WOOD AND CHARCOAL SPECIMEN ANALYSIS FOR THE MARKET STREET CHINATOWN ARCHAEOLOGY PROJECT

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Prepared by Oxford Tree-Ring Laboratory, Baltimore, Maryland 21230
Submitted in June 2013 to the Historical Archaeology Laboratory, Stanford Archaeology Center, Stanford University, Stanford CA 94305

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1. INTRODUCTION

The Market Street Chinatown settlement stood on Block 1 in San Jose, California, from 1866 until May 1887, when an arson fire broke out that destroyed the entire community but left most non-Chinese structures intact. During 1985-1988, an archaeological excavation took place in the midst of redevelopment construction that discovered 63 features identified with historic occupation of the site. Since 2002, the Market Street Chinatown Archaeology Project has been researching the material uncovered from these features.

In October 2012, the Oxford Tree-Ring Laboratory of Baltimore, Maryland, was asked to conduct an assessment of the wood and charcoal assemblage recovered during the 1980s excavation. Damaged and partial *ex-situ* wood specimens are notoriously difficult to analyze, particularly with regard to their placement and function within the original wooden structure or object. The Market Street Chinatown assemblage faced additional hurdles in the extensive burning and destruction that took place before the wood samples entered the ground; the lack of rigorous recording of the structures during the original excavation; the removal and subsequent loss of many of the largest pieces of timber found during excavation; the abrasion of original surfaces that occurred during deposition, excavation, and archaeological processing, including the extremely destructive process of wet screening; and the ensuing deterioration that has taken place over the more than twenty-five years that have elapsed since the excavation.

Nevertheless, it was recognized that the Market Street Chinatown material provided a rare opportunity to study what is, for wood, a remarkably well-preserved archaeological assemblage. Wood rarely survives in the archaeological record unless it is protected by waterlogged or hyper-arid conditions. In the case of the Market Street Chinatown collection, wood and charcoal specimens survived in 35 of the 63 features. After examining these specimens, it was determined that archaeological research potential did exist for the collection in spite of the fragmentary nature of much of the assemblage.

The initial steps of the analysis involved the recording and photographing of the entire wood and charcoal assemblage. Each individual specimen in the collection was subjected to species identification, functional analysis, and further interpretation with the aim of shedding light on specific construction techniques as well as on larger questions of urban development and human-environmental interactions at the Chinatown site.

The results of the analysis are contained in the following report, which is organized into six sections. This section, Section 1, has provided an introduction to the Market Street Chinatown Archaeology Project and has explained the main goals of the study. Section 2 lays out the methodology behind the wood and charcoal analysis. Section 3 presents the results of the species identification and the functional analysis of structural timbers and portable objects. It also

includes a register of wood specimens that were assigned individual wood sample numbers. Section 4 provides descriptions of and comparisons between eight features containing the most significant wood assemblages recovered during the excavation. Section 5 offers an interpretation of the wood and charcoal assemblage in the light of larger questions about the use of the site by the residents of Market Street Chinatown, the destruction caused by the fire of 1887, and the subsequent excavation of the site in the 1980s. Section 6 is a bibliography of the works cited in this report.

A map of the site marked with the feature locations is included, as are photographs taken of the excavation and of important structural timbers and portable objects.

Background information is included in a series of appendices. Appendix A is a table of all catalog entries containing wood and charcoal specimens, with basic information for each catalog number including the excavation level, a feature description, and any association with the 1887 fire assigned to the entry by the original excavators. Appendix B is a short introduction to wood and charcoal identification prepared by Dr. Harry A. Alden of Alden Identification Service. Appendix C presents the results of the identification of 91 specimens performed by Dr. Alden. Appendix D contains taxa information for the identified species. Appendix E presents residue analysis conducted by Ray Von Wandruszka and Anton Shapovalov.

The raw data used to construct the analysis is available in digital format on a CD. It contains 184 catalog entry recording sheets and 74 individual wood sample recording sheets.

All feature descriptions come from the Market Street Chinatown Archaeology Project Technical Report 1 (Kane 2011). Further information about the archaeological and historical context of the collection can be found in this report. Although the original excavators used the terms stratum or strata, layer, and level interchangeably in their field and lab reports, this report will use layer as the common term for all stratigraphic units.

(Cover photograph of the Market Street Chinatown before the 1887 fire taken by Andrew P. Hill; courtesy of History San Jose.)

2. METHODOLOGY

The ARS excavators identified and excavated a total of 63 features at the Market Street Chinatown site. Wood and charcoal specimens were found in 35 of these features: three cisterns (85-31/30, 85-31/33, and 86-36/7), one *acequia* or drainage ditch (85-31/27), two wooden structures (86-36/13 and 86-36/15), 28 trash pits (85-31/1, 85-31/2, 85-31/6, 85-31/9, 85-31/10, 85-31/13, 85-31/14, 85-31/18, 85-31/19, 85-31/20, 85-31/22, 85-31/24, and 85-31/28; 86-36/1, 86-36/2, 86-36/3, 86-36/4, 86-36/5, 86-36/6, 86-36/8, 86-36/9, 86-36/11, 86-36/12, 86-36/14, 86-36/16, 86-36/18, 86-36/19, and 86-36/20), and one possible trash pit/possible wooden structure (86-36/17). Wood specimens from each feature were assigned separate catalog numbers that followed the groupings of specimens established by the original excavators, with the entire wood and charcoal collection spanning a total of 184 catalog numbers (see Appendix A).

2.1 Assessment

The initial step in assessment of the collection was to separate the charcoal from the wood for each catalog entry. For classification purposes, those specimens that were burnt but still retained a cellular wood structure that could be seen under a microscope were treated as charred wood, while those specimens that had the wood structure entirely carbonized were treated as charcoal.

Identification of wood

All of the individual wood specimens were examined by the Oxford Tree-Ring Laboratory in order to identify the different types of wood found in the collection. Each wood specimen was inspected using a trinocular microscope with a magnification level up to 56.25 X. Important physical and anatomical characteristics such as the presence of pores, their size and distribution, the width of growth rings, the presence of rays, and any color variations within the wood were observed. When absolutely necessary, small nicks were made in the surface of the wood to expose the transverse, radial, and/or tangential sections, but damage was avoided as much as possible to protect the integrity of the specimens. For more detailed information about the identification process, please see Appendix B.

The goal of this examination was the accurate species identification of as many specimens as possible down to at least the genus level (e.g. oak, pine, bamboo, etc.). The specimens from each different species were then counted, weighed, bagged, and recorded separately. Specimens that were too deteriorated or too small for identification were noted in the laboratory records.

Several specimens that were deemed particularly unusual or difficult to identify were referred to Dr. Harry A. Alden, an expert in the field of wood and charcoal identification, for examination. Nineteen wood specimens were identified by Dr. Alden and assigned individual Alden

Identification Service numbers (ALD 36 to 54). A table showing the results of Dr. Alden's analysis can be found in Appendix C, with Appendix D giving information compiled by Dr. Alden on the taxa identified in the analysis.

Identification of charcoal

The large number of charcoal specimens and the difficulty of differentiating between wholly carbonized types of wood made microscopic identification of the entire charcoal assemblage unfeasible. Instead, three different kinds of features, each with a large amount of charcoal containing significant archaeological potential, were chosen for representative analysis: 86-36/5 (a wood-lined trash pit), 86-36/13 (a wooden structure), and 86-36/19 (an unlined trash pit).

Dr. Alden examined the assemblage from each of these features and identified a number of representative samples from the different species in each feature. The charcoal specimens were broken by hand, exposing the transverse surface first, then the tangential and radial faces secondly, if possible. Broken surfaces were examined under a dissecting-type optical microscope that magnifies to approximately 300X with good resolution. Parts of the sample-fragments with the largest surfaces were placed on a dish containing sand slightly moistened with glycerin, the sand allowing for accurate manipulation of the charcoal fragments and the glycerin increasing the cohesion of sand grains and decreasing the adhesion of the fragment to the sand-mass. Digital images were acquired for each group of specimens and stored on a computer. After identification, sub-samples were returned to their bags and cataloged alphabetically by scientific name. In all, a total of 72 charcoal samples from the three features were identified by Dr. Alden (see Appendix C, ALD 1 to ALD 35 and ALD 55 to ALD 91).

Dr. Alden's findings were used by the Oxford Tree-Ring Laboratory to undertake a targeted study of the charcoal specimens from the remaining 32 features in the assemblage. Using a trinocular microscope with a magnification level up to 56.25 X, as many species as possible were picked out from each feature's assemblage and then weighed, bagged, and recorded separately. Cases where unusual species were spotted that remained unidentified were noted in the laboratory records, with a distinction made between hardwood or softwood species where possible.

During this process, coal and coke (a distillation of coal) were found to be mixed in with the charcoal specimens in many of the features. Although coal and coke, being mineral-based, are distinct from plant-based charcoal, the three sometimes appear similar at first glance and all three have been used historically for domestic and industrial heat production. It was decided that the coal and coke would be separated from the charcoal but would also be weighed, bagged, and recorded for comparison purposes. Slag, a by-product of smelting ore, was found in the charcoal

assemblage of two features, and was bagged, weighed, and recorded for comparison purposes as well.

Functional analysis

The entire collection was then assessed by the Oxford Tree-Ring Laboratory for its potential for archaeological interpretation. For the charcoal, the presence or absence of different kinds of species in each feature was determined to be potentially significant. For the wood, each specimen was considered individually. It was necessary to determine at the outset if each wood specimen was anthropogenic or natural, since broken or decayed wood can sometimes resemble deliberately worked wood. Cut ends often provided the best evidence for woodworking, especially when the original surfaces of the timber were abraded or weathered. Other definitive proof of human modification included the presence of tool marks made by cutting, sawing, or other woodworking activities; nails, bands, and other metalwork; and finishing or painting.

Worked wood specimens were broken down into two broad functional categories: 1) structural timbers used in furniture, cabinetry, or architecture to fashion floors, doors, framing pieces, window casings, baseboards, mantels, crown moldings, exterior sheathing, roofing shingles, etc., and 2) non-structural timbers used in smaller, more portable objects such as gaming pieces, decorative boxes, chopsticks, and other examples of fine woodworking. The portable objects were thought of as akin to small finds artifacts, and only those specimens that were positively identifiable were placed into this category.

Given the partial nature of most of the specimens, it was often difficult to ascertain whether a specimen was a structural timber or not. It is possible that many of the smaller, more delicate structural wood specimens could have had non-structural uses. It is also possible that some of these smaller structural specimens might be the unintended results of mechanical sawing or other processing of the wood. Although the results of much of this analysis were exploratory, they did allow for some theories to be developed about the form and function of numerous wood specimens.

2.2 Catalog entry recording

A separate recording sheet was filled out for every catalog entry. 184 sheets in total gathered together the raw data upon which much of the subsequent analysis was based. Each sheet contained the following information:

- Catalog entry number
- Depth as determined by ARS excavators (usually a layer number)
- Count and weight (in grams) of all charred wood, broken down by species

- Weight of charcoal (in grams), broken down by species
- Weight of coal and coke (in grams)
- Count and weight (in grams) of natural wood, non-structural timbers, and structural timbers by type, each broken down by species
- Significant features of timbers in the assemblage, such as tool marks, surface appearance, nails or other fixings, and any intentional marks
- Condition of assemblage

The sheets for each feature were then grouped together for further analysis. In cases where features were excavated stratigraphically, the catalog recording sheets were grouped by layer and the differing assemblages from each layer were compared and contrasted.

2.3 Individual wood sample recording

Every wood specimen with significant archaeological potential was assigned a separate Oxford Tree-Ring Laboratory (OTR) individual wood sample recording number. Important attributes were noted on individual wood recording sheets in accordance with standard archaeological practice for wood assemblages (Spence 1990; English Heritage 2010). A total of 74 individual wood recording sheets were completed. All specimens were analyzed in respect to the following characteristics:

Appearance

- Size and shape, including maximum length, width, and thickness/diameter (in millimeters)
- Weight (in grams)
- Damage, breakages, and number of pieces (pre- and post- excavation)
- Surface condition (from fresh to weathered)
- Surface features, including wear, charring, paint or limewash, and carving

Natural features

- Species identification
- Natural growth features, growth pattern, and timber quality
- Evidence of induced growth, coppiced heels, etc.
- Evidence of insect, fungal, or plant damage

Technological evidence

- Evidence of felling and cutting of log to length

- Evidence of shaping and finishing of timbers, including measurement of selected tool marks and recording of tool signatures
- Details of fitting and fixings (joints, nails, pegs, holes, notches, bands, etc.)
- Traces of wear
- Intentional marks such as scribe marks, tally marks, and other carpenter's marks

Functional interpretation

- Artifact type and purpose
- Possibility of timber having been re-used or modified from original purpose

The condition of each worked timber was assessed for completeness, wear, damage, and burning or charring. Most of the samples were incomplete, with the original faces, edges, and ends truncated or extensively worn, decayed, and/or burnt. The few cases where timbers were in a relatively unmarked or unworn condition were noted, with special attention paid to samples where the original dimensions of the timber could be ascertained. Stains from concretions, oil, and other substances were noted where deemed significant.

The conversion method for turning a tree into timber was also identified. Because the specimens were relatively small, it was difficult to be precise about the conversion method other than to assign them to the broad categories of riven (split), hewn, or sawn timber.

A number of specimens with additional research potential were identified and subjected to tool mark analysis, cross-mending analysis, or dendrochronological analysis.

Tool mark analysis

Many specimens with evidence of tool marks on their surfaces were identified throughout the assemblage, with large concentrations appearing on the redwood timbers in 86-36/13 (a wooden structure) and 86-36/19 (an unlined trash pit). Thirty specimens with marks that gave a clear indication of the tool's signature were assigned individual sample numbers, photographed, and recorded. The type of tool that made the marks was noted where discernible (Figure 1). A few cases of trowel marks, presumably as a result of archaeological excavation, were also noted.

All of the individual wood samples were then compared with each other to see if any of the signatures made by the tools matched. None were found to match, a fact that is not surprising given the small size of the timbers and the large size of most mechanical saws of the period. Since the cutting disks of the saws could reach 4 to 5 feet in circumference, each timber was exposed to a very small proportion of the saw's cutting surface. In order to match, the tool marks

would need to have been cut by the exact same part of the same saw. Even if two timbers had been cut by the same saw, the fragmentary nature of the wood surviving in the assemblage makes it unlikely that those timbers could be matched up successfully.

In spite of the fact that none of the tool marks matched, the variety of tool marks made by circular and reciprocating mechanical saws, hand saws, planes, axes, and chisels revealed the diversity of 19th-century woodworking techniques used to construct the Market Street Chinatown buildings.

Cross-mending analysis

Specimens were cross-mended where possible. Only a few specimens were identifiable as part of the same artifact, most notably several pieces of coconut shell from 86-36/13-148, a possible tool handle from 85-31/33-71, and several composite wood/metal artifacts from 85-31/18 and 85-31/20.

Dendrochronological analysis

Redwood from historic structures in California has been successfully dated using dendrochronology, most notably at the Officers' Club of the Presidio of San Francisco (Worthington and Seiter 2013). For the Market Street Chinatown assemblage, three structural timbers made from redwood were identified as possible subjects for dendrochronological analysis: a board and a board offcut from 86-36/18-451 (OTR 033 and OTR 034) and a board from 86-36/5-1700 (OTR 054).

Each sample was first bisected to expose the rings. The cut surfaces were sanded on a linisher, or bench-mounted belt sander, using 60 to 1200 grit abrasive paper, and were cleaned with compressed air to allow the ring boundaries to be distinguished clearly. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.01mm. Each year's ring was measured separately and arranged chronologically as part of a sequence of ring-width measurements, with the earliest ring being placed at the beginning of the sequence, and the latest or outermost ring concluding the data set. Ring-width sequences prepared in this way were then compared with more than 150 dated reference chronologies based on living trees and historic structures in California. A match between the sample's ring-width sequence and the dated regional reference chronologies would pinpoint the felling date of the tree used to construct the sample.

The length of the sequence being dated is of primary importance in dendrochronology. A sample with 30 or 40 years' growth is likely to match with the reference chronologies at varying positions, whereas a sample with 100 consecutive rings is much more likely to match

significantly at only one unique position. Samples with ring counts as low as 50 may occasionally be dated, but only if the matches are very strong, clear, and well replicated, with no other significant matching positions.

Unfortunately, two of the samples (OTR 033 and OTR 054) contained fewer than 50 annual rings, making them unsuitable for accurate matching against the reference chronologies. The remaining sample, OTR 034, contained exactly 50 rings. The measured ring-width sequence for this sample was compared against the reference chronologies but failed to date conclusively. The data set for sample OTR 034 will be kept on file, however, and periodically re-run against any new regional reference chronologies in the hope that it will date at some point in the future.

3. ANALYSIS

3.1 Species identification

Wood can be grouped into two broad classifications: softwood and hardwood. Softwood is produced by trees in the botanical group gymnosperm, which includes the pines, firs, spruces, cedars, and other conifers. Hardwood is produced by trees in the botanical group angiosperm, which is subdivided into the monocotyledons—the palms and the bamboos—and the dicotyledons, which includes trees indigenous to North America such as beech, birch, cherry, chestnut, maple, oak, and walnut as well as tropical hardwoods such as ebony, mahogany, and teak.

The majority of the wood and charcoal assemblage was identified as belonging to one of three softwood species indigenous to the West Coast of North America: *Sequoia sempervirens* (redwood), *Pseudotsuga menziesii* (Douglas fir), and *Thuja plicata* (Western red cedar). All three of these species are well suited to woodworking, particularly in shaping interior and exterior timbers for buildings. Small amounts of hardwood species useful for woodworking were also identified amongst the charcoal and wood specimens. The various species are listed below in descending order of the amount present in the assemblage. Several standard references were consulted to determine the woodworking properties and common uses for each species, primarily Alden 1995 and 1997, Lincoln 1986, and Walker 2001.

Redwood (Sequoia sempervirens)

Redwood was by far the most numerous species found in both the wood and charcoal assemblages, making up at least 75% of the specimens. Redwood is easily worked with both hand and mechanical tools. It is extremely durable and resistant to decay, making it useful in exposed situations or for holding or transporting liquids in wooden water towers, flumes, vats, and tanks. For buildings, it is used extensively to fashion posts, interior and exterior joinery, exterior cladding, shingles, doors, and windows. It is also used to make organ pipes, coffins, and paneling, and the unconverted or round wood is used for telegraph poles. Historically redwood was used on the West Coast to make railroad ties, wooden pipes, and rain gutters (Mendocino Coast Model Railroad and Historical Society n.d.).

Douglas fir (Pseudotsuga menziesii)

Douglas fir was common in both the wood and charcoal assemblages. Douglas fir is easily worked with hand and mechanical tools, but it has a moderate blunting effect that necessitates frequent sharpening of tools. It is moderately durable and is used in heavy construction work, roof trusses, interior and exterior joinery, beams, poles, railway sleepers, mining timbers, ship

timbers, marine pilings, dock and harbor work, and cooperage for brewery and distillery vats and tanks.

Western red cedar (Thuja plicata)

Western red cedar was relatively common in the wood specimens but was not identified in the charcoal specimens, perhaps as a result of the difficulty in spotting the wood structure in burned examples of this species. Western red cedar is easily worked with hand and mechanical tools, but its acidic nature causes metals to corrode and therefore only galvanized or copper nails or other metal fittings should be used with this wood. It weathers to an attractive silver gray, making it prized for use in timber buildings as shingles, exterior weatherboarding, and vertical cladding. It is also used to construct beehives, greenhouses, and sheds and the unconverted or round wood is used for poles, posts, and fences.

Oak (Quercus spp.)

Oak can be separated into three groups: the white oak group, the red oak group, and the live oak group. White oak was the second most numerous species, after redwood, found in the charcoal assemblage. A small number of white oak timbers (fewer than ten) were found in the wood assemblage, most of them in Feature 86-36/13. Red oak and live oak were found only in the charcoal. Oak has good woodworking capabilities and is used in the construction of ships, railroad crossties, timber bridges, fuel wood, flooring, furniture, cabinetry, veneering, barrels, kegs and casks (the white oak group especially), mining timbers, containers, pallets, caskets, boxes, and paneling.

Beech (Fagus spp.)

Beech was found in small amounts in both the charcoal and the wood assemblage. Beech is an excellent wood for turnery and is used to make handles, brooms, and brushes as well as veneer, charcoal, railroad ties, cooperage, boxes, crates, baskets, pallets, furniture, flooring, sash, doors, trim, paneling, and general millwork.

Willow (Salix spp.)

Willow was found in small amounts in both the charcoal and the wood assemblage. It is used to produce lumber, veneer, furniture, paneling, interior trim, cabinetry, boxes, crates, toys, wooden shoes, polo balls, and cricket bats.

Cottonwood (Populus spp.)

Cottonwood was found in small amounts in both the charcoal and wood assemblage. Cottonwood can be used to make lumber, veneer, boxes, crates, interior furniture parts, agricultural implements, wooden ware, and cutting boards.

Bamboo (Bambuseae tribe)

Bamboo was found in small amounts in both the charcoal and wood assemblage. In addition to bamboo's culinary and medicinal uses, it can be used to construct furniture (particularly Chinese furniture), musical instruments, paper, baskets, screens, chopsticks and other utensils, and many other items.

Coconut (Cocos nucifera)

Several pieces of coconut shell were found in various features. Coconut has mainly culinary uses.

Palm (Arecaceae family)

Palm was found in small amounts in the wood but not the charcoal assemblage. Palm has mainly culinary uses, although the fronds can be used for basketwork and the wood is used for construction in some parts of the world.

Fruitwood (*Malus spp.and Pyrus spp.)*

Fruitwood was found in small amounts in the wood assemblage but not the charcoal assemblage. It is the wood from apple (*Malus* spp.) and pear (*Pyrus* spp.) trees. Fruitwood is used in fine furniture, printing and engraving blocks, umbrella handles, machines and toys, cog wheels, fruit presses, canes and walking sticks, drawing instruments, tool handles, professional and scientific instruments, toys, and specialty items.

Maple (Acer spp.)

Maple, specifically the soft maple group, was found in small amounts in the charcoal but not in the wood assemblage. Maple is used for lumber, distillation, veneer, cross ties, flooring, furniture, boxes, crates, shoe lasts, handles, spools, bobbins, musical instruments, piano frames, bowling pins, billiard cues, dumbbells, butcher's blocks, churns, chopping bowls, breadboards, croquet mallets, croquet balls, and turnery.

Camphor (Cinnamomum camphora)

One small worked piece of camphor wood was identified in the wood assemblage. Camphor is a tropical hardwood used for veneer, turned objects, chests, cabinetry, and furniture.

Ebony (Diospyros spp.)

Several ebony dominoes and a few other portable ebony objects were identified in the assemblage. Ebony is native to Equatorial West Africa. It is used for parts of musical instruments, handles for cutlery and tools, brush backs, carvings, turnery, inlaid work, finely worked boxes such as snuff boxes, and gaming pieces.

Palisander (Dalbergia spp.: *D. baronii*, *D. greveana*, *D. madagascariensis,* and *D. monticola*)

One domino was made of palisander, otherwise known as Madagascar rosewood. Palisander is a group of very rare, tropical hardwood species that are found only on the island of Madagascar. It is used for high-end furniture, cabinetry, and decorative objects such as veneer, musical instruments (especially guitars), inlays, carving, turned objects, and other small specialty wood items. Palisander has a distinctive, rosewood-like smell when it is worked.

Red sandalwood/Zitan (Pterocarpus santalinus)

One specimen of red sandalwood was found, a possible piece of a box. Red sandalwood is an extremely rare tropical hardwood native to the mountainous coastal regions of south central India. It is difficult to saw when dry, but it works well with hand tools and is an **e**xtremely durable timber, virtually immune to insect attack. It has a characteristic reddish appearance, with the heartwood containing an historic (1680-1882) red dye (santalin) soluble in alcohol but insoluble in water. The tree is very slow growing and the wood from it is highly prized, perhaps the most valued of all tropical hardwoods. It is used for high-end cabinetwork, furniture, and inlay, with the very fine-grain texture making it especially suited to intricate carving.

In China the wood is known as zitan and was especially prized during the Ming and Qing dynasties (1368 to the early 20th century). It was sometimes called the emperor's wood because of its popularity with the royal family for furniture making. Zitan was often used to make furniture and accessories for scholars such as brushes, brush rests, brush pots, arm rests, wrist wrests, table screens, and various containers such as ink boxes, notepaper boxes, and seal boxes (Frankel 1992).

Unworked wood

Species identification of unworked or "natural" wood was undertaken in the hopes of aiding in the understanding of the local woodland habitat and woodland management practices. Twigs,

branches, bark, and other types of unworked wood were identified, counted, and weighed. It was very difficult to tell whether a sample truly was unworked or if it had lost its original worked surfaces through deterioration, wear, or charring. In most of the cases that were identified as natural wood, the specimens were small twigs or branches, making it impossible to determine the species, such as with the 33 unidentified twigs found in 86-36/13-148

It was hoped that valuable information could be obtained by comparing differences in the range of species growing near the site and the range of species used in construction and other forms of woodworking on the site. Unfortunately, too few natural wood specimens existed to be able to answer these questions about woodland-management practices or climatic conditions.

Non-wood specimens

All specimens that were not made of wood were bagged separately and returned without being analyzed to the Stanford Archaeology Center, with the exception of nails, coal, coke, and slag, which were considered important non-wood artifacts that could add contextual information to the wood and charcoal assemblages. They were identified, weighed, and counted, then included in the final analysis for the wood (nails) and charcoal (coal, coke, and slag) specimens. A few composite wood/metal objects were identified during analysis. If the metal was detached, it was retained with the wood for interpretation.

3.2 Structural timbers

Many different types of structural timbers were found throughout the assemblage. Several different types cropped up repeatedly, particularly in the redwood specimens. Expanding on the work of Crone and Barber (1981), who attempted to identify and classify types of structural wood by comparing differences in the width and thickness of timbers, a typology was created for the structural wood specimens in the Market Street Chinatown assemblage. Distinctions were based on general appearance, width, and thickness. Extant lengths are no indication of the original size since almost all of the timbers are broken lengthwise. Dimensions are given in inches, as several of the types of timber follow standardized imperial timber sizing (e.g. 2" thick boarding). Almost all of these timbers were sawn rather than hewn or cleft, reflecting the widespread use of sawmills in late 19th-century California, and many retained saw marks on their surfaces.

Typology of structural timbers:

1. Strips: Very thin, flat pieces of wood 3/8" to ½" wide and 1/16" to 1/8" thick. The extant lengths vary from 1" to 3", although they are very delicate and easily broken, with very few possessing either of their original ends.

2. Slats: Thin pieces of wood sturdier than the strips but thinner than the laths. They measure from ½" to 5/8" in width and 1/8" to ¼" in thickness and vary in length from around 2" to over 5".
3. Laths: Thin strips of sawn lumber approximately 1" wide and 1/8" to 3/8" thick. Their incomplete lengths vary but range from around 1" to over 7". Laths were very recognizable and present in large numbers in several of the features. In historic construction, small laths like these were commonly used for walling, where they were nailed onto framing timbers leaving small gaps between that were filled with plaster to form an interior wall (Lounsbury 1994: 207). No evidence of plastering or nails can be seen on these laths and it is unclear what their function was.
4. Panels: Very thin and delicate pieces of wood, similar to strips but wider. They are 1/16" to 1/8" thick and vary in width from 5/8" to 1 ½".
5. Splinters: A catch-all term for thin, relatively long slivers of wood that do not retain enough original surfaces to be sure of width or thickness but appear to be pieces struck off from laths, boards, posts, and other pieces of longer structural timber or furniture. They run up to almost a foot in length.
6. Boards: Relatively wide and thick timbers. Very few boards retain their original width, although offcuts of 4"-wide boards have been identified. Four-inch wide boards were commonly used for interior and exterior sheathing and flooring and were known as clapboards, weatherboards, floorboards, etc. (Lounsbury 1994: 36). Boards often seem to have been cut to a standardized thickness of ½", 1", or 2".
7. Offcuts: Waste pieces of wood made by cutting larger pieces of timber to the desired size. Offcuts frequently are distinguished by having the wood grain running across rather than along the timber. Sizes vary, although some could be identified as offcuts of particular types of timber. The presence of offcuts was interpreted as evidence of woodworking on site, rather like debitage for lithics.
8. Nails: A separate category was created for artifacts composed solely of nails or small bits of wood attached to nails/concretions where it was impossible to place the wood into a diagnostic category.
9. Other: Worked timber that did not fit into the previous categories but that contained enough original dimensions to get a sense of the general shape and size.
10. Miscellaneous: Wood that appeared to have at least one worked surface but that was too small or deteriorated to determine its typology. In all probability, most of the miscellaneous timbers originally belonged to one or another of the diagnostic categories.
11. Composite wood/metal sheets: Wood with thin metal sheets attached to it to form a composite wood/metal object.

Boards and framing timbers

Most of the boards, posts, and other large structural timbers found throughout the assemblage were roughly sawed redwood timbers. Many had large iron nails embedded in the surfaces, some were charred, and most were badly deteriorated or eroded. Large structural timbers tended to be concentrated in Project 86-36, especially 86-35/5, a wood-lined pit, which contained 7 boards and several possible posts. Fewer large timbers survived from Project 85-31, except for a large board recovered from 85-31/27, the *acequia*; two large wooden beams or arches from 85-31/30, a brick-lined cistern; and a single framing support from 85-31/13, a wood-lined pit. In the case of 85-31/13, the framing supports for the pit consisted of 2" x 4" redwood supports and 1" x 4" and 1" x 6" redwood planks (Figure 2).

Several distinctive redwood boards measuring slightly more than 6/8th of an inch thick with one face smoothed by a mechanical plane were identified in 86-36/2 and 86-36/3. They are uncharred with no evidence of fire damage and the surfaces are very fresh. As such, they are very different from the other boards in the assemblage. It is difficult to say if this reflects differences in function or if they are evidence of a later, post-Chinatown occupation, perhaps from the timber yard that moved onto the site between the 1890s and 1920s. Features 86-36/2 and 86-36/3 were both large trash pits, with the former being interpreted by the excavators as backfill from the 1887 post-fire demolition. If the mechanically smoothed boards truly were part of the pre-fire occupation, it is likely that they were used as interior facing boards, which would have protected them from the elements and left little traces of wear on the faces, and not floorboards, for instance, which tend to be heavily worn on the uppermost face.

Composite wood/metal objects

Several specimens appeared to be composite wood/metal objects. These objects fell into three categories. One category was the possible knife handle with attached metal knife, discussed below in the section on portable objects. A second category was found in 85-31/18, a wood-lined pit, and was composed of relatively long redwood timbers that resembled very thin boards with traces of metal staining on them (OTR 066). Although many are very eroded, the best examples are preserved in 85-31/18-941 and 85-31/18-946, where several pieces were cross-mended to form a latticework of wood boarding originally held together with iron bands and iron rivets or nails (Figure 3).The largest measured approximately 8" x 3 ½".The function of such objects is unknown, but they remain very interesting examples of the intersection of woodworking and metalworking that took place on the site. The third category of composite wood/metal objects was found in 85-31/20-359, a wood-lined pit possibly associated with the earlier periods of the Market Street Chinatown. Three specimens of worked redwood with copper staining on the face were cross-mended with several copper objects in the same catalog number (Figure 4). The copper was in the form of thin sheeting, with one rim sherd intact. It originally appeared to be a layer of metal attached to the face of the redwood timbers. The function of this object(s) was unknown. The notes for the original excavation mention possible rat-proofing in another feature, a wood-lined pit in 86-36/18, although in that case the sheeting was made of iron.

85-31/30-4 and 85-31/30-5

The largest structural timbers in the excavation were found in 85-31/30, a brick-lined cistern. They were two redwood beams that appear to have been sawn by hand into a curved or semi-circular shape (Figure 5). 85-31/30-4 measures 31" long x 4.5" wide x 1" thick; 85-31/30-5 measures 29" long x 5" wide x 1" thick. Each beam originally had more than twenty iron nails or fasteners embedded in it. One (85-31/30-4) has the remains of blue-black paint or ink on it, with what appears to be two partial letters or numbers continuing off the side of the board, suggesting either that the writing was carried over onto another, now-missing piece of the structure or that the wood from another object was re-used to make the beam. The original ARS excavators interpreted the beams as part of the Chinatown temple architecture, but it is unclear what led them to this conclusion. Other possible interpretations for the use or re-use of the beams include signs, a round table top, the cover to an oven, or the cover or baseboards of the cistern.

3.3 Portable objects

A number of recognizable artifacts were found in the assemblage, including dominoes, a calligraphy brush, a clothespin, sewing spools, and a knife handle. Details can be found in the individual wood sample recording sheets, but a short description and a photograph of each artifact are included here to demonstrate the diversity of these small finds.

Dominoes (Figure 6)

Five partial and three full dominoes were previously identified in the Market Street Chinatown assemblage: 85-31/6-121 (OTR 057), 85-31/18B-132 (OTR 058), 85-31/18B-244 (OTR 059), 85-31/13-313 (OTR 060), 85-31/18-707 (OTR 061), 85-31/18-713 (OTR 062), 85-31/18B-245 (OTR 063), and 85-31/18B-324 (OTR 064). During analysis a further three possible dominoes were identified: 86-36/18-630 (OTR 035), 86-36/17-164 (OTR 038), and 85-31/18-693 (OTR 067). One of the new dominoes, 86-36/17-164, had been cracked in half but the remaining part preserves a complete lengthwise edge, along which can be seen six incised dots, indicating that it was a double-sixes domino.

Ten of the dominoes were made of ebony, while the eleventh (85-31/18-713) was made of palisander. All eleven were probably imported from China and would have been valuable objects to their owners. The game of dominoes was extremely popular in China during the late 19th century. The dominoes in common use in Overseas Chinese communities in America were a similar size to those from the province of Guangdong and were made of ebony with incised spots painted red and white (Culin 1958:116). Incised spots with traces of white and red paint can be seen on several of the dominoes in the collection. (For a more complete discussion of dominoes

and other gaming pieces from the Market Street Chinatown collection, see Camp 2004 and Chang 2004).

Chopsticks (Figures 7 and 8)

Two possible chopsticks were identified in the assemblage, each a thin piece of worked redwood over 6 inches long with squared sides, tapering down to one end (OTR 007 and OTR 008). They were found in 86-36/13-148, a wooden structure, and each appears to be complete or nearly complete in length. Sixteen other redwood timbers were found in 85-31/18-717, a wood-lined pit, that were evocative of small pieces of chopsticks, although all were incomplete (OTR 069). These small timbers were ¼" wide by ¼" thick, measured 1" to 3" long, and only a few had one intact end. Some were tapered but others were not. It is possible that the untapered ones were either too worn or too small to detect the tapering or else were chopstick blanks that would have been further refined by mechanical or hand smoothing to produce a taper. Twelve other timbers from the same feature had a similar appearance to small pieces of chopsticks but were too worn to be certain of their original dimensions. The identification of all of these possible chopsticks is speculative at best, as it is entirely possible that any or all could have been used as hair sticks or could have had an entirely different, unknown function.

Ball (Figure 9)

A semi-spherical ebony artifact with the grain running from top to bottom was discovered in 86-36/4-207, an unlined trash pit (OTR 032). It was originally a round object and, with the remaining half of the object weighing 289 grams with a diameter of almost 10 cm, it was very heavy for its size. The object was possibly a ball, such those used in the game of lawn bowls or croquet. Although it was initially thought it might be a ball cap finial for a newel post, there is no sign of a joint for slotting it into another piece of wood. To ensure that a joint is strong enough the wood would have been cut with the grain, and evidence for the joint would have survived on the remaining surface of the specimen.

Calligraphy brush (Figure 10)

A round cylinder made of beech attached to a metal tip was found in 85-31/33-71, a brick-lined cistern (OTR 055). According to Dr. Alden, the wood was very high quality, similar to ruler material, and had a dense structure featuring rays that were smaller than normal, which would have added to its dimensional stability. The high quality suggests that it was used for fine art, possibly as a calligraphy brush. Beech has been and still is a common wood for calligraphy brushes. It was probably imported from Asia.

Knife handle (Figure 11)

A knife handle made of unidentified wood was found in 85-31/24-319, a wood-lined pit (OTR 065). The handle was made of two wooden halves sandwiched around a ferrous metal sheet (the remains of the knife). Ferrous metal nails/rivets continued to bind the metal sheet to the two halves of the wooden handle. The handle appeared to have been chamfered on its outside faces near each edge, and ferrous metal concretions, perhaps broken bits from the blade of the knife, adhered to the wooden surface.

Tool handle (Figure 12)

Four similarly-shaped pieces of Western red cedar were found in 86-36/9-149, a wood-lined trash pit (OTR 040). The specimens, which were curved, were interpreted as pieces of a broken pole. When placed next to each other they measure a minimum of 15" long, although this would be an incomplete length for the artifact. The largest piece is 9 ¼" long and has a tapered end that starts 3 ½" from the break at one end. At the point where the taper begins there are signs of compression, wear, and possible metal staining, like a collar around the circumference, suggesting that the pole might have served as a handle for something fitted around the tapered end. Because Western red cedar is low in strength, any attached tool must have been relatively light, perhaps a broom or a rake. Small manufacturers of brooms and brushes were common in the Market Street Chinatown (*pers comm* Connie Young Yu).

Barrel bottoms (Figures 13 and 14)

Two possible barrel bottoms were identified in the assemblage, both of which were found in 86-36/13, a wooden structure. One was made of redwood (OTR 006) and was found in 86-36/13-148, layer 2 of the feature. The other was made of white oak (OTR 027) and was found in 86-36/13-22, layer 1. Both were flat timbers that appeared to have been cut into a circular shape originally. The remaining pieces were less than half of each original barrel bottom, but the original diameter is estimated to be at least 6 ¾" for the redwood barrel bottom and 6" for the white oak barrel bottom.

Clothespin (Figure 15)

One clothespin was found in 85-31/18-268, a wood-lined pit (OTR 070). It was charred but intact.

Sewing spools (Figures 16 and 17)

Two partial sewing spools were found in 85-31/18B, a wood-lined pit: one from 85-31/18B-246 (OTR 071) and the other from 85-31/18B-305 (OTR 072). OTR 071 was heavily charred and

split into 5 pieces but retained the remains of a stamp with the text "J.B[….]s/oo" still visible. OTR 072 was also heavily charred, with the text "[…]ook &" visible on it.

Board from a sign/crate (Figure 18)

A unique board was identified in 86-36/19-5 (OTR 073). Unlike the rest of the boards found during the excavation, this board was very thin and finely made, and was constructed of Western red cedar, not redwood. It retained its original length of 11" and thickness of ¼" with two nail small holes along one edge. Although its function was uncertain, it could have been part of a sign that was hung on a wall or post, for instance, or of a decorative yet sturdy container such as a fruit packing box or a wine crate.

Boxes (Figures 19, 20, and 21)

Three small pieces of possible boxes were identified. Two were made of ebony: one (OTR 026) from 86-36/13-22, a wooden structure, and one (OTR 036) from 86-36/14-210, a wood-lined pit. The third (OTR 056) was made of red sandalwood and was found in 85-31/13-352, a wood-lined pit. All three were constructed using fine woodworking techniques, with each having a shallow groove running the length of one face next to the edge. OTR 026 and OTR 036 have one chamfered end each. The groove was interpreted as a rabbet designed to hold a sliding lid or the bottom of the box. The chamfered end would then be a miter joint where the other side of the box would have connected to the grooved piece.

All three are made from colorful species of wood frequently used to construct valuable and decorative carved objects. The ebony ones would have been black and the red sandalwood one would have been red. Red sandalwood in particular was used to construct small boxes used by scholars, such as ink boxes, notepaper boxes, and seal boxes.

3.4 Register of individual wood samples

A register was kept of all 74 specimens assigned individual wood recording sample numbers by the Oxford Tree-Ring Laboratory (see below). These included the portable objects as well as examples of structural timbers that were subjected to dendrochronology, tool mark analysis, artifact comparison, or were otherwise considered to be especially significant.

OTR number	Catalog number	Species ID	Structural or non-structural	Type	Further analysis
001	86-36/13-148	Redwood	Structural	½" thick board	Tool mark
002	86-36/13-148	Redwood	Structural	Board	Tool mark
003	86-36/13-148	Redwood	Structural	Possible offcut	Tool mark
004	86-36/13-148	Redwood	Structural	Other	Tool mark
005	86-36/13-148	Redwood	Structural	Other	Tool mark
006	86-36/13-148	Redwood	Non-structural	Possible barrel bottom	Artifact comparison
007	86-36/13-148	Redwood	Non-structural	Possible chopstick	
008	86-36/13-148	Redwood	Non-structural	Possible chopstick	
009	86-36/13-148	Redwood	Structural	Offcut of lath	Tool mark
010	86-36/13-148	Redwood	Structural	Offcut of lath	Tool mark
011	86-36/13-148	Redwood	Structural	Offcut	Tool mark
012	86-36/13-148	Redwood	Structural	Other	Tool mark
013	86-36/13-148	Redwood	Structural	Offcut of board	Tool mark
014	86-36/13-148	Redwood	Structural	Offcut of 4" wide board	
015	86-36/13-148	Redwood	Structural	Panel	Tool mark
016	86-36/13-148	Redwood	Structural	½" thick board	
017	86-36/13-148	Redwood	Structural	Board	Tool mark
018	86-36/13-148	Redwood	Structural	Splinter	Tool mark
019	86-36/13-148	Redwood	Structural	Splinter	Tool mark
020	86-36/13-148	Redwood	Structural	Other	
021	86-36/13-148	Redwood	Structural	Other	Tool mark
022	86-36/13-148	Redwood	Structural	Other	Tool mark
023	86-36/13-148	Redwood	Structural	Other	Artifact comparison
024	86-36/13-148	Western red cedar	Structural	Other	Tool mark
025	86-36/13-148	Douglas fir	Structural	Other	Tool mark
026	86-36/13-22	Ebony	Non-structural	Possible wooden box	
027	86-36/13-22	White oak	Non-structural	Possible barrel bottom	Artifact comparison
028	86-36/13-22	White oak	Structural	Possible board	
029	86-36/13-22	Redwood	Structural	Possible board	Tool mark
030	86-36/13-22	Redwood	Structural	Possible board	Tool mark
031	86-36/2-94	Redwood	Structural	Board	Tool mark
032	86-36/4-207	Ebony	Non-structural	Ball	
033	86-36/18-451	Redwood	Structural	Board	Dendrochronology
034	86-36/18-451	Redwood	Structural	Offcut	Dendrochronology
035	86-36/18-630	Ebony	Non-structural	Possible domino	
036	86-36/14-210	Ebony	Non-structural	Possible wooden box	
037	86-36/17-164	Douglas fir	Structural	Tail piece of a dovetail joint	

OTR number	Catalog number	Species ID	Structural or non-structural	Type	Further analysis
038	86-36/17-164	Ebony	Non-structural	Domino	
039	86-36/9-179	Unidentified	Non-structural	Other	
040	86-36/9-149	Western red cedar	Non-structural	Possible tool handle	
041	86-36/9-149	Redwood	Structural	Board	
042	86-36/9-149	Redwood	Structural	Post/beam	
043	86-36/9-149	Redwood	Structural	Post/beam	
044	86-36/19-5	Redwood	Structural	Lath	Tool mark
045	86-36/19-5	Redwood	Structural	Lath	Tool mark
046	86-36/19-5	Redwood	Structural	Splinter	Tool mark
047	86-36/19-5	Redwood	Structural	Splinter	Tool mark
048	86-36/19-5	Redwood	Structural	Splinter	Tool mark
049	86-36/19-5	Redwood	Structural	Miscellaneous	Tool mark
050	86-36/19-5	Redwood	Structural	Miscellaneous	Tool mark
051	86-36/19-5	Redwood	Structural	Miscellaneous	Tool mark
052	86-36/19-5	Redwood	Structural	Miscellaneous	Tool mark
053	86-36/19-5	Douglas fir	Structural	Joinery	
054	86-36/5-1700	Redwood	Structural	Board	Dendrochronology
055	85-31/33-71	Beech	Non-structural	Possible brush handle	
056	85-31/13-352	Red sandalwood	Non-structural	Possible box	
057	85-31/6-121	Ebony	Non-structural	Domino	
058	85-31/18B-132	Ebony	Non-structural	Domino	
059	85-31/18B-244	Ebony	Non-structural	Domino	
060	85-31/13-313	Ebony	Non-structural	Domino	
061	85-31/18-707	Ebony	Non-structural	Domino	
062	85-31/18-713	Palisander	Non-structural	Domino	
063	85-31/18B-245	Ebony	Non-structural	Domino	
064	85-31/18B-324	Ebony	Non-structural	Domino	
065	85-31/24-319	Unidentified	Non-structural	Knife handle	
066	85-31/18-941	Redwood	Structural	Composite wood/metal sheet	
067	85-31/18-693	Ebony	Non-structural	Possible domino	
068	85-31/13-477	Redwood	Structural	Possible pit framing	
069	85-31/18-717	Redwood	Non-structural	Possible chopsticks	
070	85-31/18-268	Unknown	Non-structural	Clothespin	
071	85-31/18B-246	Unknown	Non-structural	Sewing spool	
072	85-31/18B-305	Unknown	Non-structural	Sewing spool	
073	86-36/19-5	Western red cedar	Non-structural	Possible sign or crate	
074	85-31/20-359	Redwood	Structural	Composite wood/metal artifact	

4. FEATURE COMPARISONS

A number of features with a relatively large number of wood specimens weighing at least 100 grams in total were selected for comparative analysis. Features with only one or two large or heavy wood specimens were not considered eligible, nor were features that contained only a large number of small, undiagnostic fragments of wood and charcoal. One feature from Project 85-31 (85-31/18) and seven from Project 86-36 (86-36/5, 86-36/9, 86-36/13, 86-36/14, 86-36/17, 86-36/18, and 86-36/19) met the criteria for analysis. Five were classified by the original excavators as wood-lined pits, one as a wooden structure, one as a wood-lined pit/possible wooden structure, and one as an unlined pit (see table below).

Feature number	Description	Stratigraphic layers	1887 fire association	Total wood (g)	Charred wood (g)	Charcoal (g)
85-31/18	Wood-lined pit	Yes	Unknown	840	121	52
86-36/5	Wood-lined pit	Yes	Unknown	1043	75	1489
86-36/9	Wood-lined pit	No	"Burn layer"	764	605	None
86-36/13	Wooden structure	Yes	"Burn layer"	3101	4	443
86-36/14	Wood-lined pit	No	Unknown	317	7	18
86-36/17	Wood-lined pit/ wooden structure	No	Unknown	199	1	116
86-36/18	Wood-lined pit	Yes	Possible	1848	324	1085
86-36/19	Unlined pit	No	Unknown	641	182	21

Each catalog number was analyzed separately and the results were combined to form assemblages by feature (see table below).

Feature number	Associated catalog numbers
85-31/18	85-31/18-268, 85-31/18-690, 85-31/18-693, 85-31/18-707,85-31/18-713,85-31/18-717,85-31/18-940,85-31/18-941,85-31/18-942,85-31/18-943,85-31/18-944,85-31/18-945,85-31/18-946,85-31/18-947,85-31/18-948,85-31/18-949,85-31/18-950,85-31/18-951,85-31/18-964,85-31/18-965,85-31/18-992, 85-31/18B-132,85-31/18B-244,85-31/18B-245,85-31/18B-246,85-31/18B-305,85-31/18B-324,85-31/18B-338,85-31/18B-352,85-31/18B-450,85-31/18B-451
86-36/5	86-36/5-122,86-36/5-231,86-36/5-238,86-36/5-274,86-36/5-304,86-36/5-442,86-36/5-813,86-36/5-1700,86-36/5-1927,86-36/5-1928,86-36/5-1929,86-36/5-1930,86-36/5-1931,86-36/5-1932,86-36/5-1934,86-36/5-1935,86-36/5-1936,86-36/5-1937, 86-36/5-1938,86-36/5-1939,86-36/5-1965,86-36/5-1981,86-36/5-1982, 86-36/5-1983
86-36/9	86-36/9-149, 86-36/9-179
86-36/13	86-36/13-22,86-36/13-148,86-36/13-213,86-36/13-227,86-36/13-350, 86-36/13-351

Feature number	Associated catalog numbers
86-36/14	86-36/14-82,86-36/14-136,86-36/14-210
86-36/17	86-36/17-164
86-36/18	86-36/18-21,86-36/18-449,86-36/18-450,86-36/18-451,86-36/18-618,86-36/18-619,86-36/18-620,86-36/18-621,86-36/18-622,86-36/18-623,86-36/18-624,86-36/18-625,86-36/18-626,86-36/18-627, 86-36/18-628,86-36/18-629,86-36/18-630,86-36/18-631, 86-36/18-632
86-36/19	86-36/19-5

Five of the features were excavated stratigraphically and thus possessed significant potential for diachronic comparison. In those cases, the catalog numbers comprising each layer were analyzed and comparisons were drawn between the layers where appropriate.

Descriptions of the archaeology of each feature and possible associations with the Market Street Chinatown businesses and residences are drawn from Kane 2011 and are given in detail below in order to facilitate interpretation. Each feature description is then followed by an analysis of the feature's wood and charcoal assemblage.

Feature 85-31/18

Feature description

"Feature 18 of 85-31 was designated by the ARS excavators as a redwood-lined pit of Chinese ethnicity….The feature was subdivided and excavated in at least three parts. The southern half of the feature was labeled as 18B in the field, but it became clear that Feature '18B' was part of Feature 18, and Features 18 and 18B were handled together in the lab and beyond by ARS. The differences between the stratigraphy of the various parts of the pit appear to be minor, so the subdivision of the wood-lined pit was a convenience for the excavators rather than reflective of significant distinctions within the feature.

"The wood-lined pit measured approximately 4 feet by 6 feet and was likely originally a privy pit that was later filled as a trash pit. This feature consisted of 3 levels and was the largest of the features in the 85-31 project, as measured by the number of artifacts recovered. Layer 1 was a largely disturbed deposit of asphalt and concrete fragments with some intermixed artifacts. Layer 2 did not appear to be as disturbed as Layer 1, and it contained a wide variety of artifacts, including ceramics, glass artifacts, wood, metal objects, faunal remains, and several leather shoe fragments. The concentration of artifacts in Layer 2 appears to have been quite large. Layer 3 saw a noticeable increase in the quantity of fish remains, a decrease in pottery fragments, and a strong odor. The bottom of the feature was indicated by sterile sand.

"The vast majority of the field notes written about Feature 18 detail the numerous artifact types excavated from the feature. This list includes opium pipes, a crystal amulet, olivella beads, multiple leather shoes and fragments, an iron pot, glass fragments, ceramics of various origins and styles (Chinese, British, porcelain, stoneware, etc.), a large quantity of animal remains throughout the feature, and building materials.

"Located in Lot 6 of Block 1, Feature 18 of Project 85-31…lay directly adjacent to the southeast corner of the site of the Bernal adobe. According to Laffey (1994, discussion of Lot 3), the Bernal adobe was most likely built by Joaquín Bernal in 1819 and was owned by the family until 1870 when it was sold to George B. Rutherford. Beginning in 1873 the adobe and its lot were leased to residents of the Market Street Chinatown. This building housed various Chinese-owned businesses until 1887 when it was destroyed by the fire, including several merchandise companies, a grocery store and a restaurant. Because of its proximity to this building, the artifacts of Feature 18 are likely associated with the activities that took place within the Bernal adobe." (Kane 2011, Appendix D, 85-31/18, p. 1.)

Wood and charcoal assemblage

Feature 18 contained 840 g. of wood, 121 g. of which were charred. The wood assemblage for Feature 18 is distinctive. Nine of the eleven dominoes, all ebony, were found in 85-31/18. Apart from the dominoes, however, the wood is almost entirely redwood. Most of the timbers are badly eroded, possibly as the result of wet screening. Although the original surfaces are highly abraded, a large number still retain their approximate original width and thickness and sometimes even length, which is highly unusual for any feature. Many of these timbers are unusual types that are not seen in great numbers in any other feature, especially the numerous timbers that are square- or rectangular-shaped in section, such as the possible chopsticks or chopstick blanks mentioned in section 3.3, as well as 85 other timbers (46 g.) that are wider (from 3/8" to 1 ½"), usually longer (up to 9"), and sometimes thicker (up to 1 ½") than the chopstick-shaped timbers. Another set of timbers found only in 85/31-18 are the composite redwood/iron objects described in section 3.2. They are found throughout the feature, but most noticeably in 85-31/940, 85-31/941, and 85-31/946.

The feature contained only a small amount of charcoal (52 g.), mostly redwood with a little bamboo and ring-porous hardwoods. The assemblage also contained 73 g. of coal/coke.

Feature 86-36/5

Feature description

"ARS designated Feature 5 of Project 86-36 as a midden of Chinese ethnicity….This feature was a wood-lined pit, possibly originally a privy pit, with a complex stratigraphy, including 10 identifiable levels. The majority of the artifacts were recovered from Layers 6 and 8, with layers 5 and 7 virtually sterile. ARS originally recorded some 1712 artifacts from this feature, making it the largest feature of ARS Project 86-36 by artifact count.

"A layer identified as 'Upper Stratum' was recorded by the ARS excavations. It was located over the majority of the feature and consisted of a disturbed matrix of gravel, concrete and asphalt with artifacts and faunal remains. Layer 1 was the first undisturbed layer within the feature. The matrix was described as a loose, gray-brown sandy silt and contained historic and recent artifacts. Layer 1a cut into Layer 1 in the west side of Feature 5. This layer was a deposit of loose ash and silt with a small quantity of Chinese artifacts and pig bones. Layer 2 was a shallow deposit of yellow clayey silt. Only artifacts (and not the matrix) were collected from this layer. Layer 3 was a concentrated deposit of gravel, concrete and asphalt. Layer 4 contained a matrix of loose brown silt with a variety of interspersed artifacts including Chinese artifacts, bone, metal fragments, egg shell fragments and charcoal. Layer 5 was sterile and was identified as a gray-yellow clay matrix. Layer 6 contained a heavy deposit of artifacts identified as Chinese in ethnicity and porcine remains in a loose, brown silt. Layer 7 was a sterile deposit of loose, moist, yellow silt and not collected for later analysis. Layer 8 contained high quantities of Chinese artifacts in a loose, brown silt matrix. In the north portion of the feature, Layer 6 sloped down to meet Layer 8.

"According to Laffey, Feature 5 could represent either of the two Chinatowns that occupied Block 1, the 1866 to 1870 Chinatown or the 1871 to 1887 Chinatown." (Kane 2011, Appendix D, 86-36/5, p. 1.)

Wood and charcoal assemblage

Feature 86-36/5 was excavated stratigraphically, with the catalog numbers containing wood and/or charcoal belonging to the following layers:

<u>General surface</u>

- *Catalog number 5-122*: Wood: 9 specimens (85 g.) of redwood, including 3 splinters (12 g.) and 1 offcut (28 g.). 1 specimen (1 g.) is charred. No charcoal.
- *Catalog number 5-1930*: No wood. 1 large lump of unidentified charcoal (40 g.).
- *Catalog number 5-1934*: No wood. 17 g. charcoal, including oak (3 g.) and redwood (4 g.). 26 g. of coal/coke.

<u>Upper layer ("upper stratum")</u>

- *Catalog number 5-304*: Wood: 15 specimens (143 g.) of redwood, including 1 timber (20 g.), possibly part of a post or beam, and 4 pieces (9 g.) of charred redwood. No charcoal.
- *Catalog number 5-1927*: No wood. 1 g. of bamboo charcoal.
- *Catalog number 5-1928*: Wood: 1 piece (1 g.) of charred redwood. No charcoal.
- *Catalog number 5-1929*: Wood: 17 pieces (7g.) of redwood, including 2 nails (2 g.) and 3 pieces (1 g.) of charred redwood. No charcoal.
- *Catalog number 5-1936*: No wood. 9 g. of charcoal.

Layer 1

- *Catalog number 5-274*: Wood: 15 specimens of redwood (8 g.), 2 pieces (2 g.) of it charred. 1 g. redwood charcoal.

Layer 1A

- *Catalog number 5-231*: Wood: 1 redwood timber (53 g.), possibly part of a post or beam. No charred wood or charcoal.

Layer 3

- *Catalog number 5-238*: 56 specimens (47 g.) of redwood, including 1 nail and 1 timber with a nail in it. No charred wood or charcoal.
- *Catalog number 5-442*: Wood: 1 redwood block (45 g.), possibly part of a small beam, with a wire nail embedded in it. No charcoal or charred wood.

Layer 4

- *Catalog number 5-1932*: Wood: 1 specimen (25 g.) of redwood, charred. No charcoal.

Layer 6

- *Catalog number 5-813*: Wood: 88 specimens (137 g.), including 61 redwood specimens (128) g., with 2 offcuts and 11 nails; 9 Western red cedar specimens (5 g.); and 2 Douglas fir specimens (1 g.). Although the wood has been wet screened and the surfaces have deteriorated, based on the shape many of the specimens appear to have been worked timbers. 10 of the specimens (6 g.) are charred, including 4 redwood (2 g.) and 2 Western red cedar (2 g.) specimens. 37 g. of charcoal, including redwood (7 g.) and oak (15 g.). 8 g. of coal/coke.
- *Catalog number 5-1937*: No wood. 9 g. of charcoal, all red oak.
- *Catalog number 5-1938*: Wood: 1 specimen (3 g.) of charred redwood. 552 g. of charcoal, including soft maple (45 g.), beech (11 g.), white oak (5 g.), oak, group unspecified (22 g.), redwood (28 g.), and 56 g. of hardwoods and softwoods from other, unidentified species. 205 g. of coal/coke.
- *Catalog number 5-1983*: 1 redwood specimen (5 g.) with a nail embedded in it. No charred wood, no charcoal.

Layer 8

- *Catalog number 5-1700*: Wood: 32 specimens (360 g.). 30 (358 g.) are redwood, with 7 large pieces of boards, including one 1" thick board at least 4 ¼" wide, and a total of 10 nails, including 5 embedded in the post and boards. 2 of the specimens (2 g.) are Douglas fir. 9 of the redwood specimens are charred (3 g.). 626 g. of charcoal, including redwood (18 g.), white oak (14 g.), live oak (9 g.), oak, group unidentified (43 g.), beech (5 g.), bark (7 g.), and 100 g. of unidentified hardwoods and softwoods from other species. 184 g. of coal/coke.
- *Catalog number 5-1931*: No wood. 12 g. of charcoal, all white oak.
- *Catalog number 5-1939*: Wood: 12 specimens of redwood (5 g.), 10 (3 g.) of which are charred. 16 g. of charcoal, including white oak (2 g.), redwood (1 g.), red oak (1 g.), and bark (8 g.).
- *Catalog number 5-1965*: Wood: 136 specimens (109 g.), including 73 (89 g.) of redwood with 14 nails, 11 (5 g.) of Western red cedar, 5 (2 g.) of Douglas fir, and 47 (13 g.) unidentified. Charred wood: 28 specimens (19 g.), including 16 (14 g.) of redwood. Charcoal: 134 g., including oak (56 g.), redwood (12 g.), and beech (11 g.). 6 g. of coal/coke.

Disturbed/unknown (left out of the layer-by-layer analysis)

- *Catalog number 5-1935 (Disturbed)*: Wood: 5 specimens (10 g.), including 3 of redwood (2 g.) and 2 of Douglas fir (8 g.). Two of the redwood specimens were charred (2 g.). No charcoal.*Catalog number 5-1981(Unknown)*: No wood. 2 g. charcoal, including 1 g. of oak.
- *Catalog number 5-1982 (Disturbed)*: No wood. 33 g. of charcoal, including 14 g. of oak, 5 g. of redwood, and 1 g. of beech.

The upper part of the feature—the general surface and "upper stratum" layers—contained 42 specimens (236 g.) of redwood and no wood of any other species. Most of the wood was too deteriorated to determine whether it was worked or not, but the few obviously worked specimens comprised 3 splinters (12 g.), 1 offcut (28 g.), 2 nails (2 g.), and 1 timber that was possibly part of a post or beam (20 g.). 9 of the specimens were charred (12 g.). This part of the feature contained 67 g. of charcoal, including oak (3 g.), redwood (4 g.), and bamboo (1 g.). 26 g. of coal/coke were present.

Layer 1, the first undisturbed layer, and Layer 1A together had 16 specimens (100 g.) of redwood, 1 of which (53 g.) was possibly part of a post or beam. Two specimens (2 g.) were charred and there was 1 g. of redwood charcoal present.

Layer 3 contained 57 specimens (92 g.) of redwood, including 1 nail and 2 structural timbers with nails embedded in them. One of the structural timbers, a possible beam, was uncharred and the other specimens were too degraded to retain their original surfaces. No charcoal.

Layer 4 contained 1 specimen (25 g.) of redwood, a charred knot. No charcoal.

Layer 6 contained 90 specimens (145 g.) of wood, including 63 redwood (136 g.), with 2 offcuts and 12 nails; 9 Western red cedar (5 g.); and 2 Douglas fir (1 g.). Although the wood has been wet screened and the surfaces have deteriorated, based on their shape many of the specimens appear to have been worked. 11 of the specimens (9 g.) are charred, including 5 redwood (5 g.) and 2 Western red cedar (2 g.). 598 grams of charcoal, including a variety of species such as soft maple (45 g.), oak, group unidentified (37 g.), red oak (9 g.), white oak (5 g.), redwood (35 g.), beech (11 g.), and 56 g. of a mix of unidentified hardwoods and softwoods from other species. 213 g. of coal/coke were present in the layer.

Layer 8 contained 180 specimens (474 g.) of wood. 115 of these (452 g.) are redwood, with 7 large pieces of boards, including one 1" thick board at least 4 ¼" wide and a possible post. 24 total nails, including 5 embedded in the redwood post and boards. 7 of the specimens (4 g.) are Douglas fir and 11 of the specimens (5 g.) are Western red cedar. 35 of the redwood specimens are charred (20g.) as are 12 unidentified specimens (5 g.). 788 g. of charcoal were present, including redwood (31 g.), white oak (28 g.), live oak (9 g.), red oak (1 g.), oak, group unidentified (99 g.), beech (16 g.), bark (15 g.), and 100 g. of unidentified hardwoods and softwoods from other species. 190 g. of coal/coke were present in the layer.

Feature 86-36/9

Feature description

"Feature 9 of Project 86-36 was described by the original ARS excavators as a rectangular, wood-lined trash pit that was ethnically mixed….Feature 9 was excavated as a single layer. This layer contained both European and Chinese artifacts in a 'thick deposit of a burn layer'…. Laffey's analysis placed Feature 9 on Lot 3 of Block 1. Given the 'mixed' nature of the deposit within Feature 9, analysis of the chronologically diagnostic artifacts will be critical for associating this feature with a specific period or occupation. Laffey suggested that a wood-lined pit such as this one would have been initially designed as a privy. Thus it is important to distinguish between the two different uses of this wood-lined feature: first, its likely original use as a privy; and second, its repurposed function as a trash pit. The cultural material within the wooden walls likely answers to the second function, and other analyses might be required to address the chronology of the original use of the pit.

"Based upon its location, Laffey suggested several possible associated occupations ranging in date from the 1850s to the 1880s. During the 1850s this area of Block 1 was owned by two hotel keepers, Jean Vioget and Augustin Châtelle. The Eagle Hotel was located in this area by 1852. By the 1860s, it is possible that parts of Lot 3 were occupied by the first Chinatown located on Block 1, but by 1873 the entire lot was part of the second Chinatown." (Kane 2011, Appendix D, 86-36/9, p. 1.)

Wood and charcoal assemblage

The wood and charcoal assemblage from Feature 9 was spread across two catalog numbers, 86-36/9-149 and 86-36/9-179. Together they contained 94 wood specimens (764 g.), including 25 specimens of redwood (641 g.), 9 specimens of Western red cedar (89 g.), 1 specimen of Douglas fir (0 g.), and 59 small chips of unidentified wood (34 g.). Structural specimens included one redwood board (OTR 041) with the incomplete dimensions of 12" long, 5" wide, and 1" thick and a nail embedded in each end, suggesting that it might have been a wallboard or a decking board; two redwood posts/beams over 3" thick (OTR 042 and 043), possibly from a building or the structure for a pit lining, one with 3 nails embedded in the timber; 1 redwood offcut; and 1 Western red cedar offcut. Non-structural timbers included 4 pieces of Western red cedar presumably from a handle, perhaps to a tool such as a broom, and one unusual, finely-worked specimen of an unidentified species cut on both edges and shaped on both faces, with a small nail embedded in one edge.

The amount of charring on the wood was difficult to determine because of staining from a black residue, similar to that found in 86-36/13 but lacking the greasy feel and the distinctive smell. However, 14 specimens (605 g.) were identified as possibly charred, including several of the large structural timbers. No charcoal was present in the feature.

This feature contained some of the largest structural timbers of the entire excavation. If several of the larger structural timbers are indeed charred, then that would support the hypothesis that this pit was identified with one of the Chinatown fires. However, the evidence is inconclusive at this time.

Feature 86-36/13

Feature description

"Feature 13 of Project 86-36 was described by the ARS excavators as a wooden structure, possibly a dwelling, of either Spanish or Chinese ethnicity….The structure consisted of wooden walls on the west, east, and south sides, with a partial wooden floor. ARS recorded that the wood was in very good condition, and removed the all of the wooden walls of the feature to the lab for

further analysis and possible reconstruction. The deposit within the walls of Feature 13 was excavated in four layers. The cultural layers of Feature 13 were primarily confined to the eastern portion of the feature….The relationship(s) among these four stratigraphic layers are somewhat unclear, and different accounts of the excavations appear to contradict each other.

“Layer 1 was deemed disturbed by the ARS excavators and was described as a loose dark brown silt with charcoal and wood fragments. The material recovered from this layer included various historical and ‘recent’ artifacts and faunal remains. Layer 1 was sometimes referred to as the ‘Top Layer’….The Top Layer was also referred to as the ‘Burn Layer’ though evidence for fire is minimal. A wooden floor was found at the base of Layer 1, about 10-20 cm down. Layer 1 appears to have extended over the full area of the feature.

“Layer 2 was an intrusion into Layer 1…located in the east portion of the feature. This layer was described as a coprolite matrix, very compact and green in color. Layer 3 was a firm, black silt with metal fragments and was located beneath Layer 2 in the eastern portion of Feature 13. Layer 4 was a thin deposit of charcoal and carbon below Layer 3 extending from the east side toward the center of the feature. Below these cultural layers lay a sterile yellow sand matrix. The western portion of Feature 13 appears to have been filled in with sterile, yellow silt, but the relationship between this ‘fill’ and the base of Feature 13 is unclear.

“The artifacts recovered from Feature 13 included a variety of historical artifacts, including several Chinese ceramics. Also recovered were fish and other faunal remains, as well as some melon and other unidentified seeds. The soils samples from this feature will be particularly important for botanical analyses carried out in the future.

“Feature 13 was an unusual feature within the ARS excavations. It was one of only a few, and possibly the only, feature containing a primary context. The majority of the features excavated on Block 1 are secondary contexts such as trash pits or demolition deposits. But Feature 13 was likely a dwelling, possibly with an intact residential layer. It seems strange, given the unique character of Feature 13, that Laffey chose to lump Feature 13 together with several rather ordinary ‘trash pits’ in her analysis of the features of Block 1. Laffey included Feature 13 in her discussion of wood-lined pits with mixed deposits on Lot 3.

“In Laffey’s interpretation of the character and location of Feature 13, she suggested several possible associated occupations ranging in date from the 1850s to the 1880s for this feature. During the 1850s this area of Block 1 was owned by two hotel keepers, Jean Vioget and Augustin Châtelle. The Eagle Hotel was located in this area by 1852. By the 1860s, it is possible that parts of Lot 3 were occupied by the first Chinatown located on Block 1, but by 1873 the entire lot was part of the second Chinatown. The assemblage from this feature could narrow down a time frame for the use of this feature.” (Kane 2011, Appendix D, 86-36/13, pp.1-2.)

Wood and charcoal assemblage

Six catalog numbers with wood and charcoal specimens are associated with 86-36/13. Layer 1 contained catalog number 86-36/13-22, Layer 2 contained catalog numbers 86-36/13-148, 86-36/13-350, and 86-36/13-351, and Layer 3 contained catalog numbers 86-36/13-213 and 86-36/13-227.

<u>Layer 1</u>

- *Catalog number 13-22*: 467 total wood specimens (627 g.), 3 of which are charred (1 g.). 79 of the specimens (212 g.) are redwood, including 3 laths, 3 splinters, 5 offcuts (2 from ¾" thick boards), 3 boards (one 1" thick board, 2 miscellaneous), and various other types of structural wood. 3 specimens (19g.) are Western red cedar. 41 specimens (81 g.) are Douglas fir, including 1 strip, 3 splinters, and 1 small specimen with a nail/pin embedded in it. Other identified species include a piece of coconut shell (5 g.), 2 timbers made of white oak (72 g.), 1 of which is possibly a barrel bottom, and 1 specimen of a possible ebony box (6 g.). 340 specimens (232 g.) are unidentified, including 33 twigs, 6 strips, 1 offcut, 3 nails, and 2 pieces of wood with metal around them. Four of the structural redwood specimens have saw marks on them. In all, redwood makes up 34% of the assemblage by weight, with the rest composed of 13% Douglas fir, 11% white oak, 3% Western red cedar, 1% coconut, 1% ebony, and 37% unidentified species.

233 g. of charcoal are present, including white oak (12 g.), live oak (2 g.), oak, group unspecified (24 g.), beech (2 g.), redwood (5 g.), and cottonwood (7 g.). 12 g. of coal/coke are also present in the layer.

<u>Layer 2</u>

- *Catalog number 13-148:* 903 total wood specimens (2207 g.), 1 of which is charred (3 g.). 604 of the specimens (1408 g.) are redwood, including 7 strips, 6 slats, 12 laths, 3 panels, 18 splinters, 9 boards (3 miscellaneous, 2 that are ½" thick, 2 that are 1" thick, and 2 that are 2" thick), 10 offcuts, 7 nails, and various other types of structural wood. 32 specimens (131 g.) are Western red cedar, including 2 boards that are ½" thick and 1 offcut. 30 specimens (118 g.) are Douglas fir, including 1 offcut and 1 nail. Other identified species include bamboo (3 g.), a worked piece of camphor (6 g.), a piece of coconut shell (11 g.), a worked piece of oak (29 g.), palm (18 g.), a worked piece of fruitwood (27 g.), cottonwood (10 g.), and a worked piece of willow (7 g.) Sixteen of the structural redwood specimens have saw marks and 4 have small cut holes, possibly for

nails. Non-structural redwood timbers include the two possible chopsticks and one possible barrel bottom. In all, redwood makes up 64% of the assemblage by weight, with the balance being composed of 6% Western red cedar; 5% Douglas fir; 1% oak; 1% fruitwood; less than 1% of bamboo, camphor, coconut shell, palm, cottonwood, and willow; and 20% unidentified species.

153 g. of charcoal, including redwood (30 g.), oak, group unspecified (23 g.), beech (11 g.), and Douglas fir (2 g.) are present, as are 21 g. of coal/coke.

- *Catalog number13-350*: 35 specimens of wood (5 g.), including 3 g. of redwood and 2 g. of unidentified wood. 20 g. of charcoal, including 5 g. of oak and 2 g. of redwood. No charred wood.
- *Catalog number 13-351*: 41 specimens of wood (18 g.), including 26 specimens (8 g.) of redwood (3 specimens of which are offcuts), 1 (o g.) of Western red cedar, 4 (0 g.) of Douglas fir, and 10 (10 g.) of unidentified wood. No charcoal, no charred wood.

Layer 3

- *Catalog number 13-213*: 167 specimens of wood (244 g.). These specimens were not examined by the Oxford Tree-Ring Laboratory.
- *Catalog number 13-227*: 37 g. of charcoal. These specimens were not examined by the Oxford Tree-Ring Laboratory.

The wood and charcoal assemblages from Layers 1 and 2 appear to be roughly similar in composition, although redwood makes up a smaller percentage of Layer 1. It is difficult to say for sure whether or not any of the catalog numbers represent a primary context, especially since after looking at the wood assemblage, a question arises about the security of the stratigraphic locations. The ARS records note that wood fragments were found in Layer 1, but there is no mention of them in Layers 2 through 4. However, the volume of wood specimens identified by ARS as coming from Layer 2 is extremely large, more than three times the weight of wood specimens from Layer 1. Catalog number 13-148 alone contains 2207 grams of wood, the largest weight of wood for a catalog number in the entire excavation. The field sketch maps show Layer 2 as a limited and relatively small intrusion into the east side of a larger Layer 1 overlaying the entire feature (and possibly into a top layer above Layer 1 that also overlays the feature). Although it is possible that this amount of wood fit into a relatively small part of the feature, it is also possible that the confusion over the relationships among the layers extends to the wood specimens that were excavated from them.

Nevertheless, the sheer amount of wood from 86-36/13 is striking. 86-36/13 contains 1613 specimens (3101 grams), the most wood by far of the entire excavation, with the second largest concentration of wood, that of 86-36/18, weighing a little more than half that of 86-36/13.

Equally striking is the presence of so many different species of wood. The charcoal assemblage contains white oak, live oak, cottonwood, beech, Douglas fir, and redwood, while the wood assemblage contains bamboo, camphor, coconut, ebony, oak (including white oak), palm, fruitwood, cottonwood, and willow in addition to the more usual redwood, Western red cedar, and Douglas fir. The camphor, oak, fruitwood, cottonwood, and willow specimens are the only examples of their species in the entire wood assemblage

Overall, when compared to the other features in the excavation, 86-36/13 has the greatest variety of species and the greatest number of types of structural wood. Every type of structural wood is present in the assemblage. This diversity of species and types is not solely a result of the greater number of wood specimens, as can be seen when other features are combined to have a similar number or weight of wood specimens.

Charcoal is present in large quantities in Layers 1 and 2 but evidence for fire damage is almost non-existent, with only four very small specimens of charred wood (4 g.). Many of the timbers have a darkened/stained appearance, an oily feel, and a distinctive smell, which appears to have been mistaken for charring in the past. Residue analysis conducted on samples of stained timber from this feature indicate that the residue is a natural wax coating, a common treatment used to protect wood from moisture. (See Appendix E for more details.) Based on the wood and charcoal assemblage, this feature does not appear to be associated with the 1887 fire.

Feature 86-36/14

Feature description

"Feature 14 of Project 86-36 was designated by the original ARS excavators as a redwood-lined pit with a deposit of mixed ethnicity….According to the excavators, the wood that lined the pit was in extremely good condition where it was still intact. The south and east walls of the pit were entirely missing (possibly cut by construction equipment). The pit was excavated in a single layer with a matrix of loose, brown silt. This layer contained a concentration of historical artifacts, including whole and broken Chinese ceramics, faunal remains, and metal fragments. The base of the feature was indicated by a firm, mottled silt-clay matrix.

"Laffey's analysis placed Feature 14 on Lot 3 of Block 1. Laffey described the assemblage of this feature as 'mixed,' based on the presence of both Chinese and European ceramics….Based upon its location, Laffey suggested several possible associated occupations ranging in date from the 1850s to the 1880s. During the 1850s this area of Block 1 was owned by two hotel keepers, Jean Vioget and Augustin Châtelle. The Eagle Hotel was located in this area by 1852. By the 1860s, it is possible that parts of Lot 3 were occupied by the first Chinatown located on Block 1, but by 1873 the entire lot was part of the second Chinatown….It is important in the case of

Feature 14 to distinguish between the two possible uses of this wood-lined feature. First, its likely original use as either a cistern or privy, and second, its repurposed function as a trash pit. The cultural material within the wooden walls likely answers to the second function." (Kane 2011, Appendix D, 86-36/14, p. 1).

Wood and charcoal assemblage

The wood and charcoal assemblage from Feature 14 was spread across three catalog numbers: 86-36/14-82, 86-36/14-136, and 86-36/14-210. Together they contained 87 redwood specimens (317 g.), 1 ebony specimen (5 g.), and 58 small unidentified wood fragments (27 g.). Twelve of the redwood specimens are structural, including two partial boards, one at least 2 ½" wide; one specimen 1 ¼" wide by 1" thick with a nail embedded in it; and two other small pieces of wood with nails attached. The ebony specimen (OTR 036) is possibly part of a wooden box.

The outer surfaces of most of the specimens are stained with a black oily substance, making it difficult to determine the extent of charring. Chemical analysis of residues (Appendix E) found that the stained wood specimens had been treated with a natural wax coating, a common treatment used to protect wood from moisture. The wax is similar to that found on wood specimens in Features 86-36/13 but the wax is present in lesser quantities, either as a result of original use or through differences in preservation. It appears that only 8 specimens weighing 7 grams are charred, none of which are large structural timbers. The feature contains a small amount (18 g.) of charcoal, made up of redwood (7 g.), oak (7 g.), and beech (4 g.). 9 g. of coal/coke are present.

Feature 86-36/17

Feature description

"Feature 17 of 86-36 was described as a wood-lined trash pit of Chinese ethnicity by the original ARS excavators….Feature 17 was excavated in a single cultural layer, and included primarily Chinese artifacts, glass fragments, and faunal remains. The matrix was described as loose, dark grey, and loamy. Several wooden beams were recovered from the feature, likely forming the lining of the feature, that resembled the wooden beams of Features 13 and 15 of 86-36. Feature 17 was found at a depth of about 10 feet, about 20 to 24 cm below Features 13 and 15. The ARS excavators suggested that Feature 17 may have been the base of Features 13 and/or 15. They also suggested that this feature may have been the lower portion of Feature 7, based on its location.

"Based on its location (though not its depth), Laffey suggested several possible associated occupations from Feature 17 ranging in date from the 1850s to the 1880s. During the 1850s this area of Block 1 was owned by two hotel keepers, Jean Vioget and Augustin Châtelle. The Eagle

Hotel was located in this area by 1852. By the 1860s, it is possible that parts of Lot 3 were occupied by the first Chinatown located on Block 1, but by 1873 the entire lot was part of the second Chinatown." (Features 86-36/7, 86-36/13 and 86-36/15)." (Kane 2011, Appendix D, 86-36/17, p. 1).

Wood and charcoal assemblage

The total weight of the wood from 86-36/17 was 199 grams, with many larger structural pieces present, although nothing as large as the posts/beams in 86-36/9. There is a wide variety of types of structural redwood, including slats, boards (two ¼" thick and 1 ½" wide boards, one 1" thick board), nails, offcuts, and other types of timber. The presence of offcuts suggests woodworking on site. One of the redwood specimens appears to be a sawn-off part of a worked branch or thin tree. There are several structural specimens of Douglas fir, including a tail piece for a crude dovetail joint (OTR 037). Several unknown specimens of Western red cedar and a partial ebony domino showing double sixes are also present. By weight, redwood makes up 75% of the assemblage, with Douglas fir comprising 10%, Western red cedar 3%, and unidentified species 11%.

The presence of charring on the wood is minimal, with only 4 tiny charred pieces of wood (1 g.). 116 grams of charcoal were present, including redwood (4 g.), oak (21 g.), and other unidentified hardwoods (22 g.). 13 grams of coal/coke were present.

Specimens from Feature 86-36/17 were submitted for chemical analysis of residues (Appendix E). The analysis found that samples of wood from Feature 86-36/17 contained a large variety of hydrocarbons suggestive of a wood preservative such as creosote.

Feature 86-36/18

Feature description

"Feature 18 of Project 86-36 was designated by the ARS excavators as a redwood wood-lined pit with artifacts of mixed ethnicity….The stratigraphy of Feature 18 was quite complicated. The feature was divided into three cells (labeled Cell 1, 2, and 3 from north to south) for the purpose of excavation, each with its own distinct stratigraphy. From the field records, it appears that these cells were arbitrary. It should be noted that 'Level' and 'Layer' were used interchangeably in the field and lab records.

"Cell 1 was excavated on 1/20/1987 in five layers. Layer 1 was a 2 cm thick deposit of ash and charcoal and contained brick fragments. It showed possible evidence of having been disturbed. Layer 2 was a yellow-brown silty clay, well packed and containing faunal remains and a whole

soy pot. Layer 3 was a small pocket of grey silt within the NE section of Layer 2. This loose matrix contained faunal remains. Layer 4 was a grey/blue/brown silt clay, loosely packed. This layer saw an increase in metal fragments and a decrease in the faunal remains recovered. Layer 5 was a firm, moist, fine-grained silt. Artifacts were collected from Layer 5, but the matrix was not collected.

"Cell 2…was excavated in a total of five layers. Two of these layers were located above a layer of wood planks, and these layers were labeled Layers 1 and 2. Two additional layers were excavated below the wood planks and were labeled Layers A and B. The nature of Levels 1 and 2 are not described in the field notes. Level 2 sat directly on a 'wooden floor' constructed of redwood, with some heavily charred planks. The strata excavated below the level of wooden planks, Layers A and B, were divided into interior and exterior areas, separated by the eastern wall of the feature…The interior strata all sloped roughly 10 to 20 degrees south to north. Level A Interior was a silty clay, grey-brown in color and approximately 14 cm thick. Beneath a 5 cm layer of sterile soil, this level contained a light concentration of iron fragments, charcoal, wood fragments, glass, and brick fragments. Level A Interior was quite distinct from Level B Interior, which consisted of a friable clay silt with large quantities of ash interspersed and was approximately 30 cm thick. The artifacts recovered from Level B Interior included fish bone, gaming pieces, ceramic fragments, opium pipe top fragments, glass bottle fragments, and a possible jade bracelet. Level B Interior rested on top of a layer of sterile sand. Level A Exterior, which was directly adjacent to the wooden wall of the feature, was described as similar to the matrix of Level A Interior, but contained more sand and very little cultural material. Level B Exterior was later determined to be the same as Level B Interior, and was described in the same terms.

"Cell 3…like Cell 2 consisted of two levels above the 'wooden floor' (Levels 1 and 2). Three levels were excavated below the wood planks in Cell 3 (Levels A, B, and C). The strata of Cell 3 also sloped south to north, as for Cell 2. Level 1 was a compact, grey-brown, silty clay. Little cultural material was recovered from this level, and the matrix was not collected. Level 2 was a mixed matrix, likely disturbed, of silty clay, grey-brown and yellow-brown in color. This level was located directly above the floor, and fragments of wood, possibly charred, were encountered above the floor in the eastern portion of the cell. The floor itself was uneven, sloping 10 to 15 degrees south to north, with significant segments missing and some evidence of charring. Below the floor, Level A Interior was similar to that of Cell 2, with a low density of cultural materials. Level C was encountered between Levels A and B. It formed a wedge between Levels A and B with the deepest portion (10 cm thick) on the south side of Cell 3, tapering to the north. Artifact density was low. Level B Interior was similar to that of Cell 2, but contained a greater density of large ceramic fragments, including complete bowls, cups and spoons. A concentration of fish scales was encountered along the south wall of the cell and as well as a concentration of egg

shell. In the southeast corner of Cell 3, a vertical steel beam, surrounded by concrete, intruded into the feature.

"An interesting aspect of this feature was discovered along the western wall of both Cells 2 and 3. A thin layer of ferrous metal, covered with paint, was found on the exterior lining of the feature wall. The large concentration of the ferrous metal fragments found in the cells was likely associated with this lining. An ARS excavator suggested that this ferrous lining was evidence that this pit was a 'rat-proofed' storage compartment. In the field, ARS suggested that this subterranean storage compartment was abandoned sometime prior to the 1887 fire and used for debris disposal. The layer of wood planks, originally serving either as the ceiling of the storage pit or possibly as the floor of the building above, collapsed into the feature, after which the upper three layers (Levels 1, 2, and 3) were deposited.

"Feature 18 of Project 86-36 was not directly discussed by Laffey, however this feature was located on Lot 2, an area of Block 1 that served many functions during the period from 1850 to 1970." (Kane 2011, Appendix D, 86-36/18, pp. 1-2.)

Wood and charcoal assemblage

The wood and charcoal assemblage for Feature 18 was spread over eighteen catalog numbers. In some cases the stratigraphic links between the catalog numbers and the cell/layer that they came from were broken, as seen below:

Cell 1 Catalog #s	**Cell 2 Catalog #s**	**Cell 3 Catalog #s**	**Unknown Cells**
621 Below Layer 3 on top of floor	622 (Wall trimmings from Cells 1 & 2)	625 Layer A	21 "Mixed pit trimmings"
622 (Wall trimmings from Cells 1 & 2)	623 Layer 1	629 Layer C	449 Layer A
	624 Layer B interior	630 Layer 1	450 Layer 2
	626 Layer B	631 Layer 2	451 Layer 1
	627 Layer B	632 Layer 2	618 Layer 2
	628 Layer 3		619 Layer 4
			620 Layer B

The material from Cells 2 and 3 appears to be relatively securely located within the feature. The material from Cell 1 and from numbers without a cell designation is more problematic. However, based on the field drawings, the layer descriptions, and the notes on the original specimen bags, it is possible to suggest a correlation between the catalog numbers and their placement either above or below the supposed wooden plank floor.

The material from 10 catalog numbers appears to have come from above the floor. Layer 1 contained 623, 630, and possibly 451; Layer 2 contained 631, 632, and possibly 450 and 618; Layer 3 contained 628; and directly below Layer 3 in Cell 1 but above the floor was catalog number 621. The material from 7 catalog numbers appears to have come from below the floor. Layer A contained 449 and 625; Layer C (between Layers A and B) contained 629; and Layer B contained 620, 624, 626, and 627. Two catalog numbers, 21 and 622, comprised a mix of wall trimmings from various layers. Catalog number 619 came from layer 4, which would imply a location in Cell 1, probably below the floor (based on the description of catalog number 621).

Wood and charcoal specimens found above the floor:

Layer 1

- *Catalog number 18-623*: 11 total specimens (123 g.), all of which are redwood and 9 of which are charred (119 g.) including 1 board. There is one piece (3 g.) of Douglas fir charcoal.
- *Catalog number 18-630*: 61 total specimens (36 g.), of which 60 (34 g.) are redwood and 1 (2 g.) is ebony. The ebony specimen is charred, as are 21 (6 g.) of the redwood. 17 g. of redwood charcoal and 3 g. of coal were present.
- *Catalog number 18-451 (possibly included)*: 68 total specimens (301 g.), including 59 specimens (272 g.) of redwood, 5 specimens (9 g.) of Douglas fir, and 4 specimens (20 g.) of unidentified wood. The redwood specimens include 28 structural pieces of wood, with 3 splinters, 1 board, and 3 offcuts, one from a 1" board. One piece of unidentified wood (3 g.) is charred. No charcoal. Specimens from this catalog number were submitted for residue analysis (Appendix E) which found that some wood was treated with natural wax, as was also found for specimens from Feature 86-36/13, 86-36/14, and 86-36/15.

Layer 2

- *Catalog number 18-631*: 154 total specimens (293 g.), including 70 specimens (239 g.) of redwood and 84 specimens (54 g.) of unidentified wood, many of which are small fragments. No charcoal, no charred wood. Contains a large number of nails (24).
- *Catalog number 18-632*: Charcoal (13 g.), including redwood (12 g.). 2 g. of coal/coke.
- *Catalog number 18-450 (possibly included)*: 10 total specimens (77 g.), all charred, including 6 pieces (68 g.) of redwood, one of which is a large fragment of a board or post, and 4 pieces (9 g.) of Douglas fir. 33 g. charcoal, all redwood.
- *Catalog number 18-618 (possibly included)*: 70 total specimens (49 g.), none charred. 46 are redwood (41 g.), including 2 nails; 1 is Douglas fir (1 g.); and 23 (7 g.) are unidentified. 1 g. of unidentified charcoal.

Layer 3

- *Catalog number 18-628*: 259 total specimens (190 g.), including 51 pieces (92 g.) of redwood (with 8 nails), 1 piece (0 g.) of Douglas fir, and 207 specimens (98 g.) of unidentified species (98 g.). 1 piece of charred unidentified wood (1 g.) and 11 g. of charcoal, including redwood (2 g.) and oak (3 g.). 1 g. of coal/coke.

Below Layer 3 but above the floor

- *Catalog number 18-621*: 24 specimens of redwood (143 g.), including 4 with nails. No charred wood, no charcoal.

Wood and charcoal specimens found below the floor:

Layer A

- *Catalog number 18-449*: 11 specimens of redwood (56 g.). No charred wood, no charcoal.
- *Catalog number 18-625*: 254 specimens total (188 g.), including 77 specimens (140 g.) of redwood, 2 of which (4 g.) are charred, and 177 specimens (48 g.) of very small unidentified wood. 46 g. of charcoal, including redwood (29 g.) and oak (12 g.). 2 g. of coal/coke.

Layer C

- *Catalog number 18-629*: 3 specimens (5 g.) of redwood, including 1 charred piece (1 g.). 7 g. of unidentified charcoal.

Layer B

- *Catalog number 18-620*: 5 redwood specimens (10 g.), none of which are charred. 60 g. of charcoal, including oak (27 g.), redwood (8 g.), and cottonwood (2 g.). 4 g. of coal/coke.
- *Catalog number 18-624*: 30 specimens (129 g.) of redwood, of which 6 pieces (80 g.) are charred, and 454 g. of charcoal, including red oak (4 g.), oak, unspecified (150 g.), and redwood (38 g.). 84 g. of coal/coke.
- *Catalog number 18-626*: 24 specimens (61 g.) of redwood, including 6 nails (33 g.) and 5 charred specimens (3 g.). 340 g. of charcoal, including redwood (8 g.), oak (27 g.), and beech (5 g.). 33 g. of coal/coke.
- *Catalog number 18-627*: 10 specimens (2 g.) of redwood, including one with a thin metal coating around it, and 85 g. of charcoal, including redwood (19 g.), and oak (25 g.). 20 g. of coal/coke. No charred wood.

Wood and charcoal specimens found in an uncertain location

Wall trimmings from Cells 1 and 2*:*

- *Catalog number 18-21*: 4 total specimens (38 g.) of redwood, including 1 nail/wood specimen that is charred (6 g.). No charcoal.
- *Catalog number 18-622*: 32 total specimens (123 g.), including 16 specimens (117 g.) of redwood, 2 specimens (0 g.) of Douglas fir, and 14 specimens (6 g.) of unidentified wood. 3 specimens (22 g.) of the redwood are charred. 15 g. of charcoal, including oak (10 g.) and redwood (3 g.). 10 g. of coal/coke.

Layer 4 (presumably Cell 1)

- *Catalog number 18-619*: 1 specimen of redwood (24 g.)

The material from each layer was analyzed to try to achieve meaningful points of comparison. Due to the large number of greatly deteriorated or badly broken specimens, however, it was impossible to identify the species or diagnostic features of much of the assemblage, which in turn made it difficult to draw any firm conclusions about the differences among the layers or between the material found above and below the wooden floor.

A few general conclusions could be drawn. There is a mix of wood, charred wood, and charcoal in the material both above and below the floor. Redwood predominates among the charred and uncharred wood across the layers, with very few other identifiable species of wood present. Catalog number 86-36/18-51, in Layer 1, had the largest number and widest variety of timbers with diagnostic features, with 28 structural timbers of wood made from redwood, including 3 splinters, 1 board, and 3 offcuts. Compared to the wood found in some of the other features, such as 86-36/13, however, this was not a very large or very varied structural wood assemblage. The only significant non-structural specimen found in the assemblage was a piece of charred ebony, possibly a partial domino, also found in Layer 1. A large number of nails were present in Layers 2 and 3, many still attached to pieces of redwood too deteriorated to identify typologically.

Charred wood was present in all of the layers, but only in significant amounts in Layers 1, 2, and B. The largest structural timbers of the assemblage were in Layers 1 and 2, including a board and some miscellaneous timbers in Layer 1 and a large post or board in Layer 2, all of which were charred, and a second uncharred board and an offcut from a board in Layer 1. Charcoal was present in all the layers but only Layer B contained a large amount. Coal was found both above and below the floor, occurring in small amounts above the floor and directly below it in Layer A, and in much larger amounts in Layer B at the bottom of the feature.

The original ARS excavators suggested that the original wooden floor of the structure had collapsed down into the subterranean storage compartment below it, with Layers 1, 2, and 3 then being deposited on top. It was hoped that this hypothesis could be verified or dismissed based on a close analysis of the wood and charcoal assemblage, but unfortunately the poor condition and partial nature of the wood specimens made it impossible to do so. It is worth noting, however,

that Layers 1 and 2 both contained larger charred structural timbers, which might point to their association with the 1887 fire.

Taken together, the different layers of 86-36/18 contain the second-largest amount of wood of all the features in the entire excavation, after 86-36/13. The total weight of the wood assemblage is 1848 grams, including 324 grams of charred wood specimens. The total weight of the charcoal assemblage is 1085 grams. Much of the wood was severely deteriorated, probably the result of wet screening, and some of the larger pieces were knots that had fallen loose from their timbers and so yielded little diagnostic information. Several of the structural timbers were quite large, but none of them approached the size of the boards or posts/beams in 86-36/9, for instance. The largest of the structural timbers tended to be found in the uppermost two layers of the feature and almost all of these were charred, pointing to a probable association with the 1887 fire for at least the upper layers of the feature.

Feature 86-36/19

Feature description

"Feature 19 of Project 86-36 was designated by the original ARS excavators as a roughly rectangular, unlined trash pit of Chinese ethnicity…excavated as a single layer of loose, grey-brown, sandy clay. A second layer was discovered, but could not be isolated from the first during excavation. This second layer was described as moist, firm, dark blue clay containing historical artifacts and was found in the northeast portion of the feature. Metal fragments and ash were interspersed throughout the matrix. In the east side of the feature, a concentrated deposit of metal and ash was uncovered. A deposit of porcine bone and glass fragments was uncovered in the south section of the feature. The ARS excavators suggested that the 'second layer' of firm clay was the original deposit, and the scatter of objects in the loose sandy clay was disturbed by the construction equipment.

"Based upon its location, Laffey suggested several possible associated occupations ranging in date from the 1850s to the 1880s for Feature 19. During the 1850s this area of Block 1 was owned by two hotel keepers, Jean Vioget and Augustin Châtelle. The Eagle Hotel was located in this area by 1852. By the 1860s, it is possible that parts of Lot 3 were occupied by the first Chinatown located on Block 1, but by 1873 the entire lot was part of the second Chinatown." (Kane 2011, Appendix D, 86-36/19, p. 1.)

Wood and charcoal assemblage

The total weight of the wood found in 86-36/19 was 641 grams. The wood assemblage here resembled that of 86-36/13, with a wide variety of structural types of redwood and Douglas fir,

including strips, slats, laths, panels, splinters, nails, offcuts, and other types of timber, but without the diversity of hardwood species found in that feature. The presence of offcuts suggests woodworking on site. Many of the structural timbers retained mechanical saw marks on their faces. There was a noteworthy lack of large structural timbers, however, with no boards made of redwood and only one thin, finely made board of Western red cedar, the specimen discussed above that was possibly part of a sign or a crate. One fragment of joinery made of Douglas fir survived (OTR 053). It was smoothed into a curved shape using a molding plane to form a construction element for a piece of furniture or a building, such as a tongue from a tongue-and-groove floorboard, a mullion from a window frame, or a decorative piece of furniture molding. In total, redwood makes up 51% of the assemblage by weight, with Douglas fir comprising 18%, Western red cedar 6%, and unidentified species 24%.

The presence of charring on the wood is minimal, with only two charred specimens (21 g.). Several of the timbers appeared to be stained with a dark substance rather than charred. 182 g. of charcoal are present, including red oak (2 g.), live oak (4 g.), white oak (7 g.), oak, group unidentified (24 g.), bamboo (2 g.), willow (2 g.), redwood (18 g.), beech (12 g.), Douglas fir (1 g.), and unidentified bark (25 g.). 66 g. of coal/coke were also present.

An analysis of the wooden structures (Features 86-36/13, 86-36/15, and 86-36/17)

From a wood-analysis standpoint, three of the most important yet tantalizing features of the excavation are the wooden structures. The ARS excavators found large, well-preserved framing elements (wooden planks, beams, walls, and a partial floor) forming several rectangular wooden structures associated with Features 86-36/13, 86-36/15, and 86-36/17. All of the structural wood was removed to ARS's lab for analysis and later reconstruction, but was subsequently lost. Questions remain, however, about the relationship between the three features.

During the excavation it was suggested that all three were possibly part of the same structure. 86-36/13 consisted of wooden walls on the west, east, and south sides, with a partial wooden floor. 86-36/15 was discovered 32 cm to the east of 86-36/13, and like 86-36/13 was a rectangular wooden structure with unusually well-preserved wooden planks forming the walls of the feature. 86-36/15 was likely part of 86-36/13, but since ARS did not reach this conclusion until partway through excavation, the two features remained separate in the field and in laboratory analysis. 86-36/17 was found about 20 to 24 cm below 86-36/13 and 86-36/15, and contained several wooden beams similar to those found in the other two features. It was suggested that, based on its location, 86-36/17 either formed the base to 86-36/13 and/or 86-36/15 or else formed the base to another nearby feature, 86-36/7. It was hoped that by examining the wood and charcoal assemblages of all three, it might be possible to gain a greater understanding of the differences and similarities between the three features.

The wood and charcoal assemblages for 86-36/13 and 86-36/17 have been discussed in detail above. In summary, 86-36/13 contains the greatest amount of wood, the greatest variety of species, and the greatest variety of types of structural redwood timbers for the entire excavation. A small amount of charred wood and a relatively large amount of charcoal were found in 86-36/13. 86-36/17 contained mostly redwood, with very small amounts of Western red cedar, Douglas fir, and ebony. As in 86-36/13, there was a variety of structural redwood specimens, a small amount of charred wood, and a relatively large amount of charcoal. 86-36/15 contained only redwood (90 g.), with some of the same types of structural redwood timbers as 86-36/13 and 86-36/15 (several strips, slates, offcuts, nails, and miscellaneous specimens). No charcoal and no charred wood were present in 86-36/15.

Like 86-36/13, the wood specimens of 86-36/15 have a darkened/stained appearance, an oily feel, and a distinctive smell. Samples of wood from both of these features were submitted for chemical analysis of residue (Appendix E), which found that the residue is a natural wax coating, a common treatment used to protect wood from moisture. The timbers from 86-36/17 do not have the same stained, oily appearance, and chemical analysis of residues found that some specimens contained a large variety of hydrocarbons, typical of wood preservatives such as creosote. The use of both natural wax coatings and creosote to protect and preserve wood are complementary and both methods may have been used in the same structure, with waxes more likely used on floor and interior surfaces and creosote-like preservatives more typically used on structural elements and exterior surfaces. .

However, the total wood assemblages for 86-36/15 and 86-36/17 are so much smaller than for 86-36/13 (90 and 199 grams versus 3101 grams respectively) that it is difficult to make valid comparisons between the three features. Therefore it seems that the wood and charcoal assemblages are not able to shed much light on the relationships between the features beyond the general characterizations that have been drawn here.

5. INTERPRETATION AND CONCLUSIONS

This section moves on from the discussion of the attributes of a select number of features to a consideration of the entire wood and charcoal assemblage and an interpretation of the site as a whole. It addresses larger questions about the composition of the buildings in the Market Street Chinatown, the use of the buildings and the site by the residents who lived there, and the destruction of the buildings caused by the fire of 1887.

Occupation deposits versus fire deposits

One of the key questions arising from this project was whether a detailed analysis of the wood and charcoal assemblage could reveal any differences between the features associated with the occupation of Block 1 before the 1887 fire and the "burn layers" associated with the 1887 fire and subsequent leveling of the site. An initial comparison of charred and uncharred timbers was inconclusive, since both types of timbers seemed to be present in both sets of features. The mere presence of charcoal, too, was considered but discarded as a signpost for one type of feature or the other, since it seemed to be prevalent in greater or lesser amounts across the entire site.

An examination of the variety of species found in the features turned up a new theory. A cursory examination of the wood found in each feature shows that different kinds of wood occur in different types of features. What is less obvious is that the composition of the charcoal assemblage actually varies greatly between features as well, and even between layers in certain features. When taken together, the diversity of species in both the wood and charcoal assemblages seems to be one indicator for deposits that might be pre-fire occupation layers.

Feature 86-36/5, a wood-lined pit 2.2 meters deep with complex stratigraphy and discrete artifact layers bounded by sterile soils, ideally demonstrates these differences. The upper layers, which are disturbed, contain only redwood timbers and a small amount of oak and redwood charcoal, some coal/coke, and a very tiny amount of bamboo charcoal. The layers with a dense concentration of undisturbed Chinese artifacts, Layers 6 and 8, have a very different mix of species. These layers contain Western red cedar and Douglas fir timbers in addition to the redwood, and a large variety of species in the charcoal assemblage, including white oak, red oak, live oak, redwood, soft maple, beech, unidentified bark, and a mix of hardwoods and softwoods from other, unidentified species. They also contain large amounts of coal and coke.

Other features that are strongly associated with the 1887 fire and widespread destruction of the buildings on the site, such as 86-36/9, primarily contain redwood, sometimes with a smattering of Western red cedar and Douglas fir. They tend to contain large structural timbers, often with charring, and relatively little charcoal. What charcoal there is tends to be redwood with some oak mixed in with it. 86-36/13, a wooden structure not associated with the fire, contains a much more

diverse assemblage. White oak, live oak, cottonwood, redwood, Douglas fir, beech, and other hardwood species are present in the charcoal. Oak, camphor, ebony, bamboo, coconut, palm, fruitwood, cottonwood, and willow, as well as the more common redwood, Western red cedar, and Douglas fir, are found in the wood assemblage. A wide variety of different types of structural timbers and possible artifacts such as barrel bottoms, a calligraphy brush, chopsticks, a knife handle, and a box were all found in the feature. The presence of large amounts of coal also probably signifies buried occupation deposits rather than fire debris. Likewise, the charcoal found in 86-36/5 and 86-36/18 contains up to 10 different species each of hardwoods and softwoods, much coal, but little redwood charcoal. This is in contrast to many of the features that contain primarily redwood charcoal with some oak charcoal present.

Charcoal production and use

In all probability, the differences in the charcoal assemblages can be explained by the way that the charcoal came to be produced. Coal in California was scarce and had to be imported while wood was plentiful; by the 1850s, charcoal had come into use and was preferred over wood for blacksmithing, smelting, and domestic cooking and heating because of its superior heating ability and cleaner burning (Whatford 2000: 112). Oak was preferred over redwood, Douglas fir, and Western red cedar for making charcoal as the resulting product burned much hotter and longer (Wilson et al 2010). Other hardwoods such as beech and cottonwood, while not as desirable as oak, also burned better than the more readily available softwoods and so were preferred over them as well.

Charcoal was made all over the state, frequently by immigrants to the country, such as the Italian workers who dominated the Sonoma charcoal making operations and the 350 Chinese workers employed in Truckee by the largest charcoal producer in the state (Whatford 2000: 113). It is very possible that not only did the residents of Chinatown heat their homes and cook with charcoal, but also that some were involved with charcoal production in some capacity.

The hardwood charcoals found during excavation were therefore probably reflective of charcoal produced off site and used for cooking, heating, smelting, blacksmithing, and other domestic and industrial processes in the Market Street Chinatown. Together with the different types of non-structural wood specimens made from a variety of species found alongside them, they represented the usual lost, discarded, and broken artifacts and waste products found in middens associated with day-to-day occupation of a site. On the other hand, the redwood structural timbers and charcoal found as the primary deposits of other features probably represent the remains of burned buildings and thus are most probably associated with either the 1870 or 1887 fires. The lack of non-structural artifacts in these post-fire deposits can be explained by scavenging of the remains after the fire to rescue whatever was left that could still be useful.

It is important to bear in mind that several factors complicate the analysis. Many of the features identified as non-fire deposits by ARS were possibly contaminated with fire debris at some point in their history, whether during the leveling of the site or during the haphazard recovery process of the excavation. Also, several of the features that ARS noted contained "burn layers," such as 86-36/13, actually show no signs of charred timbers or other burning but do show a dark, oily staining that does not appear to be connected to the fire. Therefore, any analysis should look for the presence of more than one indicator before determining whether a feature is associated with the fire or with pre-fire occupation.

Trade and travel

The diversity of species found within the features also emphasizes the role of trade within the Chinatown community. The ebony, red sandalwood, and palisander artifacts all represent valuable, high-quality objects constructed using fine-woodworking techniques and imported from Asia by the merchants of San Jose or San Francisco. The camphor as well would have come from Asia. The coconuts, and possibly the palm and bamboo specimens, would have been imported as well, perhaps from Hawaii. The presence of all these species testifies to the commercial connections that linked not only California and China but also the communities of the wider Chinese diaspora across North America, the West Indies, and Southeast Asia.

A sense of place

Several questions crop up repeatedly when thinking about the physical spaces that surrounded the residents of the Market Street Chinatown. What can the wood and charcoal assemblage tell us about the homes and businesses that made up Block 1? What were the buildings constructed of and what did they look like? What sorts of objects would the residents have had around them? What was destroyed by the fire and what survived?

By weaving together different strands of evidence, it is possible to generate potential answers to these questions, although caution must be taken since the nature of such answers is speculative at best. The following hypotheses are based on a close examination of the wood and charcoal specimens, an analysis of 19th-century photographs and eyewitness descriptions of the Market Street Chinatown, scrutiny of photographs taken during the excavations of the 1980s and of standing buildings that remain at other Chinatown sites in California, and prior technical knowledge of construction techniques.

The buildings were probably primarily made of redwood and, to a lesser extent, Douglas fir. Giant trees from the forests of Northern California were converted into timbers using large circular and reciprocating mechanical saws near to where the trees were cut down. The timbers were carted to Chinatown and joined together on site using iron nails to make one- and two-story

buildings. Redwood would have been used for much of the exterior and interior of the buildings (roof boards, sidings, interior cladding, and general joinery timbers), as well as for floorboards and for the wooden walkways between buildings. Douglas fir was probably used for the structural framing of the buildings—the rafters, joists, posts, beams, wall plates, and bottom plates. Western red cedar would have been used for shingles, sheds, and possibly cisterns. Many of the buildings were painted, but the roofs were not, weathering to a soft silver-grey over time.

Houses, outbuildings, places of business and places of worship, restaurants and gambling rooms, all were packed tightly together to make the most of a small site. Wooden steps, wooden boardwalks, and wooden partition walls, along with the wooden buildings, surrounded the residents, eventually contributing fuel for the fire that caught quickly and raged until the entire site was destroyed.

As the residents fled their homes, they snatched whatever they could carry that was valuable: money and goods, food and clothing, but also any portable wooden objects that were useful or had sentimental value. After the embers cooled, they must have gone back to what was left of their houses to rescue anything they could find. Even charred and partially carbonized wooden objects were taken away, as having a damaged box, desk, bed, or barrel was still better than having nothing at all. The remains were picked clean, then the shells of the few buildings still standing were knocked down and the site leveled in preparation for new construction. The ruins of the Market Street Chinatown were buried until a new period of rebuilding began in the 1980s, when the archaeological excavation uncovered, among many other artifacts, an extremely fragmentary but surprisingly evocative wood and charcoal assemblage that bears witness not only to the magnitude of the calamity that destroyed the Market Street Chinatown but also to the resilience of the residents who had once made a life there.

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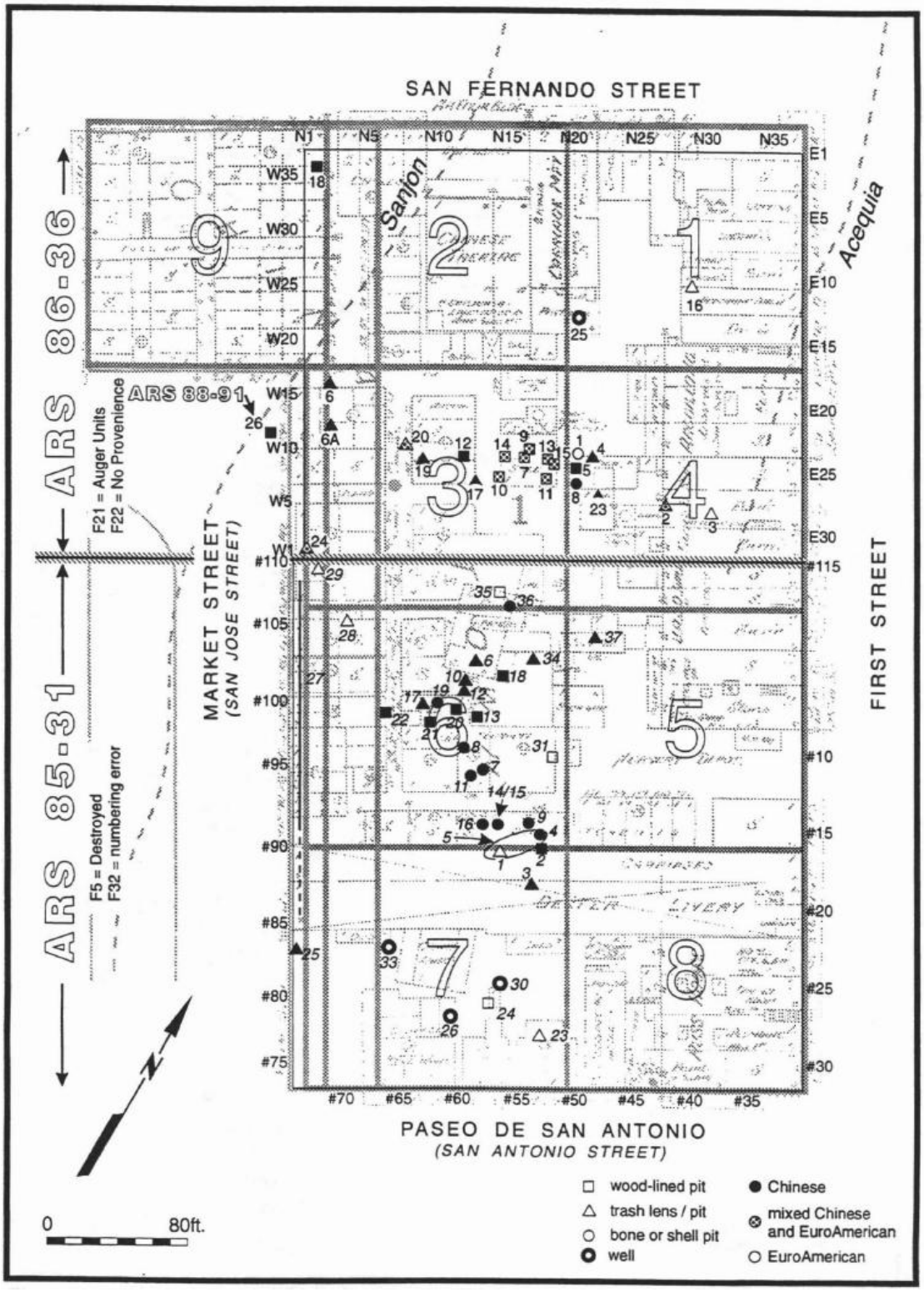

Map 1. 1884 Sanborn map of Block 1 with location of features superimposed (Kane 2011: Map A.10, from Laffey 1994: Figure 5, after Parsons 1993: Figs. 2-3; ARS various; Roop et al. 1988; and CSJ 1983)

PHOTOGRAPHS

Figure 1. Timber from 86-36/2-94 with circular saw tool marks

Figure 2. Excavation photo showing the framing supports for wood-lined pit 85-31/13

Figure 3. Composite redwood/iron objects from 85-31/18-946 (above) and 85-31/18-941 (below)

Figure 4. Composite redwood/copper objects from 85-31/20-359

Figure 5. Curved redwood beams from 85-31/30-4 (above) and 85-31/30-5 (below)

Figure 6. Ebony dominoes from 85-31/18B-244 (top), 85-31/6-121 (bottom left), and 85-31/18B-132 (bottom right)

Figure 7. Possible redwood chopsticks from 86-36/13-148

Figure 8. Possible redwood chopsticks /chopstick blanks from 85-31/18-717

Figure 9. Ebony ball from 86-36/4-207

Figure 10. Beech calligraphy brush from 85-31/33-17

Figure 11. Knife handle from 85-31/24-319

Figure 12. Western red cedar tool handle from 86-36/9-149

Figure 13. White oak barrel bottom from 86-36/13-148

Figure 14. Redwood barrel bottom from 86-36/13-22

Figure 15. Clothespin from 85-31/18-268

Figure 16. Sewing spool from 85-31/18B-246

Figure 17. Sewing spool from 85-31/18B-305

Figure 18. Western red cedar sign/crate from 86-36/19-5

Figure 19. Ebony box from 86-36/13-22

Figure 20. Ebony box from 86-36/14-210

Figure 21. Red sandalwood box from 85-31/13-352

Appendix A. Table of catalog numbers containing wood and charcoal specimens

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
85-31/1-316		Unlined trash pit	Demo layer	26	26	x
85-31/1-317		Unlined trash pit	Demo layer	2	2	23
85-31/2-345		Wood-lined trash pit	Demo layer	110	3	1
85-31/2-346		Wood-lined trash pit	Demo layer	x	x	2
85-31/2-347		Wood-lined trash pit	Demo layer	57	57	219
85-31/2-348		Wood-lined trash pit	Demo layer	x	x	3
85-31/2B-9		Wood-lined trash pit	Demo layer	x	x	7
85-31/6-121		Unlined trash pit	Possible	7	7	x
85-31/6-219		Unlined trash pit	Possible	1	x	x
85-31/6-220	Level 1	Unlined trash pit	Possible	x	x	5
85-31/6-221	Level 1	Unlined trash pit	Possible	x	x	1
85-31/6-222	Level 1S	Unlined trash pit	Possible	x	x	15
85-31/6-223	Level 3 N (bottom, last)	Unlined trash pit	Possible	2	2	16
85-31/6-224		Unlined trash pit	Possible	x	x	51
85-31/9-115		Unlined bone pit	Unknown	x	x	1
85-31/10-114	Level 1	Unlined trash pit	Ashy deposit	7	7	x
85-31/10-115	Level 1	Unlined trash pit	Ashy deposit	x	x	13
85-31/10-116	Level 1	Unlined trash pit	Ashy deposit	x	x	3

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
85-31/10-118	Dep above ash	Unlined trash pit	Ashy deposit	1	1	x
85-31/10-119	Dep above ash	Unlined trash pit	Ashy deposit	x	x	1
85-31/10-120		Unlined trash pit	Ashy deposit	3	x	x
85-31/13-313		Wood-lined trash pit	Unknown	2	2	x
85-31/13-352		Wood-lined trash pit	Unknown	2	2	x
85-31/13-353	Level 2	Wood-lined trash pit	Unknown	1	x	x
85-31/13-463	N 1/2	Wood-lined trash pit	Unknown	2	1	x
85-31/13-464	Layer 1 Above redwood post	Wood-lined trash pit	Unknown	3	x	19
85-31/13-465	Layer 1 Rear of pit, upper portion	Wood-lined trash pit	Unknown	5	x	1
85-31/13-466		Wood-lined trash pit	Unknown	1	1	23
85-31/13-468	Layer 1 Rear of pit, upper portion	Wood-lined trash pit	Unknown	x	x	1
85-31/13-470	Level 4	Wood-lined trash pit	Unknown	2	1	17
85-31/13-471	Level 2 N side	Wood-lined trash pit	Unknown	1	x	12
85-31/13-472	Level 2	Wood-lined trash pit	Unknown	1	x	1
85-31/13-473	Level 2 N side	Wood-lined trash pit	Unknown	x	x	3
85-31/13-474		Wood-lined trash pit	Unknown	7	7	12
85-31/13-475	Level 2 N 1/2	Wood-lined trash pit	Unknown	x	x	6
85-31/13-476	Level 2	Wood-lined trash pit	Unknown	x	x	3

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
85-31/13-477	Layer 3 Burned pit	Wood-lined trash pit	Unknown	267	x	x
85-31/13-480	Level 3 N 1/2	Wood-lined trash pit	Unknown	44	2	11
85-31/13-481	Level 2 N 1/2 pit at + below wood	Wood-lined trash pit	Unknown	16	1	x
85-31/13-482	Level 3 Fish feature	Wood-lined trash pit	Unknown	3	x	1
85-31/13-483		Wood-lined trash pit	Unknown	x	x	13
85-31/13-484	Level 3 Fish bone	Wood-lined trash pit	Unknown	1	1	9
85-31/13-485	Layer 3 N 1/2	Wood-lined trash pit	Unknown	1	1	26
85-31/13-486	Layer 2 N 1/2 base gray clay	Wood-lined trash pit	Unknown	x	x	9
85-31/13-488		Wood-lined trash pit	Unknown	x	x	9
85-31/14-54		Unlined bone pit	Unknown	3	3	2
85-31/18-268	Level 2	Wood-lined pit	Unknown	11	11	x
85-31/18-690	Interface between Levels 2 & 3	Wood-lined pit	Unknown	5	x	x
85-31/18-693	Interface between Levels 2 & 3	Wood-lined pit	Unknown	12	x	x
85-31/18-707		Wood-lined pit	Unknown	7	7	x
85-31/18-713		Wood-lined pit	Unknown	4	x	x
85-31/18-717	Level 3, very loose	Wood-lined pit	Unknown	142	9	1
85-31/18-940	Layer 2	Wood-lined pit	Unknown	40	x	x
85-31/18-941	Level 3 NE 1/4	Wood-lined pit	Unknown	59	10	x

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
85-31/18-942	Level 2	Wood-lined pit	Unknown	63	16	3
85-31/18-943	Level 1 E 1/2	Wood-lined pit	Unknown	41	41	x
85-31/18-944	Layer 3 NE 1/4	Wood-lined pit	Unknown	32	1	x
85-31/18-945	Level 3 E 1/2 (central area)	Wood-lined pit	Unknown	44	5	x
85-31/18-946	"Level 1 or 3"	Wood-lined pit	Unknown	81	x	1
85-31/18-947	Level 3 NE 1/4	Wood-lined pit	Unknown	81	x	x
85-31/18-948	Layer 3 SE 1/4 (corner)	Wood-lined pit	Unknown	47	x	x
85-31/18-949	Level 3 NE 1/4	Wood-lined pit	Unknown	47	x	x
85-31/18-950	Level 3 E 1/2 (central area)	Wood-lined pit	Unknown	x	x	7
85-31/18-951	Level 3, E 1/2	Wood-lined pit	Unknown	30	x	x
85-31/18-964	Level 2	Wood-lined pit	Unknown	1	1	18
85-31/18-965	Level 2	Wood-lined pit	Unknown	2	2	18
85-31/18-992	E 1/2	Wood-lined pit	Unknown	13	12	1
85-31/18B-132		Wood-lined pit	Unknown	7	x	x
85-31/18B-244		Wood-lined pit	Unknown	8	x	x
85-31/18B-245		Wood-lined pit	Unknown	3	3	x
85-31/18B-246	Level 2	Wood-lined pit	Unknown	1	1	x
85-31/18B-305	E section of feature from Bag 1	Wood-lined pit	Unknown	1	1	x
85-31/18B-324		Wood-lined pit	Unknown	6	x	x
85-31/18B-338	E 1/2 of building 1	Wood-lined pit	Unknown	1	1	x

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
85-31/18B-352		Wood-lined pit	Unknown	17	x	3
85-31/18B-450		Wood-lined pit	Unknown	9	x	x
85-31/18B-451		Wood-lined pit	Unknown	25	x	x
85-31/19(20)-341		Wood-lined pit	Unknown	5	x	x
85-31/19(20)-344		Wood-lined pit	Unknown	x	x	1
85-31/19(20) (no cat. #)		Wood-lined pit	Unknown	2	2	3
85-31/20-325	Lower level	Wood-lined pit	Unknown	x	x	1
85-31/20-351	Lower level	Wood-lined pit	Unknown	x	x	4
85-31/20-356	Lower level E	Wood-lined pit	Unknown	x	x	2
85-31/20-357		Wood-lined pit	Unknown	x	x	1
85-31/20-359		Wood-lined pit	Unknown	29	x	x
85-31/20-360	Lower level	Wood-lined pit	Unknown	1	x	x
85-31/20-364	Lower level	Wood-lined pit	Unknown	x	x	1
85-31/20-367		Wood-lined pit	Unknown	1	x	x
85-31/20-381	NE corner of feature	Wood-lined pit	Unknown	1	x	x
85-31/22-108	Layer 1, SE 1/2	Wood-lined pit	Unknown	61	x	x
85-31/24-176		Wood-lined pit	Unknown	x	x	24
85-31/24-317		Wood-lined pit	Unknown	x	x	3
85-31/24-319		Wood-lined pit	Unknown	25	x	x
85-31/24-320		Wood-lined pit	Unknown	1	x	x
85-31/24-321		Wood-lined pit	Unknown	13	x	x

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
85-31/24-322		Wood-lined pit	Unknown	1	x	7
85-31/27-314		Acequia	Demo layer	75	75	x
85-31/27-315		Acequia	Demo layer	4	4	x
85-31/28-115		Unlined trash pit	Possible	29	1	6
85-31/28-116		Unlined trash pit	Possible	2	1	2
85-31/28-117		Unlined trash pit	Possible	5	x	x
85-31/28-118		Unlined trash pit	Possible	3	x	9
85-31/30-4		Brick-lined circular feature	Unknown	643	x	x
85-31/30-5		Brick-lined circular feature	Unknown	756	x	x
85-31/33-71		Brick-lined circular feature	Unknown	3	x	x
85-31/33-219		Brick-lined circular feature	Unknown	x	x	73
86-36/1-206	Clay layer	Oyster shell pit	Unknown	2	x	x
86-36/2-17	General surface	Unlined trash pit	Unknown	8	1	x
86-36/2-94	General surface	Unlined trash pit	Unknown	95	x	x
86-36/3-91	General surface	Unlined trash pit	Unknown	16	x	4
86-36/3-92	General surface	Unlined trash pit	Unknown	29	x	x
86-36/3-93	General surface	Unlined trash pit	Unknown	47	x	x
86-36/4-207	Level 4	Unlined trash pit	Unknown	289	x	x
86-36/5-122	General surface	Wood-lined pit	Unknown	85	1	x

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
86-36/5-231	Strata 1A	Wood-lined pit	Unknown	53	x	x
86-36/5-238	Strata 3	Wood-lined pit	Unknown	47	x	x
86-36/5-274	Strata 1	Wood-lined pit	Unknown	8	2	1
86-36/5-304	Upper strata	Wood-lined pit	Unknown	143	9	x
86-36/5-442	Strata 3	Wood-lined pit	Unknown	45	x	x
86-36/5-813	Level 6	Wood-lined pit	Unknown	137	6	37
86-36/5-1700	Level 8	Wood-lined pit	Unknown	360	3	626
86-36/5-1927	Upper strata	Wood-lined pit	Unknown	x	x	1
86-36/5-1928	Upper strata	Wood-lined pit	Unknown	1	1	x
86-36/5-1929	Upper strata	Wood-lined pit	Unknown	7	1	x
86-36/5-1930	General surface	Wood-lined pit	Unknown	x	x	40
86-36/5-1931	L8	Wood-lined pit	Unknown	x	x	12
86-36/5-1932	Strata IV	Wood-lined pit	Unknown	25	25	x
86-36/5-1934	General surface	Wood-lined pit	Unknown	x	x	17
86-36/5-1935	Disturbed	Wood-lined pit	Unknown	10	2	x
86-36/5-1936	Upper strata	Wood-lined pit	Unknown	x	x	9
86-36/5-1937	Strata 6	Wood-lined pit	Unknown	x	x	9
86-36/5-1938	Level 6	Wood-lined pit	Unknown	3	3	552
86-36/5-1939	Layer 8	Wood-lined pit	Unknown	5	3	16
86-36/5-1965	Level 8	Wood-lined pit	Unknown	109	19	134
86-36/5-1981		Wood-lined pit	Unknown	x	x	2

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
86-36/5-1982	Disturbed	Wood-lined pit	Unknown	x	x	33
86-36/5-1983	Level 6, lower	Wood-lined pit	Unknown	5	x	x
86-36/6-208	Level 3	Trash pit, prob unlined	Unknown	x	x	11
86-36/7-114	Level 1	Wood-lined cistern/trash pit	Burn layer	30	3	5
86-36/7-408	Upper disturbed	Wood-lined cistern/trash pit	Burn layer	14	x	x
86-36/7-917	General surface	Wood-lined cistern/trash pit	Burn layer	7	7	x
86-36/7-1105	Level 1	Wood-lined cistern/trash pit	Burn layer	11	3	1
86-36/7-1106	Level 1	Wood-lined cistern/trash pit	Burn layer	x	x	10
86-36/8-66	0-10 cm "Cell 4"	Unlined bone pit	Unknown	31	x	x
86-36/8-111	Level 1	Unlined bone pit	Unknown	x	x	10
86-36/9-149	0-50 cm	Wood-lined trash pit	Burn layer	741	596	x
86-36/9-179	0-50 cm	Wood-lined trash pit	Burn layer	23	9	x
86-36/11-35	Level 1	Unlined trash pit	Unknown	80	1	1
86-36/12-103	General surface	Unlined trash pit	Unknown	x	x	1
86-36/13-22	Level 1	Wooden structure	Burn layer	627	1	233
86-36/13-148	Level 2	Wooden structure	Burn layer	2207	3	153
86-36/13-213	Level 3	Wooden structure	Burn layer	244	?	x
86-36/13-227	Level 3, wall debris N	Wooden structure	Burn layer	x	x	37

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
86-36/13-350	Layer 2	Wooden structure	Burn layer	5	X	20
86-36/13-351	Layer 2	Wooden structure	Burn layer	18	X	X
86-36/14-82	0-35 cm	Wood-lined pit	Unknown	2	x	x
86-36/14-136	0-35 cm	Wood-lined pit	Unknown	295	x	x
86-36/14-210	"0-35 in DBS"	Wood-lined pit	Unknown	52	7	18
86-36/15-5	Level 1	Wooden structure	Possible	16	1	1
86-36/15-107	Layer 2	Wooden structure	Possible	74	x	x
86-36/16-18	Level 1	Unlined trash pit	Unknown	1	1	10
86-36/16-62	Level 1	Unlined trash pit	Unknown	1	x	x
86-36/17-164	0-20 cm	Wood-lined trash pit/possible wooden structure	Unknown	199	1	116
86-36/18-21	"Mixed pit trimming frags"	Wood-lined pit	Possible	38	6	x
86-36/18-449	Layer A	Wood-lined pit	Possible	56	x	x
86-36/18-450	Layer 2	Wood-lined pit	Possible	77	77	33
86-36/18-451	Layer 1	Wood-lined pit	Possible	301	3	x
86-36/18-618	Layer 2	Wood-lined pit	Possible	49	x	1
86-36/18-619	Layer 4	Wood-lined pit	Possible	24	x	x
86-36/18-620	Layer B	Wood-lined pit	Possible	10	x	64
86-36/18-621	Below layer 3 on top of floor, Cell 1	Wood-lined pit	Possible	143	x	x

Catalog #	Excavation level & ARS associations	Feature description	1887 fire assoc.	Wood (g)	Charred wood (g)	Charcoal (g)
86-36/18-622	Cell 1 & 2; wall trimmings	Wood-lined pit	Possible	123	22	25
86-36/18-623	Layer 1 Cell 2	Wood-lined pit	Possible	123	119	3
86-36/18-624	Layer B Cell 2 Interior	Wood-lined pit	Possible	129	80	454
86-36/18-625	Layer A Cell 3	Wood-lined pit	Possible	188	4	46
86-36/18-626	Layer B Cell 2	Wood-lined pit	Possible	61	3	340
86-36/18-627	Layer B Cell 2	Wood-lined pit	Possible	2	x	85
86-36/18-628	Layer 3 Cell 2	Wood-lined pit	Possible	190	1	11
86-36/18-629	Layer C Cell 3	Wood-lined pit	Possible	5	1	7
86-36/18-630	Layer 1 Cell 3	Wood-lined pit	Possible	36	8	17
86-36/18-631	Layer 2 Cell 3	Wood-lined pit	Possible	293	x	x
86-36/18-632	Layer 2 Cell 3	Wood-lined pit	Possible	x	x	13
86-36/19-5	Level 1: 0-25 cm	Unlined trash pit	Unknown	641	21	182
86-36/20-417		Lined trash pit (wood?)	Unknown	77	80	8

Appendix B. An Introduction to Wood and Charcoal Identification

Harry A. Alden, PhD

There are many questions that come to mind when viewing or studying objects that are made from wood. Where did the object come from? What kind of wood is it made of? Why was this type of wood used? What is the tradition, with respect to wood use, of the culture producing the object? Many of these questions can sometimes be answered by a microscopic examination of cellular structure of the wood.

Microscopic wood anatomy is a scientific endeavor with a long, famous history. One of the earliest materials used for microscopic observation by Antony van Leeuwenhoek (1632-1723) was bark from a tree. The most famous use of wood anatomy and identification in forensics was the work of Arthur Koehler at Forest Products Laboratory, whose analysis of a ladder used in the Lindbergh Kidnapping led to the apprehension and conviction of Bruno Hauptman in "The Crime of the Century" in the 1930s. A popular current use of microscopic wood anatomy and identification is to help authenticate antiques, as seen on Antiques Road Show.

Answering Questions

Why would anyone want to know what type of wood has been used in an object?

1. General Curiosity (what wood is that?)
2. Academic Studies
    a. Authentication/Assigning Provenance (where it came from)
    b. Cultural Traditions of Use and Trade (where was it made/where did it end up and why)
    c. Replacement of Broken/Damaged areas/parts (conservation/restoration)
    d. Forensic knowledge for Crime Solving (where it came from and comparing it to crime scene trace evidence)
3. Monetary Gain (Fine Arts Dealers)
    a. Authentication
    b. Provenance relates to Value

Limitations (Levels of Determination)

Microscopic wood identification and analysis from objects d'art have limitations not always apparent to conservators, curators, art historians and collectors. These limitations are based on many factors, including the size of the sample, the level that one looks at the sample (i.e. microscopic) and the evolutionary conservative nature of wood with respect to species determination. The hierarchy of plants is based on a taxonomic system developed by Carl Linnaeus (1707-1778), where each specific type of plant is given a binomial ("two-names") with the genus (like our family names, e.g. Smith) and a species name (like our first names, e.g. John). The binomial is italicized, with the genus first and the species epithet second (e.g. Eastern White Pine is *Pinus strobus*). When one refers to an unknown species the term "sp." is used and when

one is referring to more than one species in a genus, the plural "spp." is used. Similar genera are grouped into Families (ending in –aceae), similar families into Orders, similar orders into Classes, and similar classes into Divisions.

Determination of Genus

When people think of types of wood, they generally are thinking in terms Pine, Oak, Maple, Spruce, etc., which describe genera of trees (*Pinus*, *Quercus*, *Acer* and *Picea*, respectively). Even with small samples, identification of wood to the genus level is usually very accurate.

Species Groups

Species groups are groups of species, within a genus, which have anatomical similarity. For instance, the Pines (*Pinus* spp.) can be grouped into the Red Pine Group, White Pine Group and Yellow Pine Group. The Oaks (*Quercus* spp.) contain the Red (Erythrobalanus) and White (Leucobalanus) Groups and the Maples (*Acer* spp.) have species that separate into the Hard and Soft Groups.

Species Determinations

The microscopical determination of wood to the species level is usually not possible. These limitations are based on the evolutionary conservative nature of wood. Species of wood (trees, and plants in general) have been determined in the past from the number, size, shape and orientation of external features, such as reproductive structures (flowers, fruits, cones), foliar structures (leaves or needles) or other parts of the plant like bark or branch morphology. These characters are rarely present in objects made of wood. Current, molecular techniques of DNA analysis are moot because of the paucity or lack of DNA in wood.

Species determinations are empirically (straight from the anatomical characters, without assumptions) possible for a few taxa. In the Walnut/Butternut Group (*Juglans* spp. Juglandaceae), American Black Walnut (*J. nigra*) can be separated from English/European/Persian Walnut (*J. regia*) by the presence of short chains (1-5) of calcium oxalate crystals in the axial parenchyma and irregular spiral thickenings in the vessels termed "gashes". Some empirical species separations are conditional in nature. For example, in True Mahogany (*Swietenia* spp. Meliaceae), if the specific gravity (density) of the wood is above 0.65, then the wood is Cuban Mahogany (*S. mahogani*) and not Honduran Mahogany (*S. macrophylla*). If the specific gravity is below 0.65, either species may be present.

Some species determinations are deductive through geography (and other ways). In the genus *Liriodendron* (Magnoliaceae), there are two species worldwide, Tulip Poplar (*L. tulipifera*), native to the United States and Chinese Tulip Tree (*L. chinensis*), native to China. If the wood in question is in a colonial American object, then it is deduced to be Tulip Poplar. The True Hickories would exemplify a chronological deduction. This genus had a distribution across the northern hemisphere prior to the Pleistocene (Ice Age), but afterward was restricted to eastern Asia and North America. Its presence in colonial objects is deduced as being American.

Provenance Determination

The assignment of provenance (where the object came from) based solely on microscopical wood identification is, empirically (without making any assumptions) virtually impossible, because of the limitations mentioned above. Most groups (genera, species groups) show cosmopolitan distributions, i.e., there are species on both sides of the Atlantic or Pacific. However, a few genera or species have very limited natural distributions and are good "indicator" woods. For example, Capá Blanco (*Petitia* spp. Verbenaceae) is composed of only one species, native to the Caribbean Islands. Its presence in an object would indicate that it originated in the Caribbean.

Wood identification does not, by itself, determine provenance of objects, but is an element used along with constructional and stylistic features. The determination of provenance of objects d'art has many other complicating factors.

Complicating Factors

Common Names

Most times, woods are referred to by their common names; Pines for the genus *Pinus*, Oaks for the genus *Quercus*, etc. In general, this scheme works well, but there are also many times when confusion can occur with the use of common names. For example, the name "sycamore" is the genus *Platanus* in the US, but in England and Europe it is a species of Maple (*Acer pseudoplatanus*). Also the term "poplar" can represent the Tulip Poplar (*Liriodendron tulipifera*), a wood common in colonial furniture or the True Poplars (*Populus* spp.), a wood that appears in European furniture.

The Linnaean binomial is the preferred term used when conversing about wood, unless a well accepted trade name (the most common "common name") is assumed. In addition to the above confusion, some individual species of plants, trees or woods can have numerous common names, while a particular common name can have numerous species associated with it. For example, there are at least 135 common names for "rosewood", 446 common names for "mahogany" and 475 common names for "cedar". A reasonable estimate of the total number of recognized common names for wood approaches 170,000.

Commercial vs. All Woods

Another complicating factor of wood identification is that most texts and computer software include only "commercial" species and neglect species with limited distributions or have woods that are produced in low volumes for commercial markets. This may be well and good for identification of lumber, but many ethnographic or "primitive" objects as well as those of small size may be composed of local trees or shrubs that do not appear in commercial markets. For example, there are about two dozen commercial woods used in colonial furniture, whereas for "primitive" furniture or ethnographic objects of unknown origin, any of the 27,000+ species of trees and shrubs could have been used.

Species Introductions

Since the 16th Century, trees have been imported into the British Isles and elsewhere as novel horticultural species and as plantation crops. For example, Eastern White Pine (*Pinus strobus*) was imported to England in the mid-16th Century as a horticultural curiosity, while American Black Walnut (*Juglans nigra*) and Persian Walnut (*Juglans regia*) were imported in the 17th century as food crops. *Juglans regia* later became known as English Walnut, but is originally from the Middle East (Persia).

Importation of Wood

During the past, many fragile objects that were transported across the oceans by boat were packed in wooden crates. Upon arrival at their destination, the crate wood may have been reused for other objects, rather than as firewood. Thus something like Scots Pine (*Pinus sylvestris* – Red Pine Group), an indicator of English/European provenance, may have ended up in American furniture. Also, during the colonial period, the British Navy exclusively used whole trees of Eastern White Pine (*Pinus strobus*) as ship masts. When these masts were damaged, the wood may have been used in objects (large and small) made in England. In addition, tropical woods (True Mahogany, Rosewood, Pauduk, etc.) were imported into Europe by the Dutch (Dutch East India Company) and English as early as the 17th Century.

Charcoal

1. All types of wood were burned (branches, roots, and shrubs in addition to commercial species)
2. There are no keys for charcoal identification or for woody branches
3. There are no comprehensive keys for non-commercial trees and shrubs
4. Wood samples that have been turned to charcoal have lost characteristics important for accurate identification. There are no differences with respect to weight, density, hardness or color once wood has been charred.
5. Cellular characters are more difficult to discern using reflected light microscopy and the material has lost most color contrast in comparison to wood examined with a compound microscope.
6. Sample sizes of charcoal from archaeological contexts are usually smaller than wood samples from industrial contexts. Most identification keys are based on large samples from commercially important trees. Identification of samples is tenuous when samples are smaller than 2-4 mm on a side. At this scale, a sample of white oak group may appear to be chestnut.

Materials & Methods

Method of Identification

The most efficient way to identify charcoal is by examining freshly fractured surfaces (end-grain, radial and tangential) using reflected light. Wood samples were identified prior to carbonization using memory, experience and standard microscopical wood keys and descriptions (Kukachka, 1960 for softwoods; Panshin & DeZeeuw, 1980 for hardwoods). Trade or common names are

from Little (1979). Species designations were deduced using present tree distributions and range maps (Alden, 1995 & 1997; Elias, 1980, Gleason & Cronsquist, 1963; Little, 1979)

Appendix C. Species Identification of 91 Samples

Harry A. Alden, PhD

ALD #	Common Name	*Species*
86-36/19/5 – Bag 1 of 4 – Wood Fragments		
1	Western Red Cedar	*Thuja plicata*
2	Sequoia	*Sequoia sempervirens*
3	Douglas-Fir	*Pseudotsuga menziesii*
4	Sequoia	*Sequoia sempervirens*
5	Young dicot stem in 1st year of secondary growth	
6	Sequoia	*Sequoia sempervirens*
7	Sequoia	*Sequoia sempervirens*
8	Sequoia	*Sequoia sempervirens*
86-36/19/5 – Bag 4 of 4 - Charcoal		
9	White Oak Group	*Quercus sp.*
10	Coal (Anthracite)	
11	White Oak Group	*Quercus sp.*
12	White Oak Group	*Quercus sp.*
13	White Oak Group	*Quercus sp.*
14	White Oak Group	*Quercus sp.*
15	White Oak Group	*Quercus sp.*
16	White Oak Group	*Quercus sp.*
17	Coal	
18	White Oak Group	*Quercus sp.*

86-36/19/5 – Bag 3 of 4 – Charcoal		
19	Live Oak Group	*Quercus sp.*
20	Live Oak Group	*Quercus sp.*
21	White Oak Group	*Quercus sp.*
22	Red Oak Group	*Quercus sp.*
23	Bark	
24	Bark	
25	Willow	*Salix sp.*
26	Douglas-Fir	*Pseudotsuga menziesii*
27	Bark	
28	Bark	
29	Bamboo?	
30	Sequoia	*Sequoia sempervirens*
31	Willow	*Salix*
32	Douglas-Fir	*Pseudotsuga menziesii*
33	Douglas-Fir	*Pseudotsuga menziesii*
34	Sequoia	*Sequoia sempervirens*
35	Sequoia	*Sequoia sempervirens*
85 – 31/18 B – 245 Dominoes (Charcoal)		
36	Ebony	*Diospyros sp.*
37	Ebony (Charred Wood)	*Diospyros sp.*
85 – 31/18 – 7B		
38	cf. Palisander	*Dalbergia cf. baronii et al*
85-31/18 B-324		

39	Ebony	*Diospyros sp.*
85-31/13 - 313		
40	Ebony	*Diospyros sp.*
86-36/9-149		
41	Western Red Cedar	*Thuja plicata*
86-36/13-148		
42	Bark	
43	Oak	
44	Fruitwood	
45	Sequoia	
46	Cottonwood	*Populus*
47	Willow	
48	Sequoia	
85-31/33-71		
49	Beech	*Fagus sp*
85-31/13-352		
50	Red Sandalwood	*Pterocarpus sp*
86-36/13-22		
51	White Oak Group	*Quercus sp.*
85-31/24-319		
52		
86-36/13-22		
53	White Oak Group	*Quercus sp.*
86-36/13-148		
54	Douglas -Fir	*Pseudotsuga menziesii*

86-36/5-1931		
55	White Oak Group	*Quercus sp.*
96-36/5-1937		
56	Red Oak Group	*Quercus sp.*
86-36/5-1939		
57	White Oak Group	*Quercus sp.*
58	Red Oak Group	*Quercus sp.*
59	Bark	
60	Sequoia	*Sequoia sempervirens*
61	Sequoia	*Sequoia sempervirens*
62	Sequoia	*Sequoia sempervirens*
63	Sequoia	*Sequoia sempervirens*
86-36/5-1938		
64	Beech	*Fagus sp*
65	White Oak Group	*Quercus sp.*
66	Soft Maple Group	*Acer sp.*
67	Sequoia	*Sequoia sempervirens*
68	Soft Maple Group	*Acer sp.*
69	Soft Maple Group	*Acer sp.*
70	Soft Maple Group	*Acer sp.*
86-36/13-22 2 of 2		
71	Bark	
72	White Oak Group	*Quercus sp.*
73	White Oak Group	*Quercus sp.*
74	White Oak Group	*Quercus sp.*

75	Cottonwood	*Populus sp.*
76	Cottonwood	*Populus sp.*
77	Live Oak Group	*Quercus sp.*
78	Cottonwood	*Populus sp.*
79	Sequoia	*Sequoia sempervirens*
80	Sequoia	*Sequoia sempervirens*
81	Sequoia	*Sequoia sempervirens*
86-36/5 Bag 1 of 2		
82	Live Oak Group	*Quercus sp.*
83	Sequoia	*Sequoia sempervirens*
84	White Oak Group	*Quercus sp.*
85	Sequoia	*Sequoia sempervirens*
86	Live Oak Group	*Quercus sp.*
87	White Oak Group	*Quercus sp.*
88	White Oak Group	*Quercus sp.*
89	Bark	
90	White Oak Group	*Quercus sp.*
91	White Oak Group	*Quercus sp.*

Appendix D. Taxa Information

Harry A. Alden, PhD

Softwoods

Douglas-fir (*Pseudotsuga menziesii*/ Pinaceae) contains 2 species native to western North America (Coast Douglas-fir, *Pseudotsuga menziesii* and Bigcone Douglas-fir, *Pseudotsuga macrocarpa*), 1 in Mexico (Mexican Douglas-fir, *Pseudotsuga lindleyana*), 1 in Japan (Japanese Douglas-fir, *Pseudotsuga japonica*) and 3 in eastern Asia (including Chinese Douglas-fir, *Pseudotsuga sinensis*). All species look alike microscopically. The North American species is *P. menziesii*, known as Douglas –Fir or Oregon Pine, although it is not a True Pine (*Pinus* sp.). There are two recognized subspecies of Douglas-fir: coast Douglas-fir [*P. menziesii* (Mirb.) Franco ssp. *menziesii*] and Rocky Mountain Douglas-fir [*P. menziesii* ssp *glauca* (Biessn.) Franco]. The range of Douglas-fir extends from the Rocky Mountains to the Pacific Coast and from Mexico to central British Columbia. Douglas-fir lumber harvesting occurs in the Coast States of Oregon, Washington, and California, and the Rocky Mountain States. Douglas-fir is named for Henry Douglas (1798-1834), a Scottish botanist who traveled in North America. The word *Pseudotsuga* means "false hemlock and *menziesii* is used in recognition of Archibald Menzies (1754–1842), a Scottish physician and naturalist, who discovered Douglas-fir in 1793 on Vancouver Island, British Columbia.

Modified from Elbert Little Jr. USDA Forest Service.

Western Redcedar (*Thuja plicata* Donn ex D. Don/Cupressaceae) is native to the Pacific Northwest coast of America.The word *thuja* comes from the Greek *thuia*, an aromatic wood (probably a juniper). The word *plicata* is derived from *plicate* (folded into plaits) most likely from the flat, folded appearance of the scale-like leaves.

Other Common Names: Albero della vita di Lobb, Amerikanskt livstrad, Amerikanskt livstrad, arbol de la vida, arborvitae, British Columbia red cedar, British Columbia cedar, California cedar, canoe-cedar, cedar, cedro rojo del Pacifico, cedro rosso del Pacifico, columinar giant arborvitae, giant arbor, giant arborvitae, giant-cedar, giant thuja, gigantic cedar, gigantic red cedar, grand arbre de vie, Idaho cedar, jatte-tuja, Lobb's arborvitae, northwestern red cedar, Oregon cedar, pacific arbor, Pacific arborvitae, Pacific redcedar, red cedar, red cedar of the west, red cedar pine, reuzen-thuja, reuzenthuja, riesen-lebensbaum, riesenlebensbaum, riesenthuja, shinglewood, thuja geant, thuya de Lobb, thuya geant, thuya oriental, tuia gigantesca, Washington cedar, Washington red cedar, Westamerikaanse levensboom, western arborvitae, western cedar, western red redcedar.

Distribution: Western redcedar grows in the Pacific Northwest and along the Pacific coast to Alaska. Western redcedar lumber is produced principally in Washington, followed by Oregon, Idaho, and Montana. The tree has been planted in Great Britain and New Zealand.

The Tree: Western redcedar trees reach heights of 200 ft (60.96 m), with diameters of 16 ft (4.88 m). The trunk of older trees is buttressed, fluted, and quite tapered.

General Wood Characteristics: The heartwood of western redcedar is reddish or pinkish brown to dull brown and the sapwood nearly white. The sapwood is narrow, often not more than 1 in. (2.54 cm) in width. The wood is generally straight grained and has a uniform but rather coarse texture. It has very low shrinkage. This species is light in weight, moderately soft, low in strength when used as beams or posts, and low in shock resistance.

Working Properties: The wood works well with both hand tools and machine operations. It may splinter when worked on the end grain (e.g., mortising). It is subject to compression during planing and molding. It nails and screws well and takes both stains and paint satisfactorily.

Durability: The heartwood of western redcedar is resistant to very resistant to decay. It is not immune to attack by termites and furniture beetles.

Uses: Western redcedar is used principally for shingles, saunas, outdoor furniture, decking, fencing, lumber, poles, posts, and piles. The lumber is used for exterior siding, interior finish, greenhouse construction, ship and boat building, boxes and crates, sash, doors, and millwork.

Toxicity: Can cause bronchial asthma and/or contact dermatitis.

The woods of Western Red Cedar (*Thuja plicata*) and Northern White Cedar (*Thuja occidentalis*) can sometimes be separated based on their microscopic anatomy. **Kukachka, B. F. Identification of coniferous woods. Tappi. 1960; 43:887-896.**

Redwood (*Sequoia sempervirens* (D. Don) Endl./Taxodiaceae) is represented by one species (*S. sempervirens*). A related tree, the giant sequoia (*Sequoiadendron giganteum*) is also called redwood, big tree or giant redwood. The word sequoia was selected to honor Sequoyah (also spelled Sequoia), or George Guess (1770?-1843), Native American inventor of the Cherokee alphabet. The name was unexplained by its author, an Austrian linguist and botanist. The name *sempervirens* means evergreen. The wood of *Sequoia* is anatomically distinct from other softwoods. Other common names include: Amerikansk sekvoja, California cedar, California redwood, Californische redwood, coast redwood, corla, giant-of-the-forest, Humboldt redwood, ledwood, Mexican cherry, palo colorado, pin rouge d'ambrique, pin rouge d'Amerique, pino rosso d'america, sequoia de California, sequoia roja, sequoia rossa, sequoia toujours vert, sequoie, vavona, vavona burr. Redwood is native to the Pacific Coast region from extreme southwestern Oregon (Curry County) south to central California (Monterey County). Redwood trees reach heights of 200 to 300 feet (60.96 to 91.44 m), with diameters of 6 to 12 feet (1.83 to 3.66 m). The record is 376 feet (114.60 m) tall, with a 20-foot (6.10 m) diameter and an age of 2,200 years, and represents the world's tallest tree. The sapwood of redwood is narrow and white, while the heartwood varies from a light cherry to a dark mahogany. The heartwood has no characteristic odor or taste. The wood has exceptionally straight grain, coarse texture, high dimensional stability and is resistant to warping. The wood is moderately strong in bending, strong in endwise compression, stiff and moderately low in shock resistance. Typical old-growth redwood is moderately light in weight, moderately strong and stiff, and moderately hard.

Hardwoods

Aspen/Cottonwood/True Poplar Group, the genus *Populus* (family Salicaceae), is a group of 35 species that contains Poplar, Cottonwood and Aspen. Species in this group are native to Eurasia/north Africa (25), Central America (2) and North America (8). All species look alike microscopically. This group is not to be confused with Tulip Poplar (*Liriodendron tulipifera*), that is commonly used in American Colonial Furniture.

Eastern North American Species		**European Species**	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Balsam Poplar	*P. balsamifera*	Aspen	*P. tremula*
Bigtooth Aspen	*P. grandidentata*	Balsam Poplar	*P. gileadensis*
Eastern Cottonwood	*P. deltoides*	Black Poplar	*P. nigra*
Quaking Aspen	*P. tremuloides*	Gray Poplar	*P. canescens*
Swamp Cottonwood	*P. heterophylla*	White Poplar	*P. alba*

Beech (*Fagus* spp./Fagaceae) contains 8 species that grow in Asia (4), Europe (*F. sylvatica*) and North America (*F. grandifolia*). All species look alike microscopically.

Eastern North America		Europe	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
American Beech	*F. grandifolia*	Beech	*F. sylvatica*

Ebony (*Diospyros* spp./Ebenaceae) is also known as Mgiriti, Msindi (Tanzania), Omenowa (Ghana), Kanran, Nyareti (Nigeria), and Kukuo (Gambia). It is native to Equatorial West Africa. Forms almost pure groups near riverbanks. The tree may attain a height of 50 to 60 ft with a trunk diameter of about 2 ft. The wood has a heartwood that is a uniform jet black or black brown or streaked; sapwood pink colored when freshly cut, darkening to a pale red brown, very variable in width. Texture very fine; grain straight to slightly interlocked or somewhat curly. **Sawdust may cause dermatitis**. Basic specific gravity (ovendry weight/green volume) about 0.82; air-dry density 63 pcf. It is used for parts of musical instruments, handles for cutlery and tools, brush backs, carvings, turnery, inlaid work.

Fruitwoods are composed of Apple (*Malus* spp.) & Pear (*Pyrus* spp.).

Apple (*Malus* spp./Rosaceae) consists of at least 30 species that occur on both sides of the Atlantic. Can be confused with the other fruitwood Pear, also in the Rose Family (Rosaceae). The common apple was introduced into North America by the colonial English and had quickly escaped cultivation, spreading across southern Canada and the continental United States.

Eastern North America		Europe	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Southern Crab Apple	*M. angustifolia*	Common Apple	*M. sylvestris*
Sweet Crab Apple	*M. coronaria*	Old Name	(*Pyrus malus*)

Pear (*Pyrus* spp./Rosaceae) consists of at least 20 species native to Eurasia and the Mediterranean. Like the apple, the Common Pear was introduced into North America by the colonial English and had quickly escaped cultivation, spreading across southern Canada and the continental United States.

Eastern North America		Europe	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
		Almond-Leaved Pear	*P. amygdaliformis*
		Common Pear	*P. communis*
		Wild Pear	*P. pyraster*
		????	*P. nivalis*
		????	*P. eleagrifolia*

Maple (*Acer* spp./Aceraceae) contains 70 to 120 species with 16 species in Asia, 8 in North America and 6 in the Europe/Mediterranean region. The Maples can be separated into two groups based on their microscopic anatomy (ray width), the Soft Maple Group and the Hard Maple Group. Species within each group look alike microscopically. The commercial species are to my knowledge:

Soft Maple Group

Eastern North America		Europe	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Red Maple	*A. rubrum*	Field Maple	*A. campestre*
Silver Maple	*A. saccharinum*		

The wood of Hard Maple is hard and heavy and the color of the wood can range from white to reddish brown. It has a fine, uniform texture that turns well and is resistant to shock and abrasion. The grain can be straight, curly, wavy or bird's eye. The wood of Soft Maples resembles Hard Maple except that it is not so hard and heavy or strong.

Maple is used for lumber, distillation, veneer, cross ties, pulp, flooring, furniture, boxes, crates, shoe lasts, handles, woodenware, novelties, car parts, spools, bobbins, musical instruments, piano frames, bowling pins billiard cues, Indian clubs, dumbbells, butcher's blocks, churns, chopping bowls, breadboards, cant hook handles, croquet mallets, croquet balls, turnery and plywood.

Oak (*Quercus* spp./Fagaceae) contains 275 to 500 species and can be separated into three groups based on their microanatomy; the Live or Evergreen Oak Group, the Red Oak Group and the White Oak Group. Species within each group look alike microscopically. For colonial antiques, the Live & Red Oak Groups are indicative of American origin, while the White Oak Group could be either side of the Atlantic Ocean.

Species of the White Oak Group were used in American and English furniture. To my knowledge, species in the Red Oak Group were not commercial timbers in Europe and England during the 17th and 18th Centuries. *Quercus cerris* (Turkish Oak), a species in the Red Oak Group, was introduced into England in the late 1730's from the Mediterranean Region as an ornamental tree. Its appearance in furniture would be astronomically rare. Based on these assumptions, furniture of the 17th and 18th centuries containing wood of the Red Oak Group is most likely American in origin.

Red Oak Group (*Erythrobalanus*)

Eastern North America		Europe	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Black Oak	*Q. velutina*	Turkey Oak	*Q. cerris*
Blackjack Oak	*Q. marilandica*		
Laurel Oak	*Q. laurifolia*		
Northern Red	*Q. rubra*		

Oak			
Pin Oak	*Q. palustris*		
Scarlet Oak	*Q. coccinea*		
Shumard Oak	*Q. shumardii*		
Southern Red Oak	*Q. falcata*		
Water Oak	*Q. nigra*		
Willow Oak	*Q. phellos*		
Western North America			
California Black Oak	*Q. Kelloggii*		
Interior Live Oak	*Q. Wislizenii*		
Coast Live Oak	*Q. agrifolia*		

White Oak Group (*Leucobalanus*)

Eastern North America		**Europe**	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Chestnut Oak	*Q. prinus*	Algerian Oak	*Q. canariensis*
Chinkapin Oak	*Q. muehlenbergii*	Cork Oak	*Q. suber*
Overcup Oak	*Q. lyrata*	Downy Oak	*Q. pubescens*
Post Oak	*Q. stellata*	Durmast Oak	*Q. petrea*
Swamp Chestnut Oak	*Q. michauxii*	Holm Oak	*Q. ilex*
Swamp White Oak	*Q. bicolor*	Hungarian Oak	*Q. frainetta*
White Oak	*Q. alba*	Pedunculate Oak	*Q. robur*
		Portuguese Oak	*Q. faginea*
		Pyrenean Oak	*Q. pyrenaica*
		Round-Leaved Oak	*Q. rotundifolia*
		White Oak	*Q. polycarpa*
Western North America			
Valley Oak	*Q. lobata*		
Oregon Oak	*Q. Garryana*		
Blue Oak	*Q. Douglasii*		
Engelmann Oak	*Q. Englemannii*		
Macdonald Oak	*Q. Macdonaldii*		
Scrub Oak	*Q. dumosa*		
Leather Oak	*Q. durata*		
Scrub Live Oak	*Q. turbinella*		
Deer Oak	*Q. Sadleriana*		
Canyon Oak	*Q. chrysolepis*		
Huckelberry	*Q. vaccinifolia*		

Oak			
Palmer Oak	*Q. Palmeri*		

Palisander/Madagascar Rosewood (*Dalbergia* spp.: *D. baronii*, *D. greveana*, *D. madagascariensis*, and *D. monticola*) is a group of at least 4 *Dalbergia* species that evolved in isolation on the island of Madagascar. The Bois de Rose often used for the black-striped wood of *Dalbergia baronii*.

The trees range in size from 15 to 23 meters tall and up to 1 meter in diameter. The heartwood generally ranges from a light yellow-brown to a darker orange or reddish brown. Darker black streaks are common, and can produce a grain figure known as “spider-webbing” or “landscape,” Pale yellow sapwood is clearly demarcated from heartwood. Grain is usually straight, with a uniform medium-fine texture.

Uses: Veneer, musical instruments (guitar bodies and fingerboards), furniture, cabinetry, inlays, carving, turned objects, and other small specialty wood items.

Technical Information:

Dry weight (58 #/ft^3), specific gravity basic = 0.75 and 12%=0.93

Janka Hardness: 2,550 lbf (11,360 N)

Modulus of Rupture: 24,020 lbf/in2 (165.7 MPa)

Elastic Modulus: 1,742,000 lbf/in2 (12.01 GPa)

Crushing Strength: 11,100 lbf/in2 (76.6 MPa)

Shrinkage: Radial: 3.7%, Tangential: 6.5%, Volumetric: 10.3%, T/R Ratio: 1.8

Rot Resistance: Ranges from moderately durable to very durable depending on the species.

Workability: Generally easy to work with both hand and machine tools, though depending on the species, it can blunt cutting edges rapidly. Care should be taken in gluing and finishing, due to natural oils in the wood that can disrupt the drying process. Turns and polishes well.

Odor: Madagascar Rosewood has a distinct, rosewood-like scent while being worked.

Red Sandalwood/Zitan [*Pterocarpus santalinus* Leguminosae (Papilionoideae)]
Other Common Names: Almug, bois de caliatour, caliature, caliaturewood, caliaturholz, chandandan, East Indian sandalwood, faux santal rouge, lal chandan, natha-ni, onecht

sandelhout, panaka, raktachandan, red sandalwood, red sanders, rotes sandelholz, rott sandeltra, rubywood, sandalo,sandalo rosso, yerra chandanam and Zitan.

Distribution: South central India.

The Tree: In 1932, red sandalwood grew to a girth of 4.5 feet, with a bole of 15 to 20 feet. It was noted, at the time, that mature trees (7 foot girth) were difficult to find.

General Wood Characteristics: The sapwood of red sandalwood is white, while the heartwood is orange-red when fresh, turning from a dark purple-red to almost black upon exposure. The heartwood can contain streaks of lighter or darker shades than the background color. The wood is dull and requires care to produce a smooth surface. It is very heavy, hard and strong, with a medium-fine texture and interlocked grain. It has no characteristic odor or taste.

Weight[a]

		Weight	
Moisture content	Specific gravity	lb/ft^3	kg/m^3
Green	NA	NA	NA
12%	0.99	63	1009
Ovendry	NA	NA	NA

[a]Reference (3).

Mechanical Properties[a]

Property	Green		Dry	
MOE	NA	NA	1.81×10^6 lbf/in^2	12.48 GPa
MOR	NA	NA	14.0×10^3 lbf/in^2	96.53 MPa
$C_{\|\|}$	NA	NA	14.2×10^3 lbf/in^2	97.91 MPa
C	NA	NA	NA	NA
WML	NA	NA	NA	NA
Hardness	NA	NA	NA	NA
$Shear_{\|\|}$	NA	NA	NA	NA

[a]Reference (3).

Drying and shrinkage: The timber seasons well. (3)

Kiln drying schedule: No information available at this time.

Working Properties: It is extremely difficult to saw when dry. It works well with hand tools and carves well. Difficult to obtain a fine finish, due to the interlocked grain. It polishes well.

Durability: Extremely durable timber, virtually immune to insect attack.

Preservation: No preservative treatment needed for the heartwood.

Uses: The heartwood contains a historic (1680-1882) red dye (santalin), which is soluble in alcohol, but insoluble in water. Was used locally for house posts, dolls, religious images, agricultural implements (poles, shafts and bent rims for carts), picture frames and furniture. Carving, inlay, antique Chinese urniture.

Toxicity: Can cause dermatitis, vomiting, irritation of the conjunctiva, painful swelling and redness of the face, and asthma. (1,2&5)

Additional Reading & References Cited (in parentheses):

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2. Mitchell, J.; Rook, A. 1979. Botanical Dermatology: Plants and Plant Products Injurious to the Skin. Greenglass Ltd., 691 W. 28th Ave., Vancouver, British Columbia, Canada V5H 2H4.
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4. Reddy, C. V. K. 1972. Red sanders and its history of utilization. Indian Forester Oct.589-593.
5. Woods, B.; Calnan, C. D. 1976. Toxic Woods. British Journal of Dermatology; 95(13):1-97 Published by Blackwell Scientific Publications, Oxford, England OX2 OEL.

Willow (*Salix* spp. /Salicaceae) is composed of 170 to 400 species native to Eurasia (60), South America (1), Central America (19) and North America (87). All species look alike microscopically.

Appendix E. Chemical Analysis of Residue on Sequoia Wood Fragments

Dr. Ray Von Wandruszka and Anton Shapovalov

Department of Chemistry, University of Idaho

This appendix presents the results of chemical analysis of residue on two batches of Sequoia wood fragments. Batch 1 includes fragments from Features 86-36/13 and 86-36/15. Batch 2 includes fragments from Features 86-36/14, 86-36/17, and 86-36/18.

E.1 BATCH 1: SEQUOIA WOOD FRAGMENTS

#86-36/13-148 (San Jose Chinatown)
#86-36/15-107 (San Jose Chinatown)
July 8, 2013 Analyst: Anton Shapovalov

E.1.1 Appearance of the Samples

#86-36/13-148: approximately 2-3 pounds of wood chips, up to few inches in length, various colors ranging between light brown-yellow to dark brown-black, brittle, unpleasant odor. Many chips showed signs of treatment giving them 'wet', lustrous look and a waxy feel (Fig. 1).

#86-36/15-107: 3 wood fragments, similar to those of #86-36/13-148, but all dark brown to black in color, with a similar smell. One of the pieces contained enough of the treatment material to form a thin layer on its surface. The material was soft and sticky (Fig. 2).

Fig. E-1 Sample #86-36/15-107

Fig. E-2 Sample #86-36/13-148

E.1.2 Results and Discussion

According to the documentation accompanying the consignment, features 86-36/13 and 86-36/15 came from the same structure, or closely related structures. They were therefore analyzed together henceforth will be referred to as #13 and #15.

The wood of both #13 and #15 was soft enough to be cut with scissors. The material that impregnated/covered the wood was insoluble in water and poorly soluble in methanol, but it dissolved in hexane.

Both #13 and #15 readily burned when ignited, producing a yellow-orange flame and a candle-like odor. Some waxy material was scraped off the surface of #15 and also placed in a flame; it immediately melted, caught fire, and continued to burn with a blue flame. The melting point of the material was approximately 47^{o} C.

Based on the solubility behavior, appearance, flame tests, and smell it was postulated that the wood of #13 and #15 was coated with wax. Such treatment would explain its well-preserved state.

IR spectra of the waxy material from sample #15 and modern, 'clean' paraffin wax were taken (Figs. 3,4). Both spectra contained peaks at 2850-2950 cm^{-1} and 1470 cm^{-1}, which are characteristic of the C-H stretch and the CH_2 bend. The unknown also showed the O–H stretch at 3400 cm^{-1}, which the modern wax lacked. Modern paraffin waxes are simply long alkyl chains without functional groups, while the OH (alcohol) functionality indicated by the 3400 cm^{-1} peak is common in natural waxes (Baker 1982).

Samples #13, #15, and common paraffin wax were dissolved in hexane and subject to GC/MS analysis. All three samples yielded similar results in that most components eluted towards the end of the 20-min run and were identified by MS as a complex mixture of long chain hydrocarbons (30-40 carbons long). No specific hydrocarbon is reported since no compound was identified with greater than 35% certainty, however in nearly all cases all the possible alternatives were simply variations of the same molecular formula but different branching. In case of #13 and #15 there was a greater possibility for alcohol and ester functional groups than in the paraffin wax.

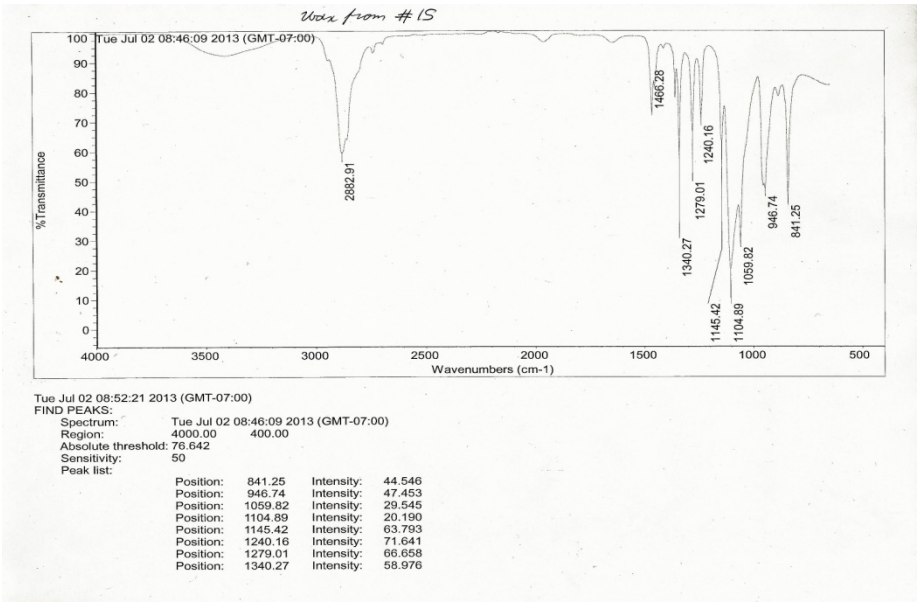

Fig. E-3 IR spectrum of the wax collected from sample #15

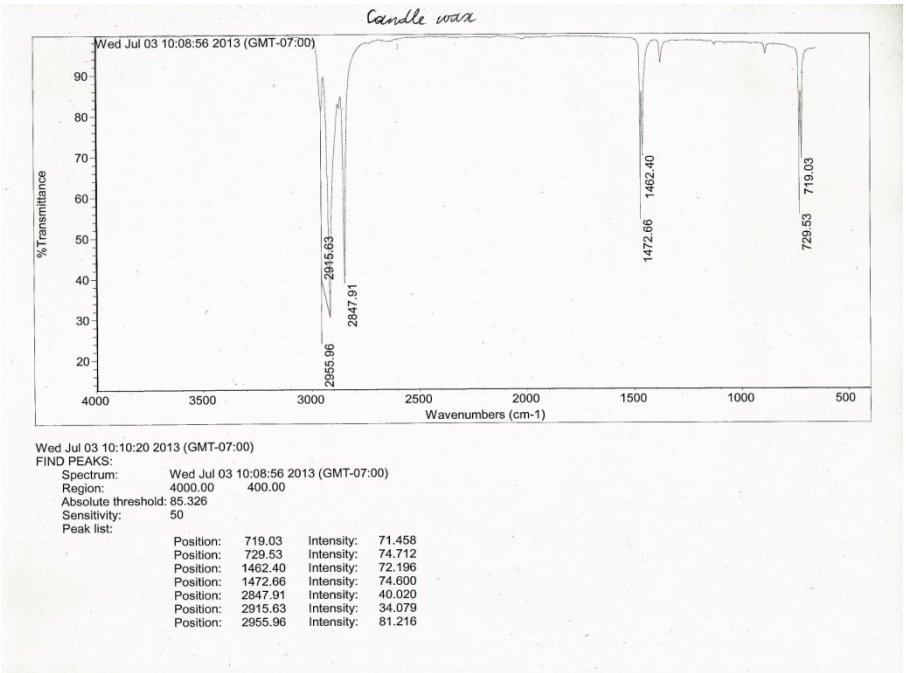

Fig.E- 4 IR spectrum of modern paraffin wax

E.1.3 Conclusion

The wood in both sample collections was coated with a natural wax. Waxing is a common way of wood treatment, providing protection from moisture. The origin of the wax could not be pinpointed exactly, but in a 19th-century Chinatown setting, taking into account that the material had to be sufficiently inexpensive to coat a (presumably sizable) wooden structure, there are a number of possibilities:

- Montan wax (from lignite) has a brown color; produced since the 2nd half of the 19th century;
- spermaceti wax (from sperm whales) is also brown;
- Chinese wax, harvested from scale insects and used for polishes;
- beeswax (may be costly)

The documentation provided with the consignment speaks of #13 and #15 as originating from features identified as wooden walls (in remarkably good condition) that were part of a dwelling. It also speaks of a “partial wooden floor” being included.

Considering the wax coating on the wood fragments, it seems unlikely that the inside walls of a dwelling were so treated. It is conceivable that the outside walls were protected with wax, but since its melting point was fairly low (47° C), exposure to the hot California sun on the side of a building would cause it to soften or even melt. Because of this, it would not have been a suitable coating for an above-ground dwelling. A wood lined underground pit, also mentioned in the accompanying documentation, may have been treated with wax against moisture and rot.

However, coal-tar creosote would seem to be a more likely product for such an application. It was available in the 19th century and would have constituted a cheaper and more robust treatment of an underground wood structure.

A more likely explanation is that the waxed wood chips were part of the "partial wooden floor" mentioned, and that the wax was simply a floor wax. Note that the so-called "Chinese wax" mentioned above was used as a polish. One could speculate that the fragments with more wax on them originated from the floor near the wall, where there was less foot traffic and the relatively soft wax was not worn away quite as much.

E.2 BATCH 2. SEQUOIA WOOD FRAGMENTS

#86-36/14-136
#86-36/17-169
#86-36/18-451
July 11, 2013 Analyst: Anton Shapovalov

E.2.1 Appearance of Samples

- #86-36/14-136, #86-36/18-451: small wood fragments, 1-2 inches in length, dark brown-black, brittle, unpleasant odor. All chips, to varying degrees, showed signs of a treatment that gave them a slightly wet, lustrous look (Figs. 1,2).
- #86-36/17-169: small wood fragments, similar to the other 2 samples, but lighter in color, similar smell, "dryer" appearance (Fig. 3).

Fig. E-5: Sample #86-36/14-136

Fig. E-6: Sample #86-36/18-451

Fig. E-7: Sample #86-36/17-169

E.2.2 Results and Discussion

The samples will be referred to as #14, #17, and #18.

The wood of all samples was soft soft and easily cut with scissors. Solubility test yielded the same results as those described in the report for samples #13 and #15. Based on this, it was postulated that all wood samples in this consignment (#13, 14, 15, 17, 18) were treated with wax. To test this hypothesis, #14, #17, and #18 were extracted with hexane and subjected to GC/MS analysis.

Samples #14, and #18 were found to contain compounds similar to those found in samples #13 and #15, but in lesser quantity. It appeared that this wood was indeed treated with wax, but less of it was preserved.

Sample #17 contained a large variety of hydrocarbons, many of which were unsaturated and contained oxygen. This indicated that they may not have come from a wax, but possibly from a wood preservative. This observation suggested that the wood in question did not originate from waxed floor boards, but from a part of the structure (a wall maybe?) that was treated with a preservative like creosote.

E.3 REFERENCES

EA Baker (1982) Chemistry and morphology of plant epicuticular waxes. In The Plant Cuticle. Ed. DF Cutler, KL Alvin, CE Price. Academic Press.