crystals (styloids) of calcium oxalate (fig.7). The transverse section shows the irregular outline of the partly detached fibre walls, typical of unlignified or weakly lignified bark fibres of Thymelaeaceae in general and Aquilaria in particular (fig.8). Thus microscopically the manuscript bark closely matched the Aquilaria bark, the material known to be used for the *Pustaha*. Identification of the exact species was impossible because several Aquilaria species appear, microscopically, more or less identical.

Identification of the inks and pigments

The black ink and red pigment used for the text and illustrations were analyzed by X-ray fluorescence spectrometry at the Central Research Laboratory for Objects of Art and Science, Amsterdam. X-ray fluorescence is a virtually non-destructive analytical method whereby inorganic elements of an unknown substance can be identified from the emitted spectrum. With the equipment of the Central Research Laboratory we were able to analyze the bark, the black ink and red pigment (fig.9). In addition to the expected elements, two additional peaks - calcium and manganese - also appear to be characteristic of the bark (fig.9a).

Calciumoxalate crystals seen under the visible-light microscope in the analysis of the bark, explains the calcium peak in the spectrum. The presence of manganese could not be clarified.

Comparisons with the bark spectra of the bark clearly showed the presence of iron in the red pigment (fig.9b). While the exact identity of the red pigment remains to be studied, the presence of iron suggests an earth pigment probably an iron oxide, known to have been used as red pigment. Comparing the spectra of the black ink (fig.9.c) with the bark (fig.9.a), two elements, iron and nickel, were both present in the ink. We suggest a speculative explanation for these two elements: in making the *baja* (ink), a sooty substance is precipitated on swords or knives and then scraped off. As a result some metal scrapings can end up in the *baja*. It is known that many Indonesian swords and knives were made from a meteorite ore, containing both iron and nickel, so it would not be surprising to find these two elements in *baja* preparations. We can tentatively assume from the presence of iron and nickel alone, that the ink was prepared in the Batak fashion of scraping soot from a sword or a knife.

Condition of the manuscript

Only two of the seven *Pustaha* parts were selected for conservation treatment (KB:A.I.4/AIa1-a6 and KB:A.I.4/AIIa1-a5). An examination of the *Pustaha* fragments showed much surface dirt had accumulated and mould stains were present. Most of the manuscript suffered from mechanical damage including loose bark fibres and torn, frayed edges and corners. The distinct discoloration in the margins was puzzling. Soot was one possible cause as it is not unthinkable that the *Pustaha* were stored above the fireplace[11]. However, these spots did not show on the IR photographs so they could not have been caused by smoke, since the soot, containing carbon, would have absorbed the IR radiation. Another possibility was that the discoloration was caused by ink deliberately applied to the closed edges of the *Pustaha* to protect the book from insects and other pests. The edges of modern *Pustaha* are stained with Parmagam, a chemical bought at the local drugstore, and given that many old manuscripts have a black, tarry substance on the edges, the cause of discoloration may very well be *baja*.

Moisture would cause the *baja* to migrate inwards, creating stains on the margins of the sheets. To test this hypothesis, X-ray fluorescence spectrometry was used. The analysis revealed a marked difference between the margin discoloration and the black writing ink (fig.9.c-d). The presence of iron in the discolouration can be detected, whereas nickel appeared to be absent. These differences do not confirm *baja* as the cause of the discolouration, assuming *baja* contains both iron and nickel. It is possible though that the margins were stained with *baja* made of soot precipitated on a potsherd or, on swords and knives **not** made of meteorite iron.

Several folds of the *Pustaha* are broken completely. Each sheet had been repaired in three places with a simple knot of green hemp thread, which must have been made after the book was finished, because some of the holes are pierced through the text.
The condition of the hemp threads was sound although most of the holes were worn, and some were torn as far as the margin. Two other sheets (KB:A.I.4/AIIa2-a3) were joined by a simple chainstich sewn with brown cotton thread. Possibly the scribe used this method to attach additional bark, alternatively it could be a repair of recent date. The brown thread was frayed and most of the pierced holes were torn on both sheets. Not long ago textile researchers discovered that the brown cotton (*kapas lawa*) used in Indonesia, was not simply white cotton which had become dirty over the years. Under magnification the fibers show much thicker cell walls than the white cotton; closer inspection identified the fibers as a mutation of the locally grown white cotton. In some areas this cotton is considered as holy and is used for cloth for ritual fertility functions. The brown thread connecting the two bark sheets is made of this cotton.

The two outermost sheets had apparently been exposed to light for a long time, because they were extensively discoloured and had become brittle as a result of photochemical degradation[12]. The folds of some of the sheets were partially broken and one sheet was completely separated, although it was clear that it belonged to the beginning of one of the *Pustaha* parts. Several corners of the bark had delaminated, were partly broken and also had become very hard and brittle.

Stains which appeared very much like mould were found on several sheets. Under the stereomicroscope a crystalline structure was noted, which did not indicate the presence of mould. To be sure, a sample of the suspected mould was cultured on a nutrient rich agar agar culture. The result was negative. Surface pH measurements of the bark sheets yielded pH values between 5.2 and 5.6 which was not considered alarming, since the average pH of woody materials is approximately 4.

Conservation

It is the policy of the Royal Library to maintain an cautious approach in treating objects and this was true for the treatment chosen for the conservation of the two parts of the manuscript. Whatever the cause of the margin stains, we decided not to remove them since they are part of the history of the document.

From textual analysis it was concluded that two of the sheets at the end of one of the *Pustaha* parts, repaired at an earlier stage, did not belong to either of the parts we selected for treatment and had at some point been attached upside down.
We decided to separate these two pages and leave them out of this treatment. The knots in the three hemp threads were carefully loosened. Two threads were left in the holes of one sheet and one in the hole of the other sheet to show the sheets were once attached. The torn holes were repaired with rice starch and Japanese paper.

Thirteen of the sixteen holes sewn with the brown thread were torn. These were repaired with rice starch and Japanese paper. While treatment of the threads was not considered necessary, it was important that the threads should not come into contact with the starch, because the starch would diminish its flexibility. The separated sheet was not attached to the adjoining one, because this intervention was considered too radical. The sheet was kept separately, and its position in the order of the *Pustaha* indicated. For similar reasons the sheets with partially broken folds were not repaired. To prevent further damage and possible loss of text, the damaged and delaminated corners were repaired. The layers were strengthened with Japanese paper and a combination of rice starch, wheat starch and a small addition of methylcellulose.

Although rice starch is similar to the original production process, as the bark was brushed with rice starch, wheat starch was added to increase adhesion[13]. Methylcellulose will enhance the flexibility of the adhesive. The loose fibres have been fixed with rice starch in order to prevent future loss of text.

A paper label inscribed with a number had been attached on the front sheet. We decided it should be removed because the adhesive could eventually become harmful and would possibly obscure the text. Since it is the only evidence of provenance, it was removed and the text underneath was recorded; it was then re-attached with rice starch paste.
The document was mechanically cleaned with a soft brush to remove the surface dirt. We found this did not clean the bark sufficiently because the surface of the bark is very rough and the dirt was deeply embedded, especially in the damaged areas. Therefore, to prevent the risk of microbiological damage, the bark sheets were cleaned with water. The ink is not fugitive in water. The water caused the bark to swell considerably, so to diminish curling the reverse of the bark sheet was cleaned immediately after the front side. The use of organic solvents was considered, but rejected as the solvents might dissolve or extract important components of the bark such as tannin, wax or resin. Since cleaning with water might dissolve part of the rice starch, a subsequent re-application was considered. However this treatment was omitted because it would interfere with further investigations such as a carbon 14 dating.

The Batak tree bark book will be kept in an storage area where the relative humidity is maintained at approximately 55% and the temperature 20 *C. The manuscript is now kept in a handmade acid-free box, which keeps it free from dust, but not air-tight (fig.10).

While this study did not develop new techniques, we believe that the combination of scientific research and conservation of the manuscript yielded to a better understanding of the *Pustaha*. The use of brown cotton thread to repair the sheets, the typical staining on the margins and the discovery of iron and nickel in the black ink, are technical aspects of the *Pustaha* which have not previously been reported. The result of the botanical analysis of the bark was interesting,

because until now it was assumed with certainty that the bark on which the *Pustaha* is written is of the *Aquilaria malaccencis* species. Our findings can only confirm the Aquilaria family, the species could not be confirmed. The application of simple IR photography in order to improve the legibility of the text will not only be very helpful for the scientists who study *Pustaha* manuscripts, but also others studying texts on tree bark.

Acknowledgments

We wish to thank H. Promés (Voorhout) for the analysis of the text. R. Gerritsen (Amsterdam) supported the experiments with UV and IR photography and reflectography. T. Thijs (Section of Optical Techniques, Royal Library, The Hague) is acknowledged for the IR photographs. The microscopic analysis of the bark was performed by Dr.P.Baas and Mrs.B. van Heuven (Rijksherbarium, Leiden). We thank P. Hallebeek (Central Research Laboratory for Objects of Art and Science, Amsterdam) for the X-ray fluorescence spectrometry tests. For helpful discussion and support we acknowledge W. Smit (Department of Conservation and Optical Techniques, Royal Library, The Hague).

References

1. The Rencong script was used by the Rejang people who live on the southwest coast of Sumatra in the province of Bengkulu. The Rencong script does not differ much from the Batak script.

2. The Batak are usually divided in six ethnic groups: Toba-, Mandailing-, Angkola-, Simalungun-, Karo- and Pakpak-Batak.

3. For more detailed information see René Teygeler, 'Pustaha. A study into the production process of the batak book', *Bijdragen tot de Taal-, Land- en Volkenkunde*, Leiden 149/3, 1993, pp. 593-611.

4. H.J.A. Promés is one of the few who can read, transcribe and translate Batak text. He studied Sanskrit, and Indonesian language and culture before he left for Medan, Sumatra to work as a missionary and teacher from 1958 to 1966. At 74, he is still translating *Pustaha.*

5. The character 'na' has an older form which is found in the *Pustaha* from the Mandailing. The character 'ta' is almost always written in Simalungun form, the same is true for the 'h' used at the end of the syllable, which character no longer exists in Toba.

6. For example the pure Toba words 'musejan nari' meaning: also, likewise.

7. The Malay east coast of Sumatra is one of the first regions of the Indonesian Archipelago to adopt the Islamic faith. The invocation 'Bismallah', actually *Bism Allah al-Rahman al-Rahim*, means 'In the Name of Allah, the Compassionate, the Merciful'. It is written at the beginning of every verse in the Koran.

8. F. Mairinger and T.B. Newton 'Die Anwendung der UV-Reflektographie in der Papierrestaurierung' *Maltechnik/Restauro* (1976), 33-39. See also F. Mairinger 'Physikalische Methoden zur Sichtbarmachung verblasster oder getilgter Tinten' *Restaurator* (1981),45-56. For general information see M. Matteini and A. Moles, *Naturwissenschaftliche Untersuchungsmethoden in der Restaurierung* (München: Callwey, 1990).

9. M.E. Florian, D.P. Kronkright, R.E. Norton, *The Conservation of Artifacts made of Plant Materials* (Marina del Rey: The Getty Conservation Institute, 1992), page 157-160.

10. A Kodak Wratten Gelatine filter 89B was used in the 700 nanometer range. This filter is also available for technical cameras in the size 10 x 10 cm.
We used black and white infrared film: HIE 135-36, Kodak High Speed Infrared Film 2481 (Spectral range 700-900 nm). A colour infrared film is available: Kodak Ektachrome Film 2236 IE 135-36, code 4143. For a technical camara, a 4 x 5" is available. Kodak 4143 High Speed Infrared Film has a wider range than black and white film. For our experiments two 650 watt halogen lamps were used. It is important to place the lamps at a 45 degree angle to prevent reflection in the lens of the camera.

11. W.A.Braasem, *Proza en poezie om het heilige meer der Bataks*, (Djakarta, Amsterdam, Surabaia: De moderne boekhandel Indonesia, 1951), page 47.

12. M.E. Florian, D.P. Kronkright, R.E. Norton, *The Conservation of Artifacts made of Plant Materials* (Marina del Rey: The Getty Conservation Institute, 1992) page 157-160.

13. That the bark was coated with a starchy substance was proven by an iodine potassium iodide stain test on a small sample from the *Pustaha*.

Materials and Suppliers

Rice starch

Lineco

P.O.Box 2604

Holyoke

Ma. 01141

USA
Wheat starch Exelcior, Metylcellulose
Lamers and Pleuger
Postbus 3045
5203DB Den Bosch
The Netherlands

Japanese paper
Tengujo 9 gr/m^2, Kozu K35 18 gr/m^2
Japico Drissler Feinpapiere
Insterburger Strasse 16
D-6000 Frankfurt/Main 93
Deutschland

Acid free paper 175 gr/m^2
Schut
Kabeljouw 2
6866 HE Heelsum
The Netherlands

Biography

René Teygeler studied sociology, bookbinding and conservation. After teaching at the Amsterdam School for Graphics, he became a conservator at the Royal Library, the Hague. In 1994 he received a government research grant for one year to examine physical and social aspects of the indonesian writing material *dluwang*, a beaten tree bark. He is currently finishing his studies in anthropology and preparing a publication on *dluwang*.

Henk Porck studies biochemistry at the Free University, Amsterdam, and completed a Ph.D. thesis on biochemical genetics in 1985. Since 1983 he has held the post of conservation scientist at the Department of Library Research of the Koninklijke Bibliotheek in The Hague. In 1991 he also became curator of the Paperhistorical Collection of the Koninklijke Bibliotheek.

Contact Address:
René Teygeler, Henk Porck
Dutch Royal Library
Koninklijke Bibliotheek
P.O.Box 90407
2509 LK The Hague
The Netherlands