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Wooden material culture and long-term historical processes in Heping Dao (Keelung, Taiwan)

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ABSTRACT

Despite being a perishable material, wood can nonetheless show in its full complexity the materiality of daily life activities, identity construction, economic exploitation, and adaptation in colonial processes. The study of two sets of wood samples in well-defined archaeological colonial contexts from the site of Heping Dao, on the northern coast of Taiwan, has unveiled otherwise unknown aspects of native exchange, adoption of indigenous practices, and differences and similarities between early European colonialism and Japanese imperialism in Asia-Pacific. Despite the constraints of taxonomic identification in subtropical (and tropical) areas, the use of different coniferous wood types has been recorded: Cupressaceae, cf. Chamaecyparis spp., cf. Cryptomeria japonica and cf. Cunninghamia spp. The paper highlights the close relationship between wooden objects and diachronic historical processes and stresses the complexity of their study in colonial contexts, with implications toward the prehistoric period.

1. Introduction

Wood played a crucial role in the life and death of past communities. Wooden artefacts reveal raw material and technological choices, technological know-how, as well as processes of use, re-use, maintenance, recycle, and discard (Hurcombe, 2009, 2014). This is clearly observed in the case study of the site of Heping Dao B presented in the current paper. Located in Heping Dao, a small island off Keelung on the northern coast of Taiwan (Figs. 1 and 2), several archaeological projects have been undertaken since 2011. A continuous occupation from the Neolithic through proto-historical times and up to the European, Qing, Japanese and Republic of China periods has been identified (Cruz Berrocal et al., 2018). Thus, Heping Dao is an exceptional site both for understanding the history of Taiwan, as well as historical processes of global dimensions, among them, colonialism (Cruz Berrocal et al., 2018). In particular, processes that might look similar in logic and motivations but are fundamentally different in their material signature -early European colonialism in Asia-Pacific (starting in the 16th century CE), and Japanese imperialism (since 1895 onwards)-, are highly visible in Heping Dao, where an exceptional preservation of archaeobotanical assemblages, in particular wooden crafts, offers a privileged kind of material evidence to explore both local and colonial history and completely different processes of identity construction and wood uses in an unparalleled way.

This paper focusses on the analysis of two sets of samples, the first preserved by mineral replacement, and the second by waterlogging (Table 1, Figs. 3–5). Both correspond to objects or fragments of objects, archaeologically well contextualised, and dating to the two most prominent episodes of colonialism in Heping Dao. The first sample was recovered from a Dutch colonial burial dated to the 17th century (Fig. 6); the second dates to the period of Japanese occupation of Heping Dao during WWII. Selecting well-preserved wooden remains from specific contexts offers an exceptional opportunity to trace a comparative historical study of colonialism, from an unusual perspective. The study adopts an approach of object biographies (Kopytoff, 1986) combined with the concept of *chaîne-opératoire* (Cresswell, 1983) and the reconstruction of the different stages of their life cycle (Sands and Marlière, 2020) including the processes of wood decay (Martín-Seijo, 2020). The study aimed to trace the life history of the objects, from raw material selection to primary use, reuse, and final deposition or abandonment.

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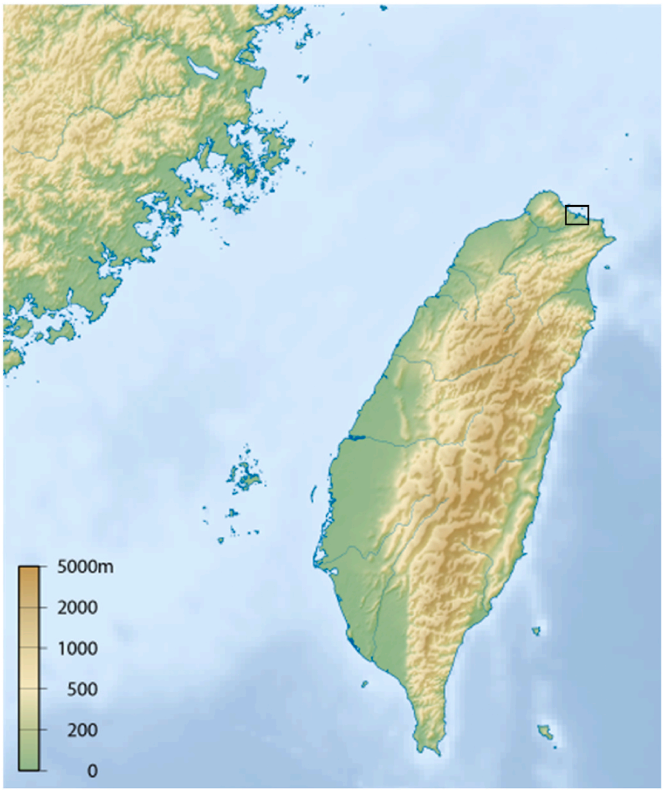


Fig. 1. Location of case study: Heping Dao, Keelung, within rectangle.

Table 1
Wood samples, kind of preservation and contexts of provenance.

Sample	Preservation	Area	SU	Context
LAB-002	Mineral replaced	1	SU106.S83	Tomb
LAB-003	Waterlogged	1	SU098	Trench

The authors' main goal was to highlight the material culture crafted from wood and involved in the day-to-day life and death of the colonial communities that lived in Heping Dao. This research has also accessed previously unsuspected social and historical processes around wood, extending towards prehistory, from a diachronic perspective.

Through this process, the authors have also produced methodological insights for the study of wooden objects, which is still extremely rare in Asia-Pacific colonial contexts. Archaeobotanical research related to wood and trees has mostly focused on translocation, arboriculture, and forest management through the analysis of charcoal remains (e.g., Thompson 1994; Allen and Ussher, 2013; Huebert and Allen, 2016; Maxwell et al., 2016; Levin, 2017; Fuller, 2018; Hofman and Rick, 2018; Huebert and Allen, 2020). The value of wood analysis and the morpho-technological study of wooden objects in combination with archaeology could however be more relevant for the understanding of aspects related to materiality and identity than has been acknowledged so far. This paper also addresses the limitations in archaeobotanical research in Asia-Pacific contexts, specifically those related to taxonomic identification (e.g. wood variability with descriptions based on few specimens, overlapping anatomical characters between genera and species, etc.) in tropical and subtropical areas with large biodiversity and high numbers of endemic species. The translocations of plants across the Pacific as well as the integration of Taiwan in the global commercial networks enlarges the number of species that has to be considered in the analysis including mainland China, Japan, and Europe.

2. Historical context

Taiwan became a strategic stronghold for both the Dutch and Spanish, who, like the Portuguese, had settled in Asia-Pacific to gain privileged access to the Chinese market. After the Dutch settled in the south of Taiwan in 1624, the Spanish founded San Salvador de Kelang in 1626. Their knowledge of the place had been gathered from different Portuguese and Spanish sources, in many cases from missionaries that travelled along the coast, as well as from the Chinese (i.e., the Boxer Codex, Hsieh, 2017), who had established a long and apparently fruitful relationship with the local communities, the Taiwanese aboriginals (Cruz Berrocal et al., 2018). It can be hypothesized that it was precisely the networks created by the Taiwanese aboriginals and the Chinese and other Southeast Asian communities that allowed the Spanish (and Dutch) to settle in the area (Cruz Berrocal et al., 2018).

The Spanish colony on Heping Dao lasted until 1642 when it succumbed under attack from the Dutch. The written texts produced by the Dutch about Kelang and their southern Taiwanese domains are interesting in political and economic terms, but the information on daily life is rather limited, as was the case with the Spanish sources. Examination of the archaeological remains has allowed the current authors to reconstruct particular aspects of the Dutch occupation of the island,

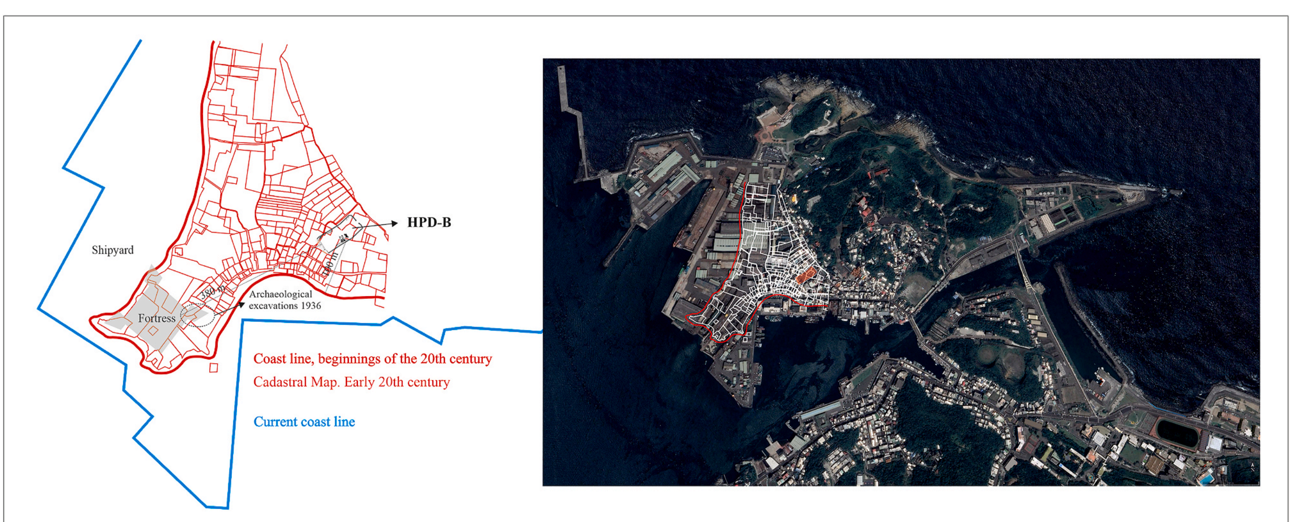


Fig. 2. Detailed location of case study, HPD-B, in Heping Dao.

including the re-use of the Church and the continuation of the life of the cemetery. Some differences have been noted, such as the orientation of burials, with the Spanish adopting an unorthodox orientation, pointing to the main axis of the church (N–S), while the Dutch followed the usual east-west orientation. While showing the differing views on the Christian orthodoxy between the Spanish and Dutch, as reflected in the materiality of their burials, the data available also points to similar practices in relation to the indigenous populations in Heping Dao.

The Dutch were expelled from Heping Dao and Taiwan in 1662, when the Zheng family, a powerful group loyal to the Ming dynasty, moved to Taiwan to use it as the headquarters for their war against the new Chinese ruling dynasty, the Qing, who annexed the island in 1683, followed by a massive Han occupation. In 1895, Taiwan became Japan's first official colony after its cession by China in the aftermath of the First Sino-Japanese war. It would remain part of the Japanese Empire until the end of WWII. After the Japanese authorities took over Taiwan, a process of assimilation of the administration and culture ensued, eased by a policy of "biological colonial management" established for 8 years (Lin and Keating, 2008). In this period, Japan implemented a scientific approach to adapt its culture to the colony in the best possible way. Exploratory research of different types –natural as well as social and anthropological-was implemented through the *Ancient Taiwanese Customs Investigation Bureau* (1901) from 1898 (Huang, 2014), accompanied by the works of the *Agrarian Investigation Bureau* and the promulgation of the *Taiwan Land Register Regulations* and *Taiwan Land Investigation Regulations* (Huang, 2014). Vast amounts of unclaimed or unregistered lands were confiscated by the Japanese Governor-General. Lands "without owner" were converted into public lands, which were then distributed among retired officials or Japanese companies, helping Japanese capital to enter Taiwan. With these measures, Japan changed the structure of land property and production in Taiwan. Through force, administration and censuses, land surveys, and ethnographic studies, the population was classified and controlled, a necessary step for Japanese rule to implement a standard colonial economy where the human and natural resources of Taiwan were used to aid the development of Japan (Huang, 2014). There was also an attempt to raise the Taiwanese standard of living through implementation of health and hygiene programs, waterworks and sewage infrastructures, education, etc. However, the Japanese's main interest was the self-sufficiency of the colony and the absorption of any surplus by Japan (Huang, 2014).

2.1. Biogeographical context and archaeological background

The subtropical island of Taiwan is situated on the Tropic of Cancer, tempered by winds from the sea and by frequent rains and typhoons (Li, 1963). Taiwan has two monsoon seasons, carried by northeast winds during the winter and southwest winds during the summer. The vascular flora of the island includes more than 4000 species, 5.6% of which have been introduced and naturalised, mostly from the Tropical Americas, followed by Asia and Europe (Hsieh, 2002; Wu et al., 2004). Its rugged topography -the highest peak reaches 3,952 m.a.s.l.- results in distinct altitudinal vegetation zones from sub-arctic to tropical (Li et al., 2013). Nine broad vegetation types have been classified according to the altitudinal gradient, seven primary and two secondary (Chiou et al., 2009). The primary vegetation types form vegetation belts -the *Ficus-Machilus* forest (<400 m), *Machilus-Castanopsis* forest (<1500 m), lower *Quercus* forest (750–2300 m) and upper *Quercus* forest (1500–2800 m), *Tsuga* forest (2200–3300 m), *Abies* forest (>2750 m), and *Juniperus* forest (>3300 m) (Chiou et al., 2009)-, while the secondary vegetation types are scattered across several belts and include *Alnus* forest (100–3000 m) and *Pinus* forest (300–3500 m) (Chiou et al., 2009).

On Heping Dao (42 m.a.s.l.), the climax vegetation is dominated by *Machilus* (Lauraceae), *Ficus* (Moraceae), and *Bischofia* (Euphorbiaceae) (Chiou et al., 2009). The historiographical information about the vegetation history of Heping Dao is still lacking; however, its size and topography points to a vegetation population stable through time.

Archaeological excavations have been undertaken in Heping Dao since 2011. The archaeological sequence of this site and its implications have been described in detail elsewhere (Cruz Berrocal et al., 2018, Cruz Berrocal et al., 2020; Chuang et al., 2018). The site, Heping Dao B (HPD-B), is in the urban network of Heping Dao, today annexed to the mainland by a bridge (Fig. 2). The archaeological record has revealed an early occupation beginning in the Neolithic, specifically, a village composed of stilt-houses in a coastal tidal environment. The occupation appears to have been permanent or at least recurrent during prehistory and throughout the transition from the Neolithic to the so-called Iron Age in Taiwan, whose chronology is conventionally assumed to encompass the period from the year 0 AD to European contact. This period is well represented in Heping Dao, which is the setting of the Spanish colony of San Salvador de Kelang.

Important monumental remains from the Spanish colonial period have been uncovered, including remains of the Dominican Church of the Convent of All Saints, and the associated cemetery (Cruz Berrocal et al., 2018, Cruz Berrocal et al., 2020) (Fig. 6). Published and ongoing studies on the architectural and skeletal remains highlight the relevance of this unique finding in the context of Asia-Pacific in the 17th century AD. Interestingly, the European material culture recovered from the site so far is very limited, i.e., two buckles and a catholic *Caravaca* cross. The potential reasons for this dearth of remains have been discussed elsewhere (Cruz Berrocal, 2017; Cruz Berrocal et al., 2018) but it may well be related to the secondary role that the Europeans might have played in early colonialism in the region. In this context, the finding of wood

Fig. 3. LAB-002. Wood pseudomorphs and iron nails from a coffin (scale 1 cm), from left to right: HPD-W001, HPD-W002 and HPD-W003.

remains in one of the tombs (see below) is extremely significant.

The Japanese period is well represented in Heping Dao by an overwhelming prevalence of Japanese material culture, presumably accumulated during WWII (Cruz Berrocal et al., 2018). Prior to this, Heping Dao seems to have been a mainly Chinese rural environment, kept as an agricultural area until the 1940s, when the restructuring of land lots currently observed took place. With the war looming, the place became strategic due to its natural bay. A shipyard was built over the remains of the Spanish fort, as well as other structures, traces of which have been recorded in the excavations; in particular, a very large trench (ca. 33 m visible length, more than 4 m wide, and 2.30 m deep) was dug as a defensive line. The large quantities of material culture produced and used during WWII were discarded shortly afterwards: the trench was filled in discrete events with an abundance of debris of mid-20th century chronology (Cruz Berrocal et al., 2018).

3. Materials and methods

3.1. Samples

During field seasons in 2011, 2012, 2014, 2016 and 2019, archaeobotanical samples were systematically gathered, combining both bulk and grab samples. The authors analysed two samples of worked wood comprising eleven fragments from six objects recovered during the fieldwork carried out in 2016 in Heping Dao (Table 1, Figs. 3–5). They were collected as grab samples, wrapped in aluminium foil, and stored in individual plastic bags. These two sets of samples comprised the evidence of artefactual wood recovered from the Spanish and Japanese colonial contexts.

The first sample (LAB-002) was gathered from a burial associated with the Convent of All Saints (Convento de Todos los Santos). The array of wooden objects (LAB-003) related to the Japanese occupation was recovered from the trench or defensive structure excavated during WWII (see above). Although the samples preserved by water saturation have lost their water content , they have maintained their original morphologies and physical characteristics.

The detailed description of the analysed samples is as follows:

LAB-002: it comprises three pseudomorphs of mineral replaced wood. It was gathered from a burial found within the Convent of All Saints of the colony of San Salvador de Kelang. The presence of wood pseudomorphs within the corrosion products, associated with five iron nails spread around the perimeter of the pit (Fig. 3), pointed to the former existence of a coffin. The anthropological study uncovered the interment of an adult in an extended, supine position with the head to the west and the forearms on the lower part of the abdomen and the elbows flexed at right angles. The corpse appeared to have decomposed in an empty space because numerous dislocations from the anatomical position were identified. This confirmed the hypothesis that a coffin had been used, possibly because the individual was a prominent figure of the colony (Cruz Berrocal et al., 2020). The orientation of the burial E-W and circumstantial evidence point to a Dutch tomb.

LAB-003: it comprises five items of waterlogged wooden objects or parts of them, recovered from the bottom fills of the large defensive trench excavated by the Japanese in WWII (see above). The objects had been disposed of after the war, alongside with many other Japanese artefacts, construction materials, and rubbish (Cruz Berrocal et al., 2018). The wooden objects were preserved by waterlogging or water saturation (Figs. 4 and 5).

3.2. Wood analysis

The analysis consisted of taxonomic identification of wood following the standard procedures (Cartwright, 2015). Samples were observed under a reflected-light microscope (Olympus CX40) and photographs were obtained using a stereoscopic microscope (Olympus SZX7) and a variable pressure Scanning Electron Microscope (ZEISS EVO LS 15, RIAIDT-Universidade de Santiago de Compostela). The SEM was equipped with an energy-dispersive X-ray (EDX) spectroscopy device, which allowed both the detailed observation of anatomical features at high magnifications as well as the identification of chemical elements (Carlquist, 2013; Hubau et al., 2013). In the case of mineral replaced wood samples, the conditions of EDX analysis were 20 kV of accelerating voltage and 8.5 mm of working distance. The systematic use of EDX in tandem with SEM provides crucial information to identify the specific elements involved in the mineralisation process, and the amount of organic matrix preserved, as well as other data related to taphonomic processes -mineral inclusions-.

In tandem with taxonomic identification, dendrological and taphonomical attributes were registered with the aim of characterising the kind of wood resources used for woodworking. The calibre of wood was assessed qualitatively following the procedures and groups established by Marguerie and Hunot (2007): strong, moderate, weak, and indeterminate. Strong growth ring curvature is present in the inner part of trunks, branches, and twigs, whilst moderate to weak curvatures are usual in the outer part of trunks and branches. The part of the plant used as raw material was registered when possible, as well as the presence of knots. The presence of wood anomalies related with growth conditions of the tree such as the presence of reaction wood was recorded (Schweingruber, 2007: 127–135), e.g., compression wood on the underside of softwood branches and tension wood on the upper side of

Fig. 4. LAB-003. From left to right: Wooden sole of a sandal: HPD-W005 -the arrow marks the wear on the heel-; pillow: HPD-W006; disc, possibly a bucket base: HPD-W004 (scale 5 cm).

hardwood branches (Ritcher, 2015) or as a strategy for regeneration after gravity-related deformations (Schweingruber and Börner, 2018). Other features related to processes of wood decay, such as the presence of fungal hyphae that are particularly visible in radial and tangential sections of wood, were also recorded (Blanchette, 2000).

The large biodiversity of subtropical and tropical areas, along with the scarcity of wood anatomical studies and identification keys in comparison with temperate areas, is a challenge for wood identification (Wheeler and Baas, 1998; Höhn and Neumann, 2018). These difficulties are increased by the alterations produced in anatomical features by carbonisation, mineral replacement and decay processes associated with waterlogging. Given these difficulties, the authors followed the four-step process described by Höhn and Neumann (2018). Firstly, the microscopic characteristics were observed and described (García Esteban et al., 2002, García Esteban et al., 2003; Richter et al., 2004) following the feature-by-feature protocols established by the IAWA. Secondly, the wood type was classified and assigned a numerical code, with all fragments with similar features grouped together. The third step was differential diagnosis to separate wood types. In the following step, the wood types were allocated to taxa, using atlases of wood anatomy (Ogata et al., 2008), the InsideWood on-line database (Insidewood, 2004-onwards) and specialised papers (Hwang, 1962; Richter, 2004; Román-Jordán et al., 2017; Siegloch, 2018) and atlases (García-Esteban et al., 2003, 2004). Finally, the wood type was named indicating the taxonomic level reached at the level of species, genus, family, or subfamily. The genus name with the suffix "spp." indicate several species of this genus must be considered. The names of wood types are given in small capitals -e.g., *Cryptomeria japonica*-to discriminate them from the botanical taxa -e.g., *Cryptomeria japonica*- (Höhn and Neumann, 2018).

3.3. Morphometric analysis and study of the technical process

All the samples studied belonged to worked wood. They were studied at the macroscopic level and each item was morphometrically analysed. Complementary data was recorded in order to obtain information related to wood-working and technological know-how, and to reconstruct the different stages of the *chaîne-opératoire* (Crone and Barber, 1981; Morris, 2000; Brunning and Watson, 2010; Martín-Seijo, 2013; Mertz, 2016): (1) raw material supply –as defined by taxonomic identification and dendrological attributes–; (2) the preparation of raw material including transport and conversion process from the original support to the manufactured object – cutting off branches, removing bark, rough-hewing and splitting the trunk or branch, etc.-; (3) product preparation –storage, drying, shaping, polishing, etc.– and (4) final product. To record the conversion process –or the types of extraction from the original support-, various previously published schemes were used (Coles et al., 1978; Crone and Barber, 1981; Shackley, 1981; Coles and Coles, 1986; Vermeeren, 2001; Pillonel, 2007; Martín-Seijo, 2013). Other attributes were recorded in relation to the object biography such as use, re-use, recycling, abandonment, and post-depositional alterations.

4. Results

All the samples studied have been identified as gymnosperms and classified into four wood types: Cupressaceae, cf. *Chamaecyparis* spp., cf. *Cryptomeria japonica* and cf. *Cunninghamia* spp. (Table 2). All of them corresponded to finished objects and no debris related to the wood-working process were recovered.

Wood pseudomorphs in sample LAB-002 (HPD-W001, HPD-W002, HPD-W003) (Fig. 3) preserved specific anatomical features such as distinct growth ring boundaries, an absence of resin canals, diffuse axial parenchyma, an absence of helical thickenings in tracheids, tracheid pitting mostly uniseriate and sometimes biseriate in opposite arrangement, and cross-fields cupressoid were identified in the samples. These features are present both in the Podocarpaceae and Cupressaceae families (Siegloch, 2018). Distinguishing between both families based on anatomical features is difficult. Podocarpaceae usually present only one cupressoid pit (rarely two) per cross-field whilst in Cupressaceae there are one to four cupressoid pits per cross-field (Siegloch, 2018). The authors classified the samples as Cupressaceae cf. *Chamaecyparis* spp. based on the presence of pits with notched borders, short and exclusively uniseriate rays (García-Esteban et al., 2002; Insidewood, 2004-onwards; Román-Jordán, 2016; Román-Jordán et al., 2017; Siegloch, 2018) (Fig. 7). The genus *Chamaecyparis* is composed of five species and four varieties, two of them present in Taiwan (Li, 1963), but it is not possible

Fig. 5. LAB-003. Wooden items of indeterminate function preserved by waterlogging. From left to right: HPD-W007 and HPD-W008 (scale 5 cm). Cupressaceae. SEM images of HPD-W007: 2. Exclusively uniseriate rays 3–11 cells high, 3. Cupressoid cross field pits and HPD-W008, 4. Exclusively uniseriate rays 3–8 cells high, 5. Cupressoid cross field pits.

to distinguish between different species based on wood anatomical features. Typical compression wood cells were identified in the tracheids, with spiral-shaped secondary wall macrofibrils (Schweingruber, 2007). In the samples, weak tree-ring curvature was observed indicating that the coffin wooden boards were most likely obtained from trunks (Table 2). The presence of compression wood could indicate that wood was obtained from a tree that grew under mechanical stress e.g., on a pronounced slope or affected by climatic events. Finally, it was not

Fig. 6. Context of samples LAB-002 and LAB-003 in the site: tomb within Convent of All Saints, and Japanese war defensive trench.

Table 2
Description of wooden items, objects, wood types, conversion, and dendrological attributes identified during the analysis of the archaeological samples.

Sample	Item Code	Item	Object	Wood type	Plant part	Tree-ring curvature	Conversion	Observations
LAB-002	HPD-W001	Board	Coffin	cf. *Chamaecyparis* spp.	Trunk	Weak	Unknown	Tension wood
LAB-002	HPD-W002	Board	Coffin	cf. *Chamaecyparis* spp.	Trunk	Weak	Unknown	Tension wood
LAB-002	HPD-W003	Board	Coffin	cf. *Chamaecyparis* spp.	Trunk	Weak	Unknown	Tension wood
LAB-003	HPD-W004	Disc	Bucket	cf. *Cryptomeria* spp.	Trunk	Strong to Moderate	Tangential	Knot
LAB-003	HPD-W005	Sole	Geta	cf. *Cunninghamia* spp	Trunk	Weak	Tangential	Knot
LAB-003	HPD-W006/001	Quadrangular piece	Takamakura	cf. *Cryptomeria* spp.	Trunk	Moderate	Tangential	
LAB-003	HPD-W006/002	Curved strip	Takamakura	cf. *Cryptomeria* spp.	Trunk	Strong to Moderate	Tangential	Preserves the pith
LAB-003	HPD-W006/003	Curved strip	Takamakura	cf. *Cryptomeria* spp.	Trunk	Moderate	Tangential	
LAB-003	HPD-W006/004	Quadrangular piece	Takamakura	cf. *Cryptomeria* spp.	Trunk	Moderate	Tangential	
LAB-003	HPD-W007		Indeterminate	Cupressaceae	Trunk	Moderate	Tangential	
LAB-003	HPD-W008		Indeterminate	Cupressaceae	Trunk	Strong to Moderate	Tangential	

possible to identify the wood conversion method. No information related to the production process could be retrieved from the analysis of the samples because only tiny fragments of wood were preserved (Table 2). The chemical analysis performed by SEM-EDX reported a percentage of Fe ranging from 55% to 74% (Table 3) compatible with preservation through mineral replacement.

Five waterlogged items were present in sample LAB-003 (Figs. 4 and 5). A semi-circular piece of wood (HPD-W004) with adherences of plant remains visible at macroscopic level (Fig. 8) has been interpreted as the base of a bucket or a small cask. The wood has been classified as a softwood belonging to the Cupressaceae family, with features described for *Cryptomeria japonica* such as the presence of distinct growth ring boundaries, abrupt transition from earlywood to latewood, mostly uniseriate tracheid pitting, tracheid pits with notched borders on outer wall, one to two taxodioid pits per cross field (Insidewood, 2004-onwards; Richter et al., 2004; Román-Jordán, 2016; Román-Jordán et al., 2017) (Fig. 9). The wooden piece preserves tree-rings with strong to moderate curvature, and a knot. It was obtained from the inner part of the trunk near the pith by tangential conversion (Fig. 10a).

A rectangular piece of wood with rounded corners (HPD-W005), with one flat side and the other with two teeth, and a base with three drilled holes (Fig. 4), has been interpreted as the sole of a geta (下駄), a traditional type of Japanese footwear. According to its morphology It can be classified as koma geta (駒下駄) (Fig. 11), probably belonging to a man due to its rectangular shape. It was carved from a single woodblock obtained from a tangential conversion of the trunk (Fig. 10b) and the teeth were shaped using a tool with a sharp edge. The teeth show signs of wear more pronounced on the heel side (Fig. 4). The anatomical features of the wood fit with those described for *Cunninghamia* (Fig. 12): distinct growth ring boundaries, mostly uniseriate and sometimes biseriate tracheid pitting, nodular end walls of ray parenchyma cells, rays from 15 to 30 cells height, and cross-field pitting taxodioid (García-Esteban et al., 2002; Insidewood, 2004-onwards; Richter et al., 2004). The genus *Cunninghamia* includes two species: *C. konishii* is endemic in Taiwan and *C. lanceolata* grows in southern and western China and it is also cultivated in Taiwan (Li, 1963). A substantial decline of *C. konishii* has occurred due to felling of original forests (Farjon, 2010).

An assemblage of four wooden pieces (HPD-W006/001 to 004) has been interpreted as a *takamakura* (高枕) which was probably used in tandem with a *sobagara* (蕎麦殼) (Fig. 11). Two of the pieces are quadrangular with rounded corners and the other two are curved strips of quadrangular section (Fig. 4). The four wooden pieces were assembled using mortise and tenon joints (Fig. 13), small iron pins were nailed in the quadrangular wooden pieces probably used for fixing a piece of cloth or other flexible material. One of the quadrangular pieces preserved the pith, with the curvature of the tree-rings ranging from strong to moderate, whilst in the rest of the wooden items the curvature was moderate (Table 2). All the pieces were obtained from tangential conversion of the trunk, and one of them preserves a knot (Table 2, Figs. 10c and 14c). These four wood fragments were classified as cf. *Cryptomeria japonica* (García-Esteban et al., 2002; Insidewood, 2004-onwards; Román-Jordán, 2016; Román-Jordán et al., 2017; Siegloch, 2018).

The remaining fragments (HPD-W007 and 008) were probably part of objects not completely preserved, which leads to their classification as indeterminate objects (Fig. 5.1). They have been classified as Cupressaceae (Figs. 5.2 to 5.5) since they do not preserve enough diagnostic features to classify them in a specific genus or species due to the high homogeneity of the Cupressaceae family (Román-Jordán et al., 2016). They were obtained from tangential conversion of the trunk. HPD-W008 was obtained from the inner part of the trunk because strong to moderate growth ring curvature was observed (Table 2) but without preserving the pith, whilst moderate curvature was registered in HPD-W007.

5. Discussion

5.1. *Challenges of studying wooden crafts from colonial subtropical contexts*

Wooden crafts contain valuable information about 1) the selection and use of wood for carpentry and woodworking, 2) technological skills and technological know-how, 3) activities related to the life and death of past communities in which wooden crafts are involved, 4) transport of crafted items, trade, and exchange, and 5) identity. However, tropical and subtropical areas with large woody taxa represent a challenge for wooden craft research. The first constraint is related to wood anatomy. In these areas many woody species, and even genera, share similar and overlapping anatomical features (Höhn and Neumann, 2018; Bodin et al., 2020), and there are a great number of tree and shrub species that have not been described yet or have been described through only a few specimens (Wheeler et al., 2020).

The recognition of microscopic features of wood structure becomes harder in mineral-replaced and waterlogged samples, as is the case in Heping Dao, even when combining light and scanning electron microscopy. The pseudomorphs maintained only vestigial or incomplete traces of anatomical features or survive as positive or negative mineral casts, and in the case of waterlogged samples the presence of cellular degradation, distortions, and other signs of decay such as fungal hyphae colonization complicates the observation of the wood structure (Cartwright, 2015). In the specific case of softwoods, exclusive in the Heping Dao assemblage, the homogeneity and overlapping wood anatomical features make it difficult to achieve an accurate taxonomic identification (Gasson, 2011). Added to this fact, there are also discordances in the diagnostic features described by different authors in the case of the different species of the Cupressaceae family (*vid.* a summary on Román-Jordán, 2016). This limitation has prevented the classification of wood types at the genera level in the current study; in all the cases the current authors added the abbreviation cf. due to the degree of uncertainty remaining in the classification.

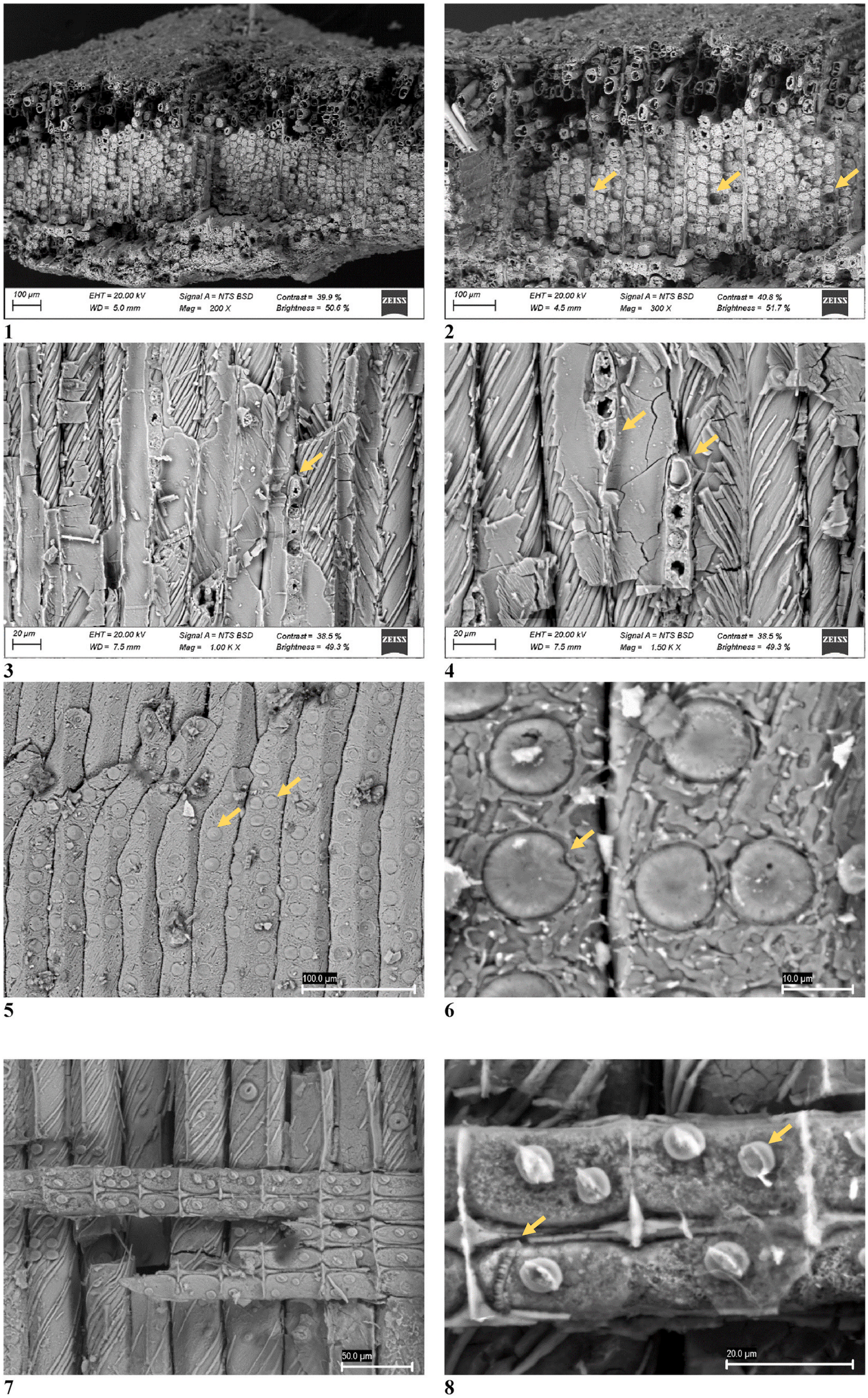
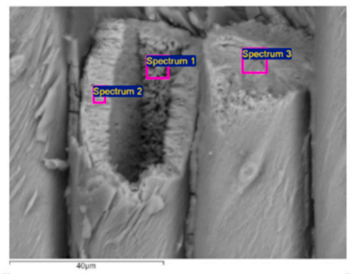


Fig. 7. HPD-W001. Mineral replaced wood. Cupressaceae cf. *Chamaecyparis* spp. 1. Resin canals absent, 2. Axial parenchyma diffuse and seemly tangentially zonate, 3 and 4. Uniseriate and very low-medium rays (up to 3–6 cells of height), 5. Tracheid pitting mostly uniseriate and sometimes biseriate in opposite arrangement, 6. Tracheid pits with notched borders on outer wall, 7. Horizontal walls of ray parenchyma smooth, and 8. Cross-field pitting cupressoid and end walls of ray parenchyma smooth.

Table 3
HPD-W001. Chemical composition provided by SEM-EDX of mineral replaced wood sample.



Element	Spectrum 1		Spectrum 2		Spectrum 3	
	Weight %	Atomic %	Weight %	Atomic %	Weight %	Atomic %
C K	12.3	31.5	9.7	20.5	13.7	35.7
O K	14.8	28.3	34.0	53.7	11.0	21.6
Al K	0.1	0.1	0.1	0.1	0.1	0.1
Si K	0.3	0.3	0.3	0.3	0.4	0.4
P K	0.0	0.0	0.0	0.0	0.2	0.2
Ca K	0.3	0.2	0.2	0.1	0.2	0.2
Fe K	72.2	39.6	55.7	25.3	74.4	41.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Fig. 8. Adherences of plant remains in one of the sides of the wooden disc (HPD-W004).

The colonial contexts involved offered further challenges. A main question (that cannot always be answered) is if wooden crafts were made *in situ* or arrived from surrounding areas or even overseas. Taiwan was a strategically important shipping port in the maritime trade network of Eurasia during the early modern period (Chin, 2010). Since the 12th and 13th centuries at least, trading junks from Fujian arrived in the southern part of Taiwan on their way to barter with indigenous inhabitants of the Philippine Islands; after the 1550s it was a meeting place for both the Chinese and Japanese smuggling merchants headed for Southeast Asian ports (Ollé, 2005; Chin, 2010). Since the 17th century, Hokkien traders from Fujian and fishermen sailed to Taiwan annually to barter with indigenous people for local products (Ollé, 2005; Chin, 2010) and Japanese *saipans* arrived in northern Formosa (Andrade, 2008). In the 17th century, as seen above, the Dutch and Spanish settled on the island and attracted merchants from the mainland, e.g., the Hokkien merchants became intermediary traders for the Dutch East India Company (VOC) (Ollé, 2005; Chin, 2010). This dense history of traders, fishermen and pirates arriving in Taiwan could have resulted in large amounts of wooden objects related to everyday life or involved in barter or trade possibly reaching the island from China, Japan, and maybe other Southeast Asian and Pacific archipelagos. Wood was a valuable cargo (Parthesius, 2010): scented woods were traded by the Dutch to China (Loureiro, 2011), and the Spanish exchanged fabrics and trinkets for precious woods, amongst other goods (Ollé, 2011). At the same time, new plants, wood, and wooden objects from Europe, tropical America and even Africa would have most likely reached the island (American plant species have been identified in Kiwulan, northeastern Taiwan, so far, and ongoing research in this regard is being carried out in Heping Dao). These considerations greatly enlarge the number of taxa to be considered during the analysis of wooden crafts from colonial contexts. The identification of furniture and objects made from European species has been previously attested in other Pacific islands (Astudillo, 2018) and it is common in harbours all over the world since the beginning of global trade networks.

5.2. Implications of the study of the early colonial coffin

Wood pseudomorphs (LAB-002), classified as cf. *Chamaecyparis* spp., were dated to cal. CE 1268–1285 (735 ± 10 BP, NTUAMS-3458), whilst the colonial burial in which they were found has a *terminus post quem* of 1642 CE. The identification of the wood provides clues about this chronological *décalage*.

Chamaecyparis spp. is a genus of the Cupressaceae family, with two of the species naturally growing in Taiwan: Taiwan Cypress (*C. formosensis*) and Taiwan bian mai (*C. obtusa* var. *formosana*) (Li, 1963). *Chamaecyparis* are very large trees of pyramidal habit: *C. formosensis* reach 65 m high and 6.5 m diameter and *C. obtusa* var. *formosana* up to 40 m high and 3 m in diameter (Li, 1963). *Chamaecyparis* trees are slow growing but long-lived; mature specimens of up to 2–3m of circumference could reach an age of 300–500 years (Lee, 1962). A specimen of *C. obtuse* var. *formosana* may even exceed 1000 years of age (Chung et al., 2012). Other specimens are known to have reached up to 3000 years old (Lee, 1962; Zobel, 1998). Both *Chamaecyparis* species are light-demanding trees, present in the mountainous areas of northern and central Taiwan -*C. formosensis* between 1000 and 2900 m and *C. obtusa* var. *formosana* between 1300 and 2800 m of altitude-, forming pure stands or mixed formations of the two species (Lee, 1962; Li, 1963). Their wood is light, with very fine texture, fine grained, durable, rich in essential oils, and strongly aromatic (Lee, 1962; Farjon, 2010). It can resist insects and withstand decay for decades even in the case of trees felled by occasional strong typhoons remaining intact on the floor (Chung et al., 2012).

The long life of *Chamaecyparis* trees may artificially age its last use. This old-wood effect is common in worked wood (Schiffer, 1986; Cook and Comstock, 2014; Calvo Trias et al., 2020) and it is reinforced by the fact that wooden boards are usually obtained from the heartwood[1] of mature trunks of old specimens, since the sapwood formed in the years just before felling is usually discarded because it is more susceptible to insect attack (Morgan, 1975). In addition to its long-lasting nature, the wood is usually seasoned in a process that may last up to several decades. Thus, while it should be possible to hypothesize that the wood could have been provisioned and used in a late prehistoric context (13th century CE) and then re-used by the colonists, a more plausible alternative would be to assess an old wood effect to explain the chronological mismatch between the radiocarbon date, the felling of the tree and the burial context of deposition.

[1] Heartwood, inner core of the tree, formed when the outer layers of xylem, the sapwood, cease their physiological functions. Not all species grow heartwood and sapwood. Hardwood refers to wood of broadleaved trees. Softwood refers to conifers (Kaennel and Schweingruber, 1995).

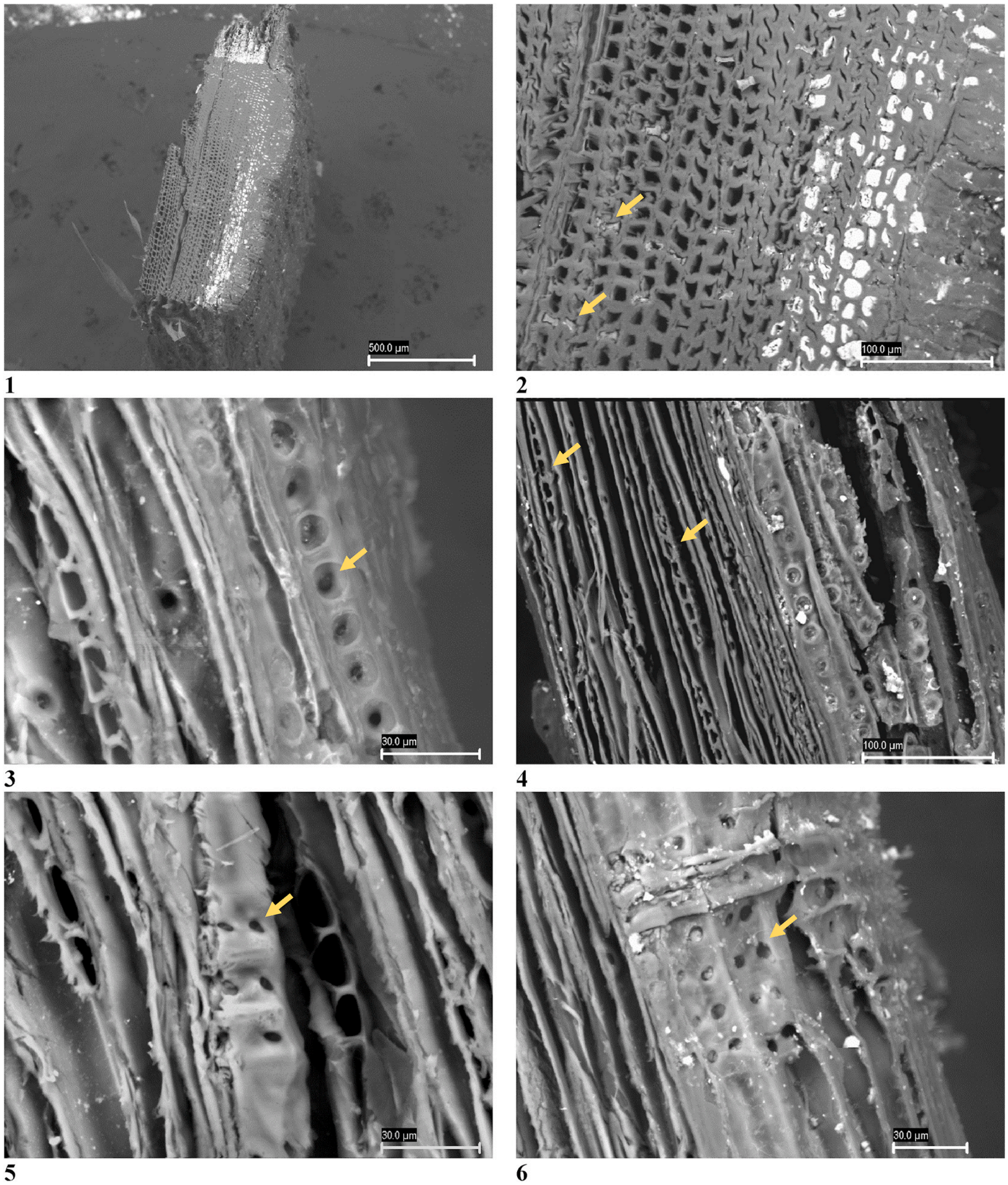


Fig. 9. HPD-W004. Waterlogged wood. Cupressaceae cf. *Cryptomeria japonica*. 1. Growth ring boundaries distinct, transition from earlywood to latewood abrupt, and axial resin canals absent, 2. Axial parenchyma diffuse and tangentially zonate, 3. Tracheid pitting mostly uniseriate, 4. Medium height rays (up to 5–9 cells height) exclusively uniseriate, 5 and 6. One and two taxodioid pits per cross-field.

The taxonomic identification and dendrological attributes of the sample provide information about the process of wood procurement. The natural distribution of *Chamaecyparis* in Taiwan (see above), limited to high altitudes between 1500 and 2500 m.a.s.l. (Li et al., 2015), points to an origin in the mountain ranges of the central part of the island, and the presence of compression wood could indicate that the timber was obtained from a mature tree trunk growing on a pronounced slope or which was subjected to mechanical stress in relation to extreme weather events such as typhoons. The mapping of current subtropical montane cloud forest of *Chamaecyparis* in Taiwan registers also isolated occurrences (particularly in the north) below 500 m.a.s.l. probably related to the winter monsoon which brings heavy fog to the windward parts of the island (Schulz et al., 2017). The present distribution of cloud forests could support the hypothesis that *Chamaecyparis* timber could have been procured in these areas, identified at low altitudes in the north of the island, not only in the mountain ranges of the central part of Taiwan (see Fig. 4, Schulz et al., 2017). These are relatively close to the areas of influence of the Europeans, but access to them probably involved the agency of Taiwanese aboriginals. The Europeans rarely launched incursions into the interior and settled within a very limited area along the north and northeastern coast of Taiwan. They felt constrained to this region and depended on the locals for most of their supplies.

Taiwanese polities were also strictly territorially constrained, and the extraction of wood from interior areas would thus have implied the existence of native networks of exchange. This is a completely new and unexpected finding, since there are no early clear textual references to *Chamaecyparis* wood. The earliest source identified so far is Yu Yonghe's *Bihaijiyou*, written in 1698. The topic was of scarce interest to Yu, a Qing civil servant displaced to northern Taiwan to extract sulfur, because only in an appendix does he mention "*xiaolang* (蕭朗), a kind of softwood. The big ones have several growth rings [several arms' length in circumference]. It is strong wood, so that it can be buried for a thousand

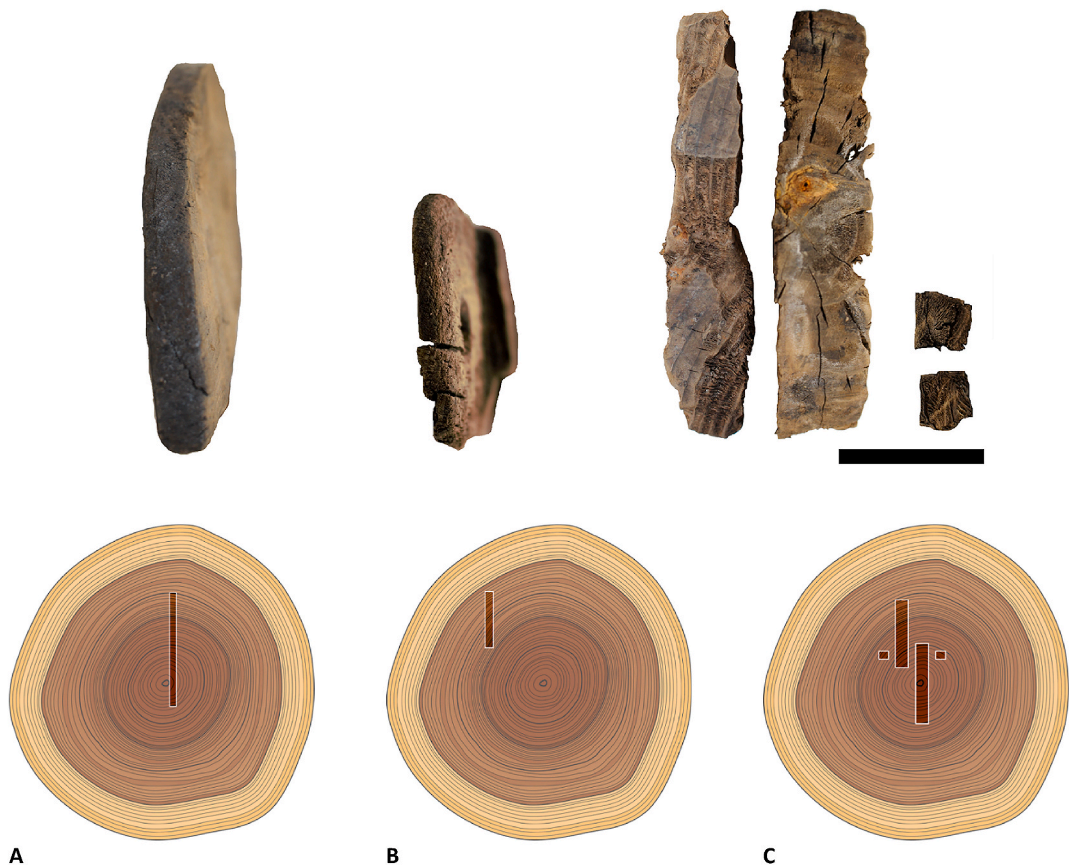


Fig. 10. Detail of transversal sections of wooden objects (scale 5 cm) and scheme summarising the types of conversion of each item from the original support: a) HPD-W004, b) HPD-W005 and c) HPD-W006.

years and still not rot. It is in the remote mountain where the wild aborigines are, so no one can take it. The flood floated trees out, and Zheng took it as a coffin. It is a wonderful wood" ("蕭朗，硬木名也。大者數圍，性極堅重，入土千年不朽。然在深山中，野番盤踞，人不能取。頃為洪水漂出，鄭氏取以為棺，實美材也") (Yu 1959: 58) (Fang Chenchen, pers. comm. June 1, 2021; Kaliher 2004). *Xiaolang* is currently considered the common name of cypress (Hung Kuang-chi, pers. comm. May 11, 2021), although a clear correspondence between both is not clearly established until 1769 in Zhu's *HaiDongZhaJi*: "*xiaolang* tree (蕭朗木), the big ones have several growth rings, the quality is heavy and fine texture, similar to yellow sandal, but it is in the inner mountain. It is cut in pieces and transported by carts. It makes the best craftsmanship. It is named cypress (baiye) or xiaolang (消郎)" ("蕭朗木，大者數圍，質重而理細，類黃檀，然求之內山，析片輦運，製器最良，或曰即柏也，一曰消郎") (Zhu 1958: 38; Fang Chenchen, pers. comm. June 1, 2021).

Yu's earliest reference to *xiaolang* is not easy to interpret, but it shows accurate knowledge of the wood's features and appreciation by the locals in northern Taiwan. The text cannot be taken as proof of absence of wood extraction, but it does show that it was not accessible for anyone apart from the indigenous tribes that inhabited the deep forests. The reference to the Zheng using it as it came with the floods clearly refers to a particular event and does not add to or take away from the idea of potential exchanges of wood between the plain and northern tribes with the inner mountain tribes. By the end of the 17th century, when Yu wrote his diaries, three successive waves of colonialism had spread across the northern part of Taiwan, starting in 1626 with the Spanish, followed by the Dutch, and finally the Qing. Although there is a tendency among Taiwanese scholars to use Qing and even Japanese textual sources as the main source about Taiwanese natives, it would be difficult to accept that their societies had remained unchanged by centuries of aggressive colonialism. Indeed, while Taiwanese aboriginals were an active part of the Spanish and Dutch colonial setting, their role and presence in Heping Dao gradually faded away over time, as observed in the archaeological record (Cruz Berrocal et al., 2018). In these conditions, it is unlikely that later colonial records can account for the native traditional knowledge on many different aspects, including wood. Furthermore, references about the native relationship with the forests, and specifically cypress, are directly reproduced from Yu's book in 1698 until at least 1835 (Kuang-chi Hung, pers. comm. May 11, 2021), but the record of 1769 mentioned above does indeed show cypress extraction.

While this paper does not claim that *Chamaecyparis* was the only or most important wood resource in Heping Dao or northern Taiwan in the 17th century or before, its discovery in the colonial context can be much more likely explained as a result of a process of extraction, forcibly based on indigenous knowledge and channels of access to this resource, fostered first by the Spanish and then by the Dutch, rather than as a mere coincidence derived from downstream washing of *Chamaecyparis* trunks caused by occasional floods. Indeed, the Spanish referred to the use of fragrant woods (potentially coniferous wood) as construction material of fifteen hundred houses in a village called Taparri-Kimaurri (Andrade, 2008: ch. 4, p. 5), which they took over in their conquest. The place later became known as San Salvador de Kelang.

The ethnohistorical sources point to a traditionally continuous, but sparse and extremely selective use of *Chamaecyparis* wood on the part of the Taiwanese aboriginals. Many native legends were related to *Chamaecyparis* forests. The ethnic groups preserved the largest specimens in their territory as sacred places where the spirits of their ancestors rested, and entry to these places to gather or hunt was generally not allowed (Li et al., 2015). Two large trees, one of them more than 30 m in circumference, located in what is currently called the Alishan National Scenic Area, and another one more than 15 m in circumference in the Xitou

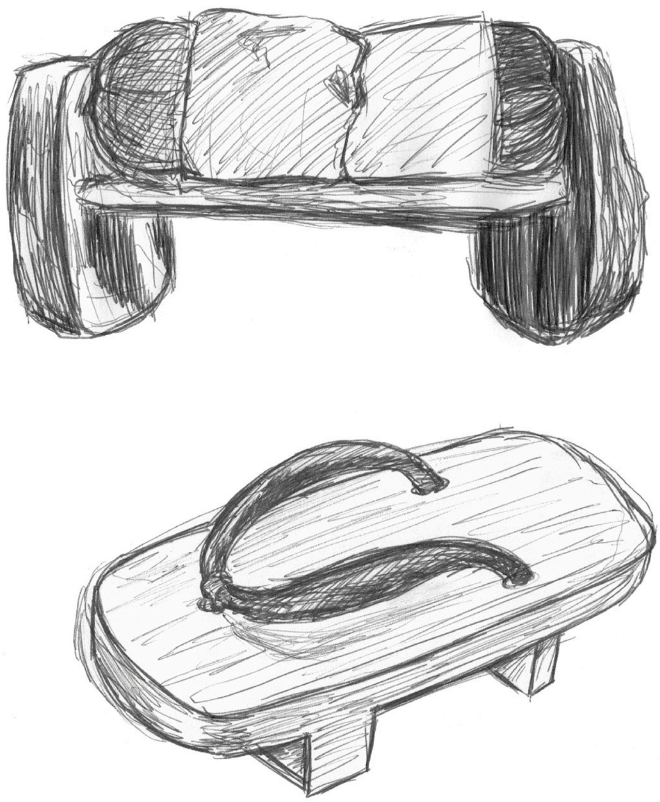


Fig. 11. From top to bottom. Top: An assemble of four wooden pieces (HPD-W006/001 to 004) has been interpreted as a takamakura (高枕) which was probably used in tandem with a sobagara (pillow) (蕎麦殻). Bottom: The traditional type of sandal known as koma geta (駒下駄). (Drawings by Noa R. Rico).

Nature Education Area, were known as "The Trees of God" by the natives (Lee, 1962: 2–3). *Chamaecyparis* has traditionally provided an objectively appreciated timber for building, resistant to decay (Lee, 1962; Farjon, 2010; Chung et al., 2012). *C. formosensis* for example is described as an excellent furniture timber, used by the Thao group of Taiwan for crafting harpoon heads (Lee, 2013: 123). *Chamaecyparis* species have also been traditionally used for medicinal treatments (Li, 2006), as well as for funerary purposes. *Chamaecyparis* wood was appreciated probably because of its delicate pale red colour, straight grain, pleasant aroma, and durable heartwood (Farjon, 2010; Lee, 2013).

While ethnohistorical sources cannot simply be applied to prehistorical times, it can be plausibly hypothesized that the symbolic status of *Chamaecyparis* wood was a historical feature, with a relatively long-time depth, which the Europeans had the opportunity to learn. The absorption of local knowledge and the adoption of local uses is indeed a well-studied feature of Spanish colonialism (not so well known for Dutch colonialism). *Chamaecyparis,* in this context, would have been appropriate for crafting the coffin of a prominent figure of the Dutch colony (Cruz Berrocal et al., 2020). As mentioned above, the fragments obtained in Heping Dao indicate that this was a relatively old tree. Its extraction in European times could thus be read as the harvest of ancient specimens of particular value, or as a potential intensification in the extraction of valuable wood, in sufficient amount as to enable its recovery from the archaeological record.

5.3. Implications of the study of daily life Japanese wooden objects

The wooden objects comprised by sample LAB-003 are clear examples of everyday objects, probably related to the Japanese military colony at Heping Dao. They were made of different wood types as suggested by their taxonomic identification: cf. *Cunninghamia* spp., cf. *Cryptomeria japonica* and Cupressaceae (Table 2).

Two of the objects were probably made of *Cryptomeria japonica:* the base of a bucket or a small cask, and a takamakura (高枕). *Cryptomeria japonica* D. Don, known as *sugi* cedar, was widely used in Japanese woodworking in the past (Obayashi and Okochi, 2013) and today (Mertz, 2016). During the Muromachi (1336–1573CE) and very early Edo period (1603 and 1868CE) in Japan, *sugi* wood was used for crafting wooden barrels with bamboo hoops, used as transportation container of Japanese rice wine, soybean sauce, or soybean paste and, also in recycling nightsoil (Ohba, 1993). Although it was introduced from Japan to China many centuries ago, the Japanese introduced the seeds of *C. japonica* to Taiwan in 1896 (Ohba, 1993), after which extensive plantations were established that replaced natural forest (Farjon, 2010). This tree is traditionally at the core of the Japanese identity. This tall conifer tree provides a characteristic fragrant, very light, workable, resistant, and durable wood (Farjon, 2010) producing boards by splitting even with simple tools (Ohba, 1993). Either if the wood itself (or the artefact) was introduced from Japan, or if the wood had grown in Taiwan, the *Cryptomeria japonica* is a symbol of the pre-eminence of Japanese identity. The selection of this taxon, together with the types of wood conversion used, the kind of joinery techniques and the style of the objects, all point to a Japanese woodcrafter. This is an expected characteristic of a Japanese colony such as Heping Dao, where it is archaeologically possible to envision how the Japanese aimed for the recreation of a small colonial Japan, refusing the (by then prevalent) Chinese artefacts, construction materials and implements. This is also observed in other types of material culture such as bottles, construction materials, porcelain, toothbrushes, metallic artefacts, and food debris, all of them of Japanese style and likely manufacture (Cruz Berrocal et al., 2018).

In contrast, the koma geta (駒下駄), a very traditional type of sandal, was likely made of *Cunninghamia* sp. wood, despite the preferred and most appreciated wood for crafting this traditional footwear in Japan was *kiri* (*Paulownia tomentosa)* (Mitsukuni, 1986: 38), which provides a resistant, light weight, and light-coloured hardwood (Hall, 2008). Other taxa such as cedar, cypress, chestnut, and oak were also referred to as raw material for making wooden footwear by Japanese crafters. In Heping Dao, however, traditional geta were produced from different woods, including Taiwanese species. The pronounced wear marks in the sole indicate that the sandal was used repeatedly before being discarded, which points to a high need of periodical replacement of the wooden footwear, eased by local procurement of resources.

Cunninghamia konishii, a large tree up to 50 m high that produces a timber valued for its durability under wet climate conditions (Farjon, 2010), is endemic in Taiwan (a subpopulation was discovered in the mid 1980s in a small area along the Lao PDR/Việt Nam border in the provinces of Houaphan, Thanh Hóa and Nghệ An) (Thomas and Nguyen, 2019). It grows in the northern and central parts of the island at altitudes of 1300–2000 m, scattered in *Chamaecyparis* forests or occasionally forming pure stands (Li, 1963). Cunninghamia also has a long history of more than 800 years of cultivation in China (Thomas and Nguyen, 2019). The status of *Cunninghamia konishii* is closely related to C. *lanceolata*; molecular genetic evidence suggests that C. *lanceolata* and *C. konishii* are the same species, and that the *C. konishii* of Taiwan derive from multiple colonizations from *C. lanceolata* from the mainland. *C. konishii* would represent a montane form rather than a distinct species, and therefore is named *Cunninghamia lanceolata* var. *konishii* (Li et al., 2019).

Interestingly, *C. konishii* was first named in 1908 by Bunzō Hayata, a well-known Japanese botanist, from specimens collected by N. Konishi on Mt Randai at ca. 2133 m altitude, i.e., during the Japanese colonization of Taiwan and the process of intensive survey of the island. Since this species is rare in cultivation and does not thrive as well as *C. lanceolata*, it is clear that the exploitation of wild populations of *C. konishii* took place under Japanese rule. The global conservation

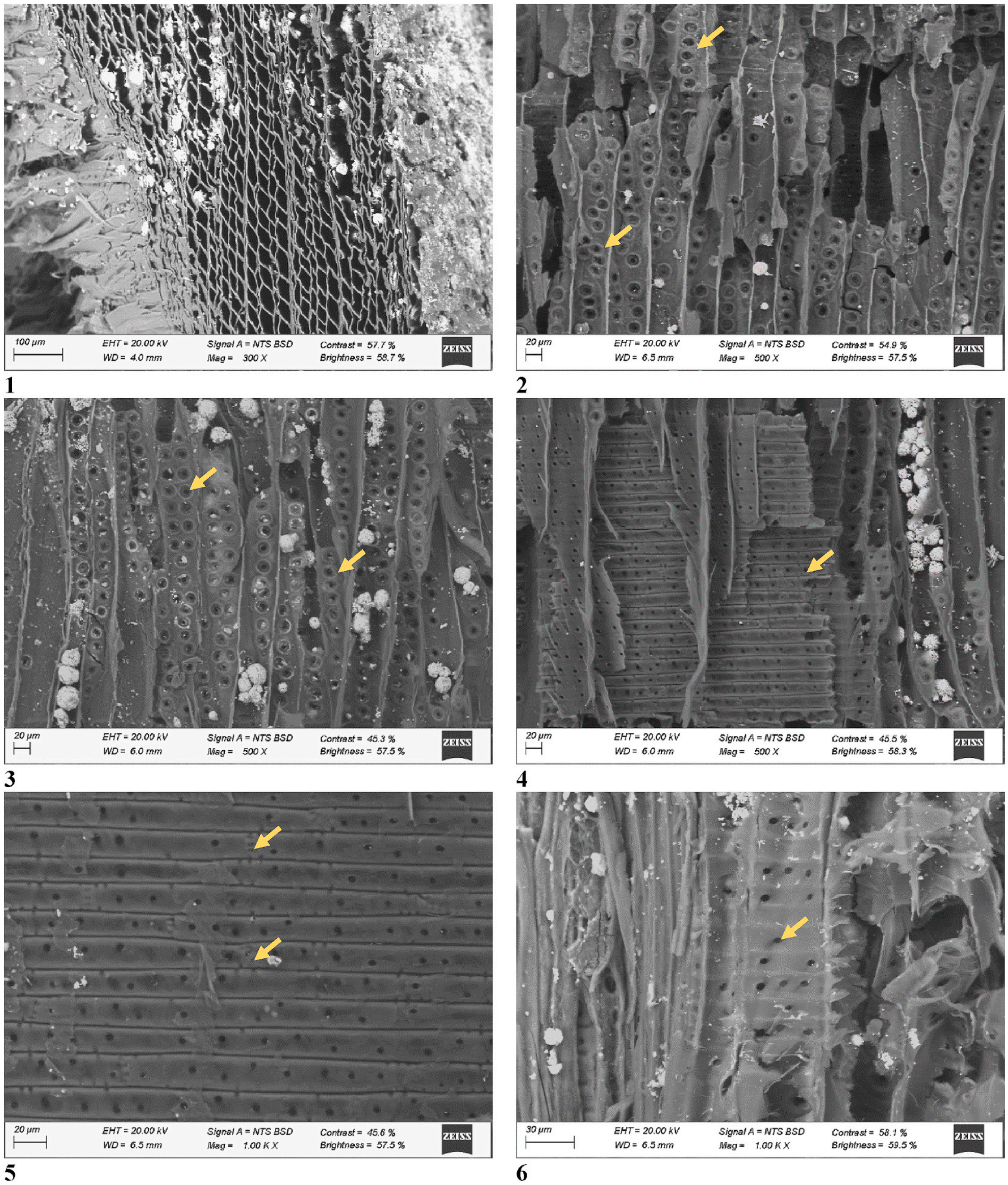


Fig. 12. HPD-W005. Waterlogged wood. Cupressaceae cf. *Cunninghamia* spp. 1. Axial resin canals absent, 2. And 3. Tracheid pitting mostly uniseriate and sometimes biseriate, 4. Ray height medium to high (5–15, 16–30 cells height), 5. Nodular transverse end walls, and 6. Cross-field pitting taxodioid.

status for *Cunninghamia konishii* is based on an estimated recent range-wide population decline of more than 50% and an ongoing decline in its area of occupancy. This reflects the level of past exploitation in Taiwan (as well as Việt Nam) (Thomas and Nguyen, 2019). So far, however, the literature points to the exploitation of the five species with largest populations in Taiwan under the Japanese occupation, including Yellow cypress (*Chamaecyparis obtusa* var *formosana*), Taiwan Red Cypress (*Chamaecyparis formosensis*), Chinese hemlock (*Tsuga chinensis*), Taiwan Incense-cedar (*Calocedrus formosana*) and Armandii (*Pinus armandii*), which would have been exploited since 1913 in Alishan (Chen, 1998; see also Hung, 2015). *Cunninghamia konishii,* also called Taiwan coffin fir, is not mentioned. Intense exploitation of this species is only attributed to the post-war period, when wood was badly needed for reconstruction, and deforestation of Taiwan yellow cypress, Taiwan Red Cypress, Taiwan Incense-cedar, Konishi-fir and Yew (*Taxus sumatrana*) rocketed (Chen, 1998). The current authors' findings show that the Japanese probably did exploit this species widely enough as to become an everyday object in war times, including specifically the making of Japanese types of material culture, such as *geta,* easily recognizable as a material signature of Japanese traditional wear. The use of an endemic Taiwanese tree alongside *C. japonica*, could also point to a yet unknown degree of accommodation to the Taiwanese colonial "homeland" on the part of the Japanese, maybe a slight, but nonetheless perceptible acceptance of local materials as deeply embedded in symbolic values for the Japanese as wood.

The remaining fragments (HPD-W007 and 008), which were worked wood from unidentified objects, were made of *Cupressaceae*. Despite the level of uncertainty in the taxonomic identification, it is interesting to note that the objects from Japanese contexts were all made from wood belonging to genera of the *Cupressaceae* family, which provides more fibrous and less resin containing wood than other softwoods such as those of the Pinaceae family, as well as being rot resistant with fragrant properties, and workable because it splits easily (Farjon 2010). Beyond raw material selection, it is also important to highlight other aspects

Fig. 13. Detail of the mortise and tenon joint for assembling the wooden pieces. In the upper part of the image and in the two laterals there are visible three little iron pins.

related to the wood-working process that have been identified through the study of these objects, such as the conversion of trunks by tangential splitting using in some cases the inner part of the trunk for making objects (HPD-W004, HPD-W006/001 to 004, and HPD-W008).

5.4. Wood exploitation and colonization

In the early colonial context, a coffin made of local wood for a Christian burial of a prominent figure in the colony, interred within the colonial Church, can take us through different levels of understanding of the colonial conditions of possibility. In the first place, it implies the absorption of local aboriginal knowledge and possibly practices. The provenance of the wood points to potential high dependency on local long-established networks and indigenous agents, rather than the more unlikely option of the Europeans having direct access to the source (Cruz Berrocal et al., 2018, Cruz Berrocal et al., 2020). While monumental structures made political, economic, and ideological statements of European dominance, less tangible but equally key elements for daily and symbolic production of value were adopted. The Europeans were isolated from their familiar surroundings and their relationship with their own material culture was consequently looser. Their praxis in their colonies was integrative, which would have deeply affected their identity formation, although no written information is left. It can only be hypothesized that in most cases, the identities of the European colonists went through an indigenization process, adopting local material culture in material and symbolic terms.

In contrast, the Japanese material culture expresses the imposition of a completely different reality on the locals; the Japanese re-enacted the Japanese homeland around them. They had the power, resources, and ideology to impose a Japanese way of life on Taiwan at all levels, from the names of people to the buildings (Huang, 2005). The wooden artefacts left behind by the Japanese community in Heping Dao during WWII offer a glimpse into everyday life, but more importantly, into the symbolic value of wooden objects, or wood itself, in the maintenance of the community. Wood of course would be an important part of Japan far-away from Japan. The Japanese define their culture as a culture of wood (*ki no bunka*) (Mertz, 2016: 15), and as has been observed in Heping Dao, a large number of everyday objects were made from it (Mertz 2016). Even very personal objects such as footwear and pillows were made of wood, and this explains the use of familiar *Cryptomeria japonica* wood, possibly imported (either in raw shape or as worked artefacts) during initial colonization, and subsequently cultivated in Taiwan. It is interesting that it is precisely wood that demonstrates an otherwise unsuspected degree of accommodation to the local context (the local wood, *C. konishii*, in this case), not observable in other types of material culture. However, clear-cut associations between wood and identity must be nuanced at this point. This was also the moment when wood globalization was a reality. The Japanese had imported wood from Alishan to Japan from the beginning of the 20th century. Since the 1920s, Taiwanese wood could not compete against American wood exported from the United States to the world, including Japan. Moreover, Taiwan became a market for Japanese wood (Hung, 2015: 184), and the cultivation of *Cryptomeria* was also introduced to the island. In the 1930s, more efficient and economic ways to exploit the Taiwanese wood resources were sought in preparation for the war, which led to a synergistic effort from private, colonial, and academic agents that deeply transformed the Taiwanese forests in the 1940s (Hung, 2015: 188).

The exploitative core of both colonial processes, rather than identity aspects, is thus probably more significant at this stage of research. An early map by Pedro de Vera (1626) (Fig. 15) clearly depicted the mountains across the bay of Keelung as "Montes Grandes de Mucha Madera" ("Big Mountains of much wood"). Extraction of wood must have been important, both in Tamsui (Borao et al., 2001), the second colony founded by the Spanish, as in Heping Dao, where its high interior areas (up to 60 m of altitude) were put to use with the construction of an auxiliary fort. Indeed, later Dutch sources confirm an increase in sediment deposition in the bay that made it more difficult for big ships to anchor (Borao, 2009: 106), a process of silting that may have also happened in the contemporary Dutch colony of Tayouan, in the south of Taiwan, to the point of obliteration of the former bay (Andrade, 2005: 296, Andrade, 2008). Neither the Dutch nor the Spanish role in the process of siltation has been studied, but wood was no doubt a key resource (Álvarez, 1930: 43–44; Ollé, 2005), especially in a naval economy as this, where ships supported the bulk of transportation (Parthesius, 2010).

As shown above, it is potentially possible that the Europeans prompted a process of intensification of wood extraction. Interestingly, one of the first accounts preserved by Dutch documents is a conflict around a group of pioneers who were led by a native group, the Siraya, from Baccluan to a place where the Siraya said they were free to cut wood, in return for Indian textiles. The Dutch were attacked by another Siraya group from Mattau. Andrade (2008: ch. 1, p. 5) points out that it is possible that the people of Baccluan had deliberately led the Dutch to cut wood in an area close to or claimed by Mattau. Generally speaking, wood appears as one of the prominent goods that were used by the aborigines to trade with the Europeans (Andrade, 2008: ch. 8, p. 11). Sandalwood, firewood, and whitewood (*withoudt*) are mentioned as especially valuable exported goods. Chinese middlemen as well as the indigenous people exploited the resources for the Europeans. In fact, the VOC hired thousands of Chinese masons, carpenters, and workers who built the company's fortress, warehouses, docks, and domiciles. Construction in turn sparked building-related industries, such as brick-making, mortar-making, and woodcutting (Andrade, 2008: ch. 6, p.4).

The topic of wood exploitation by Europeans and the potential environmental impacts that this had in Taiwan has not been studied so far, although it has some precedents in other colonies in Southeast Asia from a historical point of view (Peluso, 1991; Boomgaard, 1992). That this exploitation could have occurred in Taiwan as well is in line with available geomorphological and archaeological evidence, and with historically known extractive economic processes implemented by the Europeans, in particular by the Dutch in Taiwan: for example, their

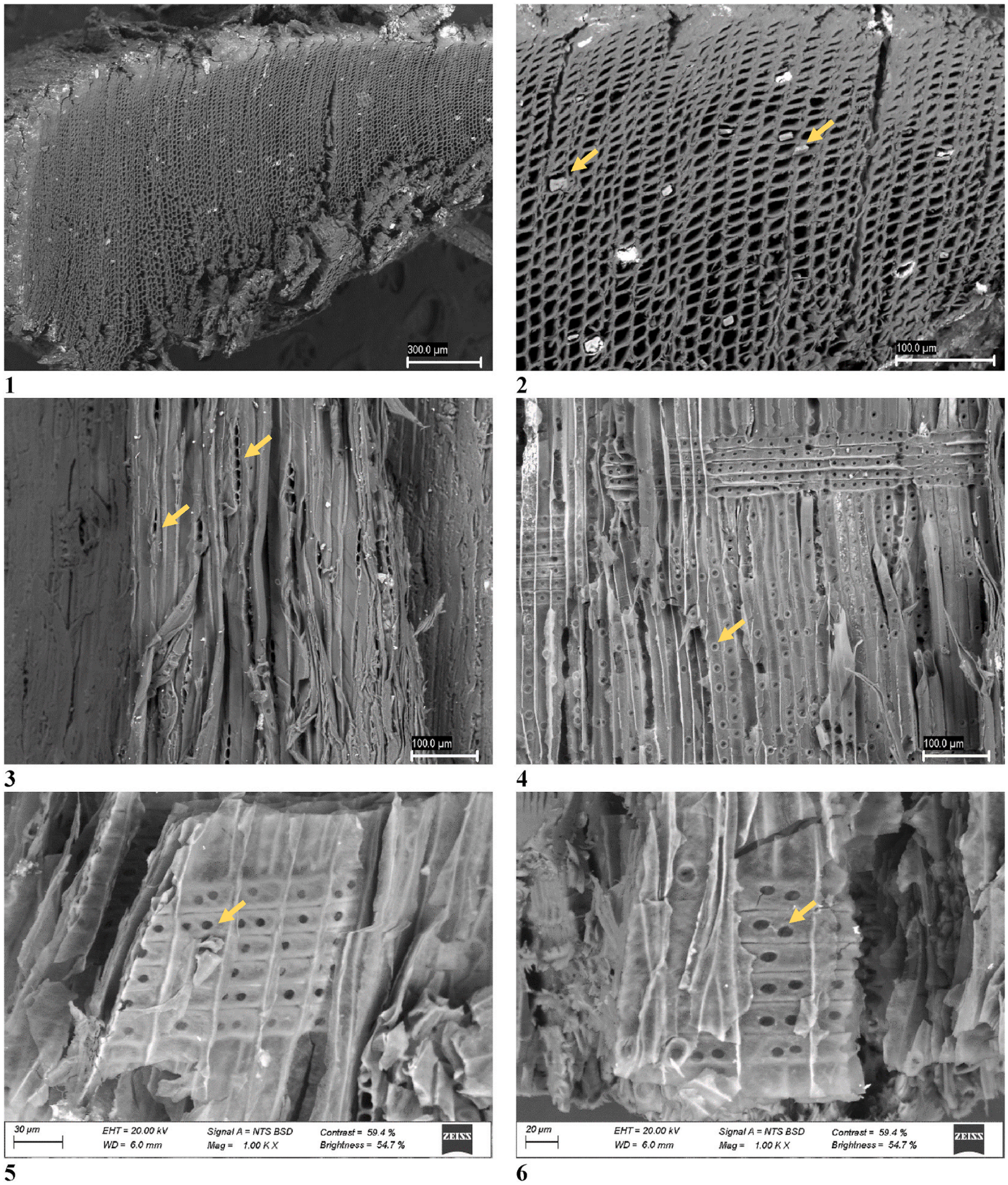


Fig. 14. HPD-W006. Waterlogged wood. Cupressaceae cf. *Cryptomeria japonica* 1. Axial resin canals absent, 2. Axial parenchyma diffuse, 3 Rays exclusively uniseriate and ray height short and medium, 4. Tracheid pitting mostly uniseriate, 5 and 6. One and two taxodioid pits per cross-field.

fostering of the exploitation of Taiwanese sika deer through Chinese middlemen was so drastic that the Dutch colonial governments had to impose hunting seasons and limit the most effective hunting systems already during the 17th century (Andrade, 2008). Although *Chamaecyparis* forests are believed to have remained pristine until the 20th century (Li et al., 2015), the current paper can tentatively start to challenge this observation, as a history of exploitation of this wood, unknown until now, starts to emerge.

The intensity of this exploitation, of *Chamaecyparis* and other species, could have been kept relatively low since it clearly drew from the indigenous practices. At least there is no evidence to the contrary so far. The intensification of wood extraction was surely implemented by the Qing Government after 1875 (Hung, 2015): indeed, the Japanese foresters sent by the Government in 1898 and 1899 found badly preserved forests (Hung, 2015). However, the Japanese colonial state was prominent in the scientific exploitation of Taiwanese forests. An important target of the Japanese land policy was the mountain management of Taiwan, since “To subjugate Taiwan, [they] must conquer its forests” (pronounced by the first governor-general of Taiwan, in Hung, 2015: 174). The colonial policies on the Taiwanese forests underwent different paradigm shifts, discontinuities, and conflicts (Hung, 2015), as the nationalization and monopolization of forest resources encountered a lot of resistance (e.g., the Beipu Affair in 1907; the Lingipu Affair in 1912), especially from the Taiwanese aboriginals, who “had a notorious history of employing headhunting and other violent methods to protect the forests against incursion” (Hung, 2015: 175). Resistance was dealt with through military campaigns, isolation, forced work, exacerbation of conflict among tribes, relocation to the plains, and an aggressive policy of appeasement and education (Huang, 2014). The goal was to pacify or exterminate the aborigines, specifically where logging was to take place. By 1915, this policy had been largely successful: a total of 258,380.04 ha of government-owned forest were turned over to private managers between 1915 and 1925. In particular, the exploitation of camphor (*Cinnamomum camphora),* usually high in the mountains, blossomed. Some

Fig. 15. Map of the Spanish Port in Jilong drawn by Pedro de Vera, Taiwan, 1626 (MP-FILIPINAS,141, Archivo General de Indias, Seville, Spain).

75% of the world's camphor production at the time of occupation came from Taiwan. Historical research has so far focused on this species, but camphor was not the only tree intensively exploited. Species such as *Taiwania cryptomerioides* (Harrison and Kirkham, 2019) were also overexploited at the beginning of the 20th century. It is plausible to hypothesize that the Japanese joined in a network of exploitation already put in place in previous years and centuries, since the Chinese highly appreciated the *Taiwania* wood for producing luxury coffins (Harrison and Kirkham, 2019). It is also likely that many other species such as *C. konishii* were intensively exploited by the Japanese at the time, as discussed above.

6. Conclusions

Wood is a pervasive material in human life up until at least the mid-20th century, and it offers glimpses of historical and social conditions that cannot be easily observed through other types of material culture. In Heping Dao, two wooden assemblages have allowed the authors to diachronically explore different aspects of colonialism involving wood provenance. The local/foreign dichotomy in analysing wood can therefore be most illuminating in the study of colonialism, of course mediated by the different scope, distances involved, divergent economic power, changing local conditions of possibility (Cruz Berrocal et al., 2018), and possibly the nature of the artefacts involved.

Large-scale as well as small-scale dimensions of life that are not necessarily consigned to written texts can be accessed in wood, as seen in this paper. Texts provide a late and potentially partial perspective on many daily life issues such as the original wood used for personal objects in colonial contexts, or the scope of tree exploitation. Furthermore, in the case of Taiwan, texts only provide the foreigners' worldview. They will never reach deep into the aboriginal past, for which archaeology is the fundamental tool. Maybe unexpectedly, wood can also be explored in this way.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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