ARCHITECTURAL CHINOISERIE IN GERMANY:
MICRO- AND MACRO-APPROACHES TO HISTORICAL RESEARCH

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CHINOISERIE ARCHITECTURE IN GERMANY:
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This research deals with Chinoiserie architecture in Germany during the eighteenth century and the early nineteenth century. The purpose of this research is not to describe the developmental process of this style in detail but to explore two different scopes of conducting historical research for historic architecture—a micro approach and a macro approach. The former approach focuses on individual buildings and describes their history by integrating written records and archaeological evidence, particularly the wood elements in the old structure. The latter approach takes a higher perspective and looks at the formation of the style, especially demonstrating the social dynamics that supported the movement of the ideas and objects.

Taking the Chinese Tower in Donaustauf as an example, the first part of this work investigates the history of the Chinoiserie building with the help of two archaeological investigation techniques— wood anatomy and dendrochronology. It investigates its technical/design details and explains its construction history.

The second part of this work seeks the reasons that Chinoiserie chose these design elements by examining its social context. Several studies by previous scholars have demonstrated the important role of the nobility in the diffusion of this pseudo-Chinese fashion. Using the methods of social network analysis, three factors are examined that may have influenced the choice of paradigms among the patrons of the buildings:

geographical adjacency, personal contact, and kinship. The statistical results of the Quadratic Assignment Procedure (QAP) indicate that patrons' usage of paradigms is considerably correlated with their kinship, which improves our understanding of the significance of the genealogical relationship in influencing the taste in design and construction and the reception of foreign cultures.

BIOGRAPHICAL SKETCH

Yanan Sun began her training as an urban planner at Tongji University, Shanghai, China. Before attending the doctoral program at Cornell University in 2009, she earned a Master of Engineering Degree in City and Regional Planning from the same university and a Master of Science Degree in Integrated International Urban Studies from the Bauhaus University, Weimar, Germany.

Yanan is interested in the history of architecture and city from a cross-cultural perspective. She explores new ways of collecting and integrating historical evidence by means of wood anatomy and of interpreting history with help of social network analysis.

To my mother, my father

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PREFACE

This dissertation is submitted for the degree of Doctor of Philosophy at Cornell University. The research described herein was conducted under the supervision of Professor Michael A. Tomlan in the Department of City and Regional Planning, Professor Matthew Brashears in the Department of Sociology, and Professor Kevin Nixon and Dr. Maria Alejandra Gandolfo-Nixon in the Department of Plant Biology, Cornell University, between October 2011and December 2014.

This work is to the best of my knowledge original, except where acknowledgements and references are made to previous works. Neither this, nor any substantially similar dissertation has been or is being submitted for any other degree, diploma or other qualification at any other university. This dissertation contains two parts with less than 42,000 words.

This work is dedicated to my mother and my father, who showed me opposite perspectives of viewing the world when I was a child.

Yanan Sun

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TABLE OF CONTENTS

LIST OF FIGURES

Figures in APPENDIX

LIST OF TABLES

INTRODUCTION

The investigation of historical architecture can be conducted from different perspectives. Some scholars focus on individual buildings and seek to reconstruct their history and to find their uniqueness in order to demonstrate their historic significance. Others stress the common features in one style and make efforts to reconstruct the developmental process of the style by examining many buildings. While both approaches are frequently used in the field of historic preservation, there is hardly any attempt to juxtapose them in one research and question their essential role to understand the nature of historic architecture. Taking Chinoiserie architecture as an example, this research combines two approaches to investigate one style of architecture. Borrowing methods from archaeology for the micro-approach and from sociology for the macro-approach, it reveals the technical and social origin of architectural Chinoiserie. By showing the advantages and limitations of applying interdisciplinary methods to investigating Chinoiserie, it also justifies historical research as an independent field of research to deal with incomplete information and evidence as to identify the true significance of historic buildings.

Chinoiserie

As the number of sea routes to and from East Asia was increased in the sixteenth century, a blast of "Chinese" wind hit Europe in almost every aspect of the arts. This exotic input created a new taste among Europeans, termed "Chinoiserie." Beginning with small curiosities such as porcelain clocks and lacquer jewelry boxes, Chinoiserie gradually diffused its influence into other forms of arts such as textile design and furniture—greater and greater in size as well as in richness of design ideas. Architecture was not immune to this influence. While Chinoiserie in different art forms share a great deal in iconography, its unique development in architecture, raises a special set of questions. While more is known about Chinoiserie in decorative arts, architectural Chinoiserie has been understudied and demands a new methodology to explore its history.

Although several European countries have Chinoiserie buildings, this research focuses on what is today known as Germany, where the greatest number of Chinoiserie houses was built and has survived.

The Micro-Approach

The micro-approach aims to understand the details of individual construction as much as possible. Previous scholars have written excellent works about the design characteristics of the style. There lacks, however, an investigation of the material usage of the style, which is usually the starting point of heritage conservation.

The investigation of construction details usually begins with a historical research. One can find rich information about wood usage in the Chinoiserie buildings in records such as travel accounts, construction logs, and purchase inventories. These records are very valuable because they are the only sources that record the buildings that have already disappeared. They are insufficient, however, because the information on these records is usually too general and brief to provide satisfactory answers to study the usage of materials, because these construction details are not normally found in written documents.

To obtain more information about construction materials, this research relies on two archaeological techniques — wood anatomy and dendrochronology, which allows us to understand the wooden structure more precisely. Although they can tell the species and the age of wood more reliably, there are limitations in using these methods. They require wood samples from the buildings; and they are only applicable to the buildings that still exist and to the regions where a master chronology exists for the purpose of crossdating. Due to the fact that only a few wooden Chinoiserie buildings have survived, this research applies a case-study approach. The Chinese Tower in Donaustauf was chosen because well-preserved original timbers are available from this building.

In addition to the material properties, the technique of fabrication and construction is also of interest. Hence, the timber framing of the Chinese Tower was studied and compared with the traditional Chinese and German timber framing techniques in order to reveal how the Chinese timber techniques influenced the German techniques.

With the help of the structure survey and the material investigation of timbers, Part One of this research provides a deeper understanding about the history of the Chinese Tower in Donaustauf at the end.

The Macro-Approach

The macro-approach seeks social motivations of the formation of architectural Chinoiserie. Unlike previous research, which grounds arguments on stylistic similarities and assumes the direct interaction with China after the fifteenth century inspired the development of Chinoiserie, this research goes further to ask “HOW” did it happen. Particularly, this approach asks how was the mode of architectural Chinoiserie located in and diffused through various princely territories of German cultures. It borrows the sociological methods of network analysis and reveals how the Chinese taste was transmitted through tightly-woven networks of patrons and architects. This approach demonstrates that one kind of network, the royal kinship, has played a significant role in dictating the paradigms of design features of Chinoiserie architecture.

As one may immediately realize, the networks of royal kinship could extend to almost every royal house in Europe. To bring this study to a manageable scale, thirty-seven buildings on seven historical sites were selected, which includes a broad area of social, political, and geographic units, examining similarities and difference in adopting of Chinoiserie in various sub-German cultures.

The selection of these sites meets the requirement that the building should have Chinoiserie features on the exterior. Some sites that are frequently mentioned in previous works but do not meet this criterion are not included. For instance, Nymphenburg near Munich has the earliest and probably the first Chinoiserie building in Germany dating from 1716. However, since it does not show any Chinese features on the exterior, it is not included in this research. From the perspective of location, each site in this selection can reveal some specific meaning that Chinese-styled architecture took on within a more closely delimited cultural, social milieu. For instance, sites under one political power, such as Prussia and Bavaria, reveals how the Chinese taste was inherited, re-interpreted and reformed by succeeding monarchs along the same family lines.

While this selection appears to be legitimate from the perspective of historiography, it arouses problems in the application of social network analysis, which is rather demanding on the "completeness" of data. In spite of methods to treat incomplete data set, it is unavoidable that this research has to confine its conclusions only to the selected buildings and the social network around them. Although the network analysis can provide a new method of reasoning, it is impossible to collect all the information that this method requires to stretch its conclusion to cover the whole history of the China mode. Within the selected data set, it suffers from missing information as well, e.g., the unrecorded architects or the unknown year of construction, so it should be stated at the outset that the results of the quantitative analysis stand only within the defined scope of research and the final conclusions should be integrally understood with both the quantitative and qualitative analysis that are provided.

The research questions are approached in three steps: documentation research, paradigm detection, and network analysis.

Unlike conventional historical research, which closely read the contents of old documents at great cost of time and energy, this study only searches for information that is relevant to the research questions. That is, it treats historical research as a process of data collection. Similar methods can be found in previous historical network research, which discusses how social networks can be obtained from archival data, such as journal articles, newspapers, court records, and the minutes of executive meetings (Burt and Lin 1977). During the documentation phase, two types of information are sought: records that exhibits the historical exterior of the selected buildings, such as architectural drawings and old photos; and information about the persons that have contributed to the construction of the selected buildings, specifically their personal acquaintances and their genealogical relationships.

The central question in detecting design paradigms is to cluster selected buildings into groups according to their similar design features. While it is possible for art historians to achieve this goal by stylistic analysis with their eyes, it is not inevitable to bias the analysis as result of the amount of data or the limitations of human cognition. Therefore, this research represents each building as a vector whose components stands for their design features. If a building possesses a certain design feature, the corresponding vector component will have the value of “1,” otherwise it remains “0.”

After representing buildings with vectors, this research goes on to calculate the similarity between any two buildings using Cosine, Jaccard, Pearson, and Hamming measures of similarity.

Finally, the similarity measures are applied to two clustering algorithms, hierarchical clustering and k-Means clustering, to determine the optimal numbers of clusters that are simultaneously the number of design paradigms. By examining the frequency of design features used in each paradigm in historical context, it is possible to describe the feature development of the Chinoiserie taste over time.

In diffusion analysis, the goal is to compare the factors that have been suggested by previous scholars, which may have influenced the adoption of Chinoiserie in two steps. In the first step, four matrices are built. They are (1) the matrix of paradigm choice, in which a pair of patrons will obtain a value of "1," if they prefer to use the same paradigm; (2) the matrix of geographical adjacency, whose cells indicate whether two patrons had bordered territories; (3) the matrix of personal contact, whose cells indicate whether there is historical records to show the personal interaction between any two patrons; (4) the matrix of kinship, whose cell values show the genealogical distance between any two patrons.

In the second step, correlation between the matrix of paradigm choice and the other three matrices are examined using Quadratic Assignment Procedure (QAP). The one that is significantly correlated to paradigm choice is regarded as having substantially influenced the diffusion of Chinoiserie among the selected sites.

Purpose of the Study

Besides a substantial investigation of the history of Chinoiserie architecture, in this research, I attempt to show how methods of wood investigation and social network analysis, as quantitative approaches, can justify historical generalizations. Quantification has shown itself as a powerful tool in historical analysis. It helps to make the work both easier and more reliable, and, in some cases, it provides a means of dealing with questions that could not be attacked in another other way. (Aydelotte 1971, pp. 60–61) The methodology being adopted here demonstrates interdisciplinary analysis is not only a valid approach, but also is necessary to provide more accurate understanding.

Stating that the interdisciplinary approach is important should be old news today. Describing exactly how it matters for the development of the field of adoption is a more interesting, but also a more difficult challenge. Knowing the pro and cons of other methods helps us to think about the task and limitation of our own field more precisely.

While research using quantitative methods is not immune to the perils of speculative interpretation, a balanced relationship between quantitative methods and historical methods helps avoid imprudently over-empowering the results of formal methods in interpretations. It is because, although archeological and sociological methods can help to justify historical explanations, their independence of historical context and their reliance on the completeness of data set boundaries on the degree to which they can be used to explore the historical legacy.

Significance

This dissertation contributes to the literature on Chinoiserie by adding a broader set of technical and social dimensions to study the transcultural arts with quantitative methods, thereby complementing historical arguments with another means of analysis. This study improves the understanding of construction by revealing cultural conventions hidden in construction techniques. This study revolutionizes the theoretical understanding of art development in the sense that historical dynamics were enmeshed in a network of people and knowledge, thereby providing a structuralistic alternative to narrative in studying architectural history. Examining the architectural domestication of Chinese influence in Germany, this project will set a conceptual and methodological example for the studies of Chinoiserie in other countries as well, e.g., France and England, shedding light on studies of artistic trans¬culturalization at large. Most importantly, this research demonstrate how methods from other disciplines can help the advancement of historical argument as well as limitations.

Chapter Organization

This work is organized as follows. Chapter One paints the historical background of Chinoiserie and its development in architecture. Chapter Two reviews previous literature in the history of architectural Chinoiserie. It continues with two different approaches of studying architecture Chinoiserie in two parts. Part One, which includes Chapter Three, Four, Five and Six, applies the archaeological methods of wood anatomy and dendrochronology to investigate the history of the Chinese Tower in Donaustauf intensively. Part Two applies the macro-approach and uses the methods of social network analysis. Chapter Seven reviews the application of social network analysis in historical research and previous research about the role of social connections in the diffusion of architectural Chinoiserie. In Chapter Eight the design features and people who were related to the construction of selected buildings are summarized. Then, in Chapter Nine, based on the similarity of using design features, design paradigms are detected using four mathematical similarity measures. The quantitative results are compared and contrasted with historiographical arguments that were provided previously. In Chapter Ten, this project goes on to testify the hypothesis and observation of previous scholars: China-mania ran in families. (Jacobson 1993, pp. 90) This is done by examining the correlation between patrons' choice of paradigms with their geographical locations, personal contact, and kinship, using Quadratic Assignment Procedure (QAP). Finally, by comparing and contrasting the results of quantitative analysis with historical research, Part Two comes to the conclusion that kinship among the royal patrons played a significant role in the formation and diffusion of the Chinoiserie taste in German construction during the eighteenth century and the early nineteenth century.

CHAPTER 1. CHINOISERIE: ITS ORIGIN AND DEVELOPMENT

Introduction

The first construction of Chinese-inspired artistic work in Europe arises from the knowledge gained by travelers to the Far East before the sea routes were secured. Although evidence exists for the transfer of Chinese ideas as early as the first century, the focus of this chapter is the origin and development of Chinese influence on the Western arts between the seventeenth and nineteenth century, which is collectively known as "Chinoiserie" a French word denoting "Chinese-esque." While the term Chinoiserie is sometimes used only to cover the eighteenth century Rococo-Chinoiserie styles, it is more accurate to remember the intention to deliberately copy or to adapt Eastern styles began in the sixteenth century. (Impey 1977, p. 12) Chinoiserie alludes to themes about China, but it is European in character, because the intellectual reprocess of the European artists endows it with a kind of artistic effect that cannot be found in the original Chinese arts. The stylistic and substantial features are inspired by information gained and brought back by missionaries and merchants from the Far East after the late seventeenth century, but it also conjures the old European memories that were entrenched by the marvelous tales of Marco Polo[1] in the thirteenth century and earlier.

Although the word is coined with the etyma "chinois," its geographic reference is broader than China, even during its largest territorial expansion. A closer examination of the usage of the term indicates that the word "Chinese" included a sweep of almost all the East Asian regions, including Japan and Korea. The use of "Japanese," "Chinese," and sometimes "Indian" to name the same building is an evidence of the lack of differentiation between the Eastern cultures

[1] Marco Polo (1254-1324), an Italian merchant who traveled to China and took a post from Genghis Khan, his travels are recorded in *Livres des merveilles du monde* (*Book of the Marvels of the World*, also known as *The Travels of Marco Polo*, c. 1300).

in Europe. In this research, Chinoiserie, and sometimes “Chinese,” remains the major words to describe the style in question, while keeping in mind its geographic range extends beyond what is today called China.

European Knowledge about Chinese Architecture

Having acknowledged the “European” nature of the term Chinoiserie, the question arises “how did Europeans receive their knowledge about Chinese construction?” Sinologists such as Henry Yule and Cordier Yule (Yule, Cordier 1915, 13-16, pp. B.1 14) have held that the Sino-European interaction peaked in three periods: from the first to the third century based on the evidence of Chinese silk in archaeological finds and classical literature; from the thirteenth to the fourteenth century with the accounts of travelers like Marco Polo and Franciscan Friar Odoric[2]and the Popes’ treasury; and from the end of the sixteenth century to the beginning of the modern time. If we assume in each period of time inter-cultural interaction could also increase the European knowledge about Chinese architecture, it should be possible to find some evidence in the documentation associated with the structures about the contacts between the East and the West.

In the first period, Latin and Greek literature shows some knowledge about China and probably some about Chinese buildings. Chinese were known as “Sere.” The region of the Seres is a vast and populous country, touching on the east the Ocean and the limits of the habitable world, and extending west nearly to Imaus[3] and the confines of Bactria[4]. The people are civilized men, of mild just and frugal temper, eschewing collisions with their neighbors, and even shy of close

[2] Odoric of Pordenone (between 1265 and 1286 – 1331), an Italian late-medieval Franciscan friar and missionary explorer, whose account was an important source for *The Travels of Sir John Mandeville*.

[3] The old name for Pamir Mountains.

[4] 大夏, the ancient name of ahistorical region located, one of the ancient civilizations of Iranian peoples, covering the modern-day flat region that straddles Afghanistan and Tajikistan.

intercourse, but not averse to dispose of their own products, of which raw silk is the staple, but which include silk stuffs, furs, and iron of remarkable quality. (Yule 2006, p. xli) The rhetoric style of Ammianus Marcellinus[5] hampers our ability to confirm whether the ancient Greeks caught the sight of the Great Wall[6], but a few of them, like Maës Titianus[7], did see the Stone Tower[8] in the Alai Valley[9]. (Yule 2006, p. cxlvi) Apart from these faint allusions, no sources informed Westerners about Chinese architecture.

The next period of contact is more fruitful thanks to the accounts of Marco Polo and Franciscan friars. From their narratives, Europeans could learn not only about Chinese palaces but also about provincial architecture that had various functions, e.g., temples, shops, and post offices. These references are in text. Images, mostly in Marco Polo's manuscripts and mappa mundi[10], were created by Europeans that had never seen Chinese construction in reality. It can be

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[5] Ammianus Marcellinus (325/330 – after 391), a fourth-century Roman soldier and historian, whose major historical account survived from Antiquity, e.g., in the work by Procopius.

[6] Ptolemy, by way of gainsaying the myth, disclosed a lingering hearsay about a brazen wall on the Chinese border,

> "*Of inland cities are named Akadra, Aspithra, Cocco- or Coccora-Nagara, Saraga, and Thine the Metropolis. But this last, they say, hath in reality neither brazen walls nor anything else worth mentioning*." (book vii, ch. 3). (Yule 2006, p. cxlvi)

Ammianus Marcellinus told coincidentally also a "wall" on the border. However, many scholars disprove it as the allusion to the Great Wall in China. According to Yule,

> "*one passage indeed of the geographical description of Ammianus is startling at first sight in its seeming allusion to the Great Wall; and apparently also by Reinaud. But a comparison of the passage with Ptolemy's chapter on Serice from which it is derived will show, I think, convincingly that he is speaking merely of an encircling rampart of lofty mountains with which the spacious and happy valley of the Seres is conceived to lie."* (Yule, Cordier 1915, 13-16, p. 16)

[7] Maës Titianus, an ancient traveler of Macedonian culture who is recorded as having travelled farthest along the Silk Road from the Mediterranean world.

[8] A disappeared landmark recognized by ancient travelers as the border of China, probably in Irkeshtam of today.

[9] A broad, dry valley running east-west across most of southern Osh Province, Kyrgyzstan. On the east there is the low Tongmurun pass and then more valley leading to the Irkestam border crossing to China.

[10] Medieval European map of the world, which does not only show geographic information but also the belief of the constitution of the world such as the Garden of Eden. In Medieval Latin, *mappa* means "cloth" or "chart" and *mundi* means "of the world."

reasonably assumed that during the process of graphic production a number of imaginary touches were provided to complement the contents provided in the texts.

The third period, in which the term Chinoiserie was born, is a completely different story from the previous ones. Although the Europeans had not obtained a thorough understanding of Asian construction before the end of the nineteenth century, the number of images of Chinese buildings increased substantially. Many East Asian goods carried astonishingly accurate depictions of pavilions, pagodas, and palaces on the imported lacquer panels.

Similarly, East Asian buildings have also come into the attention of early European travelers. For instance, Juan Gonzalez de Mendoza[11], whose work *Historia … del gran Reyno de la China,* was widely read outside Iberia after being published in Rome in 1585, greatly admired Chinese buildings and was curious about their construction materials. "They have a kind of white earth of which they make bricks, of so great hardness and strength, that for to break them, you must have pickaxes, and use much strength." Johan Nieuhof[12] presented a greater variety of Chinese building materials. His description of the Porcelain Pagoda in Nanking[13] paid an extraordinary amount of attention to details of construction, sparking ideas about Chinoiserie architecture. It seems that Nieuhof's failure to recognize the difference between glazed tile and porcelain was the origin of the rumor that Chinese used porcelain to build their houses.

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[11] Juan Gonzalez de Mendoza (1545-1618), the author of the first Western history of China to publish Chinese characters for Western delectation. His work, *Historia de las cosas más notables, ritos y costumbres del gran reyno de la China* (The History of the Great and Mighty Kingdom of China and the Situation Thereof) compiles observations of several Spanish travelers in China.

[12] Johan Niehof (1618-1672), a Dutch traveler who has been to China and wrote an account of this journey. Rich in illustrations, this account was soon translated in other major European languages and became one of the most important graphic sources for Chinoiserie.

[13] Bao'ensi，大报恩寺，Temple of Repaid Gratitude，a historical pagoda on the south bank of external Qinhuai River in Nanjing, China, constructed in the 15th century during the Ming Dynasty, mostly destroyed in the nineteenth century during the course of the Taiping Rebellion.

The art historian Von Erdberg holds three types of media provided the sources of knowledge about Chinese architecture in the third period: the European-made prints in travel and history books; pictures done by the Chinese themselves, such as watercolors, woodcuts, porcelains, etc.; and a mixture—watercolors done by European Jesuits[14] in China and under Chinese influence. (Erdberg 1936, p. 18) In addition, as the need for Chinese design grew, treatise and handbooks created by European designers also provided inspirations for practice.

Architectural Chinoiserie

From the seventeenth century, while small objects of decorative arts[15] in Chinese taste became widely admired and increasingly available, the possession of "Chinese" architecture was still restricted to the wealthy and influential. Preliminary research indicates that, over three hundred of Chinoiserie buildings were designed and built from 1670 to 1850s in Central Europe[16], one third of which are located in Germany[17]. Around 1800, almost every park and garden in Germany possessed a pavilion in the Chinese taste. (Vogel 1932, p. 335) These buildings appeared disparate but clearly endogenous in design. Europeans would have definitely believed they were of Chinese, or at least approximating Chinese ideas.

[14] Jesuit, member of the Society of Jesus (S.J.), a Roman Catholic order of religious men founded by St. Ignatius of Loyola, noted for its educational, missionary, and charitable works, once regarded by many as the principal agent of the Counter-Reformation, and later a leading force in modernizing the church. http://www.britannica.com/EBchecked/topic/302999/Jesuit

[15] Besides visual arts, European literature of this period also showed a predilection to Chinese elements.

[16] The earliest one was Le Trianon de Porcelaine in Versailles. Some Chinoiserie buildings were still constructed to the end of the nineteenth century, its last peak of construction was seen in the 1850s, and for instance three open pavilions, built for the merchant family Uhlich aus Triest after 1840 in Zdravilški Park, the Chinese Garden House (1854) in the Kurausanlagen of Wiesbaden.

[17] Other European countries were equally competitive in building Chinoiserie. Construction in these countries often took the form of large-scale compounds or villages, such as Dottingheim in Sweden and Zarskoje Selo in Russia, which only the rich could afford. In comparison, the Chinese taste was more widespread in Germany.

Recognizing that Chinoiserie is seen in various forms of arts, the focus of this dissertation is exclusively architectural. Two important observations must be made before going further. First, to design and construct Chinoiserie buildings demands more financial and technical resources than creating Chinoiserie in other forms of arts. To construct a building in Chinese taste a wide range of practical knowledge is needed from craftsmen. Second, compared to other forms of Chinoiserie arts, fewer buildings have survived. The artifacts that are small, movable, and less expensive can be secured, relocated, and restored with less efforts and cost. In contrast, buildings were often left to the mercy of war and disasters.

There were four types of architectural Chinoiserie constructed during the eighteenth century: Chinese-influenced buildings, Chinese follies, Chinese rooms, and Chinese gardens. This categorization does not exclude more than one category in one location. For instance, the Chinese-influenced building and follies can be constructed in a Chinese garden and a Chinese room can be arranged in a Chinese-influenced building. Gierarchy emerges among the types of architectural Chinoiserie. Generally, the most expensive are the Chinese-influenced buildings, followed by the Chinese follies, Chinese gardens, and the Chinese rooms. It would be ideal to include a survey of all the examples. However, as *Chinoiserie-China als Utopie* (1975) pointed out, every European palace in the eighteenth century possessed at least a Chinese salon, if not a Chinese pavilion. This dissertation only focuses on the first two types. Unlike researchers such as Laske and von Erdberg who either embrace interior designs or others who confine their attention to garden structures, this work is dedicated to examining structures and embraces decorative exteriors but excludes interior decorations. The function of buildings, no matter if they are palaces or garden follies, does not serve as a criterion to set research boundaries.

Art historical studies generally adopt a three-phase definition of Chinoiserie architecture: Baroque Chinoiserie (1660s - 1715), Rococo Chinoiserie (1715-1760s), and Neoclassical Chinoiserie (1760s - 1840s). The term “Baroque” is used to describe the style in arts and architecture that begins in Rome about 1600. It first meant lacking coherence likely because it violated classical norms where the parts where always governed by rules in architecture of the classical language. The Baroque was out of favor generally until the 1920s and 1930s. The term Rococo generally is more exuberant and excessive than the Baroque. It follows the Baroque chronologically and it was out of favor until the mid-twentieth century. The term Neoclassical was not invented until the mid-nineteenth century. Neoclassicism is generally associated with the Age of Enlightenment during the eighteenth and early nineteenth century. As the definition implies that Chinoiserie can be seen in all three periods as elements of larger designs in form and decoration, probably because borrowing some elements from East Asian arts was a necessary reaction to the social needs of the time.

Each phase of development shows some unique features of style.

Baroque Chinoiserie can be considered both “architectural” and “decorative.” The most obvious examples[18] are the Trianon de Porcelaine, the palaces at Pillnitz, and the Kiosque at Lunéville[19]. The Japanese Palace in Dresden[20] is also included, since they are all decorative art, exaggerated in the dimensions by the whim of a sovereign. (Erdberg 1936, p. 4, p.64) They served as precedents to the more decidedly Asiatic garden buildings of the eighteenth century,

[18] Other examples of Baroque Chinoiserie architecture can be found in Vogel 1932, p. 43

[19] A Chinoiserie building in the Park of Lunéville, recorded in the book of Le Rouge.

[20] *Japanisches Palais*, built in 1715, extended from 1729 until 1731 to store the Japanese porcelain collection of Augustus the Strong that is now part of the Dresden Porcelain Collection; partially destroyed during the World War II and reconstructed afterwards.

which were usually on a smaller scale. (Erdberg 1936, p. 64) The number of examples of Baroque Chinoiserie is limited. Comparison with travel pictures and early designs can be made, but in most cases no direct attributions are possible. (Erdberg 1936, p. 59) By the middle of the eighteenth century, the climax of the French Renaissance style of garden passed and Chinoiserie was assimilated into the prevailing taste for the Baroque. By the time the century drew to its close, the days of the Baroque were numbered.

Chinoiserie, however, did not die out with Baroque. New design elements of Chinoiserie were invented in the Rococo period. Certain common features can be used as diagnostics. For instance, up-swept roof-lines, Chinese lattice, pagodas, figures with pigtails or conical hats, and parasols, singly or in combination, are not only diagnostic, but almost obligatory. Chinoiserie did not remain unchanged. As certain objects became familiar to western eyes they no longer necessarily held an automatic eastern connotation. (Impey 1977, p. 11) Chinoiserie began to absorb elements of more under spread European styles, such as the Gothic. Meanwhile, a new style of garden developed in England, pursuing an idyllic landscape, which helped lengthen the time Chinoiserie was in favor, because it shared the a kind of Naturalism with the Chinese gardening.

In Neoclassical Chinoiserie, the designs seemed to become restrained and rigid. There is little difference of style between design and executed buildings; specimens with individual characteristics are rare, assumedly because the publication of pattern books standardized ideas. (Erdberg 1936, p. 59)

CHAPTER 2. LITERATURE REVIEW

This chapter provides a review of the developing scholarship regarding Chinoiserie, and goes on to examine the development of ideas about historical network research. It is important to point out that the taste for the Chinese art, architecture, and decorative arts has a longer history than the term "Chinoiserie," which has been adapted recently. Trade with merchants specializing in all kinds of Chinese goods was known from at least the time of Marco Polo, and accelerated during the eighteenth and nineteenth century. The term "Chinoiserie" is, itself more associated with the rise of art history, and subsequently architectural history, as is shown below.

Works of six authors are particularly devoted to the topic of architectural Chinoiserie. They are Friedrich Laske (1909), Hans Vogel (1932), Eleanor von Erdberg (1936), Osvald Sirén (1990), Patrick Conner (1979), and Gerd-Helge Vogel (2004–2005).

There is, at the same time, a great number of works that address the style at large or in other forms of arts, for example, those of Julius Lessing (1880), Richard Graul (1906), Adolf Reichwein (1923), Chisaburō Yamada (1935), M. G. May (1938), Hugh Honour (1961), Oliver Impey (1977), Alain Gruber (1975), Madeleine Jarry (1981), Madeleine Jarry and Liselotte Wiesinger (1981), Lothar Ledderose (1991), Karl Armer and Albrecht Bangnet (1991), Dawn Jacobson(1993), and Johannes Hallinger (1996). Many museum catalogues feature Chinoiserie. This includes the Musée des arts décoratifs de France (1911), California Palace of the Legion of Honor (1966), Sperlich and Börsch-Supan (1973), and Alain Gruber (1984).

Apart from the Pan-European perspective of these authors, there exists even a greater number of researchers that limit their scope within a particular geographical boundary or focus on a specific form of arts, such as Belevitch-Stankevitch's (1910) and Cordier's (1910) books about "*le goût* *chinois*" in France, Schulz' (1926) publication on *Chinoiserie in Augsburg and its application in ceramics*.

While the first group of literature is directly relevant to this research, the studies in the second group offer a historical background to carry on a preliminary round of exploratory discussions. The third group of literature, detailed in a particular region or a particular type of art, will be referred to only when it is relevant to the topic in question. All three groups of literature, despite of different emphasis, remain narrative and descriptive in nature.

The first of the six authors was an architect by training. Laske profits from his professional knowledge to reveal the influence of East Asia in all aspects of architecture—exterior, interior, and garden design. In contrast, is von Erberg: an historian's argument centered on the exterior features. One important merit of her work is the effort to trace the sources of knowledge of Chinese architecture in Europe, which not only helps to reveal the origin of artistic elements of Chinoiserie architecture, but also sheds light on why Europeans were not willing to imitate the authentic Chinese architecture. Sirén's book though titled as *China and Gardens of Europe of the Eighteenth Century*, focuses only on England, France and Sweden, and excludes Germany and Austria. This work contains the most painstaking documentation and field research. The author does not intend to present a story-like account of the development of Chinoiserie. Instead, he captures the last material evidence of this type of architecture by photography and site investigation. The art historian Conner's book is a collection of celebrated buildings in two exotic styles: the Chinese and the Indian. These were governed by three factors: the availability of well authenticated patterns, the public image of each of the two countries of the particular time, and the European attitude to landscape gardening. By emphasizing the last factor, Conner also aims to complete the works of von Erdberg and Sirén not only with more details, but also by expanding the research boundary to include North America.

The article by Lessing, one of the earliest academic investigations about the influx of East Asian arts in Europe, serves as a valuable historical account about the recognition of the exotic impact on European life. After reviewing of the importance of Asian in ancient times, he delves into the period between the sixteenth and the nineteenth centuries, in which he presents a discourse of two well-admired products: silk and porcelain, which Europeans had gradually learned to produce on their own. Graul's thin pamphlet is a forerunner of Chinoiserie research because it sets a framework that fundamentally influences the studies in the later periods. Graul proposed that Chinoiserie started with the import of porcelains, when Europeans began to value and attempted to imitate them in material and design. He also touches upon the development of Chinoiserie in architecture, specially the works of the English architect, William Chambers, who points out that Chinese architecture is, after all, a kind of "toy" architecture and is not suitable for European needs.

As an educator, Reichwein aims to present to a younger generation the evidence of intellectual interaction between the East and the West, in which arts are one of the important aspects. Reichwein's statements about architecture are based on the book of Laske, while improving the understanding of English-Chinese landscape through literature research. Yamada, thanks to his cross-cultural background and his perspective as art historian, expands Laske's scope without rambling deeply into the jungle of literature and philosophy as Reichwein does. Of the four periods of Chinoiserie defined by Yamada, only the last period contains architectural aspects.

Honour's book attempts to show the vision of the Cathay period. It was a flowery empire, distant in both space and time, based partly on travelers' tales about China, which first filtered into Europe in the thirteenth century, and partly on Chinese wares, many of which were deliberately designed for the European market. The book is abundantly supported by examples of literature and artifacts, including architecture. While Honour follows a chronological order, Impey, whose book Honour has prefaced, organizes her work by types of art works. The chapter about architecture is rich in examples. Impey expands the boundary of Chinoiserie to include Byzantine (Impey 1977, p. 75), which is almost as broad as talking about the influence of all of Asia and the Middle East on Europe, instead of only East Asia. As its subtitle indicates, *Chinoiserie* by Madeleine Jarry is a book about European decorative art. Although it barely touches upon architecture, Jarry provides an excellent summary of the origin of Chinoiserie by tracing the influence of imports from China, such as in porcelain and lacquer, on the technological and stylistic changes in Europe. (Impey 1977, p. 12)

PART ONE MICRO-APPROACH: HISTORICAL RESEARCH OF THE CHINESE TOWER IN DONAUSTAUF

CHAPTER 3. WOOD USAGE IN CHINOISERIE ARCHITECTURE

The Cultural Value of Wood

Wood is strong, elastic, and often can be carved in intimate detail. Unfortunately, it is not very durable against weathering unless it is protected from water by special physical and chemical treatment. Old lumbers have to be periodically treated or replaced to secure the architectural soundness of historic buildings. This requires a special knowledge of the original wood, including the physical dimensions, the provenance, and its botanical classifications. This knowledge is especially important to historic buildings, where wood does not only satisfy the need to support buildings, but also carries cultural and social meanings. Besides the well-known wood culture in Asia, in Europe, there was also a wood culture influencing the choice of wood, for instance, as Perlin states,

> "in former times, most commoners 'knew their places' when they built: they constructed their houses our of such inexpensive woods as willow or plum, reserving oak for churches, princes' palaces, and noblemen's lodgings. But in the affluent age of Elizabeth, according to William Harrison, the most trusted commentator of the period, all these [other woods] are rejected and nothing but 'oak' was used." (Perlin 1991, p. 175)

Various documents also show Europe imported wood from Asia. For instance, on the cargo list of Madre de Dios, a Spanish ship pirated by Englanders in 1592, marks "Ebenwood as black as jet." (Impey 1977, p. 37) Ebony (*Diospyros* spp.) is native to Southeast Asia and western Africa. Due to the Treaty of Tordesillas and the Treaty of Saragoza, Spanish ships were not allowed to visit western Africa. And the supply was probably picked up from the Spanish East Indies in Asia and carried across the Pacific before sailing into Atlantic[21]. It is conceivable to determine how the timber was valued in Europe, for against the transportation cost piled up by cross-Pacific and cross-Atlantic shipping, the merchants could still profit. But so far, such expensive wood has not been found on any existent building or relevant construction records in Germany. The timber imported from Asia, such as ebony[22], was only used for furniture or interior decoration. Ebony, padouk and teak furniture was popular in the northern European nations. (Impey 1977, p. 111)

Ancient Chinese Wooden Architecture

Wood was a major construction material in ancient China. It was not only used in decoration but also in the load-bearing frame, which interlocks wooden supports to form a skeleton of the building. This makes Chinese wooden architecture distinct because walls are not load-bearing

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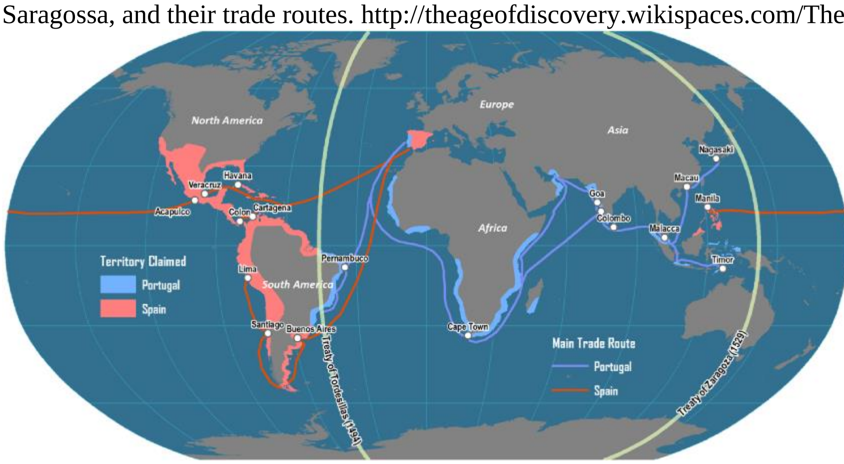
[21] Territorial separation between Portugal and Spain according to the Treaty of Tordesillas and the Treaty of Saragossa, and their trade routes. http://theageofdiscovery.wikispaces.com/The+Treaty+of+Tordesillas



[22] Ebony is one of the heaviest and hardest woods, harder than oak or elm. It is probably not suited for general construction because of its weight and difficulty to work, in addition to expense and size limitations. It was frequently found in decorative elements in Asian architecture but not yet in Chinoiserie architecture.

elements, but merely an enclosure. The materials of Chinese buildings also came into the attention of the Europeans. For instance, Nieuhof reported "the Houses in China are for the most part built of Wood, or rest upon Wooden Pillars; yet they are covered with Tyles." (Conner 1979, pp. 16–17) A unique element in the wooden structure is "dougong" (斗拱), which interlocks wooden brackets to join the pillars and columns to the frame of the roof. In the later periods, as the proportion of dougong became larger, it was also lavishly painted and was treated as a decorative element. The ancient Chinese also preferred wood to make decorative parts, such as the lattice on windows and ceilings, which was constructed of woven strips fastened to the beams. The Chinese craftsmanship was so sophisticated level that no glue or fasteners were necessary to join the wooden elements together. Asian framing is significantly different from western framing, with its predominant use of post and lintel framing and an almost complete lack of diagonal bracing.

Ancient Chinese wooden architecture had a special method of standardizing and prescribing different elements, which were passed down over thousands of years and were recorded in bureaucratic manuals such as *Yingzao Fashi* (《营造法式》) and *Qing Architecture Standards* (《清工程做法》). The techniques in these two manuals provide the main Chinese examples that allow us to compare and contrast Chinoiserie architecture with traditional German wooden construction.

Fachwerkhaus in Germany

The "Fachwerkhaus" is the most famous timber framing in Germany. It boomed between the thirteenth and sixteenth century when lavish decorations were used. At the beginning of the seventeenth century, the design of Fachwerkhaus became simpler and the timber dimensions were gradually reduced until it was replaced by modern industrial construction methods.

The main load-bearing structure of Fachwerkhaus is timber frame that makes use of mortise and tenon joints. Brick masonry, adobe, or wooden planks are used as the wall infill materials. There are two types of Fachwerkhaus in Germany: The older *Ständerbau* (also *Geschossbau* or *Säulenbau*) uses wall columns that rise from the threshold to the roof ridge; while in the younger *Rähmbau* or *Stockwerksbau*, each story is built as an independently enclosed "case." Timber shortage and the expense of importing larger lumber from Northern Europe and Russia in the later Middle Age may be the reason of this new development. Regardless, there was the need to adopt a new technique to build multi-story buildings with short timbers.

Wood in Chinoiserie Architecture

More and more buildings used wood as major construction materials in the development of Chinoiserie architecture. Some later Chinoiserie buildings, such as the Chinese Tower in Donaustauf and the Chinese Pavilion in Veitshöchheim, were completely built in wood. The Chinese Tower in the English Garden in Munich, which was burned down several times, was repeatedly rebuilt in wood. Some records of timber procurement for Chinoiserie architecture indicate oak, spruce, and pine were the most common. Other records may provide the provenance of the lumbers. For instance, Schmid reports the wood of the Chinese Tower in the English Garden of Munich was provided by the State Administration of Palace Linderhof[23], while the larch shingles were from Austria. (Schmid 1983, p. 44) It is clear the choice for wood had its design consideration, because many Chinoiserie buildings, though not wooden, imitated

[23] *Staatliche Verwaltung Schloss Linderhof*

the wooden features of the Chinese architecture, for instance, the Chinese pavilion on the Belvedere in Bruchsal (after 1756). (Erdberg 1936, p. 75)

CHAPTER 4. THE FORM AND CONSTRUCTION OF THE CHINESE TOWER

The inspiration that Chinese arts provided can be revealed in Chinoiserie arts. A unique character of Chinoiserie architecture is also its association with the ancient Chinese architecture which is low in height, has sweeping roofs, and presents structural joints, known as dougong. Wood as a building material was responsible for this special form. Hence, it is appropriate to inquire how it has been appropriated by the Chinoiserie architecture. The first goal of this chapter is to investigate the influence of Chinese architecture on Chinoiserie architecture in terms of form and structure.

The Structure of the Chinese Tower

The Chinese Tower (Fig.4-1[24]) is a pavilion-like wooden structure in octagonal plan. It has a double-eave hip roof, which warps up, resembling the sweeping roof line of Chinese architecture. At the top of the roof, there is a golden spike with four vertically aligned small plates as decoration. Under the roof, there are two stories with colonnade on an octagonal stone foundation. The entire structure resembles the American platform framework or the German frame construction (*Rähmbauweise* or *Stockwerkbauweise*). That is, one floor is built on the other as stacking one “box” or “case” on the other. The entire structure is built with wood with the exception of the roof covering, the stairs, the columns on the second floor, and the pedestals of the columns on the first floor. The two roofs are painted with white and red stripes, while the rest of the building stays in the color tone of dark brown.

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[24] Provided by Franz Kastenmeier in December 2014.

The First Story

The plan of the first story (Fig.4-2) is octagonal. In-situ survey shows each part of the plan is slightly different in dimension (about 1-2 cm), probably due to the deformation of the timbers over time. There are eight massive columns in the eight corners of the octagonal plan; all are in the form of chevrons and painted with dragons (Fig.4-3). They stand on stone pedestals. The connection technique between the wooden columns and the stone pedestals is unknown. Between the columns, there are railings with simple straight sticks. The rusted metal spare parts (Fig.4-4) under the railings indicate the railings were previously fixed to the ground. One side of the octagon does not have the railing, which opens the only entrance to the building. In the middle, there is a slightly tapered, round column (Fig.4-5), butting the joining point of the eight beams from the eight corner columns. Besides these eight beams from the corner to the center, there are another eight beams in similar dimension between every two columns on the edges of the octagon (Fig.4-6). Thus, the entire structure of the first floor can be summarized as an octagonal wheel on eight posts in the corners and a post in the middle, where the eight radial, "spikes (wooden beams)" of the wheel join each other.

Inside the colonnade, a room about 17.2 $m.^2$ is enclosed by wooden walls with large openings. Although all eight sides of the room look similar, on one side — the side where there is no railing between the columns — is a three panel glass door (Fig.4-7).

The floor of the first story is nicely laid out in a pattern of spider net (Fig.4-2): from the central point, where the round wooden column stands, radiate twenty-four lines to the outside. There are also lines parallel to the edges of the octagon. At the cross points of the radiating lines and parallel lines, there are round, red stone tile works, which vary in size from the middle to the outside. The outer tile works are the bigger (Fig.4-8).

The Second Story

In the loggia of the first story, there is a spiral stair (Fig.4-9[25]) leading to the loggia on the second story (fig. 4-10), which also has eight corner columns. These columns consist of two parts. The lower part is probably made of timber and wrapped by copper sheets, while the upper part is made of cast iron which has a capital in Romanesque style but no pedestal. Railings between the columns are filled with simple slant lattice. The central space of the second story is also enclosed by walls with large openings, which gives the entire building a light and airy impression. The floor slabs of the second story are laid on the bulky, wheel-like ceiling framework of the first story and are finished in a delicate pattern. All the openings on the second story appear to be French windows, but they are actually alternatively doors and windows. That is, there are four doors and four windows on the second story.

The whole wall surface on the second floor is painted with decorations that mix European and Chinese artistic elements. Traditionally, Chinese architectural painting had an established system of patterns and a set of rules, indicating who and where certain patterns were permitted to use certain patterns of paintings. Some of these patterns appear on the wall painting of the Donaustauf Tower, such as the symbols of Ruyi and longevity. Some patterns seem to be European in origin, for example, the tiger and the sun. In general, the design should be the creation of the architect or the painter himself, without following the Chinese system of architectural painting, but some of the traditional Chinese symbols were obviously known to the designer (Fig.4-11).

[25] Konrad 1990, photo 12.

The ceiling of the second story is a dome with light emanating from the cupola, which is different from the roof form on the outside. From the outside, the structure has a double eave roof of two sweeping and upwarping roof boards like waves. The inside, however, is formed to a hollow sphere, which resembles the inner space of a dome. The dual form of the roof is achieved by nesting one framework into the other: the outer one gives the roof a sweeping shape on the outside, and the inner one gives a dome shape on the inside. This kind of timber frame looks like the upper part of the traditional Hammer-beam roof in Europe, but differently engineered. Because it does not have hammer post between rafters and beams, the arched brace of hammer-beam structure becomes an important load-bearing element and is supported by the posts underneath. The support from the lower posts makes it safer for the arched braces to bear the weight of the cupola (the upper level of the double eave roof).

In Comparison to the Traditional Chinese and German Timber Framing

Timber framing has played a crucial role in the history of Chinese architecture. At the end of the seventeenth century, European noblemen began to create buildings to resemble Chinese architecture by using elements such as sweeping roof and lattice. Behind the appearance of these features, there are technical reasons for their construction. This comparison of traditional Chinese and European methods yields interesting insights.

Comparison of Load Carrying Structure

One obvious distinction between the Chinese and the German timber framing is that the Chinese completely exposes timber structure, while the European usually seals up the ceiling and walls with plasterwork. This is especially true for the Chinese garden pavilions, where structural elements are normally left visible. In this respect, the Donaustauf pavilion follows the German tradition, as its ceilings on both floors are closed with plasterwork as are the walls on the second floor. Walls on the first floor are not plastered, because the first floor was used as an aviary (Fig.4-12[26]) and between the corner columns there were wooden curtains that could be drawn down in winter to keep the birds warm (Fig.4-13[27]).

Chinese architecture tends to be low in height and only one story. The double eave was common in the buildings of high status. Some types of buildings, such as the pagoda (塔)and the multi-storied pavilion (楼阁), used conventional techniques to construct multi-storied buildings. Actually, putting aside the need of large inner space for living, the Chinese pagoda was able to achieve more stories than the German timber framing, which has normally three to four stories. In the Chinese timber framing, there are mainly two types of frameworks to increase the stories of a building: overlaying structure (叠圈架) and overall structure (整体架 or 通柱式). The overlaying structure is similar to American platform framing and German frame construction (*Rähmbauweise* or *Stockwerkbauweise* in German) of the half-timber house (*Fachwerkhaus*), in which each story is constructed like a case, and the whole building is constructed like a pile of such cases. To join stories vertically, three types of connections are usually used, intersecting-posts (叉柱造), wrapping-posts (缠柱造), and Yongding-posts (永定柱) to connect the posts of the upper story to the dougongs of the lower story. The Qing Dynasty utilized the overall structure more, which is similar to the post construction (also called ridge-post framing) in Germany (*Geschossbauweise* or *Ständerbauweise*). This method uses long vertical elements, e.g., posts or columns that continue from the ground to the roof. The floors are to be hung from these long vertical elements.

[26] Konrad 1990, photo 10.

[27] Konrad 1990, photo 5.

The Donaustauf pavilion uses the first type of framework, the overlaying structure (Fig.4-14). Each story has its own set of posts and beams to build a case-like unit. By overlaying the two units together, we can get a two-story structure. There are no vertical elements reaching from the ground work to the roof as in the case of the second type of framework. On the first floor, there is a free-standing column (Fig.4-5) supporting the joining point of the eight beams (joists) on the ceiling, because it is here that the structure has vertical stress that cannot pass onto the columns on the outside. This is not commonly seen in the Chinese framing, because the Chinese method overlays hollow double-walled cases without top and bottom and uses a thick interfloor structure for consolidating the connection of the "cases," which resembles the structure of bamboo stem or a tube-in-tube system with truss-belts, for example, the wooden pagoda in County Ying (Fig.4-15[28]). The floor slab in the middle is not structurally crucial. The German frame construction (*Rähmbauweise)* method, in contrast, uses one-tube structure and has massive structural ceiling joists (*Deckenbalken)* to tighten the outer framework. The meeting points of the heavy ceiling joists need sufficient vertical support from the posts underneath. In a rectangular plan, the posts can be hidden in walls. In the octagonal plan of the Donaustauf pavilion, the meeting point is in the center, and the post that supports it cannot be hidden in the wall. It is left free standing.

Comparison of Roof Structure

The ancient Chinese timber framing is known by two paradigms — the Song paradigm and the Qing paradigm, mainly because of the periods that they were established. The Song paradigm refers to the technical system that was normalized in Song Dynasty, while Qing paradigm refers to that in Qing Dynasty. In both paradigms, there is a structural category specified for buildings

[28] Jäger, 1888, p. 42.

of round or polygonal plan. In the Song paradigm, it is called hip-rafter-clustering structure (簇角梁结构); in the Qing system, it is called pyramidal roof or pavilion roof. (攒尖) (Fig.4-16[29]). The grand hip rafters (大角梁), which is one type of rafters in the Chinese roof framing, come from the capitals of the lower columns and join to a suspended column in the center, which is called "Thunder God" column in Chinese (雷公柱). Above a grand hip rafter, there are four broken rafters (折簇梁) to form the hip line. The four broken rafters are respectively called upper broken rafter (上折簇梁), middle broken rafter (中折簇梁), lower broken rafter (下折簇梁), and sub-broken-rafter (子折簇梁) from the top down. The Thunder God column functions as the same time as lightening rod. There are usually other conductive devices such as fire ball (火珠), treasure ball (宝珠), and treasure top (宝顶) on top of the Thunder God column to better receive the lightning attack. The timbers directly connected to the column are usually electricity conductible species, for example, Nan-wood (楠木, timber from the species *Phoebe zhennan S. Lee* and *Machilus* Nees), Ge-wood (格木, *Erythrophleum fordii* Oliv.), pine (松, *Pinaceae Pinus),* and cypress (柏, *Cupressaceae*). While Nan-wood and Ge-wood are only present in Asia, pine and cypress can also be found in Europe. During the Age of Discovery, a great quantity of Asian timbers was imported to Europe. It is interesting to know whether they were used for constructing Chinoiserie buildings or whether the choice of timber followed the Chinese tradition. These questions can be answered by examining wood materials of Chinoiserie buildings with the help of wood anatomy and dendrochronology, which is the topic of the next chapter.

29 Jäger, 1888, p. 28.

To build double-eaved pavilion roof, the type of post and lintel[30] construction (抬梁式构架) is usually used to rest the posts of the upper eave on the beams of the lower eave (Fig.4-17[31]).

In Europe there are also conventional methods to build pyramid hip roofs, known as a "gazebo" (Fig.4-18[32]), in which the hip rafters (sometimes called main rafters) join each other directly, to an apex block or to a small ring of purlins in the middle. There are different ways to arrange the rafters between the hip rafters. One way is to let all rafters join each other in the middle in the same manner as hip rafters. Hence, the plan from above shows rafters "radiate" from the center to the beams at the edge. Another way is to lay all the in-between rafters in parallel so that all of them join the main rafters on the hip line (called jack rafters), except one in the middle joining the main rafters in the middle (called common rafters, sometimes also hip rafters). To make a double eave gazebo (or pyramid hip), one simply places the posts of the upper eave on a circle of joint purlins of the lower eave. Interestingly, the roof line is normally achieved by forming the rafters into various shapes, e.g., onion dome or bell.

The upper eave of the Donaustauf pavilion uses the structure of German convention (Fig.4-14). It has a column in the middle which allows all the rafters to join together (Fig.4-19[33]). On top of the column, there is a metal spike resembles the lightening device on the Chinese architecture, which is however usually round rather than spikelike.

[30] The lintel actually refers to beam here. The Chinese convention translates this type of structure as "post and lintel" construction. But it is actually about raising beams on posts and is not related to the lintels of windows or doors.

[31] Ma 马, 1991, p. 65, p. 67.

[32] http://woodworkersworkshop.blogspot.de/2011/05/basic-pavillion-gazebo-with-6-sides.html

[33] Konrad 1990, photo 44

For the lower eave, the Donaustauf pavilion has a double layer structure. For the outer layer the German method is used for the lower part of double eave gazebo. The inner layer is made by a circle of arched rafters (or truss) whose lower ends are bounded together by a circle of tie beams to form a dome ceiling. The Donaustauf Tower divides the columns of the inner circle into two parts and bends the upper columns into arches, so that the structure is able to create a dome-like ceiling which Chinese architecture does not have. The reason for the Donaustauf method is probably due to the wish to make a high dome ceiling on the inside and a sweeping roof line on the outside. The method provides the possibility to form the interior and the exterior differently; The German method of bending rafters gives the freedom to make the roof into desired shapes both interiorly and exteriorly.

The “upwarping” effect on the corners of the roof is worthy of explanation. Traditionally, the Chinese architecture was raised because the hip rafter has two parts and the lower part is higher than the common rafters. Since both the lower hip rafters and common rafters rest on the same purlin, there appears to be a slope from the hip where the lower hip rafters rest. In the structure of pavilion roof, this upwarping is achieved by cutting the last of the five broken rafters, i.e., the sub-broken-rafter into a hook shape (Collins 1974, p. 29).

More precisely, the slope of the roof in Chinese architecture is determined by the rules of raising a truss, in which the span between every pair of columns or struts is officially stipulated to be the same (x), and the height difference between each pair of columns, which is the same to the height difference of the beams or trusses they raised, is prescribed to the order of, for instance, 0.5x, 0.7x, and 0.9x. Thus, the slope of the roof is always fixed to the depth of the building. In contrast, the German method allows a free choice of slope simply by tilting the hip rafters differently (Fig.4-20). (Collins 1974, p. 32)

The Donaustauf Tower achieves the sweeping line by cutting the complete piece of hip rafter into hook shape instead of breaking it into segments. Similar to the upper eave, the sweeping roof line of the lower eave is also achieved by forming the rafters into arch. The slope of the roof is determined by the inclination of the rafter. There seems no application of the Chinese rules of raising a truss. There seems to be no structural reasons to follow the path taken other than giving the roof a "sweeping" look.

In Comparison to other Chinoiserie Buildings

Besides its similarity to typical Chinese and German timber framing, the Donaustauf Tower can be compared with other Chinoiserie buildings. Due to the fact that most of the wooden Chinoiserie buildings have not survived, the comparison is limited by the historical records available.

Decorative "Dougong"

Traditional Chinese architecture has two major types of wooden structures — the large paradigm (大式) and the small paradigm (小式). The large paradigm refers to the wooden frame with dougong and the small paradigm wooden frame without dougong. Dougong is a structural element of interlocking wooden brackets to join columns to the framework of the roof without glue or fasteners. After the Song Dynasty, dougong became more ornamental than structural, and was used mostly in palatial and religious buildings. The small paradigm uses the mortise and tenon joint similar to that in traditional European timber framing, often pegged. In the Donaustauf Tower, there is no sign that any attempt was made to integrate dougongs into the structure. Only between the columns and beams on the first floor are there decorated brackets (*Knagge*), seemingly to suggest a visual effect given by dougongs (Fig.4-21). Brackets

(*Kopfband* or *Knagge*, Fig.4-22, 4-23[34]) are common joinery between the beams and posts in the German half-timber house. Although it is hard to determine whether the brackets in the Donaustauf Tower were intended to imitate dougong, it is clear some Chinoiserie buildings use it for this purpose. For instance, in the Chinese Pavilion in Pillnitz (Fig.4-24[35]), the brackets between columns and beams are formed into right-angled edge, which have less structural meaning than decoration. The same treatment appeared on the plan for a Chinese bridge by William Chambers in Sanssouci (Fig.4-25[36]), *la Maison Chinoise* in the *Désert de Retz* (Fig.4-26[37]) and the design of a Chinese Temple in the pattern book of Charles Over (Fig.4-27[38]). The origin of this treatment may be found in Chambers' book, *Designs of Chinese buildings, furniture, dresses, machines, and utensils, "*They (columns) have no capitals; but instead thereof the upper part of the shaft is pierced by the beams, and generally surrounded with several little consoles that help to support them." (Chambers 1757, pp. 11–13) Most buildings appeared in the book also have these "little consoles," whose right-angled forms make it difficult to believe they can "support" beams structurally. The Chinese Tower in the English Garden in Munich also uses brackets in large quantity, but similar to the Donaustauf Tower, their form (Fig.4-28[39]) makes them structurally feasible, and it is difficult to determine whether they are intended to imitate the Chinese dougong.

[34] http://web.hszg.de/umgebindehaus/uebersicht/konstruktion/verbindung.html

[35] German Federal Archive (Deutsches Bundesarchiv) , http://commons.wikimedia.org/wiki/File:Bundesarchiv_Bild_183-42354-0006,_Dresden,_Schloss_Pillnitz,_Chinesischer_Pavillon.jpg

[36] William Chambers: Aufriss der Chinesischen Brücke, 1763. Feder in Schwarz, farbig aquarelliert, Plansammlung Nr. 2365, @ SPSG. http://www.perspectivia.net/content/publikatione http://www.perspectivia.net/content/publikationen/friedrich300-colloquien/friedrich-kulturtransfer/galerie/dorgerloh_gaerten/abbildung-13/viewn/friedrich300-colloquien/friedrich-kulturtransfer/galerie/dorgerloh_gaerten/abbildung-13/view

[37] Le Rouge 1775, XIII Cahier, 12

[38] Over 1758, p. 21

[39] http://commons.wikimedia.org/wiki/File:Chinesischer_Turm,_Munich_-_DSC07119.JPG

Roof Framework

The roof framework of the Donaustauf Tower has almost the same structure of the Chinese pavilion designed by Christian Friedrich Schuricht (1753-1832) in Pillnitz (Fig.4-29[40]). The roof structure of the Pillnitz Pavilion is also double layered, so that the interior has a dome-like ceiling and exterior has sweeping roof lines. This seems also to be the case of the Pagoda in Mulang (Fig.4-30[41]) and a Chinese pavilion in the pattern book of Jean-Charles Krafft (Fig.4-31[42]), where the roof line disagrees with the shape of the interior ceiling. This allows Chinoiserie buildings to obtain a Chinese sweeping roof line and a European inner space at the same time.

Multi-Story Construction

Most Chinoiserie buildings of timber framing are one-story, small-scale pavilions. One method to build a two-story pavilion is to add an external staircase (Fig.4-32[43]). In this way, there is no direct access through the floors. Another method, as in the case of the Donaustauf Tower, uses a spiral staircase (*Wendetreppe*) to connect floors. The same method is also used in the Chinese Tower in the English Garden, Munich. Instead of installing the stair in the loggia on the side, the spiral staircase of the Munich Tower goes up around a middle column that stretches from the foundation to the roof (Fig.4-33[44]). This is a usual staircase treatment for pagoda with a central column in China, called center-through pattern (穿心式). Moreover, the main structure of the

40 http://www.deutschefotothek.de/documents/obj/71077818

41 http://www.museum-kassel.de/index_navi.php?parent=10268

42 Krafft 1993, pp. Cah.8 pl.58.

43 Krafft 1993, pp. Cah.12 pl.89.

44 http://commons.wikimedia.org/wiki/File:Chinesischer_Turm,_Munich_-_DSC07116.JPG

Munich Tower (Fig.4-34[45]) is very different from the Donaustauf Tower. The former uses the typical overall structure (整体架,通柱式) of the Chinese multi-story construction method and has a circle of columns around the central staircase from the foundation to the ridge. To get a tapering effect from the outside, two methods are used in the Munich Tower. One is to put the outermost columns of the upper story in the middle of the beams between the outermost columns and the second outermost columns on the lower story, so that the outermost columns of the upper story has a "set-back" from the outermost columns of the lower story. This method is used on the first and the fourth floors. The other method is to simply decrease the numbers of column circles on the upper stories. For instance, on the second floor, there are three circles of columns, while on the third floor, it is reduced to two.

In summary, the Chinese Tower in Donaustauf mainly used the German method of construction. It attempted to imitate appearance of traditional Chinese architecture on the outside, while once inside it complied with the European preference of spatial arrangement.

[45] Provided by Dr. Hermann Neumann in Bayerische Schlösserverwaltung (BSV), The Bavarian Department of State-owned Palaces, Gardens and Lakes, otherwise known as the Palace Department.

CHAPTER 5. WOOD INVESTIGATION ON THE CHINESE TOWER IN DONAUSTAUF

Wood Investigation

The aim of this chapter is to understand the construction material of the Chinese Tower in Donaustauf as to answer questions, what kind of timber was used and how old are they.

A series of techniques have been systematically developed for studying wooden object, whether small or large. For buildings, some of these techniques, such as wood anatomy, dendrochronological and C_{14} dating can be applied to both structural elements as well as decorative elements. Nowadays, Japan seems to be the most advanced in preserving wooden architecture, not only because more than 90% of buildings listed as a National Property or Important Cultural Property of Japan are made of wood, but also because of its long tradition and spiritual awareness of conservation. (Yokoyama et al., p. 1) Japanese centuries' campaign for preserving wooden structures specifically demonstrates the importance of scientifically identifying wood species, which should be learned by other historical sites with wooden structures.

Previously, the identification of wood heavily relied on personal experience. By reading the grain, sometimes with the help of magnifying glass, experienced carpenters can tell to what species (or the common name) it belongs. Determination of wood species by naked eye is difficult, however, especially in case of old timber. Even skillful carpenters sometimes make errors. For example, a pole of Okuno-in Kiyomizu temple, which was built in 1633, was believed to be made of Japanese cedar (*Cryptomeria japonica* D.Don) for a long time by owners and carpenters. It was later identified to be hinoki (*Chamaecyparis obtusa* Endl) by the features of its wood anatomy. This is a good example showing why wood species should be identified scientifically at least based on its microscopic features. (Yokoyama et al., p. 7) Recently, the possibility of genetic identification has been exploited. After matching the haplotypes detected on ancient woods (i.e., 51 ancient oak wood samples originating from various European archaeological sites, dating from the Neolithic period to the eighteenth century) and the haplotypes characterized from fresh samples from the same localities, Deguilloux and his colleagues conclude the technique could be used to infer or confirm the transport of wood by man, providing interesting perspectives for the genetic analysis to identify the origin of wood. (Deguilloux et al. 2006, p. 1216) More specifically, the success of this approach was higher if the DNA was isolated from outer sapwood (without cambium) by comparison to DNA isolated from the transition zone between sapwood and heartwood and the inner heartwood, because Inhibitor tests can indicate more PCR (Polymerase chain reaction) inhibitory substances in the outer sapwood in comparison to transition wood and heartwood. (Rachmayanti et al. 2009, p. 185)

The investigation of wood usage on Chinoiserie architecture attracts less attention than the study of the stylistic elements, partially because not all of them were made of wood. Even when buildings were originally built in wood, the materials were often replaced with masonry work during renovation and rehabilitation. Wood investigations of Chinoiserie architecture encounter three scenarios. In the first scenario, nothing is known; neither an examination of the historical records, nor modern examination is possible. In the second scenario, some historical records about timber usage can be obtained, but the amount of information is very limited. Usually, in the over-hundred-year-old records, one can only find common names of wood in their broadest sense. Old written texts might provide some clues about the origin of the timber. In the last scenario, both documentation research and technical examination were carried out and recorded, and therefore are available for further studies. For the first two scenarios, if the buildings still exist, microscopic investigation can be conducted. Otherwise, the woods used in the building remain unknown. In the last scenario, it is very often the case that through many unrecorded changes the actual wood materials do not agree with the old documents, hence, the information is doubtful and needs to be carefully evaluated (Table 5-1).

Table 5-1 Three Investigation Scenarios

Scenario	Historical Records	Past *in-situ* Examination	Examples
I	none	none	Ludwigburg
II	common names, provenance	none	Mulang, Saarbrücken
III	common names, provenance	previous investigation	Chinese Tower in Donaustauf

The Chinese Tower in Donaustauf belongs to the third scenario, in which both historical records and some preliminary research are available but incomplete. To get a better understanding of the construction materials, two investigation methods—wood anatomy and dendrochronology are applied to the samples collected from the building.

Sample Collection

Nineteen wood samples were taken from the Chinese Tower in Donaustauf during its relocation in 1999 and were well preserved. Eight samples were sent to the Jahrringlabor Hofmann, Stuttgart, in 1999 for dating. These samples plus one roof beam were chipped into about 1x1x1 cm cubes for documentation and control (Nr.1- 9). Other seven samples remain unexamined and are awaiting further investigation (Nr.10-14, Nr.16, 17). The remainder of the samples are not considered in the present work because one sample (Nr.15) is difficult to transport while the other two were tangentially cut off from two columns and are not suitable for conducting dendrochronological examination (Nr.18, 19). These three were only photographed for documentation purposes (Table 5-2, Fig.5-1 to Fig.5-16, and Fig.5-25).

Table 5-2 List of Wood Samples from the Chinese Tower in Donaustauf

Nr	Name	German Name	Photos	Dimension (cm)	Examination
1	purlin crown	Pfettenkranz E.G.	Fig.5-1	1x1x1, Appendix III	1999
2	lantern ceiling	Deckelaterne	Fig.5-2	1x1x1, Appendix III	1999
3	column VII	Säule VII		lost?	1999
4	column VI	Säule VI	Fig.5-3	1x1x1, Appendix III	1999
5	column without Nr.	Säule ohne Nr.		lost?	1999
6	lantern column	Säule Laterne	Fig.5-4	1x1x1, Appendix III	1999
7	lantern ceiling	Deckelaterne		lost?	1999
8	column VIII	Säule VIII	Fig.5-5	1x1x1, Appendix III	1999
9	roof beam	Dachbalken	Fig.5-6	1x1x1, Appendix III	2014-15
10	column II	Säule II	Fig.5-7	Appendix III, paints outside	2014-15
11	lantern crown	Kranz Laterne	Fig.5-8	Appendix III	2014-15
12	column IV	Säule IV	Fig.5-9	Appendix III	2014-15
13	lantern middle column	Mittelsäule Laterne	Fig.5-10	Appendix III	2014-15
14	roof beam	Dachbalken	Fig.5-11	Appendix III	2014-15
15	column without Nr.	Säule ohne Nr.	Fig.5-12	photos only	2014-15
16	round column	runde Säule	Fig.5-13	Appendix III	2014-15
17	column V	Säule V	Fig.5-14	Appendix III	2014-15
18	tangentially cut column I		Fig.5-15	photos only, with painting of dragon tail	2014-15
19	tangentially cut column II		Fig.5-16	photos only, ground henna painting	2014-15

Wood Identification

After collecting the wood samples, the first question to address is their taxonomical determination, plainly what kind of wood they are. Wood anatomy is an effective method for identifying the species of the samples by observing the cellular structure on three planes of sections — transversal, radial, and tangential sections — under the microscope. This method is applied to sample Nr.1 to sample Nr.17, except sample Nr.15.

The identification of historical woods is difficult when comparing old samples with identification of recent, healthy wood. This is due to several factors, among them: 1. Samples are usually covered with layers of coatings such as paint; 2. The available samples are commonly very small, and unfortunately the ideal cubic size of 1 cm is rarely possible to obtain; and 3. The three planes of orientation for the sections are rare, especially, the radial sections that are normally not accessible.

Sample Preparation

To get clear picture of the cellular structure of wood, large sample pieces are needed. These are cut into small, thin microscopic sections according to the following steps.

- Preliminary preparation

Small cubes (about 1x1x1 cm) are chiseled off from the large samples, and then all cubic samples are split with knife to see the anatomical orientation. This will facilitate further sectioning.

- Softening and embedding

Samples are immersed in javel water to soften the hardwood.

- Sectioning

All cubic samples are sectioned with a razor blade or with a microtome to get very thin sections of transversal, radial (when possible) and tangential sections. These are placed on a microscope slide, on which three drops of water are already placed. Finally, a cover slip is placed on the top of the thin sections for allowing observation under the microscope. In this case, although samples can be stained, it was not necessary. Samples were observed using a Leitz Laborbux microscope.

Identification

Species can be identified by taking thin sections from the transverse, radial, and tangential planes, and identifying diagnostic features using key features, such as described in *Wood Anatomy of Central European Species* (Schoch, Schweingruber 2004) and *Computer-aided Wood Identification.* (Wheeler 1987) Detailed observations are described as follows (Table 5-3).

- *Quercus spp.*: Sample number 4 (column VI), 8 (column VIII), 10 (column II), 12 (column IV), 15 (column without a number), 16 (round column), and 17 (column V).

Transversal section: vessel elements, ring porous, flame-like distribution of pores mixed with groups of fibers in latewood, thin-walled tyloses in the vessels of early wood, parenchyma rays present

Radial section: vessel elements with piceoid pits, homogeneous rays with thick-walled ray cells, fibers present

Tangential section: fibers present, vessel elements along multiseriate and uniseriate rays of 4-15 cells, vessels with simple perforation plate

Identification: based on the observations, these samples can be *Quercus robur* L. (Pedunculate Oak), *Quercus pubescens* Willd. (Pubescent Oak), and *Quercus petraea* Liebl. (Sessile Oak). It is not possible to differentiate the three species based only on anatomic features. Methods of discrimination suggested by other scholars such as morphological analysis are not applicable to dry timber wood.

- *Picea abies* Karsten*:* Sample number 1(purlin crown), Sample number 2 (lantern ceiling), Sample number 6 (column lantern), Sample number 9 (roof beam), Sample number 14 (roof beam)

Transversal sections: no vessels, distinct growth ring boundaries, mostly gradual transition from early- to latewood (Nr.6, Nr. 9) rarely abrupt transition from early- to latewood (Nr.2), large resin canals bordered with 8 to 12 thick-walled epithelial cells.

Radial sections: resin canals, uniseriated tracheid pits average ray height 10 to 20 cells rarely up to 25 cells, ray tracheid with dented thick walls, one large pit in the cross-field from parenchyma cells to tracheid. Piceoid pits in the cross fields of the early wood, no biseriate bordered pits.

Tangential sections: average height of rays 9 to 15 cells. Resin canals in rays with thin-walled epithelial cells, no double resin canals.

Identification: These samples should be *Picea abies* Karsten (Common Spruce, Norway spruce). However, the differentiation of *Larix decidua* Mill. (European Larch) and *Picea* using wood anatomic characteristics is not always possible. In *Picea* the transition from early wood to latewood is gradual and generally uniseriate bordered pits appear in the radial section of tracheid.

- *Abies alba* Mill.: Sample number 11 (lantern crown), Sample number 13 (lantern middle column)

Transversal sections: no vessels, distinct growth ring boundaries, gradual transition from early- to latewood, no resin canals.

Radial sections: uniseriate pits in radial cells. Rays homocellular. Horizontal ray walls thick, smooth to dentate, walls of marginate ray cells thin. Tangential walls of rays distinct nodular chains. Taxodioid pits in early wood rays, in latewood piceoid pits. Often crystals in marginal ray cells

Tangential sections: average ray height 15 to 30 cells.

Identification: *Abies alba* Mill. (silver fir)

Table 5-3 Results of Wood Identification

Nr	Name	Latin Name	Common Name	Notes
1	purlin crown	*Picea abies* Karsten	Norway spruce	also possible *Larix decidua* Mill. (European larch)
2	lantern ceiling	*Picea abies* Karsten	Norway spruce	*q.v.*Nr.1[46]
3	column VII	*Quercus spp.*	oak	lost, according to 1999 dendro-records
4	column VI	*Quercus spp.*	oak	possibly *Quercus robur* L. (Pedunculate Oak), *Quercus pubescens* Willd. (Pubescent Oak), or *Quercus petraea* Liebl. (Sessile Oak).
5	column without Nr.	*Quercus*	oak	*q.v.* Nr.3
6	lantern column	*Picea abies* Karsten	Norway spruce	*q.v.*Nr.1
7	lantern ceiling	*Picea abies* Karsten	Norway spruce	*q.v.*Nr.3
8	column VIII	*Quercus spp.*	oak	*q.v.*Nr.4
9	roof beam	*Picea abies* Karsten	Norway spruce	*q.v.*Nr.1
10	column II	*Quercus spp.*	oak	*q.v.*Nr.4
11	lantern crown	*Abies alba* Mill.	silver fir	
12	column IV	*Quercus*	oak	*q.v.*Nr.4
13	lantern middle	*Abies alba* Mill.	silver fir	

[46] *q.v.* = see reference mentioned above.

	column			
14	roof beam	*Picea abies* Karsten	Norway spruce	*q.v.*Nr.1
15	column without Nr.	*Quercus spp.*	oak	*q.v.*Nr.4
16	round column	*Quercus spp.*	oak	*q.v.*Nr.4
17	column V	*Quercus spp.*	oak	*q.v.*Nr.4
18	tangential cut column	*Quercus spp.*	oak	*q.v.*Nr.4
19	tangential cut column	*Quercus spp.*	oak	*q.v.*Nr.4

Dendrochronology

Dendrochronology or tree-ring dating is a technique that uses the annual pattern of growth for determining the age of trees. Trees put on a layer of new wood under the bark each year. The thickness of that layer–the tree-ring–depends on various factors. The genetic make-up of the tree and the type of soil in which it is rooted both play a role, as do other environmental factors, but generally it is climatic factors that determine whether the ring will be wide or narrow. Conditions favorable to growth will result in a wide ring; unfavorable ones will produce a narrow ring. Therefore, examination of the annual growth rings of a tree reveals not only its age, but also the fluctuating climatic conditions during its lifetime. Within restricted geographical units, trees of the same species growing at the same time normally show similar trends in tree-ring growth. This can be seen by measuring the widths of the rings from different trees, plotting them against time in years, and superimposing the plots, known as tree-ring curves. Trees in the same woodland will show a high degree of agreement in year-to-year variation over long periods of time. The latter is most pronounced in samples from the same tree and this very strong similarity can sometimes be used as a means of determining when two timbers have been cut from a single tree.

The process of synchronizing two ring patterns is known as crossmatching or crossdating. It should produce only one true position of match. For example, Fig. 5-17 shows the position of match between two ring sequences; if one of the sequences is offset by one year to either side of that illustrated, there would be no agreement between the two curves, and hence no tree-ring match.

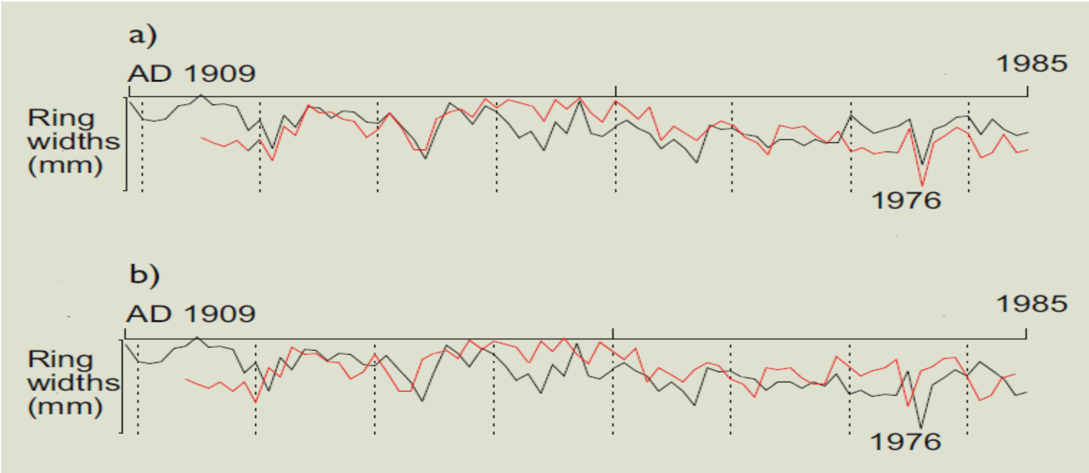

Fig. 5-17 Example of Crossmatching/ Crossdating[47]

Although crossmatching shows up best between trees from the same site, similarity in ring pattern can also be seen between trees from different woodlands, particularly if a site master curve (made up from a group of trees from each woodland) is used. In this way, crossmatching can be used for comparisons of woodlands that are located over considerable distances, such as London to Belfast, Sheffield to Exeter, and even Worcester to southern Germany.

Dendrochronology has two major drawbacks: first, not all samples can be dated and second, it only dates the rings in the wood sample. The age based on dendrochronology is not necessarily the same as the date the timber was felled or the date it was used. If bark is present, the date of the last measured ring will be the year in which the tree last grew, and the method will be precise

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[47] Ring patterns from two living oak trees at Quendon, Essex; both were sampled in 1985.The vertical scale is logarithmic: a) shows the curves in their matching position; the narrow ring at drought year 1976 is marked; b) shows the result of shifting one of the curves by just one year – there is no longer a match. (English Heritage 2004, p. 6)

to the year. If bark is not present, the date of felling will be less precise (English Heritage 2004, p. 5)

For eight samples (Nr.1-8), dendrochronological examination was carried out in 1999. Seven samples (Nr.10 - 17) are examined in this study. Details are as follows.

Sample Preparation

Samples were first divided into hardwood and softwood, since this will influence how their sections are prepared. Four samples were identified as oak, i.e., hardwood. They were sanded and soften with water to make the boundary of each ring clearly visible during the measuring. For the softwood samples, sanding turned out to be ineffective. They were, instead, softened with water and razed with a razor blade to get clear radius paths for ring-width measurement.

Sample Measurement

Ring widths were measured to an accuracy of 0.01mm on a travelling stage. The stage was connected to a computer, which uses a suite of specially written dendrochronology programs. In this study, the program developed by André Billamboz, was used for measuring the rings.

Basically, the sample is viewed through a low-power binocular microscope with the crosswire aligned with the start of the first ring. The stage is moved along until the crosswire reaches the start of the next ring, and the program measures the distance between both rings and the distance is recorded. To make it easier to recheck the measurements, some labs use special markers, for instance, at Cornell University Dendrochronology laboratory every tenth ring is marked with a dot using a needle (wet samples) or felt tip (dry samples); every 50th ring has two dots, and 100th three dots. This can be done before or during the measurement process. However, this does not seem to be the convention in Germany, where a great number of samples are wet measured.

Usually, it is only necessary to measure oak samples for one time, but it is imperative that a note is made during measurement of any "problem rings[48]". The solution to deal with the "problem rings" is to measure several paths on the same sample and check the quality of correlation among various radii (self-correlation test). Only the well-correlated radii are selected to calculate an average curve (*Mittelkurve*) for the tree-ring pattern of the sample, which is used to cross date the sample with a reference chronology for determining its age. Details of measurement for each sample are as follows.

- Sample 10. column II

Three radii were measured; generally they corresponded with one another (R1-3) in the later parts of each radius, but showed some chaos in the early parts of the radii. This is common, when the radius is measured from the pith. To get a relatively reliable average curve free from the disturbance of pith, the early parts of the three radii were truncated (Radius A: 0-27, Radius B: 0-31, Radius C: 0-26) to make them self-reconciled. Finally, the average curve was indexed using exponential method for crossdating (Table 5-4, 5-5, Fig.5-18).

Table 5-4 Raw Measure Data of Sample Nr.10

Sample Nr.10	column II			Species:	Quer.		Common Name			Oak
Year	Ring Width									
R1									Ring Count:	126
1-10	260	282	277	277	249	181	190	239	222	150
11-20	176	218	244	239	267	243	211	249	176	221
21-30	140	102	158	165	203	173	193	144	148	133
31-40	129	79	91	87	137	151	144	126	121	141

[48] Problem rings refer to the rings which are partially missing or whose width is too narrow to measure correctly.

41-50	166	225	288	516	484	323	361	254	325	356
51-60	235	302	358	271	270	180	133	140	109	123
61-70	144	133	214	178	142	140	112	131	140	165
71-80	138	116	104	112	104	121	104	94	82	91
81-90	145	84	105	64	101	84	67	64	124	81
91-100	109	66	91	73	89	74	77	105	99	100
101-110	130	143	158	162	175	259	201	225	179	208
111-120	166	112	173	148	139	134	130	127	184	141
121-130	147	114	173	162	142	136				
R2								Ring Count:		130
1-10	356	328	239	559	352	333	320	231	223	306
11-20	371	252	295	294	253	267	263	245	196	155
21-30	185	136	140	147	190	236	232	232	273	163
31-40	159	120	103	99	90	62	79	68	82	136
41-50	119	108	118	169	183	218	433	457	381	383
51-60	382	314	356	298	207	286	199	229	118	187
61-70	115	128	155	126	137	181	154	176	130	104
71-80	101	139	121	123	113	87	89	69	83	91
81-90	92	77	85	59	86	77	66	58	91	79
91-100	78	76	81	80	76	56	65	61	63	55
101-110	76	59	45	51	66	59	101	130	220	287
111-120	223	247	237	197	191	158	130	125	149	172
121-130	152	146	164	136	142	157	143	126	158	197
R3								Ring Count:		123
1-10	405	346	318	228	271	350	347	205	264	276
11-20	332	319	336	284	236	203	267	203	164	142
21-30	188	153	276	228	242	376	159	146	125	89
31-40	103	129	162	157	124	133	157	159	238	178
41-50	361	406	418	377	291	371	359	263	317	185
51-60	219	245	156	134	114	130	125	138	179	221
61-70	173	128	130	123	91	170	124	119	126	88
71-80	100	91	97	137	60	84	66	64	78	63
81-90	70	73	90	69	132	111	78	68	84	68
91-100	78	75	55	90	82	54	57	89	98	69
101-110	71	135	227	294	217	291	253	267	170	222
111-120	140	138	157	211	160	126	182	157	191	158
121-130	169	107	174							
R Average	with R1-3						Ring Count:		130	
1-10	356	328	239	410	317	305	334	275	241	241
11-20	294	275	264	225	245	262	278	277	258	217
21-30	223	172	209	163	152	179	195	196	241	195
31-40	182	215	132	125	98	81	90	111	132	146
41-50	123	121	139	165	215	228	437	449	374	374

51-60	309	337	357	265	275	276	230	248	151	151
61-70	123	122	134	136	150	205	168	149	133	113
71-80	108	150	137	127	118	93	100	88	100	111
81-90	82	81	81	89	83	82	67	77	88	72
91-100	91	104	80	86	75	72	72	75	64	74
101-110	88	71	67	90	102	95	111	147	235	261
111-120	222	239	233	210	158	184	139	134	147	171
121-130	146	152	162	147	149	163	158	125	156	197

Table 5-5 Measure Paths of Sample Nr.10

Radius	Measurements	Self-correlation test
A	R1	R1:R2, good
B	R2	R2:R3, good
C	R3	R1:R2:R3, good

R1-3 are selected to calculate average curve.

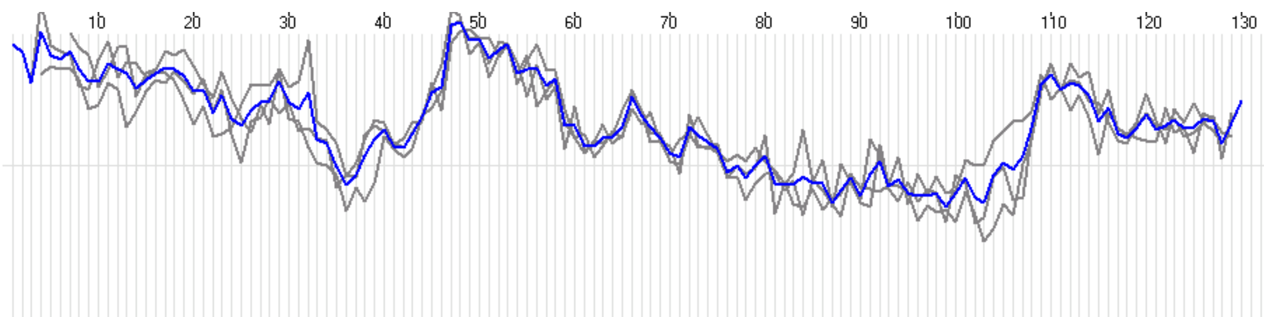

Fig. 5-18 Raw Measurements and Average Curves of Sample Nr. 10

- Sample 11. lantern crown

Two radii were measured. The first radius was measured for three times (R1, R4, R5). The first measurement of the first radius did not correspond with the second (R4) and third measurements (R5). The second radius was measured in the two parts. R3 is the measurement of the first part of the second radius; R2 was the measurement of the second part of the second radius. R2-4 were selected to calculate the average curve (Table 5-6, 5-7, Fig.5-19).

Table 5-6 Measure Paths of Sample Nr.11

Radius	Measurements	Self-correlation test
A	R1, R4, R5	R1≠R4=R5
B	R2, R3	R3: R4: R5, good

R2-5 are selected to calculate average curve.

Table 5-7 Raw Measure Data of Sample Nr.11

Sample Nr.11	lantern crown			Species:	Abies		Common Name			silver fir
Year	Ring Width									
R1								Ring Count:		54
1-10	79	313	374	260	317	59	62	227	140	270
11-20	309	259	320	223	385	356	245	351	328	367
21-30	369	336	325	276	238	293	220	191	242	241
31-40	195	208	247	206	200	195	193	159	189	218
41-50	196	189	139	169	159	200	161	165	126	128
51-60	108	149	145	114						
R2								Ring Count:		24
1-10	252	215	194	182	206	190	185	170	166	138
11-20	150	126	148	94	125	104	92	138	124	112
21-30	99	96	74	63						
R3								Ring Count:		61
1-10	75	99	214	341	258	356	101	96	238	124
11-20	252	207	262	271	348	279	410	367	228	299
21-30	362	320	388	347	387	380	282	170	178	195
31-40	254	234	230	206	208	201	177	250	211	205
41-50	189	201	208	169	146	163	123	139	153	142
51-60	91	133	97	114	127	125	112	100	91	74
61-70	52									
R4								Ring Count:		55
1-10	86	326	379	274	285	65	85	217	129	267
11-20	266	301	254	326	215	391	352	255	349	311
21-30	367	344	344	307	274	259	261	243	192	241
31-40	239	199	187	239	218	192	195	198	128	215
41-50	234	178	209	149	163	181	194	151	188	115
51-60	123	119	135	134	141					
R5								Ring Count:		54
1-10	331	381	272	298	77	86	226	132	290	270
11-20	286	271	319	221	380	369	249	351	318	364
21-30	350	343	332	268	258	261	251	207	249	228
31-40	188	208	247	213	191	197	183	163	197	209
41-50	193	194	147	165	176	192	162	180	130	133
51-60	106	133	135	126						

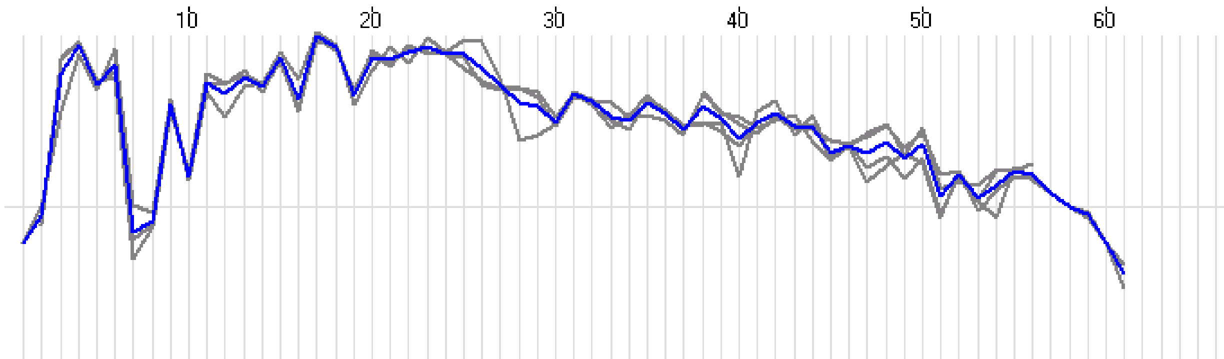

Fig. 5-19 Raw Measurements and Average Curves of Sample Nr.11

- Sample 12. column IV

Three radii were measured. Radius One was measured twice (numbered as R1 and R4) and the results accorded with each other. Radius Three were measured for three times (R3, R5, and R6) by two persons, whose results showed the first measurement (R3) had errors (Table 5-8, 5-9, Fig.5-20).

Table 5-8 Raw Measure Data of Sample Nr.12

Sample Nr.12	column IV			Species:	Quer.		Common Name		oak
Year	Ring Width								
R1							Ring Count:		88
1-10	331	288	324	265	292	402	346	452	400	332
11-20	354	198	234	186	130	141	153	179	226	224
21-30	211	183	199	178	258	253	291	193	176	171
31-40	173	194	182	153	152	161	113	131	106	98
41-50	75	51	77	66	94	70	81	79	74	75
51-60	64	64	66	75	56	86	79	119	149	192
61-70	169	182	185	157	181	161	294	265	196	166
71-80	152	156	208	193	198	198	158	194	153	153
81-90	170	162	181	202	126	151	146	127		
R2								Ring Count:		88
1-10	124	113	118	85	109	101	73	97	103	107
11-20	143	109	168	390	236	295	245	363	343	504
21-30	542	499	471	415	361	259	258	255	209	179
31-40	294	366	376	309	290	237	239	346	302	292
41-50	229	201	206	214	207	219	182	163	147	170
51-60	135	123	87	90	63	68	66	105	72	101

61-70	90	73	73	76	42	53	61	45	59	50
71-80	94	107	177	197	225	264	236	315	227	317
81-90	322	287	245	172	195	217	205	196	0	0
R3								Ring Count:		111
1-10	179	282	177	164	196	187	86	136	167	168
11-20	172	176	164	178	150	114	128	128	142	136
21-30	143	180	153	153	119	79	76	84	74	57
31-40	66	37	56	78	58	47	59	65	101	73
41-50	119	259	150	218	183	265	338	298	395	409
51-60	315	261	206	211	167	167	170	155	188	234
61-70	294	235	246	238	205	287	255	250	212	181
71-80	239	167	169	164	147	109	121	89	107	91
81-90	73	116	77	49	81	52	57	59	51	49
91-100	55	35	42	45	50	54	45	74	79	115
101-110	125	174	231	236	308	293	366	410	332	281
111-120	201									
R4								Ring Count:		87
1-10	335	275	336	256	300	376	365	451	359	346
11-20	358	224	219	188	137	142	140	180	233	254
21-30	219	207	200	169	263	242	247	207	196	159
31-40	163	191	167	163	145	164	118	117	113	92
41-50	64	52	79	68	77	80	89	81	72	70
51-60	79	63	68	59	59	79	88	122	136	191
61-70	163	178	183	153	185	181	298	292	197	173
71-80	122	159	181	219	179	211	145	204	147	168
81-90	142	175	182	190	123	157	140	0	0	0
R5								Ring Count:		113
1-10	208	153	135	158	161	187	193	97	128	169
11-20	136	161	204	177	190	135	123	126	144	138
21-30	119	144	170	169	157	116	70	69	84	68
31-40	62	54	52	50	71	65	48	61	68	86
41-50	88	122	267	159	205	187	272	334	271	405
51-60	382	360	294	213	213	190	173	179	165	199
61-70	283	294	244	273	226	192	336	251	266	194
71-80	196	188	155	184	170	146	119	133	104	104
81-90	92	79	63	42	59	57	73	66	43	62
91-100	42	45	59	53	41	44	44	51	70	63
101-110	82	133	148	175	236	233	277	300	339	392
111-120	329	245	189							
R6								Ring Count:		108
1-10	182	194	98	142	161	149	176	185	159	185
11-20	136	121	153	116	136	133	149	167	162	155
21-30	116	68	73	90	66	62	57	49	45	87

31-40	57	44	67	58	97	86	118	259	161	217
41-50	184	274	343	277	417	387	312	269	203	221
51-60	170	155	178	164	189	254	281	229	257	246
61-70	256	294	251	289	207	195	174	163	180	159
71-80	143	140	129	95	105	87	76	47	44	62
81-90	58	64	66	57	53	52	45	60	35	47
91-100	36	47	48	62	66	84	125	139	190	246
101-110	244	285	282	372	393	365	285	208	0	0
R Average	with R1,R2,R4-6							Ring Count:		130
1-10	208	153	135	158	161	185	194	98	135	165
11-20	143	169	195	168	188	136	122	140	130	137
21-30	126	147	169	166	156	116	69	71	87	86
31-40	79	76	62	68	86	65	63	77	78	109
41-50	94	136	316	224	275	227	300	360	353	453
51-60	405	364	338	240	229	198	170	170	160	208
61-70	272	286	242	242	222	207	299	260	277	206
71-80	193	180	174	191	179	157	144	147	120	118
81-90	104	86	68	50	69	63	83	71	74	73
91-100	63	62	68	51	55	55	50	65	70	93
101-110	112	164	163	190	223	205	249	230	324	333
111-120	275	223	169	170	202	206	191	205	152	199
121-130	150	161	156	169	182	196	125	154	143	127

Table 5-9 Measure Paths of Sample Nr.12

Radius	Measurements	Self-correlation test
A	R1, R4	R1:R4, good
B	R2	R2:R4, good
C	R3, R5, R6	R3≠R5=R6, R3 error

R1, R2, R4-6 are selected to calculate average curve.

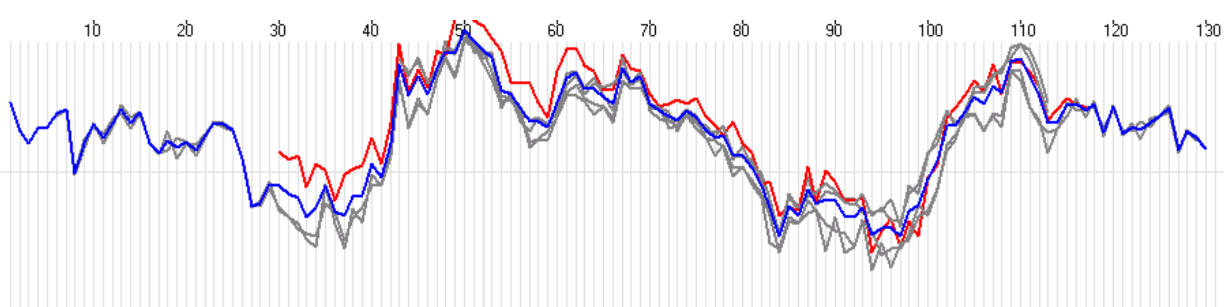

Fig. 5-20 Raw Measurements and Average Curves of Sample Nr. 12

- Sample 13. lantern middle column

Two radii were measured, which corresponded to each other very well (Table 5-10, 5-11, Fig.5-21).

Table 5-10 Raw Measure Data of Sample Nr.13

Sample Nr.13	lantern middle column		Species:	Abies		Common Name			silver fir
Year	Ring Width									
R1							Ring Count:			61
1-10	436	455	483	340	386	315	388	292	273	317
11-20	316	207	165	161	230	154	211	86	106	169
21-30	115	101	162	86	81	85	84	107	123	140
31-40	98	69	131	100	80	48	64	129	75	102
41-50	217	168	129	108	80	65	68	88	100	122
51-60	100	112	104	86	74	84	56	68	18	58
61-70	58									
R2							Ring Count:			49
1-10	427	444	448	390	386	322	419	235	297	329
11-20	294	245	172	207	209	176	195	114	121	165
21-30	137	146	201	97	83	84	123	107	164	153
31-40	84	95	101	154	132	61	71	161	87	84
41-50	181	201	153	106	61	75	51	76	54	
R Average	with R1,R2						Ring Count:			61
1-10	432	450	466	365	386	319	404	264	285	323
11-20	305	226	169	184	220	165	203	100	114	167
21-30	126	124	182	92	82	85	104	107	144	147
31-40	91	82	116	127	106	55	68	145	81	93
41-50	199	185	141	107	71	70	60	82	77	122
51-60	100	112	104	86	74	84	56	68	18	58
61-70	58									

Table 5-11 Measure Paths of Sample Nr. 13

Radius	Measurements	Self-correlation test
1	R1	R2:R2, good
2	R2	

R1, R2 are selected to calculate average curve.

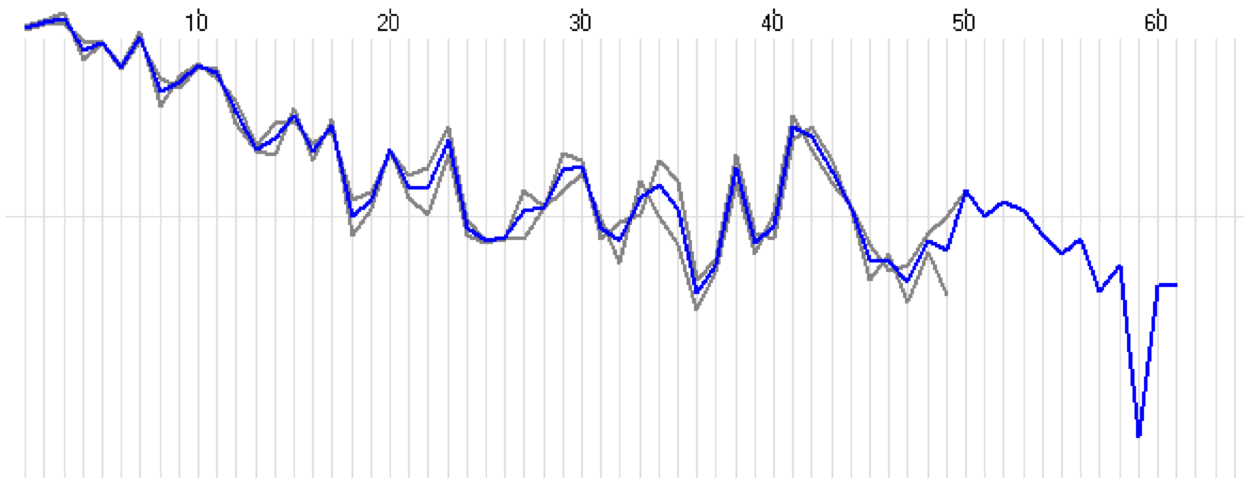

Fig. 5-21 Raw Measurements and Average Curves of Sample Nr. 13

- Sample 14. roof beam

Three radii were measured (R1, R2, R3). The second radius was measured twice (R4). R1 and R2 were chosen to calculate the average curve (Table 5-12, 5-13, Fig.5-22).

Table 5-12 Raw Measure Data of Sample Nr.14

Sample Nr.14	roof beam			Species:	Picea		Common Name		Norway spruce	
Year	Ring Width									
R1							Ring Count:			67
1-10	219	333	420	431	326	388	379	316	281	313
11-20	333	274	257	249	344	327	270	277	255	222
21-30	246	234	243	222	161	177	182	129	129	167
31-40	154	118	146	153	114	136	121	148	138	105
41-50	110	124	101	68	122	128	111	81	87	109
51-60	78	76	71	90	77	77	98	104	85	110
61-70	119	84	68	78	76	54	62			
R2							Ring Count:			46
1-10	284	344	381	426	386	419	318	293	294	239
11-20	283	224	224	158	298	265	202	227	215	230
21-30	184	221	213	185	64	100	173	96	125	137
31-40	127	109	100	105	74	108	97	111	119	88
41-50	89	85	98	85	77	92				
R3							Ring Count:			40
1-10	318	377	412	354	388	435	356	307	257	234
11-20	192	177	192	151	239	199	152	176	142	152

21-30	127	118	136	136	115	111	52	58	119	145
31-40	136	123	113	115	99	122	81	131	117	104
R4							Ring Count:			45
1-10	301	352	376	428	387	413	314	284	303	229
11-20	275	226	228	188	292	262	198	227	215	226
21-30	183	219	239	196	84	109	163	98	118	150
31-40	133	106	100	95	82	106	92	106	101	92
41-50	95	74	100	89	86					
R Average	with R1,R2						Ring Count:			67
1-10	281	352	397	410	372	414	342	300	284	254
11-20	271	225	225	187	293	263	206	227	207	208
21-30	185	198	208	185	106	124	143	95	123	150
31-40	138	114	115	117	92	118	98	124	119	97
41-50	98	94	100	81	95	110	111	81	87	109
51-60	78	76	71	90	77	77	98	104	85	110
61-70	119	84	68	78	76	54	62			

Table 5-13 Measure Paths of Sample Nr. 14

Radius	Measurements	Self-correlation test
A	R1, R4	R1:R4, good
B	R2	
C	R3	

R1 and R2 are selected to calculate average curve.

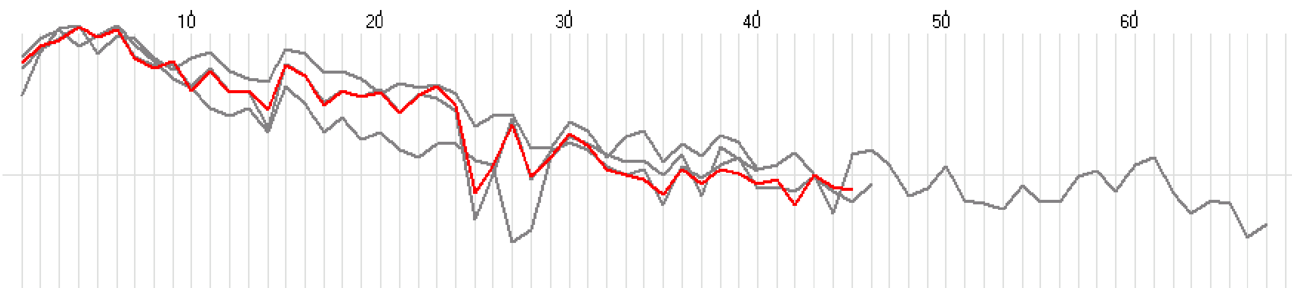

Fig. 5-22 Raw Measurements and Average Curves of Sample Nr. 14

- Sample 16. round column

Four radii were measured (R1-R4), which corresponded to another well (Table 5-14, 5-15, Fig.5-23).

Table 5-14 Raw Measure Data of Sample Nr.16

Sample Nr.16	round column			Species:	Quer.		Common Name		oak
Year	Ring Width									

Year										
R1								Ring Count:		72
1-10	162	131	270	164	218	342	134	469	75	90
11-20	83	66	43	28	25	116	105	71	55	114
21-30	102	76	47	81	48	101	162	115	143	91
31-40	60	102	64	238	238	133	112	111	83	164
41-50	248	231	208	171	195	115	136	99	158	129
51-60	106	109	115	168	232	240	303	327	153	179
61-70	176	136	144	72	142	183	153	176	137	186
71-80	234	172								
R2								Ring Count:		69
1-10	302	360	180	296	249	339	404	136	291	179
11-20	112	97	155	105	191	122	111	132	89	134
21-30	89	118	104	76	106	98	152	150	133	121
31-40	175	59	41	85	113	120	115	86	87	121
41-50	159	255	192	192	119	129	112	99	139	156
51-60	125	173	119	144	121	185	221	300	244	169
61-70	142	112	168	122	104	63	117	63	64	
R3								Ring Count:		67
1-10	243	224	196	189	135	100	100	108	127	119
11-20	130	155	138	137	139	214	267	315	303	244
21-30	227	165	143	172	260	247	261	261	198	190
31-40	225	357	327	444	219	178	170	225	164	96
41-50	142	197	159	222	190	277	211	196	145	63
51-60	100	37	73	128	118	161	153	132	100	128
61-70	89	128	185	129	114	90	87			
R4								Ring Count:		81
1-10	166	121	125	218	290	685	308	341	426	236
11-20	127	236	233	239	128	82	121	82	62	65
21-30	42	94	154	183	181	250	159	153	137	165
31-40	151	137	219	216	234	215	138	146	91	115
41-50	98	194	224	247	180	172	138	238	307	281
51-60	261	239	299	175	157	179	227	228	223	220
61-70	250	172	331	322	473	476	291	274	267	247
71-80	254	129	190	236	176	285	233	232	285	205
81-90	133									
R Average	with R1,R3,R4							Ring Count:		99
1-10	166	121	125	218	290	685	308	341	294	184
11-20	199	200	226	291	131	276	98	86	73	66

21-30	43	61	90	150	143	161	107	134	120	121
31-40	99	109	170	180	197	173	139	112	84	108
41-50	96	184	197	178	143	140	120	205	274	276
51-60	257	218	240	152	145	150	215	201	197	197
61-70	188	177	263	306	368	416	221	210	204	203
71-80	187	99	158	205	163	228	187	232	243	191
81-90	139	63	100	37	73	128	118	161	153	132
91-100	100	128	89	128	185	129	114	90	87	

Table 5-15　Measure Paths of Sample Nr. 16

Radius	Measurements	Self-correlation test
A	R1	
B	R2	
C	R3	
D	R4	

R1-4 are selected to calculate average curve.

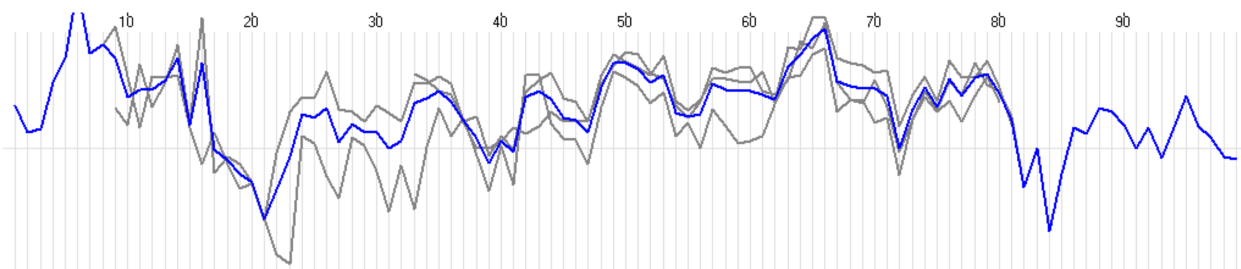

Fig. 5-23　Raw Measurements and Average Curves of Sample Nr. 16

- Sample 17. column V

Four radii were measured (R 1-3, R8).　The first radius was repeatedly measured: R4 and R7 are the measurements of the second part (close to the bark) of the radius; R5 was the measurement of the first part (close to pith) of the radius.　R6 and R9 were other times of measurement of the whole radius.　R4-9 were selected to calculate average curve (Table 5-16, 5-17, Fig.5-24).

Table 5-16　Raw Measure Data of Sample Nr.17

Sample Nr.17	column V	Species:	Quer.	Common Name	oak

Year	Ring Width									
R1								Ring Count:		154
1-10	176	113	149	129	106	81	68	109	136	129
11-20	247	167	308	371	294	211	247	253	405	334
21-30	306	301	311	314	319	279	395	371	293	341
31-40	353	402	244	332	247	295	311	277	248	194
41-50	252	355	303	274	298	291	131	180	168	174
51-60	151	185	236	236	209	164	170	189	236	173
61-70	249	196	228	207	101	151	231	154	194	208
71-80	188	208	137	130	87	74	96	132	145	216
81-90	129	167	109	82	118	188	118	117	108	126
91-100	122	96	81	132	76	110	134	116	173	123
101-110	100	87	86	103	85	88	114	142	125	121
111-120	121	122	109	114	131	112	141	114	107	120
121-130	120	87	101	97	83	106	94	133	99	97
131-140	105	85	95	69	90	91	70	94	79	174
141-150	100	71	86	90	77	73	107	95	81	65
151-160	63	109	55	76						
R2								Ring Count:		128
1-10	161	69	117	126	261	83	103	104	194	130
11-20	181	257	331	355	254	233	217	170	226	204
21-30	166	188	167	174	159	159	176	192	146	168
31-40	169	154	233	167	174	206	193	150	148	115
41-50	120	127	139	106	143	132	107	114	153	95
51-60	116	136	130	118	92	108	154	99	99	78
61-70	121	78	103	79	47	88	125	119	87	117
71-80	73	66	100	64	51	43	52	58	55	74
81-90	95	70	96	80	66	34	47	51	85	118
91-100	72	110	72	71	81	74	90	140	83	99
101-110	75	67	100	80	105	94	90	87	115	107
111-120	79	58	92	59	76	62	69	98	103	78
121-130	114	114	62	100	85	78	73	75		
R3								Ring Count:		89
1-10	137	56	59	96	48	79	67	86	74	100
11-20	127	140	174	188	183	263	277	193	211	288
21-30	208	222	185	138	213	192	145	215	205	170
31-40	220	162	102	128	116	252	196	206	170	178
41-50	133	139	146	207	139	163	135	120	139	135
51-60	178	233	206	225	264	243	221	133	143	177
61-70	203	228	263	183	104	123	140	109	104	81
71-80	78	94	100	90	96	78	75	49	79	80
81-90	63	98	75	86	96	44	59	43	79	
R4								Ring Count:		130

1-10	352	293	365	347	289	271	246	302	279	260
11-20	211	234	254	326	265	211	239	266	119	165
21-30	175	162	118	221	261	263	231	168	202	215
31-40	249	177	263	158	211	190	122	201	229	157
41-50	192	240	183	213	121	86	91	85	76	100
51-60	123	159	188	135	132	115	81	126	173	148
61-70	98	112	128	97	101	111	87	113	116	116
71-80	163	124	67	107	88	98	88	96	110	117
81-90	137	113	116	123	100	111	147	101	145	122
91-100	114	112	130	74	82	115	80	91	118	131
101-110	108	108	87	83	84	82	84	72	99	78
111-120	84	70	109	90	79	85	85	78	82	100
121-130	92	81	76	105	63	72	68	70	63	74
R5								Ring Count:		37
1-10	26	21	23	19	17	14	28	31	104	151
11-20	122	143	99	61	100	134	144	218	181	284
21-30	388	264	294	268	257	392	328	307	311	304
31-40	298	335	362	354	350	324	295			
R6								Ring Count:		142
1-10	252	264	381	351	337	265	254	215	268	233
11-20	273	290	341	305	364	356	282	275	243	289
21-30	279	269	209	226	264	319	252	203	257	265
31-40	124	170	164	154	130	224	247	273	230	172
41-50	192	222	252	176	261	156	205	184	120	216
51-60	225	155	189	248	174	227	123	96	75	88
61-70	72	105	112	151	185	147	139	107	91	119
71-80	162	159	94	111	126	91	112	104	90	118
81-90	123	116	152	120	64	108	84	94	88	95
91-100	116	122	139	110	116	120	104	109	138	99
101-110	141	125	103	113	137	71	93	113	63	112
111-120	121	131	111	99	89	93	83	73	79	72
121-130	99	70	98	63	114	86	73	91	87	68
131-140	87	105	90	79	73	106	70	68	66	61
141-150	71	56								
R7								Ring Count:		125
1-10	185	262	200	194	151	161	154	205	153	164
11-20	144	112	76	109	91	86	92	134	149	132
21-30	132	111	148	85	121	87	116	112	104	125
31-40	85	118	161	138	147	196	177	146	138	111
41-50	78	92	90	89	111	103	116	123	120	94
51-60	76	86	106	87	75	66	104	81	91	70
61-70	77	82	88	80	108	62	61	70	71	97
71-80	84	99	100	129	145	118	102	97	83	104

81-90	105	79	119	91	80	97	116	85	96	175
91-100	69	116	106	119	88	108	111	72	67	77
101-110	88	74	90	68	75	60	102	72	55	67
111-120	63	57	46	69	70	52	64	72	60	50
121-130	55	45	50	47	49					
R8							Ring Count:		93	
1-10	52	11	17	16	27	50	77	33	64	111
11-20	66	99	76	86	126	148	170	188	189	261
21-30	279	202	213	294	226	230	185	173	178	177
31-40	133	182	181	150	212	172	136	129	131	197
41-50	228	196	194	218	177	168	211	234	170	123
51-60	140	129	110	119	162	161	194	210	343	327
61-70	265	185	204	247	202	256	166	193	115	116
71-80	92	65	96	93	78	79	95	74	91	66
81-90	74	61	57	67	76	72	77	89	85	82
91-100	85	51	79							
R9							Ring Count:		165	
1-10	29	25	17	14	13	40	35	85	159	129
11-20	123	108	63	86	148	129	208	200	269	369
21-30	277	286	294	278	341	356	293	305	296	222
31-40	201	303	228	258	335	212	273	283	277	289
41-50	301	230	298	294	252	211	237	243	327	281
51-60	208	255	254	125	167	156	144	161	218	257
61-70	236	270	176	189	218	267	174	267	180	194
71-80	202	129	207	238	144	200	256	183	239	121
81-90	97	70	97	85	108	116	169	176	152	147
91-100	106	104	107	179	142	105	109	125	97	103
101-110	101	103	123	132	112	164	116	71	91	75
111-120	98	86	98	102	130	141	104	108	127	103
121-130	91	145	106	134	105	107	149	153	76	86
131-140	117	79	100	108	136	99	103	96	91	86
141-150	79	88	70	88	81	95	68	112	84	79
151-160	87	79	83	79	89	91	91	66	104	70
161-170	63	69	60	59	43					
R Average	with R4-9						Ring Count:		166	
1-10	36	19	19	16	19	35	47	50	109	130
11-20	104	117	79	78	125	137	174	202	213	305
21-30	315	251	267	273	272	340	289	281	263	239
31-40	212	272	251	259	297	280	260	285	278	264
41-50	269	220	269	254	230	190	214	230	269	215
51-60	185	205	201	113	155	149	148	142	228	248
61-70	234	210	166	196	188	229	156	220	144	166
71-80	159	104	168	189	134	161	207	158	183	114

81-90	93	75	84	78	96	107	132	151	128	124
91-100	101	81	103	155	134	93	100	121	92	102
101-110	97	89	109	115	106	147	106	66	94	80
111-120	97	87	97	107	125	141	111	111	117	98
121-130	104	134	96	135	111	101	118	134	77	89
131-140	130	73	105	113	129	102	105	96	85	80
141-150	78	85	72	94	74	88	65	109	83	72
151-160	83	79	72	74	91	86	76	70	97	66
161-170	63	65	59	61	55	49				

Table 5-17 Measure Paths of Sample Nr. 17

Radius	Measurements	Self-correlation test
A	R1, R4-7, R9	
B	R2	
C	R3	
D	R8	

R4-9 are selected to calculate average curve.

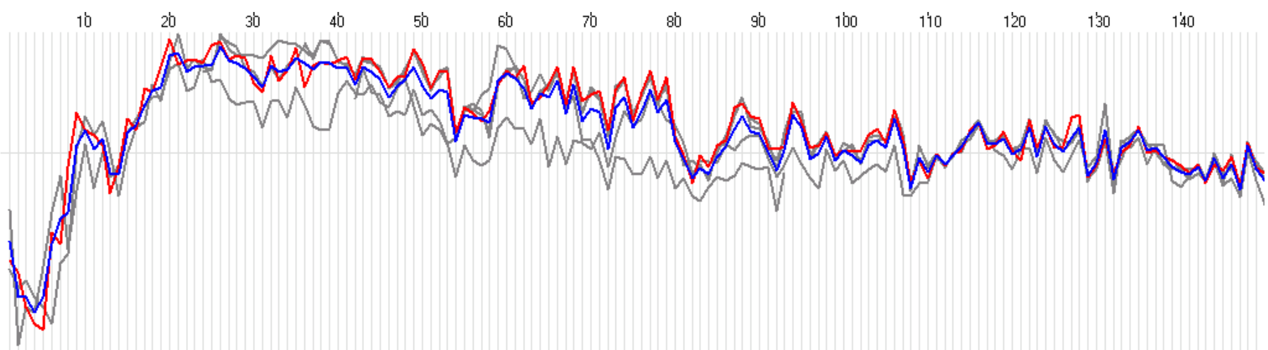

Fig. 5-24 Raw Measurements and Average Curves of Sample Nr. 17

Crossdating

Crossdating is for matching patterns of ring widths or other ring characteristics (such as ring density patterns) among several tree-ring series that allows the identification of the exact year in which each tree ring was formed. For example, one can date the construction of a building, such as a stave church, by matching the tree-ring patterns of wood taken from the buildings with tree-ring patterns from living trees, if the timbers were felled from local forests. Since it is quite time-consuming to get the tree-ring patterns from the living trees, dendrochronologists construct “master chronologies” (also known as reference chronology) to represent the unique features of ring-growth of specific geographical and climatic regions over a long time span. Thus, crossdating in these regions can be simply done by matching the ring pattern of a sample to the master chronology. To assure the reliability of the matching, statistics, such as t-score and Trend (*Gleichläufigkeit*) are also applied.

In order to make use of the chronological information contained in the tree-rings, long tree-ring chronologies have to be reconstructed by overlapping ring patterns from successively older samples. The aim is to produce a long year-by-year record of mean tree growth far back in time. In practice, the chronology will be constructed so that each year is represented by data from several samples of the same tree. This process of replication is crucial for ensuring the validity of any reference chronology. The tree-ring pattern from a timber of unknown date can then be compared to the ring pattern of the reference chronology to locate the portion with which it is most similar, a process not unlike that of fingerprinting. When an acceptable match has been found, the date of each ring on the test sample can be read off the reference graph with calendrical precision. Dendrochronology is therefore an accurate and precise dating method and, since the production of tree-ring dates relies solely on the similarity between ring patterns, the results are completely independent of other dating evidence, history, or theory.

In this research, a combination of three methods is used to ensure reliability: visual matching, statistical tests, and replication. All these methods are independent of external dating evidence such as construction history and craftsman’s markers. However, with the help of historical records, the dating of samples with less visual clarity and statistical significance can be achieved with more confidence.

Correlation — Oak (*Quercus spp*)

Four oak samples (Nr.10, 12, 16,17) were correlated with two regional reference chronologies that include Donaustauf — the chronologies of Southern Germany (SD,1001-1987 AD, 987 rings), Western Germany (WESTD, 1001-1975 AD, 975 rings). Both chronologies also include the years when the Chinese Tower might have been built, therefore, are suitable for the dating of the Tower.

During the process of matching the sample curves to the reference chronologies, several dating results were obtained (Table 5-18). The results indicating an age before Christianity were discarded because it is unlikely that wood can remain in a good condition after two thousand years. After that, to choose the result that represents the best fit between the sample curve and the reference curve, the value of "Pointer Interval" (*Weiserintervalle* in German) is compared. According to Schweingruber et al., the definition of "Pointer Interval" is as follows: We define an interval as a link between two adjacent years. A pointer interval is one in which a significant proportion of the curves shows a conspicuous upward or downward trend. An interval trend value shows the percentage of intervals with the same trend within a given period. A sequence of pointer years or pointer intervals are "signatures" in the sense of Douglass (1939) and Huber (1951). (Schweingruber et al. 1990, p. 20) Besides comparing the value of "Pointer Interval", other statistics such as Gleichläufigkeit, T-test, especially the algorithm of Baillie and Pilcher are usually checked to ensure the quality of correlation between the sample curves and the reference curves. These additional tests signify how "significant" or "unique" is the matching between the sample curves and the reference curves, which increases the confidence of dating. Table 5-19 shows the result of cross-dating. While sample Nr.12, 16, 17 are dated to the 1920s-30s, sample Nr.10 is dated to the 1750s-60s. This result indicates the column IV and V can only be installed after 1930s, while column II and the round column might be used earlier.

Table 5-18 Suggested Dating Results for Sample Nr. 13

DC-Nr	DC-Labcode	DC-Art	Ref-Nr	Ref-Art	Üb.	GL	WJ	t-TH	t-TB	Ergebnis
13	RB	Abi	Standard	Tanne	60	74,6	84,6	4,6	4,8	1837
13	RB	Abi	Standard	Tanne	60	68,	77,8	4,7	3,4	1638
13	RB	Abi	Standard	Tanne	60	61,5	75,	2,8	3,1	942
13	RB	Abi	Standard	Tanne	60	64,8	74,1	3,6	3,	1683
13	RB	Abi	Standard	Tanne	60	60,7	72,	2,9	3,3	1936
13	RB	Abi	Standard	Tanne	60	61,5	69,6	2,	2,9	934
13	RB	Abi	Standard	Tanne	60	63,9	65,2	2,3	3,	1706
13	RB	Abi	Standard	Tanne	60	64,8	61,5	3,5	3,9	1169
13	RB	Abi	Standard	Tanne	60	62,3	58,6	2,3	3,4	1890

Table 5-19 Dating Results for Sample Nr. 10, 12, 16, 17

Sample	Name	Species	Start Year	End Year	Pith	Sap-wood	Wane	Ref. C	Ponter Interval	Gleichläufigkeit	t-TB	t-TH	est.felling year	
Nr.10	column II	*Quercus spp.*[49]	1616	1746	Yes	No	No	WESTD	73,7	58,8	3,4	2,5	1756	1766
Nr.12	column IV	*Quercus spp.*	1687	1817	Yes	No	No	SD	75,	61,5	4,1	4,2	1827	1837
Nr.16	round column	*Quercus spp.*	1697	1796	Yes	No	No	SD	80,8	58,6	2,9	2,5	1806	1816
Nr.17	column V	*Quercus spp.*	1661	1827	Yes	No	No	SD	73,8	58,7	3,2	2,9	1837	1847

Table 5-20 Dating Results for Sample Nr. 11, 13, 14

Sample	Name	Species	Start Year	End Year	Pith	Sap-wood	Wane	Ref. C	Ponter Interval	Gleichläufigkeit	t-TB	t-TH	est.felling year
Nr.11	lantern crown	*Abies alba* Mill.	1721	1782	Yes	No	No	Bayern	65,7	68,9	2,7	3,5	unknown
Nr.13	lantern middle column	*Abies alba* Mill.	1776	1837	Yes	No	No	Hemm	84,6	74,6	4,8	4,6	unknown
Nr.14	roof beam	*Picea abies* Karsten	1759	1826	Yes	No	No	Hemm	64,3	67,2	5,1	4,4	unknown

[49] Possibly *Quercus robur* L. (Pedunculate Oak), *Quercus pubescens* Willd. (Pubescent Oak), or *Quercus petraea* Liebl. (Sessile Oak). In dendrochronological crossdating, the same reference curves are applied to these species.

Correlation — Fir (*Abies spp.*) and Spruce (*Picea spp.*)

One fir sample (Nr.11) correlated to the master reference chronology of Bavaria (BAYERN, 1056-1886 AD, 830 rings); the other fir sample (Nr.13) correlated to the reference chronology from Hemmenhofen (Hemm, 820-1985, 1166 rings). The spruce sample (Nr. 14) correlated to the reference chronology of Hemmenhofen (Hemm, 1032-1985, 954 rings). The results of cross-dating are as follows (Table 5-20).

Sample Nr.11 and Nr. 13 only have about 60 rings, which is a relatively small number of rings to ensure statistical reliability. And both samples have piths, which means the early part of ring patterns reflects little common features with ring patterns of the grown-up trees in the same period. These two factors make it difficult to determine whether they are correlated with each other, that is, if they have the same provenance. Furthermore, because all three samples do not show the waney edge (barks), and there is no reliable information about the average ring number of sapwood for fir and spruce, it cannot be determined in which year the trees were felled and installed in the Chinese Tower. Dendrochronological methods can only suggest the life span of the trees shown on the samples.

Summary and Interpretation

In this chapter, fifteen wood samples were examined with the intention of providing an estimate of the age of the timber used during the construction of the Chinese Tower. Three samples (Nr.3, 5, 7) were investigated in 1999 but the original samples were lost. Some information about them are recorded in the documents of previous investigation. The species of thirteen samples (Nr.1, 2, 4, 6, 8-14, 16, 17) were investigated utilizing anatomical methods. Five of them (Nr.1, 2, 6, 9, 14) are identified as Norway spruce

(*Picea abies* Karsten); two are identified as silver fir (*Abies alba* Mill.) that are softwoods. The rest of the samples are oak (*Quercus spp*.[50]), a hardwood, unfortunately it was impossible to exactly known to which species they belong. Three samples were not examined at the laboratory, nevertheless, *in-situ* examination with simple preparations indicated they are also oaks.

After wood identification, seven samples (Nr.10-14, 16, 17) were dated using dendrochronological methods. Four samples (Nr.12-14, 17) show the last ring in the early nineteenth century, while three samples (Nr.1, 2, 46) show the production of the last ring in the late eighteenth century. Regrettably, this fact cannot provide any clue about when the Chinese Tower was first constructed. Although the felling date or the life span of the timber has been estimated, factors that might have affected it when it was used must also be taken into account. If the timber is a repair or has been reused, for example, its date of felling will be different to the date of the structure. Although the tree-ring dates the samples independently, the interpretation of these dates relies on other evidence. It is therefore important that tree-ring analysis is accompanied by relevant historical records, e.g., timber purchase records. Expert examination of structural timbers before and during sampling will often indicate whether they have been seasoned or reused. However, this information is not available at this point as the samples were collected during the relocation in 1999, prior to the present study.

Historically, four reasons can be claimed for the fact that sampled timber is not the same age as the building: seasoning, stockpiling, repairs, and reuse. Seasoning is the drying

[50] Possibly *Quercus robur* L. (Pedunculate Oak), *Quercus pubescens* Willd. (Pubescent Oak), or *Quercus petraea* Liebl. (Sessile Oak).

and hardening of timber by storing it for several years so as to render it fit for use. However, the seasoning of timber for general building purposes is a fairly recent introduction. Previously, trees were usually felled and used as required. (Charles, Charles 1995, p. 46; Rackham 1990, p. 69; Schweingruber 1988, p. 147) There are some exceptions. Timber boards for paneling and furniture, for example, would have to be seasoned to prevent warping. One estimate is that on average paneling is stored for three to ten years before use (Bauch et al. 1978), but recent work suggests that paneling can be used within a year of felling. Other examples of seasoning are generally to be found in high-status structures rather than in vernacular buildings. (English Heritage 2004, p. 12) Stockpiling is a time interval between felling and use whenever a third party is involved between the supplier and user. It may also occur where large quantities of timbers are collected for major building projects. Repairs can be identified by a change in building style and/or timber joints. In standing buildings, a dendrochronologist taking cores can sometimes detect a difference between primary timbers and later repairs by a change in the wood itself as well. For example, a column needs repair; therefore a section of the column is replaced with a "new timber". If one sample were taken from the timber of the repair process, the dating result will be different from the dates when the building was firstly established. In the tree-ring record, repairs can be detected by the appearance of distinct phases of felling in a bar diagram. These felling phases will be easier to identify if the timbers have sapwood or bark edge. Since many samples from the Chinese Tower do not show sapwood or bark, the life span shown on the samples are used to give a sense of the time sequence of timbers used during the construction of the building (Table 5-21, Fig.5-25, 5-26). Timber has always been a precious commodity and it was reused whenever possible, especially the valuable species like oak of large size. However, this can only be known, when social and historical backgrounds of the buildings are provided.

In short, it is possible that timbers of different times were installed at once and it is also possible that they were added at different time points, when renovation was done to the building. The earliest timbers are from the end of the second half of the eighteenth century and are relatively large in dimension, which suggests the Tower construction might have begun shortly after this period of time. Other larger timbers are aged between the1800s and 1830s, suggesting a substantial construction or renovation phase in the following periods. This provides evidence from two theories to describe the history of the Tower. The first theory is that the construction of the Tower was begun around the turn of the nineteenth century and was renovated after the 1830s. The other theory is that the Tower was begun after the 1830s. During the initial construction, old timbers of the nineteenth century were used.

Table 5-21 Dating Results of Previous and Current Dendrochronological Research

Nr	Name	Start Year	End Year
1	purlin crown	1757	1838
3	column VII	1662	1829
4	column VI	1656	1809
5	column without Nr.	1677	1805
7	lantern ceiling	1747	1838
8	column VIII	1706	1823
10	column II	1616	1746
11	lantern crown	1721	1782
12	column IV	1687	1817
13	lantern middle column	1776	1837
14	roof beam	1759	1826
16	round column	1697	1796

17 column V 1661 1827

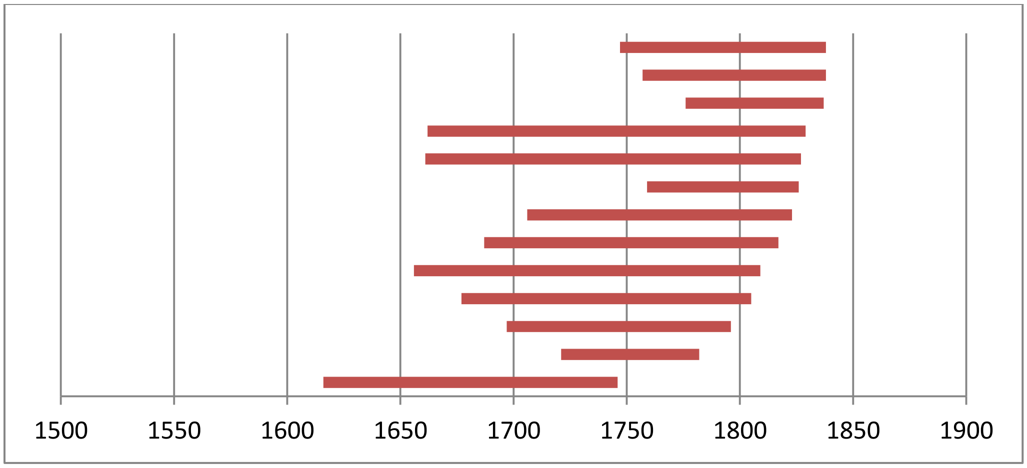

Fig. 5-25 Time Sequence of Samples according to the Last Ring

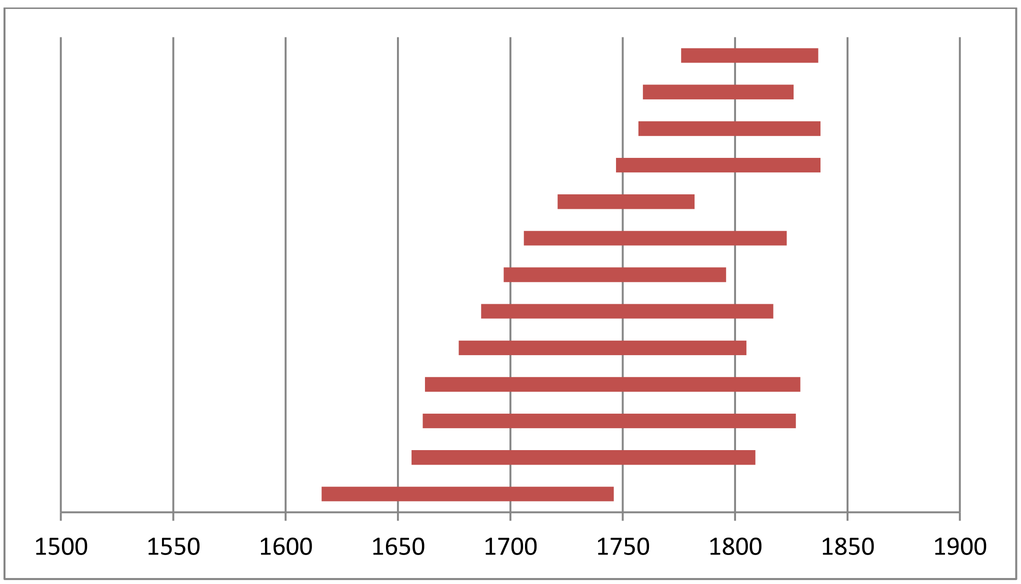

Fig. 5-26 Time Sequence of Samples according to the First Ring

CHAPTER 6. HISTORY OF THE CHINESE TOWER IN DONAUSTAUF

Based on documentation research and the information provided by the investigation of wood anatomy and dendrochronology, this chapter summarizes a history of the Chinese Tower, which, though not conclusive, is constructive for future studies if new evidence is made available.

As a result of the Treaty of Paris[51] in 1810, the area of Donaustauf became the property of the King Ludwig of Bavaria. In 1812, the territory of Donaustauf, with restriction of the sovereign, was given to Maximilian Karl, Prince of Thurn and Taxis as an indemnity of his imperial post. The House of Thurn and Taxis was related to the Crown Prince Ludwig, later King Ludwig I of Bavaria. Ludwig's wife, Princess Therese, was the niece of Princess Therese of Thurn and Taxis. They often visited the royal family. The Prince of Thurn and Taxis and his family were very fond of the Danube scenery and had a castle there. The castle came with a garden in French fashion, and was called the Prince Garden (*Fürstengarten*).

The earliest mention of a Chinese style building in the Prince Garden is in the description about the buildings handed over (*Gebäudeliste des Übergabeprotokoll*) from the King Ludwig to the Prince of Thurn and Taxis.

> "On the eastern side of the castle, next to the herb garden, there is a Tree Garden, in which two small summer houses were located, one

[51] It was "*Pariser Vertrag*" in German. Different from "Vertrag von Paris," which was signed in the same year but in January between France and Sweden. This one was signed on the 28th February 1810, clarifying the territory between France and Bavaria.

ordinary and one Chinese. Both are made of wood and painted[52]."

(Dallmeier 1995, p. 165; Kastenmeier 1999, p. 1)

A plan of the Prince Garden was probably included in the protocol (Hs.Nr.34, Plan-Nr.171a), but unfortunately it is unavailable. A Cadastral map (*Urkastasterkarte*) of 1816 shows an octagonal garden house was located in the Tree Garden south of a rectangular garden house of smaller size. One construction payment shows in 1817 that 11000 wooden shingles were ordered. These should be for the Chinese Summer House mentioned in the handover protocol (Hage 1994, p. 28) as indicated by the archival record of the municipality states. Shortly after the handover in 1812, the princely family began some renovations to the castle; nevertheless, these are not confirmed by the records at the Central Archive of Thurn and Taxis. (Dallmeier 1995, p. 167) On the same cadastral map (*Urkastasterkarte*), the building of Reithalle (1830) was added with hand drawing, which suggests some corrections were made after the construction had begun or when it was still in the planning stage. The situation around the 1830s is also conveyed by this map, and suggests the octagonal garden house still stood in the Tree Garden.

The earliest graphic views of the Summer House were provided by Jocab Alt and Robert Batty. Alt's color printing was engraved by Adolph Friedrich Kunike[53] in his *Zwey hundert vier und sechzig Donau-Ansichten nach dem Laufe des Donaustromes von seinem Ursprung bis zu seinem Ausflusse in das Schwarze Meer* (Fig.6-1[54]) (Jörg Traeger

[52] Original in German: "An der Ostseiter des Schlosses liegt nächst des Wurzgartens der Baumgarten; hierin befinden sich zwei Sommerhäuschen, ein ordinäres und ein chinesisches, beide sind von Holz und ausgemalen."

[53] Most of Kunike's engravings stemmed from the drawings of Jacob Alt.

[54] Jörg Traeger 1980, p. 69.

1980, p. 69)*;* Batty's work was engraved by C. Corbould in 1821 (Fig.6-2[55]). Unfortunately the appearance of Donaustauf from the West and the Chinese house stands in the shadowy background in the East. It is difficult to get a clear appearance of it. The latter seeks a perspective from the location of the Walhalla[56] and leaves the Chinese house too far in the background. This is the common problem of all the old drawings that portray Donaustauf with a western perspective and a Walhalla perspective. However, the two pictures agree with each other in that the Chinese Summer House had two stories and double-eave gazebo roof, which did not sweep or warp up. A French travel guide of 1825 view of the Chinese Summer House (Fig.6-3[57]) gives us the earliest clear graphic view of the Chinese Summer House, behind which the other "ordinary" garden house mentioned in the handover protocol and shown on the cadastral map of 1816 can also be identified. In this picture, the Chinese house has two or three stories (the uppermost one might be a cupola); the first floor is larger to give the second floor a terrace, not a loggia as the current one. The roof does not sweep. In the same year, a water-colored outline etching of Joseph Steingrübel also shows the Chinese house (Fig.6-4[58]) similar to the depictions of Alt and Batty. In the two articles written by Joseph Rudolf Schuegraf in 1834, the Chinese house can be clearly seen in the sketches (Fig.6-5[59]). In 1837, in the coper engraving of Johann Bichtel about a ship accident around Donaustauf, a Chinese house appears quite different from the one on the French travel

[55] This figure appeared on eBay on sale by the seller "bluemoondesigns" until January 21, 2015. A blank-and-white copy can be found the Regensburg Museum. (Jörg Traeger 1980, p. 70)

[56] Walhalla has not yet been built during this period of time.

[57] Bray 1825, no page number.

[58] This work is in private collection and was once seen when it was on sale online on the website of ZVAB

[59] Schuegraf 1834, between p.72 and p.73.

guide but similar to those drawn by Alt, Batty, and Steingrübel (Fig.6-6[60]). In spite of the different representation, on the old drawings, it is sure that a summer house in Chinese style had been standing in the Prince Garden before 1842, when the famous neoclassical monumental building Walhalla was inaugurated. A garden plan by Victor Keim (Fig.6-7[61]) confirms this, in which his hand drawing depicted the house in a hexagon. On the 1836 painting of Leo von Klenze[62], the Chinese building can be hardly seen (Fig.6-8[63]). This may due to the fact that the perspective angle is too sharp to include small buildings like the Chinese house, or the building was actually no longer there. Two years later around 1838, while one steel engraving (Fig.6-9[64]) clearly indicates the existence of the Chinese house, while on a color painting of Johann Baptist Dilger (Fig.6-10[65]), it is hard to discern. In the sketch of Joseph Mallord William Turner, the Chinese house also seems to appear (Fig.6-11[66]).

On October 18, 1842, Walhalla was opened to the public. Shortly before the inauguration, the Donaustauf Castle needed to be expanded and renovated to accommodate a great number of guests. Karl Victor Keim was commissioned for this

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[60] © Stadtarchiv Ulm, Chronik Zeitbild 1837.6.22 Nr. 1. http://www.ulm.de/sixcms/detail.php?id=121731&template=d_ulm_gl_bild_popup2. A black-and-white copy can be found in Mehler ca. 1899, p. 197.

[61] Provided by Franz Kastenmeier. A digitalized version can be found in Jörg Traeger 1980, p. 106.

[62] Leo von Klenze: Walhalla mit der Fernsicht gegen Regensburg. Lithographie von G.A. Lebsché (nach Klenze: Walhalla in artistischer und technischer Beziehung, München 1842)

[63] Jörg Traeger 1980, p. 84.

[64] Müller 1838, no page number.

[65] This is the image provided by ZVAB when on sale. A black-and-white copy is available in: Zur Abbildung Donaustauf 1938, p. 57.

[66]http://www.tate.org.uk/art/artworks/turner-1-the-walhalla-from-wortherstrasse-showing-a-house-in-that-street-and-the-wirtshaus-d31347

project, for only 154 days. One of his tasks was to "establish (or re-establish[67]) a Chinese Summer House.[68]" (Konrad 1990, pp. no page number) The reconfiguration and the enlargement of the Prince Garden did not begin until the renovation of the Castle was ended. The first plan was made by the nurseryman Junghaenel. In August 1842, Keim confirmed that the construction materials for the castle were cleared away from the garden and its construction could begin at any time. At the same time (August 15, 1842), the head of the princely administration, Baron Doernberg, approved the plan of Junghaenel in the name of the Prince. Junghaenel also intended to build a Chinese pigeonry near the existing Chinese Summer House. The committee of economics recommended a different location down to the Danube; however, it was put on hold[69]. (Dallmeier 1995, p. 173) When talking about the opening of the Walhalla Donaustauf in 1842, Müller also mentioned the urgent project by Keim along with the Chinese Summer House (Müller 1847, p. 10), but there were no more details about its construction.

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[67] The German word "*Aufstellung*" can be translated as "establish, build" as well as "re-establish, rebuild." Without context, it is difficult to determine.

[68] "*Im Zusammenhang mit dem Schloßbau waren folgende Aufträge zu bewältigen: ... die Aufstellung eines chineischen Sommerhauses.*" (Konrad 1990, no page number)

[69] Before the inauguration of the Walhalla, the Palace Garden was expanded and renovated. "*Die entscheidende Umgestaltung bzw. Erweiterung erfuhr jedoch der Staufer Schloßgarten erst mit der Vollendung des Schloßumbaues für die Walhalla-Einweihungsfeierlichkeiten. Die ersten Planungen stammten vom Kunstgärtner Junghaenel (1842/43) Hans Dünninger, Jean Baptiste Metivier und Karl Victor Keim in ihrer Bedeutung für das fürstliche Bauswesen. Im August 1842 bestätigte Architekt Victor Kiem, der Schloßgarten sei von Baumaterialen so geräumt, dasß mit der Gartenanlage jerderzeit begonnen werden könnte. Der Chef der fürslichen Verwaltung, Baron Doernberg, genehmigte im Namen des Fürsten gleichzeitig (15, August 1842) die Ausführung des vorgelegten Gartenplans. Junghaenel hatte auch ein Taubenhaus in der Nähe des bestehenden chinesischen Sommerhauses vorgesehen gehabt. Da dieses Taubenhaus auch "chinesisch" sein sollte, schlug die fürstliche Ökonomiekommission einen anderen, entfernteren Platz dafür unten an der Donau vor. Doch wurde vorerst dieses Detail der neuen Gartenanlage zurückgestellt.*" (Dallmeier 1995, p173)

This series of documents shows there was already a Chinese Summer House standing in the garden before Junghaenel's plan was carried out. It is, however, not known whether it was the old one, or a new one by Keim. Considering the short time that the renovation was given, it was hardly possible to tear it down. It would be less time-consuming if to renovate it. Some documents written for inauguration ceremony indicate that the Chinese Summer House and the Forsthaus[70] provided fourteen rooms to accommodate the guests[71]. (Dallmeier 1995, p. 170)

Thereafter, few changes were recorded about the Chinese house. In the later drawings of Donaustauf, for instance the engravings of August Brandmayer (Fig.6-12[72]), Adalbert Müller (Fig.6-13[73]), Emanuel Labhart (Fig.6-14[74]), Bernhard Grüber (Fig.6-15[75]), and Johann Georg Scharf (Fig.6-16[76]), it becomes clear that a Chinese pavilion stood on the waterfront of the Danube. It was a two-story building with sweeping double-eave roof, similar to the existing one.

The dendrochronolgical investigation provides no absolute answer about when the Chinese house was firstly built, but indicates timber from a wide time span, from about 1760s to about 1860s. Admittedly, it may result from a one-time usage of timbers from different felling times. Due to the fact that some timbers were even felled after the

70 Another house in the property of the noble family at the time.

71 Über die Innenausstattung der schließlich insgesamt 112 Räume im Schloß und der vierzehn Räumlichkeiten im chinesischen Sommerhaus sowie im Forsthaus liegen weitere Eckdaten vor. (Dallmeier 1995, p. 170)

72 Konrad 1990, no page number; Jörg Traeger 1980, p. 93.

73 Konrad 1990, no page number; Müller 1846, no page number.

74 Jörg Traeger 1980, pp. 10–11.

75 Konrad 1990, no page number.

76 Scharf, Huber 2012, under cover.

reconstruction of the Prince Garden in 1842, it is more possible the different dates of the timbers are the result of constant rehabilitation, in which timbers in bad condition were replaced by new ones. This kind of constant maintenance was common among Chinoiserie buildings, because some structural and technical "innovations" to create the unfamiliar Chineseness often proved to be undurable. Constant maintenance is needed also because wood as construction material is vulnerable to weathering, particularly in a moist climate. This is especially a problem for the wooden Chinoiserie structure located in the open air, e.g., gardens and parks. In the records of other wooden Chinoiserie buildings, for instance, the Pagoda in the Chinese village in Kassel, we can also find replacement of single structural elements during the restoration in 1826. Cost estimate by master builder Regenbogen include: "a new column of oak timber 11' high".[77] Dendrochronological investigation cannot directly tell us when the current house was firstly built, but the possibility that the construction was started before 1842 cannot be discounted. This contribution opens a door for alternative explanation about its history. This helps us to remove misleading prejudice when interpreting historical documents by providing additional unwritten information.

On the March 4, 1880 the Donaustauf Castle near the grand market, was completely burned to the ground. The Chinese Summer House was fortunately spared from that fire. In 1902 it was relocated to Regensburg in the new summer residence of the Princely House of Thurn and Taxis, Prüfening. Another article in *Burgpfeifer* reports, "the Prince Albert Maria Lamoral let it move to the Palace Prüfening in 1899." There, the Chinese

[77] Information provided by Gerd Fenner in Kassel Museum. Original in German:" - *1826, Wiederherstellung; Kostenanschlag Baumeister Regenbogen: Eine neue Säule von Eichenholz 11' Höhe*"

house was still used by the royal family for music and tea time until the Second World War.

The Chinese house was first called the "Summer House" in old records. The name of the "Chinese Tower" came from the description of Karl Hans (Bauer (1970), p. 359), quoted by Fritz Uhl, and thereafter was widely spread. Hans's description reflects the situation of the Chinese house in Prüfening:

> "One can call the delightful Tea and Music Pavilion a Chinese Tower, which constitutes a special adornment of the Donaustauf Park. This ornamental architecture is formed in octagon; wooden posts carry the upper construction, which was open to every side of the loggia. The sweeping roof crowns a Chinese lantern. Railings and walls are painted with dragons and Chinoiserie (patterns) [78]."(Fritz Uhl 1993)

As the knowledge of the older generations that the Chinese house was almost lost, it was rediscovered by Mr. Franz Kastenmeier, chairman of the Association of the Chinese Tower in Donaustauf, purely accidentally, on an aerial photograph of the park of Prüfening in Regensburg. The tower in Prüfening was the tower that formerly stood in Donaustauf because a photo of the 1950s (Fig.5-1779) shows the old Donaustauf Tower looked exactly the same as the one found in Prüfening. Already in 1990 Kastenmeier had noticed that many historical views and images of the nineteenth century of the

[78] Original in German: "*Einen chinesischen Turm könnte man den entzückenden Tee- und Musikpavillon nenne, der eine besondere Zierde des Parks von Donaustauf bildet. Die reizende Gartenarchitecktur ist im Achteck angeordnet, Holzpfosten tragen den Oberbau, der sich mit Loggien nach allenSeiten hin öffnet. Das geschweifte Dach krönt eine chinesische Laterne. Brüstungen und Wände sind mit Drachen und Chinoiserinen bemalt*." (Fritz Uhl 1993)

[79] From the brochure of the Association of the Chinese Tower in Donaustauf, 2006.

Donaustauf market that he has collected for over twenty years displayed the Chinese Tower in the garden of Prince Donaustauf. In the spring of 1999, the Chinese Tower of the castle Prüfening was brought back to its original location in the Prince's garden of Donaustauf by the Association as a landmark of the history of Donaustauf.

In summary, although the available evidences cannot support a conclusive construction of the history of the Chinese Tower in Donaustauf, they reveal several significant historical facts about the Tower:

(1) As early as the beginning of the nineteenth century, a garden house in Chinese style already stood in the Prince Garden of Donaustauf. It should have been built by the royal family of Bavaria or by previous owner of the property.

(2) The fate of this garden house is unknown. It is possible that it was completely torn down and replaced by the Chinese Tower shortly before the inauguration of the Walhalla. Or, it was renovated to the Tower.

(3) The existing tower was constructed/reconstructed in the 1840s, when the Castle of Donaustauf was renovated to be in accordance with the opening of Walhalla. The design was made by Victor Keim or some Junghaenel whose life is unknown. Since then, few changes were made to the building.

(4) The Tower survived the great fire in 1880 and was moved to the Garden of Prüfening.

(5) In 1990s, the Tower was discovered by the municipality of Donaustauf. Because of its significance to local history, the municipality, particularly the Association of the Chinese Tower in Donaustauf, made substantive efforts to relocate and rehabilitate the Tower.

CONCLUSION OF PART ONE

Three points can be made about the wood investigation of the Chinese Tower in Donaustauf.

Structurally, the Donaustauf Tower adopted the German frame construction (*Rähmbauweise* or *Stockwerkbauweise*) of the half-timber house (*Fachwerkhaus*), in which each story is constructed like a case, and the whole building is constructed like a pile of such cases. Even though the ancient Chinese framing system also had a similar method of "piling" stories over each other, it is unlike the German method by the fact that it stacks hollow "cases" to form a tube-in-tube vertical structure as in the case of the wooden Pagoda in the County Ying. In the roof framing, the Chinese Tower adopted a "double layer" structure that can also be seen in other Chinoiserie buildings such as the Chinese Pavilion in Pillnitz and the Pagoda in Mulang. The purpose of this double-layer structure is to form different shapes for the exterior and interior space. On the outside, the Donaustauf Tower achieves the sweeping line by cutting the entire hip rafters into hook shape. On the inside, the tower forms a dome ceiling by using arched roof posts. Then, the inside layer of the globe of the arched posts is nested in the out layer of the umbrella of the hooked rafters.

Materially, the Donaustauf Tower used three types of timber: oak (*Quercus*), Norway spruce (*Picea abies* Karsten), and silver fir (*Abies alba* Mill.). This choice of wood species was common in the medieval construction in Germany and was similar to other Chinoiserie buildings, e.g., the Pagoda in Mulang. At least by the known case, it denies the hypothesis that the expansive timbers imported from Asia were used to Chinoiserie buildings. It is probably due to the fact that European builders did not attempt to "copy" the Chinese architecture but to create their own "Chineseness." Using the same species as the original Chinese structure was not required. Based on taxonomic identification, dendrochronological investigation indicates the timbers can be dated from various time periods, between the 1760s and 1860s. While it is possible that timbers of different time were installed at once, it is more likely that they were added at different points when renovation was done to the building. This is supported by historical records that verify the existence of the Tower was earlier than felling years of some timbers found as part of the structure.

Historically, the existence of a Chinese Summer House is traced to as early as the beginning of the nineteenth century, i.e., before 1812. Several textual and graphic documents, such as handover protocol between the King of Bavaria and the Prince of Thurn and Taxis, the old cadastral map, and old drawings, indicate a Chinese summer house had been standing in the Prince Garden before the inauguration of the Walhalla. Shortly before the opening ceremony of the Walhalla in 1842, the Castle and the Prince Garden had gone through a renovation under a heavy time pressure. Although one document shows the project supervisor Karl Victor Keim was commissioned with the task of "establishing (or re-establishing)" a Chinese summer house, it is not known if this commission was carried out, because under the time pressure some of the issues were put on hold, such as the pigeonry planned by Junghaenel. Thereafter, the Chinese house stood in the garden until being moved to the park of Prüfening in Regensburg, after the castle was burned down in 1880. However, it is possible that between 1842 and 1880 the house was occasionally restored because some timbers felled in this period of time were added to the building.

In a nutshell, these three chapters show, structural, material, and historical investigations of Chinoiserie architecture can be inter-dependent to understand the history of a Chinoiserie building. While the structural research informs us how the architecture Chinoiserie was technically accomplished, the material study tells us with what it was made and when it was made. These two kinds of study are crucial, especially when there are no sufficient historical records. Meanwhile, structural and material investigations cannot stand alone, as their results lack of an appropriate historical context.

PART TWO MACRO-APPROACH: THE DIFFUSION OF ARCHITECTURAL CHINOISERIE

CHAPTER 7. CHINOISERIE AND SOCIAL NETWORKS

Historical Network Research

Social network theory and practice is a relatively recent development. Although it has theoretical roots by earlier sociologists such as George Simmel and Émile Durkheim, its analytical methods begin to develop in the early twentieth century, as tools of graph theory were systematically introduced to analyze social relations.

Network analysis is not completely strange to historians. Evidence can be found in numerous to demonstrate historical relationships. (Sun 2013, pp. 100 – 101) Proofs can also be found in theoretical concepts such as "*histoire croisée* (entangled history). (Düring, Stark 2011, p. 593) In describing this nascent network thinking in history, the word "metaphor" was frequently used to differentiate it from the modern network analysis, which derives its arguments from algorithmic analysis. Although some authors have mentioned some differences between the two kinds of network thinking (Bertrand, Lemercier 2011, p. 13, Sun 2013, pp. 100–101), a seriously epistemological investigation has yet to be written and published.

Since the 1990s, a more formal analysis of historical networks had made appearance in historical research, predominantly, in the history of citation relationship, kinship, and economic history. (Düring, Stark 2011, p. 593, Bertrand, Lemercier 2011, p. 13) Padgett's Florentine Families is a good example of applying network analysis to historic occurrences. Current historical network research exhibits extreme diversity and heterogeneity. (Bertrand, Lemercier 2011, pp. 14 – 15) After over 30-years of exploration, the field has begun to awaken with new self-awareness. The once isolated promoters, mostly doctoral students, have organized discussions to strengthen their connections with each other. They meet once a year at the Conference of Historical Network Research (HNR) and other regional gatherings.

The essential issue that hampers the cooperation of the two fields of history and network analysis seems to lie in the antagonism between quantitative research and qualitative research. Social network analysis is in nature quantitative, while historiography does not have to be quantitative and usually opts for qualitative logic, especially in the case of art and architectural history. Historians' disposition to qualitative approach seems to be a reasonable choice to deal with the limited amount of numerical information, given the considerable larger quantity of biographical and descriptive information. One of the most vexing topics in historical network research is the often fragmentary, unstructured nature of data. (Düring, Stark 2011, p. 593, Bertrand, Lemercier 2011, p. 15) Some historians can obtain a considerable amount of quantitative data, for example, from tax register. This data is not only relatively complete but also structured and thus is directly applicable to network analysis. Other historians, unfortunately, have to deal with incomplete, unstructured data in various forms. (Bertrand, Lemercier 2011, p. 15, Sun 2013) In dealing with this problem, some authors rely on robust concepts of centrality measures, bimodal networks, visualizations, and the adaptation of widespread theorems such as brokerage or the concept of strong and weak ties. (Düring, Stark 2011, p. 593, Bertrand, Lemercier 2011, p. 21)

Another question that has received much attention is whether and how formal network analysis helps interpreting history. While realizing the analytical power of network methods, one is also forced to re-consider the role of historians in the process of historical network analysis. Although formal network methods generate quantitative, algorithmic measures to support historiographical arguments (Bertrand, Lemercier 2011, p. 19), to reveal similar structures between networks does not exempt interest in the substance of the relationships (Bertrand, Lemercier 2011, p. 20), all of which returns to the concerns at the heart of the historian craft. (Bertrand, Lemercier 2011, p. 20) As often said, the devil is hidden in the details.

Moreover, due to the absence of historical data, the reliability of network analysis is sometimes questionable and the results of the analysis is often unexplainable, if conventional historical methods such as oral history and documentation research is not counterpoised to network analysis. (Sun 2013, pp.108 – 109)

Chinoiserie "Networks" in Previous Research

Previous historians of Chinoiserie have realized the importance of family network to the diffusion of the taste. As Jacobson states, "China-mania ran in families." (Jacobson 1993, pp. 90) This was particularly true to Germany, where the Chinese taste of one royal house was easily transmitted to another through the inter-marriage relationship. For instance, Frederick the Great of Prussia, was the most important arbiters of the Chinese taste in the north of the country. His favorite sister Wilhelmine of Prussia, with whom he has corresponded frequently, owned the famous site of Chinese taste— Sanspareil. Another sister of him, Louisa Ulrika of Prussia, was also not immune from the Chinese favor in the Prussian court. To her fifteenth birthday, she received a surprise birthday gift in Drottningholm–a Chinese pavilion (*China Slott*). After she became the Queen of Sweden, more Chinoiserie buildings were constructed there.

Besides the natural connection of genealogy, Yamada indicates the exposure to other nearby China-friendly environments also helped its diffusion. For instance, the connection between Holland and Germany is important because in his youth the Great Elector, Frederick William (1620-1688) studied in Holland. (Yamada 1935, p. 36) The personal connections of specialists could also contribute to the spread of Chinoiserie. For instance, Friedrich II had sent his gardener Krutisch to Wilhelmstal to study the new styles in gardening, including the Chinese style. (Huth 1929, p. 14) In another instance, the famous writer Voltaire, who had spent much of his time at the court of Lunéville previous to 1749, may have aroused Frederick the Great's interest in Chinese buildings and the inspirations from Lunéville may have well affected the plan and elevation and the skeleton of his Chinese House in Sanssouci. (Erdberg, Pond 1936, p. 67)

In summary, Chinoiserie has never attracted the scholarly attention that architecture styles such as the Baroque and Rococo do. While the major body of the literature focuses on the featuristic analysis, some works have pointed out the social dynamics behind the development of style, especially the social networks of relevant contributors. Historical network research can provide analytical tools to testify historical interpretations, if its quantitative methods are properly counterpoised with historical methods, which are adept at dealing with biographical and descriptive information.

CHAPTER 8. CHINOISERIE: GERMAN EXAMPLES

Historical Sites

Having introduced a general overview of the three major phases of development of Chinoiserie in architecture, the discussion now turns to the examples chosen for closer examination. In order of the appearance in the text these are located in Pillnitz, Potsdam, Wilhelmshöhe, Saarbrücken, and Munich. This order generally follows the above-mentioned three phase of Chinoiserie development in architecture and includes a broad range of areas and sub-German cultures.

The Pillnitz, Dresden[80]

Pillnitz, the summer residence of Saxony rulers, became infatuated with Chinese style shortly after Nymphenburg. This was sponsored by two patrons: August the Strong[81] (1670-1733), and Frederick Augustus I of Saxony.[82] The latter began a new wave of Chinoiserie construction in Pillnitz after 1768.

The Riverside Palace[83], the Upper Palace[84], and the New Palace[85] are the largest Chinoiserie constructions in Germany.

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[80] The capital city of the German State of Saxony.

[81] *August II der Starke* (1670-1733), King of Poland, Grand Duke of Lithuania, a great supporter to the Chinese taste, promoted the research of porcelain production in Germany. He had a large collection of Chinese porcelain and prints.

[82] *Friedrich August I von Sachsen* (1750/1763-1827), King of Saxony, Duke of Warsaw, successor of August the Strong. Because of his renunciation of the Polish throne, he was also called "*August der Gerechte*" (August the Just).

[83] *Wasserpalais* in German.

[84] *Bergpalais* in German.

[85] *Neues Palais* in German.

The Riverside Palace was built for August the Strong by the architect, Matthäus Daniel Pöppelmann[86] in 1720/21 and renovated by the architect, Zacharias Longuelune[87] in 1725[88] (Fig.8-1).

The Upper Palace was started two years later, in 1722/23, and was the work of Matthäus Pöppelmann (Fig.8-2). By designing the Riverside Palace and the Upper Palace Pöppelmann might be inspired by the palace compound described in the travel reports of Jahn Nieuhof (Welich 2010, p. 218, Fig.8-5). However, there are some ideas whose origin cannot be associated with the Chinese archetype, for instance the chimney motif. (Yamada 1935, p. 53)

There are other opinions about the origin of the roof forms of the Riverside Palace and the Upper Palace. While Reichwein firmly believed they were borrowed from China (Reichwein 1967, p. 59), Yamada regards it as a variation of Mansard roof that was traditional in European architecture. (Yamada 1935, p. 53)

After 1818 the architect, Christian Frederick Schuricht[89], was commissioned by Frederick Augustus I to build a New Palace (Fig.8-3), when the Countess's Palace was burnt down (Fig.8-4).

[86] Matthäus Daniel Pöppelmann (1662-1736), was the court architect of August the Strong, He also developed a urban plan for a portion of Warsaw.

[87] Zacharias Longuelune (1669-1748), was a French architect who worked both for Frederick the Great and August the Strong. Later, he became the Senior State Architect (*Oberlandbaumeister*) in Saxony.

[88] From 1873 King Albert of Saxony carried on a renovation for the halls in the Riverside Palace, which is not in the time period of this research.

[89] Christian Frederick Schuricht (1753-1832), was the court architect of Frederick Augustus I beginning in 1818. His style was mainly classical.

After 1800 the amount of Chinoiserie construction in Pillnitz was greatly reduced and only two more elements of significant size constructed. In 1804, Schurich designed two pavilions for Frederick Augustus I. Only one was chosen and executed. The Chinese Pavilion (Fig.8-6), which still exists, indicates the influence of contemporary travel reports and pattern books that can be found in the archives of Pillnitz. The painter for the interior was Johann Ludwig Giesel[90]. The contents of the paintings were the illustrations in contemporary travel reports, e.g., *Reis van Lord Macertneij naar China* by Sir Georg Staunton[91] in 1798-1801. The other unexecuted design (Fig.8-7) is the Bridge Pavilion, which was influenced by Chambers. Traces of the pattern book of Johann Gottfried Grohmann[92] can be identified around 1804. (Welich 2010, p. 218) However, before Schurich, an architect named F. da Fonte[93] may have already designed a pavilion in the Chinese taste. The drawing is still available today in the archive of Pillnitz (Fig.8-8)

The garden also contained several Chinoiseries which no longer exist. Some undated old plans show a Chinese Bowling Alley[94] and a Merry-go-round[95] with Chinoiserie decorations, as well as the pleasure boats on the Elbe with dragon's heads and putti. (Erdberg 1936, p. 63) They were probably built for August the Strong at about the same

[90] Johann Ludwig Giesel (1747-1814), a German painter of Holland style. Between 1787 and 1794, he was the court painter in Warsaw. After 1794, he came back and worked in Dresden.

[91] Sir George Staunton, 2nd Baronet (1781–1859), an English traveler and Orientalist, who has been to the Far East for two years (1792-1794).

[92] Johann Gottfried Grohmann, not much is known about his life. His publication *Ideen-Magazin für Architecten, Künstler und Handwerker die mit der Baukunst zuthunhaben*, was one of the most influential pattern books for Chinoiserie architecture.

[93] Nothing is known about this F. da Fonte.

[94] *Chinesischer Kegel* in German.

[95] *Ringel-Rennen* in German.

time as the Riverside Palace and the Upper Palace. One of the boats is preserved in the Johanneum[96], Dresden.

Sanssouci, Potsdam

Chinoiserie construction in Sanssouci started with the Chinese Tea House (Fig.8-9) in 1754. Several buildings in Chinese style were added over the next decades. Chinese fashion in Sanssouci did not fade away from its first sponsor Frederick the Great[97] to his successor Frederick William II of Prussia[98].

The Chinoiserie construction in Sanssouci marks the advent of Rococo Chinoiserie, differentiating itself from the previous Baroque Chinoiserie in Pillnitz which are serious in form and large in mass. The frolic-like designs that are unique in Rococo Chinoiserie have developed into maturity at Sanssouci. Most of Chinoiserie buildings have survived.

In 1754 the King drew himself a sketch of a garden house and gave it to Johann Gottfried Büring[99] (1723-after 1788) to improve. (Kopisch 1854, p. 100) Construction continued until 1763, producing "the most successful example of a Chinese pavilion" in Germany. (Reichwein 1967, p. 62) The structural work was finished in 1755 (Manger 1987, p. 239), but progress was interrupted by the Seven Years' War, and the interior was finished

[96] Built between 1586 and 1590 as the *Stallgebäude*, the stables of the adjacent Dresden Castle, now he Dresden Transport Museum (*Verkehrsmuseum Dresden*).

[97] Frederick the Great, *Friedrich II also Friedrich der Große* (1712-1786), nicknamed *Der Alte Fritz* ("Old Fritz"), King of Prussia, Elector of Brandenburg, famous for his reorganization of Prussian armies, his patronage of the Arts and the Enlightenment.

[98] *Friedrich Wilhelm II. von Preußen* (1744-1797), King of Prussia; Elector of Brandenburg, Pleasure-loving and indolent, the antithesis to his predecessor, but similarly a generous patron to arts.

[99] Johann Gottfried Büring (1723-after 1788), a German master builder and architect of the late Baroque period, most of his works were in Potsdam.

in 1763. The official inauguration was delayed until the April 30th, 1764. (Wacker 1993, p. 11)

The idea for a round pavilion on a garden plan for the grounds might stem from Georg Wenzeslaus von Knobelsdorff[100] (Wacker 1993, p. 12), who was a close friend of the King. On the plan of 1752[101] (Fig.8-10), which might have been produced by von Knobelsdorff, the location of the Chinese Tea House was marked out. This suggests that von Knobelsdorff might be the first one who introduced the idea of a building there. (Dorst 1993, p. 30; Manger 1987, p. 12; Erdberg 1936, p. 68)

The Chinese Kitchen (Fig.8-12) was built for Frederick the Great by Johann Gottfried Büring in 1763 at some distance to the Chinese Tea House. The Chinese figures and most of the decorations vanished during the renovation of 1789 by Johann August Eyserbeck[102], who was appointed by Frederick William II to adapt the garden near the Tea House to a more landscape style. No historical plans or drawings have been found to document the appearance of this building before the renovation. (Wacker 1993, p. 17)

In 1763, Manger reported,

> "He (the King) sometimes dined in this house (the Chinese Tea House) in summer. Given that the distance of the kitchen to the Pleasure Palace was too great to bring the dishes there without getting cold, he

[100] Georg Wenzeslaus von Knobelsdorff (1699 – 1753), a painter and architect in Prussia. A soldier in the service of Prussia, he resigned his commission in 1729 as captain so that he could pursue his interest in architecture. In 1740 he travelled to Paris and Italy to study at the expense of the king, Frederick II of Prussia.

[101] The sketch was sorted under the documents of Knobelsdorff, but probably was drawn by Krüger, who worked under Knobelsdorff at the time.

[102] Johann August Eyserbeck (1762-1801), a German gardener and Prussian court.

> ordered the construction of a Chinese kitchen not far away from the Chinese. It is assumed Büring made the plans." (Dorst 1993, pp. 35–36)

His account is the most detailed description of the historical appearance of this building,

> "This kitchen has a length of thirty-two foot and a depth of eighteen foot, a door and four windows with six concave sides, new pilaster with embellishment in snake form together with flowers, which was drawn according to the nature. On the parapet wall came five metal-sheet pagodas, whose tops could be moved by the wind, (upon) which was also drawn (with decorations), and on top of the chimney there was a big canopy of metal sheet." (Manger 1987, pp. 266–267)

Although the kitchen still exists, in 1786, after the death of the King, it was changed into an apartment, whereupon its Chinoiserie embellishment was lost. (Dorst 1993, p. 36) Both the function and the details of this building have changed.

The Dragon House (Fig.8-13) was built by Carl von Gontard[103] (1731-1791) in 1769-1770 in the park near the Belvedere[104] as a gardener's dwelling. (Reichwein 1967, p. 61) The early history of this building is unclear, although the house was left unattended and fell into decay.

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[103] Karl Philipp Christian Gontard (1731-1791), a German architect; primarily in Berlin, Potsdam, and Bayreuth

[104] The Belvedere auf dem Klausberg is a building in Sanssouci, designed by Georg Christian Unger.

In addition to the existing Dragon House, there is also an old architectural drawing of a dragon house of the same period of time in the archive of Potsdam, which is several floors higher (Fig.8-14). This could be resulted from the wish of the King. Perhaps, the lower type pleased the King better than the higher one. So one plan was put aside. The King and Knobelsdorff probably knew of the work of Frischer von Erlach[105], *Entwurf, Einer Historischen Architektur* (1721), in which "*Pagode von Sinkicien* (Fig.8-15)" appeared to be a low pagoda. (Giersberg 1993, p. 52) Who created this design is often debatable. The architect, painter and friend of Knobelsdorff, Andreas Ludwig Krüger[106] (1743- c.1805) drew a kind of low pagoda in his sketch pad around 1745 (Fig.8-16). (Harksen 1993, p. 52) This could be compared with a design by Karl Philipp Christian von Gontard (1731-1786) in 1769/72. (Harksen 1993, p. 52) The draft could have been drawn by Büring based on the fact that the wall painting of the Dragon House was similar to that of the Chinese Kitchen in Deer Garden[107]. (Dorst 1993, pp. 36–37) Büring's ignorance of William Chambers[108]' work in 1763, indirectly suggests that he learned about Chambers later. Therefore, the Dragon House in Sanssouci may be an

[105] Johann Bernhard Fischer von Erlach (1656 –1723), an Austrian architect, sculptor, and architectural historian. His book *Entwurf, Einer Historischen Architektur* (*A Plan of Civil and Historical Architecture*) (1721) was one of the first and most popular comparative studies of world architecture and inspired later Chinoiserie architecture..

[106] Andreas Ludwig Krüger (1743-1822), a German architect and engraver in Potsdam.

[107] *Rehgarten*, a garden near the Chinese Tea House

[108] Sir William Chamber (1723-1796), born in Gothenburg, Sweden, where his father was a merchant. Between 1740 and 1749 he was employed by the Swedish East India Company making three voyages to China where he studied Chinese architecture and decoration. Returning to Europe, he studied architecture in Paris with J. F. Blondel. His classmates included the Cassel architect, Simon Louis du Ry who later contributed to the Chinese village Mulang. The Chambers spent five years in Italy, before he moved to London in 1755, where he established an architectural practice.

In 1757 he published a book of Chinese designs which had a significant influence on contemporary taste. He developed his Chinese interests further with his Dissertation on Oriental Gardening (1772), a fanciful elaboration of contemporary English ideas about the naturalistic style of gardening in China.

imitation of the pagoda in Kew[109]. Yamada agrees that the Dragon House was inspired by Chambers' design. (Yamada 1935, p. 70)

Sanssouci was one of the few German sites that was directly affected by the English ideas of neoclassical Chinoiserie: William Chambers personally designed three bridges for Sanssouci, two of which remained unexecuted. In 1763, these bridges were commissioned to Chambers. Thereupon, "*trois Elevations et trois Plans de Ponts à la Chinoise*" were sent to the King, Frederick the Great. One of the plans was executed and was later replaced by a modern one. The preserved plan (Fig.4-17) is not the executed one, which can be verified by comparing with the description in the repair report of 1788. (Harksen 1993, p. 51)

The New Garden, Potsdam

The New Garden in Potsdam is within a comfortable walking distance to the Park of Sanssouci. The land was purchased and went through some early construction when the future King Frederick William II was the Crown Prince. Like his predecessor, Frederick William II was an enthusiastic proponent of Chinese fashion. He had been intensively involved in advising the design and planning of the Chinese village of Mulang, which is also a selected site in this research. As a friend of the owner of Mulang, in 1796, he even personally visited the site, which was recorded by the famous Streider's history of the construction of Wilhelmshöhe.

[109] A park site developed from the exotic garden at Kew Park, formed by Lord Capel John of Tewkesbury. Now, the world's largest collection of living plants. In the 1760s, Chambers built several Chinoiserie structures here.

The Chinese Parasol (Fig.8-17), which still exists, was built for the King Frederick William II (1744/86-1797) after 1787. It is more exotic in appearance than the other Chinoiserie buildings on the same site. Its early creation reflects the fantastic Rococo features that were still popular. In comparison, the Schindelhaus and the Gate House appear to be "conventional," and more neoclassical. It is not clear who the architects were for these three buildings. Some scholars speculate that the Schindelhaus (built around 1790) (Fig.8-18) may have adopted the plan from the publication of Georges-Louis Le Rouge[110] , and the Gate House (Fig.8-21) may have been designed by Karl Philipp Christian von Gontard (1731-1791) or Andreas Krüger (1743- c.1805) in 1789/90.

Compared to the Chinoiserie architecture in Sanssouci, the designs in the New Garden appear to be less fanciful. Except for the Chinese parasol, here the Neoclassicism dominates the architecture and design. Some authors have even debated whether the buildings in the New Garden should be categorized as Chinoiserie. Flaske was the first one who included the Gate House and the Schindelhaus as "influenced" by the Chinese architecture. Reichwein carried this point further. Vogel takes them as examples for architectural Chinoiserie. (Vogel 1932, p. 326) But these two buildings were not listed by von Erdberg. When comparing the buildings in the New Garden with other contemporary designs that also claimed to be in Chinese taste, e.g., *Maison de Garde en forme de Hammeau* in Steinfurt[111], one can start to understand why it was regarded as Chinoiserie by many scholars. The influence of East Asia seems to be undeniable.

[110] Georges-Louis Le Rouge (c.1707-c.1790), a cartographer, architect, draftsman, and engraver. He collected architectural drawings through Europe and published in *Détail des nouveaux jardins à la mode*, which is one of the largest documentation of gardens and parks in Europe.

[111] The Park of Bango is a park near the town of Burgsteinfurt in the German state of North Rhine-Westphalia. The park was once rich in Chinoiserie buildings and was recorded by Le Rouge.

These buildings were included in this research for the purpose of exhibiting the waning influence of Chinese designs.

Mulang, Wilhelmshöhe[112]

As early as 1769 Frederick II of Hessen-Kassel[113] commissioned a pavilion in the Chinese style in his Wilhelmstal Park. (Paetow 1929, p. 36) His ambition of constructing a Chinese village was not realized until 1781. After his death in 1785, the task was continued by his son, William IX of Hessen-Kassel[114], who made visits to the friendly princes, like Franz of Anhalt-Dessau[115] and King Frederick William II of Prussia, who possessed wonderful Chinoiserie buildings. (Dötsch 2006, p. 7) William IX gave the name "Mou-lang" to the previously called "Chinese colony" in 1791. (Paetow 1929, p. 37)

It is not known who actually laid the first plan for the village of Mulang. Several candidates can be suggested. The first is Daniel August Schwarzkopf, who studied under the garden master Philip Miller[116] in Chelsea[117], London. He was recommended to Landgrave Frederick II by the Count of Veltheim, and became the Court Gardener in

[112] A unique landscape park in Kassel, Germany, the largest European hillside park, and second largest park on a mountain slope in the world, began in 1696 by the Landgrave Charles I of Hesse-Kassel and was accomplished 150 years later by William IX.

[113] *Friedrich II. von Hessen-Kassel* (1720–1785), Landgrave of Hesse-Kassel, an enlightened despot, and raised money by renting soldiers (called "Hessians") to Great Britain to help fight the American Revolutionary War. He was a generous patron in large construction projects such as Wilhelmstahl and Wilhelmshöhe.

[114] *Wilhelm I. von Hessen-Kassel* (1743-1821) was *Wilhelm IX*. from 1760 *Graf von Hanau*, Elector of Hesse, successor of Frederick II of Hessen-Kassel. He had already received several territories during his father's lifetime and was able to finance several small-scale gardens.

[115] *Leopold III. Friedrich Franz von Anhalt-Dessau* (1740-1817), Duke of Anhalt-Dessau, known also as "Prince Franz" or "Father Franz."

[116] Philip Miller (1691–1771) was an English botanist of Scottish descent.

[117] Chelsea Physic Garden, established in 1673, the second oldest botanical garden in Britain, after the University of Oxford Botanic Garden (1621).

1766. The Casseler architect Simon Louis du Ry could be also the planner for the fact that he studied by Jacques-François Blondel[118] (1705-1744) in Paris as the same time as Williams Chambers. He was employed as the court master builder. (Steinhauer 2003, pp. 23–25) The participation of Heinrich-Christoph Jussow[119], who in 1801 succeeded du Ry as the court master builder, can be excluded, because he has yet to begin his study in England. It was also possible that the Landgrave Frederick II came up with the idea for himself, for he possessed a bulky collection of works in garden architecture, which demonstrated his great interest in the construction.

Mulang was rich in Chinoiserie buildings, of which the Pagoda (Fig.8-21) and several others still exist. However, except the Pagoda, the Chinoiserie features of other buildings have been altered by several rehabilitations. Many buildings were originally built for Frederick II but renovated substantially for William IX around 1791. Historical documents indicate that many other architectural fancies were once built in Mulang as well, such as two open pavilions around 1785 (Fig.8-21). Although many architectural drawings have survived, they are often not signed or dated. The documents do not identify specific architects for individual buildings.

With the help of two old paintings, it is possible to clearly identify nine buildings once standing in Mulang (Fig.8-22). Three houses in the first row to Kiang River[120] are,

[118] Jacques-François Blondel (1726-1799), a French architect and teacher. After running his own highly successful school of architecture for many years, he was appointed Professor of Architecture at the *Académie d'Architecture* in 1762. Simon Louis du Ry and William Chambers were his students.

[119] Heinrich-Christoph Jussow (1754-1825), a German architect and garden planner. He studied firstly mathematics and illustration in Cassel. After spending many years abroad, he became the garden architect of William IX.

[120] A river runs around Mulang.

from the left to right, the Dairy[121], Chinese Hall[122]/Dining Hall[123] and the Kitchen[124] (Fig.8-23). The Chinese Hall (Fig.8-24[125]) was originally built for Frederick II before 1785. In 1791 it was renovated to a dinning place for William IX. Supplementary buildings to the service of the Dining Hall, the Dairy and the Kitchen, whose previous function was probably different in the regent of Frederick II, were also renovated for him. The Pagoda, built for Frederick II in 1781, after the “Banqueting House” in the pattern book of *Ornamental Architecture* by Charles Over[126] (Fig.8-25), is the only building in Mulang that still maintains Chinoiserie features. The similar design could be found by the Schellenhäusle[127] in Bad Mergentheim[128]. Three residential buildings have also survived, but lost their Chinoiserie features completely. These are the Hall Guards' Apartment[129], the Supervisors' Apartment[130], and the Bagatelle (Fig.8-26). The last one was originally built for Frederick II as a Dairy Building[131] in 1784. The design was ascribed to du Ry. This house, which was used by Jussow between 1787 and 1791, was given the name “Bagatelle” by William IX in 1791. Another striking construction on the site was the Windmill, built for Frederick II by the workman master Arhnholz in 1784/85

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121 *Milchkammer* in German.

122 *Chinesischer Saal* in German.

123 *Speisesaal* in German.

124 *Küche* in German.

125 The building was firstly called as “Chinese Hall/ Salon.” The figure shows the appearance of the Chinese Hall, before it was renovated into Chinese Dining Hall.

126 Charles Over, a British architect, not much is known about him. His publication *Ornamental Architecture* was one of the most important pattern book for Chinoiserie architecture.

127 A Chinoiserie pavilion in the palace park of Mergentheim, which still exists.

128 In the city of Bad Mergentheim, there is a Palace Mergenheim, which is famous for having been the residence of high masters of German orders.

129 *Saalwächters Wohnung* in German.

130 *Aufsichters Wohnung* in German.

131 *Meiereigebäude* in German.

(Steinhauer 2003, p. 29), renovated in 1791 for William IX. It was demolished, but some unsigned old drawings preserved in the State Museum of Hessen show it was once indeed styled with Chinese features.

In addition, others buildings were constructed for William IX after 1791. Their original architects remain mostly unknown and their Chinoiserie features have mostly disappeared. No historical graphics survive to give us a clue of their original appearances. These include the small houses[132] in the Chaussee[133], the Herder House[134], the Sheep Pen[135], the Barn[136], and the Cowshed[137] for William IX in 1791.

After the turn of the eighteenth century, Chinoiserie continued to be built at Wilhelmshöhe. Two buildings were said to have been built in Wilhelmshöhe. The Connection Gallery[138] (Fig.8-27) designed by Jussow for William IX in 1812 was built in 1813, and demolished in 1851. The Bowling House[139] was built for William IX in 1832 within seven days. It was a curious mixture of gothic and Chinese styles. It might be the last Chinoiserie building in Wilhelmshöhe.

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132 *Klines Haus an der Chaussee 4, 9, 10, 6* in Fig. 8-23.

133 The main street runs through Mulang.

134 *Hirten Wohnung H* in German, Fig. 8-23.

135 *Schafstall* 8 in German. Number, in 1794 and was enlarged in 1795.

136 *Scheuer* SCH in German, 1795, Fig. 8-23.

137 *Kuhstall* 7 in German, originally built as a *Pferdestall*.

138 *Verbindungsgalarie* in German.

139 *Kegelhaus* in German.

Ludwig Park, Saarbrücken[140]

The gardens in Ludwig Park (Fig.8-28) — Ludwigsberg, Schönthal, and Dianenhain[141] — all began and ended under the patronage of Louis of Nassau-Saarbrücken[142], Prince of Nassau-Saarbrücken. Due to his own interest in architecture and landscape, at least two "family dynasties" of architects and garden masters were fostered, the Köllner and the Stengel. Contributions from other artists can also be seen, for instance, the sculptor and painter Johann Heinrich Heideloff[143] and the landscape architect Friedrich Ludwig von Sckell. The latter will be mentioned again in history of the English Garden in Munich. He drafted a renovation plan for Ludwigsberg, whose construction situation was not clearly known. (Trepesch 1999, p. 14) Some payments strongly suggest that the plan was carried out. There is a payment for the Chinese Pagoda on Katharinenberg[144] planned by Balthasar Stengel[145]. (Trepesch 1999, pp. 15–16) Von Sckell's reconstruction plan was not dated, but assumedly was finished in 1785 or 1789 shortly before the French Revolution. Radically, von Sckell planned to remove all the small follies and changed the site into English style like he did in Nymphenburg. (Hannwacker 1992, p. 54, Trepesch 1999, p. 14)

140 The capital of the state of Saarland in Germany

141 Because these three garden sites actually bordered to each other and were developed under the same patronage, they are treated in this research as one site.

142 *Ludwig von Nassau-Saarbrücken* (1745-1793), the last ruling prince of Nassau-Saarbrücken, was an enlightened absolutist ruler from 1768 until the French Revolution. In 1793 he fled to Aschaffenburg in Bavaria.

143 Johann Heinrich Heideloff (1760-1807), the court sculptor of Nassau-Saarbrücken, fled before the French Revolution, Later, worked in Biebrich, Wiesbaden.

144 A hill in the Ludwig Park.

145 Balthasar Wilhelm Stengel (1748-1824), the second son of Friedrich Joachim Stengel, succeeded his father to be the court architect of Nassau-Saarbrücken. Some of his drawings were discovered in Berlin after the World War II

Sharing the fate of other historical sites on the French border, Ludwig Park was greatly destroyed during the French Revolution. However, historical documents show that it was once rich in Chinoiserie buildings. Including bridges, tents, or pavilions, at least nine Chinoiserie structures can be identified in the images Fig.8-29 and Fig.8-30.

Johann Frederick Christian Köllner[146] was responsible for planning the garden of Ludwigsberg beginning around 1769 and was succeeded by his son, Heinrich Ludwig Köllner[147]. Both men had studied in England and France, the latter, also by the Garden Master Johann Ernst August Bernhard Petri[148] in Zweibrücken[149]. (Lohmeyer 1937, pp. 91–118) The younger Köllner took over the commission from his father as Chief Construction Director of Ludwigsberg after 1785. Prince Louis made a study tour to other European countries between 1759 and 1766, including England and France. In 1770 the elder Köllner drafted a plan for Ludwigsberg, probably at the rear of the Ludwig Palace. No evidence has come to light that any buildings in Chinese taste were built in this area. The Chief Master Builder Friedrich Stengel[150], who was later replaced by his son Balthasar Stengel (1748-1824), supervised the construction. Between 1784 and 1791 the garden was expanded and restructured, and construction in Chinese taste can be seen in the documentation. For example, the *Affenkaserne* (Building Nr. 13, Fig.8-31)

[146] Johann Frederick Christian Köllner (1733-1809), the garden director of Nassau-Saarbrücken.

[147] Heinrich Ludwig Köllner (1762-1824), successor of his father Johann Köllner, from 1793 the palace administrator in Saarbrücken after the French Revolution.

[148] Johann Ernst August Bernhard Petri (1744-1809) , stemmed from a family with long tradition in garden design. His grandfather Johann Nikolaus and his father Johann Georg were the court gardeners in Sachsen-Eisenach. His uncle Johann Ludwig was firstly the court gardener in in Nassau-Saarbrücken then in Pfalz-Zweibrücken

[149] A town in Rhineland-Palatinate, Germany.

[150] Friedrich Joachim Michael Stengel (1694-1787), the court architect of Nassau-Saarbrücken. His style was mainly Baroque.

designed by Balthasar Stengel, which was greatly influenced by Chambers, got its name from its front figure of a stick-swinging monkey on a pyramid roof. During the design phase the architect had refused the proposal of a cage with lattice openings. Obviously, this was to meet the needs of more space to accommodate guests in the park. Many buildings in the park had to accommodate the guests or the staff of the court because there was not enough place in the Pleasure Palace itself. (Paul 2009, p. 9) After the Revolution in 1804, Johann Adam Knipper der Jüngere[151]. built probably the last structure in Chinese taste in Saarbrücken — the Garden Pavilion for eight Saarbrücker civil families (Fig.8-32). This pavilion was torn down in 1959.

To the west of Ludwig Palace emerged the Schönthal (Dörfchen), a garden for the second wife of the Prince, Catharina Kest[152]. It existed only for five years until the French Revolution. In comparison to Ludwigsberg, the garden of Schönthal was richer in Chinoiserie. Around 1789, Johann Köllner and his son took over the landscape planning. (Lohmeyer 1937, pp. 91–118) Records show that three bridges were built in Chinese fashion: the Chinese Bridge with Swan Boat (Nr. 21, Fig.5-33), the Three Stream Bridge (Nr. 24, Fig.8-34), and the Chinese Roof Bridge (Nr. 26, Fig.8-35), all of which were probably designed by Balthasar Stengel between 1769 and 1790. According to Pauli, Stengel took ideas from the two books of William Chambers, which were published in 1757 and 1772.

[151] Johann Adam Knipper der Jüngere (1784-1870), an architect and master builder in Saarbrücken; the son of Johann Adam Knipper des Älteren (1746–1811), who was also an architect and master builder.

[152] Katharina Margaretha Kest (1757-1829) , born as the daughter of a serf, became the mistress of Louis of Nassau-Saarbrücken, and later his wife. They had seven children together.

Between 1789 and 1791 appeared the Dianenhain, north of Ludwigsberg and Schönthal, arose the garden of Dianenhaim. The plan was laid out by Heinrich Köllner as shown by a drawing date 1789. (Leonardy, pp. (I).16) The old drawings indicate three buildings in Chinese mode: the Chinese Pleasure House *Adolfsfreude* (Fig.8-36), the Clock Tower (Fig.8-37), and the Chinese Gate.

The Chinese Pleasure House *Adolfsfreude* was a wooden pavilion on a stone basement, built by Balthasar Stengel around 1790. It was influenced by the Chinese Orangerie in the Garden of Désert de Retz[153] in the pattern book of Le Rouge (Fig.8-38). The Clock Tower seems to imitate the form of a Chinese pagoda, which was designed by Balthasar Stengel after a treatise of Chambers. The tower was probably made of ashlar and bricks. The lantern-like ornament under the roof and the doors were painted with green rust by Heideloff. The Chinese characters were painted on the plate over the entrance. (Paul 2009, p. 211) There is another architectural drawing showing a gate rich in lattice, which was probably made by Balthasar Stengel but never executed.

English Garden, Munich

The construction of the English Garden in Munich was begun by Sir Benjamin Thompson[154] (1753-1814) in 1789, was followed by Reinhard von Werneck[155] (1753-

[153] An Anglo-Chinois on the edge of the *forêt de Marly* in the commune of Chambourcy, in north-central France. It was built at the end of the eighteenth century by the aristocrat François Racine de Monville. Most of its Chinoiserie buildings disappeared but were recorded by Le Rouge.

[154] Sir Benjamin Thompson (1753-1814), Count Rumford, an American-born British physicist and inventor. He later entered government service in Bavaria, being appointed Bavarian Army Minister and re-organizing the army, in 1791, was made a Count of the Holy Roman Empire.

[155] Reinhard von Werneck(1753-1842), born in Ludwigsburg, joined the Bavarian army in 1797. In 1798, he was given the direction of the English Garden “to fill out his free hours” (“*zur Ausfüllung seiner Mußestunden*”); which became his main duty in 1799, with the guidance of Friedrich Ludwig von Sckell. Werneck became the major architect after Thompson left Munich in 1798, and was replaced by Sckell in 1804.

1842) and Friedrich Ludwig von Sckell[156] (1750-1823), who had been counseling the project from the very beginning[157].

The English Garden is functionally different from many other sites because although it was commissioned by a nobleman, the Elector Charles Theodore[158], it was intended to entertain and inform the public, not the princely family privately.

It contained several structures in Chinese taste. The Chinese Tower was perhaps the most well-known, but there was also the Chinese Restaurant, a Chinese Temple, a Gothic Temple, two wooden summer houses, and a few bridges in oriental style. (Schmid 1983, p. 44) Small Chinese gadgets in wood were planned near the Chinese Restaurant, but there is no evidence they were actually built. (Hallbaum 1927, p. 189) With the exception of the Chinese Tower and the Chinese Restaurant, all of the buildings have disappeared. (Schmid 1983, p. 44)

The Chinese Tower (Fig.8- 40, 4.34) was planned by Thompson and was designed by the Mannheim military architect Joseph Frey[159] (1758-1819) in reference to Chinese wood skeleton construction method. As the time to tower was built, Johann Baptist Lechner[160] (1758-1809) may have been involved in the construction. (Schmid 1983, p.

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[156] Friedrich Ludwig von Sckell (1750-1823), a German landscape architect, who was specialized in English-style landscape. He has redesigned many famous German sites from Baroque or Rococo to English style.

[157] The involvement of von Sckell in the early stage was previously doubted. After the discovery of a personal memory of Sckell in 1807, it becomes clear that von Sckell had been involved from the scratch. (Hallbaum 1927, pp. 183–184)

[158] Charles Theodore, *Karl Theodor von der Pfalz* (1724-1799), Prince-Elector, Count Palatine and Duke of Bavaria.

[159] Joseph Frey (1758-1819), a military architect in Manheim, not much is known about him. He seems to be noticed only because of his design for the Chinese Tower in the English Garden.

[160] Johann Baptist Lechner (1758-1809), a German architect, who designed several famous buildings in the English Garden in Munich, e.g., the Apollo Temple.

43) The Tower was started in the winter of 1789 and finished in 1791. Payment records show many craftsmen took part in the construction: the court master carpenter Johann Erlacher, the court locksmiths Matthias Rädl, the copper-smith Meßner and Michael Leithner, as well as the court master bricklayer Simon Streitner and the pavement-layer Zietsch[161]. (Dombart c1972, p. 72)

On May 25th, 1790, the Prince-Elector ascended the Chinese Tower during his visit to the English Garden. Ever since it was opened to the public, the Chinese Tower became a popular location for the social life of Munichers, even though von Sckell stated in 1807 it should not be renovated, since, when it "gets completely decayed, it must be demolished". (Schmid 1983, p. 44)

The Chinese Tower had suffered fires on several occasions. The last time was on July 13th, 1944, when it was hit by a bomb and burnt down. Beginning February 19th, 1946, Professor Franz Zell[162] was responsible for the re-establishment of the Tower under the guidance of Bavarian Palace Administration[163]. On June 12th, 1951, the Society of the Reconstruction of the Chinese Tower[164] was founded. And on July 12th, 1952 the roofing ceremony took place. On September 6th, 1952, the Tower was inaugurated and turned over to the State of Bavaria[165]. (Schmid 1983, p. 44)

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161 Not much is known about these craftsmen. Their names appeared on several construction payments for the English Garden.

162 Franz Anton Zell (1866-1961), a German architect and folklorist. In 1912, he became the lecturer (with the tile "Professor") in the Construction Vocational School of Munich (*Baugewerkschule München*). He was also a member of the Association of German Architects (*Bund Deutscher Architekten*).

163 *Bayerischen Schlösserverwaltung*

164 *Verein des Wiederaufbau des Chinesischen Turms*

165 *Bayern*, a state of Germany, located in the southeast.

The Chinese Tower in English Garden is a free imitation of the Chinese Pagoda in Kew[166], London. Instead of stone, it uses wood as building material in its original color, which gives the tower an aerial, light, frolic like impression that its archetype does not have.

The Chinese Restaurant (Fig.8-41) was originally named the Chinese Pleasure Palace. According to Lipowski, the Chinese Restaurant was designed by Johann Baptist Lechner (Dombart c.1972, p. 80) and built probably in 1789/90, at the same time of the Chinese Tower. The construction and furnishing were participated by Simon Streitner, Johann Erlacher, Franz Paul Homann, and Johann Michael Hilger. April 1st, 1792 was the arranged date for the official opening.

The building was originally built in wood. In 1912 it was stripped down and renewed in stone. Although the renewal made efforts to stay true to its antitype, some oriental features could not be preserved as the material changed.

Summary

In summary, information about Chinese architecture appeared much earlier in European documents than the appearance of architectural Chinoiserie. While the origin of architectural Chinoiserie has its roots in this former European knowledge, its real mother is the creativity and imagination of European architects of the seventeenth century, who produced a style that made the Europeans believe to be Chinese. Although architectural Chinoiserie shares a number of design features with Chinoiserie in decorative arts, its development shows a different pattern, as the creation of architecture needs more

[166] Designed by William Chambers in 1761-2, one of the most famous work of Chambers and was imitated by a number of Chinoiserie architects. At the time, it was the tallest building in Europe.

financial and technical resources. As a result, although three sub-Chinoiserie-styles: Baroque Chinoiserie, Rococo Chinoiserie, and Neoclassical Chinoiserie can be identified, the history of architectural Chinoiserie in various locations shows a great difference.

On the one side, the six selected sites in Germany show a great variety of when and how Chinoiserie was built. On the other side, a similar social structure behind each site can be identified: the patronage of noblemen did not only enable the establishment of individual buildings, but also influenced the choice of specific design features by financing the architects, whose designs matched their own taste. Also, noblemen influenced one another in the choice of designs, since they had opportunities to know others construction projects. Based on these observations, the next two chapters go further to examine how noblemen influenced each other and its meaning to the diffusion of architectural Chinoiserie.

CHAPTER 9. PARADIGMS DIFFERENTIATION OF CHINOISERIE ARCHITECTURE

All Chinoiserie buildings were designed to give an impression of Chineseness. Some archetypes can be intuitively observed, for instance, Chinese figures as decorative statues, or Chinese styled lanterns and bells. These archetypes seem to "update" themselves, as new design elements were imported from the East Asia or created by European artists. Some of the archetypes tend to be used together, showing a kind of design paradigm. The term "paradigm" refers to an archetypal solution of combining design features to achieve an impression of Chineseness.

This chapter proposes a new method for detecting the changes in designing Chinoiserie architecture over time by clustering the selected buildings into groups according to their design features. This defines the nature of paradigms for Chinoiserie architecture. Although it may be possible for the trained eyes of art historians to identify some of the changes in design patterns for a small number of examples by visual comparison, this research takes a quantitative approach. It considers situations where the size and the complexity of samples make direct human cognition impossible. In this approach stand two core questions: (1) how to represent the design of a building mathematically, that is, in numbers and (2) how to group these buildings into clusters, more specifically, which similarity measures and algorithm should be employed to allocate the thirty-seven buildings into different groups so that buildings in the same group show maximum similarity as compared to those outside of the group. The two buildings of the thirty-seven buildings have missing information. The Connection Gallery in Mulang (VG-ML) has missing information of its construction materials and the Hall Keeper’s House in Mulang (SW-ML) has missing information of its ornament details (Table 9-1).

Table 9-1   Selected Chinoiserie Buildings

Nr	Building	Style	Abbreviation[167]
1	Water Palace	Baroque	WP-Pill
2	Upper Palace	Baroque	MP-Pill
3	Chinese Tea House	Rococo	CTH-San
4	Design of Chambers' Bridge	Neoclass.	CBD-San
5	Design of Dragon House	Rococo	DHD-San
6	Dragon House	Rococo	DH-San
7	Clock Tower/Bell Tower	Rococo	GT-Lud
8	Chinese Gate Design	Neoclass.	CGD-Lud
9	Chinese Pagoda	Rococo	CP-ML
10	Chinese Hall 1747	Baroque	CH-ML
11	Dining Hall (Chinese Hall)1790	Rococo	DH-ML
12	Chinese Parasol	Neoclass.	CP-NG
13	Schindelhaus	Neoclass.	SH-NG
14	Chinese Tower	Neoclass.	CT-EG
15	Chinese Restaurant	Neoclass.	CW-EG
16	Bridge Pavilion Design	Neoclass.	BP-D-Pill
17	Dairy	Neoclass.	MK-ML
18	Kitchen	Neoclass.	CK-ML
19	Bagatelle	Neoclass.	Bag-ML
20	Small Chinese Houses at Chaussee	Neoclass.	CHs-ML
21	Hall Keeper’s House	Rococo	SW-ML (missing)
22	Milk House	Rococo	MH-ML
23	Cow Shed	Rococo	KS-ML
24	Supervisor’s House	Rococo	AS-ML
25	Windmill	Rococo	WM-ML
26	Herder House	Rococo	HW-ML
27	Connection Gallery	Neoclass.	VG-ML (missing)
28	Chinese Pavilion	Neoclass.	CP-Pill
29	Chinese Lattice Bridge	Neoclass.	CLB-Lug
30	Chinese Bridge with Swan Boat	Neoclass.	SwaB-Lud

[167] In the application of software such as MATLAB and UCINET, abbreviations will be used to get a quicker calculation speed and to make it easy to display results.

31	Chinese Roof Bridge	Neoclass.	RB-Lud
32	Three Stream Bridge	Neoclass.	TSB-Lud
33	Garden Pavilion	Neoclass.	GP-Lud
34	Affenkaserne	Rococo	AK-Lud
35	Adolfsfreude	Neoclass.	Ado-Lud
36	New Palace	Neoclass.	NP-Pill
37	Chinese Tower	Neoclass.	CT-Don

Building Representation

The first question is how to represent the design of a building quantitatively. This research models a building as a bag of design elements, which are assumed to appear independently. Each design elements corresponds to a dimension in the resulting data space and each building then becomes a vector consisting of binary values on each dimension. Thirteen design elements of Chinoiserie were found in the selected buildings. They were not seen in typical European architecture and were associated with Chinese culture. They are chosen to constitute the dimensions of the vector (i.e., components of the vector) for a building. These elements are characteristic to Chinoiserie architecture. If a building has used *any* of the thirteen design elements, the corresponding components of its representation vector will obtain the value of "1." If not, then "0."

Let B = $\{b_1....b_n\}$ be the set of all selected buildings, and D = $\{d_1,..., d_{13}\}$ be the set of distinct design (D) elements occurring in B. A building is then represented by a thirteen dimensional vector d_b. Let dv (b, d) denote the appearance (value of 1) and disappearance (value of 0) of $d \in$ D on the building $b \in$ B. Then the vector representation of a building b is

$$D_b = (dv\,(b, d_1), \ldots\, dv\,(b, d_{13}))$$

For example, to represent the Chinese Tower in the English Garden, Munich, we use the vector $D_{CT\text{-}EG}$ = [0,0,0,1,0,1,0,1,1,0,0,0,1], for it has the 4th (lattice), 6th (sweeping roof), 8th (bells), 9th (wood as main construction material) and 13th (combined with Neoclassicism) design features from the thirteen features. The representation vectors of the selected buildings are in Table 9-2.

Table 9-2 Vector Representation of Selected Buildings

Nr	Abbreviation	plastic decoration	calligraphy	wall painting	lattice	roof lantern	roof	top	bell/lantern	wood	solid	Baroque	Rococo	Neoclassical
1	WP-Pill	1	0	1	0	1	1	1	0	1	1	1	0	0
2	MP-Pill	0	0	1	0	1	1	1	0	0	1	1	0	0
3	CTH-San	1	0	0	0	1	0	0	1	0	1	0	1	0
4	CBD-San	0	1	0	1	0	1	1	1	1	1	0	0	1
5	DHD-San	1	0	0	0	0	1	1	1	0	1	0	1	0
6	DH-San	1	0	1	0	0	1	1	0	0	1	0	1	0
7	GT-Lud	1	1	0	1	0	1	1	1	0	1	0	0	1
8	CGD-Lud	0	0	0	1	0	0	0	0	0	1	0	0	1
9	CP-ML	1	0	0	1	1	1	1	1	1	1	0	1	0
10	CH-ML	1	0	0	1	0	1	0	0	1	0	1	0	0
11	DH-ML	0	0	0	0	1	1	0	1	0	1	0	1	0
12	CP-NG	1	0	0	0	0	1	0	1	0	1	0	0	1
13	SH-NG	0	0	0	0	0	1	0	0	0	1	0	0	1
14	CT-EG	0	0	0	1	0	1	0	1	1	0	0	0	1
15	CW-EG	0	0	0	0	1	1	1	0	1	0	0	0	1
16	BP-D-Pill	0	1	0	1	0	1	0	0	1	1	0	0	1
17	MK-ML	0	0	1	1	1	1	0	0	0	1	0	1	0
18	CK-ML	0	0	1	1	1	1	0	0	0	1	0	1	0
19	Bag-ML	0	0	0	0	0	1	0	0	0	1	0	0	1
20	CHs-ML	1	0	0	1	1	1	1	0	0	1	0	0	1

21*	SW-ML[168]	0	0	0	0	0	0	0	0	0	1	0	1	0
22	MH-ML	1	0	0	0	0	1	0	0	0	1	0	1	0
23	KS-ML	0	0	0	0	0	1	0	0	0	1	0	1	0
24	AS-ML	0	0	0	0	1	1	0	0	0	1	0	1	0
25	WM-ML	0	0	0	0	0	1	1	0	1	1	0	1	0
26	HW-ML	0	0	0	0	0	1	0	0	0	1	0	1	0
27*	VG-ML	0	0	0	1	1	1	0	0	0	0	0	0	1
28	CP-Pill	0	0	0	1	1	1	1	0	1	1	0	0	1
29	CLB-Lud	1	0	0	1	0	0	0	1	1	0	0	0	1
30	SwaB-Lud	0	0	0	1	0	0	0	0	1	1	0	0	1
31	RB-Lud	0	0	1	1	0	1	0	1	1	1	0	1	0
32	TSB-Lud	1	0	0	1	0	1	1	0	0	1	0	0	1
33	GP-Lud	0	0	0	1	0	1	1	0	1	1	0	0	1
34	AK-Lud	1	0	0	1	0	1	0	0	1	1	0	1	0
35	Ado-Lud	0	0	1	1	0	0	1	0	0	1	0	0	1
36	NP-Pill	0	0	0	0	1	1	1	0	0	1	0	0	1
37	CT-Don	0	0	1	1	1	1	1	0	1	0	0	0	1

[*] Missing data are assigned with “0,” because it is reasonable to assume the features did not exist instead of speculating that it was used.

Similarity Measures

With buildings presented as vectors, it is possible to calculate their mutual similarities with mathematical methods. Generally, the current similarity measures can be roughly seen as from four major computation families. These are distance family (e.g., Euclidean distance, Hamming dis/similarity), inner-product family (e.g., cosine similarity, Jaccard), correlation family (e.g., Pearson's correlation), and probability family (depends on the probability distribution functions).

Different measures of similarity are used for different types of situations. For example, the measures from the cosine and the correlation families are recommended if some index of similarity is needed for being invariant to scaling. This is to say that multiplying all elements by a nonzero constant will not change the computation results, and they can be applied when the probability distribution functions of variables are not given. First and foremost, the type of data, i.e., whether the data is valued or binary (I/O), should be taken into consideration. Since the buildings are represented with binary vectors, only the similarity measures for binary data are suitable. Ever since Jaccard proposed a similarity measure to classify ecological species in 1901, numerous binary similarity and distance measures have been proposed in various fields. (Choi et al. 2010, p. 43) Another example, Hamming similarity, is a special type of distance measurement that is specialized in dealing with binary strings such as DNA sequences. Choi and his colleges collected seventy-six binary similarity and distance measures used over the last century. (Choi et al. 2010, p. 43) They categorized similarity measures for binary data into three types: inner-product based, Hamming based (from the distance family), and correlation based. Generally, the Hamming based measures treat the presence and the absence of features equally while the inner-product based ones take only the presence into account and exclude the absence. The decision to include or exclude the absent term is a difficult and contentious one. (Cha et al. 2005, pp. 4–5) While Hamming-based similarity measures are additive forms of the positive and negative matches, the correlation based measures are multiplicative forms. Nonetheless, contributing factors of positive and the negative matches are considered equally important in correlation based similarity measures as well as Hamming based ones. (Cha et al. 2005, p. 6)

Since there is no previous reference to help us determine which kind of similarity measures could be suitable to study architecture, this research starts with the most widespread ones, namely (1) the cosine and (2) Jaccard[169] measures from the inner-product family, (3) the Pearson measure from the correlation family, and the most basic form of (4) Hamming measures.

Definitions of Similarity Measures[170]

Given an *m*-by-*n* data matrix X, which is treated as *m* (1-by-*n*) row vectors $x_1, x_2, ..., x_m$, the various distances between the vector x_s and x_t are defined as follows:

- Cosine similarity measure

$$d_{st} = 1 - \frac{x_s x'_t}{\sqrt{(x_s x'_s)(x_t x'_t)}}$$

- Correlation similarity measure

$$d_{st} = 1 - \frac{(x_s - \overline{x}_s)(x_t - \overline{x}_t)'}{\sqrt{(x_s - \overline{x}_s)(x_s - \overline{x}_s)'}\sqrt{(x_t - \overline{x}_t)(x_t - \overline{x}_t)'}}$$

Where,

[169] Related to Tanimoto coefficient. Jaccard similarity cannot be applied to k-mean clustering, reasons see the section, *Clustering.*

[170] http://www.mathworks.de/help/stats/pdist.html

$$\bar{x}_s = \frac{1}{n}\sum_j x_{sj} \quad \text{and} \quad \bar{x}_t = \frac{1}{n}\sum_j x_{tj}$$

- Hamming similarity measure

$$d_{st} = (\#(x_{sj} \neq x_{tj})/n)$$

- Jaccard similarity measure

$$d_{st} = \frac{\#[(x_{sj} \neq x_{tj}) \cap ((x_{sj} \neq 0) \cup (x_{tj} \neq 0))]}{\#[(x_{sj} \neq 0) \cup (x_{tj} \neq 0)]}$$

Clustering

Cluster analysis involves applying one or more clustering algorithms to find hidden patterns or groupings in a dataset. Clustering algorithms form groupings or clusters in such a way that data within a cluster have a higher measure of similarity than data in any other cluster. Cluster analysis is an unsupervised learning method and an important task in exploratory data analysis. The most common clustering algorithms are:

- Hierarchical clustering: builds a multilevel hierarchy of clusters by creating a cluster tree

- K-means clustering: partitions data into *k* distinct clusters based on distance to the centroid of a cluster

Hierarchical clustering starts with each observations as a separate cluster, i.e., there are as many clusters as observations, and then combines the clusters sequentially, reducing the number of clusters at each step until only one cluster is left. The clustering method uses the dissimilarities or distances between objects when forming the clusters. (Hill et al., 117-118)

Different from the hierarchical clustering, which can be applied even if there is no prior knowledge of how many clusters there should be, the k-means clustering requires that it is necessary to predetermine how many clusters the computation software should produce. Moreover, in contrast to hierarchical clustering, which considers similarity in a case-by-case manner, k-mean clustering iterates the calculation throughout the dataset until the minimum sum of the distance between the within-cluster data to their centroid is reached. This iteration makes it possible to avoid serious mistakes as in hierarchical clustering, in which a single error in the dataset can mislead the results in the early stage. Because k-means clustering needs a way to define the position of a centroid in order to minimizes the sum of distances from points in a cluster to that centroid, not all the similarity measures could be applied to this clustering algorithm. For instance, this does not apply to the Jaccard similarity measure, for which no algorithm is invented to locate its centroids.

Determine the Number of Clusters

One of the biggest problems with cluster analysis is to decide the optimum number of clusters. Very frequently, both the hierarchical and the k-means techniques are used successively. The former is used to get some sense of the possible number of clusters and the way they merge as seen from the dendrogram. Then the clustering is rerun with only a chosen optimum number in which to place all the observations by k-means clustering.

Using the cosine, Jaccard, and correlation similarity measures, the dendrograms of hierarchical clustering show two big groups with occasional isolated points (Fig. 9-1 to Fig.9-3), which suggests two can be the optimal number for clustering the thirty-seven buildings. The result of Hamming similarity (Fig.9-4), however, seems to suggest three is the optimal number for clustering, probably due to the fact that it collects all the isolated points to one level of hierarchy.

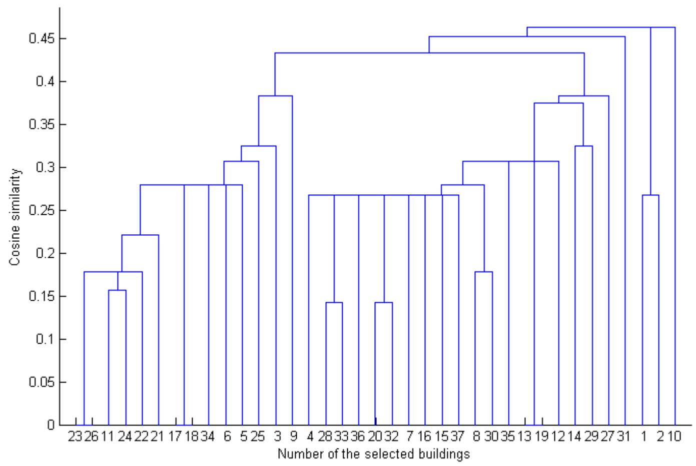

Fig. 9.1. Hierarchical Clustering with Cosine Similarity Measure

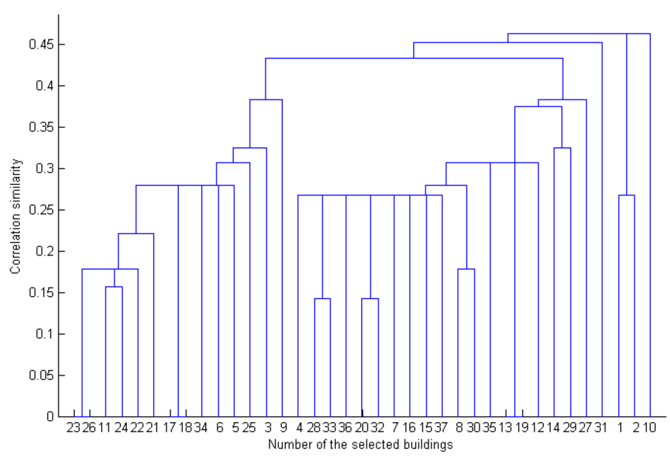

Fig. 9.2. Hierarchical Clustering with Correlation Similarity Measure

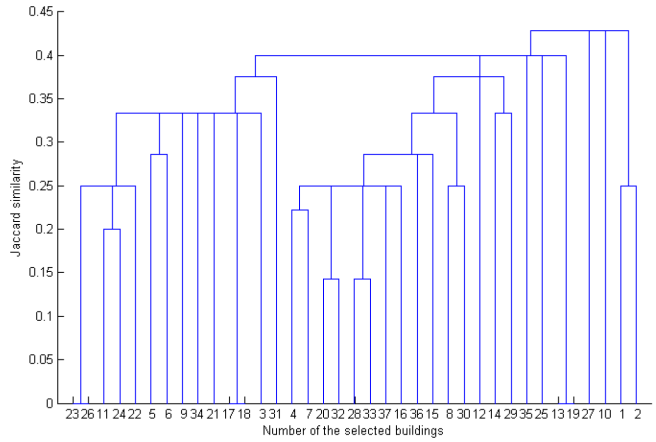

Fig. 9.3. Hierarchical Clustering with Jaccard Similarity Measure

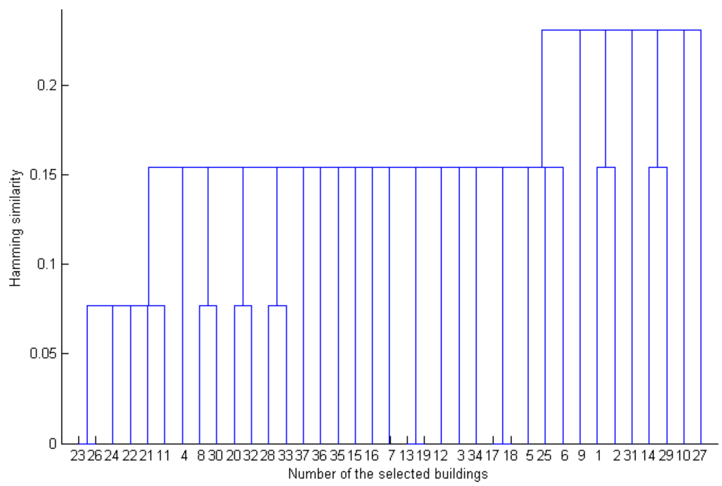

Fig. 9.4. Hierarchical Clustering with Hamming Similarity Measure

Validating Cluster Identity

To decide which number is relatively better and to verify the clustering is reasonable, the Silhouette Value is employed. Since we have used two clustering algorithms and four similarity measures, there should be eight evaluations (2x4). But because Jaccard similarity cannot be applied to k-means algorithms, there are finally seven evaluations (Table 9-3).

Table 9-3 Two Clustering Methods cross Four Similarity Measures

		Clustering methods	
		Hierarchical	K-means
Evaluation methods	Silhouette	cosine, correlation, Hamming, Jaccard	cosine, correlation, Hamming

Silhouette Value[171]

The silhouette value for each point is a measure of how similar that point is to points in its own cluster, when compared to points in other clusters. The silhouette value for the *i*th point, S_i, is defined as,

$$S_i = (b_i - a_i) / \max(a_i, b_i)$$

where a_i is the average distance from the *i*th point to the other points in the same cluster as *i*, and b*i* is the minimum average distance from the *i*th point to points in a different cluster, minimized over clusters.

The silhouette value ranges from -1 to +1. A high silhouette value indicates that *i* is well-matched to its own cluster, and poorly-matched to neighboring clusters. If most points have a high silhouette value, then the clustering solution is appropriate. If many points have a low or negative silhouette value, then the clustering solution may have either too many or too few clusters. The silhouette clustering evaluation criterion can be used with any distance metric.

The silhouette value tells us both how tightly a data point is associated with its assigned cluster and how dissimilar it is from other clusters. Each data point has a silhouette value and the mean silhouette value over all points summarizes the overall quality of the clustering. The approach works as follows: run a clustering method with a similarity

171 http://www.mathworks.de/help/stats/clustering.evaluation.silhouetteevaluation-class.html

measure several times, each time with a different *k*, and calculate the mean silhouette value for each *k*. If our data really fall into two groups, then we should see a peak in the silhouette values when *k*=2. The result of evaluating hierarchical clustering shows a peak does appear when *k*=2 for all the similarity measures. We do not have a peak at *k*=3.

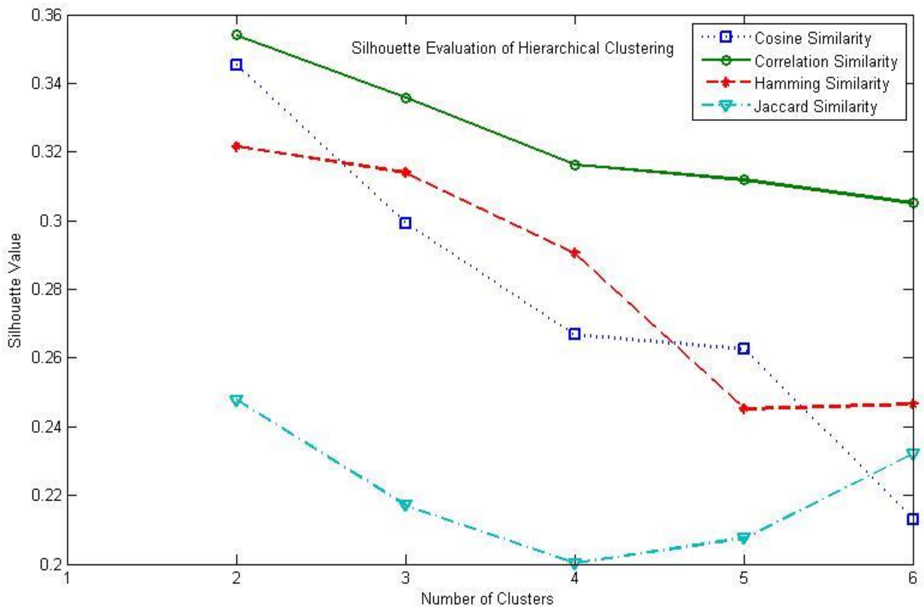

Fig. 9.5. Silhouette Value of Hierarchical Clustering

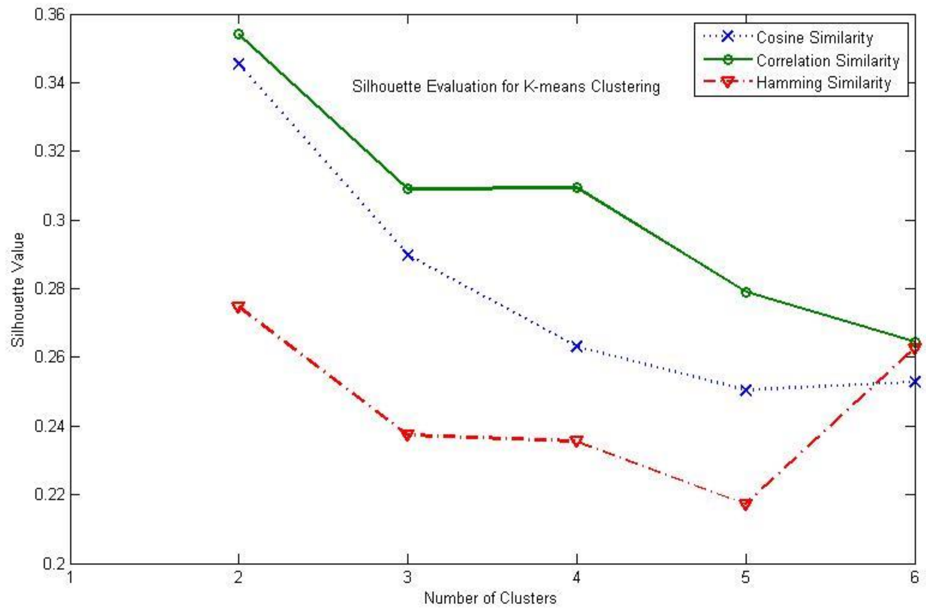

Fig. 9.6. Silhouette Value of K-means Clustering

The graph of mean silhouette values for k-means clustering also shows a peak at *k*=2. And this is true to all the three applicable similarity measures — cosine, correlation, and Hamming.

Design Paradigms of Chinoiserie Architecture

After dividing the thirty-seven buildings into two clusters (Table 9- 4), it is now possible to study the design paradigms in each cluster.

Table 9-4 Two Clusters of Selected Buildings

Abbreviation	H.Cos	H.Corr.	H.Ham.	H.Jac.	K.Cos	K.Corr.	K.Ham.
WP-Pill	2	1	**1**	2	1	1	2
MP-Pill	2	1	1	2	1	1	1
CTH-San	1	1	1	1	1	1	1
CBD-San	2	2	2	2	2	2	2
DHD-San	1	1	1	2	1	1	1
DH-San	1	1	1	2	1	1	1

GT-Lud	2	2	2	2	2	2	2
CGD-Lud	2	2	2	2	2	2	2
CP-ML	1	1	1	2	1	1	2
CH-ML	2	2	2	2	2	2	2
DH-ML	1	1	1	1	1	1	1
CP-NG	2	2	2	2	2	2	1
SH-NG	2	2	2	2	2	2	1
CT-EG	2	2	2	2	2	2	2
CW-EG	2	2	2	2	2	2	2
BP-D-Pill	2	2	2	2	2	2	2
MK-ML	1	1	1	2	1	1	1
CK-ML	1	1	1	2	1	1	1
Bag-ML	2	2	2	2	2	2	1
CHs-ML	2	2	2	2	2	2	2
SW-ML	1	1	1	1	1	1	1
MH-ML	1	1	1	1	1	1	1
KS-ML	1	1	1	1	1	1	1
AS-ML	1	1	1	1	1	1	1
WM-ML	1	1	1	2	1	1	1
HW-ML	1	1	1	1	1	1	1
VG-ML	2	2	2	2	2	2	2
CP-Pill	2	2	2	2	2	2	2
CLB-Lug	2	2	2	2	2	2	2
SwaB-Lud	2	2	2	2	2	2	2
RB-Lud	1	1	1	2	1	1	1
TSB-Lud	2	2	2	2	2	2	2
GP-Lud	2	2	2	2	2	2	2
AK-Lud	1	1	1	2	1	1	1
Ado-Lud	2	2	2	2	2	2	2
NP-Pill	2	2	2	2	2	2	2
CT-Don	2	2	2	2	2	2	2

First, it is desirable to know which of the thirteen design elements are predominantly favored in one cluster rather than in the other cluster. By weighing the frequency of the adoption of one design element in one cluster against the overall frequency of this element in both clusters, we can summarize the most frequently used design elements in this cluster, that is, the design paradigm of this cluster (Table 9-5).

Table 9-5　Characteristic Features in Each Paradigm

	Number of buildings	Cluster 1		Cluster 2	
		Nr.	%	Nr.	%
plastic decor	13	7	0.54	6	0.46
calligr	3	0	0.00	3	1.00
wall painting	8	6	0.75	2	0.25
lattice	20	5	0.25	15	0.75
copular	14	8	0.57	6	0.43
roof	31	15	0.48	16	0.52
top	16	6	0.38	10	0.63
bell+latern	10	5	0.50	5	0.50
wood	15	5	0.33	10	0.67
solid	33	17	0.52	14	0.42
Baroque	3	2	0.67	1	0.33
Rococo	15	15	1.00	0	0.00
Neoclass	19	0	0.00	19	1.00

The table shows all buildings with Rococo taste and a predilection for wall paintings go to the first cluster, while in the second cluster, Chinese calligraphy, lattice, and wood materials are most important features.

Second, it is meaningful to compare this quantitative classification with previous research. While it is not the same as the Yamada's division about Chinoiserie, it agrees with many scholars who concentrate on architectural features.　For instance, Reichwein, who realizes the development of architectural Chinoiserie was rather different, deals with it in two periods — Rococo and the Chinoiserie in the age of feeling. (Reichwein 1967, pp. 54–55)　He stresses that it was with the playful adoption of Chinese architectural motives what we call Chinoiserie began.　(Reichwein 1967, p. 62) The later period of architectural Chinoiserie saw the combination of Chinese style with other styles such as Gothic. (Reichwein 1967, pp. 119–120)　Although it is impossible to match the thirteen elements in the two clusters perfectly with the description of Reichwein, it can at least be observed that all the Rococo buildings go into Cluster One and that many design elements, such as calligraphy and lattice, which became popular in the period of English landscape appear predominantly in Cluster Two. This seems to suggest that Cluster One represents the playful Chinoiserie named by Reichwein, while Cluster One represents the Chinoiserie in the time of English landscape.

Honour and von Erdberg, divide architectural Chinoiserie into three periods. Both of them, however, recognized the significant difference between Chinoiserie in the time of Neoclassicism (when the English landscape was in mode) and that in the time of Baroque and Rococo. For instance, Honour points out Neoclassical Chinoiserie was, in comparison, not only simpler and less fantastic that Baroque and Rococo Chinoiseries, but also much closer to genuine Chinese objects. (Honour 1961, p. 177) This agrees with the design features in Cluster Two, in which elements more genuine to Chinese arts were appropriated by European artists firstly after the middle of the eighteenth century, such as calligraphy, lattice pattern, and wood material. Similarly von Erdberg discerns three types of Chinoiserie, the Exotic style, the Grotesque style (1670s-1770s), and the Imitative style (after the late 18th century), of which the former two were frequently mixed. She explains, the Exotic style followed the Turkish influence and used Chinese ideograms to confirm the exotic character ornamentally. (Erdberg 1936, pp. 10–11) The Grotesque style, in contrast, originated from pure Chinese models, underwent a thorough change, but not toward a European reality, as in the Exotic style. The Grotesque style stressed and exaggerated all queer and unusual traits, which caters the sense of play. (Erdberg 1936, p. 12) The Imitative style, as a child of Neoclassicism, demanded almost scientific exactness, hesitated to change exotic forms, and pursued the authentic "Chinese". (Erdberg 1936, p. 15) In short, the Rococo was the ruler, and China only the servant who had to supply the decoration. When the classicistic style set up China as the ruler, it established a tyrant who could allow no freedom for the Western personality. (Erdberg 1936, p. 17)

In summary, unlike previous studies, which divide architectural Chinoiserie into three periods, the result of the quantitative clustering suggests two should be a more proper classification based on the usage of design elements. Interestingly, this difference does not indicate a conflict to previous research. On the contrary, it discloses their common grounds and affirms the conclusion in previous works. By examining the arguments of previous scholars in details it is revealed that, although scholars have decided for the classification of three, most of them have already recognized the difference between Neoclassicism and the other two — Baroque and Rococo — is much larger than that within Baroque and Rococo. If they had followed their arguments about design elements to a more general classification, they would also have come to the result of two.

Since design elements in Cluster Two originate from the time of Neoclassicism and the elements in Cluster One were mostly adopted by Baroque and Rococo buildings, it can be summarized that, based on the usage of design elements, Chinoiserie architecture shows two paradigms. The first paradigm, which is represented by design features in Cluster One, agrees with the Baroque and Rococo Chinoiseries defined by most previous scholars, while the second paradigm, represented by Cluster Two, coheres with the Neoclassical Chinoiserie in the past research. The first paradigm show a high degree of design freedom: the buildings repeat less frequently the same design elements.

Statistically, few design elements in this paradigm enjoy extremely high popularity. In contrast, in the second paradigm, several elements, such as Chinese calligraphy and lattice, are rather predominant. They were almost a “must” in designing a Chinoiserie building during this period. This “patternization” of designing Chinoiserie architecture might be influenced by the great epochal spirit of Neoclassicism, which tended to regulate design freedom with some “rules”. Some pseudo-anthropological publications by authors who have personally been to China, e.g., Williams Chambers, took on the role of “classics” for Neoclassical Chinoiserie. Meanwhile, the increasing amount of pattern books, such as those published by Le Rouge and the Halfpennies, helped to strengthen this process of patternization until Chinoiserie came to an end.

CHAPTER 10. DIFFUSION ANALYSIS

Introduction

Chinoiserie is an emblematic case of transcultural interaction in the late Middle Age. The study of such historical phenomenon calls for a fundamental understanding of the social context that made it to be. This research focuses on the role of a special social group — the nobility. The reasons are two. First, several previous studies have argued the significance of royal societies in promoting Chinoiserie with various evidence from different perspectives. However, there lacks holistic approaches to prove, compare and integrate these arguments. Second, from the seventeenth century, while small objects of decorative arts[172] in Chinese taste, such as porcelain and paintings, became widely admired and increasingly available, the possession of "Chinese" architecture was still restricted to the wealthy and influential. To some extent, the history of Chinoiserie architecture, like other architectural styles (e.g., Baroque) in the Middle Ages, repeats how the nobility squandered wealth to feed pleasure. Nevertheless, before the French Revolution, they were the main patron to arts in that socio-economic structure. Thanks to the connections of European gentry and aristocracy, and the artists under their sponsorship, the medieval arts could diffuse all over Europe, including the Chinese taste.

While there are many approaches to analyze this historical occurrence, my discourse is built on a structuralistic foundation, and argues the social networks of nobility have enabled and facilitated the stylistic and material adoption of the Chinese taste in Europe. Particularly, this chapter asks, which of the following factors that have significantly

[172] Besides fine arts and architecture, European literature of this period also showed a predilection of Chinese elements.

contributed to the paradigms adoption among patrons: geographic adjacency, personal contact, and kinship.

Factors Influencing the Choice of Paradigms

During historical research, many types of personal relations are discovered in archives, e.g., heir, apprenticeship, sponsorship, and friendship. Since this study concerns how such relationships contributed to the diffusion of Chinoiserie, it is necessary to learn more about these connections. Here, the focus of historical research shifts from the buildings to the persons. Among the connections among different groups of people, this research is limited to those among royal patrons (Table 10-1) with the purpose to extend the research on the influence of royal kinship from the field of politics and economy to the field of arts. To disclose relations among them, this chapter turns to the records about their territorial adjacency, personal interactions, and genealogical bonds. While records about territorial adjacency and genealogical bonds are easy to access, the chance of discovering records about personal interactions such as letter correspondence and meetings is at the mercy of documents available.

Table 10-1 Royal Patrons of the Selected Chinoiserie Buildings

Abbreviation	Full Name	Life	Title
August J	Frederick Augustus I of Saxony	1750-1827	King of Saxony, Duke of Warsaw
August S	August II the Strong	1670-1733	King of Poland, Grand Duke of Lithuania
Charles	Charles Theodore	1724-1799	Prince-Elector, Count Palatine and Duke of Bavaria
F v Kassel	Frederick II of Hessen-Kassel	1720-1785	Landgrave of Hesse-Kassel
Franz	Leopold III Frederick Franz of Anhalt-Dessau	1740-1817	Duke of Anhalt-Dessau
Frederick II	Frederick the Great	1712-1786	King of Prussia, Elector of Brandenburg

K TT	Maximilian Karl of Thurn & Taxi	1802-1871	Prince of Thurn and Taxis
Louis NS	Louis of Nassau-Saarbrücken	1745-1793	Prince of Nassau-Saarbrücken
Ludwig I	Ludwig I of Bayern	1786-1868	King of Bavaria
Max I	Maximilian I Joseph of Bavaria	1756-1825	King of Bavaria
Wilhelm II	Frederick William II of Prussia	1744-1797	King of Prussia; Elector of Brandenburg
Wilhelm IX	Wilhelm IX of Hessen-Kassel	1743-1821	Elector of Hesse

Geographic Adjacency

Although Chinoiserie was a pan-European phenomenon, the time and ways that it settled itself varied greatly in individual territories. The situation is more complicated in Germany. The Federal Republic of Germany[173] is a nation that grew out of a geographic region in the Central Europe[174] east of France and north of Italy. Before the North German Federation[175] in 1866, the region remained a loose association of independent states under the Holy Roman Empire[176]. Each state had a prince or elector. Their territories were adjacent to one another. Communications on the borders allowed the exchange of goods, fashions, and modes. Based on this general observation, it is reasonable to examine whether being geographical neighbors played a role in transmitting the Chinese taste from one princely territory to another. That will testify

[173] *Bundesrepublik Deutschland*

[174] A region between the Eastern and Western parts of the European continent, currently including Austria, Czech Republic, Germany, Hungary, Liechtenstein, Poland, Slovakia, Slovenia, Switzerland.

[175] *Norddeutscher Bund* (1867-1871), was a federation of twenty-two independent states of northern Germany,. It was the first modern German nation state and the basis for the later German Empire (1871–1918), after several southern German states such as Bavaria joined.

[176] *Heiliges Römisches Reich* (962-1806), was a political complex of territories in the Central Europe, which included the Kingdoms of Germany, Bohemia, Burgundy, Italy and numerous small territories.

whether or not the probability of territory adjacency of the royal patrons is related to the probability of adopting the same paradigm.

Although the borders of German states was subject to constant change in the history of the Holy Roman Empire, the situation of the selected sites remained unchanged. Therefore, the adjacency relationship among them stayed relatively stable. To visualized the geographical relation among the sites, the situation of 1789 can be taken as an example, based on which an adjacency matrix among patrons can be constructed (Table 10-7). In the matrix of adjacency relationship, if two patrons had any two territories bordering to each other, they will obtain a value of "1" in the cell crossed by them, otherwise, "0." Since locational adjacency is a type of undirected relationship,[177] the matrix of adjacency is symmetric (Table 10-2).

[177] This means, if A is bordered to B, B must be also bordered to A. This is different from directed relationship, for example, the "love" relation. The fact that A loves B does not necessarily guarantee that B loves A.

Table 10-2 Matrix of Territorial Adjacency

ID	August J	August S	Charles	F v Kassel	Franz	Frederick II	K TT	Louis NS	Ludwig I	Max I	Wilhelm II	Wilhelm IX
August J	0	1	0	1	1	1	0	0	0	0	1	1
August S	1	0	0	1	1	1	0	0	0	0	1	1
Charles	0	0	0	0	0	0	1	0	1	1	0	0
F v Kassel	1	1	0	0	0	0	0	0	0	0	0	2
Franz	1	1	0	0	0	1	0	0	0	0	1	0
Frederick II	1	1	0	0	1	0	0	0	0	0	1	0
K TT	0	0	1	0	0	0	0	0	1	1	0	0
Louis NS	0	0	0	0	0	0	0	0	0	0	0	0
Ludwig I	0	0	1	0	0	0	1	0	0	1	0	0
Max I	0	0	1	0	0	0	1	0	1	0	0	0
Wilhelm II	1	1	0	0	1	1	0	0	0	0	0	0
Wilhelm IX	1	1	0	1	0	0	0	0	0	0	0	0

Table 10-3 Matrix of Paradigm Choice of the Royal Patrons

ID	August J	August S	Charles	F v Kassel	Franz	Frederick II	K TT	Louis NS	Ludwig I	Max I	Wilhelm II	Wilhelm IX
August J	0	0	1	0	0	0	1	1	0	0	0	0
August S	0	0	0	1	1	1	0	0	0	0	1	1
Charles	1	0	0	0	0	0	1	1	0	0	0	0
F v Kassel	0	1	0	1	1	1	0	0	0	0	1	1
Franz	0	1	0	0	0	0	0	0	0	0	0	0
Frederick II	0	1	0	1	1	1	0	0	0	0	1	1
K TT	1	0	1	0	0	0	1	1	0	0	0	0
Louis NS	1	0	1	0	0	0	1	1	0	0	0	0
Ludwig I	0	0	0	0	0	0	0	0	0	0	0	0
Max I	0	0	0	0	0	0	0	0	0	0	0	0
Wilhelm II	0	1	0	1	1	1	0	0	0	0	1	1
Wilhelm IX	0	1	0	1	1	1	0	0	0	0	1	1

We might hypothesize that the matrix of paradigm adoption (Table 10-3) would be positively correlated with the matrix of geographical relations. That is, pairs of patrons whose properties were close to each other are more likely to adopt the same type of paradigm. Correlating the two matrices using Quadratic Assignment Procedure (QAP) returns the following results (Table 10-4):

Table 10-4 QAP Correlation of Geo-Adjacency and Paradigm Choice

		1	2	3	4	5	6	7
		Value	Signif	Avg	SD	P(Large)	P(Small)	NPerm
1	Simple Matching[178]:	0.659	0.07	0.575	0.052	0.07	0.938	2500
2	Jaccard Coefficient:	0.29	0.07	0.181	0.063	0.07	0.949	2500

The Value column (1) indicates the observed value between the two networks is in this case 0.659 for Simple Matching. This means, if there is a 1 in a cell in the matrix of adjacency, there is a 65.9% chance that there will be a 1 in the corresponding cell in the matrix of paradigm choice. This would seem to indicate association. Because of the density of the two matrices, however, matching randomly re-arranged matrices will display an average matching of .575 (shown in the column of standard (SD)), so the observed measure differs hardly at all from a random result. Moreover, the percentage of random correlations that was as large as 0.659 was 0.070 that is 7% (shown in the column of significance (Singnif)). That is, of the 2,500 random permutations just over 175 produced a correlation of 0.659 or higher. At a typical 0.05 level,

178 UCINET provides five alternative measures of association. When both relations(matrices) are binary, simple matching and the Jaccard coefficient are reasonable measures, which is the case in this research. Other measure, the Pearson correlation is a standard measure when both matrices have valued relations measured at the interval level. Gamma would be a reasonable choice if one or both relations were measured on an ordinal scale. The Hamming distance is a measure of dissimilarity or distance between the scores in one matrix and the scores in the other (it is the number of values that differ, element-wise, from one matrix to the other).

this correlation would not be considered significant since $0.07 > 0.05$.The same is also true to Jaccard coefficient.

Hence, we can confidently say that the patrons' choice about paradigms is not significantly associated with the adjacency of their territories. This might be explained by the fact that the German society in this period of time was not a geographically enclosed society; besides neighbors, each state had many alternative information sources through which to learn about the outside world. Some princes even had their own agents in the East Asia. For instance, Frederick the Great established the Emden Company[179] to trade directly with the city of Canton in China. Although as early as 1757 the business was destroyed by the outbreak of the Seven Years' War[180] and the business was occupied by French troops, the small company was very successful, never losing any of its four ships. It brought many Asian goods to the Prussian court. In this situation, the patrons of Sanssouci and New Garden — Frederick the Great and his successors — would have more direct input from their own company than from its neighboring princes.

Personal Interaction

Documentation shows that some patrons had substantial personal relationships, with close friendships and engagement in common hobbies. These personal relationships did not only influence their political decision but also generated a kind of amiability to each other's artistic tastes, including opinions about the appropriate nature of design.

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179 The German name is "*Königlich Preußische Asiatische Compagnie in Emden nach Canton und China*," similar to the East India Company of UK and Holland, but smaller in scale.

180 The Seven Years' War (1754-1763), was a war that involved most of the great powers of the time in Europe, North America, South America, and Africa, resulted in the transfer of colonial possessions between Great Britain, France, and Spain.

Table 10-5   Matrix of Personal Contact by the Royal Patrons

ID	August J	August S	Charles	F v Kassel	Franz	Frederick II	K TT	Louis NS	Ludwig I	Max I	Wilhelm II	Wilhelm IX
August J	0	1	0	0	0	0	0	0	0	0	0	0
August S	1	0	0	0	0	0	0	0	0	0	0	0
Charles	0	0	0	0	0	0	0	0	0	0	0	0
F v Kassel	0	0	0	0	1	0	0	0	0	0	1	1
Franz	0	0	0	1	0	0	0	0	0	0	1	1
Frederick II	0	0	0	0	0	0	0	0	0	0	1	0
K TT	0	0	0	0	0	0	0	0	0	0	0	0
Louis NS	0	0	0	0	0	0	0	0	0	0	0	0
Ludwig I	0	0	0	0	0	0	1	0	0	0	0	0
Max I	0	0	1	0	0	0	0	0	1	0	0	0
Wilhelm II	0	0	0	1	1	1	0	0	0	0	0	1
Wilhelm IX	0	0	0	1	1	0	0	0	0	0	1	0

This kind of interaction might lead to the similarity of choosing paradigms. We can hypothesize that the matrix of paradigm choice would be positively correlated with the matrix of personal acquaintanceship (Table 10-5) — pairs of patrons that were acquainted with each other are more likely to choose the same type of paradigm. Correlating the two matrices using Quadratic Assignment Procedure (QAP) returns the following results (Table 10-6):

Table 10-6 QAP Correlation of Personal Acquaintance and Paradigm Choice

		1	2	3	4	5	6	7
		Value	Signif	Avg	SD	P(Large)	P(Small)	NPerm
2	Simple Matching:	0.735	0.033	0.65	0.039	0.033	0.978	2500
3	Jaccard Coefficient:	0.239	0.033	0.108	0.054	0.033	0.978	2500

The Value column indicates the observed value between the two networks is 0.735 for Simple Matching. This means, if there is a 1 in a cell in the matrix of personal acquaintance, there is a 73.5% chance that there will be a 1 in the corresponding cell in the matrix of paradigm choice. The density of the two matrices matching randomly re-arranged matrices will display an average matching of 0.650. And the percentage of random correlations that were as large as 0.735 was 0.033, which is 3.3%. At a typical 0.05 level, this correlation would be considered significant since 0.033< 0.05. The same is also true to Jaccard coefficient. Hence, we can confidently say that the patrons' choice about paradigms is significantly associated with their personal contact. This might be easy to understand, if we compare it with the phenomenon around us. Friends tend to share the same preferences for design, colors and modes. Some documents show that the royal patrons did consult to determine these preferences. For instance, Dötsch reports, out of the common interest in Gothic architecture, William IX visited the Prince Franz of Anhalt-Dessau and the King Frederick William II of Prussia. (Dötsch 2006, p. 7)

Kinship

Another factor that influenced the social life of the Middle Age was the genealogical connections. It is generally accepted that most of the European noble households were somehow interrelated due to the belief that only royalty can marry royalty. This incestuous marriage strategy was further strengthened by reigning powers to form and maintain political and military alliances. In Germany, all the monarchies are related to each other by marriage, and can all be put into a single family tree. The imitation or competition among siblings and relatives resulted in the spreading the artistic styles in fashion. While the previous section deals with the recorded interactions among noblemen, this section aims to examine the role of natural genealogy. That is, how much did consanguinity influence the behavior of European nobilities? To avoid over-exploring social relations for historical interpretation, this research bases its arguments only on the noblemen that were related to the selected sites.

First, this research proved, despite the unequal distance of their kinship, all the royal sponsors that appeared in this research were blood related. This fact, however, does not permit us to assume that they had active interaction with one another. Some of them were even four generations apart, such as Charles Theodore and Max II. Their consanguinity rate[181] (R) is as low as 0.63%. On the one hand, interaction among those with lower consanguinity rates is not

[181] GeneWeb comes with an efficient relationship and consanguinity calculator.

The relationship calculator calculates the family relationship between two persons who share one or more common ancestors. It displays the lines from the two persons to the common ancestors and the type of relationship: cousin, once-removed, twice-removed, etc.

The consanguinity rate is 25% for siblings, 6.25% for first cousins, etc. It can help to understand inbreeding in families. For example, the consanguinity rate of the parents of Charles II of Spain was 25.26%, because of multiple inbreeding marriages and though they were not siblings.

completely absent. As stated previously in this research, many noblemen contacted each other because of some common hobbies and interests, which could be only afforded by this social class. On the other hand, more actual interactions did appear among royal members who have higher consanguinity rate.

To simplify the complex situation in noble genealogy, the links between agents of patrons are weighted according to their genealogical distance. This distance is measured by the "calculation of relationship" (R), also called the consanguinity rate by Didier Rémy[182] in GeneWeb. The following table shows some important thresholds of normal R values (Table 10-7).

Table 10-7 R Value and Typical Kinship

R Value	Typical Kinship
25%	parent-offspring
25%	full siblings
12.25%	aunt/uncle-nephew/niece
6.25%	first cousins

The table shows the R values (Table 10-8) among the eleven patron agents are clearly higher than normal, being the result of incestuous marriage among noble families. For instance, the R value between Frederick II of Hessen-Cassel (1720-1785) and Wilhelm IX of Hessen-Cassel (1743-1821), who were father and son, is 28.23%. It is higher than normal R value of 25% for parent-offspring relationship, which suggests that Frederick II and his wife may have been to some extent consanguineous.

182 Sewall Wright's coefficient of relationship (r) is different from Rémy's coefficient in that it takes the consideration of inbreeding. Hence, the value of r is simply twice the R value, ranging from 200% to 0.

Table 10-8 R Values among the Royal Patrons

	August J	August S	Charles	F v Kassel	Franz	Frederick II	K TT	Louis NS	Ludwig I	Max I	Max II	Wilhelm II	Wilhelm IX
August J	0	*10,48%*	*1,06%*	*3,06%*	*1,06%*	*3,87%*	*1,67%*	*1,03%*	*2,06%*	*2,31%*	*9,24%*	*3,15%*	*3,09%*
August S	*10,48%*	0	*1.67%*	*5.97%*	*1.66%*	*6.00%*	*2.67%*	*1.83%*	*2.87%*	3.01%	*1.63%*	*5.01%*	*5.44%*
Charles	*1,06%*	*1.67%*	0	*1.65%*	*0.94%*	*1.45%*	*1.27%*	*0.78%*	*2.73%*	*4.33%*	*0.63%*	*0.63%*	*1.39%*
F v Kassel	*3,06%*	*5.97%*	*1.65%*	0	*1.75%*	*4.81%*	*2.13%*	*1.37%*	*2.23%*	*2.33%*	*1.53%*	*4.09%*	*28,23%*
Franz	*1,06%*	*1.66%*	0.94%	*1.75%*	0	*1.77%*	*1.20%*	*0.93%*	*1.36%*	*1.31%*	*0.44%*	*1,76%*	*1,73%*
Frederick II	*3,87%*	*6.00%*	*1.45%*	*4.81%*	*1.77%*	0	*1.79%*	*1.28%*	*2.07%*	*2.21%*	*0.92%*	*17,13%*	*7,83%*
K TT	*1,67%*	*2.67%*	*1.27%*	*2.13%*	*1.20%*	*1.79%*	0	*1,27%*	*5,18%*	*1,94%*	*0,67%*	*2,15%*	*2,41%*
Louis NS	*1,03%*	*1.83%*	*0.78%*	*1.37%*	*0.93%*	*1.28%*	*1,27%*	0	*1,31%*	*1,39%*	*0,42%*	*1,38%*	*1,43%*
Ludwig I	*2,06%*	*2.87%*	*2.73%*	*2.23%*	*1.36%*	*2.07%*	*5,18%*	*1,31%*	0	*26,57%*	*0,99%*	*2,31%*	*2,56%*
Max I	*2,31%*	3.01%	*4.33%*	*2.33%*	*1.31%*	*2.21%*	*1,94%*	*1,39%*	*26,57%*	0	*1,25%*	*2,42%*	*2,18%*
Max II	*9,24%*	*1.63%*	*0.63%*	*1.53%*	*0.44%*	*0.92%*	*0,67%*	*0,42%*	*0,99%*	*1,25%*	0	*0,96%*	*1,13%*
Wilhelm II	*3,15%*	*5.01%*	*0.63%*	*4.09%*	*1,76%*	*17,13%*	*2,15%*	*1,38%*	*2,31%*	*2,42%*	*0,96%*	0	*5,47%*
Wilhelm IX	*3,09%*	*5.44%*	*1.39%*	*28,23%*	*1,73%*	*7,83%*	*2,41%*	*1,43%*	*2,56%*	*2,18%*	*1,13%*	*5,47%*	0

Table 10-9 Matrix of Kinship among Royal Patrons

ID	August J	August S	Charles	F v Kassel	Franz	Frederick II	K TT	Louis NS	Ludwig I	Max I	Wilhelm II	Wilhelm IX
August J	0	1	0	0	0	0	0	0	0	0	0	0
August S	1	0	0	1	0	1	0	0	0	0	1	0
Charles	0	0	0	0	0	0	0	0	0	1	0	0
F v Kassel	0	1	0	0	0	1	0	0	0	0	1	1
Franz	0	0	0	0	0	0	0	0	0	0	0	0
Frederick II	0	1	0	1	0	0	0	0	0	0	1	1
K TT	0	0	0	0	0	0	0	0	1	0	0	0
Louis NS	0	0	0	0	0	0	0	0	0	0	0	0
Ludwig I	0	0	0	0	0	0	1	0	0	0	0	0
Max I	0	0	1	0	0	0	0	0	1	0	0	0
Wilhelm II	0	1	0	1	0	1	0	0	0	0	0	1
Wilhelm IX	0	0	0	1	0	1	0	0	0	0	1	0

Table 10-10 Matrix of Kinship among Royal Patrons with Time Dimension

ID	August J	August S	Charles	F v Kassel	Franz	Frederick II	K TT	Louis NS	Ludwig I	Max I	Wilhelm II	Wilhelm IX
August J	0	0	0	0	0	0	0	0	0	0	0	0
August S	1	0	0	1	0	1	0	0	0	0	1	0
Charles	0	0	0	0	0	0	0	0	0	1	0	0
F v Kassel	0	0	0	0	0	1	0	0	0	0	1	1
Franz	0	0	0	0	0	0	0	0	0	0	0	0
Frederick II	0	0	0	1	0	0	0	0	0	0	1	1
K TT	0	0	0	0	0	0	0	0	1	0	0	0
Louis NS	0	0	0	0	0	0	0	0	0	0	0	0
Ludwig I	0	0	0	0	0	0	1	0	0	0	0	0
Max I	0	0	1	0	0	0	0	0	1	0	0	0
Wilhelm II	0	0	0	1	0	1	0	0	0	0	0	1
Wilhelm IX	0	0	0	1	0	1	0	0	0	0	1	0

Based on the value of R, the matrix of kinship (Table 10-9) is dichotomized: if R>=0.04, the cell obtains the value of "1;" otherwise, "0." This dichotomization is based on the observation, when R is around 0.04, that the two persons had higher possibility of having substantial personal contact. R can also be regarded as an index of potential personal contact. Statistics also corroborate this observation if we examine the correlation between the matrix of documented personal contact and the matrix of dichotomized genealogical relations.

Meanwhile, as this research deals with the diffusion of ideas among the actors, the kinship, as the major relation in question, should be regarded with time dimension. That is to treat kinship as directed relationship due to the fact that some actors, though genealogically related, lived in different periods of time. It was impossible for the forefathers to learn the ideas from their offspring as they already passed away when the offspring was born. Thus, the Table 10-9 needs to be adjusted with this consideration. As shown in Table 10-10, the actors without overlapping time of lives are not assigned with "1", even though they have high R values.

Table 10-11 Correlation between Personal Contact and Kinship

		1	2	3	4	5	6	7
		Value	Signif	Avg	SD	P(Large)	P(Small)	NPerm
2	Simple Matching:	0.879	0.002	0.742	0.032	0.002	0.998	2500
3	Jaccard Coefficient:	0.429	0.002	0.084	0.059	0.002	0.998	2500

The result (Table 10-11) shows with a high confidence of 99.8% (=1- P(Small)) that we can accept the hypothesis of the possibility of personal contact is correlated with the genealogical relationship between two patrons. In other words, if two patrons were genealogically close to each other, the chance that they had other substantial personal relationships, such as friends or political alliance, was very high. This may be not difficult to understand in modern society, where the family size is relatively small and it seems to be easy for relatives to meet frequently. However, in the Medieval times, to inherit crowns and property, the children raised in one royal household might be dispersed or married far away from each other. Due to the old methods of communication, it was often difficult to remain in close contact.

Since we have shown the high correlation between personal acquaintance and genealogy, it is not surprising to see the choice of paradigm also has a high correlation with kinship, even higher than personal contact (Table 10-12). Kinship turns out to be a better indicator of paradigm choice, for, if we correlate the matrix of kinship with that of paradigm choice, kinship turns out to be a much more significant variable than personal contact. This is probably because the genealogical matrix fills in the information that are missing in historical documents, thereby improving the correlation significance.

Table 10-12 Correlation of Kinship with Paradigm Choice by the Royal Patrons

		1	2	3	4	5	6	7
		Value	Signif	Avg	SD	P(Large)	P(Small)	NPerm
2	Simple Matching:	0.780	0.006	0.644	0.040	0.006	0.997	2500
3	Jaccard Coefficient:	0.341	0.006	0.116	0.055	0.006	0.997	2500

Regression of the Three Factors

Rather than correlating one relation with another, we may wish to examine how all the three relations influence the choice of paradigms. That is, rather than symmetric association between the relations, we may wish to examine asymmetric association. The standard tool for this question is linear regression, and the approach allows us to use more than one independent variable. From the correlation analysis above, we might hypothesize that closeness to each other in terms of location, personal relation and kinship would increase the likelihood of choosing the same type of paradigms.

First, we can treat the matrix of paradigm choice as dependent matrix, while the matrices of geo-adjacency, personal interaction and kinship are independent networks. Then, we can perform a standard multiple regression analysis by regressing each element in the paradigm network on its corresponding elements in the networks of adjacency, recorded personal interaction, and genealogical distance. To estimate standard errors for R-squared and for the regression coefficients, we can use quadratic assignment. We will run many trials with the rows and columns in the dependent matrix randomly shuffled, and recover the R-square and regression coefficients from these runs. These are then used to assemble empirical sampling distributions to estimate standard errors under the hypothesis of no association.

UCINET offers four alternative methods for Tools>Testing Hypotheses>Dyadic (QAP)>LP - QAP Regression. Table 10-13 shows the results of the "full partialing" method.

Table 10-13 Model Fit of the Regression of the Three Factors[183]

R-square	Adj R-Sqr	Probability	# of Obs
0.181	0.169	0.003	132

Table 10-14 Regression Coefficients of the Three Factors

Independent	Un-stdized Coefficient	Stdized Coefficient	Significance	Proportion As Large	Proportion As Small
Intercept	0.176612	0			
GEO ADJACENT	0.101473	0.108595	0.165	0.165	0.836
KINSHIP	0.433018	0.349801	0.009	0.009	0.991
PERSONAL CONTACT	0.064762	0.050209	0.303	0.303	0.697

The descriptive statistics and measure of goodness of fit are standard multiple regression results (Table 10-14). The model R-square (.018) indicates that knowing the closeness of geographic location, personal relations and kinship are institutionally similar reduces uncertainty in predicting the same choice of paradigm by about 19%, which is relatively high in social research. The significance level (by the QAP method) is .004. Usually, we would conclude that we cannot be sure the observed result is random.

Since the dependent matrix in this example is binary, the regression equation is interpretable as a linear probability model. The intercept indicates that, if two patrons do not have bordered territories, they do not know each other personally, and they are

[183] Number of permutations performed: 2000

not genealogically close to each other, the probability that they chose the same type of paradigm is 0.177. If two patrons have bordered territories, this increases the probability of common choice by .101. If the two patrons have a close genealogical relationship, the probability of common choice is increased by 0.433. If the two patrons know each other personally, the probability of common choice is increased by .065. In sum, the kinship among patrons greatly increases the possibility of choosing the same paradigm.

Moreover, using the QAP method, only the kinship effect is different from zero at conventional (e.g. $p < .05$) levels. This suggests although locational and personal links are to some extent contributive to paradigm choice, they could appear quite frequently simply by random permutation of the cases. In contrast, the kinship relation appears to be significantly characteristic to the observed cases, which can be recognized as a special pattern. The results are interesting, because in pairwise correlation analysis, kinship and personal contact seem to be equally influential to the choice of paradigm, but when put together, the influence of kinship turns out to be much more influential than personal contact. As a matter of fact, even geographical location turns out to be more predictive to paradigm choice than personal contact.

CONCLUSION OF PART TWO

During the three periods of intensive interactions between Europe and China—the Sino-Roman relations, Pax Mongolica, and the Age of Discovery— abundant information about Chinese architecture was brought back to Europe. The processing of the information was modulated by the European conceptualization about what cities and architecture should be. This is reflected in graphic representation in medieval documents such as the manuscripts of Marco Polo and the publications of William Chambers. In the last period of interaction, as the accounts and images about Chinese architecture became extensive and accurate, Europe developed an interest to create its own "Chinese" buildings, which corresponded to the fashion that had already grown in other forms of arts—Chinoiserie. Chinoiserie architecture is different from authentic Chinese architecture. The deviation of European knowledge about the true Chinese architecture, however, should not be taken as the only reason for this difference. It was the social-economic context that provided the artists in the sixteenth century a possibility to appropriate only part of the exotic features from China. The artistic needs in this social-economic context did not require authenticity and precise imitation of the original cultures, but only an impression to form a feeling of exoticism and otherness. Meanwhile, it also appealed to elements that were familiar and recognizable to the European eyes. This allowed as well as forced the European artists to create new "Chinese" elements to please the contemporary artistic consumption. Hence, Chinoiserie is in nature "European," even though its association with the Chinese arts cannot be denied.

The development of Chinoiserie in architecture was different from that in other forms of arts, probably due to two reasons. First, architecture needs more material resources to be realized. It took more time to be built. Second, because it could not be imported as goods such as porcelain, silk, and lacquer, few Europeans have seen Chinese architecture with their own eyes. The information firstly provided to European architects was difficult to form a full understanding. Nevertheless, Chinoiserie managed to accompany three periods of major architectural styles in Europe: Baroque, Rococo, and Neoclassicism. In each period, Chinoiserie found a new way to weave itself into the needs of the major style and generated a number of new design elements. Unlike previous studies, which divide architectural Chinoiserie into three periods, the quantitative analysis on thirty-seven Chinoiserie buildings in Germany shows there were two types of design paradigms. The first paradigm was mainly used in the periods of Baroque and Rococo and allowed a great freedom to select, combine, and invent design features. Borrowing from others' ideas could be often seen, but there were no obligatory principles to follow. In contrast, in the second paradigm the creativity was reduced. A number of design elements were patternized and became obligatory to build a Chinese appearance. The two paradigms, however, did not follow each other in time sequence. As seen in Chapter Three, very early buildings "born" in the Baroque time, e.g., the Chinese Hall in Mulang, can also belong to the second paradigm which consists of design elements predominantly in the Neoclassical time. This is because the combination of design elements on these buildings coincidently matches that in the later time, although the origin of this similar treatment might be very different. In comparison to previous research that comply the stylistic development of Chinoiserie to Baroque, Rococo, and Neoclassicism chronologically, the advantage of the quantitative method in this research is to differentiate design patterns only based on the elements that have been used. It allows early buildings to be grouped with late buildings together, if they share the same way of using design elements, therefore, more subjective to the nature of design.

To investigate the socio-economic context that nourished architectural Chinoiserie, this research focuses on a special social group — the nobility. By correlating three factors— geographical adjacency, personal contact, and kinship— with the choice of paradigms by the royal patrons, it confirms the observation of previous scholar that kinship has played an important role in the diffusion of Chinoiserie in architecture. It also precisely differentiates this social factor with two other factors that were also proposed by previous scholars. It shows, although locational and personal contacts are to some extent contributive to paradigm choice, they are not unique to the development of Chinoiserie. In contrast, kinship appears to be significantly characteristic to the selected buildings. The results also show, although personal interaction is related to kinship, the influence of kinship to paradigm choice turns out to be much more influential than personal contact.

OVERALL CONCLUSION

It is not only the historical interpretation that makes this research meaningful, but also its methods of collecting evidence and dealing with historical records. By analyzing information extracted from historical records with quantitative methods of archaeology and sociology, it shows a new way for historical discourse and expands the dimension of data that a historian can process. However, promoting quantification in history is not necessarily equal to acceptance without reservations. It is sometimes exactly where the limitations of arguments stay.

As the case in this research, the conclusion is confined only to the buildings that were included. In the micro-approach, the information provided by dendrochonological dating cannot generate any historical meaning without sufficient historical records. Although the location of many crucial documents is known, they are unfortunately not accessible to scholars, because they are in private possession and the owners are not willing to contribute to the research of the Chinese Tower in Donaustauf. The advantage of dendrochronology as an independent method of dating is in this case greatly reduced. It can only indicate a time span where the Tower was possibly built but it is not able to determine the year of construction. Moreover, the inner structure of the Tower is not accessible due to the plaster work, leaving many construction details unexamined. In the macro-approach, it is not impossible that other unselected buildings exhibit a different pattern of development and do not support the arguments of this work. Moreover, this research testifies only three factors that are frequently mentioned by previous scholars to be influential to the diffusion of the Chinese fashion. It does not take account of other factors such as political alliance and credit relations, which are conceivably correlated to the use of design elements. While demonstrating the important role of the nobility, this research inevitably elicits the question, "how being relatives can lead to the similarity of artistic taste?" That is to ask the mechanism of the influence of the kinship on the cultivation of taste. Although this research made some efforts to answer this question by looking at a few examples, it can be imagined a separate study can be dedicated to this topic independently. Similarly, this research can also be extended to other social groups that took part in the construction of Chinoiserie buildings. Architects, for instance, as a special group of experts, educated in the same craftsmen families and professional schools, shared some sort of social networks as well. This can also be the topic of an independent research.

These reservations do not serve to discredit the quality of this research but to mark its limits, and to re-state the strength of conventional historical methods to deal with the incompleteness of historical records. It is the integration of the two that makes the conclusions of this research contributory to the field of architectural history.

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APPENDIX: FIGURES

CHAPTER 4

Fig. 4-1 The Chinese Tower in Donaustauf

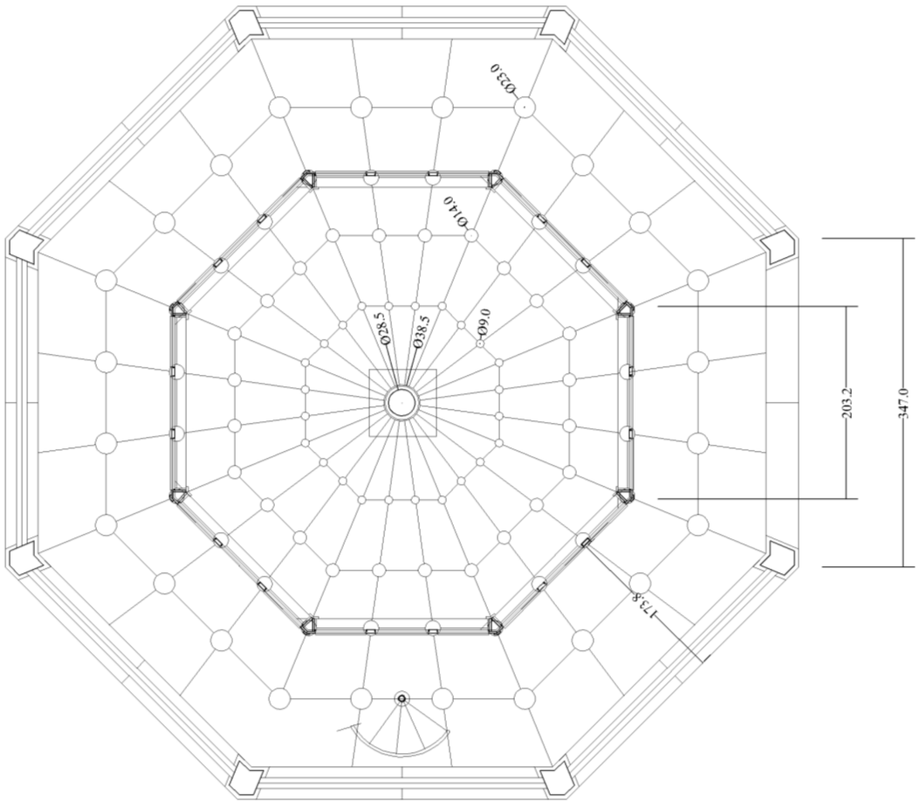

Fig. 4-2　Plan of the First Story

Fig. 4-3　Columns on the First Floor

Fig. 4-4 Rusted Metal Spare Part

Fig. 4-5 Round Column on the First Floor

Fig. 4-6   Beams and Columns on the First Floor

Fig. 4-7   Windows and Doors on the First Floor

Fig. 4-8　Floor on the First Floor

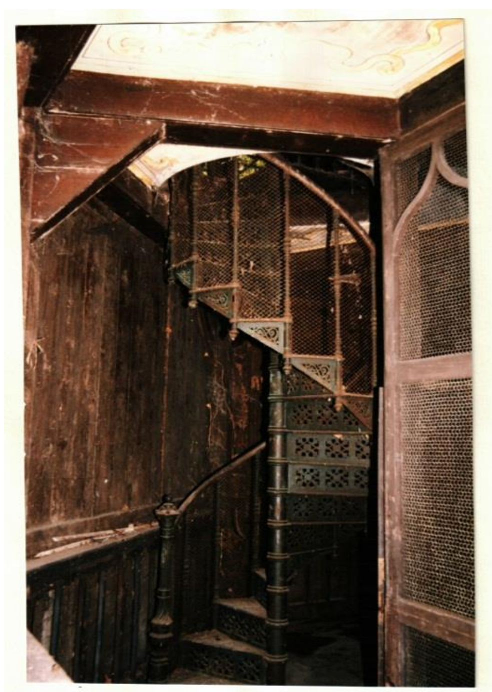

Fig. 4-9　Spiral Stair

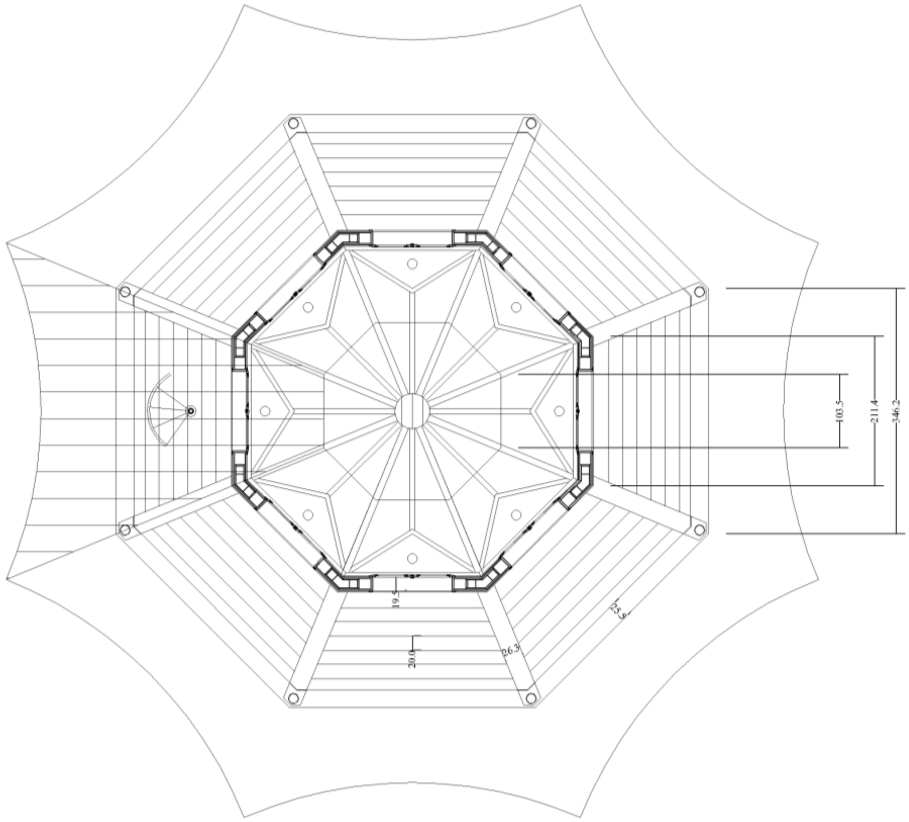

Fig. 4-10　Plan of the Second Floor

Fig. 4-11　Painting under the Roof

Fig. 4-12 The Chinese Tower Used as Aviary

Fig. 4-13 Wooden Curtain of the Chinese Tower

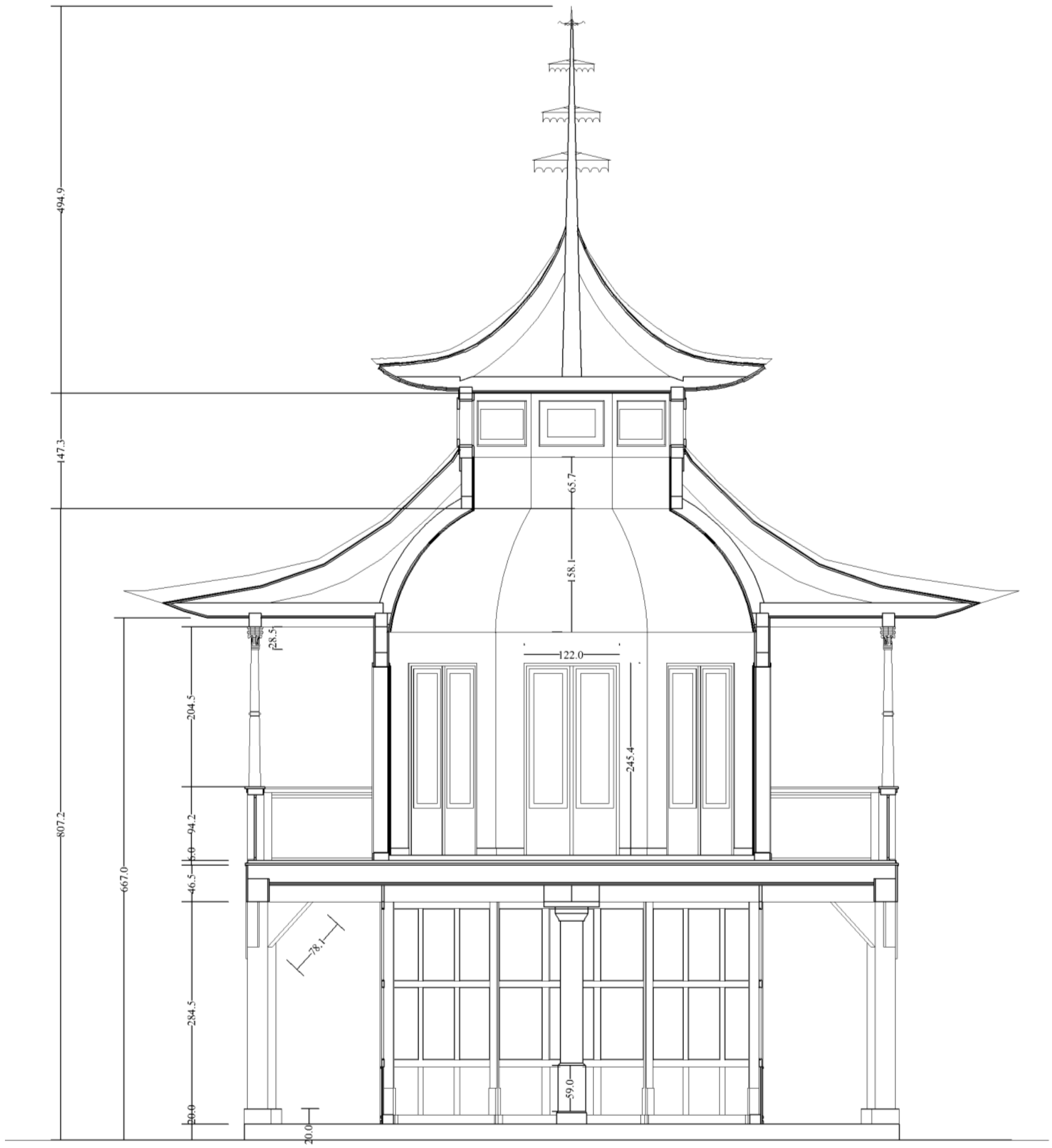

Fig. 4-14 Section of the Chinese Tower

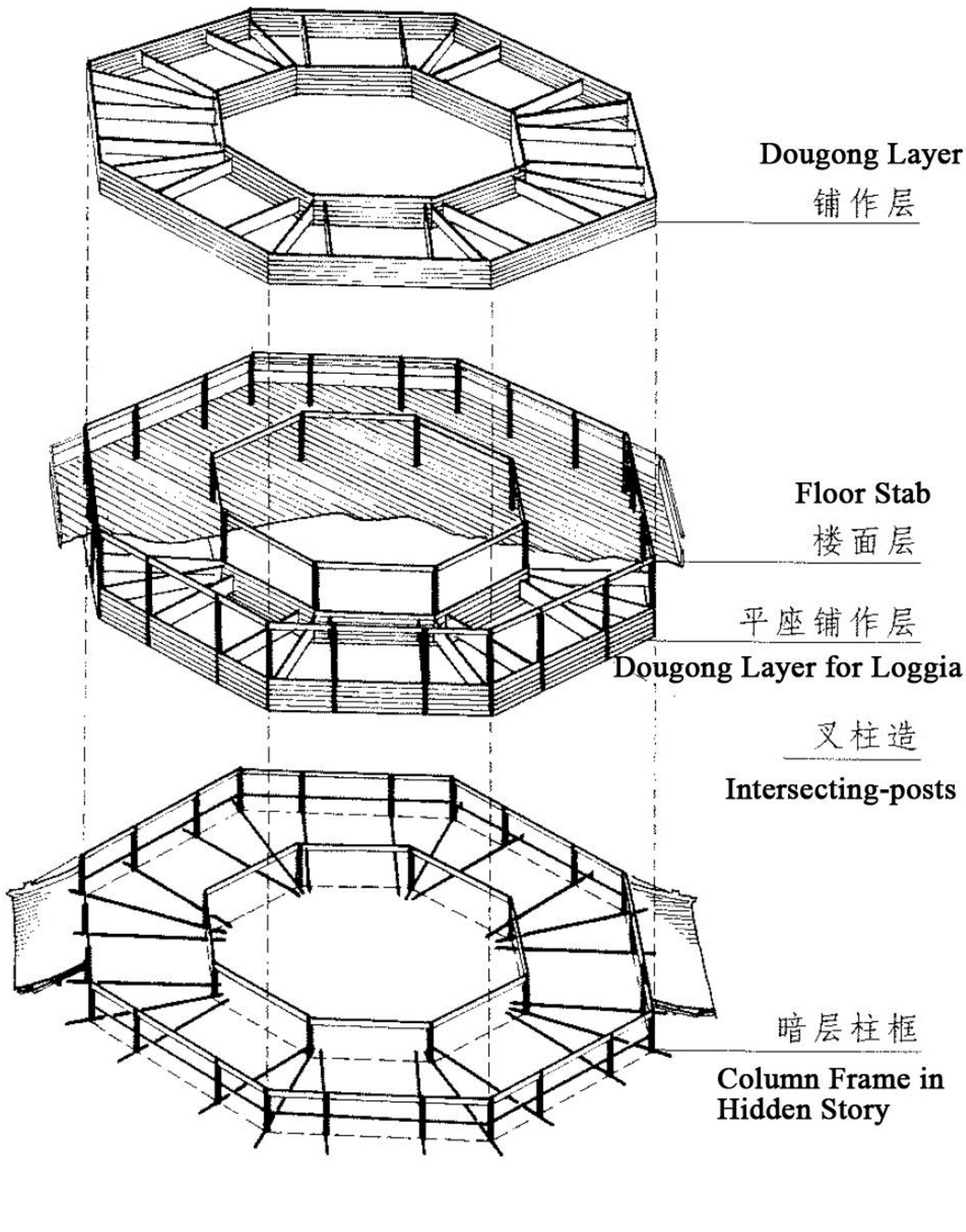

Fig. 4-15 The Wooden Pagoda in County Ying

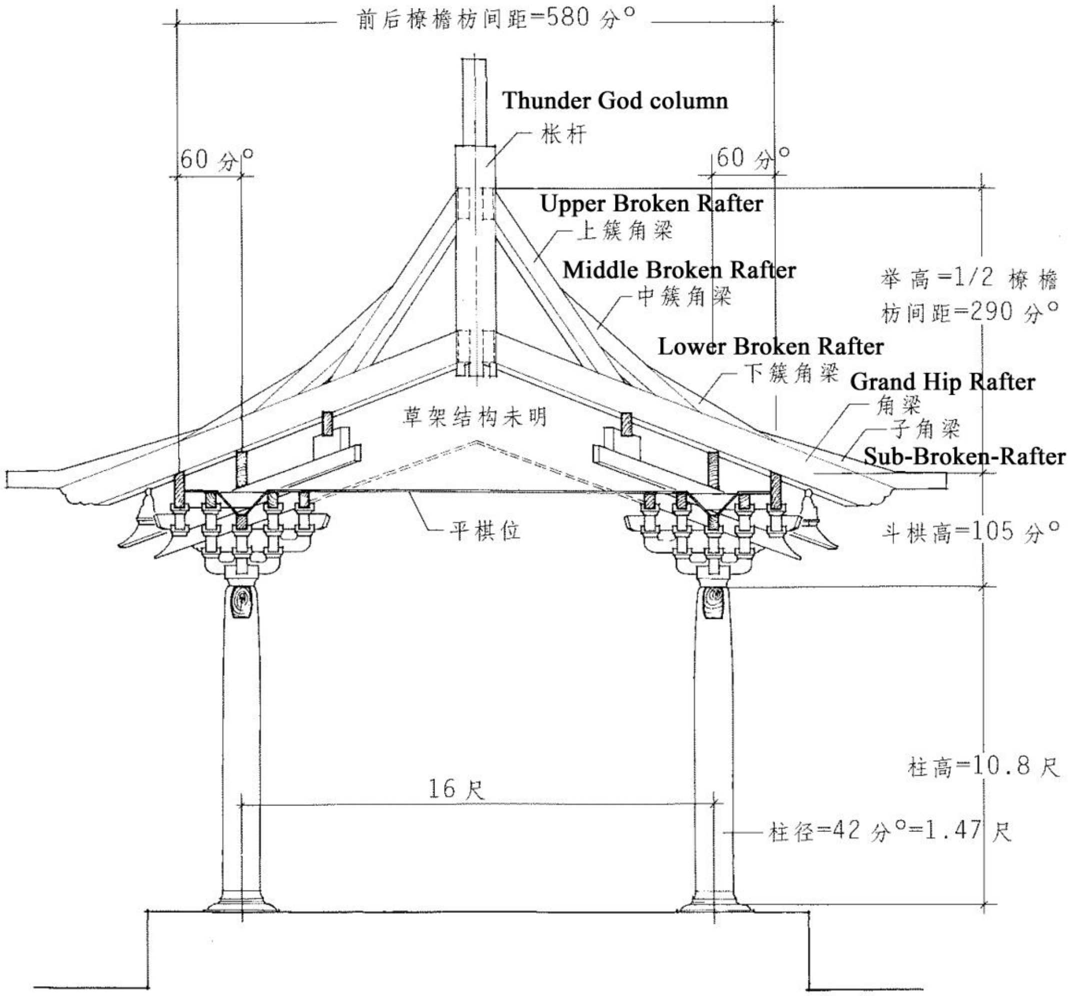

Fig. 4-16　Pyramidal Roof in Qing System

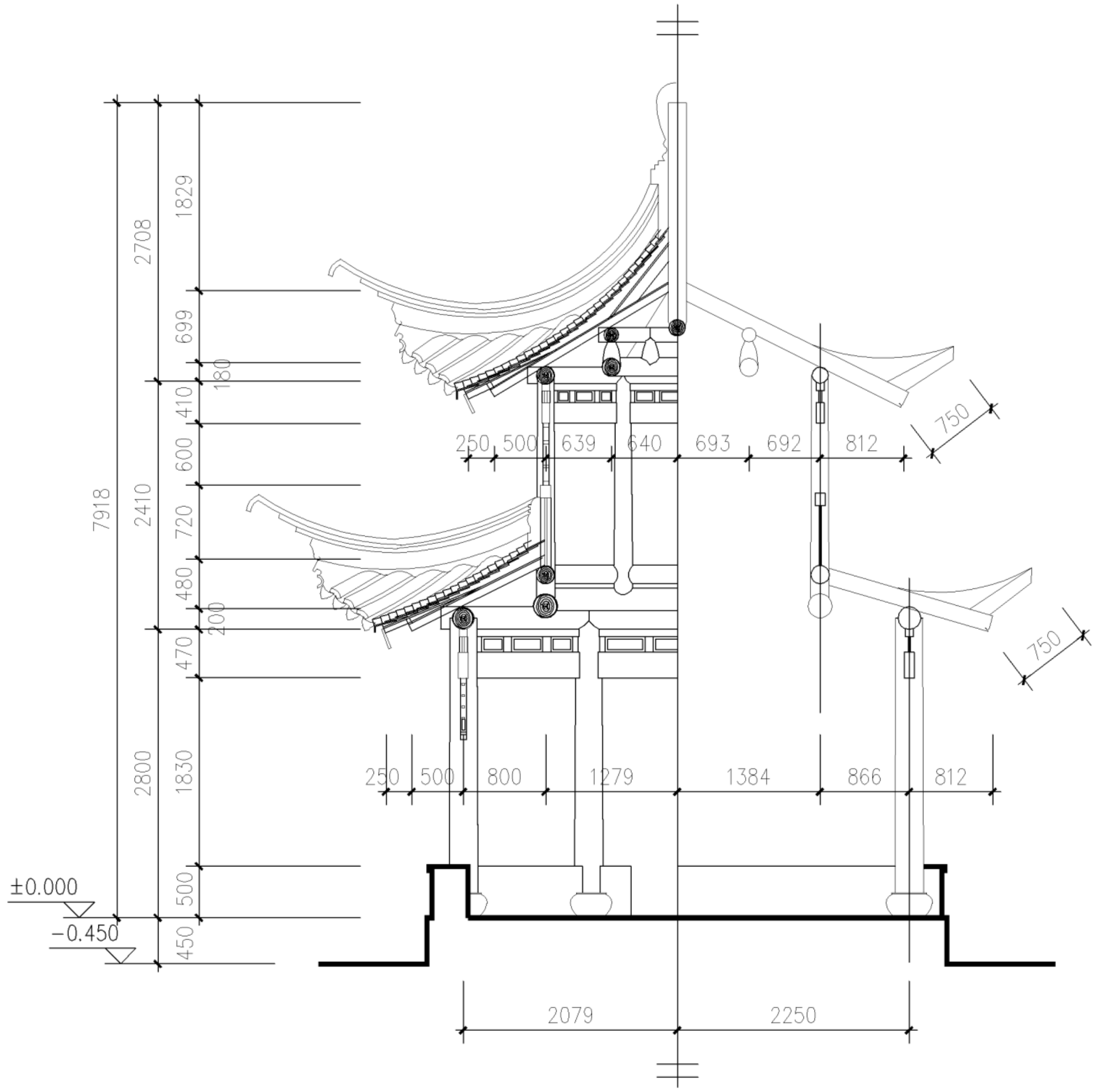

Fig. 4-17 Post and Lintel Construction

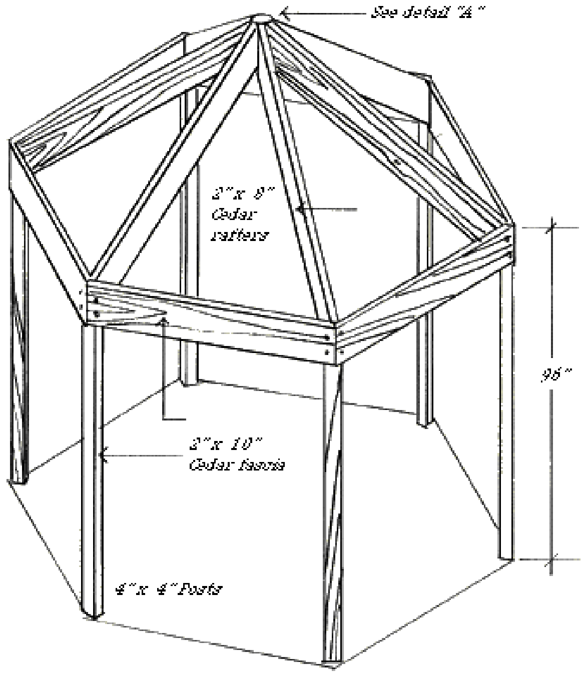

Fig. 4-18   Gazebo Structure

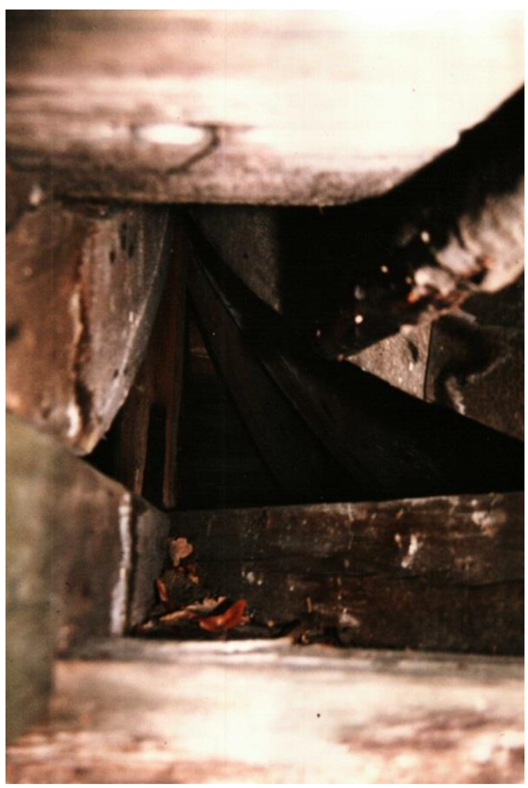

Fig. 4-19   Rafters under the Roof

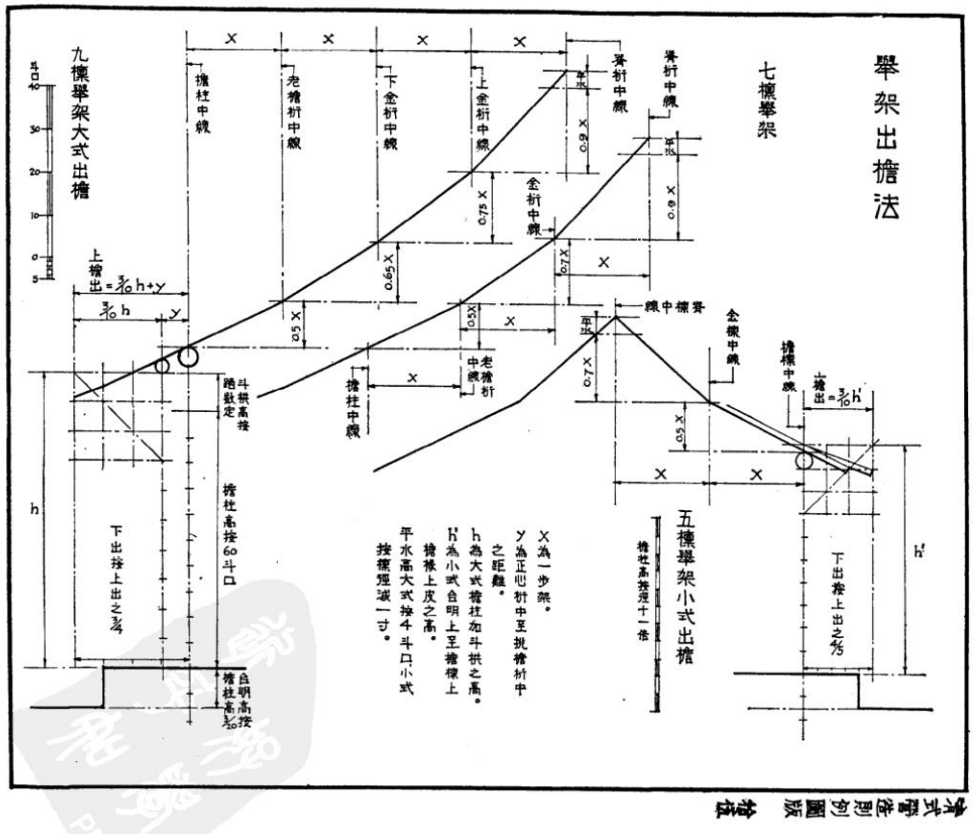

Fig. 4-20 The Brocken Hip Rafters

Fig. 4-21 Dougong Effect

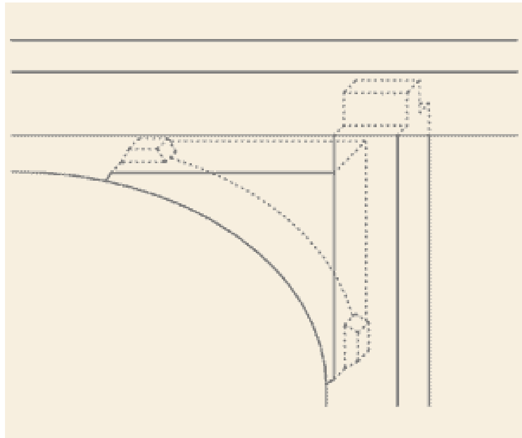

Fig. 4-22 Kopfband

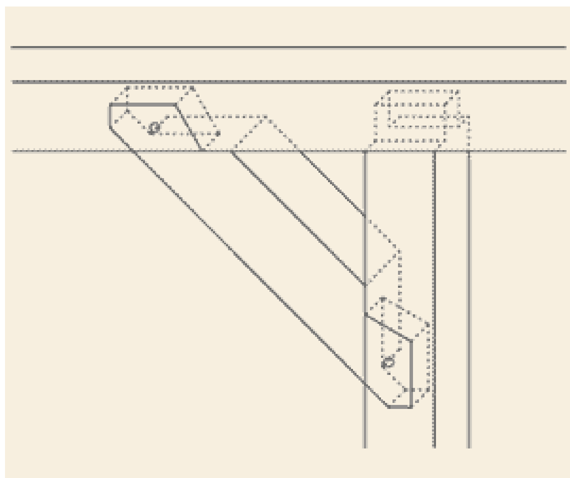

Fig. 4-23 Knagge

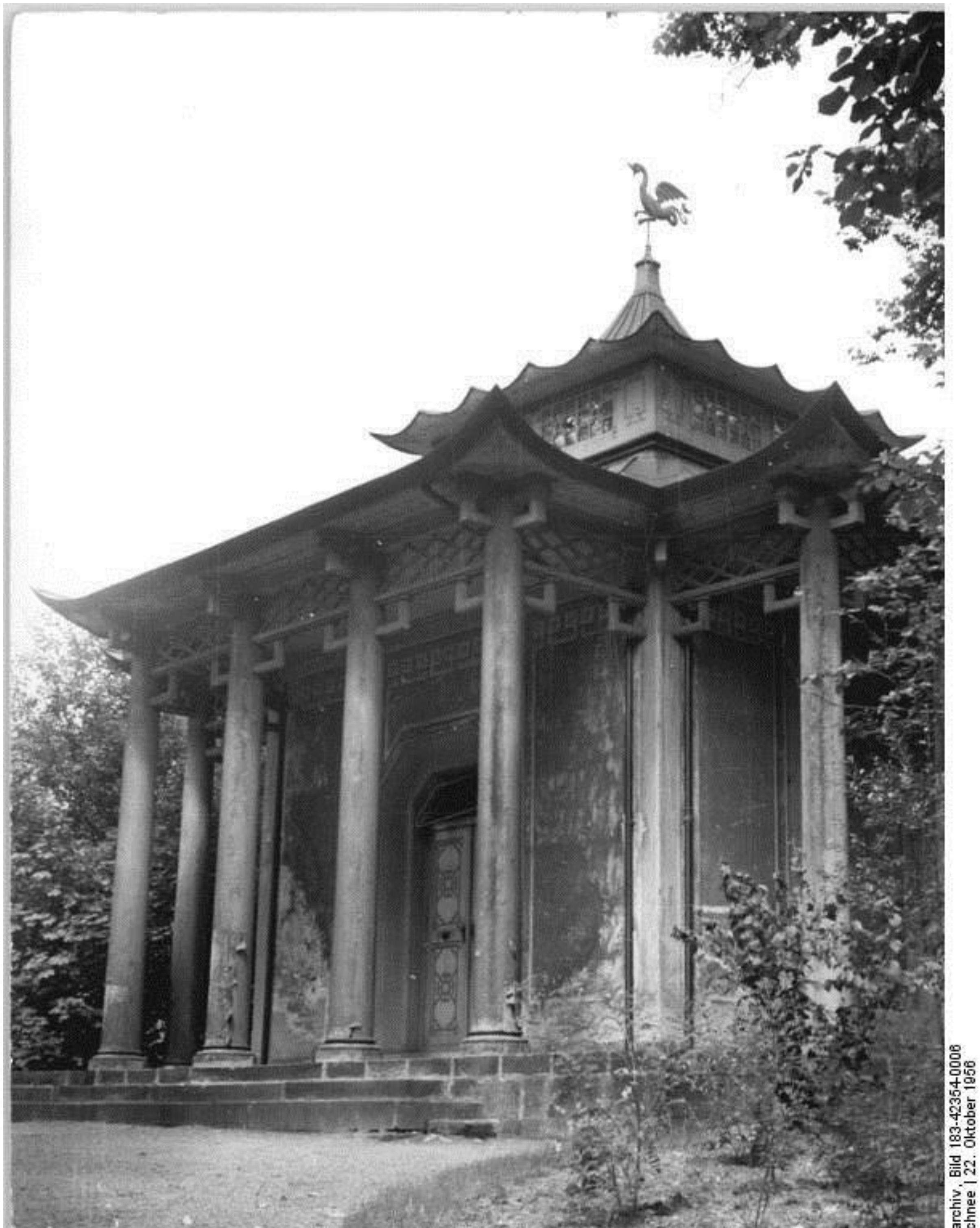

Fig. 4-24 The Chinese Pavilion in Pillnitz

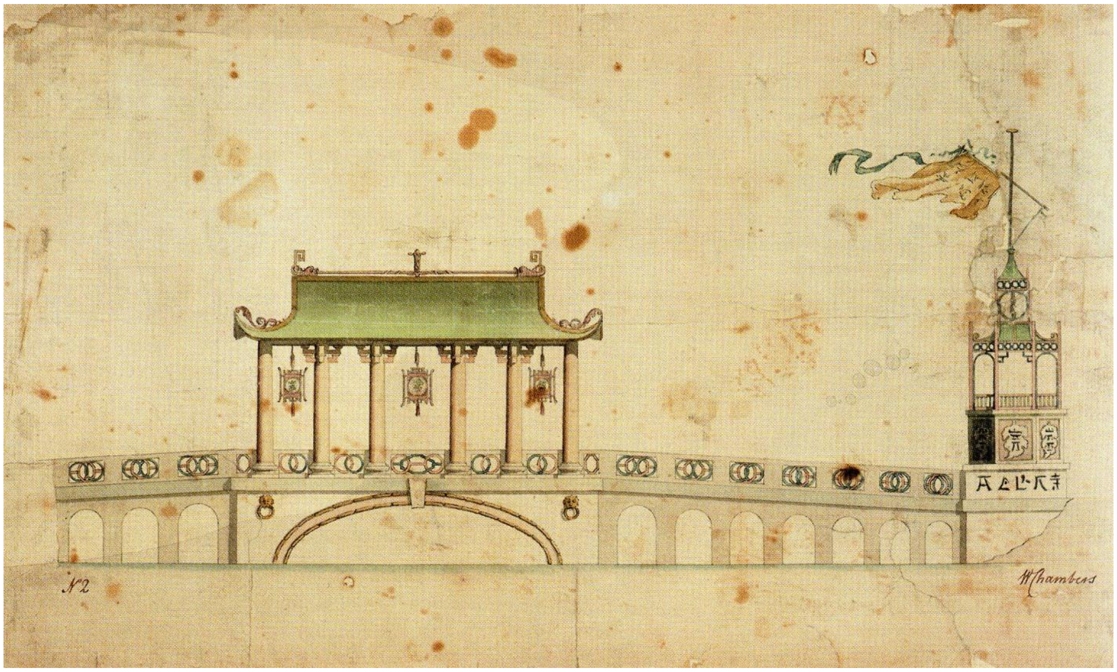

Fig. 4-25 The Chinese Bridge by Williams Chambers for Sanssouci[184]

Fig. 4-26 La Maison Chinoise in the Désert de Retz

[184] Plan Collection (Plansammlung) Nr. 2365, all right at Prussian Palaces and Gardens Foundation Berlin-Brandenburg (Stiftung Preußische Schlösser und Gärten , SPSG)

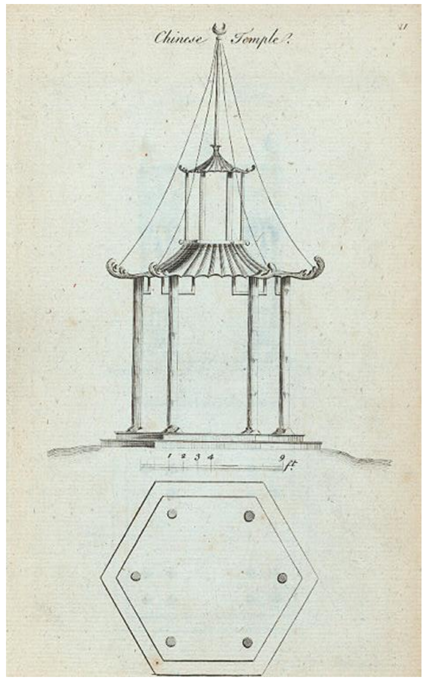

Fig. 4-27 Chinese Temple by Charles Over

Fig. 4-28 The Chinese Tower in Munich

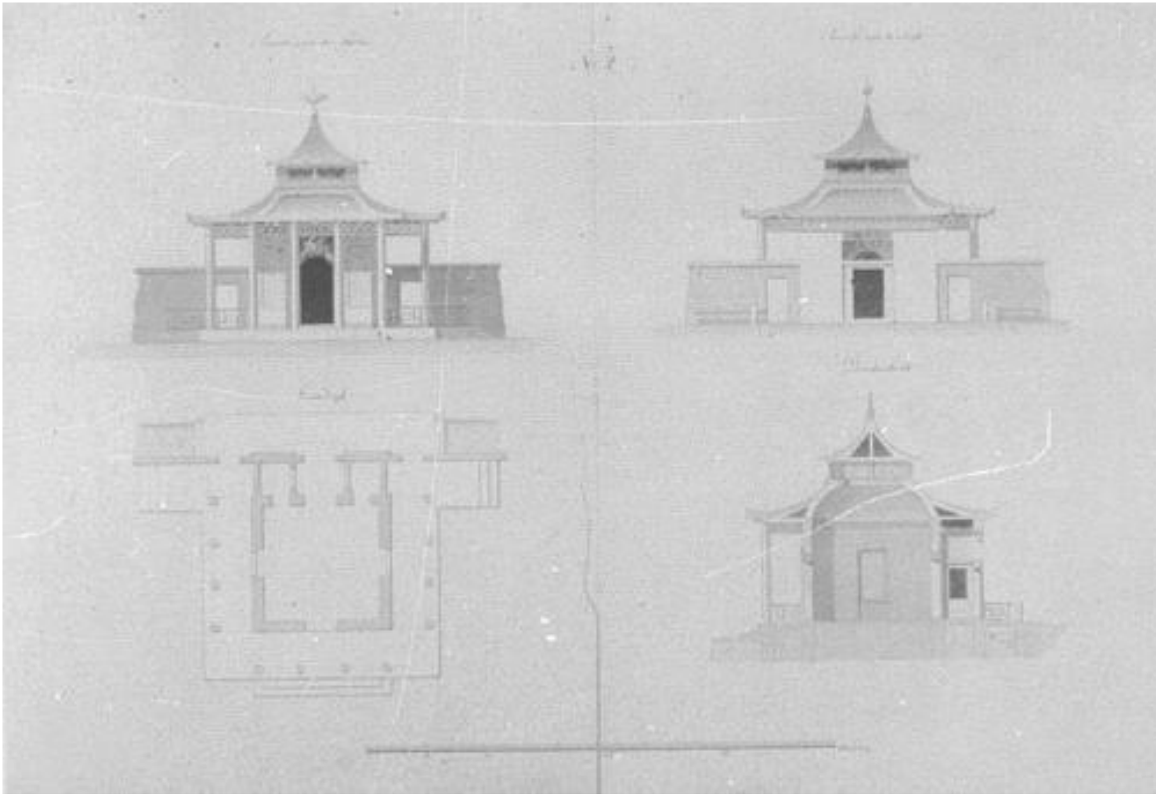

Fig. 4-29　Chinese Pavilion by Christian Schuricht

Fig. 4-30　The Dome in the Chinese Pagoda in Mulang

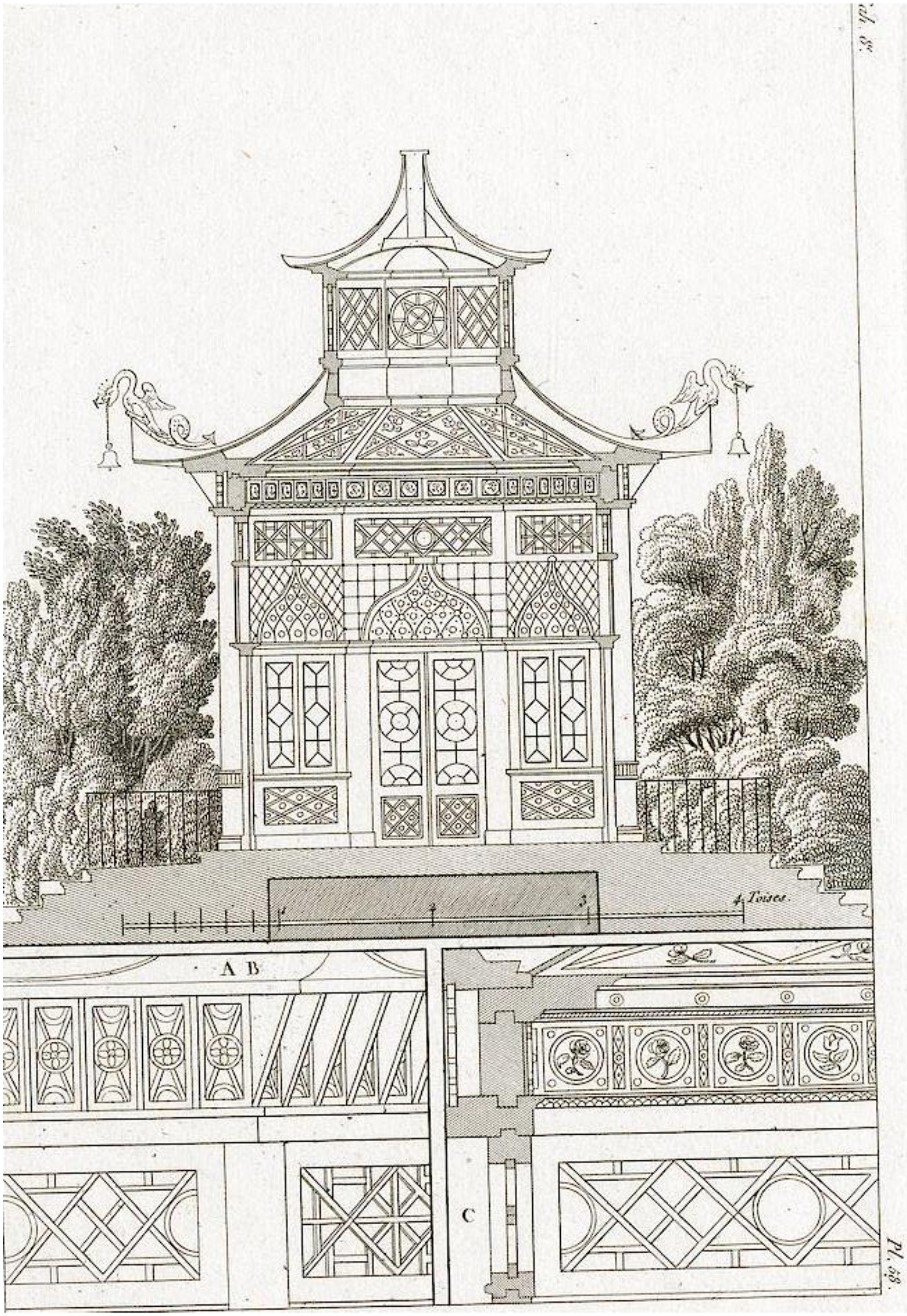

Fig. 4-31   A Chinese Pavilion by Jean-Charles Krafft

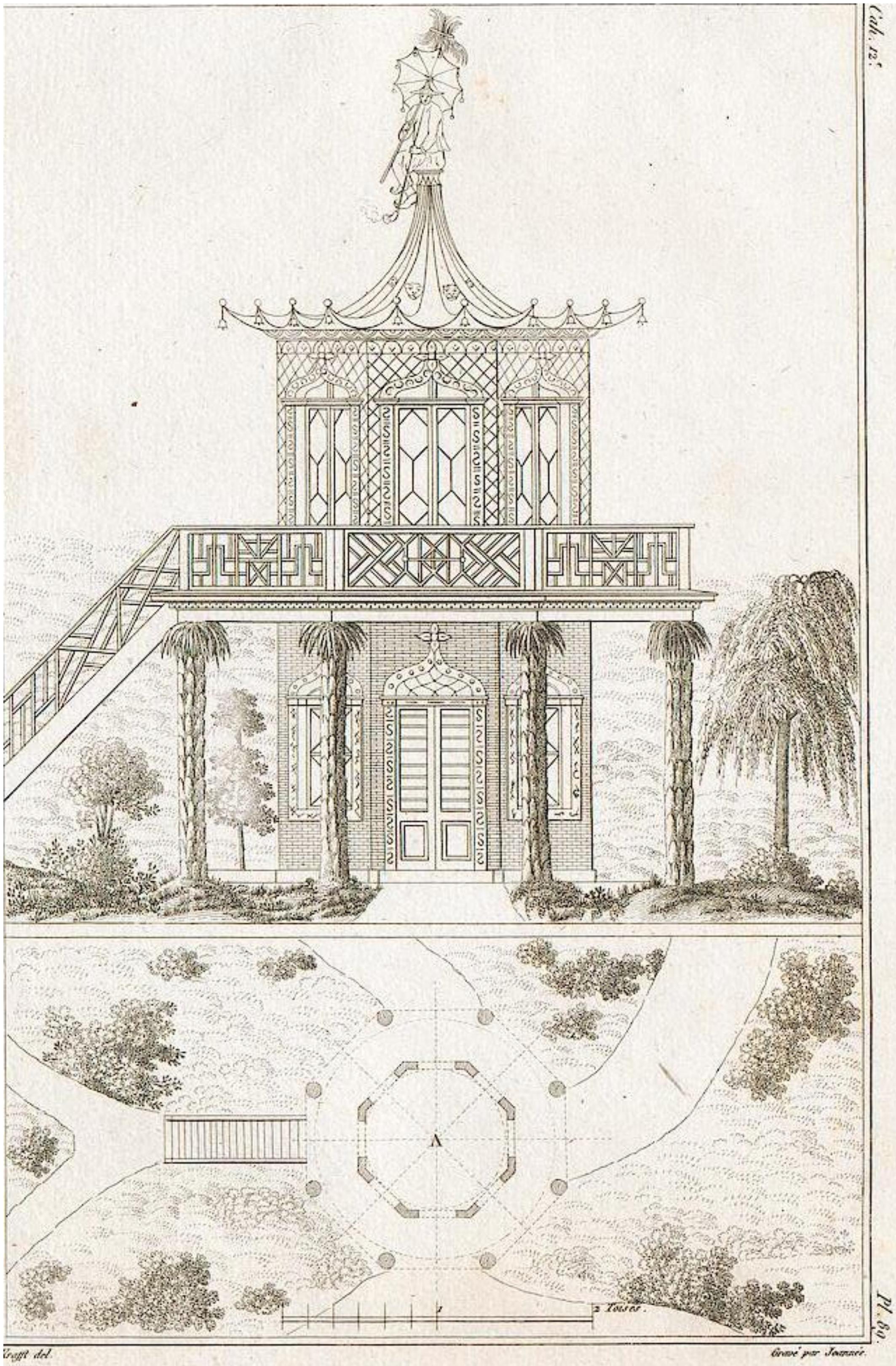

Fig. 4-32 A Chinese Pavilion by Jean-Charles Krafft

Fig. 4-33 The Chinese Tower in Munich

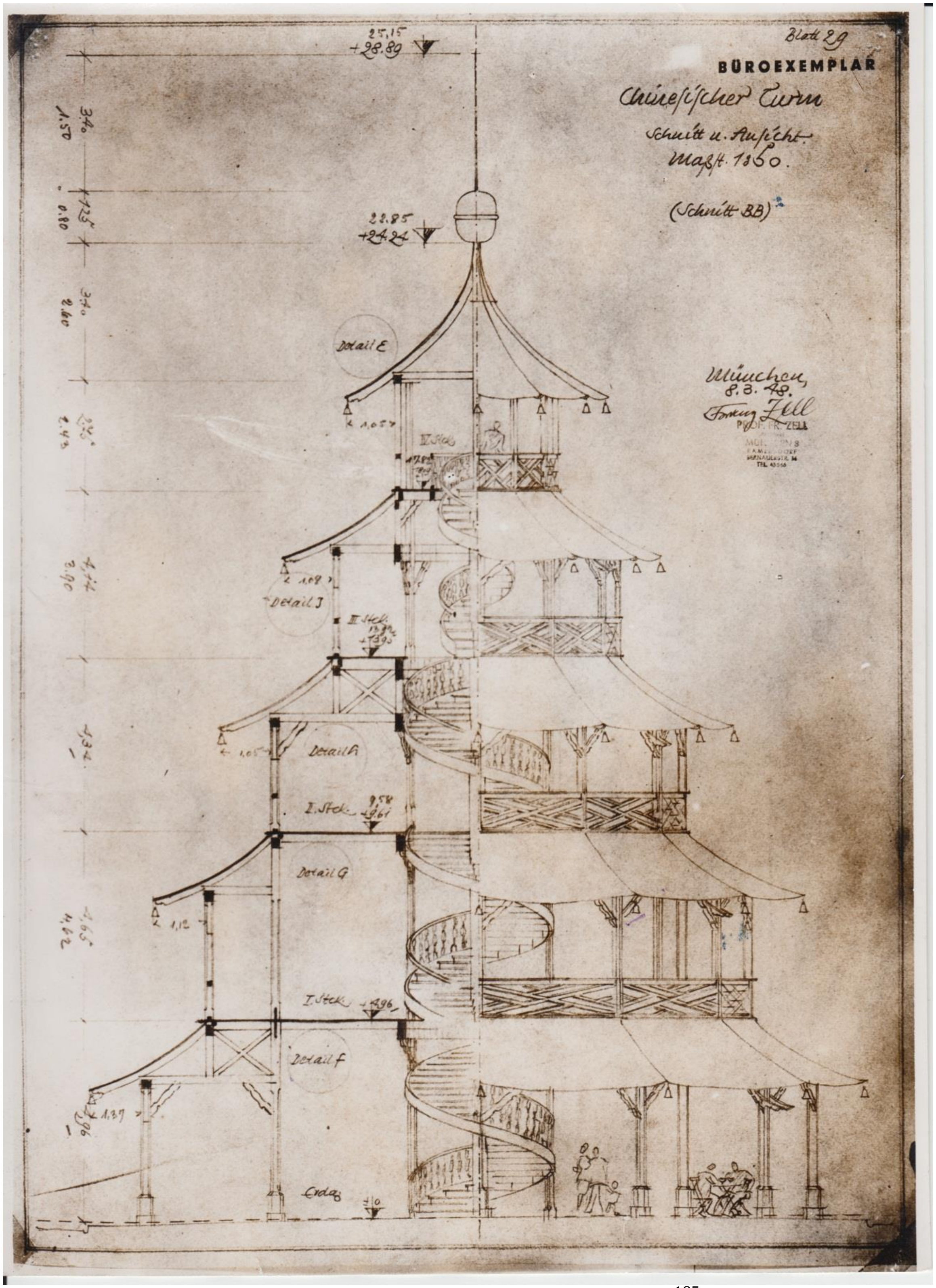

Fig. 4-34   The Chinese Tower in Munich[185]

[185] Provided by Bavarian Palace Administration, the Department of Garden

Fig. 5-1 Sample Nr.1 Purlin Crown

Fig. 5-2 Sample Nr.2 Lantern Ceiling

Fig. 5-3   Sample Nr.4 Column VI

Fig. 5-4   Sample Nr.6 Lantern Column

Fig. 5-5 Sample Nr.8 Column VIII

Fig. 5-6 Sample Nr.9 Roof Beam

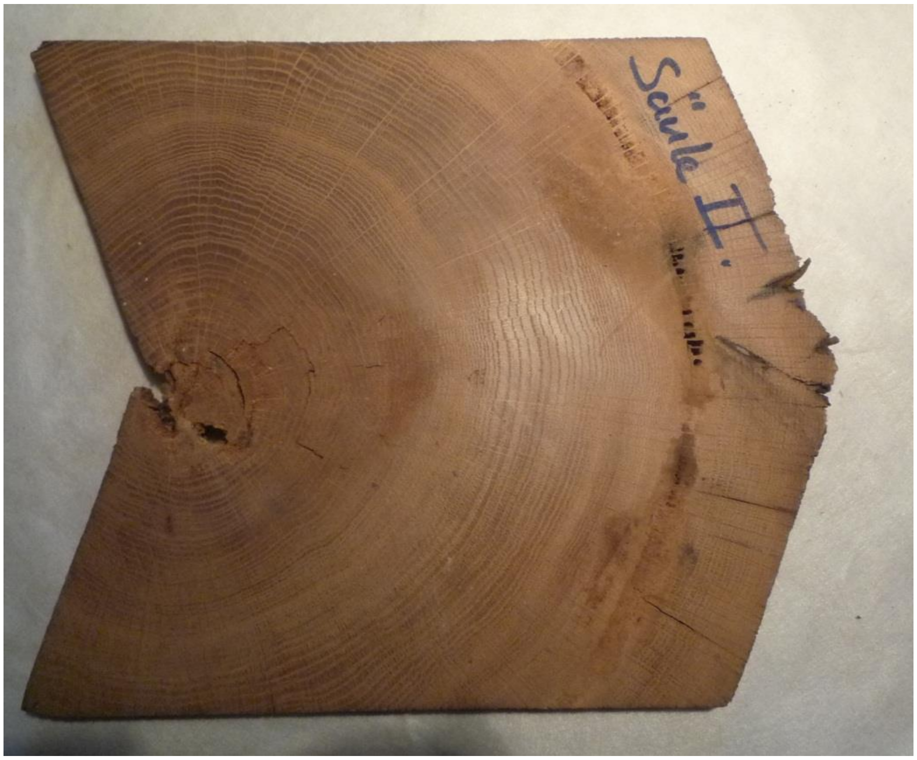

Fig. 5-7   Sample Nr.10 Column II

Fig. 5-8   Sample Nr.11 Lantern Crown

Fig. 5-9   Sample Nr.12 Column IV

Fig. 5-10   Sample Nr.13 Lantern Middle Column

Fig. 5-11   Sample Nr.14 Roof Beam

Fig. 5-12   Sample Nr.15 Column without Number

Fig. 5-13 Sample Nr.16 Round Column

Fig. 5-14 Sample Nr.17 Column V

Fig. 5-15 Sample Nr.18 Tangentially Cut Column I

Fig. 5-16 Sample Nr.19 Tangentially Cut Column II

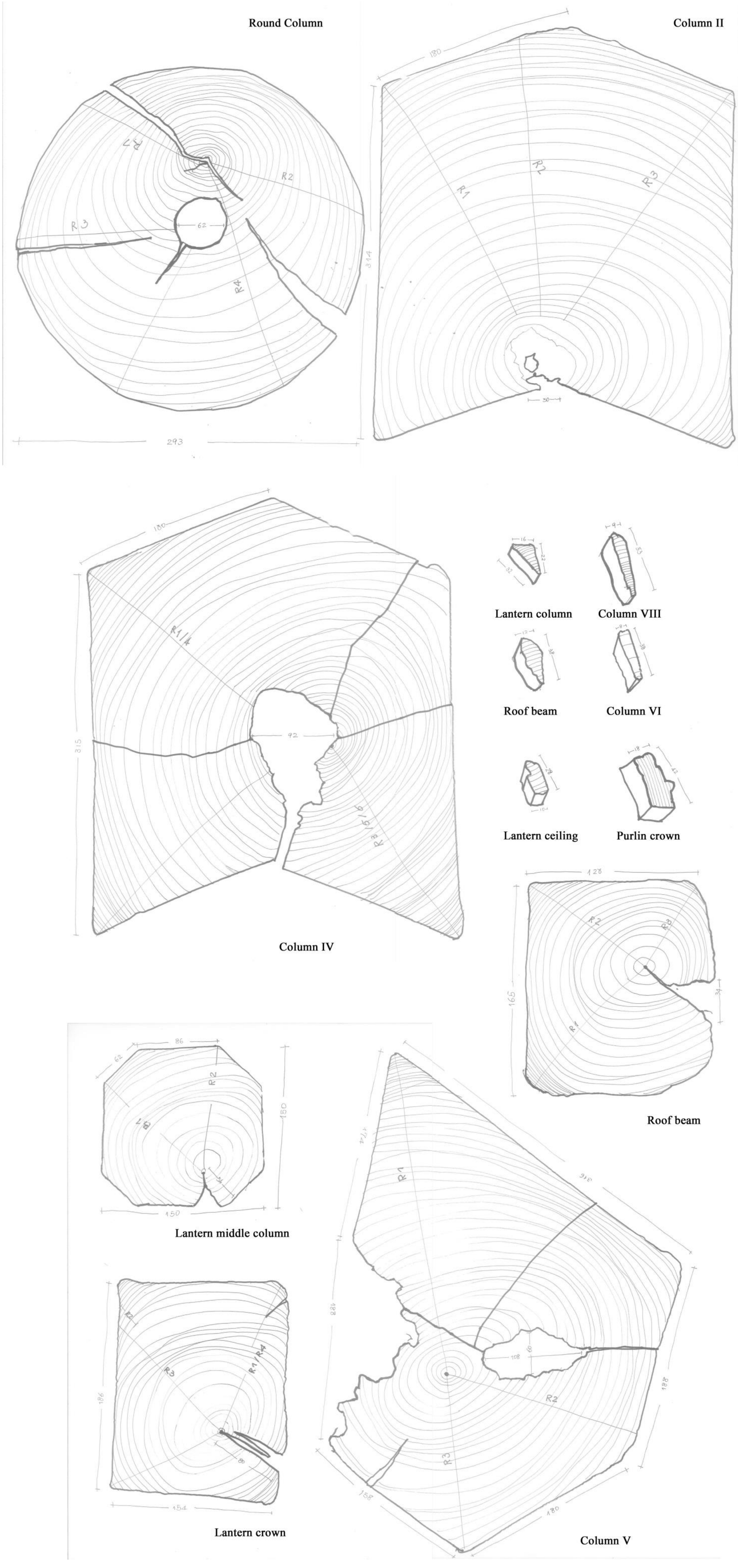

Fig. 5-17 Sample Dimension

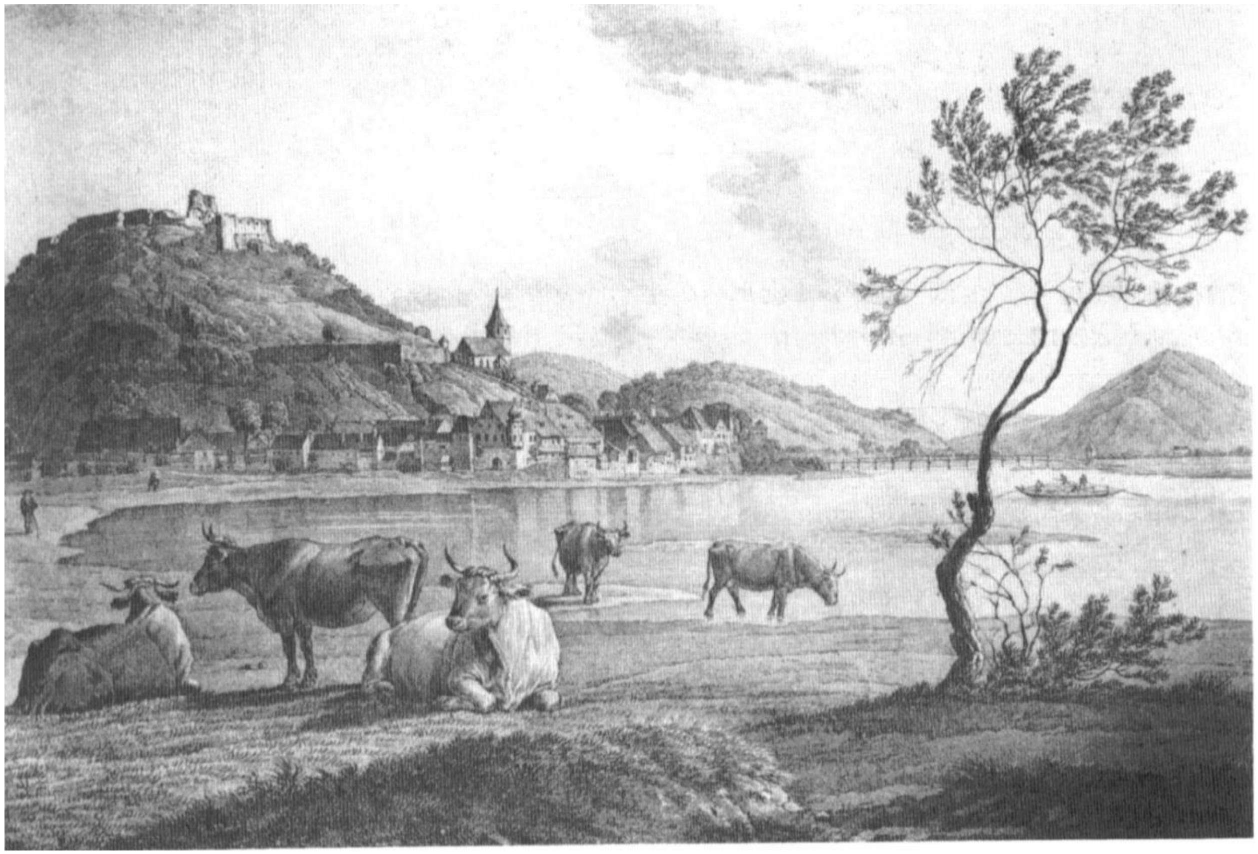

Fig. 6-1 Jocab Alt: Donaustauf mit B äuberg vor dem Bau der Walhalla[186]

[186] Lithography, befor 1830, Exemplar in Museum der Stadt Regensburg.

Fig. 6-2 Robert Batty: Castle of Donaustauf

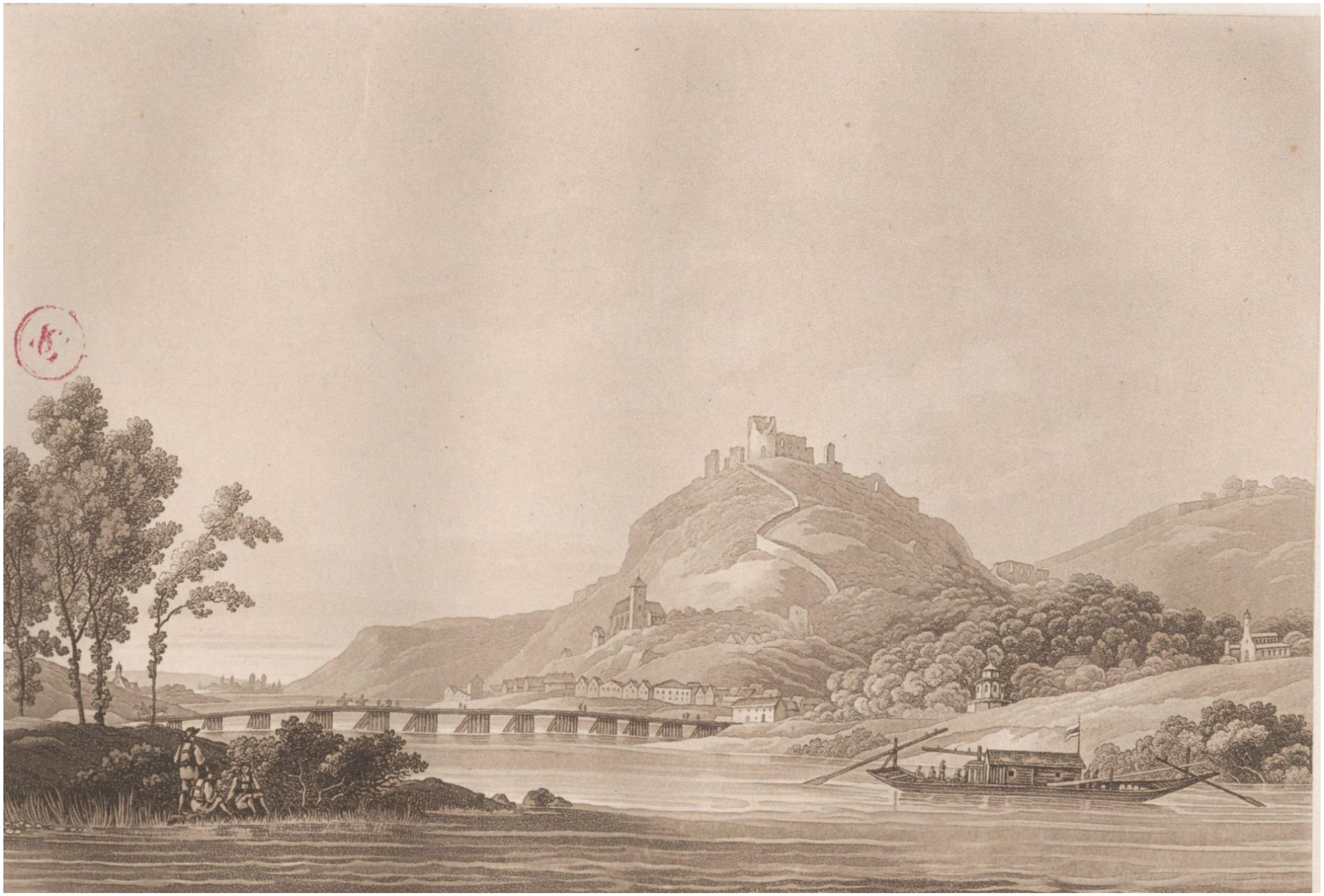

Fig. 6-3 François Gabriel de Bray: Vue de Donaustauf

Fig. 6-4 Joseph Steingrübel: Vue de Donaustauf sur le Danube

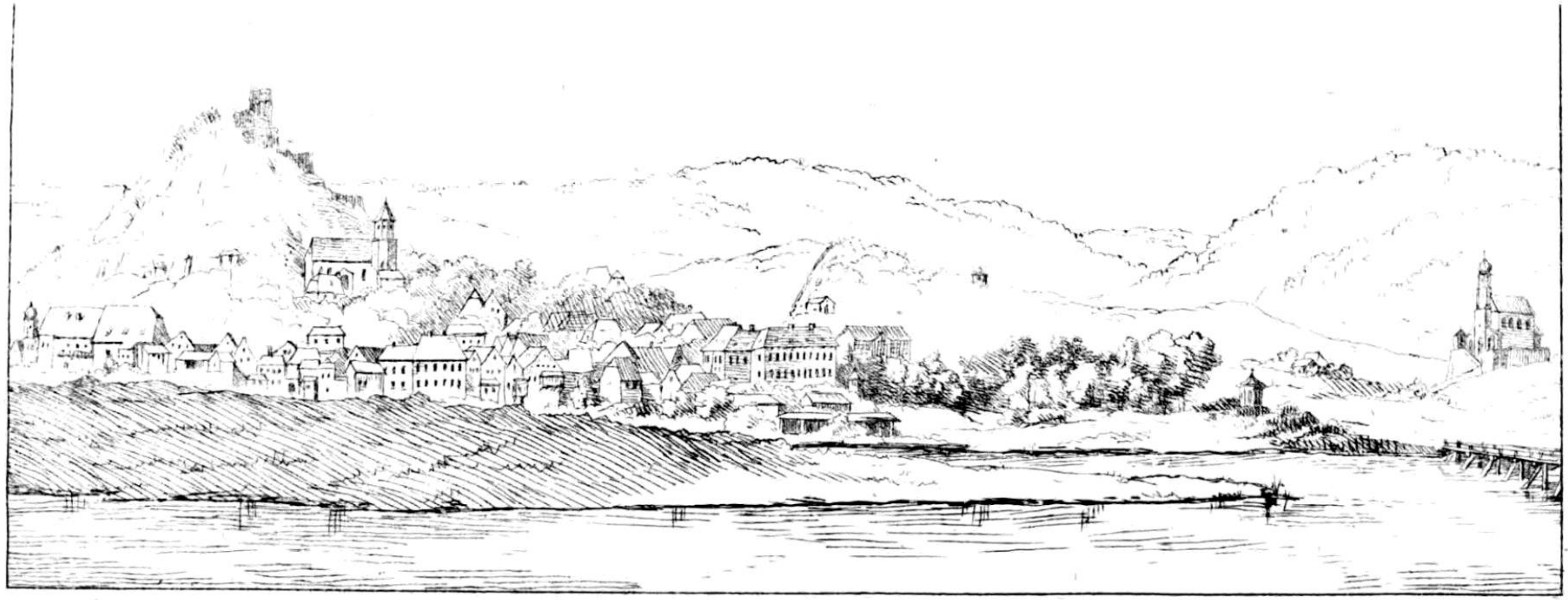

Fig. 6-5 Joseph Rudolf Schuegraf: Vue de Donaustauf

Fig. 6-6 Johann Bichtel: Unglücksfall am 22 Juni. 1837

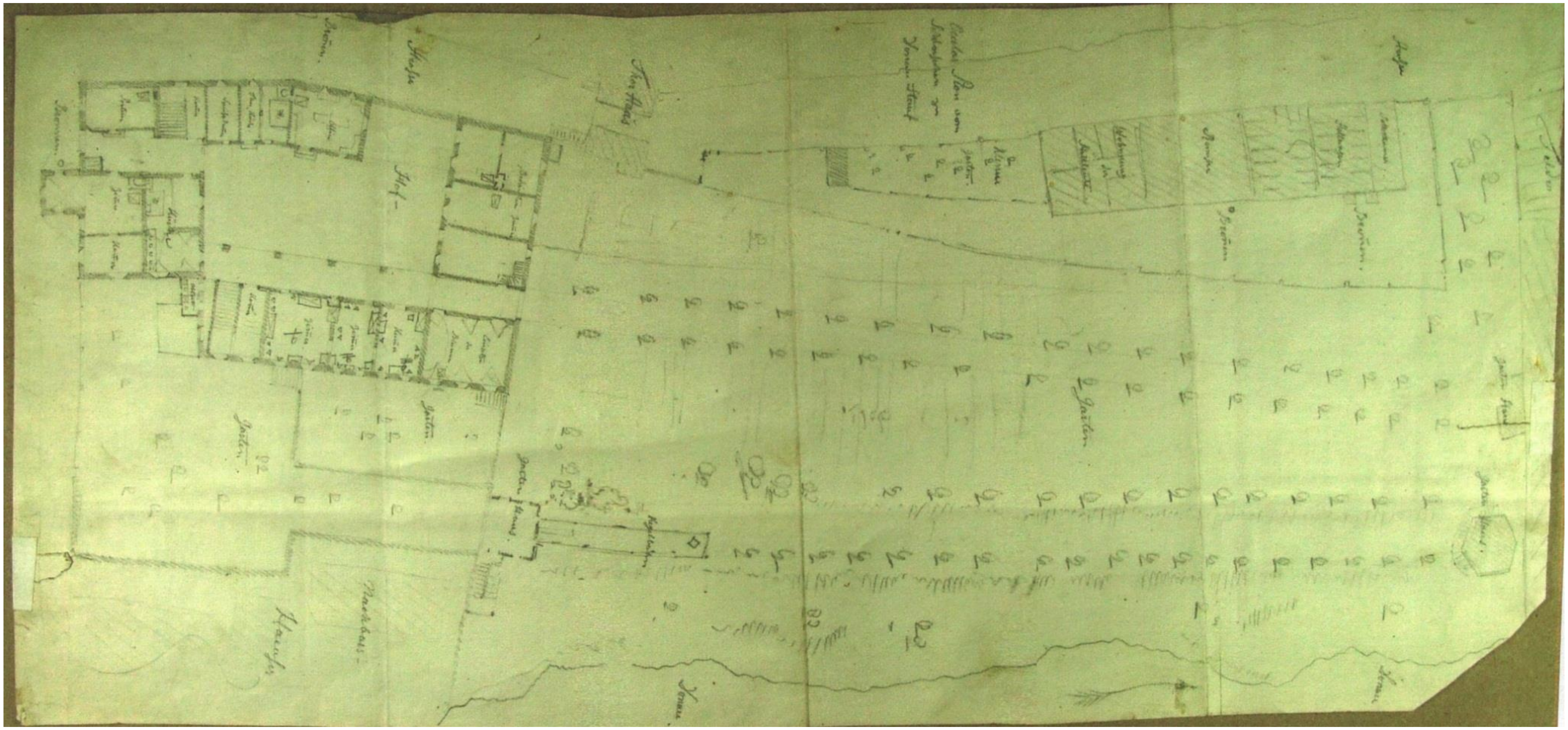

Fig. 6-7 Victor Keim: Garden Plan

Fig. 6-8 Leo von Klenze: Walhalla mit der Fernsicht gegen Regensburg

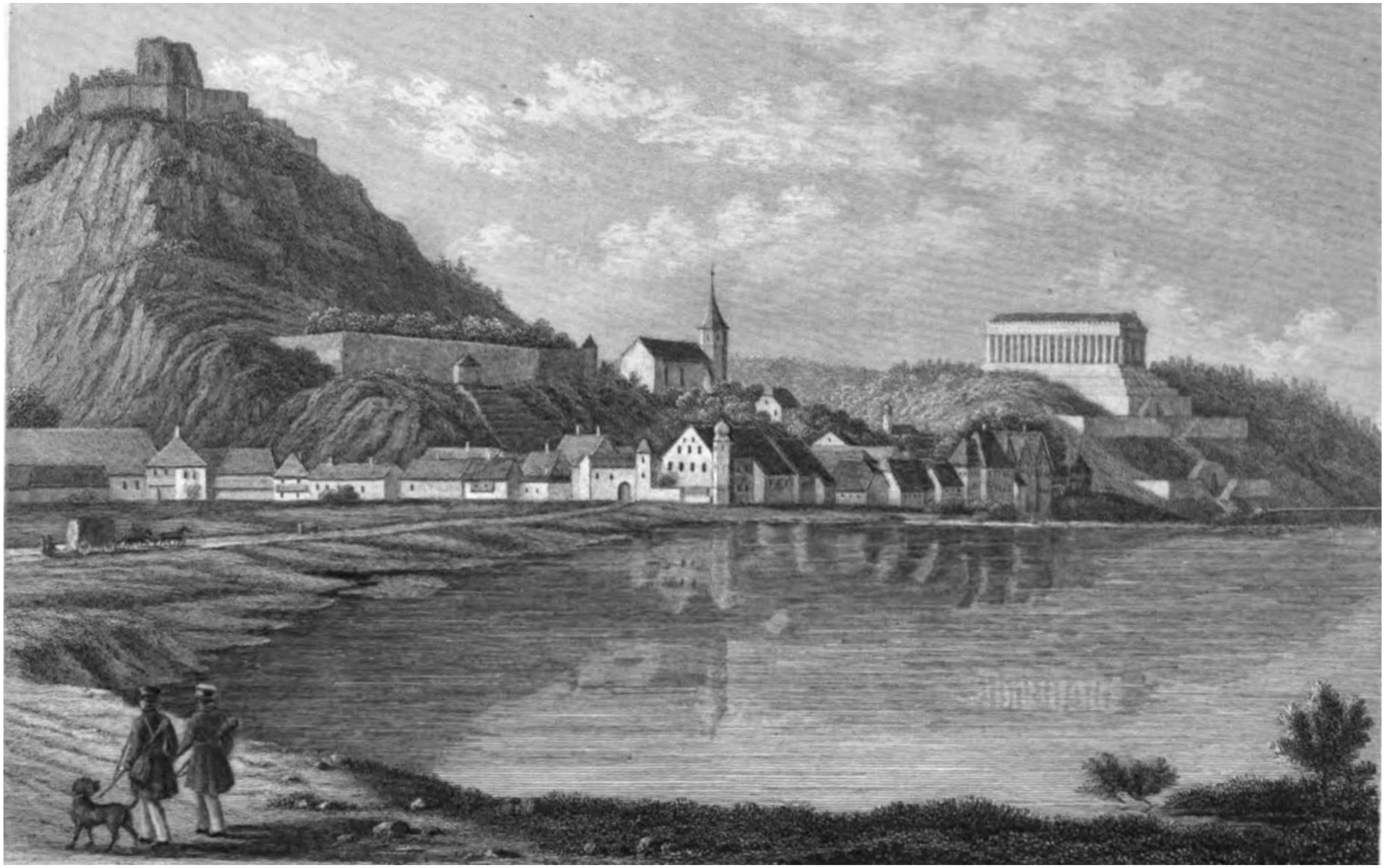

Fig. 6-9 Schürch: Donaustauf and Walhalla

Fig. 6-10 Johann Baptist Dilger: Donaustauf

Fig. 6-11 Joseph Mallord William Turner: Sketches of the Prince Garden

Fig. 6-12 August Brandmayer: Donaustauf

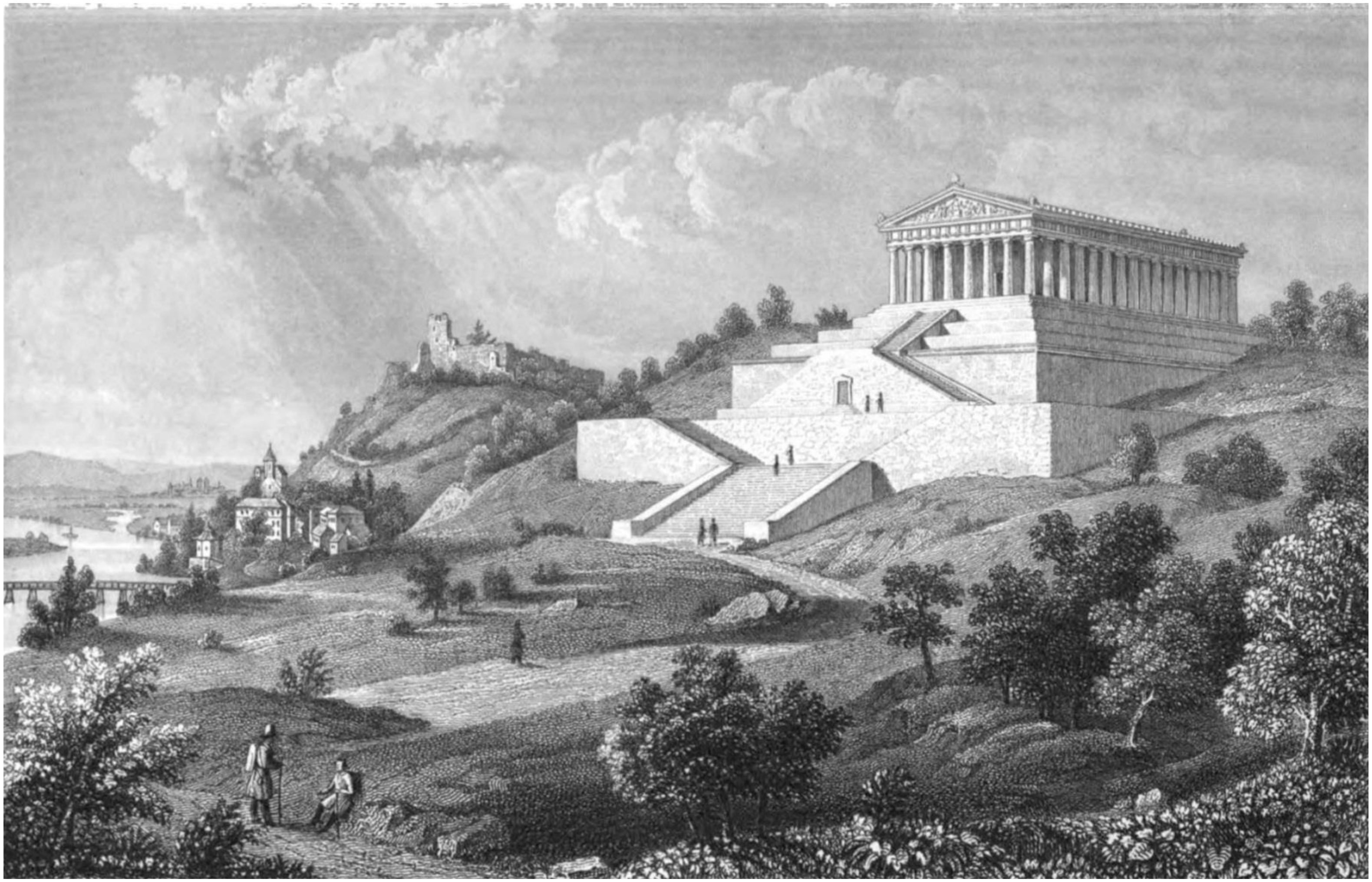

Fig. 6-13 Adalbert Müller: Walhalla

Fig. 6-14 Emanuel Labhart: Walhalla by Sunset

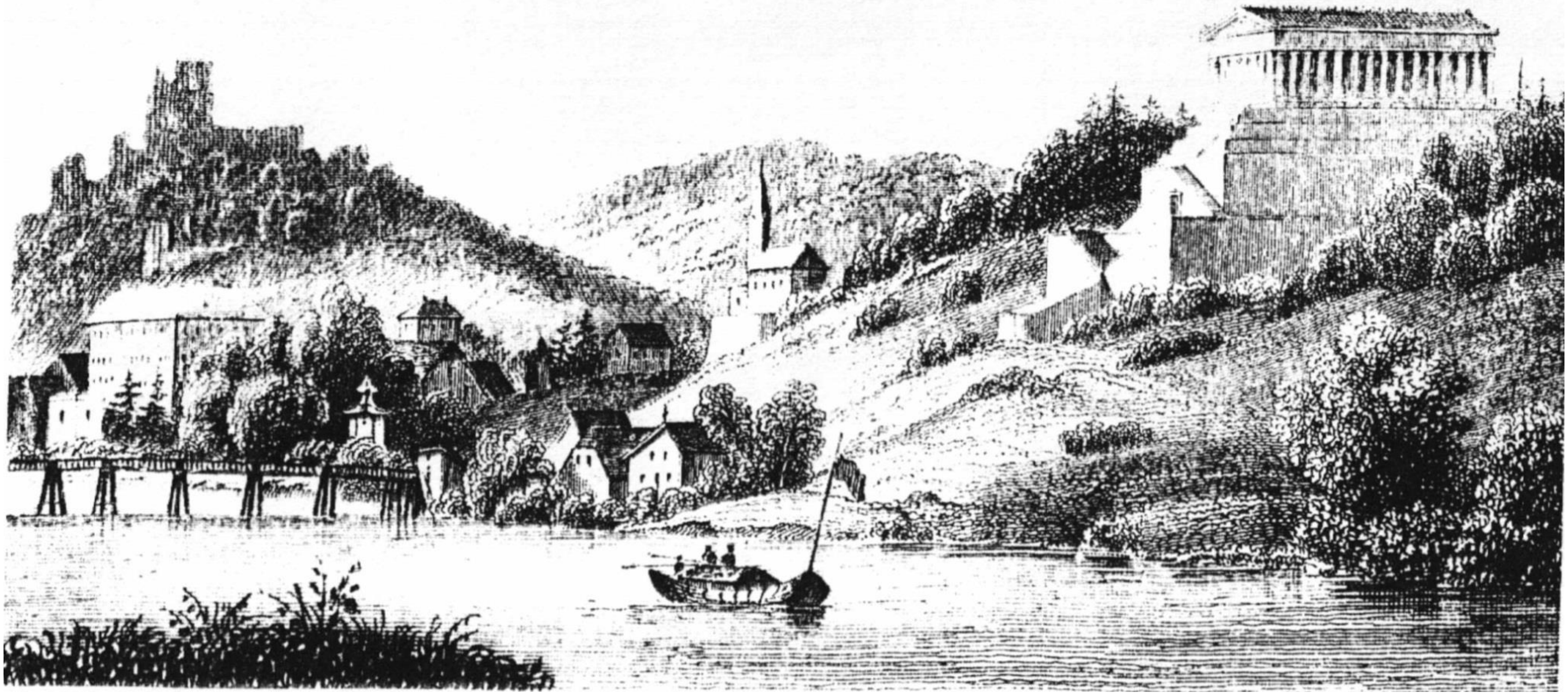

Fig. 6-15 Bernhard Grüber: Walhalla and Donaustauf

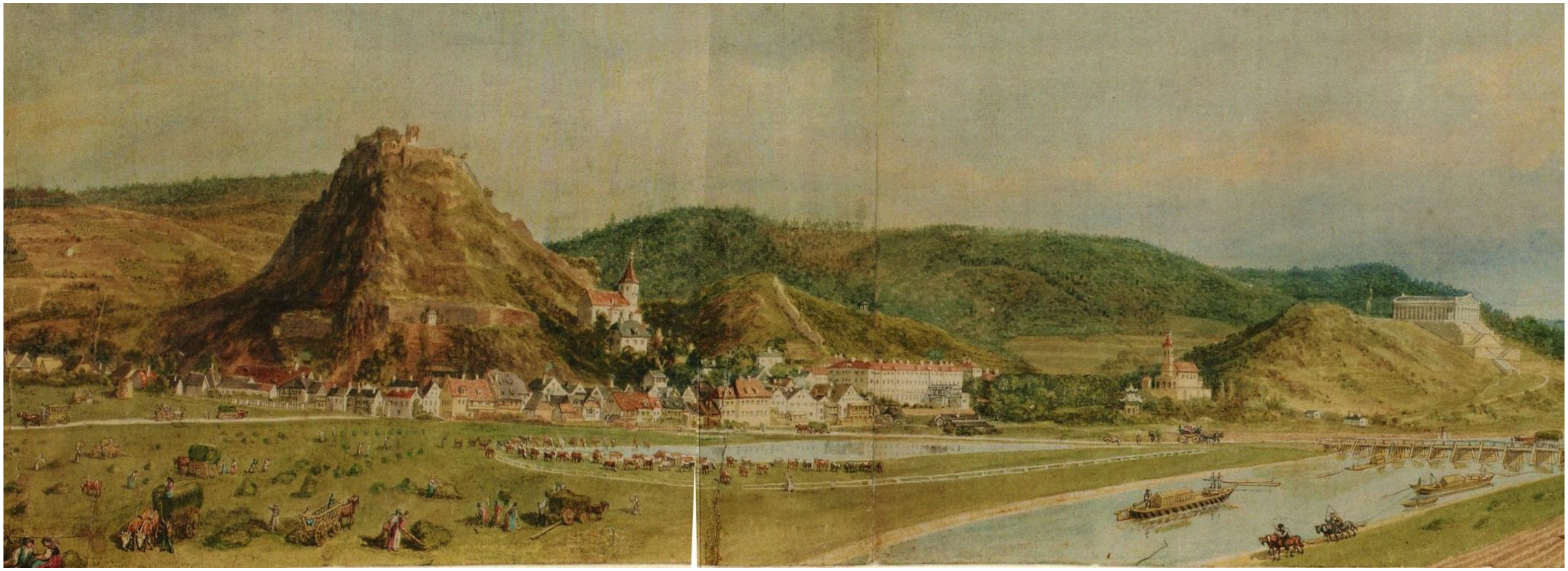

Fig. 6-16 Johann Georg Scharf: Donaustauf with Walhalla

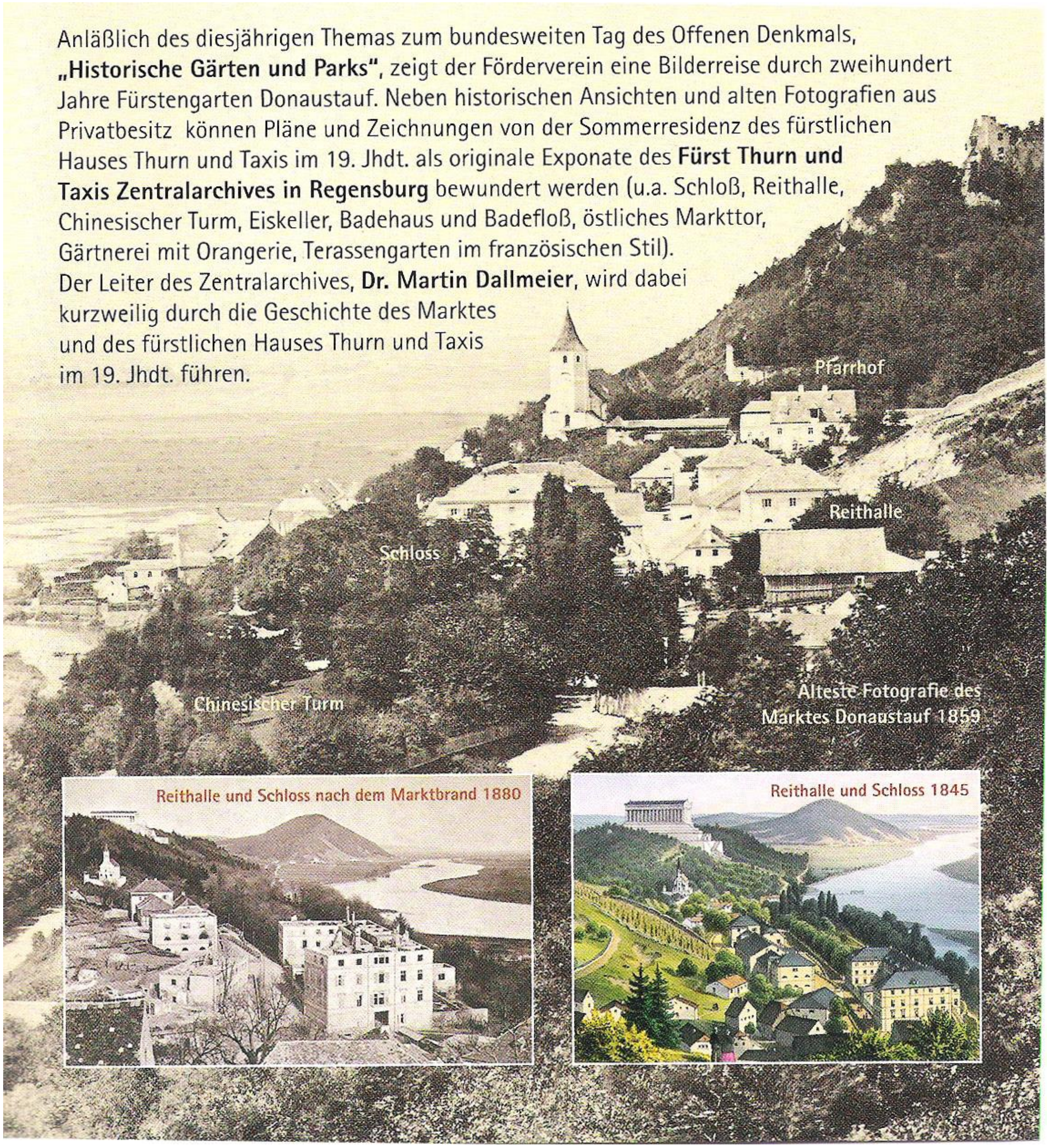

Fig. 6-17 The Chinese Tower on a Photo of the 1950s

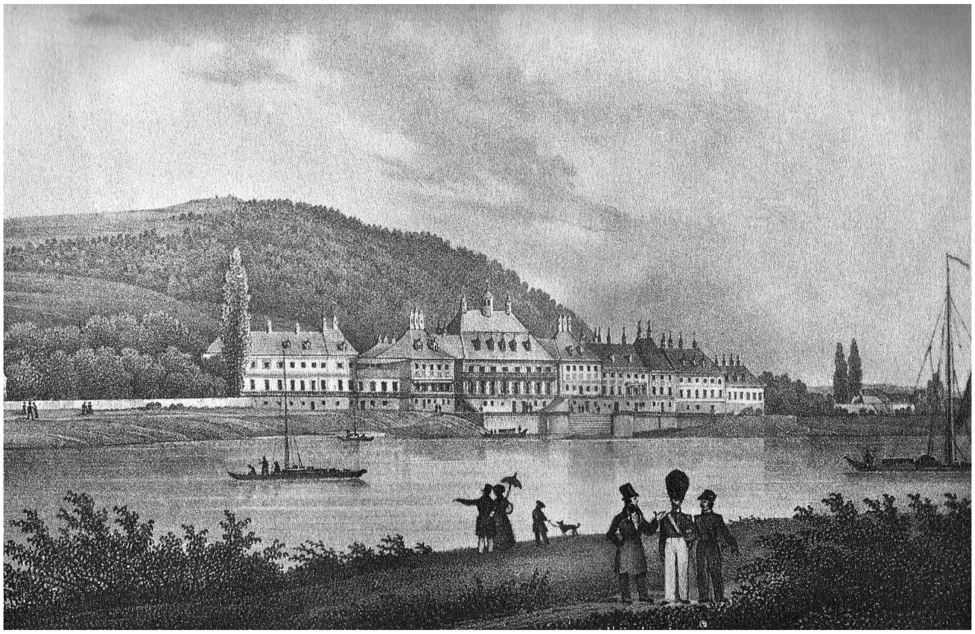

Fig. 8-1 Historical View of the Water Palace in Pillnitz, Henry Winkles[187]

Fig. 8-2 The Upper Palace in Pillnitz, Heribert Pohl, 2013[188]

[187] Steel engraving, c. 1850. http://de.wikipedia.org/wiki/Datei:Ansicht_Pillnitz_um_1850.jpg
Schwarze 1975

Fig. 8-3 The New Palace in Pillnitz, Reneman, , 2010[189]

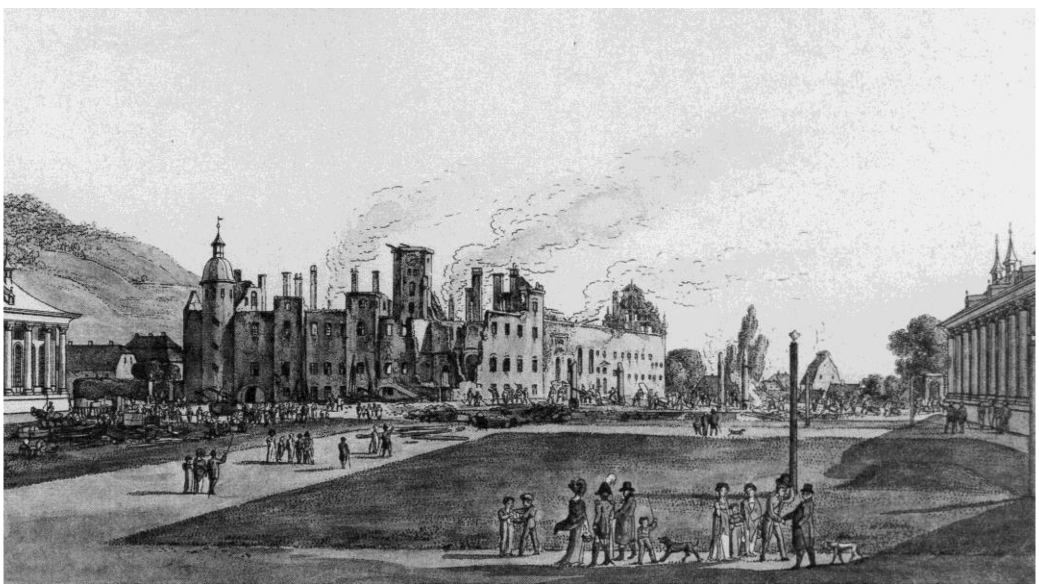

Fig. 8-4 Ruins of the Old Palace at Pillnitz after the Fire of 1818[190]

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188 http://commons.wikimedia.org/wiki/File:Dresden,_Schloss_Pillnitz,_Bergpalais_(9653993658).jpg

189 http://commons.wikimedia.org/wiki/File:Schloss_Pillnitz_Neues_Palais_2010-09-15.jpg

190 Christian Friedrich Sprinck. http://de.wikipedia.org/wiki/Datei:Pillnitz_ruineAltesSchloss_1818_Ch.F.Spinck.jpg

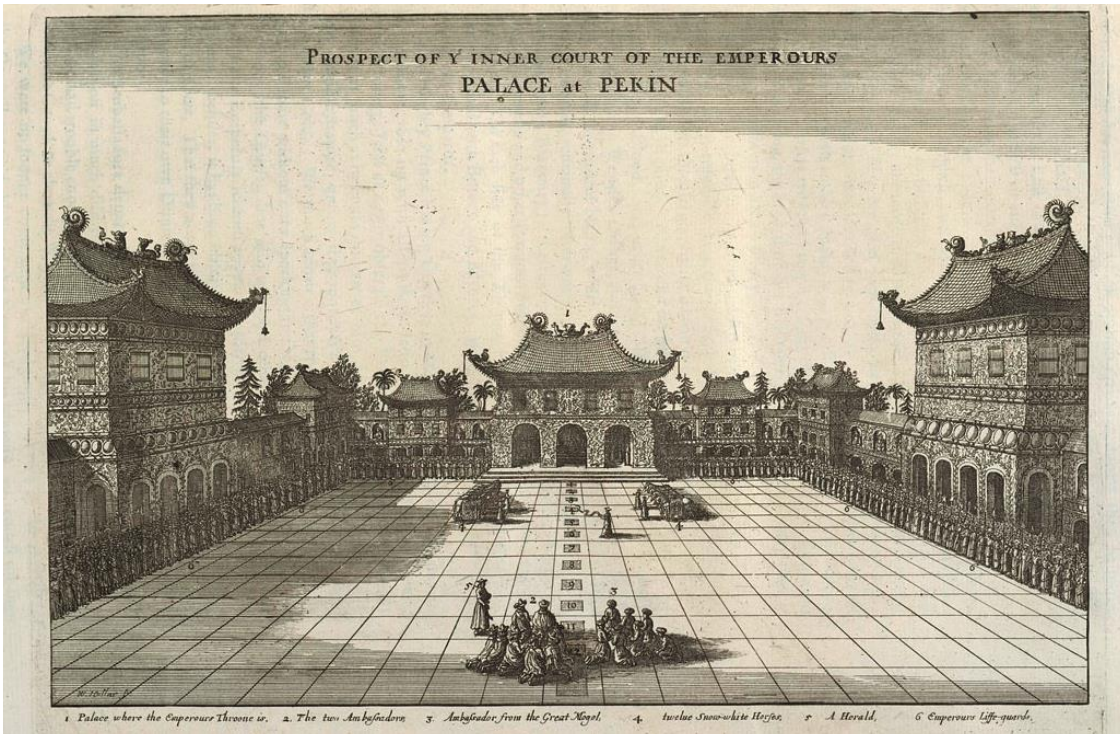

Fig. 8-5   Emperor's Palace in Peking, Johan Nieuhof, 1665

Fig. 8-6 The Chinese Pavilion in Pillnitz, Walter Möbius, Photo, 1929[191]

[191] Möbius 1929

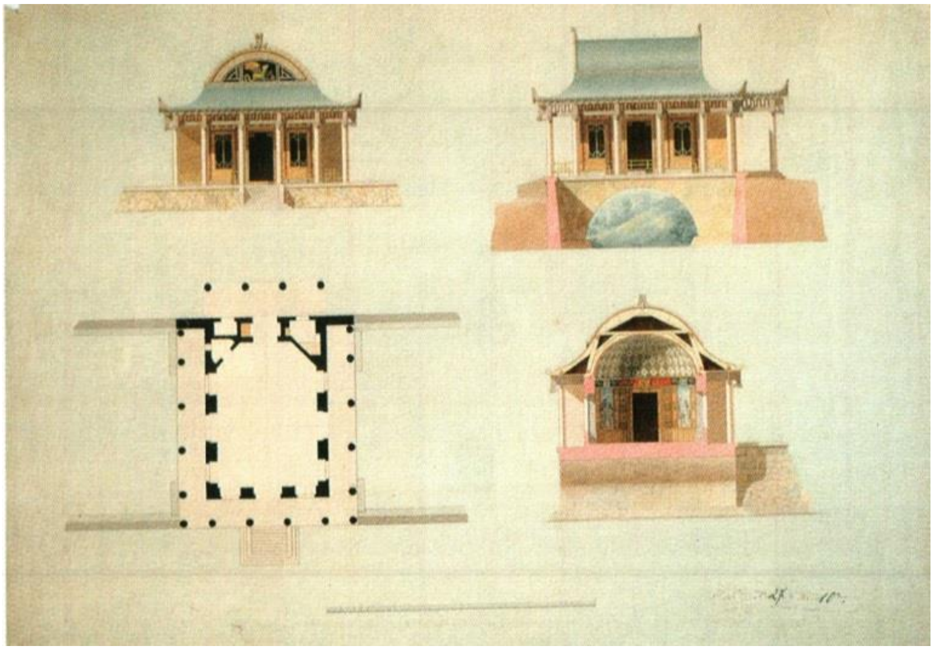

Fig. 8-7 Design of the Bridge Pavilion, Christian Schurich, c.1804[192]

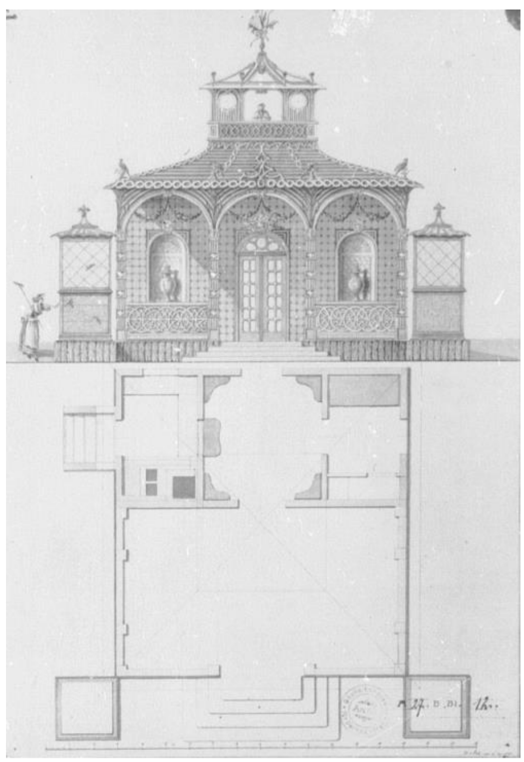

Fig. 8-8 Design of a Chinese Pavilion in Pillnitz, F. da Ponte, 1770[193]

[192] Vogel, p. 73

Fig. 8-9 The Chinese Tea House in Sanssouci, Potsdam, 2008[194]

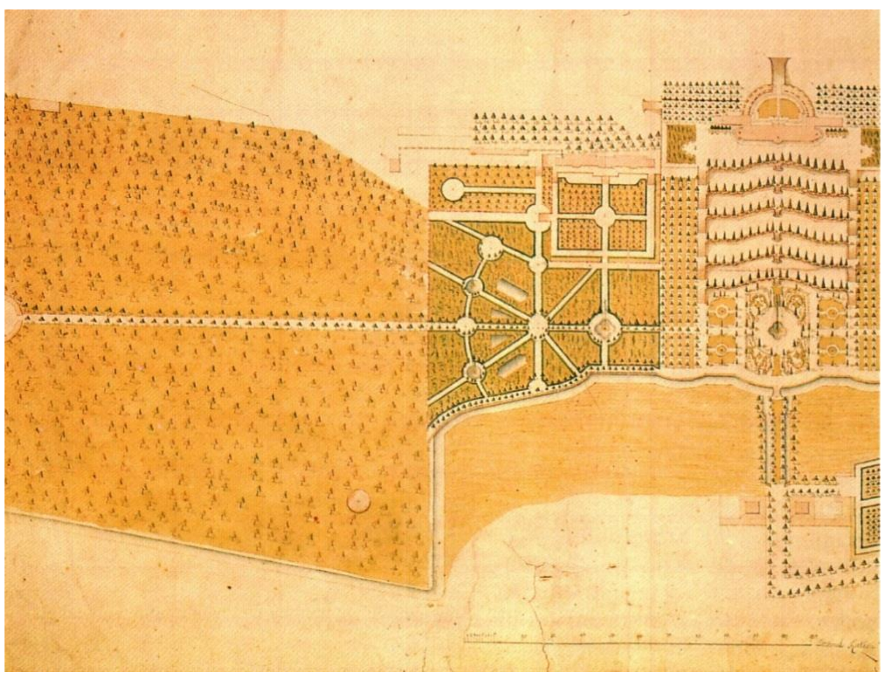

Fig. 8-10 Plan for the Deer Garden in Sanssouci, Georg Wenzeslaus von Knobelsdorff, 1752[195]

[193] Ponte 1770

[194] http://commons.wikimedia.org/wiki/File:Chinesisches_Haus_Sanssouci.jpg

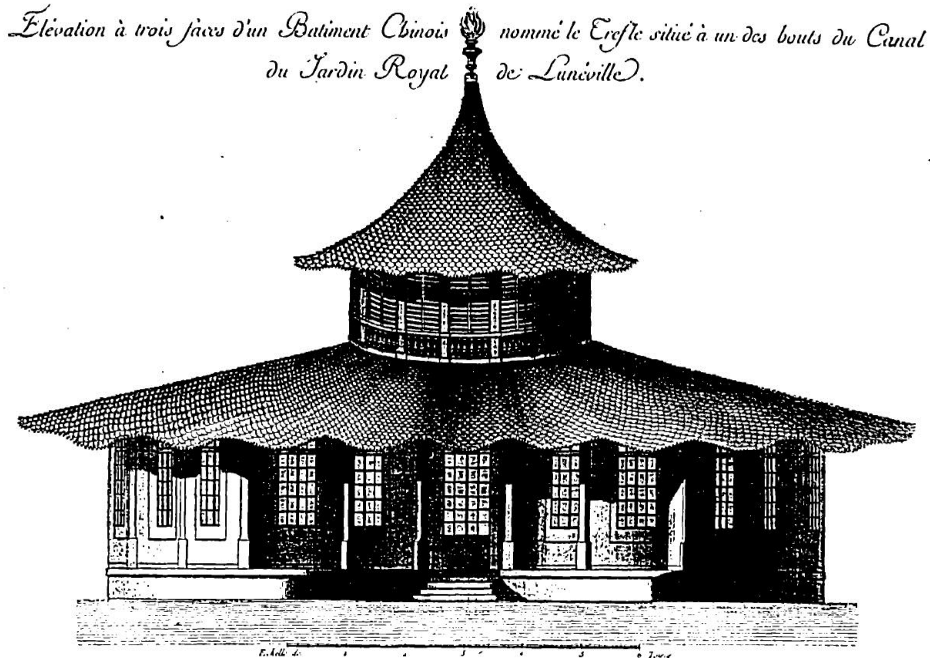

Fig. 8-11 Le Tréfle at Lunéville by Emmanuel Héré de Corny, 1738-39[196]

Fig. 8-12 The Chinese Kitchen in Sanssouci,, 2005[197]

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195 Wacker 1993, p. 12

196 Revue lorraine illustrée 1907, p. 47

197 http://commons.wikimedia.org/wiki/File:Ehemalige_Chinesische_K%C3%BCche.jpg

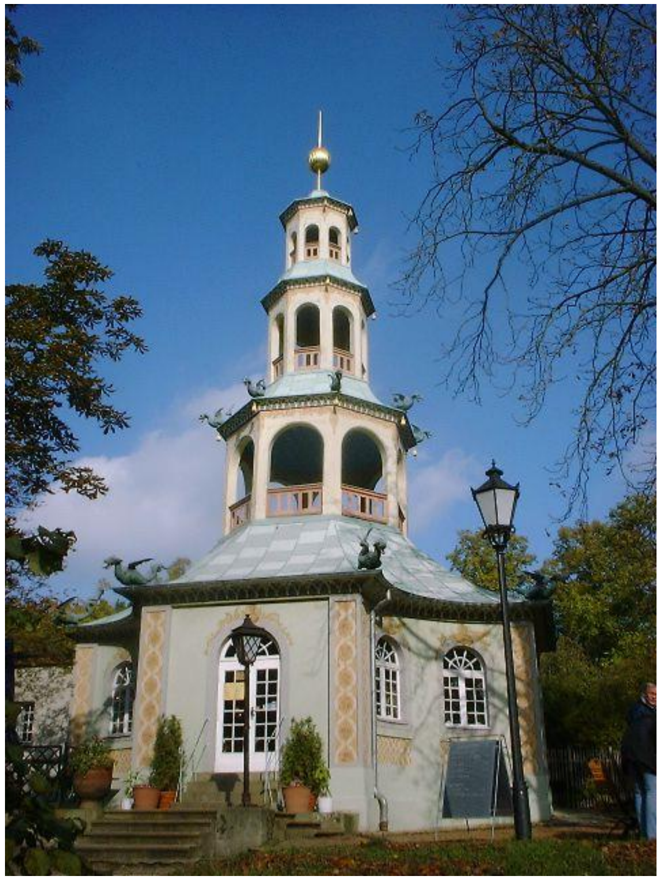

Fig. 8-13 The Dragon House in Sanssouci, 2004[198]

[198] http://de.wikipedia.org/wiki/Datei:Potsdam_Drachenhaus.jpg

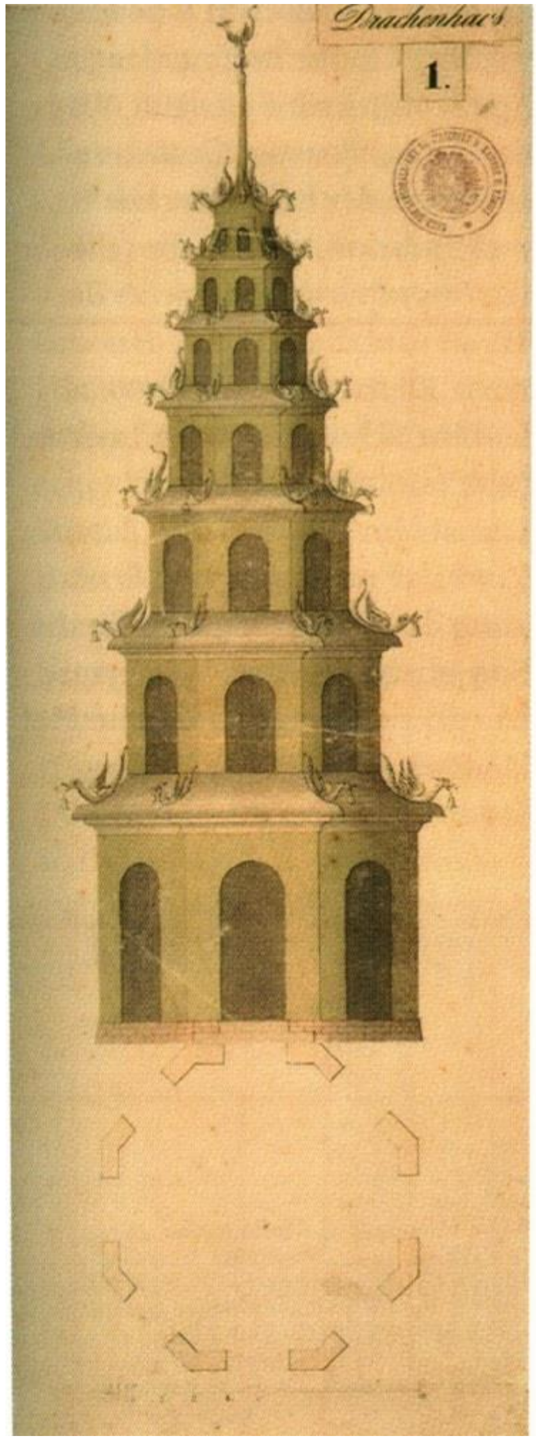

Fig. 8-14 Dragon House Design, c. 1770[199]

[199] Vogel, p. 129

Fig. 8-15 The Beautiful Pagoda in front of the Small City of Sinkicien in the Province of Hantun, 1725[200]

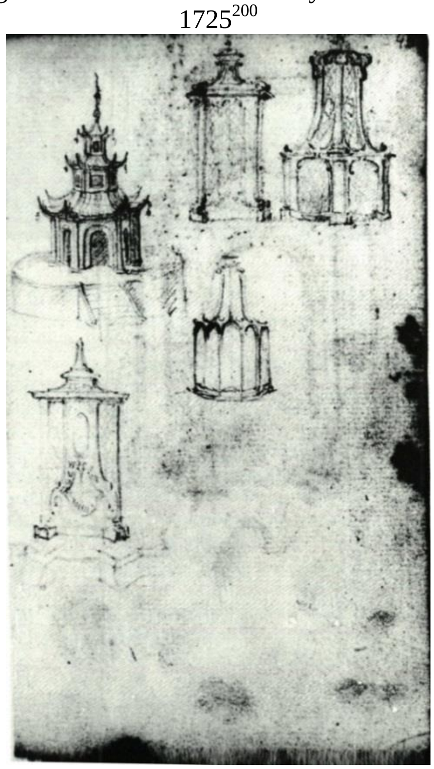

Fig. 8-16 Sketch of the Pagoda of Sinkicien, probably by Adrea Krüger in the File of Knobelsdorff, c.1745[201]

[200] La belle Pagode prés de lq peitte Ville de Sinkicien dans la Province de Hantum Fischer Erlach 1725, pp. TA

[201] See also fig.8.10. Dorst 1993, p. 30

Fig. 8-17 The Chinese Parasol in the New Garden, Potsdam, 2004[202]

[202] Prussian Palaces and Gardens Foundation Berlin-Brandenburg (Stiftung Preußische Schlösser und Gärten, p. 8

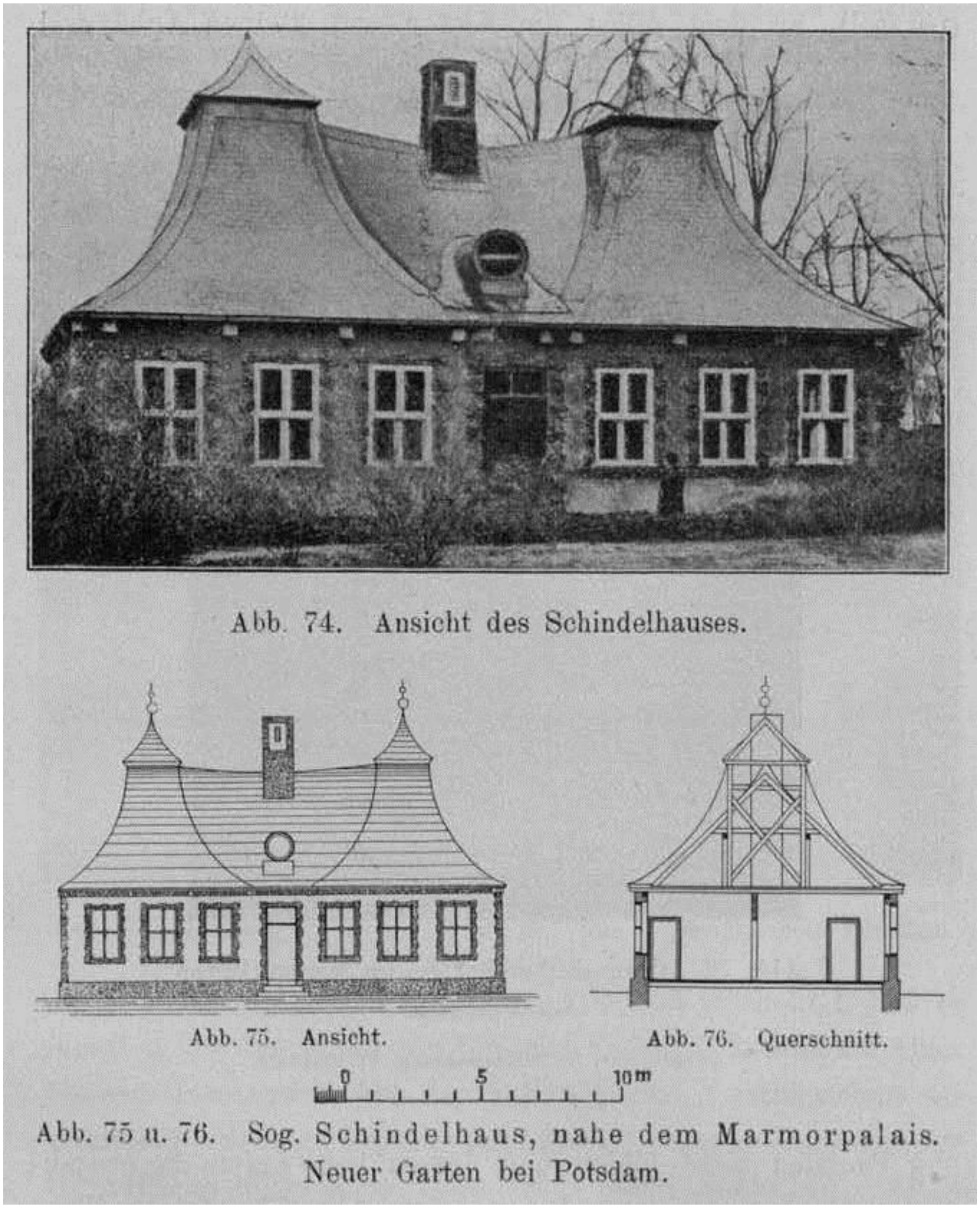

Fig. 8-18 Schindelhaus in the New Garden, Potsdam[203]

[203] Laske 1909, p. 83

Fig. 8-19 The Gate House in the New Garden, Potsdam[204]

Fig. 8-20 The Chinese Pagoda in Mulang[205]

204 http://www.wissenschaftliches-bildarchiv.de/Archiv/050/058/Details-050-058.htm

205 http://www.film-commission-hessen.de/en/location-guide/detailansicht/?location=832

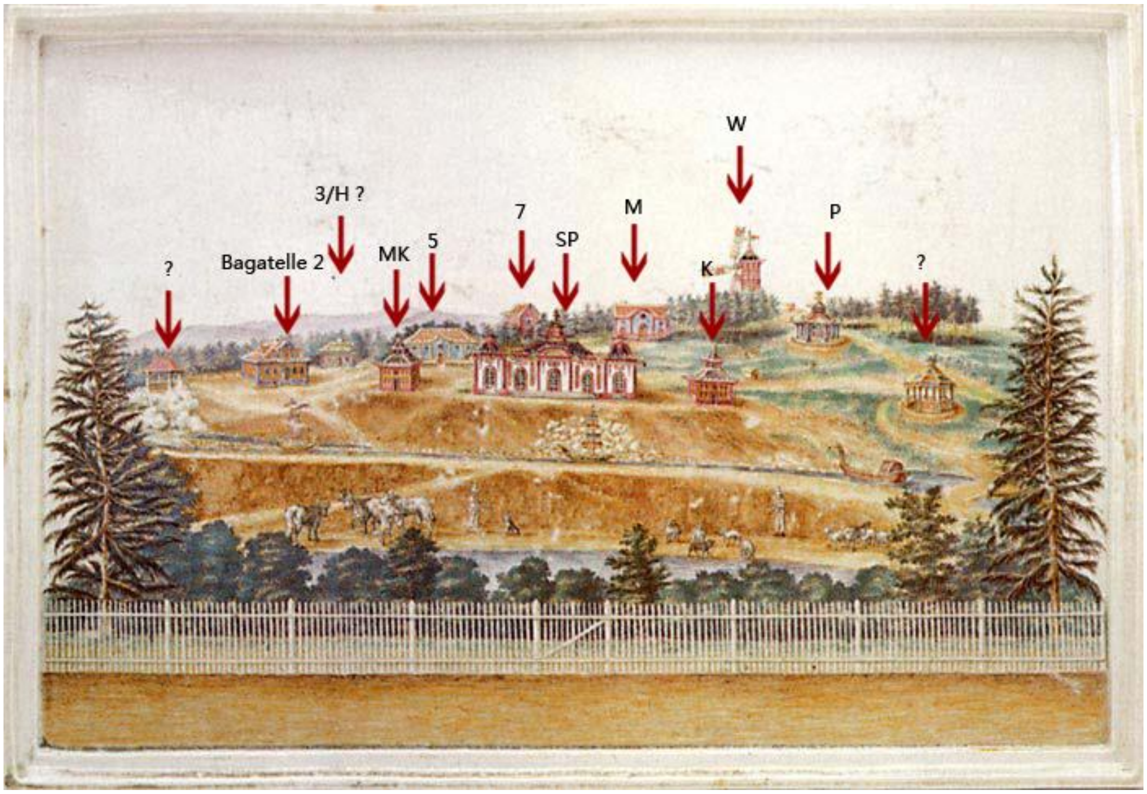

Fig. 8-21 Mulang on a Faience Plate marked by the Author, Cassle Porcelain Manufacture, 1785

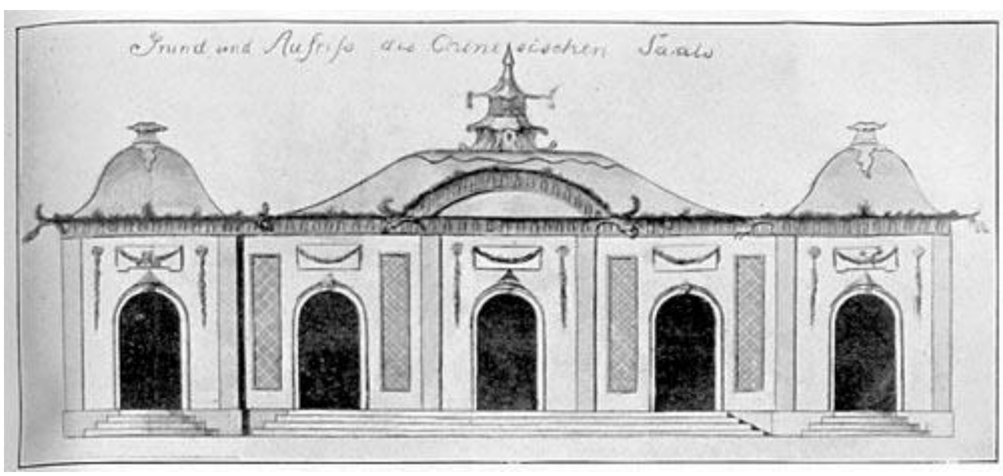

Fig. 8-22 The Chinese Hall[206]

206 Holtmeyer 1913, p. XLV

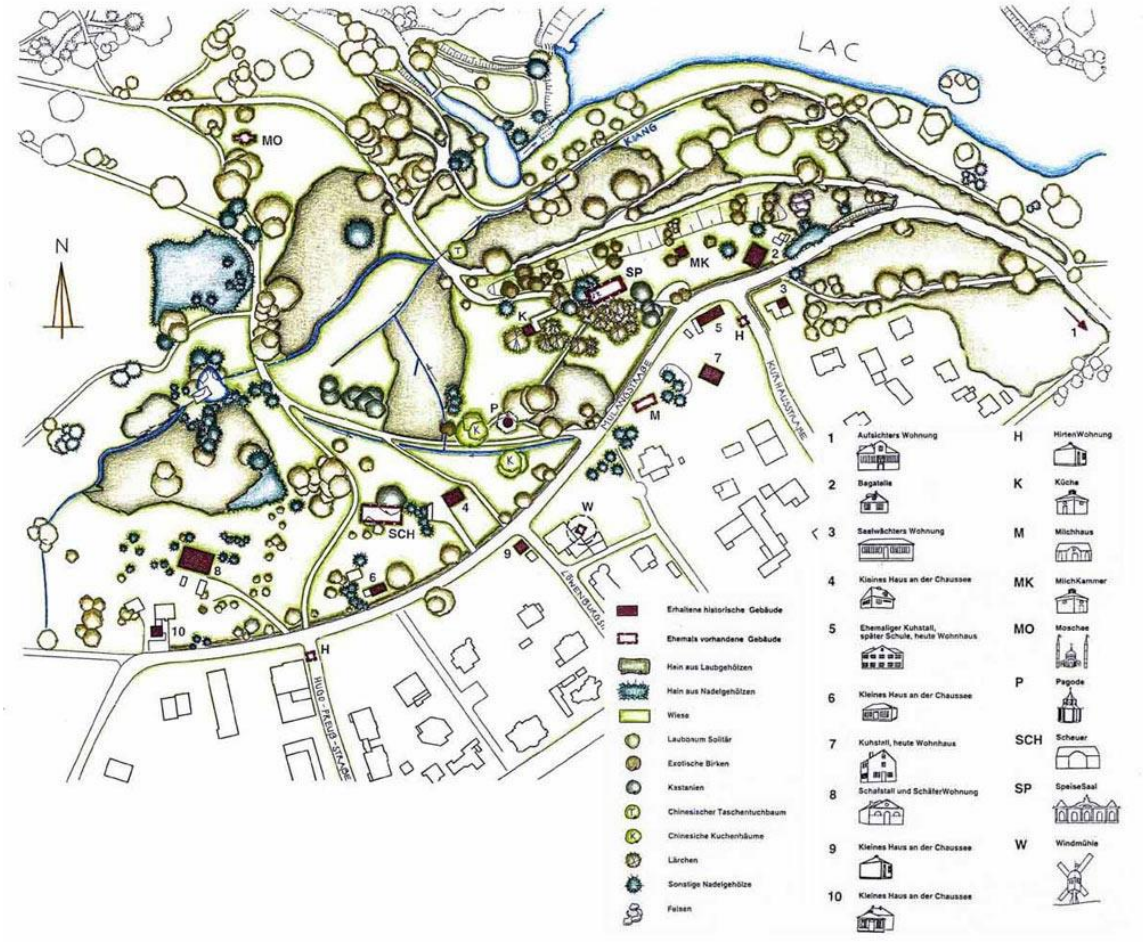

Fig. 8-23 Plan of Mulang[207]

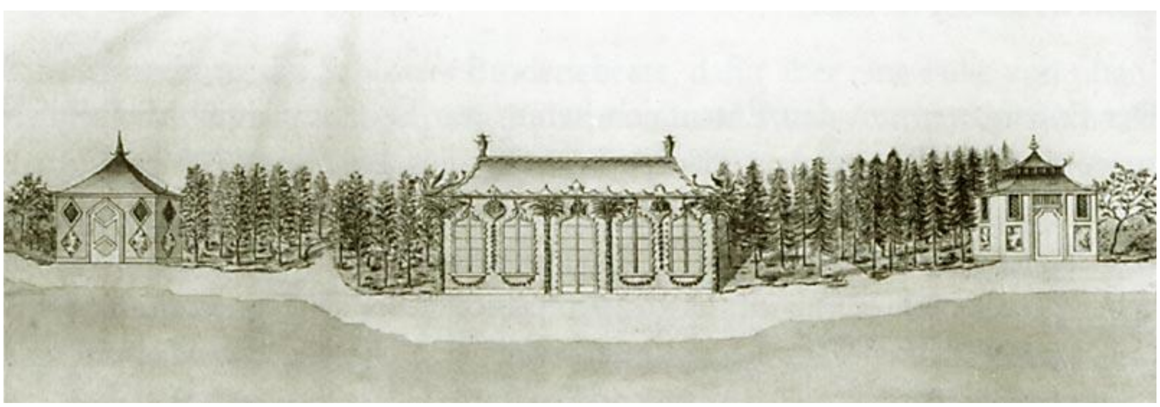

Fig. 8-24 Design of the the Dairy, Chinese Hall/Dining Hall and the Kitchen[208]

[207] Steinhauer 2003, p. 47

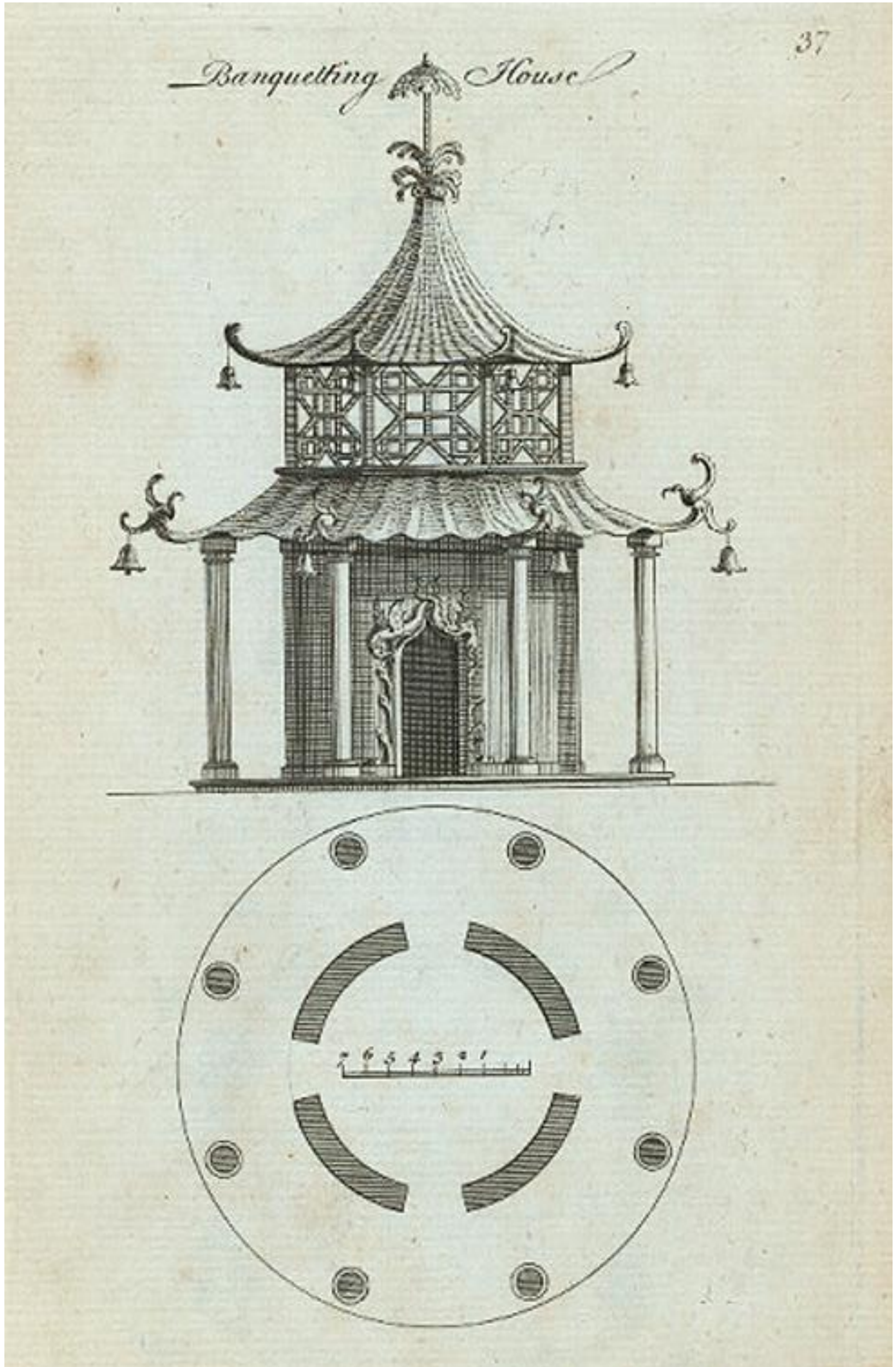

Fig. 8-25 Banqueting House in *Ornamental Architecture in the Gothic, Chinese and Modern Taste*[209]

[208] State Museum Kassel, http://www.kassel-wilhelmshoehe.de/chinesen.html

[209] Over 1758, pp. Pl. 37

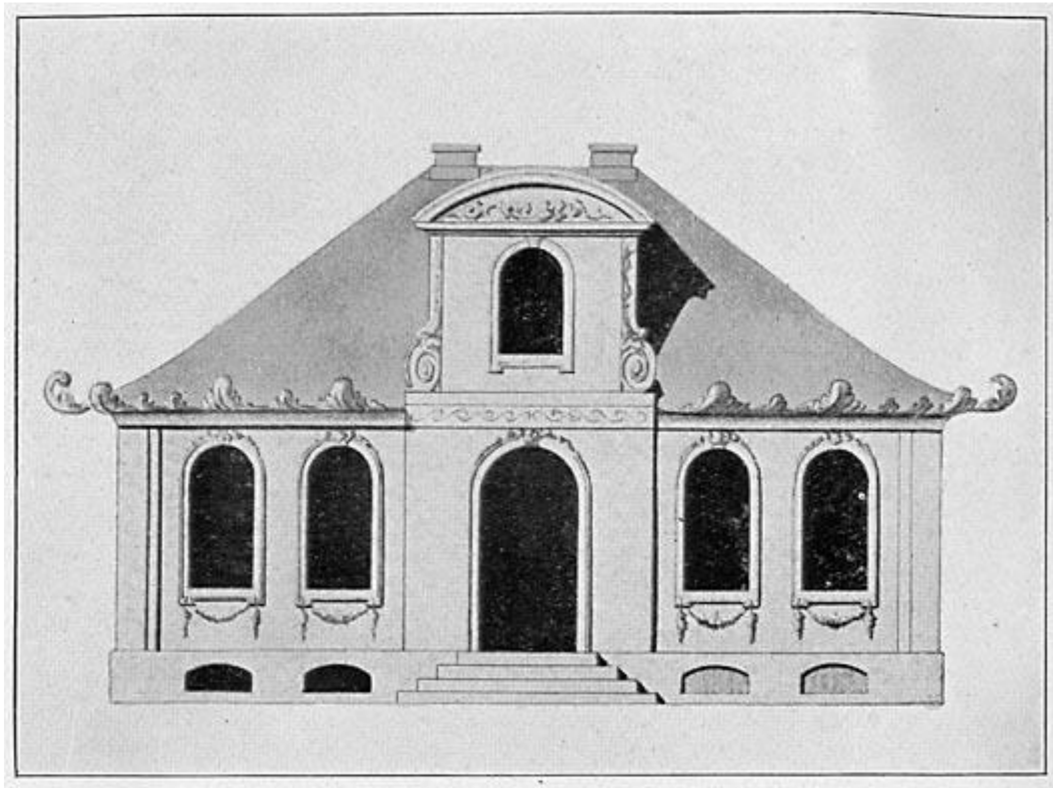

Fig. 8-26 Desing of the Bagatelle[210]

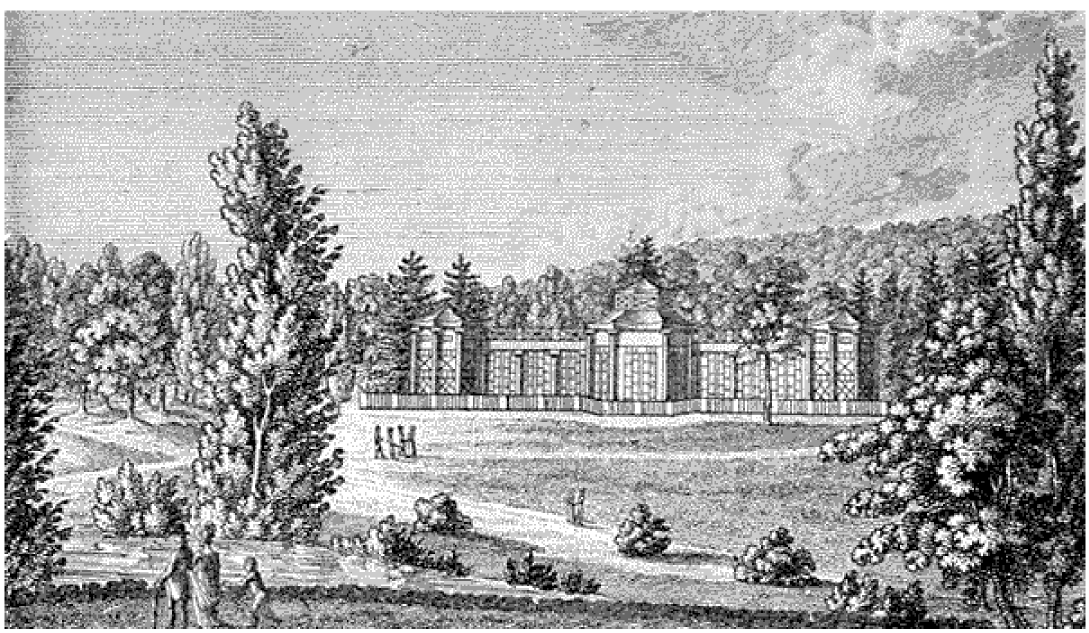

Fig. 8-27 The Connection Gallery in Mulang[211]

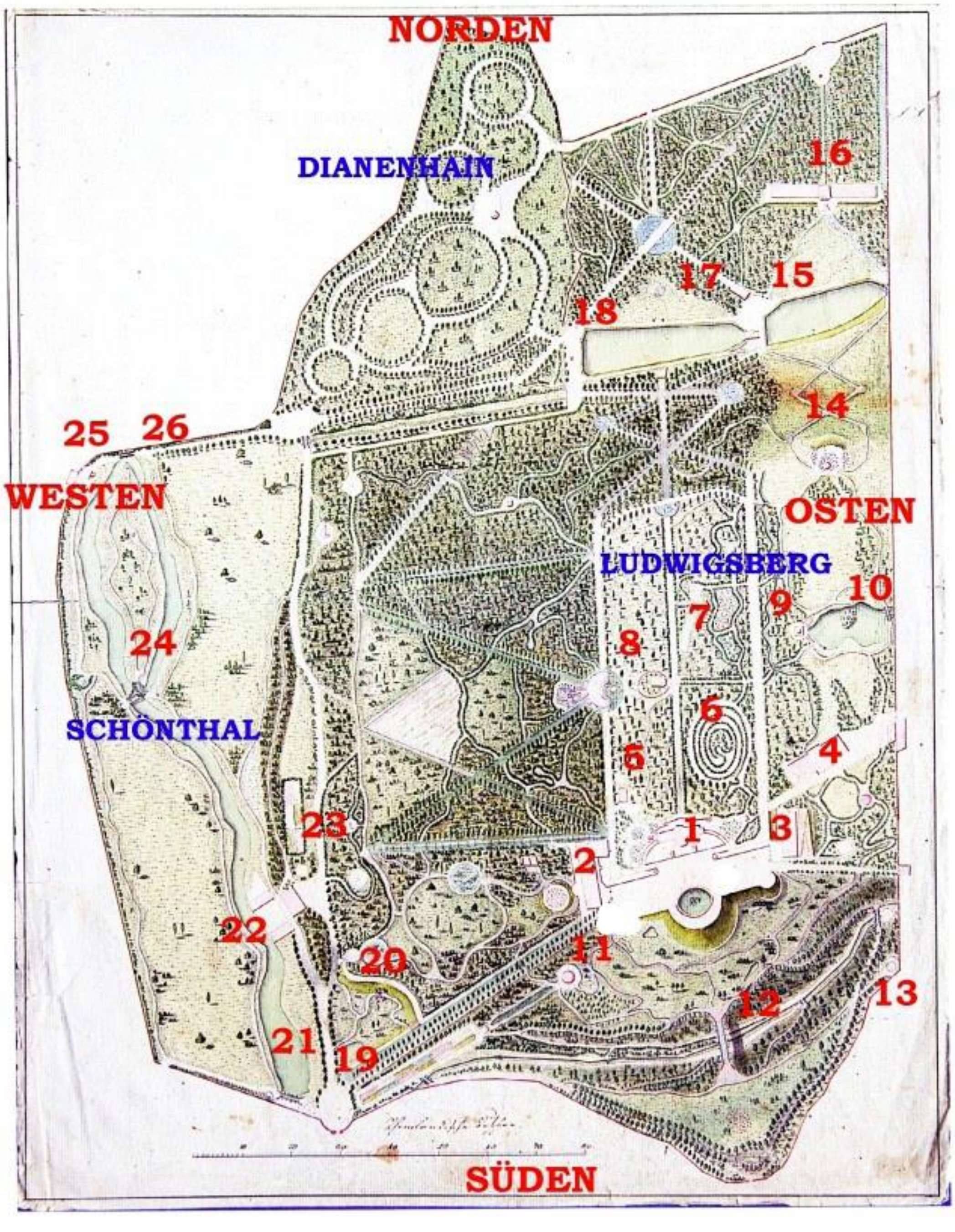

Fig. 8-28 The Plan of Ludwig Park[212]

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[210] Palace Library of Wilhelmshöhe, Holtmeyer 1913, p. XLVII

[211] Holtmeyer 1910, pp. Tafel 173

[212] Paul 2009, p. 94

Fig. 8-29 Button Miniatures, Johann Friedrich Dryanders, c.1788[213]

Fig. 8-30 Color Copies of the Button Miniatures, Johann Ludwig Lex, c.1788[214]

213 Paul 2009, p. 22

214 Paul 2009, p. 21

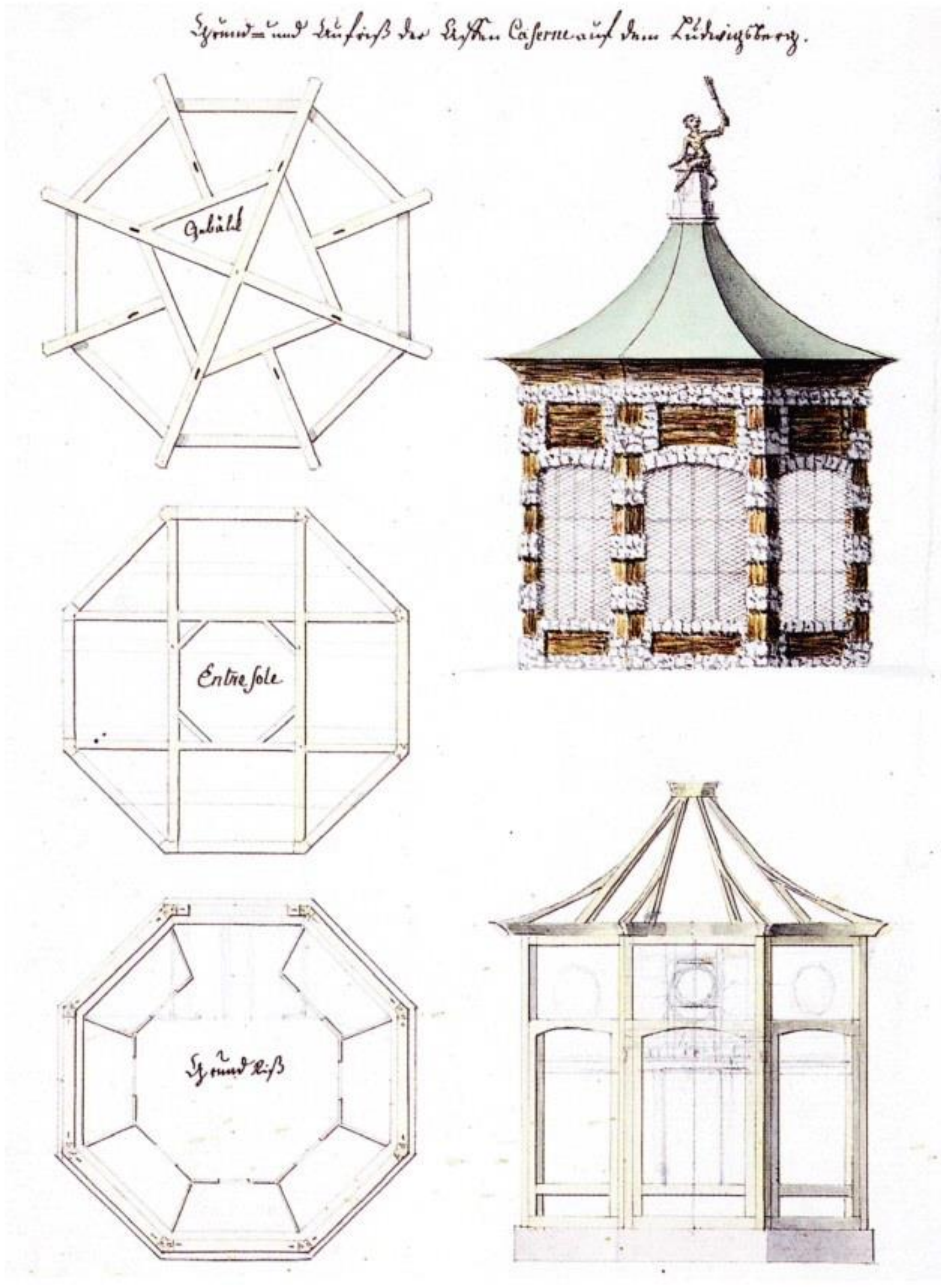

Fig. 8-31 Affenkaserne, Balthasar Wilhelm Stengel, c.1784-1791[215]

215 Paul 2009, p. 184

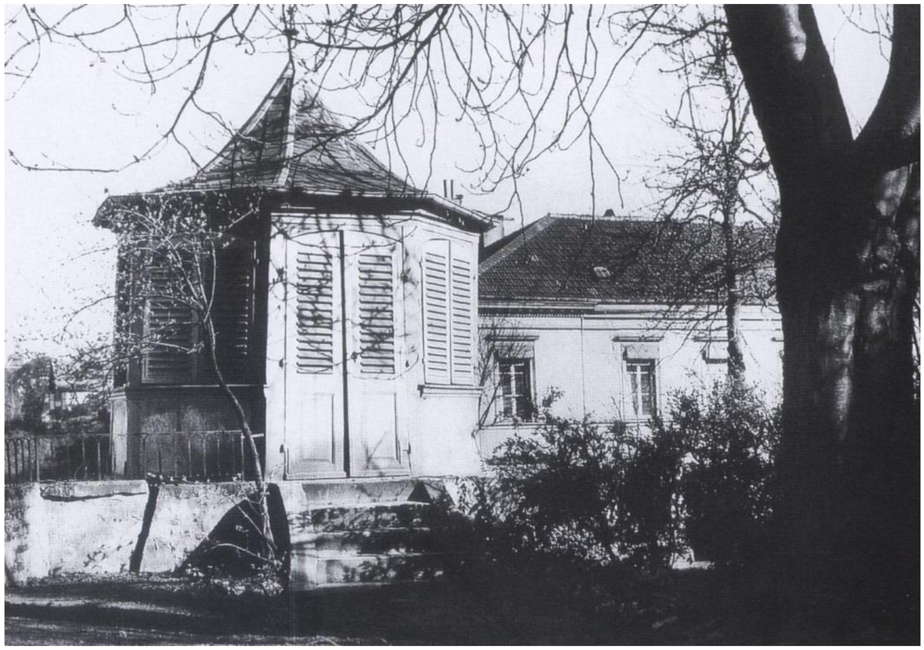

Fig. 8-32 Palace Pavilion (Garden Pavilion), Ludwigsberg, after 1804[216]

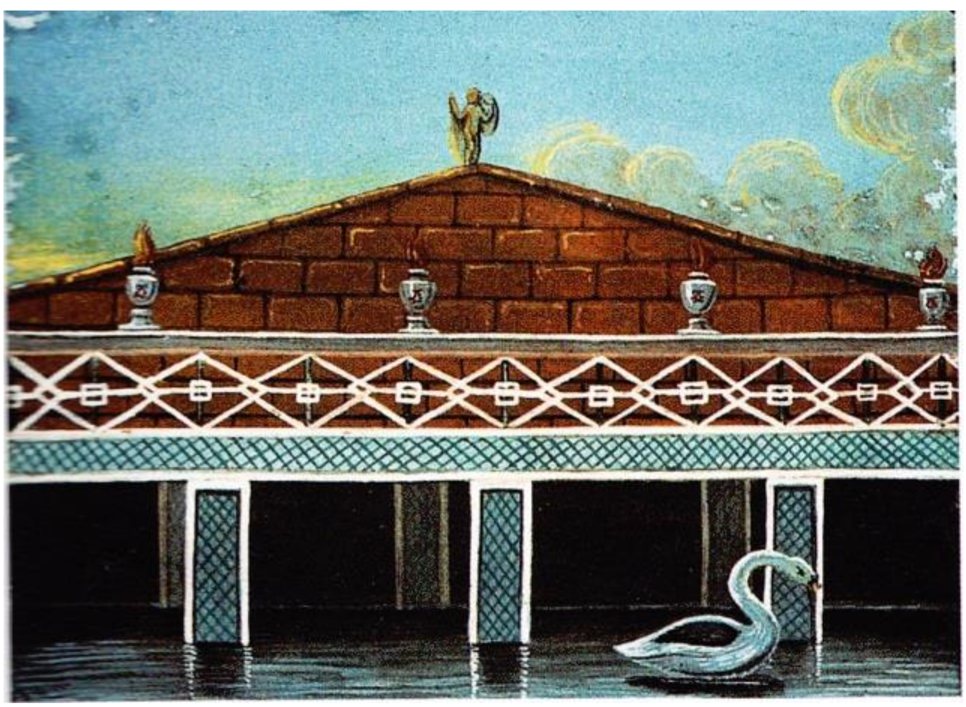

Fig. 8-33 The Chinese Bridge with Swan Boat,[217]

[216] Image Archive of the Old Collection in Saarland Museums, Skalecki 1999, p. 225

[217] Detail from fig.8.30. Paul 2009, p. 257

Fig. 8-34 The Three Stream Bridge[218]

Fig. 8-35 The Chinese Roof Bridge[219]

218 Detail from fig.8.30. Paul 2009, pp. cover

219 Detail from fig.8.30. Paul 2009, p. 258

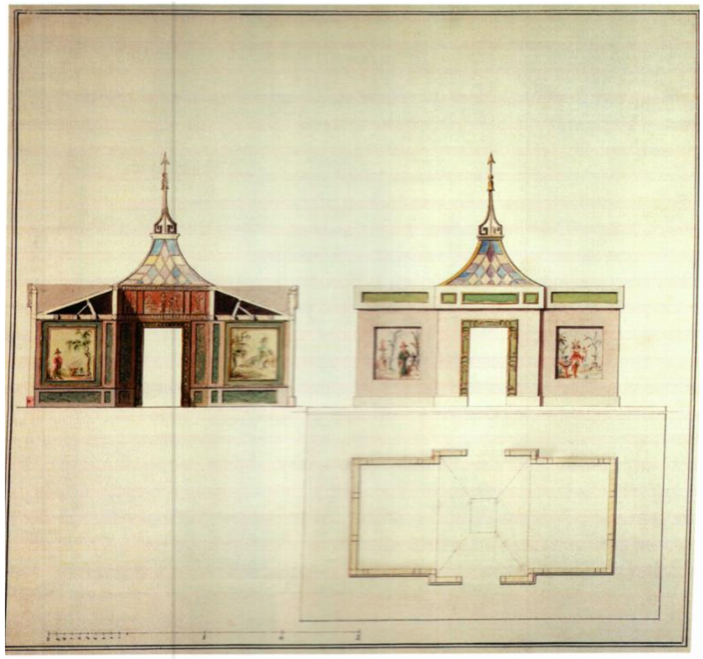

Fig. 8-36   Pleasure House Adolfsfreude, Balthasar Stengel, c.1790[220]

Fig. 8-37   The Clock Tower, Balthasar Stengel, Color Feather Pen, 1789-1791[221]

[220] Paul 2009, p. 45

[221] Art Library, Berlin, Cat. Nr.72. Paul 2009, p. 49

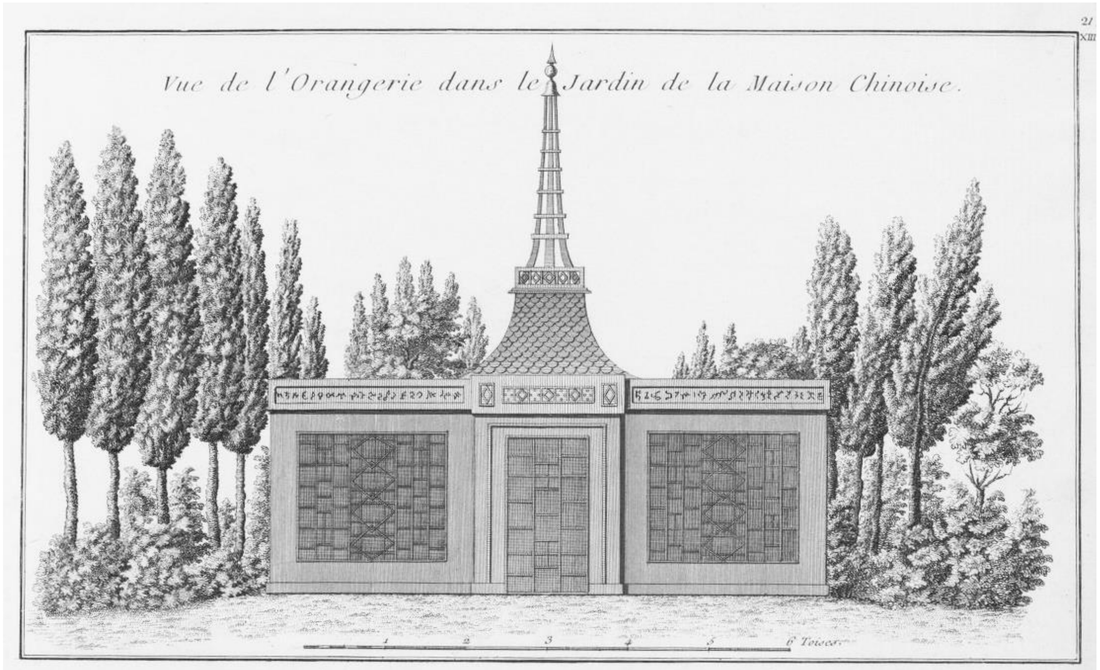

Fig. 8-38 The Chinese Orangerie in the Garden of Désert de Retz[222]

[222] Le Rouge, Chambers 1775, pp. XII Cahier, 21

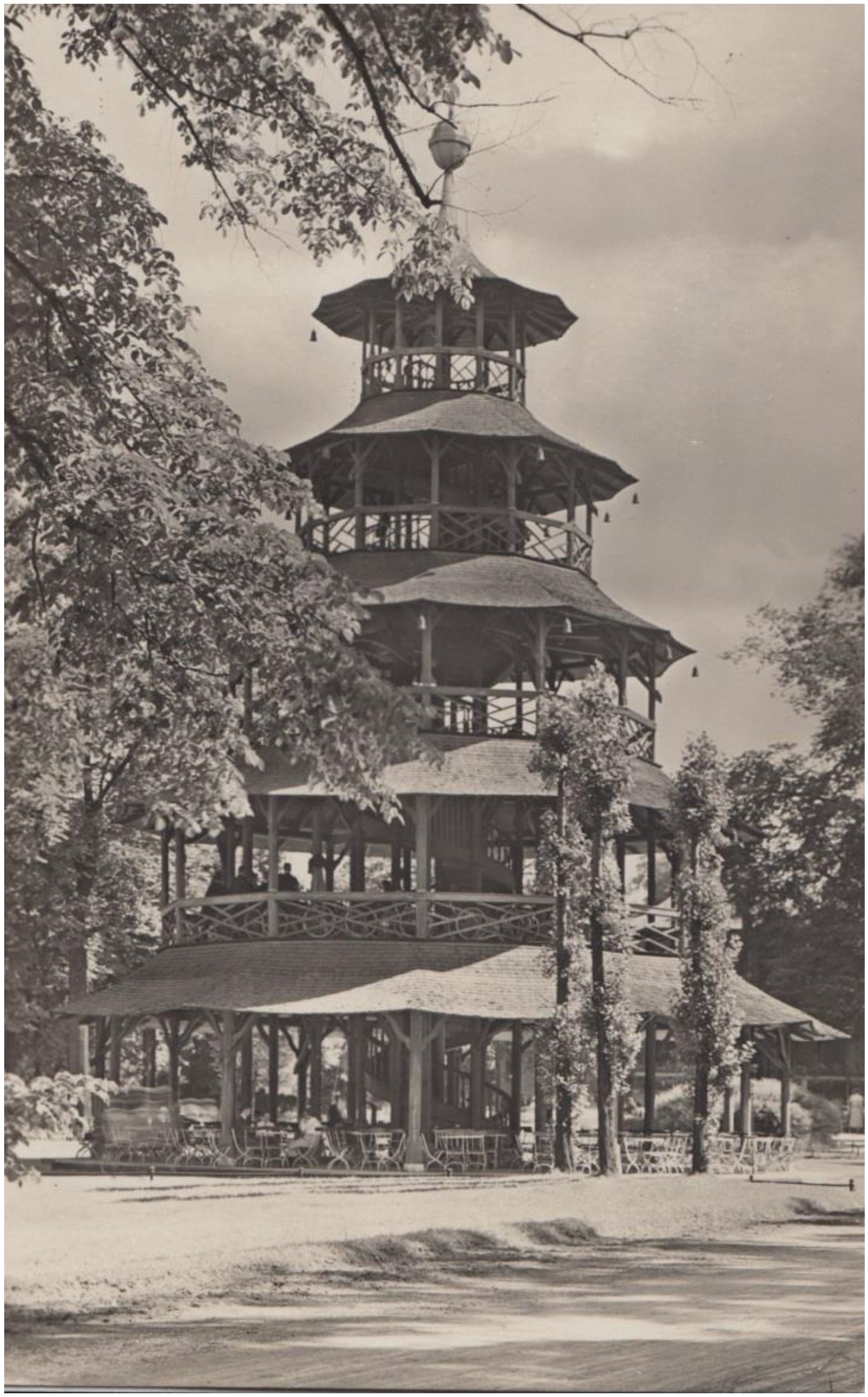

Fig. 8-39 The Chinese Tower in the English Garden, Munich, c. 1932[223]

[223] Provided by Bavarian Palace Administration, the Department of Garden

Fig. 8-40 The Chinese Tower and the Chinese Restaurant, Carl August Lebschée, Aquatint, c.1835[224]

[224] Schmid 1983, pp. 46−47