SHORT COMMUNICATION

THE CLAY PRINT LIBRETTOS: HISTORY AND CONSERVATION IMPLICATIONS

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ABSTRACT—Clay print librettos were popularly used by Cantonese Opera troupes from the 1930s to 1970s in Hong Kong. Clay printing is a planographic lithograph technique that uses clay as the printing plate. This project surveyed approximately 100 librettos from the collection of the Hong Kong Heritage Museum to investigate their history and the printing technique. Four librettos were selected for further technical analysis to characterize the clay, ink, and paper used in their production. The clay was determined to be kaolin and the ink colorant was methyl violet. The paper fibers included softwood pulp, hardwood pulp, bast fibers, and reed fibers. The librettos exhibited evidence of wear with tear damage, staining, and ink offsetting. Methods for conservation treatments and appropriate housing are presented.

TITRE—Des librettos imprimés sur argile: les implications pour leur histoire et leur conservation RÉSUMÉ—Les librettos imprimés sur argile étaient utilisés de façon populaire par les troupes d'opéra cantonais à Hong Kong de 1930 à 1970. L'impression sur argile est un procédé d'impression planographique qui utilise une plaque d'argile comme matrice. Ce projet examine environ 100 librettos de la collection du *Hong Kong Heritage Museum* (musée du patrimoine de Hong Kong) afin d'étudier leur histoire et les techniques d'impression. Quatre librettos ont été sélectionnés pour des analyses techniques plus poussées afin de caractériser l'argile, l'encre, et le papier utilisés lors de leur production. L'argile utilisée est du kaolin et le colorant de l'encre du méthylviolet. Les fibres de papier comprennent de la pâte de bois résineux et de feuillus, des fibres libériennes et de la pâte de roseaux. Les librettos portent des traces d'usure avec des déchirures, des taches et du maculage d'encre. Les méthodes de traitements de conservation et de mise en réserve sont présentées.

TITULO—Libretos impresos sobre placas de arcilla: historia e implicaciones de conservación RESUMEN—Los libretos impresos sobre placas de arcilla fueron popularmente usados por las compañias de ópera cantonesa desde los años 1930 hasta los 1970 en Hong Kong. La impresión sobre arcilla es una técnica planográfica litográfica que utiliza arcilla como placa de impresión. Este proyecto evaluó aproximadamente 100 libretos de la colección del *Hong Kong Heritage Museum* (Museo del Patrimonio de Hong Kong) para investigar su historia y la técnica de impresión. Cuatro libretos fueron seleccionados para someterlos análisis técnicos adicionales y caracterizar la arcilla, la tinta, y el papel utilizados en su producción. Se determinó que la arcilla era caolín y el colorante de la tinta era violeta de metilo. Las fibras de papel incluían pulpa de madera blanda, pulpa de madera dura, fibras del tallo de plantas, y fibras de caña. Los libretos exhibían evidencias de desgaste con daños de rasgados, manchas, y transferencia de tintas. Se presentan métodos para tratamientos de conservación y acondicionamiento apropiados.

TÍTULO—Os *librettos* impressos por gravação em argila: implicações históricas e de conservação RESUMO—Os *librettos* gravados em argila eram utilizados popularmente pelas companhias de Ópera Cantonesa desde 1930 até 1970, em Hong Kong. A gravação em argila é uma técnica de litografia planográfica que utiliza a argila como placa de impressão. Neste projecto foram inspecionados aproximadamente 100 *librettos* da colecção do *Hong Kong Heritage Museum* (Museu do Património de Hong Kong) para investigar a sua história e a técnica de impressão. Quatro *librettos* foram seleccionados para mais análises técnicas para caracterização da argila, da tinta e do papel utilizados na sua produção. A argila foi identificada como sendo caulin e o corante da tinta como violeta de metilo. As fibras de papel incluíram fibras de polpa de madeira macia e dura, fibras de junco e de cânhamo. Os *librettos* apresentaram evidências de desgaste, através de rasgos, manchas e migração de tinta. São apresentados métodos para tratamentos de conservação e correta armazenagem.

1. HISTORY AND DEVELOPMENT

1.1 OPERA HISTORY AND DEVELOPMENT

The earliest Chinese Operas, dating to the Tang Dynasty (AD 712–755), were only performed for the pleasure of the emperors and nobles. Since that time, more than 300 specialized forms have been developed. One major regional type, Cantonese Opera or Guandong Drama, is a traditional Chinese art form involving music, singing, martial arts, acrobatics, and acting. Records indicate an early form of the Cantonese Opera, called the Southern Opera, was performed publicly as early as the Song Dynasty (AD 1179–1276) in the capital city, Hangzhou.

In 1276, when the Mongol army invaded, Emperor Gong and several hundred thousand of the Song people, including opera performers, fled south into Guangdong province. Shows named "Cantonese Opera" were actively performed in Guangzhou, one of the big cities in the region, during the 12th and 13th centuries. From the Yuan Dynasty (AD 1279–1368), the style of the opera changed as it mixed with some local operas and multi-act performances in the southern area. Many classical Cantonese operas performed today such as *The Purple Hairpin* and *Rejuvenation of the Red Plum Flower* originated from the Yuan Dynasty (Jiang and Huang 1988).

During the 19th and early 20th centuries, the troupes were very active around the Guangdong region. But in the 1920s, because of the political reasons, most of the troupes of the Cantonese Opera left Guangzhou and moved to Hong Kong and southeast Asia. The troupes often lived on boats and performed at towns along the Pearl River delta region. These kinds of troupes were known as "Red Boat Troupes" because their boats were commonly painted red.

The Cantonese opera became increasingly popular and by the 1930s, was performed in most major cities in Southern China including Guangzhou, Hong Kong and Macau. The opera scripts, costumes, music, make-up, and stage design were developed rapidly to cope with the large demand (P. Leung 1988; Siu 1997).

2. CLAY PRINT LIBRETTOS

The librettos of the opera, usually in the form of manuscripts, were manually printed by clay or lead plate. Clay print librettos were most widely used within the troupes because of low production cost and convenience in printing. For most performances, the total number of copies was fewer than 20, as librettos were not distributed outside the troupes. By the 1970s, with the advances in printing and reproduction technology, the clay printing method had been replaced by stencil printing and photocopying.

The sheets of the clay print librettos were bound with twisted paper or cotton thread on the right side. The front cover was printed with the title of the opera, blank spaces for filling in the act number, role, and name of the performer. Some libretto covers also had the name of the printer and the printing company. The ink was violet in color. The role and names of the performers were handwritten on the covers with markers or pens.

2.1 PRINTING PROCESS

The clay print method is no longer used today and no known publication on such technique can be traced. According to the communication with the opera performers (Wo 2006) and examination of previous interview reports (Cheung 2003; C. Leung 2004a, 2004b, 2006), it was learned that the librettos were manually printed by the planographic printing method using clay as the printing tablet. A wooden tray, with holes in its sides for water drainage, of the size approximately equal to two pages of librettos (50 × 30 cm), was filled with wet clay to about 3 cm deep. The clay was laid at the center of the wooden tray, leaving a margin of 2 cm at the edges. The clay was flattened with a wooden scraper to provide a flat, smooth surface for printing. The ink was prepared by mixing acetic acid, glycerol, and dye powder.

The master copy was first written on a piece of paper with a Chinese brush (fig. 1a). While the ink was still wet, the paper was placed on the clay surface with the ink side facing down. The ink was transferred to the clay surface as mirror image by brushing with a scraper on the verso of the master copy (fig. 1b). The master copy was removed and kept. The right-reading copy was then made by placing a blank piece of paper on the clay surface and brushing with the scraper on the verso (fig. 1c). The printed copies were hung by clips to strings until dry.

This printing procedure was repeated to produce more copies as required. The clay was cleaned after

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printing by rinsing with large amount of water. The water was drained away through the holes in the side of the tray. The clay was flattened and dried before being reused.

The paper copies were folded and then bound with thread, twisted paper, or staples. One master copy could produce about 15 copies; the ink intensity decreased gradually as more copies were made (fig. 2). The printed librettos were distributed to the performers, music players, and other personnel for use. The whole printing process was usually carried out by one printer. Most printing companies were located in the district of Yaumatei in Hong Kong. The materials used, such as dye powder, acetic acid, and glycerol, were purchased from hardware shops in that area (Wo 2006).

3. TECHNICAL EXAMINATION OF MATERIALS IN FOUR LIBRETTOS

Four librettos from the collections of the Hong Kong Heritage Museum were selected for technical examination and treatment for this paper (table 1). Dating from the 1950s to 1960s, the golden age of Cantonese opera in Hong Kong, thses librettos were owned by the performers, and were acquired from them by the Heritage Museum in recent years.

3.1 CLAY

In one of the librettos, *Goddess of Sea*, traces of the clay used for printing were left on some of the pages (fig. 3). Analysis by infrared spectroscopy [Nicolet Nexus 470 FTIR Spectrometer, ATR cell, 64 scans, 400–4000 cm^{-1}, 4 cm^{-1} resolution (fig. 4)] and EDAX energy dispersive x-ray spectrometry [FEI Quanta 200 scanning electron microscope at 30kV (table 2)] indicate the clay residue is kaolin, a hydrous aluminum silicate ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$). Kaolin is a phyllosilicate mineral formed by the decomposition of aluminum silicates that usually crystallizes as hexagonal platelets about a micrometer in diameter (Parham and Kaustinen 1974; Beazley 1991). Clay was used for printing because it provided a flat, smooth surface, as well as good absorbance qualities for holding the ink transferred from the master copy and then releasing the ink onto the pages of subsequent copies. Any excess ink from the master copy was absorbed by the clay and thus reduced the ink feathering on the printed copies.

Table 1. Four librettos selected for technical examination

Librettos	Year of Production	Accession Number
Dragon and Phoenix	1967	2000.40.209
Goddess of Sea	1955	2000.40.114
Eighteen Buddha	1950s	2000.50.17
Golden Hairpin	1950s	To be accessioned

Table 2. Elemental composition of the clay residue (accession no. 2000.40.114) by energy dispersive spectrometry

Element	wt %
Oxygen	46.38
Magnesium	0.61
Aluminum	20.79
Silicon	26.17
Potassium	3.94
Iron	2.12

3.2 INK

The ink used for the librettos printing was analyzed by FTIR and identified as methyl violet (fig. 5). Methyl violet was discovered in 1861 and was synthetically produced from the chemical constituents of coal tar, a waste product of the distillation of soft coal. Methyl violet is usually a mixture of tetramethyl, pentamethyl, and hexamethyl pararosanilins with the formulae $C_{23}H_{26}N_3Cl$, $C_{24}H_{28}N_3Cl$, and $C_{25}H_{30}N_3Cl$, respectively. Tetramethyl and pentamethyl pararosanilins, or methyl violet 2B and 6B, are commonly used as pH indicators and dyes. Hexamethyl pararosanilin, also known as crystal violet or methyl violet 10B, is commonly used as a moderate strength external disinfectant (Dube 1998). In the concentrated dry state, methyl violet appears as dark green crystal or powder that exhibits a metallic luster (fig. 6). The ultraviolet-visible spectrum of methyl violet 6B dissolved in water showed that it has an intense absorption in 500–620 nm region (fig. 7). Its color intensity is imparted by the highly

Fig. 1a. Printing materials (reproduction): 1. Brush (to replace scraper); 2. Wooden tray filled with clay; 3. Master copy; and 4. Chinese brush and ink

Fig. 1b. The characters are transferred to the clay surface as mirror images

Fig. 1c. The right reading copies are made by transferring the ink on the clay surface to the blank paper

conjugated organic systems. Methyl violet is the most widely used printing ink in the 20th century and one of the most important colorants of copying pencils, as it can produce multiple strong-intensity copies in a

Fig. 2. Librettos (1997.44.197.1–4) printed from the same master copy showing different ink intensity

brilliant violet hue. However, methyl violet exhibits poor lightfastness and is vulnerable to oxidation (Dube 1998).

Tests were conducted to assess the solubility of methyl violet 6B (C.I. No. 42535) with different solvents. Two drops of each solvent were added to 0.3 mg of methyl violet powder on a watch glass and observed under a microscope. The solubility was rated from 0 (insoluble) to 10 (highly soluble). The results are listed in table 3. These tests revealed that methyl violet is soluble, in varying degrees, in a wide range of commonly used solvents. Polar solvents like water, acetone, methanol, and ethanol dissolve the dye readily.

3.3 INK SOLVENT

The solvent used in the printing ink preparation was glycerol and acetic acid. Glycerol is propan-1,2,3-triol, a polar solvent with a high boiling point (290°C). The low evaporation rate of glycerol allows the printer to make multiple copies before the ink dries. Glycerol has a much higher viscosity (934 mPa) than water (0.890 mPa) and can reduce the feathering of dyes once the paper is printed (Lide 1996; Hansen 2000). Acetic acid, also known as ethanoic acid, is miscible

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Fig. 3. Clay residue on the libretto (2000.40.114)

with glycerol. According to the information collected from the interviews, the purpose of using acetic acid is to produce a less viscous medium for brush writing. However, the main reason for using acetic acid instead of other commonly available solvents like water or ethanol is still unknown.

3.4 PAPER SUBSTRATE

More than a hundred librettos from the collections of the Hong Kong Heritage Museum were surveyed, and it was noticed that only a few kinds of paper were used for printing. All paper was machine-made laid paper with dimensions approximately 25 × 30 cm. The thickness of the papers, measured with Mitutoyo Dial Thickness Gauge, ranged from 0.15–0.20 mm. Ninety percent of the papers had a pale brownish tone while the remainder were much lighter in color.

Fiber identification was done on samples of the project's four librettos using Olympus BX-60 polarizing microscope. In the libretto *Golden Hairpin*, softwood, hardwood pulps, and bast fibers were identified. *Dragon and Phoenix* was composed of reed fibers, softwood, and hardwood pulps (fig. 8). *Goddess of Sea and Eight Hundred Buddha* contained softwood pulps and bast fibers (fig. 9). The libretto *Dragon and Phoenix* contained reed grass fiber, which was a common material used in modern China paper making industry (Wang 1999). All papers except *Dragon and Phoenix* contained lignin as revealed by the phloroglucinol microchemical test. The printed side of the paper appeared to be glossier than the other side and the printed side was less water-absorbent upon testing with a drop of water on its surface. The paper sizing was found to be a proteinaceous material, as confirmed by the biuret test.

4. CONDITION OF THE CLAY PRINTED LIBRETTOS

Detailed examination of the four librettos in this study showed their overall conditions were fair. The grain

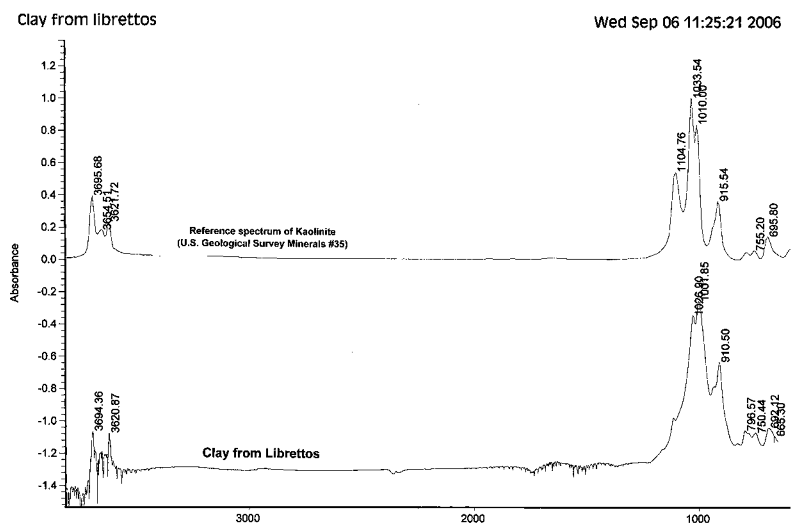

Fig. 4. FTIR spectrum of clay residue (2000.40.114) and kaolin

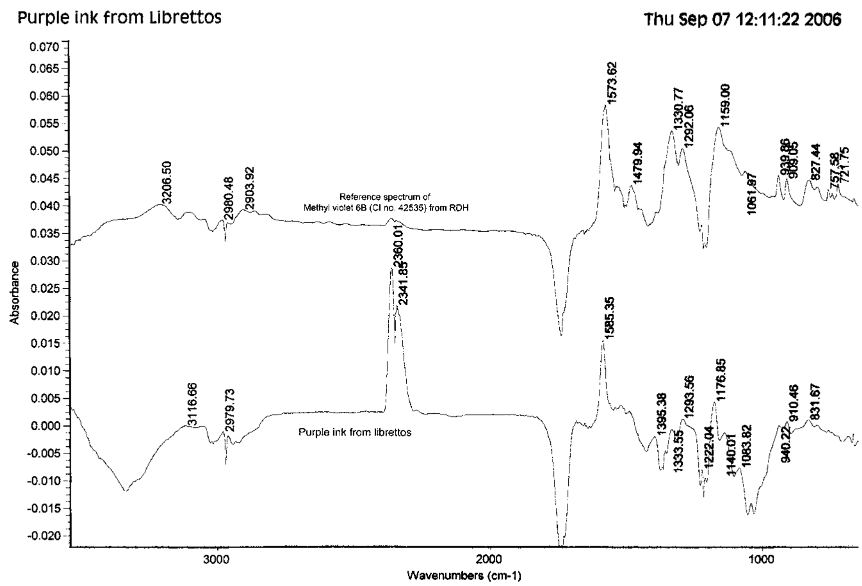

Fig. 5. FTIR spectrum of the ink on libretto (2000.50.17) and methyl violet (Riedel-de-Haën)

directions of the paper all ran from head to tail. The librettos were printed on one side. Each page was folded and bound on one edge. The intensity of ink varied a lot on the same page. Very few librettos showed ink feathering. Some early printed copies have very thick and intense ink that exhibited a metallic sheen. Apart from the printed ink, there were many markings using pens, pencils, or markers by the previous owners of the librettos.

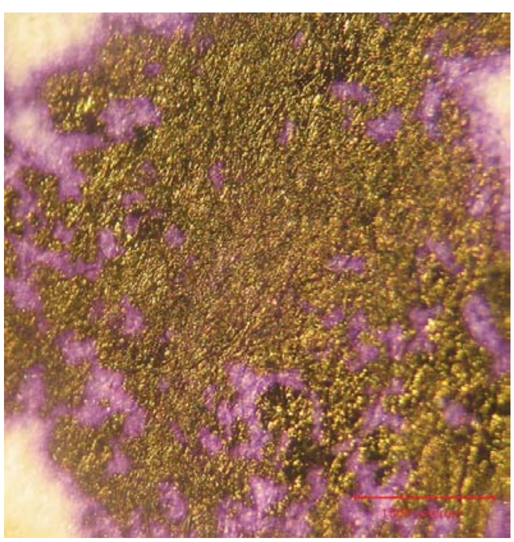

Fig. 6. Metallic sheen of the ink (2000.50.17)

Since the librettos have been frequently used by the performers on various occasions, they all displayed signs of handling damages such as wear and tear. As a general pattern, the covers and the first few pages were worn, torn, dented, detached, or even lost. There were serious folds and creases along edges and some splits along the binding holes. The covers, particularly along the edges, were heavily soiled. The inks on the covers were usually lighter than the inside pages, which might be the result of abrasion during handling and light discoloration. The overall condition on the inside pages was better with only slight dents and creases along the page edges.

The pH values of the four librettos were tested by placing a drop of deionized water on the paper surface and measuring with a flat electrode. Twenty random spots on each libretto were tested; the pH values ranged between 5.0 and 6.0. Some librettos had foxing stains and the pages were slightly discolored, especially on the covers and along the edges.

Some librettos were bound by staples that had rusted and stained the pages. Previous repairs with cellotape were also found on some librettos. The aged cellotape was brittle and caused stains on the pages.

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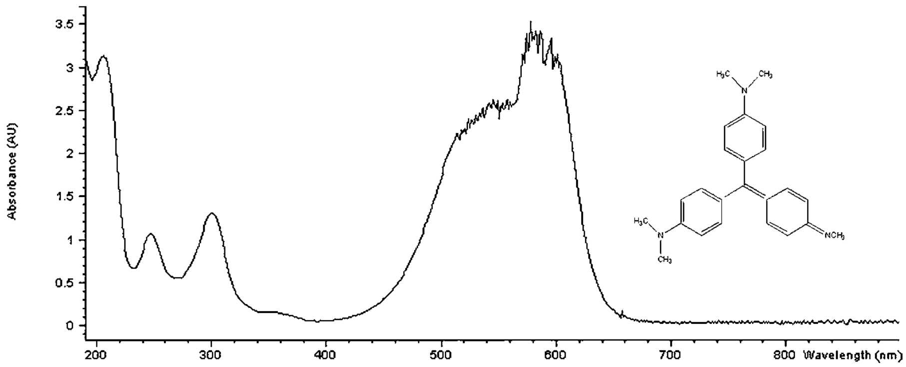

Fig. 7. Ultraviolet visible spectra of methyl violet (Riedel-de-Haën) in water

5. TREATMENT

Folds and creases were relaxed by humidification with ultrasonic humidifier or damp sponge, and then flattened by drying between blotters under weight. Minor tears were repaired using spider tissue (a gossamer web-type repair tissue), adhered with 4% methylcellulose in water. The librettos with surface dirt were cleaned carefully with a soft hair brush and a dry cleaning sponge, and precaution was taken to avoid abrasion of the ink. Librettos with serious physical damages were unbound by cutting the twisted paper or cotton threads, to allow repair of the leaves.

The rusty staples used for binding were removed to prevent the corrosion products from further staining and damaging the paper. The rust stains were removed locally by rinsing on the suction table with 1% sodium ethylenediaminetetraacetate in water as a chelating agent. A heated spatula at 70°C was used to remove the cellotape. The remaining adhesive residue was removed by swabbing with petroleum spirit.

Losses on the pages were filled with Japanese kozo paper toned with acrylic color, and adhered with methylcellulose. The folds and tears were reinforced by applying spider tissue supports with methylcellulose. To avoid undesirable thickness increase on the repaired libretto, the adjacent sides of both the original and the repaired paper were pared down before joining. The covers and the first few pages were strengthened along the spine with toned Japanese kozo paper.

Deacidification was carried out on the librettos with pH value lower than 5, by spraying a solution of calcium hydroxide and calcium carbonate at pH 7.5 on the verso of the paper. The process was carried out repeatedly until the pH of the paper reached

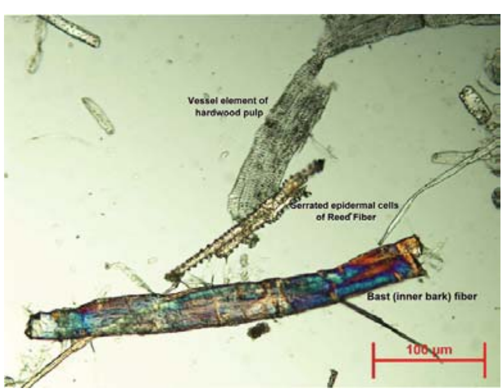

Fig. 8. The paper pulp of the libretto (2000.40.209) shows a mixture of bast, reed, and hardwood fibers under slightly uncross-polars

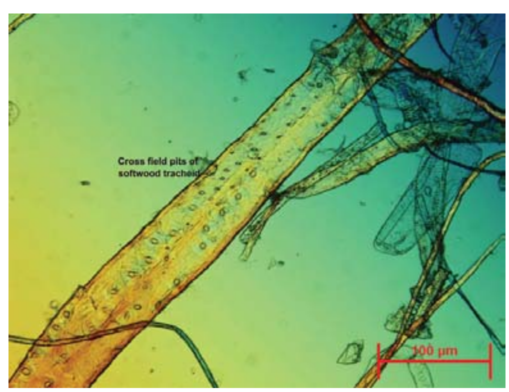

Fig. 9. The paper pulp from libretto (2000.40.114) shows the presence of softwood tracheid under slightly uncross polars.

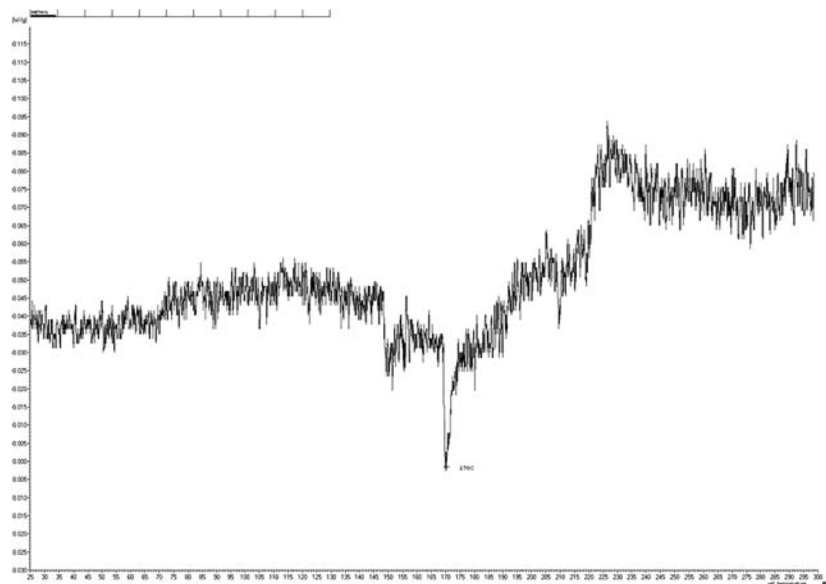

Fig. 10. Methyl violet (Riedel-de-Haën) melts or decomposes at 170°C by differential thermal analysis

6.0. Special attention was paid to avoid wetting the recto of the paper too much. The ink in the vicinity of the treated areas was fixed with cyclododecane by applying with a heated spatula at 60°C before the wet treatment was carried out (Bruckle et al. 1999). Differential thermal analysis (fig. 10) by Mettler Toledo FP900 Thermosystem showed that methyl violet will melt or decompose at around 170°C. For this reason, precautions were taken to avoid melting the ink. Stains along the edges could be removed by rinsing with distilled water on a suction table.

Where bleaching was necessary, 0.5% sodium borohydride in water was used under suction, but special attention was taken to avoid the bleaching agent coming into contact with the ink. The pages were stable enough to withstand the release of hydrogen during borohydride bleaching. Bleaching with an oxidizing agent is not recommended because methyl violet is vulnerable to oxidation (Dube 1998).

After all the pages were treated, the librettos were rebound as they originally had been bound, with cotton threads or twisted paper, using the original binding holes

6. ETHICAL CONSIDERATIONS

Some librettos had clay residue on the pages that was identified to be kaolin. It is chemically inert and would not induce deterioration or cause staining on the paper (Beazley 1991). However, the uneven distribution of clay on the librettos was unsightly and obscured the characters written. Although removal of the clay would allow a more aesthetically pleasing presentation of the librettos, this was not done. The clay left after printing, even though it was unintentional, represents part of the history in making the libretto and was considered as an integral part of the object. It is important evidence for understanding this unique clay print method. After discussions with the curators and having taken into consideration their historical importance, the clay residues were left "uncleaned."

7. EXHIBITION PRECAUTIONS AND HOUSING SYSTEM

Because of the huge number of librettos, a task force was formed including conservators, curators, and personnel from collection management, to assess the condition and develop a preservation plan for the librettos. The primary goal of the project is to survey the condition of the librettos in storage and implement the appropriate preservation measures to ensure their future well-being.

First, a condition inspection of the libretto collection was made and the librettos were classified into

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Table 3. The solubility of methyl violet (Riedel-de-Haën) in different solvent with rating 0-insoluble to 10-highly soluble

Solvent	Solubility Rating	Solvent	Solubility Rating
1,1,1-trichloroethane	1	dimethyl sulfoxide	10
1,2-dichlorobenzene	6	ethanol	9
1,2-propanediol	10	ethanolamine	1
1,4-dioxane	1	ethyl acetate	0
1-2-dichloroethane	7	ethylene glycol	9
1-butanol	9	ethylene glycol mono-methyl ether	9
1-metyl-2-pyrrolidinone	10	ethylene glycol mono-butyl ether	10
2,6-dimethyl-4-heptanone	0	formamide	9
2-propanol	8	glycerol	9
4-methyl-2-pentanone	1	hexane	0
acetic acid	8	isophorone	4
acetone	8	methanol	10
acetophenone	6	n-butylacetate	0
benzene	0	nitroethane	7
benzyl alcohol	8	nitromethane	9
butanone	3	n-n-dimethylformamide	10
carbon tetrachloride	0	propylene carbonate	9
chlorobenzene	3	pyrrole	9
chloroform	8	tetrahydrofuran	2
cyclohexane	0	toluene	0
dichloromethane	4	triethanolamine	5
diethyl ether	0	water	7
diethylene glycol	10	xylene	0

various categories based on their physical condition. Then, the related information on each individual object such as artifact description, location, grading of condition, and the treatment required, was computerized in order to facilitate information retrieval and formulate the treatment plans.

For housing, each libretto is interleaved with a piece of silicon release paper to prevent the ink from transferring onto the covers of the adjacent libretto. Simple four-flap archival cases with labels are made from acid-free corrugated boards for the long-term storage (fig. 11). The librettos are grouped together in a stack according to the title of the opera and dimensions. The height of each stack ranges from 10 to 15 cm (about 15–20 copies) to facilitate handling and storage.

Since methyl violet exhibits poor lightfastness, the light intensity recommendations for displaying the librettos are to keep the levels below 100 lux and to have regular rotation of exhibits. Also, as exposure to ultraviolet radiation would induce the fading of the methyl violet due double bonds scission of its color-producing conjugated system (Dube 1998), UV filters should be added to the lighting system during exhibition. The recommended optimum conditions for storing the librettos is a temperature of 22°C and relative humidity of 55 ± 5%.

Fig. 11. Tailor-made four-flaps archival cases for permanent storage

8. CONCLUSION

This project surveyed approximately 100 librettos from the collection of the Hong Kong Heritage Museum to investigate their history and the printing technique. Four librettos were selected for technical analysis to characterize the clay, ink, and paper used in their production. The clay was determined to be kaolin and the ink colorant was methyl violet. The paper fibers included softwood pulp, hardwood pulp, bast fibers, and reed fibers. The librettos exhibited evidence of wear, with damages such as tears, staining, and ink offsetting. Methods for conservation treatments and appropriate housing are presented.

This article presents a Chinese traditional clay print method adopted in the production of librettos. Since there is no known publication on this printing method, it is hoped that based on the analysis of the materials used, this traditional culture can be made known to more people, and arouse the interest of conservators to make suggestions as to the most appropriate treatment and preservation strategy for these rare collections.

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REFERENCES

Beazley, K. 1991. Mineral fillers in paper. *The Paper Conservator* 15:17–26.

Bruckle, I., J. Thornton, K. Nichols, and G. Strickler. 1999. Cyclododecane: Technical note on some uses in paper and objects conservation. *Journal of the American Institute for Conservation* 38:162–75.

Cheung, C. 2003. Oral interview report with Kwok-yuen Chan. Hong Kong Heritage Museum. Shatin, Hong Kong.

Dube, L. 1998. The copying pencil: Composition, history and conservation implications. *The Book and Paper Group Annual* 17:45–52.

Hansen, C. M. 2000. *Hansen solubility parameters: A user's handbook*. Boca Raton, Fla.: CRC Press LLC.

Leung, C. 2004a. Oral interview report with Siu-Fai Yuen. Hong Kong Central Library, Causeway Bay, Hong Kong.

Leung, C. 2004b. Oral interview report with Yu-tin Mo. Hong Kong Central Library, Causeway Bay, Hong Kong.

Leung, C. August 30, 2006. Personal communication. 10th floor, Hong Kong Central Library, Causeway Bay, Hong Kong.

Leung, P. K. 1988. *Cantonese opera costumes*. Hong Kong: Regional Council.

Lide, D. R. 1996. *CRC handbook of chemistry and physics*. 76th ed. Boca Raton, Fla.: CRC Press, Inc.

Parham, R. A., and H. A. Kaustinen. 1974. *Paper making materials*. Appleton, Wisc.: The Institute of Paper Chemistry.

Siu, W. N., and P. Lourick. 1997. *Chinese opera images and stories*. Vancouver, Canada: UBC Press.

Wang, J. H. 1999. *Papermaking raw materials of China*. Beijing: China Light Industry Press. 131–2.

Wo, Y. T. August 28, 2006. Telephone communication. Paper Conservation Laboratory, Hong Kong Heritage Museum, Shatin, Hong Kong.

FURTHER READING

Barton, A. F. 1991. *CRC handbook of solubility parameters and other cohesion parameters*. 2nd ed. Boca Raton, Fla.: CRC Press Inc.

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Blũher, A., A. Haberditzl, and T. Wimmer. 1999. Aqueous conservation treatment of 20th century papers containing water-sensitive inks and dyes. *Restaurator* 20:181–97.

Burgess, H. D. 1988. Practical considerations for conservation bleaching. *Journal of the International Institute for Conservation-Canadian Group* 13:11–26.

Cowan, J., and S. Guild. 2001. Dry methods for surface cleaning of paper. *CCI Notes Technical Bulletin 11*. Ottawa, Canada: Canadian Conservation Institute.

Derrick, M. R., D. Stulik, and J. M. Landry. 1999. *Infrared spectroscopy in conservation science.* Los Angeles: The Getty Conservation Institute.

Ilvessalo-Pffäfli, M-S. 1995. *Fiber atlas: Identification of papermaking fibers*. Berlin, Germany: Springer.

Jiang, L. B., and J. M. Huang. 1988. *History of Chinese opera*. Beijing: China Theatre Press.

Lehtaru, J., and T. Ilomets. 1997. Use of chelating agent EDTA with sodium thiosulphate and sodium borohydride in bleaching treatment. *Restaurator* 18:191–200.

Shashoua, Y., and A. Rugheimer. 1997. An evaluation of the use of cellulose ethers in paper conservation at the British Museum. *IPC Conference Papers Proceedings of the 4th International Conference of the Institute of Paper Conservation*. London, UK. 150–9.

SOURCE OF MATERIALS

Methyl Violet 6B (C.I. No. 42535)
Riedel-de-Haën Laborchemikalien
GmbH & Co
D-30926 Seelze
Germany

Spider Tissue, Acid-free corrugated boards
PEL
Vinces Road, Diss
Norfolk, IP22 4HQ
England

Japanese kozo Paper
Yaguchi Koetsu'an Ltd.
Kyoto, Japan
(www.koetsuan.com)

Cyclododecane Kremer Pigments Inc.
228 Elizabeth St.
New York, NY 10012

Methyl cellulose
Talas
568 Broadway
New York, NY 10012

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