Conservation of Ancient Thai Books

by Chiraporn Aranyanak

Ancient Thai books or *Samut Thai* are important handwritten manuscripts in Thailand which have been in use for a very long period. A large numbr of ancient Thai books produced in the Ayutthaya period *(1350-1767 AD)* are still in service. The major contents of Thai books are Buddhist scriptures, various sciences, historical records, political leaders and their achievements, literary works, etc. A number of them are illustrated manuscripts while others are just texts. Illustrated manuscripts, are widely known as one of the Thai classical arts. The painting techniques are similar to those used in Thai mural paintings. The painting can either be on one side only or on both sides.

MATERIALS AND TECHNIQUES

Ancient Thai books are made of locally hand-made paper produced from plants of the Moraceae family. The paper produced from Siamese rough bush or toothbrush tree *(Streblus asper Lour)* is called *khoi* paper and the paper produced from paper mulberry *(Broussonetia papyrifera Vent.)* is called *sa* paper.

The barks of these plants are removed from the stem and soaked in water for 3-4 days. They are then steamed for 48 hours and soaked in dilute lime solution for about 24 hours. The wet fibres are pounded by hand until they reach a condition suitable for paper making, and they are then made into a dilute suspension in a large tank or vat.

A portion of the suspension is dipped into a rectangular mould fitted at the bottom with a wire screen or a square-shaped piece of cloth. The fibres are then spread out into flat, thin sheets. The water is allowed to drain away and the mould is gently shaken from side to side to ensure even formation of the sheet. The excess water is removed by rolling with a bamboo stick. The mould is then placed in the open air to dry and, when dry, the sheet of paper is removed.

Fig. 1 White Thai books and black Thai books.

The paper is then sized with starch mixed with lime solution. The Thai book produced from this sized paper is called White Thai Book or *Samut Thai Khao*. Another type of Thai book called Black Thai Book or *Samut Thai Dam* is produced from the paper sized with starch mixed soot or charcoal powder (Fig. 1). It is a very strong and durable material.

The author is a Senior Scientist in the Conservation Section of the Bangkok National Museum, Department of Fine Arts, Thailand.

Fig.2 An example of Thai book made of silk.

After drying, the surface of the paper is smoothed or burnished by rubbing it with a polished stone. Many pages of paper are joined with starch paste to make a long sheet of paper. This sheet of paper is then folded accordion-fashion into the desired size for the book. The folded sheets can be between 30-60 cm long by 12-20cm wide. When unfolded the pages can be more than 18 metres in length.

Writing in beautiful calligraphic style is executed under the lines at regular intervals. Materials used for writing on Thai books are mainly soot, Chinese ink, a white pigment obtained from mother-of-pearl, red pigment from annatto *(Bixa orellana Linn)*, gold leaf, yellow pigments from gamboge *(Garcinia hanburyi Hook.f.)* and orpiment.

Covers of ancient Thai books are mostly applied with lacquer and some have gilt decoration on the black lacquer background.

A small proportion of ancient Thai books are made of textiles, for example, cotton and silk (Fig. 2). Writings are executed by means of embroidery.

In the past these ancient Thai books, wrapped in a piece of cloth, were mostly kept in a temple scripture repository located in the middle of a pond to prevent insect attack.

CAUSES OF DETERIORATION

The most common causes of deterioration of ancient Thai books are as follows.

Humidity and Temperature

Since Thailand is situated near the equator, the climate is characterized by uniformly high temperature and heavy rainfall distributed throughout the year. In Bangkok, day-time temperatures are usually around 30°C. The night temperature may be about 28-30°C in the warmer period and 18-22°C in the cooler period. Daily temperatures normally vary by not much more than 2-3°C. Relative humidities inside a building are usually around 60-70% most part of the year. These climatic conditions (Figs. 3-5) affect the deterioration of ancient Thai books in many ways.

Insects

Insects play the most important role in the deterioration of ancient Thai books. A detailed survey of insects living on ancient Thai books revealed that termites often cause extensive and irreparable damage.[1] The common species is *Coptotermes havilandi* (Holmgren). It is one of the subterranean termites belonging to the family Rhinotermitidae. They enter buildings through cracks and crevices in the foundations. Climate conditions in Thailand are optimum or near optimum for termites throughout the year.

Several species of the family Anobiidae are among the most destructive insects in libraries, museums, archives, temples and in private collections. The dominant species of anobiid beetle is the bookworm beetle *(Castrilus sp.)* Infestation is frequently overlooked, especially in the early stages of the attack. The female adults lay eggs in holes or crevices in the books. The young larvae, when they hatch, are about 3mm long and they are creamy-white in colour. The body is soft, vermiform, cylindrical and curved. The thoracic segments are larger than those of the abdomen, giving a distended appearance. Their mouthparts are formed for chewing. The anobiid larvae dig long, round galleries that usually work from the edges toward the centre of the book (Fig. 6). Both flight holes and tunnels are circular in section and about 1-1.5mm in diameter.

Other important species belonging to this family are *Stegobium* sp. or drugstore beetles, and *Lasioderma surricorne* (F.) or cigarette beetle.

In Thailand, cockroaches are very active all year round. They produce superficial erosion of irregular shape and also cause unsightly stains and unpleasant odours. The major species are *Periplaneta americana* (L.) or American cockroach, *Periplaneta brunnea* Burmister or large brown cockroach, *Neostylopyga rhombifolia* (Stoll) or harlequin cockroach, and *Supella longipalpa* (F.) or brown-banded cockroach. Eggs enclosed in egg-cases are laid in tiny cracks

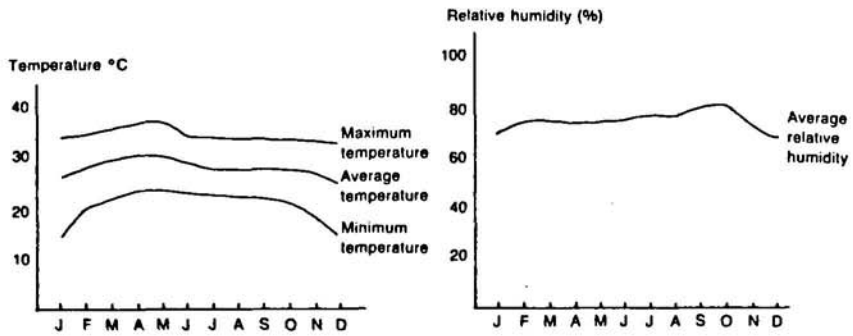

Fig. 3 Variations of climatic conditions inside a building in Bangkok National Museum.

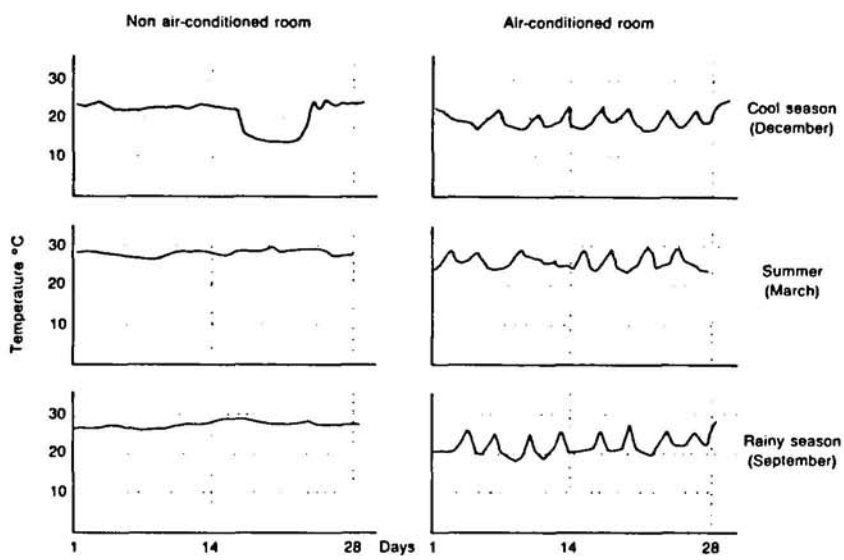

Fig. 4 Temperatures compared for air-conditioned and non air-conditioned rooms. (Air-conditioning operates 9 a.m.- 4 p.m.)

in the walls and in hidden places. Both nymph and adult are harmful stages of these insects.

Serious damage is also caused by silverfish and firebrat, primitive insects of the order of Thysanura, family Lepismatidae. They feed mostly on starchy, sugary and cellulose products. Therefore ancient Thai books are their favourite food. They are also very active all year round. The length of the life-cycle is 1½-2 years. Three dominant species of silverfish and firebrat were identified: *Lepisma saccharina* (L.), *Acrotelsa collaris* (F.), *Thermobia domestica* (Pack).

Booklice are commonly found on ancient Thai books. They feed mainly on flour, glue, paper and fungi. The nymphs and adults have the same appearance except for the lighter colour of the nymphs. They cause tiny surface holes with irregular shapes. The dominant species found in libraries and museums in Thailand are *Liposcelis* spp.

Fungi

Ancient Thai books are commonly damaged by fungi. The production of mycelium as well as spores and other propagules causes a lot of undesirable situations, e.g. distinctive odour, unsightly spotting, stubborn stains, decrease in strength, decrease in flexibilily, etc.

Many fungal species have been identified.[2] The dominant species are *Trichoderma* spp., *Geotrichum* spp.,

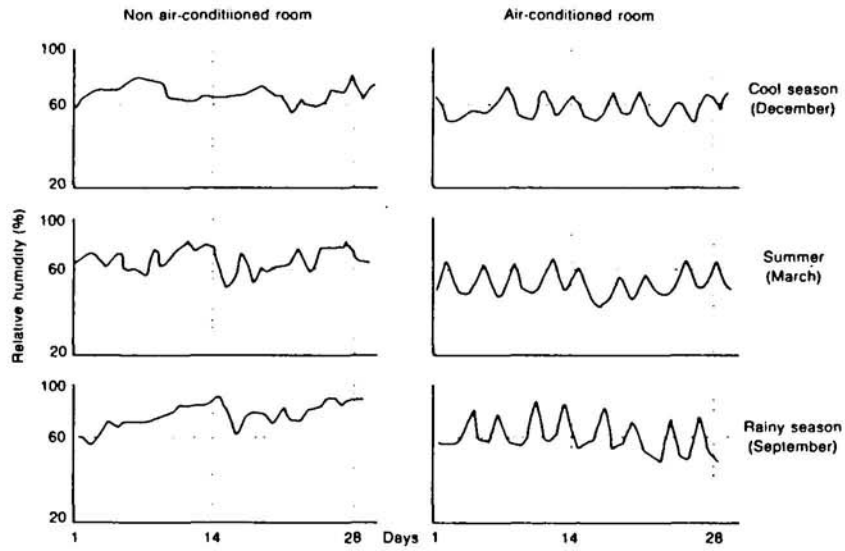

Fig. 5 Relative humidity compared for air-conditioned and non air-conditioned rooms. (Air-conditioning operates 9 a.m. - 4 p.m.)

Aspergillus niger, Aspergillus terreus, Aspergillus candidus, Aspergillus flavus, Aspergillus fumigatus, Chaetomium globosum, Helminthosporium spp., *Cladosporium* spp., *Penicillium* spp., *Fusarium rosium*, and *Curvularia* spp., The study revealed that more fungal species were found in air-conditioned rooms than in those without air-conditioning.

Paper, starch and the binding medium of the paint are all nutrient materials for fungi. The growths of certain fungi appear as black, brown, green, yellow and purple spots on the paper (Fig. 7). Some fungi produce pigments, pigmented mycelia, spores and some reproductive structures on the surface.

Light

Most of the exposed ancient Thai books are, more or less, invisibly damaged by long exposure to light. Ultraviolet and visible radiation bring about a number of changes in the physical and chemical properties of paper and textiles. Most of them are embrittled, weakened and discoloured. Paints, inks and other design materials have faded. The usual light sources in National Libraries and National Museums are daylight and fluorescent tubes without any filter attached. Most windows are normally wide open. The average illumination levels range from 200-500 lux and the average amount of ultraviolet radiation ranges from 50-300 microwatts/lumen. This is a situation which clearly ought not to continue.

CONSERVATION TREATMENT

Cleaning

The first step in the cleaning operation is dusting with a soft brush. Accretions or stains on those parts where the ink or paint is not soluble in water are usually removed by a swab of cotton wool moistened with water or a mixture of water and ethanol (about 50 : 50). The proportion of ethanol and water can be varied according to need.

Various organic solvents are also used for the removal of resistant stains. Some of the organic solvents that are found useful are ethanol, methanol, xylene, toluene, acetone and trichloro-ethane.

Treatment against fungi

In the case of an outbreak of fungus, the infected paper is firstly kept in a well-ventilated condition and is dried. The dried mould is removed with a brush and a cotton swab. Fungal mycelia are cleaned off with ethanol.

The book is then fumigated with thymol vapour in a gas-tight chamber which is slightly warmed with a heating bulb. In some libraries, strips of thymol-impregnated paper are used for interleaving between infected papers and are also kept inside the storage cabinet to act as a preventive against fungal growth.

Studies were also made on the effect of several fungicides on the growth of the fungi found on ancient Thai books.[3] The results showed that solutions of 0.2% thymol, 1.5% Dowicide A (sodium-ortho-phenylphenate), 0.08%

Dazomet (3,5-dimethyltetrahydro-1,3, 5, 2H-thiadiazine-2-thione), 0.4% Mergal AF (chloracetamide fluoride and quaternary ammonium), could inhibit these fungi and other microorganisms commonly found in the surrounding air. *Aspergillus niger* was found to be the most resistant species.

Treatment against insects

The infected books are fumigated with methyl bromide in a gastight chamber. Insect-repellent chemicals like paradichlorobenzene and naphthalene balls are normally used. At the National Library, pepper *(Piper nigrum* L.) is used to protect ancient Thai books and palm-leaf manuscripts from insects. It is a traditional technique which has long been used to protect textile and paper from insect attack.

RESTORATION

Tears in ancient Thai books are usually mended by pasting a patch of *sa* paper over the place where the tear is. An area about 2-3mm wide around the tear is pared gradually to produce a bevelled edge towards the tear from both sides. A piece of *sa* paper is cut out to the size of the tear and its edges are also prepared to obtain a bevel at the edges of the patch. Several layers are joined together to achieve the same thickness as the original paper. A thick paste of methyl cellulose is applied over it and also slightly over the periphery of the gap. Finally it is allowed to dry under pressure between two sheets of release paper.

For the filling of small holes, a strip of *sa* paper is placed over a sheet of glass and its edges are made slightly wet with the help of a soft brush. The fibres of the *sa* paper are spread with a pointed stylus and used to fill in the hole as much as required. They are then pressed with blotting-paper.

Tears and holes in black Thai books are similarly mended with *sa* paper dyed with black dye.

Fig. 6 Damage caused by bookworm beetle.

Fig. 7 Fungal stains and spots are commonly present on ancient Thai books.

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FOOTNOTES

[1] Vasittee Nana, Chiraporn Aranyanak and Siriwat Wongsiri, 'Studies of insect pests in the destruction of cultural materials' in Proceedings of the 24th National Conference, Kasetsart University, Bangkok (1986).

[2] Chulee Chaisrisuk, Poonpilai Suwannarit and Chiraporn Aranyanak, 'Survey of fungal species effecting deterioration of paper in National Library' in Proceddings of the 23rd National Conference, Kasetsart University, Bangkok (1985).

[3] Chulee Chaisrisuk, Poonpilai Wuwannarit and Chiraporn Aranyanak, 'Effect of fungicides on funal species isolated from mural painting at Wat Prasrirattanasatsadaram' in Proceddings of the 22nd National Conference, Kasetsart University, Bangkok (1984).