STUDIES IN DENDRO-EGYPTOLOGY:
THE LABORATORY OF TREE-RING RESEARCH EGYPTIAN WOODEN COLLECTION

by

Hend Ali Ahmed El Sherbiny

A Thesis Submitted to the Faculty of the

DEPARTMENT OF GEOSCIENCES

In Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENE

In the Graduate College
THE UNIVERSITY OF ARIZONA
2015

STATEMENT BY THE AUTHOR

This thesis has been submitted in partial fulfillment of requirements for the Master of Science degree at The University of Arizona and is deposited in the Antevs Reading Room to be made available to borrowers, as are copies of regular theses and dissertations.

Brief quotations from this manuscript are allowable without special permission, provided that accurate acknowledgment of the source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the Department of Geosciences when the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

Hend Elsherbiny 5/18/15

APPROVAL BY RESEARCH COMMITTEE

As members of the Research Committee, we recommend that this thesis be accepted as fulfilling the research requirement for the degree of Master of Science.

Ronald H Turner 5/18/15

Major Advisor

5/18/15

5/21/15

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

There is an urgent need to establish a dendrochronological record for ancient Egypt. I have chosen this topic in order to explore the possibility of establishing a master chronology from ancient Egypt. This study focuses specifically on dendrochronological analyses of ancient Egyptian artifacts and will identify the main types of wood resources with the highest dendrochronological potential for ancient Egyptian periods. This study concerns the practicalities for building a tree-ring chronology for ancient Egypt, introduces a need for a Dendro-Egyptological approach which uses the principles of dendrochronology in combination with Egyptology, and draws parallels with dendroarchaeological research across the United States. This study starts out by shedding light on the past work of dendrochronology and dendroarchaeology in Egypt. Then wooden samples in the Laboratory of Tree-Ring Research (LTRR) are examined with a reference to the Arizona State Museum (ASM) Egyptian wooden collection. The LTRR data set is conducted to reveal any implications for Dendro-Egyptology and interpret evidence for early timber trade in ancient Egypt. Then this study concludes with a discussion of the future directions for Dendro-Egyptology. The goal of this thesis is to provide a framework for developing Dendro-Egyptology.

Chapter 1

Introduction

Dendrochronology, the science of dating tree rings, was developed in the dry environment of the American Southwest when tree-ring research was used in combination with archaeological data to understand the timing past human and environment interactions (Bannister et al. 1998: 311; Cowie 2013; Dean 1996; Douglass 1929; Haury 1935: 98; 1962; Judd 1962; Nash 1998: 261-263; 1999; 2000; Nash and Dean 2005; Reid and Whittlesey 2005; Schweingruber 1988; Speer 2010; Touchan and Hughes 2009; Webb 1983). Since that development, a similar pattern has been repeated in archaeological contexts all over the world (Bannister 1970: 1), and dendroarchaeology has become a discipline in its own right. In the Mediterranean area (Rich 2013) considerable progress has been made in constructing long tree-ring chronologies and using tree-rings to date sites and buildings (Cichocki et al. 2004: 840; Kuniholm and Striker 1987; Lev-Yadun 1992; Lev-Yadun et al. 1996; Liphschitz 1986; Touchan et al. 1998). In Egypt (Figure 1.1) where the potential is promising, however, very little dendrochronological work has been conducted. The goal of this thesis is to provide a framework for developing dendro-Egyptology. I begin by analyzing Egyptian wood and artifacts housed at the LTRR and ASM. If these samples are appropriate tree species, and retain other attributes of dendrochronologically useful species (Ahlstrom 1985; Speer 2010; Towner 2002).

Dendrochronology is not well-known in Egypt for a number of reasons. Archaeologists still rely on Egyptian chronologies (see appendix) based on ancient textual sources such as Egyptian *Royal Annals*, the *Royal Canon of Turin*, *King Lists* and Manetho's *Aigyptiaka*, (see Hornung et al. 2006). Classical and Near Eastern archaeologists also rely on textual evidence (for

Near Eastern texts, see Kitchen 2013); and do normally apply other dating techniques such as radiocarbon (Bronk Ramsey 2013: 29-30).

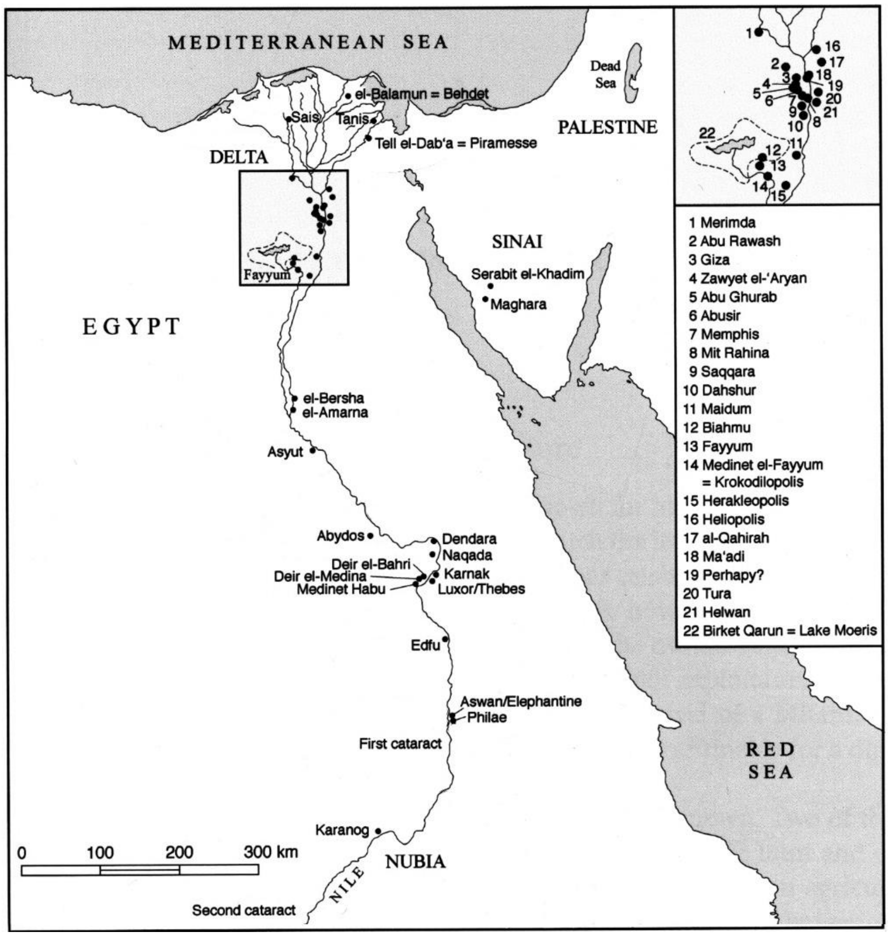

Figure 1.1: Map of Egypt showing archaeological sites (mainly based on Baines 2013)

The material culture of Egypt, such as the Pyramids, the Great Sphinx at Giza, mummies, and treasures of the golden King Tutankhamun, has captivated the world and inspired generations of archaeologists, and is simply, in many cases, too precious and sacred to be used for dendrochronological analysis. The potential of other materials (structural timbers, etc.) has not yet been realized because the technique is not widely known in Egypt and training is not provided for field archaeologists. It is very strange that although dendrochronology was invented in Arizona decades ago, it is still not common in Egypt (Cichocki 2006: 365-366). The reason for this is mainly due to the fact that some Egyptologists believe that Egyptian chronology is stable and accurate, although that is not really the case (Shaw 2000; Hornung et al. 2006; Kitchen 2013).

To follow the model of Douglass, Bannister, and American southwestern archaeology in general (Bannister 1962; Bannister and Robinson 1975; 1992; Cordell and Fowler 2005; Dean 1978; Douglass 1929; Haury 1935: 98-99; 1962; 1994; Reid and Whittlesey 2005), the beginnings of a tree-ring record for Egypt should logically be rooted in long-lived trees that are growing in the larger region today (compare Dunwiddie 1979). Some potential for this lies in the long lived *Juniperus phoenicea* of the Sinai Peninsula (El-Bana et al. 2010; Shmida 1977), some of which have been shown to live for more than 800 years, but their rings are often very difficult to analyze. I might be able to cross-match such samples with material from other areas — e.g. Jordan (Touchan et al. 1998), but that has yet to be attempted.

Figure 1.2: A wooden piece from Acacia Tree from a Beam from Djoser Complex, Saqqara, Third Dynasty, Old Kingdom (photo by the author).

Applying dendrochronology to Egyptian material culture has encountered some problems. Cedar and juniper have been successfully crossdated, both long lived trees that grow near each other in places such as the mountains of Lebanon, the Taurus Mountains of Turkey, and Cyprus (Kuniholm et al. 2007; Kuniholm et al. 2014: 94). Indigenous Egyptian wood (Figure 1.2) such as sycamore, tamarisk, and acacia depend on the water flow in neighboring canals rather than on prevailing climate (Kuniholm et al. 2014:94). In most museum collections of Egyptian artifacts, the word “wood” is used in description rather than identifying the exact species names (Bassir 2013). The labels for Egyptian wooden artifacts is often written as “wood” without identifying wood species. It seems that Egyptologists probably think that all kinds of indigenous wood are the same. Most of Egyptian wooden artifacts are made of acacia. Carrying out dendrochronological work on indigenous Egyptian wooden species is problematic because Kuniholm has examined more than 1000 samples of acacia for dendrochronological potential without success (Kuniholm et al. 2014:94). I also counted the rings of a cross-section from an acacia tree from Saqqara, collected in 1931 from a beam from the funerary complex of King Djoser, Third Dynasty-Old Kingdom (Figure 1.2). Each time I counted a different number of rings because ring boundaries are either invisible or partially invisible, and without identifying specific rings dendrochronology is not possible. Ten students were tasked with counting the rings on one of the sections Douglass collected in 1930s from an Egyptian pyramid; they generated 10 different counts (Kuniholm et al. 2014:95). Therefore, this study focuses on the LTRR samples of cedar or juniper, in addition to briefly shedding light on the ASM samples of indigenous wood.

Problem Statement

This thesis examines the LTRR wooden objects. Studying archaeological LTRR samples will help in determining the possibilities of conducting dendrochronological research on Egyptian wooden materials.

Thesis Outline

This thesis is presented in five chapters, including this introductory chapter. Chapter 2 presents briefly the past work of dendrochronology and Dendro-Egyptology. Chapter 3 describes the Laboratory of Tree-Ring Research (LTRR) Egyptian wooden collection and presents the implications of this research. Chapter 4 sheds light on ancient wood trade routes and wood species and uses in ancient Egypt. Chapter 5 concludes with the results of this research and suggests future directions and additions to Dendro-Egyptology.

Chapter 2

Past Work of Dendrochronology and Dendro-Egyptology

In this chapter, I introduce briefly the past work of dendrochronology and Dendro-Egyptology, outlining the pioneers of dendrochronology and their efforts to establish a dendrochronological sequence for Egypt.

Past Work of Dendrochronology

Dendrochronology is the study of tree time (Nash 2002:243), and can be described as a multidisciplinary science that provides chronological, behavioral, and environmental data to an astonishing variety of fields of inquiry such as "architectural analysis, biology, climatology, economics, ecology, fire history, forestry, geology, history, hydrology, pollution studies, political science, resource economics, sociology, volcanology, and other disciplines" (Nash 2002:243; Spear 2010). Ferguson (Ferguson 1970:183) indicates that "Dendrochronology or tree-ring dating" can be defined as "the study of the chronological sequence of annual growth rings in trees". The main task of this science is to create a calendar date for a wood or charcoal specimen (Stokes and Smiley 1996:xi). Because tree-rings offer essential information and insights into time and past events, dendrochronology can be utilized to date material culture, establish chronologies, and define sequences. In this sense, archaeologist Fay-Cooper Cole of the University of Chicago confirms that "Chronology is the soul of archaeology" (Nash 1998:261-262). By the mid-20th century, dendroarchaeology became very important among archaeologists as a tool in dating material culture (Baillie 1982; Bannister 1962:508; Bannister and Robinson 1992; Dean 1978, 1996; Haury 1935:98-99; Kuniholm 2001, 2002; Speer 2010; Towner

2002:68). Although several decades have passed since this science was established, dendrochronology is still a relatively new science. Stokes and Smiley (1996:xv) state that:

> Dendrochronology, or tree-ring dating as it is often called, is defined as the study of the chronological sequence of annual growth rings in trees.

It is pointed out that “Dendrochronology has gained recognition among archaeologists as an accurate tool for chronological control” (Speer 2010:152). Haury (1935:98-99) referred to the importance of tree-rings in archaeology as a potential tool for archaeologists to use in dating. More than a half century later, Dean (1978) stressed the significance of using tree-rings in dating archaeological material. It is stated that tree-rings have been used “to verify the dating of historical works of art” and “to determine the origin of and trade routes for wood that has been incorporated into artifacts” (Speer 2010:152).

The principles of crossdating were discovered by Douglass in the last century when he recognized that accurate annual dating of tree rings could be achieved by matching patterns of narrow and wide rings across trees at a site (Maxwell et al. 2011:237). He could relate dendrochronological principles to history, climatology and astronomy. In 1914, Douglass began to date wood from various historical and archaeological sites. He had collecting pieces from different regions since 1911, when he recognized the importance of crossdating long before others in that field (Kuniholm 2001:3; Schweingruber 1988:257-258).

Finally, it is very important if interpreting the tree-ring dates to understand (1) past human behavior (past human behaviors as well as archeologist and dendrochronologist behaviors) (Dean 1996; Towner 2002:79), (2) the past environment (tree species affected by ancient people may refer to local species availability, and archaeological tree ring samples can be used to reconstruct past precipitation and temperature regimes and also to identify past climatic severe events) and,(3), the interaction between past human behavior and environment (Towner 2002:77).

Past Work of Dendro-Egyptology

In terms of applying dendrochronology to Egyptian material culture, some dendrochronologists have been interested in exploring the possibility of establishing a dendrochronology for ancient Egypt for decades. I here present what they have done and comment on some of their pioneering works in order to shed light on the new field of Dendro-Egyptology.

A.E. Douglass (1867-1962): The Father of Dendrochronology

A.E. Douglass is the Father of Dendrochronology. By the early 1920s, Douglass had pioneered the science of dendrochronology, most importantly, the principle of crossdating which he applied to a variety of different disciplines from climatology to astronomy to archaeology. He established the LTRR at the University of Arizona in 1937. During the developmental LTRR phase from 1930 to WWII, it has been pointed out that:

> Douglass pursued a passion for replicating dendroarchaeological successes in other parts of the world, specifically the Near East. His personal correspondence before WWII explores this prospect. The idea of being able to establish tree-ring dates, especially for ancient Egyptian material was a very exciting, even romantic prospect. Douglass, while consulting with James Henry Breasted of the University of Chicago … and other prominent Egyptological institutions, developed a feasibility study of ancient Egyptian wooden sarcophagi. The initial study went well ... Yet, before the specimens could be properly analyzed and substantial progress towards a chronology achieved, WWII intervened, and this prospect remains unrealized (Creasman et al. 2012:85).

Later, that passion for the Near East would inspire Bannister to conduct extensive dendrochronological work in that important region of the ancient world (Bannister 1970:1;

Bannister and Robinson 1975:213). In the 1920s, Douglass contacted several Egyptologists exploring the probability of establishing chronology for ancient Egypt based on dendrochronology. By 1932, Douglass, in consultation with numerous members of the Egyptological and museum communities, believed that enough amount of wooden material already existed in the museums of the world to make significant advance (Breasted 1933; Douglass 1932).

In the 1930s, Douglass conducted a small feasibility study to crossdate tree-ring specimens of Egyptian coffins in American museums (Touchan and Hughes 2009). This occurred in the LTRR development from year 1930 to WWII (Douglass 1929; Creasman et al. 2012:81-82). Douglass tried to employ a technician to establish a chronology for Egypt based on dendrochronology, but, the technician accepted another position to work in the Southwest (Douglass 1936; Nash 1999). In 1937, Douglass established the LTRR at the University of Arizona (UA) and became its first director until his retirement in 1958 (Creasman et al. 2012:82). As a result of this passion, in 1938, Douglass received ten specimens from the Eleventh Dynasty coffin of Ipi-Ha-Ishutef (OIM 12072) from J. Wilson, director of the Oriental Institute (OI) of the University of Chicago (Teeter 2011). Douglass conducted dendrochronological work on this coffin to crossdate the specimens, but the project stopped due to the outbreak of WWII.

E.W. Haury (1904-1992): The Southwest Archaeologist

E.W. Haury received his BA degree in 1927 and his MA degree in 1928. Then he started teaching at the Univeristy of Arizona Department of Archaeology in the academic year 1928-1929 (Reid 1993:245-246). The following year (1929) he worked with Douglass (Bannister and Robinson 1992; Reid and Whittlesey 2005). Haury had hoped to write a dissertation on the application of tree-ring dating in Egypt (Thompson et al. 1997:158-159). In the 1930s, he gathered successfully wooden specimens from the ancient Egyptian collection at the Museum of Fine Arts in the city of Boston, stating that, "I believe it is not unlikely that tree-rings might well substantiate and possibly amplify" the chronological timetable of Egypt in the ancient phase of its long history (Haury 1935:108). However, he worked on a large collection from southern Arizona and earned his Ph.D. in anthropology on the classic period of the Hohokam culture in 1934. Thus, his research on Egyptian material was short-lived.

B. Bannister (1926-): The Student of Douglass

B. Bannister was a student of Haury and research assistant for Douglass (Touchan and Hughes 2009). As a student of Douglass (Bannister et al. 1998), the same passion for the Near East inspired Bannister; therefore, he conducted extensive dendrochronological work for archaeological tree-ring dating in that region of the ancient world (Bannister 1970; Bannister and Robinson 1975; Touchan and Hughes 2009).

In the 1960s, Bannister visited Egypt and collected and examined tree-ring specimens from pyramids and coffins. For example, he examined specimens from the pyramids of the Fourth Dynasty king Sneferu (c. 2613-2589 BC) in Dahshur (Kuniholm: Personal Communication, February 2014), in order to set up a systematic tree-ring dating of ancient Egyptian archaeological sites (Bannister 1970:7; Touchan and Hughes 2009). He confirmed the viability of cedars (*Cedrus libani*) imported in antiquity for crossdating (Bannister 1970:7; Touchan and Hughes 2009). Bannister (1970:7) concludes:

> The establishment of absolute tree-ring dates for ancient Egypt might eventually be possible and the securing of core samples from living cedars of Lebanon would constitute a logical first step.

After analyzing those specimens that Bannister collected, Dean referred to the possibility of future successes in this area (Dean 1978). Then P.I. Kuniholm took over.

P.I. Kuniholm (1937-): The Head of the Middle Generation

P.I. Kuniholm has developed Aegean and Eastern Mediterranean dendrochronological and dendroarchaeological sequences. In the 1970s, he was inspired by the work of Bannister at Gordion in Turkey and decided to conduct an extensive project by creating the basis for dendrochronology in the ancient Near East on a large scale. He began by building chronologies of living trees from several forests from southern Italy to eastern Turkey (Kuniholm and Striker 1987; Kuniholm 1990b, 1994; Touchan and Hughes 2009). Kuniholm started the Aegean dendrochronology project with his Ph.D. dissertation on this region of the ancient world. He also founded the Cornell Dendrochronology Laboratory (now the Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology) in 1976, creating the field of archaeological dendrochronology of the Mediterranean and Near East. He was encouraged by Bannister and Dean to establish dendrochronology for ancient Egypt, and as a result, he collected a significant set of ancient Egyptian wood specimens from American museums. In 1973, he showed interest in conducting dendroarchaeological work on ancient Egyptian material culture (Kuniholm: Personal Communication, February 2014) [Figure 2.1].

Figure 2.1: A capital face of the goddess Hathor, Dynasty XXX, in the Metropolitan Museum of Art in New York (after Kuniholm et al. 2014:96; used by permission).

He worked on a Twelfth Dynasty Dahshur boat (Carnegie Museum of Natural History in Pittsburgh 1842-1) and a likely Eleventh Dynasty Sakkara coffin (OIM 12072), attempting to crossdate two floating cedar chronologies from these two sites and dynasties of ancient Egypt (Kuniholm 1990a, 1991, 1992, 2007), both recently radiocarbon dated and discussed by Manning et al. (2014). In the 1990s, Kuniholm studied the coffin of Ipi-Ha-Ishutef (OIM 12072) (Figure 2.2-2.3), and conducted dendrochronological work on it (1990a, 1991:3, 1992:459-460, 2007:369-370). In 1991, he states that:

> I was able to crossdate the innermost rings of the Da[h]shur Boat (in the Carnegie Museum in Pittsburgh) with a sequence from the coffin of Ipi-ha-Ishutef, an army clerk of Dynasties IX/X (in the Oriental Institute of the University of Chicago). This is the first time that we have been able to achieve inter-site crossdating of cedar wood found in Egypt (but undoubtedly imported from Lebanon).

Figure 2.2: Part of the lid of Ipi's coffin (left) and the Dahshur boat during reassembly (right below) in Pittsburgh and after reassembly (right above) (after Kuniholm et al. 2014:98; used by permission).

Kuniholm's work suggested the coffin of Ipi a year date of 2076 BC (Kuniholm et al. 2014). A recently proposed radiocarbon range dated this coffin from 1883-2063 BC (Manning et al. 2014:405-406), very close to Kuniholm's measurement date. Kuniholm's work gave the Dahshur boat a year date of 1883 BC, while the Manning et al. (2014:406) is 2 years outside the proposed radiocarbon range from 1898-1885 BC. No terminal rings or waney edged are present on either the coffin or the boat, therefore these are *terminus post quem* dates (Kuniholm et al. 2014:99).

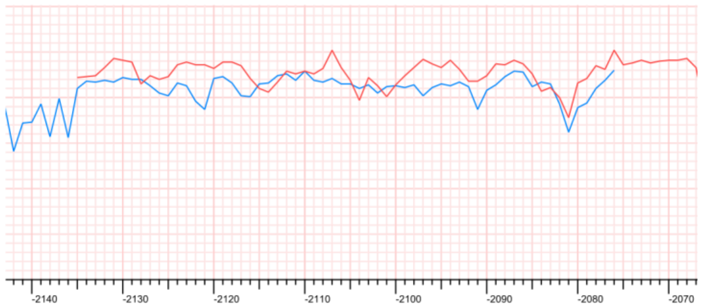

Figure 2.3: Screen shot of CHI4&5.14C (Ipi, in blue) versus PIT555.mwn (Dahshur, in red) (after Kuniholm et al. 2014:99; used by permission).

Conclusions

Dendrochronology has been very successful in the US Southwest. Although many attempts have been made by serious scholars on Egyptian wooden material, Dendro-Egyptology is still not flourishing as a solid discipline; much work needs to be done until it becomes an accepted and deeply rooted field. The situation in the US Southwest is very deferent from that of Egypt. In US Southwest, the local wood has been used to establish master chronologies; in Egypt local wood which the ancient Egyptians used to make their artifacts is inadequate for establishing a master chronology. There are no long-lived trees, and sampling existing structures–such as mosques and other historic buildings, is not feasible. One possible avenue of research for establishing a dendrochronological sequence for Egypt, however, is analysis of existing collections.

Chapter 3

Analysis of the LTRR Egyptian Wooden Collection

In this chapter, I present results of my analysis of Egyptian wooden material culture housed in both LTRR and ASM. The LTRR collection is mainly cedar/juniper and some local wood, while the ASM collection is comprised of indigenous wood.

The LTRR Collection

The LTRR collection consists of varied items of wooden material that have been collected from Egypt and are now housed in several American museums (Table 3.1). They are funerary items in nature and belong mainly to nonroyal elite members from different ancient Egyptian periods.

Table 3.1: Descriptions of wood elements at the LTRR.

Species No.	Species	Form	Provenience	Date collected	Collected By	Number of Rings	Remarks
EGY-1	Acacia?	X Sec. WD	Side wall, from Zoser's tomb, Saqqara. Third Dynasty (ca. 3000-2800 B.C.)	1931	P. Duell	Hard to count the rings, some are visible and many are invisible.	Well sanded XSec. With inc. bark, cracks in the wood.
EGY-2	Cedar	WD	Plank from El Bershah (from Museum of Fine Arts, Boston)	1932	E. Haury	58 rings	XII Dynasty (ca. 2000 B.C.) Undefined small piece of wood.

EGY-3 (OI-1)	Cedar	½″ Core	Wide edge-board from top of coffin (from Oriental Institute Museum, Chicago)	1938	W. Boyes	117 rings	
EGY-4 (OI-2)	Cedar	½″ Core	Egyptian coffin, Narrow outer broad of top. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	110 rings	
EGY-5 (OI-3)	Cedar	½″ Core	Egyptian coffin. Wide edge-board from top of coffin (from Oriental Institute Museum, Chicago)	1938	W. Boyes	93 rings	
EGY-6 (OI-4)	Cedar	½″ Core	Egyptian coffin. Left end top front broad. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	72 rings	
EGY-7 (OI-5)	Cedar	½″ Core	Egyptian coffin. Upper broad front, near eyes. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	65 rings	1″ short of middle

EGY-8 (OI-6)	Cedar	½″ Core	Egyptian coffin. Top board back. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	77 rings	
EGY-9 (OI-7)	Cedar	½″ Core	Egyptian coffin. Bottom board, back. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	50 rings	
EGY-10 a & b (OI-8a & b)	Cedar	½″ Core	Egyptian coffin. Lower board, right end. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	10 a has 72 rings, 10b has 81 rings	
EGY-11 (OI-9)	Cedar	½″ Core	Egyptian coffin. Top board, right end. (From Oriental Institute Museum, Chicago)	1938	W. Boyes	66 rings	
EGY-12 (OI-10)	Cedar	½″ Core	Egyptian coffin. Top board, left end. (from Oriental Institute Museum, Chicago)	1938	W. Boyes	42 rings	
EGY-13 a & b	Unk.	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman		Two pieces of a broken; not well sanded core.

EGY-14 a & b	Unk.	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman		Two pieces of a broken core; not sanded.
EGY-15 (BOS-1)	Unk.	WD Block	From Museum of Fine Arts, Boston	1938	E. Schulman	66 rings Mostly complacent rings	Almost rectangular piece of wood. It has two holes in its side surface for dowels. One hole contains the dowel and it comes out from the other side. The other hole does not have the dowel.
EGY-16 (BOS-2)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman		6 pieces of EGY-16. The rings are complacent; not sanded; local wood? Hard to see.
EGY-17 (BOS-3)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	The well sanded side has 50 rings	Undefined shape of 7 sides, The dowel still in.
EGY-18 (BOS-4)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman		Not found in the collection.
EGY-19 (BOS-5)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	51 rings	Undefined shape of 7 sides, the side contains the rings almost rectangular. There is also another small square piece of EGY19 and it is not sanded.
EGY-20 (BOS-6)	Unk.	WD block	From Museum of Fine Arts, Boston	1938	E. Schulman		Not sanded so it is hard to see.
EGY-21 (BOS-7)	Unk.	WD	From Museum of	1938	E. Schulman	42 rings	A six sided undefined shape

			Fine Arts, Boston				It has a big hole near the middle- it is the other part of EGY-22.
EGY-22 (BOS-8)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	The well sanded side has 63 rings; mostly complacent	Almost a six sided shape; one side has two holes with their dowels. The wood has a hole in the middle and a crack.
EGY-23 (BOS-9)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	Two sides were sanded. The well sanded one has 111 rings. There is another rectangular piece of wood labeled EGY-23? With two sanded sides the well sanded side has 53 rings and it has four holes.	Almost a square piece of wood, has two holes in the middle and another two holes one at each side.
EGY-24 (BOS-10)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	It has two sanded sides, the well sanded one has 52 rings.	A rectangular piece of wood with three holes in its surface.
EGY-25 (BOS-11)	Unk.	WD shingle	From Museum of Fine Arts, Boston	1938	E. Schulman	47 rings	A square piece of wood has one well sanded side.

EGY-26 (BOS-12)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	It has two sanded sides. The well sanded side has 128 rings.	Almost square piece of wood; has two tiny holes near the side, and one a little big hole near the middle for dowels? And another big hole in the other side.
EGY-27 (BOS-13)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman		Almost rectangular piece of wood, not sanded
EGY-28 (BOS-14)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman		Not found in the collection.
EGY-29 (BOS-15)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	The well sanded side has 110 rings.	A square piece of wood from a coffin? It has a small hole at the not sanded side.
EGY-30 a? (BOS-16)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	The well sanded side has 28 rings.	A six sided shape (rectangular?), it has three holes for dowels in one side, in the other side it has two holes.
EGY-30 b? (BOS-16)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	The well sanded side has 31 rings.	A six sided piece of wood; has two small holes in one side contains the dowels, and three small holes in the opposite side with no dowels. In the wide side there are two holes the small one has its dowel in as well as the big hole.

EGY-30 c? (BOS-16)	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman	100 rings	A rectangular piece of wood; it has a big hole near the middle, and a small hole near the side.
EGY-31 (BOS-17)	Unk.	WD block	From Museum of Fine Arts, Boston	1938	E. Schulman		Not found in the collection.
EGY-32 (BOS-18)	Unk.	WD block	From Museum of Fine Arts, Boston	1938	E. Schulman		The piece is not sanded so it is hard to read the rings.
EGY-33 (BOS-20 ?)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	95 rings	EGY 33-EGY 46 pieces from the same coffin.
EGY-34 (BOS-21)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	92 rings	
EGY-35 (BOS-22)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	115 rings	
EGY-36 (BOS-23)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	163 rings	
EGY-37 (BOS-24)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	78 rings	
EGY-38 (BOS-25)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	85 rings	
EGY-39 (BOS-26)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	196 rings	
EGY-40 (BOS-27)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	206 rings	The core is in two pieces.

EGY-41 (BOS-28)	Cedar	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	90 rings	Note on envelope: INSFT (carrying pole “In coffin lid about 50 rings from center of tree by count. See BOS-29 (EGY-42) for sequence to center-same lid.”
EGY-42 (BOS-29)	Cider	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman	116 rings	Note on envelope: inside about 508 rings. From center of tree-radial is 180º from BOS-28 (EGY-41) and 7.5´ along trunk (probably toward base, but not certain).
EGY-43 (BOS-30)	Cider	½″ Core	From Museum of Fine Arts, Boston	1938	E. Schulman		Broken into 10 small fragments Doubtful 16 repairable note on envelope “same end of 21.965 as BOS 28 (EGY-41) but coming in from coffin edge as BOS 29 (EGY-42).”
EGY-44	Cedar	WD CNIPS (2)	From Museum of Fine Arts, Boston	1938	E. Schulman		Two fragments. Note on envelope:” to CNIPS from neighboring plank, in process of getting start on boring for BOS-28(EGY-41).” See drawing on core EGY-41
EGY-45	Unk.	WD	From Museum of Fine Arts, Boston	1938	E. Schulman		A tiny square un sanded piece of wood. Probably from VII to IX Dynasty.

EGY-46 (DD-1)	Unk.	Wood block	From Museum of Fine Arts, Boston	1942	D. Dunham	35 rings	Note on envelope: "Egyptian coffin wood given by Dunham, Boston Museum May 1, 1942." Almost a small square piece of wood
EGY-47	Unk.	WD	Egypt	?	Wilson & Burtch		Note says" from Dr. Wilson and N. P. Burtch" Egyptian wood. Date not known; could be as late as Roman times."
NA-1	*Ficus sycomo rus L.*	XS	Egypt, Cairo, Matariya tree	1965	B. Bannister		
NA-2	*Ficus sycomo rus L.*	Core SIC	Egypt, Cairo, Matariya tree	1965	B. Bannister		Same tree as NA-1
NA-3	Acacia?	½″ Core frag.	Egypt, Meidum Pyramid	1965	B. Bannister		Decayed, in very bad condition
NA-4	Juniper	½″ Core frag.	Egypt, Meidum Pyramid-shaft leading to main chamber.	1965	B. Bannister		Fragments, 2 pieces.
NA-5	Juniper	½″ Core frag.	Egypt, Meidum Pyramid-shaft leading to main chamber.	1965	B. Bannister		8 fragments of different lengths
NA-6	Juniper	½″ Core frag.	Egypt, Meidum Pyramid-shaft leading to	1965	B. Bannister		

			main chamber.				
NA-7	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		A note on an empty envelope said NA-7
NA-8	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Probably lost in 3/82 fire. A note on an empty envelope said NA-8, 9, 10
NA-9	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Missing, lost while on loan to Cornell, stated by P. P. Creasman
NA-10	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Probably lost in 3/82 fire
NA-11	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Missing, lost while on loan to Cornell, stated by P.P. Creasman
NA-12	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965/6?	B. Bannister		Missing, lost while on loan to Cornell, stated by P.P. Creasman
NA-13	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Missing, lost while on loan to Cornell, stated by P.P. Creasman
NA-14	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Missing, lost while on loan to Cornell, stated by P.P. Creasman
NA-15	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister	175 rings	
NA-16	*Juniperus* sp.	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Missing, lost while on loan to Cornell, stated by P.P. Creasman
NA-17	Juniper	½″ Core	Egypt, Dahshur, S. Pyramid	1965	B. Bannister		Missing, lost while on loan to Cornell, stated by P.P. Creasman

NA-18	Unk.	3 frags, small	Egypt, Saqqara, Southern Tomb near the Step Pyramid of Zoser.	1965	B. Bannister	
NA-19	Unk.	Frag. (1/3 XS)	Egypt	1965	B. Bannister & H. Michael of Univ. of Penn.	Floater, from S. Pyramid, collected for C-14

Kuniholm and Newton worked on building chronologies constructed from Egyptian materials collected by Douglass, Bannister, and others (Kuniholm: Personal Communication) [Table 3.2].

Table 3.2: Chronologies made by Kuniholm and Newton (Kuniholm: Personal Communication)

	Senwosret III's Boat	Djehutynakht's Tomb, Tomb 10 A	Ipihaishutef's Coffin	Sneferu's Bent Pyramid	Sneferu's Meidum Pyramid
Source	Dahshur	Dayr al-Barsha, Middle Egypt	Provenance unknown, probably Saqqara	Dahshur	
Current Location	Carnegie Museum, Pittsburgh, Cornell	MFA, Boston	Oriental Institute, University of Chicago, Lab of Tree Ring Research, University of Arizona	LTRR	LTRR
Species	Cedar	Cedar	Cedar	Juniper	Juniper

Approximate Dating	Dynasty 12, Senwosret III	Dynasty 11	Dynasties 9-10 (2213-2035 BC), according to the chronology of K. Baer	Dynasty 4	Dynasties 3 and 4
Notes	A 322 year long integrated cedar chronology from 8 trees. The samples from this group included an additional sample of deck planking that is 410 years long, but does not fit with the other samples. Cuttings on its under-side suggest that it is reused.	A 222 year long cedar chronology from sequences from the lid to Djehutynakht (male) inner coffin, the lid to Djehutynakht (female) outer coffin and some of the cedar planks/ blocks from object # 155-638 (this object has not yet been positively identified as coming from Tomb 10 A).	Two cedar chronologies for this coffin have been established (CHI 345 is 145 years long and comes from planks from the coffin lid, CHI 444 is 83 years long and comes from planks of the coffin body). The two sequences do not crossdate with one another.	Two juniper chronologies have been established from logs from the upper chamber. One chronology developed from 4 different trees is 263 years long, the other chronology was developed from 3 trees and is 193 years long. Difficulties in crossdating may be due to the erratic nature of the samples near the ends.	A 137 year juniper sequence from one tree.

As shown above, the specimens from the coffin of the local governor, Djehutynakht and his wife (from Tomb 10A at Dayr el-Bershah, now at the Boston Museum of Fine Arts) include (EGY 33 to EGY 46), but only 11 cores show any dendrochronological potential. Kuniholm and Newton have analyzed these cores and crossdated three planks. If radiocarbon assays confirm the dendrochronological results —with multiple pieces and at least 222 years of overlap, possibly more —they would be able to report the dendrochronological dates next year (Kuniholm 2014 et. al.:100). Cores numbers EGY 33, 34, 37, 38 crossdated and may be from the same tree.

Out of 47 cores titled by EGY only 35 cores are useful for conducting dendrochronology and only one core out of 19 cores titled by NA is good for dendro work as follow: EGY 35, 36, 39, 40, 41, and 42 are crossdated and also may be from the same tree. EGY 21 and EGY 22 match. EGY 30a, b, c match EGY 24, 25, 26, 29. EGY 30a, b, c and EGY 29 are from the same coffin and tree. EGY 23 a, b match EGY 22, 15, 2. EGY 23a, b through EGY30a, b, c are from the same coffin and tree. EGY 19, 21, and 15 NA match. Below I present the coffin of Ipi-Ha-Ishutef (OIM 12072) as an applied case study for conducting Dendro-Egyptology on ancient Egyptian wooden material culture.

The Coffin of Ipi-Ha-Ishutef (OIM 12072): A Case Study

After examining the LTRR specimens, I identified ten samples as imported wood; probably cedar/juniper. Because it is a little bit hard to identify cedar and juniper under the microscope, I cannot distinguish between them. These samples are ideal for doing a dendrochronological work in the Levant. Therefore, I have examined them under the microscope and generated skeleton plots to check the ring definition and sensitivity, and to determine the number of rings.

I examined ten samples (EGY 3 to EGY 12) as a model for Dendro-Egyptology. These specimens came from a coffin that was excavated around the pyramid complex of king Teti (Dynasty Six, Old Kingdom) at Saqqara of the Memphite Necropolis (PM III[2]: 393-574; Firth and Gunn 1926: 61-65; Málek 1984: 409; Chauvet 2001).

The dendro-Egyptological study and analysis of wooden specimens taken from the coffin of the scribe and overseer of the expedition [or army], Ipi-Ha-Ishutef, (OIM 12072) , passed through several attempts without reaching or achieving its final goals. This coffin of Ipi-Ha-Ishutef (PM III[2]: 570) had been inscribed and decorated with textual and pictorial representations designed to assist the coffin owner in his afterlife. The interior of the lid contains funerary and magical spells used by non-royal elite members and known as Coffin Texts (Lesko 2001; Lichtheim 2006: 131 f.). The remainder of the coffin's interior bears depictions of items that the Ipi-Ha-Ishutef had used on earth and would need in the hereafter. The date of this coffin is the First Intermediate Period [specifically dynasties: 9-10]; however, Teeter (2011: 127, Fig. 51) attributes it to Dynasty 11 without providing any supporting evidence. As a result of that chaotic period, the Levantine timber which the ancient Egyptians had imported since ancient times stopped due to economic and security concerns. Therefore, the ancient Egyptians were forced to reuse the old timber they had found accessible in constructing their new wooden material culture (Lichtheim 2006: 83 ff.; Creasman 2013).

Methodology

The ten cores from this coffin were mailed in a wooden envelope from the Oriental Institute (OI) of the University of Chicago to Andrew Ellicott Douglass at LTRR in 1938.

Table 3.3: Specimen identification and descriptions

OI Number	LTRR Number	Core Location on Coffin
1	EGY-3	Lid – Right Side – Top
2	EGY-4	Lid – Right Side – Lower
3	EGY-5	Lid – Right Side – Middle
4	EGY-6	Front Board – Top – Left End
5	EGY-7	Front Board – Top – Right – Above the Eyes
6	EGY-8	Back Board – Top – Middle
7	EGY-9	Back Board – Lower – Left
8 A	EGY-10 A	Side Board – Right - Lower – Down
8 B	EGY-10 B	Side Board – Right - Lower – Up
9	EGY-11	Side Board – Right – Top – Middle
10	EGY-12	Side Board – Left – Top

Core Number 8 has two pieces, 8A and 8B; however, I only use the OI numbers throughout the study. Table 3.3 shows that the selected cores were taken from different spots on the coffin as requested by Douglass (Figures 3.1, 3.2, 3.3, 3.4). I skeleton plotted for each core. The ten counts on the cores refer to previous dendrochronological attempts on the coffin. The cores are well surfaced except for Core 1. I first introduce the photographs of the coffin and the locations of cores, then the scans of the cores and the skeleton plots done on them.

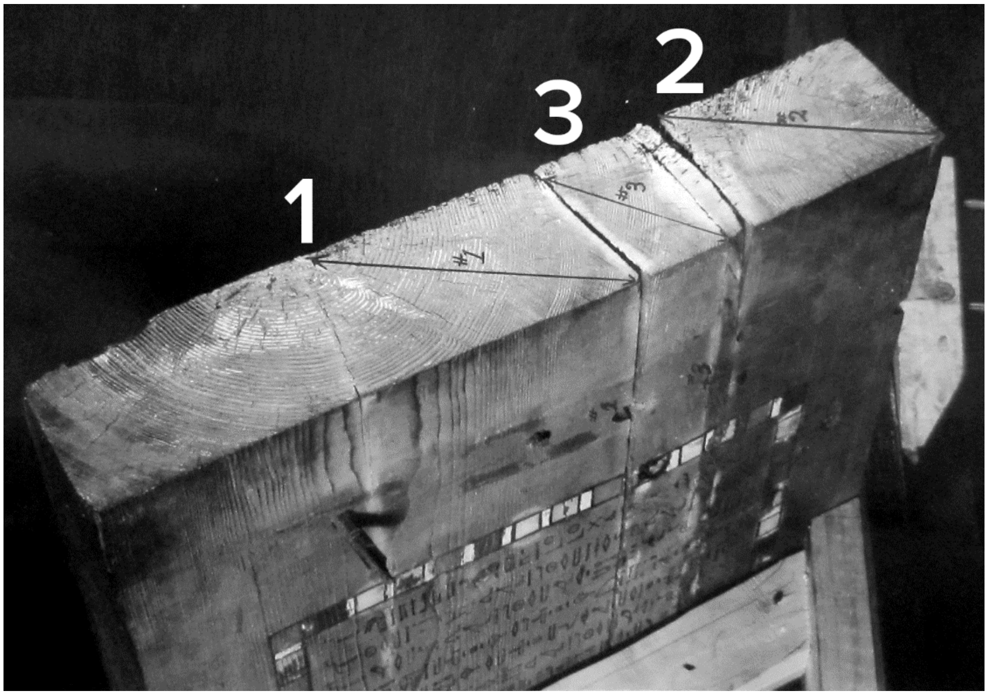

Figure 3.1: Location of cores 1, 2, and 3 on coffin OIM 12072 (courtesy of LTRR).

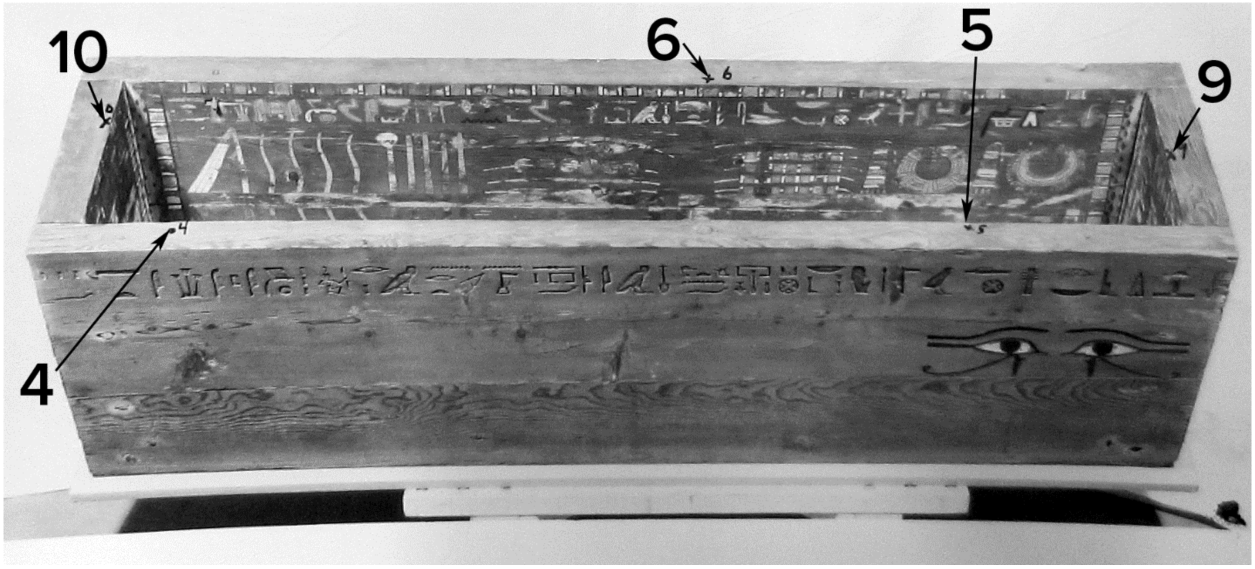

Figure 3.2: Location of cores 4, 5, 6, 9, and 10 on coffin OIM 12072 (courtesy of LTRR).

Figure 3.3: Location of cores 6 and 7 on coffin OIM 12072 (courtesy of LTRR).

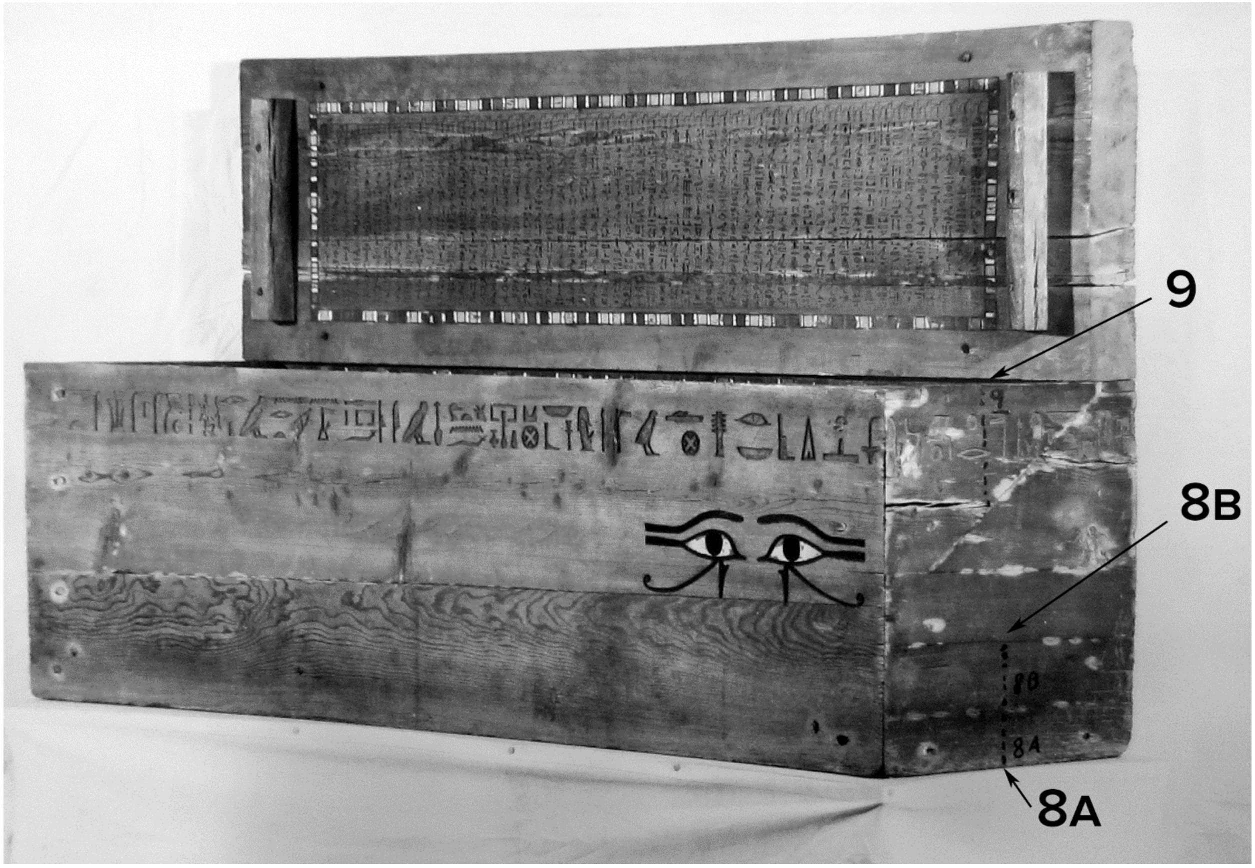

Figure 3.4: Location of cores 8 A, 8 B, and 9 on coffin OIM 12072 (courtesy of LTRR).

Results

The crossdating of the cores shows that some cores match with each other; as Cores 1, 2, and 3 show good cross match (Figures 3.5, 3.6), therefore, may be they were cut from the same tree; cores 4 and 9 also cross match (Figures 3.8). Cores 5 and 6 show some matching and were probably cut from the same tree (Figures 3.9). False Ring number 44 was not counted according to the traces of previous counting points on Core 8A. By adding False Ring 44 to this core, I have found that Cores 8A and 8B match and were probably cut from the same log (Figures 3.12).

Figure 3.5: Core 1.

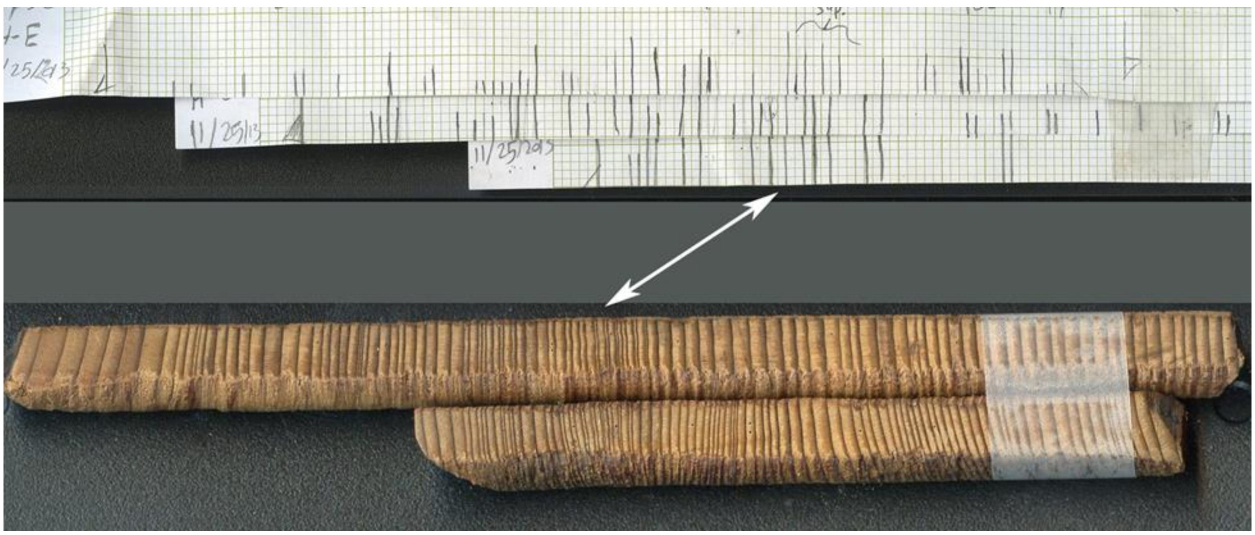

Figure 3.6: Cores 2, 3 and the skeleton plots for cores 1, 2, 3.

Figure 3.7: Core 4.

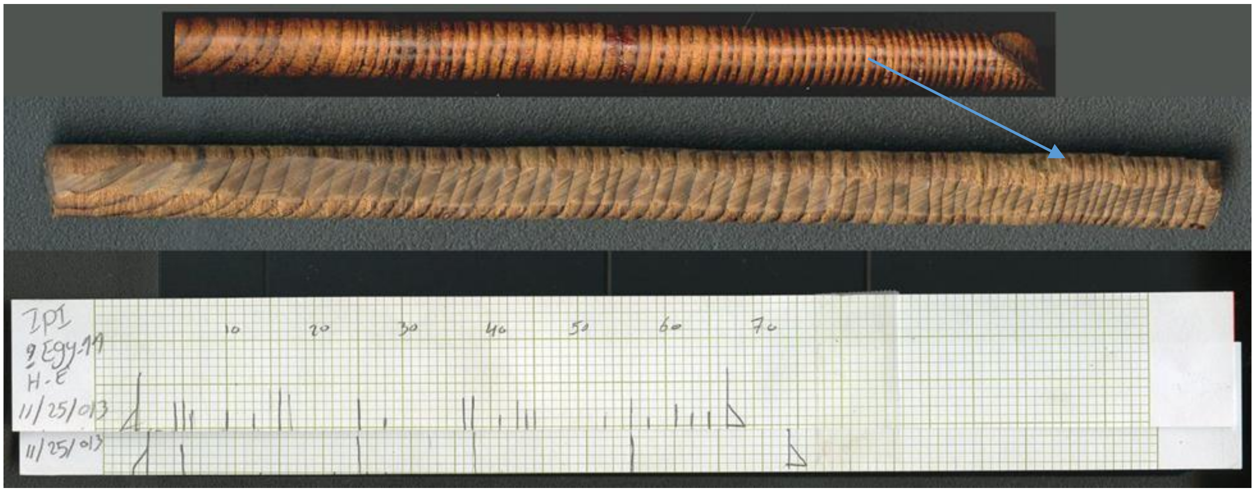

Figure 3.8: core 4 and 9.

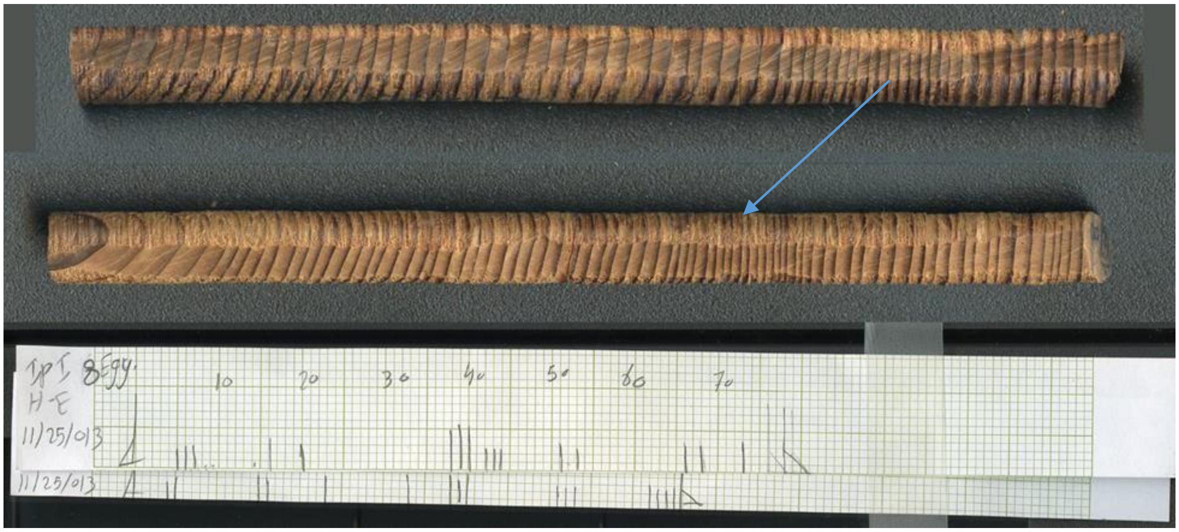

Figure 3.9: cores 5, 6.

Figure 3.10: Core 7.

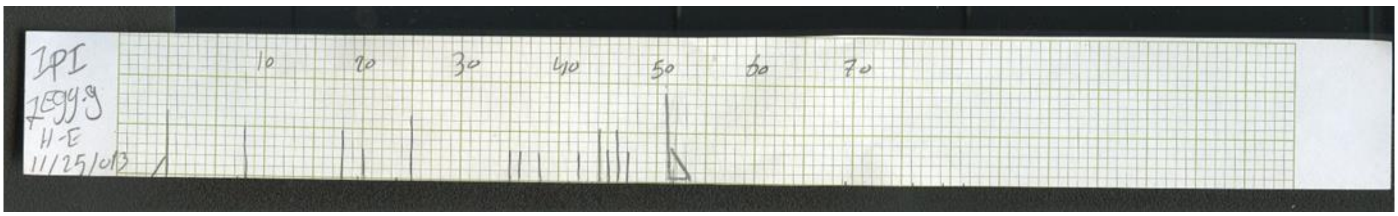

Figure 3.11: Skelton plot for core 7.

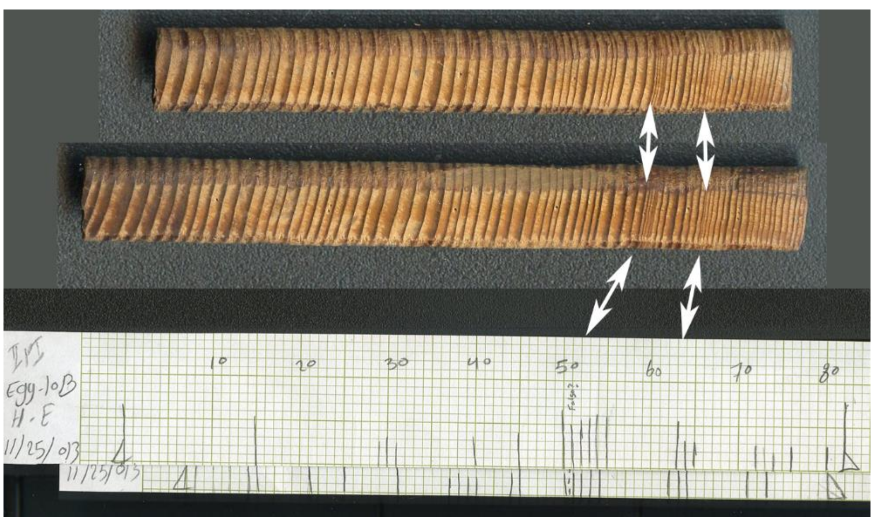

Figure 3.12: cores 8A and 8B.

Figure 3.13: Core 10.

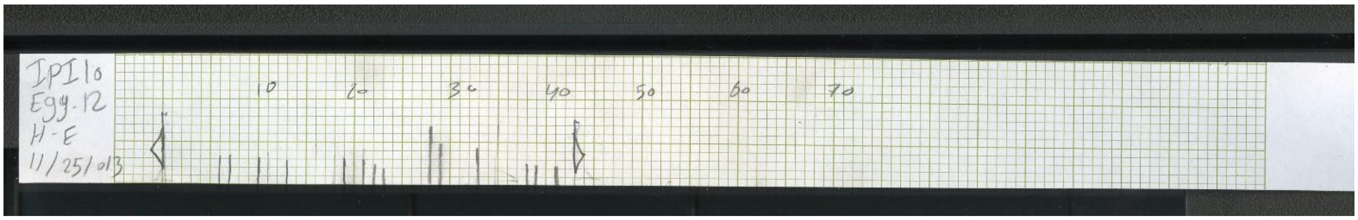

Figure 3. 14: Skelton plot for core 10.

Discussion

Without having a master chronology for Dendro-Egyptology, the date of this coffin can be fixed by crossdating two floating chronologies as Kuniholm has done with this coffin and the Twelfth Dynasty Dahshur boat (Kuniholm 1990a, 1991, 1992, 2007, Kuniholm et al. 2014) which provided a good estimate (also compare recently Manning et al. 2014). Therefore, we still depend on the date which Egyptologists had assigned to this coffin according to their traditional Egyptological tools and common Egyptian chronology and we cannot reject that date. Egyptologically, the coffin is also unpublished and still under study by a scholar from the Oriental Institute. Cores, especially Core 4 (Figure: 3.7), show complacent rings and that was a challenge for crossdating.

Some cores match and probably come from the same tree, others match and are from different trees, and some do not match at all like cores 7, 10 (Figures: 3.10, 3.11, 3. 13, and

3.14). Kuniholm and Newton suspected at the time a missing-ring problem, but could not prove it with the available material (Kuniholm et al. 2014:99). I worked on Ipi later on 2013 and could define that missing ring. This coffin was probably reused from a previous wooden object. Although many cases of wood reuse in ancient Egypt have been documented (Creasman 2013), it is difficult to confirm that happened with this coffin.

The ASM Samples Collection

The ASM Samples Collection is mainly Egyptian indigenous wood. These samples are some wooden figures and items that were donated to the museum over a long time. As can be seen, these samples are precious artifacts at the ASM, therefor it will be hard to take them from the museum to the LTRR for examination. Probably in the future scanning them could be the solution to detriment the possibility of conducting dendrochronological research on them.

Conclusions

In order to conduct dendrochronology on these materials, several specimens needed to be date and match them with others from the same period, as Kuniholm did when he matched coffin of Ipi-Ha-Ishutef and the Pittsburgh boat, by dating them on the basis of comparing their ring patterns with wooden material culture from Anatolia. As the case study of the coffin of Ipi-Ha-Ishutef (OIM 12072) shows that work has been previously started by Douglass in 1930s and Kuniholm in 1990s, and followed by Manning et al. (2014) and Kuniholm et al. (2014), the present state of applying dendrochronology to Egyptian material culture still needs more work. There is a real and urgent need for establishing a master chronology for this new scientific field:

dendro-Egyptology. The ASM samples show that it is hard to conduct dendrochronological studies on them because they are indigenous Egyptian wood (Cichocki 2006:366).

Chapter 4

Wood Trade Routes and Wood Types and Uses in Ancient Egypt

It is known in Egyptological literature that indigenous Egyptian wood species are of poor quality; good quality timber always had to be imported from the Near East (Baines and Malék 2000:20). Connections between Egypt and Byblos in Lebanon are documented since the Old Kingdom. Byblos played an important role as a port, and from the time of the unification of Egypt it was employed by the ancient Egyptians as a major source of wood (Shaw 2000:320). Although several wooden objects have been found from Predynastic Egypt, good woodworking became only probable with the use of copper as metal tools by early Dynastic Egypt (Jones 1995:72). The famous cedar of Lebanon is found in Egypt as early as the Second Dynasty (c. 2890-2686 B.C.) [Shaw: 2000:320]. Sneferu (c. 2575-2551 B.C.) of the Fourth Dynasty records the arrival of a convoy of forty ships laden with *mrw* wood from Lebanon. The first funerary boat of Khufu, the builder of the Great Pyramid at Giza, was made of Lebanese cedar. Furthermore, a type of wooden statue (naked youth) is characteristic of the end of the Old Kingdom (Baines and Malék 2000:129). So strong was the connection between the country of origin of timber and the process of boat building dependent on it, that the Egyptian named their sea-going ships "Byblos-ships", a term which was still in use in the Late Period to describe Nakau's newly introduced Greek triremes. Even in the Coffin Texts, the deceased is said to punt with a pole made from the "cedar" of Byblos, and during his Asiatic campaigns, Tuthmose III (c. 1479-1424 B.C.) built cargo vessels of the same wood, obtained from the same locality (Jones 1995:72-73). Old Kingdom Byblos ships were probably like those of King Sahure. These seem to have come back to Egypt from someplace in the Levant. Even if Byblos boats were clearly attached to Syria-Palestine in the Old Kingdom, then the word became generic, occurring only once in the New Kingdom, and in the Ptolemaic Period it was employed to identify the warships of the Greeks. And even in late Old Kingdom Egypt, Byblos ships were utilized to trade with the remote land of Punt (Vinson 1994:23). Wood was occasionally used for the manufacture of stelae, especially from the Third Intermediate Period onwards (Baines and Malék 2000:62).

As early as Dynasty One, coniferous wood (almost *Cedrus libani*) was being traded from the Levant to the Nile Valley. Throughout ancient Egyptian history the trade was resumed, as a result Byblos had become among the most important trading ports on the Levantine coast (Oakley 1932:159). By the late Predynastic Period trade goods from the Levant are found all over Egypt, and by Dynasty One large beams of imported wood were utilized in buildings (Vinson 1994:20). In his tomb self-presentation, Weni, who lived in the Sixth Dynasty, tells us that the Pharaoh Merenra (c. 2255-2246 B.C.) sent him to bring a false door, lintels, and portals for a royal pyramid complex in six barges and three two-boats of eight ribs. Sometime later, the same king commissioned him to build a "broad-boat" of 60 cubits (31.5 m) in length and cubits (15.75 m) in breadth of local acacia to transport an offering-table from the alabaster quarry at Hatnub in Middle Egypt (Breasted 1988, I:§323; Jones 1995:65).

Imported Wood

Egypt imported wood from Lebanon and other places (Davies 1989:146-156). Wood of enough size and quality was always rare in ancient Egypt (Jones 1995:72). Fine woods such as cedar, juniper, and ebony were imported from western Asia and tropical Africa (Shaw 2000:320). Moreover, Nubia, to the south, was a region through which African goods reached the country and an important source of hard wood (Baines and Malék 2000:178).

Cedar

Cedar (*Cedrus libani*) is called *mrw*/*ʿŠ* in ancient Egyptian (*Wb.* I: 228[1-5]; Nibbi 2003:69-83). Cedar is described as being pinkish-brown, straight-grained, aromatic, very durable, and takes a good polish (Gale et al. 2000:349-350). It resists rot and insects and has a distinctive scent. Cedar is a large tree varying between 30-40 meters in height. Items made of cedar have been found from as early as the Predynastic Period until the Ptolemaic Period (Gale et al. 2000:349-350). It is mainly used for making coffins, shrines, boats, and furniture (Lucas & Harris 1989:432; Gale et al. 2000:349; Kuniholm et al. 2014). The Tutankhamun collection also contains a beautiful cedar throne (Eaton-Krauss 2008:57-67 [no. 2]). The Metropolitan Museum of Art houses a distinctive panel of Thutmose IV's throne which was made of cedar (Dorman 1987:53-54, fig. 35). The trade of cedar stretches back to the reign of Khasekhemwy (Second Dynasty), but the Fourth Dynasty Palermo Stone (reign of King Sneferu) suggests much heavier trading, "bringing forty ships full of cedar/pine wood to Egypt" (Strudwick 2005:65-66 esp. 66; Breasted 1988:146; Ward 2000:20-22; Leospo 1987:121). There are several references to cedar in Egyptian records under different rulers of the New Kingdom and later (such as Hatshepsut, Thutmose III, and others) [O'Connor 2006:1-38 esp. 18]. The tomb of Sennefri (TT 99) depicts his trip to and from Byblos in Lebanon on the mission of acquiring cedar wood for the Amun temple at Karnak (Bryan 2006:81; Laskowski 2006:190). An inscription accompanies the workshop scene in the Rekhmire's tomb (TT 100), "Making furniture out of ivory, ebony, *sesnedjem*-wood, *meru* wood, and real cedar from the top of the terrace (i.e. Lebanon) [Hodel-Hoenes 2000:155]. These are just a few from the multitude of examples of cedar use. It is traditionally believed among scholars that Egyptians traded for "conifer timber from the Levant" among which are Lebanese cedar, juniper, cypress, fir, pine and others (Davies 1995:146-156;

Thirgood 1981:87). Meiggs (1982) and other scholars (Lucas 1989:432-434; Killen 1980), agree with Lucas when he claims, "it became common to call any cedar wood found in Egypt as *Cedrus libani*". This is the point of contention for Nibbi (1994), who argues in several articles against this opinion and considers it an assumption that should be changed. According to Nibbi, "cedar of Lebanon cannot be distinguished anatomically through the microscope from other cedar. It is scientifically impossible to label ancient cedar wood as *Cedrus libani*, because this can only be an assumption and not a conclusion based on any evidence" (Nibbi 1994:35-52 esp. 35; and see also, Nibbi 1996:37-59; Nibbi 1987:13-27; Nibbi 1985:17-26). She lists several reasons for not accepting the conclusion that all types of cedar used in Egypt were from Lebanon (such as the existence of *Cedrus brevifolia* in Lebanon among other trees) [Nibbi 1994:37]. She also disagrees with many of Meiggs's opinions, for instance, his considering *ʿŠ* the Egyptian word for cedar. Loret (1916) rejects the use of *ʿŠ* to designate cedar, suggesting that fir or pine, or even the generic term for both, would be a more accurate translation. Loret's main point is that when *ʿŠ*, "was labeled in the ancient Egyptian iconography, it was shown to be pale gold and never a reddish-brown, as was the case with cedar" (Loret 1916:33-51). Nibbi (1996) adds that *mrw* is mentioned in the Merikare text as an example of wood which is said to come from the west. She goes through the examples that Loret used as his arguments and one of them is the sarcophagi of Sopi in which three headrests are depicted. The caption of the first reads *ʿŠ* and the object is pale yellow in color; the third is reddish and *mrw* is written. None of the varieties of cedar are pale and yellow (Nibbi 1996:43, fig.1). Davies (1995:152) Prefers the use of *ʿŠ* to designate cedar, "though it might also on occasion have had a generic usage". Some scholars don't agree with Nibbi's methods of ignoring the texts and subsequent conclusions; they believe that the lack of specific characteristic of Egyptian wood designations leaves much room for lexicographical disapproval and that Egyptians were not always specific with their terminology regarding wood (e.g., El Gabry 2014).

Botanists define four species of cedar today, but it is not possible to differentiate between the wood each produces. *C. deodara* grows in the Himalayas, *C. brevifolia* in Cyprus, *C. atlantica* in the Atlas Mountains of the Maghreb, and *C. libani* in forests at elevations to 1000 meters above sea level in Lebanon, on the coastal mountains of Syria, and in southern Turkey (Mikesell 1969:1-28; White 1983:155). Although the Egyptians may have exploited Libyan and more western resources, texts point to the Levantine coast as the source of cedar and other large conifers (Green 1983:38-59).

Juniper

Juniper from the Levant, *Juniperud excels*, J. communis are known as *ʿŠ?* or *mrw?* These species of juniper grow with cedar in the mountains of the Eastern Mediterranean and reach 20-25 meters in height. Currently, ten percent juniper is mixed with cedar in a cedar forest growing at an elevation between 1700 and 2000 meters above sea level in southern Turkey (Kuniholm: Personal Communication). Juniper's red fragrant wood provided resin and oil used as incense; it was often confused with cedar, although junipers were almost never of comparable height or girth (Meiggs 1982:410-416). A piece of wood from the Khufu I hull has been identified as juniper (Nour 1960:45), as has wood from ancient Egyptian musical instruments in the Louvre (Nibbi 1981:23). Dendrochronological testing by the Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology identified juniper logs in the ¾ Meidum pyramid and the Dynasty Four pyramid at Dahshur (Letter to P. I. Kuniholm from M. Newton on 30 June 1989 mentioned in Ward: 2000). Nibbi (1981) argues that *ʿŠ* is juniper, citing the scarcity of identified cedar samples before Dynasty Nine or Ten, but juniper is less frequently reported than cedar for the same period. Recent work amply documents abundant cedar remains (Nibbi 1981; Davies 1995:150) and shows that more than half the identified juniper objects date to the Graeco-Roman Period.

Cypress

Cypress (*Cupressus sempervirnes*) is a reddish-brown, even-grained, smooth, aromatic, and durable wood that takes a good polish (Gale et al. 2000:350; Hepper 1990:46). It exists in Syria, Lebanon, Turkey, and Crete among other areas. It was used in the manufacture of furniture, boats, statuary, carving, monumental doors and construction (Gale et al. 2000:350). The Metropolitan Museum of Art contains several pieces of furniture that are entirely or partially made of cypress, e.g. Hatnofer's chair (Lucas and Harris 1989:434). Cypress grows to 30 meters in coastal mountains from Maghreb to Jordan (White 1983:153; Rowton 1967:261-273). Cypress has been identified in the Dynasty Three plywood coffin of Saqqara, Middle Kingdom dovetail tenons, and in Dynasty Eighteen jewelry and toilet boxes, becoming more common in the Late Period (Arnold 1992:97-99; Davies 1995:150-151; Lucas and Harris 1989:434). Other types of imported wood may be used occasionally, but because we have no textual evidence, we cannot prove it.

Indigenous Wood Species

Scientists tend to describe the areas adjoining Egypt in ancient times as deserts devoid of all vegetation, similar to today. But, according to the Egyptian reliefs and paintings, scientists need to modify the old point of view (Nibbi 1981:1; Thirgood 1981:87). There was a moister climate in North Africa reaching its peak around 10,000 B.C. (Quézel 1963). Sinai still carries evidence of the Mediterranean phase of vegetation in small lush valleys where scientists reported seeing a number of juniper trees in the hilly areas of northern Sinai, namely Gabel El-Maghara, in Yelleg and Halal (Range 1921; Boulos 1960; El Banna et. al 2010). Lucas and Harris (1989:312) recorded a report from year 1943 that about 100 junipers had been seen in these areas, indicating survivals of a former forest. In confirmation of this, there is an evidence for juniper in northern Sinai from Neolithic Period (Phillips and Par-Yosef 1974:483 f.). There is *Juniperus phoenicea* in Sinai called *wʿn* in ancient Egyptian language. This is the only native (?)Egyptian conifer. It grows to 10 meters in the mountains of northern Sinai today (Boulos 1960:129; Ward 2000:17) and probably represents the remnants of a once abundant woodland dating to the Neolithic period (Phillips and Bar-Yosef 1974:483-491; Ward 2000:17).

Sycamore Fig

Sycamore fig (*Ficus sycomorus)* was called *nht* in ancient Egyptian (Hannig 2006:442; *WB* II: 282 [7-13]). It grows in the Nile Valley, Sinai and Oases of the Western Desert and was used as timber in all kinds of woodwork because of its resistance to decay, and because it was light and easy to carve (Gale et al. 2000:345; Germer 1985:124-125; Killen 1980:6; Lucas and Harris 1989:447-448; Deglin 2012:86). Sycamore is characterized by its hardness (Śliwa 1975:11), pale, light, fibrous and coarse texture, and poor quality for construction (Gale et al. 2000:340). Its many knots (Svart 1998:127) and prevalence throughout Egypt have led to identification of many pieces of this tree in ancient contexts (Killen 1980:1, 6). The sycamore tree has small and sweet fruit (figs) and the leaves and milky fluid were used as medicine (Germer 2001:537). The tree’s girth can reach 8 meters and its height 20 meters. Permission from the king’s palace was required before cutting sycamore trees. Sycamore figs were associated with Hathor, Neith, Nut, and other goddesses, usually with the goddess of the tree. Mentioned in funerary and religious texts throughout Egyptian history that huge trunks and many small branches, sycamore trees dominate the subterranean world and appear in the Pyramid and Coffin Texts (Baum 1988:18-87).

Nile Acacia

The Nile Acacia (*Acacia nilotica*) was called *Šndt*/*Šnd* in ancient Egyptian (Hannig 2006:831). Acacia has been used in Egypt since the Predynastic Period (Lucas and Harris 1989:442) and evidence of its use can be traced throughout Egyptian history (Killen 1994b:7). Several varieties of this genus are native to Egypt and it is the most used of the indigenous trees (Svarth 1998:127). It is described as red, hard, and durable (Gale et al. 2000:335-336), although the limited dimension of the timber makes it inconvenient for use in large objects (Cooney 2007:206). It was a good source for building ships because it is tough and durable (Leospo 1987-1989:120). Using this wood in shipbuilding was mentioned in the Sixth Dynasty self-presentation of Weni from Abydos (Strudwick 2005:356). According to Svarth, it was used broadly in furniture making, dowels, bows and arrows (Svarth 1998:172). Hepper (1990:23) details, "Acacia bark provided an important source of tannin for the preparation of leather from hides, and a blue dye for linen cloth was extracted from acacia pods".

Texts document an Old Kingdom expedition to Middle and Upper Egypt that built acacia boats 60 and 100 cubits (32-52 m) long (Lichtheim 2006:21-23). Modern records of traditional watercraft from Upper Egypt and the Sudan suggest that it remained a primary wood source for the region (Hornell 1942:1-36). Dockyard records of the early Middle Kingdom refer to the delivery of boatloads of "white" acacia timber (Simpson 1965:2). Its hardness was valued for manufacturing tenons. The Khufu vessel, the Lisht timber, and the shrines of Tutankhamun include acacia tenons. Coffins from the Old, Middle and New Kingdoms had both tenons and pegs of acacia. Furniture of all periods, the Predynastic Period logs and roots, the Early Dynastic

Period beams, and tree trunks of acacia are also known (Lucas and Harris1989:40; Davies 1995:146-156). Acacia was also valued for tool-making. Large mallets made of wood taken from the root-trunk junction used the natural strength of the gnarly wood, and axe hafts the Predynastic to the Coptic period are identified as acacia (Podzorski et al. 1985:122-124; Gale 1987:128).

Tamarisk

Tamarisk (*Tamarix nilotica* and *Tamarix aphylla)* is called *jsr* in ancient Egyptian (*Wb*. I: 130; Hannig 2006:116-117; Gale et al. 2000:345). This wood has been described as coarse and dense (Gale at al. 2000:345). Tamarisk, also called salt ceder (Hepper 1990:48), is a desert shrub with thin branches and leaves. It was less highly regarded because it provide only pieces of limited size. It also can warp during the seasoning process, further limiting the scope of its uses to small objects of daily life (Leospo 1987:120). Tamarisk has many defects, such as knots, as well as being difficult to work (Killen 1980:6). Objects made of tamarisk have been found from as early as the Neolithic Period until the Graeco-Roman Period. This species grows everywhere in Egypt and it is the only one to become a full tree and not stay as a shrub (Deglin 2012:86).

Carob

Carob (*Ceratonia Siliqua*) is called *nḏm* in ancient Egyptian. Carob is a small evergreen that produces hard, strong, and good quality wood (Gale et al. 2000:338). It is widely found in the Mediterranean region, but in Egypt, it grows only in gardens (Baum 1988:162-168). The carob is a small evergreen tree with a thick and knotty trunk up to 10 meters high. Carpenters appreciate its reddish, dense wood. The carob prefers non-irrigated, semi-arid to arid conditions; its roots can extend quite deep in order to reach subterranean water.

During the New Kingdom, ancient Egyptian pharos acquired some carob wood furniture and logs from Syria, based on the Annals of King Thutmose III, which record that he received tributes from the Levantine cities in his first campaign (Breasted 1988:436; Killen 1980:2; Meggis 1982:60, 65). Booty of carob was also taken from Syria in his second campaign (Breasted 1988:447, 512).

Carob, a dominant eastern Mediterranean plant, is recorded by Gabel Haggege on the western desert coast of Egypt in connection with *Juniperus phoenicea* and *Olea europaea* (Ward 2000:16). It is noted that scattered carob trees grew along the northwest Egyptian coast (Lucas & Harris 1989:443). Local conditions argue against the development of shrubby, Mediterranean vegetation, and the uniqueness of the population may more reasonably indicate introduced plants (Ward 2000:16).

The word *nḏm* appears in the First Intermediate Period at Dendera, in a list of orchard plants from Dynasty Eighteen, and in recipes for perfumes and unguents from Late Period laboratories at Edfu and Dendera. New Kingdom pharaohs obtained carob-wood furniture and logs from Syria (Breasted 1988:436,512). The same word, but with a different determinative, is used to describe a product of Punt, but it is thought that this was an acacia (Ward 2000:16).

Dom Palm

Dom Palm (*Hyphaene thebaica*) is called *mꜣm* in ancient Egyptian (Hannig 2006:338). The Dom palm is principally a fruit tree, like the date palm, but it is too dense and hard, which is why Egyptian craftsmen used it in manufacturing boats and beams (Gale 2000:347; Ward 2000:17; Killen 1980:3; Lucas& Harris 1989:444; Baum 1988:106-120). It grows in Upper-Egypt. The leaves are used in cordage and mats; its fibers are used for making brushes. It has been used probably in furniture, but it was used as the webbing for some chairs and stools (Greiss 1957:41-48,112,114,127).

Like the date palm, ancient woodworkers used its hard trunk for beams and boat or raft construction (Cumming 1984:139; Lucas 1962:444; Täckholm 1974:763). The ancient Egyptians associated the Dom palm with Nubia and Punt, and it was sacred to the temple of Hathor at Dendera. The Dom palm's primary distribution is in Upper Egypt from Abydos southward and in the western oases (Ward 2000:17).

A Second or Third Dynasty tomb at Saqqara used Dom palm wood for roofing, but the tree is mentioned in texts only after the Old Kingdom. The Eighteenth Dynasty black granite statue of the Butler and Foreman of works, Minmosi from Medamud, proclaims, "I taxed the chieftains of the land of Nubia… many ships of Dom palm wood as yearly taxes …." Minmosi was super intendant of works under Amenhotep II at the Turah quarries (Cumming 1984:139).

Date Palm

Date palm (*Phoenix dactylifera*) is called *bnrt* in ancient Egyptian (Greiss 1957:41-48,112,114,147-148; Hannig 2006:271). The date palm has been characterized as soft, fibrous and poor construction quality (Gale et al. 2000:347-348). It is well represented in Egypt (Delta and Nile valley) and often depicted on tomb scenes. The wood was usually used for buildings (roof timber). Its stringy texture makes it inconvenient for executing joint work, but appropriate for mats and baskets (Ward 2000:16-17; Lucas 1989:443-444).

The date palm's cylindrical trunk reaches 20 meters or more. Salt and heat tolerant, the date palm lives in the Delta and the Nile Valley, the Egyptian oases, humid parts of the desert, and along the Red Sea coasts. A food source from at least the Paleolithic in Egypt, the date palm appears on palettes and in a list of offerings from Dynasty One. Its leaves, fibers, and poor quality wood were utilized to make mats, baskets, and roofs. Date-palm wood has also been identified in two wood samples from coffins (Březinová et al. 1976:139-142). Archaeologists have commonly attributed ancient cordage samples to the date palm, but a recent analysis suggests that modern Egyptians use and rely on it more than people of Pharaonic times (Ryan and Hansen 1987).

Plum

The use of this wood to make furniture is otherwise unknown (Eaton-Krauss 1995:85-89; Baum 1988:266; Gale et al. 2000:343). Furthermore, there is a stool from the Seventeenth-Eighteenth Dynasty as being made of Christ's thorn (*nbs*), known as sidder (*ziziphus spine Christi*) (Gale et al. 2000:347; Cooney 2007:207; Baum 1988:169-176; Lucas and Harris 1989:446). To sum up, these local species usually produced poor quality wood with short lengths and small cross sections which limited the kinds of constructions.

Wood Uses

Wood was used in ancient Egypt for different purposes such as making boats, statues, coffins, furniture, and funerary boxes (Table 4.1). Sycamore was one of the most important trees in ancient Egypt and was used in funerary equipment, for making furniture, statues (Figure:4.1), boats (for more about boat building and woodworking techniques (see Jones 1995:72-83); about boats from the Predynastic Period through the Graeco-Roman Period (see Vinson 1994:7-52), coffins, stelae, and minor tools, boxes, dovetail tenons, models, and vases from the Old Kingdom until the Roman Period (Brezinova and Hudra 1976:141; Davies 1995:146-156; Simpson 1965:34; Leospo 1987-1989:120). When the Eighteenth Dynasty queen Hatshepsut was building barges for transporting her obelisks, a call for cutting sycamore fig trees was issued across the country in order that sufficient wood could be acquired (Janssen 1975:371). A transverse section cut from a wooden model of a building-cradle (used in raising blocks of stone) found in a "Foundation Deposit" under the Temple of Queen Hatshepsut at Deir el-Bahari, and dating from about 1500 B.C. the wood is that of sycamore (Oakley 1932:158). Late New Kingdom prices suggest that the standard value of a sycamore fig log, of unspecified size but probably almost small, was one-fifth of an axe (Janssen 1975:371). Sycamore is mentioned in Egyptian texts from the Eighteenth Dynasty and it was often depicted on the tomb walls of the same period (Gale et al. 2000:340). Although this wood was extensively used in Egypt when only small lengths were required, it has serious limitations, and its coarse grain and light spongy texture make it unsuitable for long straight beams. The hulls of many Nile boats in ancient Egypt were made of this wood, cut into short rectangular blocks and built "brickwise" (Oakley 1932:158).

Davies (1995) conducted an analysis of thirty-six wooden coffins from the Department of Egyptian Antiquities at the British Museum; the important goal of this project was to confirm the identity of these woods and at the same time to determine the nature and extent of their use. The thirty-six coffins date from the Old Kingdom (the Sixth Dynasty) to the late Second Intermediate Period/ early Eighteenth Dynasty. Of the thirty-six coffins analyzed, twenty-four are made of native wood-twenty of sycamore fig, three of tamarisk, one of sidder, and twelve of imported wood, mainly cedar (Davies 1995:146,148).

Of the two hundred and thirty-one statues in the corpus of the Old Kingdom from different museums, only fourteen have had their wood identified by scientific means, a further three have been identified visually. Three others have identifications, but no confirmation that this is the result of a scientific analysis. This is not enough to make any satisfactory conclusions about the types of wood preferred. Fifteen of the statues are made of woods indigenous to the Nile valley (fourteen confirmed analyses), the remaining five are imported woods (Harvey 2001:617).

Five statues are made of sycamore:

1- The statue of Chief Lector Priest, Kaaper, late Dynasty IV, found by Mariette in Saqqara Tomb 36 (C 8), recent analyses states that it is made of sycamore wood (Saleh and Sourouzian 1987:40; Lokma 2005).

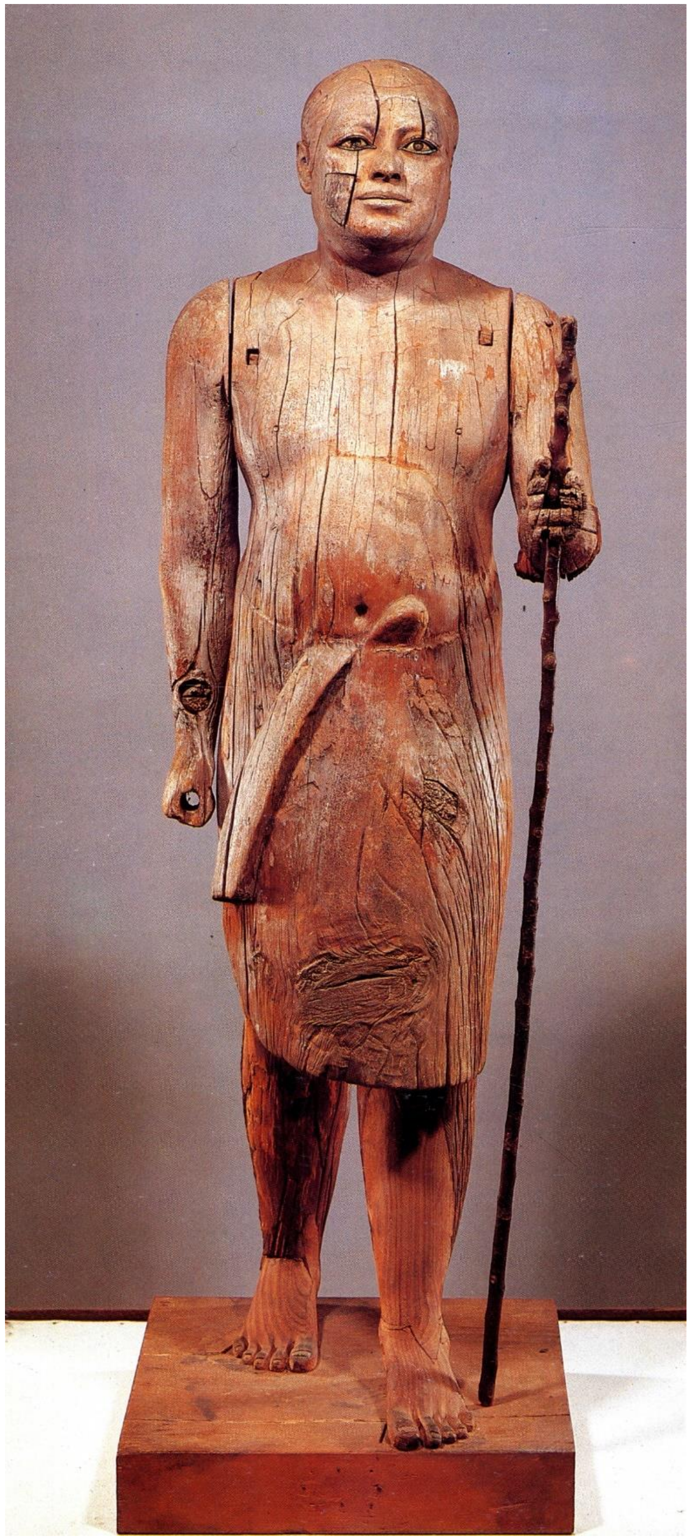

Figure: 4.1 Statue of Ka-aper, called "Sheikh el Baled", sycamore wood, Old Kingdom, Egyptian Museum in Cairo (after Saleh and Sourouzian 1987:40; used by permission)

2- A statue of a striding male at Hildesheim museum is made of *Ficus sycomorus L.* (Harvey 2001:88).

3- A head and torso of a striding male at Hildesheim museum is made of *Ficus sycomorus L.* (Harvey 2001:91).

4- A statue of a striding male at Louvre (E 10357) has *Ficus* as its wood type (Harvey 2001:96,617).

5- A head of a statue from tomb D2 at Meir (Blackman 1914) is *Ficus*; the tomb belongs to Pepiankh Heryib and dates to the later part of the reign of Pepy II (Baer 1960:133), Ashmolean Museum (Harvey 2001:617).

Tamarisk was mainly used in the production of coffins, bows, tamaris rafts, dowels, pegs, and furniture such as chairs, beds, boxes, and lids (Lucas 1985:447; Gale et al. 2000:345; Śliwa 1975:11).

Esteemed by carpenters because of its red color and heaviness, Egyptian texts contain several references to the use of carob for manufacturing fine furniture (such as footstools, tables and chairs), as well as bows and toiletry tools (Ward 2000:16).

Although there is no direct evidence of its use in boatbuilding, use of carob wood in New Kingdom furniture (Breasted 1988:436, 512) suggests that its qualities may also have been appreciated in the superstructure of furnishings of finer watercraft. Toilet articles and mummy labels also have been identified as carob (Davies 1995:150).

The Egyptian plum, *Balanites aegyptiaca* L. Delile (Germer 1985:98-99) was used for boat building. Palms were used for furniture and for roofing timber, most often in the oases, such as the dom palm, *Phoenix dactylifera* L. (Gale et al. 2000: 347; Germer, 1985:232-233; Lucas and Harris 1989:443-444).

The sidder, called *nbs* (*ziziphus spina-christi* (L.) Desf. (Gale et al. 2000:347; Germer, 1985:114-115; Killen 1980:6; Lucas &Harris 1962:446), was used as timber for joinery and for small items (Deglin 2012:86).

Acacia nilotica is a hard wood, excellent for fuel and charcoal but it was mainly used for timber in boat building, for tools (Deglin 2012:86) and false doors (Figure: 4.2).

Figure: 4.2 False door of Ika, Acacia wood, Old Kingdom, Egyptian Museum in Cairo (after Saleh and Sourouzian 1987:58; used by permission)

It seems that ancient Egyptians advanced techniques in joinery or laminating in order to lessen the impact of low grade and fibrous timber in an attempt to create a large sheet of material which was dimensionally stable and equally strong in all directions, such as the plywood used in a coffin in the Step Pyramid of the Third Dynasty King Djoser at Saqqara (Gale et al. 2000:356-357, fig. 15.19; Killen 1980:9).

The publication of Maadi excavations (Rizkana and Seeher 1989) described about ninety-five samples, eleven of them cedar. The samples included some carbonized timber. The majority tamarisk and acacia; eight samples were unrecognizable under the microscope (Kroll 1989:134-136).

The samples were divided into building wood and firewood, but some samples did not fit in either category; they were small pieces of red-brown pencil-sized wood, and some were found inside pottery vessels, not in the ground (Kroll 1989:134). Nibbi did not agree that the cedar found in Maddi was imported from Lebanon, because cedar was imported to obtain long straight timbers (Nibbi 1981:2; Nibbi 1987:135; Nibbi 1990:26). She states that the pattern of growth of the cedar of the Lebanon does not give any possibility of obtaining straight timber from its trunk, because one of its characteristics is the heavy side branching from a low level and this differentiates it from the Atlas and other cedar (Nibbi 1981:15; Nibbi 1987:13-17; Nibbi 1990:26).

Boats were often made of acacia or sycamore because these are among the most famous indigenous Egyptian woods and they were well-known boat-building material in subsequent periods. Pine and cypress were shipped from the Levant for royal or divine boats from the beginning of ancient Egyptian history (Vinson 1994:15).

Due to the close relationships between ancient Egypt and the Levant throughout ancient Egyptian history from the Fourth millennium B.C. onwards, the connections between these two cultures were significant. In those ancient periods, there were two ways of trading between Egypt and the Levant, by land and by sea. There were two land trade routes, southern route, ran from the east of Egypt through the Wadi Tumilat and across the Sinai peninsula to Beersheba in southern Palestine, from where it proceeded north along the central mountain route, passing by Hebron, near Jerusalem, and points north (Hoffmeier and Moshier 2013:485). The second route, the one that passes by the Mediterranean coast in north Sinai, ending at Gaza in southern Canaan (Hoffmeier and Moshier 2013:486).

Many scholars think that the "Ways of Horus" (*w3wt Ḥr*) was the actual name of a route that connected Egypt and Asia (Gardiner 1920; Oren 1987; 2006; Bietak 1996:fig. 1; Hoffmeier 2005, 2006). It had a double function military and trade (Bergoffen 1991; Gardiner 1920; Oren 1987, 2006).

Table 4.1: Uses of wood in ancient Egypt.

Wooden Remains/ Period	Predynastic Period	Archaic Period (First and Second Dynasties)	Old Kingdom	Middle Kingdom	New Kingdom	Third Intermediate Period	Late Period
Structural Timber	X		X		X		X
Coffins	X	X	X	X	X	X	X
Statues		X	X	X	X		
Furniture		X	X	X	X	X	X
Ships and Boats	X	X	X	X	X		
Minor Objects	X	X	X	X	X	X	X

Based on Lucas and Harris 1962; Wittmack 1912; Brunton and Caton-Thompson 1928; El Gabry 2014; Gale et al. 2009; Davies 1995; Nibbi 1981, 1990; Arnold 2001; Ward 2000, 2006, 2012; Ward and Zazzaro 2010; Sowada 2009; Harvey 2001; Killen 1994a, 1994b, 1996; Deglin 2012 (after Kuniholm et al. 2014:94; used by permission).

Conclusions

The ancient Egyptians used wood for many uses beginning in the Predynastic Period. They imported wood from the Near East and also used local wood species of poor quality in their woodworking. Many terms had been given by them to the different types of wood that they used. The richness of wood sources in ancient Egypt indicates that dendrochronological research on ancient Egyptian wooden material culture and may be possible.

Chapter 5

Conclusions and Future Directions

Dendro-Egyptology is still a new field and needs such much effort to stand on its own. Bannister (1963) said that in order for dendrochronology to be carried out three conditions must be first be met: (1) The ancient inhabitants of a region must have used wood in quantity in their construction; (2) The wood must be cross-datable; and (3) enough of it must be preserved for proper study. All three conditions can be met —in certain circumstances— in Egypt. If dendrochronological research is to succeed in Egypt, it is most probably must be with cedar and juniper, both long-lived trees that grow next to each other in the mountains of Lebanon, the Taurus Mountains of Turkey's southern coast, and in Cyprus (Kuniholm et al. 2007). Perfect samples for dendrochronological research would be of species that have been demonstrated (1) to produce annual growth rings, (2) respond to a range of climatic variables, and (3) retain more than 100 rings in order to produce viable cross matches (Fritts 1976; Cowie, 2013; Bradley 2015). In a perfect scenario, they would have some bark or outermost rings preserved and ideally come from contexts where reuse would be unlikely (Mitsutani 2004; Okochi et al. 2007).

The very limited dendrochronological work conducted on Egyptian wood, primarily by Kuniholm, demonstrates the possible limitations for this ideal scenario. Cedar (or juniper) wood is likely to have the greatest potential for building long chronologies from ancient funerary materials in Egypt, but as cedar trees are very long-lived (sometimes up to 500 or 600 years) (Cichocki 2006) and were used to produce multiple planks, it is possible that planks from the same tree may all appear to have different ages (depending from where in the tree they were cut) and may not overlap in time sufficiently to build a single chronology. It is also, as in many archaeological contexts, typically the practice to remove the bark and sapwood, utilizing only the more durable heartwood. Without preservation of the last ring under the bark, it will not be possible to give a felling date for the trees used to make the artifact and by implication, the date of manufacture. Even where such evidence is preserved, there is also the common practice of reuse (Ward 2000). Timber used in tomb construction however might be realistically expected to include some sapwood as occurs in other old world contexts (Kuniholm 1980) and in such a scenario a relatively accurate "date after which" —"*terminus post quem*" could be provided; indeed, in the best scenario of bark being present, there would be a possibility to estimate the exact tree-ring year for construction. Enough of such long-lived trees brought together could allow us to construct very long sequences extending back through many generations and produce a continuous chronology against which new samples could be matched.

Kuniholm's work has also shown the potential to crossdate modern cedar trees from Lebanon with those in Turkey and the Eastern Mediterranean. Therefore, if the first Egyptian tree-ring chronologies are floating, i.e., cannot initially be linked up with trees growing in the present, there are at least several long tree-ring chronologies from Anatolia that may present possibilities for dating new materials. For example, the 1598-year long juniper chronology extending through the Late Bronze Age into the Iron Age (Kuniholm 1993; Kuniholm et al. 1996; Manning et al. 2001) could overlap Egyptian samples.

Conclusions

Dendrochronology has been very successful in the US Southwest. Although many attempts have been made by serious scholars to date Egyptian wooden material, Dendro-Egyptology is still not flourishing as a solid discipline. Much work needs to be done until it becomes an accepted and deeply rooted field. The situation in the US Southwest is very different than that of Egypt. In US Southwest, the local wood has been used to establish master chronologies; in Egypt indigenous wood which the ancient Egyptians used to make their artifacts is inadequate for establishing a master chronology. There are no long-lived trees, and sampling existing structures–such as mosques and other historic buildings, is not feasible. One possible avenue of research for establishing a dendrochronological sequence for Egypt, however, is analysis of existing collections.

In order to conduct dendrochronology on these materials, several specimens are needed to date these and match them with others from the same period. Kuniholm did just this when he matched coffin of Ipi-Ha-Ishutef and the Pittsburgh boat, by dating them on the basis of comparing their ring patterns with wood from Anatolia (Kuniholm et al. 2014). The case study of the coffin of Ipi-Ha-Ishutef (OIM 12072) shows that work started by Douglass in 1930s and Kuniholm in 1990s, and followed by Manning et al. (2014) and Kuniholm et al. (2014), of applying dendrochronology to Egyptian material culture still needs more work. There is a real and urgent need for establishing a master chronology for this new scientific filed of Dendro-Egyptology. The ASM samples show that it is hard to conduct dendrochronological studies on them because they are local Egyptian wood species that lack the necessary attributes for crossdating.

The ancient Egyptians had used wood since their Predynastic Period. They imported wood from the Near East and also used local wood species of poor quality in their woodworking. Many terms were given by them to the different types of wood that they used. The richness of wood existence in ancient Egypt can encourage developing dendrochronological research on ancient Egyptian wooden material culture.

Future of Dendro-Egyptology: Problems and Solutions

Dendro-Egyptology in Egypt is promising and the country is virgin soil for conducting this science on its material culture. Although radiocarbon dating is useful and Egypt is among the few African countries that have radiocarbon laboratories, it is not as accurate as the tree-rings which are also used to improve the precision of radiocarbon dating (Taylor 2013; Jansen-Winkeln 2006; Ambers 2002; Manning et al. 2014). I believe that we should extend tree-ring sequences with older dead wood and then overlap tree-ring patterns with material from buildings constructed over the last two thousand years. The next stage would be to use wood from successively older buildings and other structures—although they are relatively few in number—to fill around 1300 years. Therefore, I plan to carry out dendrochronology on Egyptian wooden artifacts at American and European as well as Egyptian Museums (Bassir 2013). For example, the gilded wooden shrines of the Golden Pharaoh, Tutankhamun (Figure 5.1), can also be studied through dendrochronology as well as the statue of Kaaper or the Sheikh el Beled statue and the Third Intermediate and Late Periods coffins (Saleh and Sourouzian 1987). I will also work on Egyptian wooden artifacts such as shrines, chairs, stools, beds, statues, boats, and coffins (Figure 5.2) [El Gabry 2014].

Figure 5.1: The third gilded wooden shrine of the Golden Pharaoh Tutankhamun, Dynasty 18, New Kingdom, Egyptian Museum in Cairo (Courtesy of the Supreme Council of Antiquities; used by permission).

Figure 5.2: A wooden statue of the Golden Pharaoh Tutankhamun, Dynasty 18, New Kingdom, Egyptian Museum in Cairo (Courtesy of the Supreme Council of Antiquities; used by permission).

Future research on the remaining timbers in the Bent Pyramid of King Sneferu at Dahshur (Fakhry 1954; 1959; Maragioglio, Rinaldi, and Howell 1963; Verner 1998; Jánosi 2004; Kuniholm et al. 2007; Lehner 1997) which Bannister and Iskander did not core may contribute to Dendro-Egyptology. Bannister's core holes are still there to show where he did work, I will core the remaining timbers (see Meiggs 1982; Arnold 1991, Figure 5.24 (and Figure 5.25) for an image [captioned there as cedar] of the juniper timbers in the western burial crypt of the Bent Pyramid at Dahshur). Dendrochronological work also should be done on some wooden elements of the Step Pyramid complex of King Djoser (or Zoser) at Saqqara (Lehner 1997; Verner 1998; Firth and Quibell 2007). There are also some very good Eleventh and Twelfth Dynasty cedar boards with a lot of rings from Dayr al-Barsha in the University of Pennsylvania Museum in Philadelphia which also contains a cedar chest excavated by Sir Flinders Petrie with notes in his handwriting on it (Kuniholm: Personal Communication of July 25, 2014; Silverman 1997). There are also cedar boards discovered in a cave at Mersa/Wadi Gawasis on the Red Sea (Kuniholm: Personal Communication of July 25, 2014; Ward and Zazzaro 2010; Ward 2012).

Coptic and Islamic wooden architectural and decorative elements, such as mihrabs, minbars, columns, Quran holders, and icons from archaeological sites at the Museum of Islamic Art and the Coptic Museum in Cairo, are also good examples for future dendrochronological work. I will apply to the Permanent Committees of Egyptian and Islamic and Coptic Antiquities and the museums' boards of the Supreme Council of Antiquities, Ministry of Antiquities and Heritage, Cairo, Egypt, to get their permission to scan and photograph these wooden artifacts without harming them. I plan to scan and photograph these Egyptian wooden artifacts with a high resolution camera (Mitsutani 2004; Okochi et al. 2007). This technique has a high potential for success, although it is easier to work with the wood itself than with a photograph. Modern technologies make things easier. Recently the British Museum held an exhibition called *Ancient Lives. New Discoveries* where it displayed eight mummies from its collection. They all were CT-scanned and visualization of what is inside the bandages was presented along with the mummies (Taylor 2004; Taylor and Antoine 2014; Fletcher et al. 2014). Thus dendrochronology in Egypt can be carried out in a sensitive way without any damage due to these samples and fully considering issues relating to reuse and chronology, and collecting the maximum information. I plan to establish a dendro-databank and these collected data should be stored in a centralized database for the whole country so that every precious piece sampled will be counted towards my broader goal: establishing an absolute master chronology for Egypt. Since much of the wood preserved in any Egyptian context is likely to be from artifacts, there is a real need to establish a protocol for collecting as much archaeological meta-data to accompany the dendrochronological measurements (Brewer et al. 2010).

Some obstacles on the road may slow down this process of the new discipline of dendro-Egyptology however, the major problem that faces the introduction of dendrochronology to Egypt is the unfamiliarity of this new science in the country. Therefore, it is important to found a new department at the faculty of sciences at Cairo University in cooperation with its faculty of archaeology. This academic program in this new department should be interdisciplinary combining Egyptian material culture, sciences, and statistics. Translating and publishing articles and fundamental books in dendrochronology into Arabic (Schweingruber 1988, for example) is the first step that should be taken in order to introduce the science of dendrochronology to Egyptian authorities, scholars, Egyptologists, scientists, professionals, and students. We should also provide training and hold workshops for Egyptian archaeologists and scientists to make them learn the principles of dendrochronology and how to take samples for dendro-analysis.

Because no coring can be carried out on Egyptian wooden material, therefore scanning or photographing Egyptian wooden material would be the best way to carry out dendrochronological work in Egypt without harming its material culture (Mitsutani 2004; Okochi et al. 2007). Because Egyptian law prevents transferring artifacts abroad, there is a real need to found a laboratory of tree-ring research in Egypt and attach it to the mother laboratory of tree-ring research at the University of Arizona.

Future Research

The future of Dendro-Egyptology has many hopes as well as challenges. As a newly-born science within dendrochronology, or dendroarchaeology, and dendroclimatology, this field faces the problem of not yet having a master chronology for Egypt. Dendro-Egyptology still needs a cooperative and productive team work of Egyptologists, Near Eastern archaeologists, archaeologists, conservators, scientists, mathematicians, and dendrochronologists (dendroarchaeologists and dendroclimatologists). Dendro-Egyptology should apply several and different methodologies and techniques to advance it into the right and suitable direction. I plan to make a tree-ring chronology for Egypt as part of the new generation in Egypt who will make this happen; however, I acknowledge that it will need much time, money, and effort.

Therefore, I plan to study Egyptian artifacts from the beginning of Islamic Egypt in 642 AD (Petry 1998) and move to the end of the family of Mohamed Ali Basha in 1952 AD (Bassir 2012; Daly 1998; Fahmy 2002, 2009). This study will be a great addition not only to the history of Islamic Egypt but also to the history of the Near East during the period since the whole region was usually under one monarchy. Therefore, this chronology can be used for Egypt and the neighboring areas especially the Levant, Iraq, and North Africa. Because Egypt was under the Ottoman Empire for almost four centuries (Petry 1998), and with a long record of importation of wood from the Ottomans into Egypt (Mikhail 2011), the chronology which Kuniholm (1980; Kuniholm et al. 1996) built for the Aegean can be crossdated with the Egyptian and the Near Eastern chronologies. I also plan to work on older materials from archaeological sites. Jewish Synagogues, monasteries, and Coptic churches, Islamic mosques in Egypt, such as Saint Catherine's Monastery at Mount Sinai (Rossi and De Luca 2006), the Hanging Church (Enss 2005), the Ben Ezra Synagogue (Roth 2003), and the mosque of Amr Ibn al-As in Al-Fustat or Old Cairo (Behrens-Abouseif 1989), are good possibilities for Dendro-Egyptology. Also, early in the year of 2015, a team from LTRR composed of P.P. Creasman, W. Wright, and C. Baisan went to Egypt to collect samples from indigenous trees to investigate the possibility of conducting dendrochronological work on them.

To sum up, the road to establish dendrochronological sequences for Egypt is so long and still at the beginning. Many scholars since Douglass did their best to found what I call Dendro-Egyptology, but the future of this new field is still open and needs so much effort, time, and money. I think this field will be improved significantly by broadening its scope and by training many young Egyptian scholars and making them strongly engaged in this field. The future of this science is promising and full of many challenges as well as hopes.

APPENDIX: CHRONOLOGY OF EGYPTIAN HISTORY

CHRONOLOGICAL TABLE OF EGYPTIAN HISTORY (after Baines 2013 and Bassir 2012)

Predynastic	ca. 5000-3000 BC
Naqada 1	ca.3800-3500 BC
Naqada II	ca. 3500-3300 BC
Naqada III (Late Predynastic and Dynasty 0)	ca. 3300-3000 BC
Early Dynastic Period	
1st -3rd Dynasties	ca. 3000-2575 BC
Old Kingdom	
4th- 8th dynasties	ca. 2575-2150 BC
First Intermediate Period	
9th- 11th dynasties	ca. 2150-1980 BC
Middle Kingdom	
11th-13th dynasties	ca. 1980-1630 BC
Second Intermediate Period	
14th-17th dynasties	ca. 1630-1520 BC
New Kingdom	
18th-20th dynasties	ca. 1540-1070 BC
Third Intermediate Period	
21st-25th dynasties	ca. 1070-715 BC

Late Period

25^{th}- 30^{th} dynasties	ca. 715-332 BC
Second Persian Period (31^{st} dynasty)	
Macedonian Period	332-305 BC
Ptolemaic Period	305-30 BC
Roman Period	30 BC-AD 395
Byzantine Period	AD 395-640
Muslim Rule	AD 640
Formation of the Mamluk dynasty	AD 1250
Egypt is conquered by the Ottomans	AD 1517
Egypt is conquered by the French under Napoleon Bonaparte	AD 1798
Egypt is controlled by British troops	AD 1882
Egypt becomes a British protectorate	AD 1918
Egypt gains independence under King Fuad I	AD 1922
Overthrow of the monarchy by a military coup led by the Free Officers Movement	AD 1952

REFERENCES CITED

Ambers, J.
2002 Radiocarbon Measurement of Wood from the Coffin. *Horemkenesi: May He Live Forever! The Bristol Mummy Project*, 54, edited by D. P. Dawson, S. Giles, and M. Ponsford. Bristol City Council, Bristol.

Arnold, D.
1991 *Building in Egypt*. *Pharaonic Stone Masonry*. Oxford University Press, New York.

1992 *The Pyramid Complex of Senwosret I*. Vol. III. *The Southern Cemeteries of Lisht*. Metropolitan Museum of Art, New York.

2001 Holzdächer spätzeitlicher ägyptischer Tempel. *Archaische griechische Tempel und Altägypten: internationales Kolloquium am 28. November 1997 am Institut für Ägyptologie der Universität Wien,* edited by M. Bietak, pp.107-115. Verlag der Österreichischen Akademie der Wissenschaften, Wien.

Baer, K.
1960 *Rank and Title in the Old Kingdom: The Structure of the Egyptian Administration in The Fifth and Sixth Dynasties*. University of Chicago Press, Chicago.

Baillie, M. G. L.
1982 *Tree-Ring Dating and Archaeology*. University of Chicago Press, Chicago.

Baines, J. and J. Malek
2000 *Cultural Atlas of Ancient Egypt.* Checkmark Books, Oxford.

Baines, J.
2013 *High Culture and Experience in Ancient Egypt*. Equinox, Sheffield.

Bannister, B.
1962 The Interpretation of Tree-Ring Dates. *American Antiquity* 27(4):508-514.

1963 Dendrochronology. In *Science in Archaeology. Fifty-Five International Authorities Present the Definitive Sourcebook of Method and Technique,* edited by D. Brothwell and E. Higges, pp.162-176. Basic Books, New York.

1970 Dendrochronology in the Near East: Current Research and Future Potentialities. *Proceedings of the Seventh International Congress of Anthropological and Ethnological Sciences, Moscow, 1964* 5, pp. 336-340. Reprinted: *Tree-Ring Bulletin* 1997 Special Issue.

Bannister, B., R. E. Hastings, Jr., and J. Banister
1998 Remembering A. E. Douglass. *Journal of the Southwest* 40(3):307-318.

Bannister, B., and W. J. Robinson
1975 Tree-Ring Dating in Archaeology. *World Archaeology* 7(2):210-225.

1992 Archaeology and Dendrochronology In *Emil W. Haury's Prehistory of the American Southwest*, edited by J. J. Reid and D. E. Doyel, pp.49-54. University of Arizona Press, Tucson.
Bassir, H.
2012 Egypt. Pharaohs, Kings and Presidents. *The Histories of Nations*. *How Their Identities Were Forged*, edited by P. Furtado, pp.19-25. Thames & Hudson, New York.

2013 The Grand Egyptian Museum. A Home for Interconnections. *Journal of Ancient Egyptian Interconnections* 5(4):6-8.

Baum, N.
1988 *Arbres et Arbustes de l'Egypt Ancienne. La Liste de la Tombe Thébaine d'Inéni (no 81)*. Peeters Publishers, Leuven.

Behrens-Abouseif, D.
1989 *Islamic Architecture in Cairo. An Introduction*. American University in Cairo Press, Cairo.

Bergoffen, C. J.
1991 Overland Trade in Northern Sinai. The Evidence of Late Cypriote Pottery. *Bulletin of the American Schools of Oriental Research* 284: 59-76.

Bietak, M.
1996 *Avaris. The Capital of the Hyksos*. British Museum Press, London.

Blackman, A. M.
1914-1953 *The Rock Tombs of Meir I-VI*. Egyptian exploration fund, London.

Boulos, L.
1960 *Flora of Gebel El-Maghara.* Ministry of Agriculture, Cairo.

Bradley, R. S.
2015 *Paleoclimatology*. *Reconstructing Climates of the Quaternary*. Academic Press, Amsterdam.

Breasted, J. H.
1933 *Letter to A. E. Douglass, University of Arizona, Tucson, Arizona, USA, dated November 1 1933.* Unpublished letter. On File at the Laboratory of Tree-Ring Research, University of Arizona, Tucson.

1988 *Ancient Records of Egypt. Historical Documents from the Earliest Times to the Persian Conquest.* Vol. II. University of Chicago Press, Chicago.

Brewer, P. W., K. Sturgeon, L. Madar, and Manning, S. W.
2010 A New Approach to Dendrochronological Data Management. *Dendrochronologia* 28: 131-134.

Brunton, G. and Caton-Thompson, G.
1928 *The Badarian Civilisation and Predynastic Remains near Badari*. British school of archaeology in Egypt, London.

Bryan, B. M.
2006 Administration in the Reign of Thutmose III. In *Thutmose III. A New Biography*, edited by E. H. Cline and D. B. O'Connor, pp.69-122. University of Michigan Press, Ann Arbor.

Březinová, D., H. Bohumil, and E. Strouhal
1976 Multidisciplinary research on Egyptian mummies in Czechoslovakia, IV: xylotomic examination of timber from Ancient Egyptian coffins. *Zeitschrift für ägyptische Sprache und Altertumskunde* 103:139-142.

Brezinova, D., and B. Hurda
1976 Xylotic Examination of Timber from Ancient Egyptian Coffins. *Zeitschrift für ägyptische Sprache und Altertumskunde* 103:139-142.

Bronk Ramsey, C.
2013 Using Radiocarbon Evidence in Egyptian Chronological Research In *Radiocarbon and the Chronologies of Ancient Egypt*, edited by A. J. Shortland and C. Bronk Ramsey, pp.29-39. Oxbow Books, Oxford.

Chauvet, V.
2001 Saqqara. In *The Oxford Encyclopedia of Ancient Egypt*, Vol. III, edited by D. B. Redford, pp.176-179. Oxford University Press, New York.

Cichocki, O., M. Bichler, G. Firneis, W. Kutschera, W. Müller, and P. Stadler
2004 Synchronization of Civilizations in the Eastern Mediterranean in the Second Millennium BC. Natural Science Dating. In *Tools for Constructing Chronologies: Crossing Disciplinary Boundaries*, edited by C. E. Buck and A. Millard, pp. 83-110. Springer-Verlag, New York.

Cichocki, O.
2006 Dendrochronology In *Ancient Egyptian Chronology*, edited by E. Hornung, R. Krauss, and D. A. Warburton, pp. 361-368. Brill, Leiden.

Cooney, K. M.
2007 *The Cost of Death: The Social and Economic Value of Ancient Egyptian Funerary Art in the Ramesside Period*. Nederlands Instituut voor het Nabije Oosten, Leiden.

2015 Coffins, Cartonnage, and Sarcophagi. In *A Companion to Ancient Egyptian Art*, edited by M. K. Hartwig, pp. 269-292. Wiley Blackwell, Chichester.

Cordell, L. S., and D. D. Fowler (editors)
2005 *Southwest Archaeology in the Twentieth Century*. University of Utah Press, Salt Lake City.

Cowie, J.
2013 *Climate Change: Biological and Human Aspects*, 2nd ed. University Press Cambridge, Cambridge.

Cumming, B.
1984 *Egyptian Historical Records of the Later Eighteenth Dynasty*. Aris & Phillips, Warminster.

Creasman, P. P.
2013 Ship Timber and the Reuse of Wood in Ancient Egypt. *Journal of Egyptian History* 6:152-176.

Creasman, P. P., B. Bannister, R. H. Towner, J. S. Dean, and S. W. Leavitt
2012 Reflections on the Foundation, Persistence, and Growth of the Laboratory of Tree-Ring Research, Circa 1930-1960. *Tree-Ring Research* 68(2):81-89.

Daly, M. W. (editor)
1998 *The Cambridge History of Egypt.* Vol. II. *Modern Egypt, from 1517 to the End of the Twentieth Century.* Cambridge University Press, Cambridge.

Davies, W. V.
1995 Ancient Egyptian Timber Imports: An Analysis of Wooden Coffins in the British Museum. In *Egypt, the Aegean, and the Levant. Interconnections in the Second Millennium B.C.*, edited by W. V. Davies and L. Schofield, pp.146-156. British Museum Press, London.

Dean, J. S.
1978 Tree-Ring Dating in Archaeology. *University of Utah Anthropological Papers: Misc. Paper 24*, edited by J. Jennings, pp.129-163. University of Utah Press, Salt Lake City.

1996 Dendrochronology and the Study of Human Behavior In *Tree Rings, Environment and Humanity: Proceedings of the International Conference, Tucson, Arizona 17-21 May 1994*, edited by J. S. Dean, D. M. Meko, and T. W. Swetnam, pp.461-469. Radiocarbon, Dept. of Geosciences, University of Arizona, Tucson.

Deglin, F.
2012 Wood Exploitation in Ancient Egypt. Where, Who and How? In *Current Research in Egyptology 2011: Proceedings of the Twelfth Annual Symposium Which Took Place at Durham University, United Kingdom, March 2011*, edited by H. Abd El Gawad, N. Andrews, M. Correas-Amador, V. Tamorri, and J. Taylor, pp.85-96. Oxford-Oakville: Oxbow Books.

Dorman, P. F.
1987 *The Metropolitan Museum of Art. Egypt and the Ancient Near East.* Metropolitan Museum of Art, New York.

Douglass, A. E.
1929 The Secret of the Southwest Solved by Talkative Tree Rings. *National Geographic Magazine* 56(6):736-770.

1932 *Letter to P. Duell, American Express Company, Cairo, Egypt, Dated July 2 1932*. Unpublished Letter. On File at the Laboratory of Tree-Ring Research, University of Arizona, Tucson.

1936 *Letter to S. Stallings, dated 29 February 1936*. Unpublished letter. On file at the Laboratory of Tree-Ring Research, University of Arizona, Tucson.

1941 Crossdating in Dendrochronology. *Journal of Forestry* 39(10):825-831.

Dunwiddie, P.
1979 Dendrochronological Studies of Indigenous New Zealand Trees. *New Zealand Journal of Botany* 17:251-266.

Eaton-Krauss, M.
1995 Notes on Some New Kingdom Stools with Bulls' Legs and Tutankhamun's "Feeding Chair" In *Divitiae Aegypti: koptologische und verwandte Studien zu Ehren von Martin Krause*, edited by C. Fluck, L. Langener, S. Richter, S. Schaten, and G. Wurst (eds), pp. 84-92. Dr. Ludwig Reichert, Wiesbaden.

2008 *The Thrones, Chairs, Stools, and Footstools from the Tomb of Tutankhamun.* Griffith Institute, Oxford.

El-Bana, M., K. Shaltout, A. Khalafallah, and H. Mosallam
2010 Ecological status of the Mediterranean *Juniperus phoenicea L*. Relicts in the Desert Mountains of North Sinai, Egypt. *Flora* 205:171-178.

El Gabry, D.
2014 *Chairs, Stools, and Footstools in the New Kingdom. Production, Typology, and Social Analysis*. Archaeopress, Oxford.

Enss, E.
2005 *Holzschnitzereien der spätantiken bis frühislamischen Zeit aus Ägypten. Funktion und Dekor*. Reichert, Wiesbaden.

Fahmy, K.
2002 *All the Pasha's Men. Mehmed Ali, His Army, and the Making of Modern Egypt*. American University in Cairo Press, Cairo.

2009 *Mehmed Ali. From Ottoman Governor to Ruler of Egypt*. Oneworld, Oxford.

Fakhry, A.
1954 *The Bent Pyramid of Dahshûr* (with papers by H. Mostafa and H. Ricke). Imprimerie de l' Institut français d'Archéologie orientale, Le Caire.

1959 *The Monuments of Sneferu at Dahshur*. General Organization for Government, Cairo.

Ferguson, C. W.
1970 Concepts and Techniques of Dendrochronology. In *Scientific Methods in Medieval Archaeology*, edited by R. Berger, pp.183-200. University of California Press, Berkeley.

Firth, C. M., and B. Gunn
1926 *Excavations at Saqqara*: *Teti Pyramid Cemeteries* I. Institut Français d'Archéologie Orientale, Le Caire.

Firth, C. M., and J. E. Quibell
2007 *The Step Pyramid*. With Plans by J.-P. Lauer. Institut Français d'Archéologie Orientale, Le Caire.

Fischer, H. G.

1996 A Chair of the Early New Kingdom. In *Egyptian Studies III*. Metropolitan Museum of Art, New York.

Fletcher, A., D. Antoine, and J. D. Hill
2014 *Regarding the Dead*: *Human Remains in the British Museum*. British Museum, London.

Fritts, H. C.
1976 *Tree Rings and Climate*. Academic Press, London.

Gale, R. P.
1987 Wood Identification. In *Tools and Weapons I. Axes*, V. W. Davies, with Contributions by R. Michael Cowell, J. R. S. Lang, R. Burleigh, R. Gale, and M. Bimson, p.128. British Museum Publications, London.

Gale, R., P. Gasson, N. Hepper, and G. Killen
2000 Wood. In *Ancient Egyptian Materials and Technology*, edited by P. Nicholson and I. Shaw, pp. 334-371. Cambridge University Press, Cambridge.

Gardiner, A. H.
1920 The Ancient Military Road between Egypt and Palestine. *Journal of Egyptian Archaeology* 6:99-116.

Germer, R.
1985 *Flora des pharaonischen Ägypten*. Sonderschrift, Deutsches Archäologisches Institut, Abteilung Kairo 14. Mainz: Zabern.

1986 Zeder. In *Lexikon der Ägyptologie*, vol. VI, edited W. Helck and E. Otto, cols. 1357-1358. Harrassowitz, Wiesbaden.

2001 Flora. In *The Oxford Encyclopedia of Ancient Egypt*, vol. I, edited D. B. Redford, pp.535-541. Oxford University Press, Oxford.

Green, M.
1983 The Syrian and Lebanese Topographical Data in the Story of Sinuhe. *Chronique d'Égypte* 58:38-59.

Greiss, E. A. M.
1957 *Anatomical Identification of some Ancient Egyptian Plant Materials*. Impr. C. Tsoumas, Le Caire.

Hannig, R.
2006 *Großes Handwörterbuch Ägyptisch- Deutsch (2800-950 V.Chr.): Die Sprache der Pharaonen*. P. von Zabern, Mainz.

Haury, E. W.
1935 Tree Rings. The Archaeologist's Time-Piece. *American Antiquity* 1(2):98-108.

1962 HH-39: Recollections of a Dramatic Moment in Southwestern Archaeology. *Tree-Ring Bulletin* 24 (3-4):11-14.

Harvey, J.
2001 *Wooden Statues of the Old Kingdom*: *A Typological Study*. Brill, Leiden.

Hepper, N.
1990 *Pharaoh's Flowers. The Botanical Treasures of Tutankhamun*. H.M.S.O., London.

Hodel-Hoenes, S.
2000 *Life and Death in Ancient Egypt. Scenes from Private Tombs in New Kingdom Thebes*. Cornell University Press, Ithaca.

Hoffmeier, J. K.
2005 *Ancient Israel in Sinai. The Evidence for the Authenticity of the Wilderness Tradition*. Oxford University Press, New York.

2006 "The Walls of the Ruler" in Egyptian Literature and the Archaeological Record. Investigating Egypt's Eastern Frontier in the Bronze Age. *Bulletin of the American Schools of Oriental Research* 343:1-20.

Hoffmeier, J. K, and S. O. Moshier
2013 "A Highway out of Egypt": The Main Road from Egypt to Canaan In *Dessert Road: Archaeology in Ancient Egypt and Beyond,* edited by F. Förster and H. Riemer, pp.485-510. Heinrich-Barth-Institut, Köln.

Hornell, J.
1942 Frameless Boats of the Middle Nile. *Sudan Notes and Records* 25:1-36.

Hornung, E., R. Krauss, and D. A. Warburton (editors)
2006 *Ancient Egyptian Chronology*. Brill, Leiden.

Jánosi, P.
2004 Die Pyramiden der Könige der 4. Dynastie. *Die Pyramiden Ägyptens - Monumente der Ewigkeit: Schloß Schallaburg, 1. Mai bis 1. November 2004,* edited by C. Hölzl, pp.49-75. Brandstätter, Wien.

Jansen-Winkeln, K.
2006 Dynasty 21 In *Ancient Egyptian Chronology*, edited by E. Hornung, R. Krauss, and D. A. Warburton, pp.218-234. Brill, Leiden.

Janssen, J. J.
1975 *Commodity Prices from the Ramessid Period*. Brill, Leiden.

Jones, D.
1995 *Boats*. University of Texas Press, Austin.

Judd, N. M.
1962 Andrew Ellicott Douglass 1867-1962. *American Antiquity* 28(1):87-89.

Killen, G.
1980 *Ancient Egyptian Furniture*. Vol. I. Aris and Phillips, Warminster.

1994a *Ancient Egyptian Furniture. II: Boxes, Chests and Footstools*. Aris & Phillips cop., Warminster.

1994b *Egyptian Woodworking and Furniture*. Shire Publications. Princes Risborough.

1996 Ancient Egyptian Carpentry, Its Tools and Techniques. In *The Furniture of Western Asia, Ancient and Traditional. Papers of the Conference Held at the Institute of Archaeology, University College London*, *June 28 to 30*, *1993,* edited by G. Herrman and N. Parker, pp.13-20. Philipp von Zabern, Mainz.

Kitchen, K. A.
2013 Establishing Chronology in Pharaonic Egypt and the Ancient Near East. Interlocking Textual Sources Relating to c.1600-664 BC In *Radiocarbon and the Chronologies of Ancient Egypt*, edited by A. J. Shortland and C. Bronk Ramsey, pp.1-18. Oxbow Books, Oxford.

Kroll, H.

1989 Die Pflanzenfunde von Maadi. In *Maadi, III: The Non-Lithic Small Finds and the Structural Remains of the Predynastic Settlement*, I. Rizkana and J. Seeher, pp.129-136. Zabern, Mainz.

Kuniholm, P. I.
1980 *Dendrochronology at Gordion and on the Anatolian Plateau*. Ph.D. Dissertation. University of Pennsylvania, Philadelphia.

1990a Aegean Dendrochronology Project: 1989-1990 Results. VI. *Arkeometri Sonuclari Toplantisi*: 127-138.

1990b The Archaeological Record: Evidence and Non-Evidence for Climatic Change In *The Earth's Climate and Variability of the Sun Over Recent Millennia*, edited by S. K. Runcorn and J-C. Pecker, pp.645-655. Philosophical Transactions of the Royal Society of London A. London

1991 Aegean Dendrochronology Project. December 1991 Annual Report. *http://dendro.cornell.edu/reports/report1991.pdf*

1992 Aegean Dendrochronology Project Extensions to the Log Chronologies. VIII. *Arkeometri Sonuclari Toplantisi*: 453-464.

1993 A Date-List for Bronze Age and Iron Age Monuments Based on Combined Dendrochronological and Radiocarbon Evidence. In *Aspects of Art and Iconography. Anatolia and Its Neighbors. Studies in Honor of Nimet Özgüç*, edited by M. J. Mellink, pp.371-373. Türk Tarih Kurumu Basimevi, Ankara.

2001 Dendrochronology and Other Applications of Tree-Ring Studies in Archaeology In *The Handbook of Archaeological Sciences*, edited by D. R. Brothwell and A. M. Pollard, pp.1-11. John Wiley & Sons, Ltd., London. http://dendro.cornell.edu/articles/kuniholm2001a.pdf

2002 Archaeological Dendrochronology. *Dendrochronologia* 20(1-2):63-68.

Kuniholm, P. I., and C. L. Striker
1987 Dendrochronological Investigations in the Aegean and Neighboring Regions, 1983-1986. *Journal of Field Archaeology* 14:385-398.

Kuniholm, P. I., B. Kromer, S. W. Manning, M. Newton, C. E. Latini, and M. J. Bruce
1996 Anatolian Tree Rings and the Absolute Chronology of the Eastern Mediterranean, 2220–718 BC. *Nature* 381(6585):780-783.

Kuniholm, P. I., C. B. Griggs, and M. W. Newton
2007 Evidence for Early Timber Trade in the Mediterranean. In *Byzantina Mediterranea. Festschrift für Johannes Koder zum 65.Geburtstag*, edited by K. Belke, E. Kisslinger, A. Külzer, and M. A. Stassinopoulou, pp.365-385. Böhlau Verlag, Wien.

Kuniholm, P. I., M. W. Newton, H. Sherbiny, and H. Bassir
2014 Dendrochronological Dating in Egypt: Work Accomplished and Future Prospects. *Radiocarbon* 56(4) and *Tree-Ring Research* 70(3):93-102.

Laskowski, P.
2006 Monumental Architecture and the Royal Building Program of Thutmose III. In *Thutmose III. A New Biography*, edited by E. H. Cline and D. B. O'Connor, pp.183-237. University of Michigan Press, Ann Arbor.

Lehner, M.
1997 *The Complete Pyramids*. *Solving the Ancient Mysteries.* Thames and Hudson, London.

Leospo, E.
1987-1989 Woodworking. Furniture and Cabinetry. In *Egyptian Civilization*, vol. I, edited by A. M. Donadoni Roveri, pp.120-159. Electa Spa; Istituto Bancario San Paolo, Milano-Torino.

Lesko, L. H.
2001 Coffin Texts. In *The Oxford Encyclopedia of Ancient Egypt*, vol. I, edited by D. B. Redford, pp.287-288. Oxford University Press, New York.

Lev-Yadun, S.
1992 The Origin of the Cedar Beams from Al-Aqsa Mosque. Botanical, Historical and Archaeological Evidence. *Levant* 24:201-208.

Lev-Yadun, S., M. Artzy, E. Marcus, and R. Stidsing
1996 Wood Remains from Tel Nami, A Middle Bronze IIA and Late Bronze IIB Port, Local Exploitation of Trees and Levantine Cedar Trade. *Economic Botany* 50 (3):310-317.

Lichtheim, M.
2006 *Ancient Egyptian Literature*. Vol. I. *The Old and Middle Kingdoms*. University of California Press, Berkeley.

Liphschitz, N.
1986 Overview of the Dendrochronological and Dendroarchaeological Research in Israel. *Dendrochronologia* 4:37-58.

Lokma, N.
2005 *Restoration and Conservation of the Wooden Statues Found in the Mastaba of Kaaper*. Supreme Council of Antiquities, Cairo (in Arabic).

Loret, V.
1916 Quelques Notes Sur l'Arbre. *Annales du Service des Antiquités de l'Égypte* 16:33-51.

Lucas, A., and J. R. Harris
1989 *Ancient Egyptian Materials and Industries*. 4th ed. Edward Arnold, London.

Málek, J.
1984 Saqqara. First Intermediate Period and Middle Kingdom. *Lexikon der Ägyptologie,* vol. V, edited by W. Helck and E. Otto, col.409. Harrassowitz, Wiesbaden.

Manning, S.W., B. Kromer, P. I. Kuniholm, and M. W. Newton
2001 Anatolian Tree-Rings and A New Chronology for the East Mediterranean Bronze-Iron Ages. *Science* 294: 2532-2535.

Manning, S. W., M. W. Dee, E. M. Wild, C. Bronk Ramsey, K. Bandy, P. P. Creasman, C. B. Griggs, C. L. Pearson, A. J. Shortland, and P. Steier
2014 High-Precision Dendro-^{14}C Dating of Two Cedar Wood Sequences from First Intermediate Period and Middle Kingdom Egypt and a Small Regional Climate-Related ^{14}C Divergence. *Journal of Archaeological Science* 46:401-416.

Maragioglio, V., C. A. Rinaldi, and E. Howell.
1963 *L'architettura delle piramidi Menfite. Testo. Parte III*. Torino, Tip. Artale.

Maxwell, R. S., J. A. Wixom, and A. E. Hessl

2011 A Comparison of Two Techniques for Measuring and Crossdating Tree Rings. *Dendrochronologia* 29:237-243.

Meiggs, R.
1982 *Trees and Timber in the Ancient Mediterranean World*. Clarendon Press, Oxford.

Mikhail, A.
2011 *Nature and Empire in Ottoman Egypt. An Environmental History*. Cambridge University Press, Cambridge.

Mikesell, M. W.
1969 The Deforestation of Mount Lebanon. *Geographical Review* 59:1-28.

Mitsutani, T.
2004 *Dendrochronology and the Latest Imaging Equipments. Applications to Ancient Architecture, Carved Wooden Buddha Statues, and Wooden Artifacts*. National Research Institute for Cultural Properties, Nara City.

Moeller, N.
2005 The First Intermediate Period: A Time of Famine and Climate Change? *Egypt and the Levant* 15:153-167.

Nash, S. E.
1998 Time for Collaboration. A. E. Douglass, Archaeologists, and the Establishment of Tree-Ring Dating in the American Southwest. *Journal of the Southwest* 40(3):261-305.

1999 *Time, Trees, and Prehistory: Tree-Ring Dating and the Development of North American Archaeology, 1914-1950*. University of Utah Press, Salt Lake City.

2000 Seven Decades of Archaeological Tree-Ring Dating. *It's About Time. A History of Archaeological Dating in North America*, edited by S. E. Nash, pp.60-83. University of Utah Press, Salt Lake City.

2002 Archaeological Tree-Ring Dating at the Millennium. *Journal of Archaeological Research* 10(3):243-275.

Nash, S. E., and J. S. Dean
2005 Paleoenvironmental Reconstructions and Archaeology. Uniting the Social and Natural Sciences in the American Southwest and Beyond In *Southwest Archaeology in the Twentieth Century*, edited by L. S. Cordell and D. D. Fowler, pp.125-141. University of Utah Press, Salt Lake City.

Nibbi, A.
1981 *Ancient Egypt and Some Eastern Neighbours*. Noyes Press, New Jersey.

1985 The Lebanon and Djahy in the Egyptian Texts. *Discussions in Egyptology* 1:17-26.

1987 Some Remarks on the Lexikon Entry Zeder, Cedar. *Discussions in Egyptology* 7:13-27.

1990 A Note on the Cedarwood from Maadi. *Discussions in Egyptology* 17:25-7.

1994 Some Remarks on the Cedar of Lebanon. *Discussions in Egyptology* 28:35-52.

1996 Cedar Again. *Discussions in Egyptology* 34:37-59.

2003 Cedar yet again. *Discussions in Egyptology* 56, 69-83.

Nour, M. Z., M. S. Osman, Z. Y. Iskandar, and A. Y. Moustafa
1960 *The Cheops Boats.* Part. I. General Organisation for Government Printing Offices, Cairo.

O'Connor, D.
2006 Thutmose III. An Enigmatic Pharaoh. In *Thutmose III. A New Biography*, edited by E. H. Cline and D. B. O'Connor, pp.1-38. University of Michigan Press, Ann Arbor.

Oakley, K. P.
1932 Woods Used by the Ancient Egyptians. *Analyst* 57:158-159.

Okochi, T., Y. Hoshino, H. Fujii, and T. Mitsutani
2007 Nondestructive Tree-Ring Measurements for Japanese Oak and Japanese Beech Using Micro-Focus X-Ray Computed Tomography. *Dendrochronologia* 24:155-164.

Oren, E. D.
1987 The ‘Ways of Horus’ in North Sinai. In Egypt*, Israel, Sinai. Archaeological and Historical Relationships in the Biblical Period*, edited by A. F. Rainey, pp.69-119. Tel Aviv University, Tel Aviv.

Oren, E. D.

2006 The Establishment of Egyptian Imperial Administration on the “Ways of Horus”. An Archaeological Perspective from North Sinai. In *Timelines. Studies in Honour of Manfred Bietak*. Vol. II, edited by E. Czerny, I. Hein, H. Hunger, D. Melman, and A. Schwab, pp.279-92. Peeters, Leuven.

Petry, C. F. (editor)
1998 *The Cambridge History of Egypt.* Vol. I. *Islamic Egypt, 640-1517*. Cambridge University Press, Cambridge.

Phillips, J., and O. Bar-Yosef
1974 Gebel Maghara-Northern Sinai. *Paléorient* 2(2): 483-484.

PM =1976 Porter, Bertha and Rosalind L.B. Moss. *Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs, and Paintings*. Vol. III.2. Clarendon Press, Oxford.

Podzorski, P. V., N. C. Rem, and J. A. Kundsen
1985 Identification of Some Egyptian Wood Artifacts in the Lowie Museum of Anthropology. *MASCA Journal* 3:122-124.

Quézel, P.
1963 De l’application de techniques palynologiques à un territoire désertique. Paléoclimatologie du Quaternaire Récent au Sahara. *Research Arid Zone* (UNESCO, Paris) 20:243-249.

Range, P.
1921 *Die Flora der Isthmuswüste: auf Grund des vom Verf. in d. Jahren 1915/16 gesammelten, von Herrn Prof. Dr. Georg Schweinfurth bestimmten Materials unter Benutzung d. einschläg. Literatur*. Gesellschaft f. Palästina-Forschung, Berlin.

Reid, J. J.

1993 Emil Walter Haury 1904-1992. *Kiva* 59 (2): 242-59.

Reid, J. J., and S. M. Whittlesy
2005 Seven Years That Reshaped Southwest Prehistory In *Southwest Archaeology in the Twentieth Century*, edited by L. S. Cordell and D. D. Fowler, pp.47-59. The University of Utah Press, Salt Lake City.

Rich, S. A.
2013 *Ship Timber as Symbol? Dendro-Provenancing & Contextualizing Ancient Cedar Ship Remains from the Eastern Mediterranean/Near East.* Ph.D. Dissertation, The Katholieke Universiteit, Leuven.

Rizkana, I., and J. Seeher
1989 *Maadi, III: The Non-Lithic Small Finds and the Structural Remains of the Predynastic Settlement*. Zabern, Mainz.

Rossi, C., and A. De Luca.
2006 *The Treasures of the Monastery of Saint Catherine*. White Star, New York.

Roth, N.
2003 Synagogues. In *Medieval Jewish Civilization: An Encyclopedia*, edited by N. Roth, pp. 620-624; 628-631. Routledge, New York.

Rowton. M. B.
1966 The material from western Asia and the chronology of the Nineteenth Dynasty. *Journal of Near Eastern Studies* 25 (4), 240-258.

Ryan, D. P., and D. H. Hansen
1987 *A Study of Ancient Egyptian Cordage in British Museum*. British Museum, London.

Saleh, M. and H. Sourouzian
1987 *The Egyptian Museum, Cairo*. *Official Catalogue*. Organisation of Egyptian Antiquities Press, Cairo.

Schweingruber, H. F.
1988 *Tree Rings Basics and Applications of Dendrochronology*. D. Reidel Pub. Co., Dordrecht.

Shaw, I. (editor)
2000 *The Oxford History of Ancient Egypt*. Oxford University Press, Oxford.

Shmida, A.
1977 Remarks on the Palaeoclimates of Sinai, Based on the Distribution Patterns of Relict Plants In *Prehistoric Investigations in Gebel Maghara, Northern Sinai*, edited by O. Bar-Yosef and J. L. Phillips, pp.36-41. Institute of Archaeology, the Hebrew University of Jerusalem, Jerusalem.

Silverman, D. P. (editor)
1997 *Searching for Ancient Egypt: Art, Architecture, and Artifacts from the University of Pennsylvania Museum of Archaeology and Anthropology*. Cornell University Press, Ithaca.

Simpson, W. K.
1965 *Papyrus Reisner*. Vol. II. Museum of fine Arts, Boston.

Śliwa, J.
1975 *Studies in Ancient Egyptian Handicraft. Woodworking*. Nakladem Uniwersytetu Jagiellońskiego, Cracow.

Sowada, K. N.
2009 *Egypt in the Eastern Mediterranean during the Old Kingdom: An Archaeological Perspective*. Academic Press; Fribourg.

Speer, J. H.
2010 *Fundamentals of Tree-Ring Research*. University of Arizona Press, Tucson.

Stokes, M. A., and Smiley, T. L.
1996 *An Introduction to Tree-Ring Dating*. University of Arizona Press, Tucson.

Sturdwick, N.
2005 *Texts from the Pyramid Age.* Society of Biblical Literature, Atlanta.

Svarth, D.
1998 *Egyptisk møbelkunst fra faraotiden= Egyptian Furniture-Making in the Age of the Pharaoh*. Skippershoved, Skårup.

Täckholm, V. A.
1974 *Student's Flora of Egypt.* Cairo University, Cairo.

Tarhule, A., and M. K. Hughes
2002 Tree-Ring Research in Semi-Arid West Africa. Need and Potential. *Tree-Ring Research* 58 (1/2):31-46.

Taylor, J. H.
2004 *Mummy: the inside story*. British Museum Press, London.

2013 New Radiocarbon Dates for the 21st Dynasty In *Radiocarbon and the Chronologies of Ancient Egypt*, edited by A. J. Shortland and C. Bronk Ramsey, pp.167-173. Oxbow Books, Oxford.

Taylor, J., and D. Antoine, M. Vandenbeusch, and B. Moreno.
2014 *Ancient Lives. New Discoveries*. *Eight Mummies. Eight Stories*. British Museum Press, London.

Teeter, E.

2011 *Religion and Ritual in Ancient Egypt.* Cambridge University Press, New York.

Thirgood, V. J.

1981 *Man and the Mediterranean Forest: A History of Resource Depletion.* Academic Press, London.

Thompson, R. H., C. V. Haynes, Jr., and J. J. Reid.
1997 Emil Walter Haury. *Biographical Memoirs* 72:151-174. National Academy of Sciences of the United States of America. National Academic Press, Washington.

Touchan, R., D. Meko, and M. K. Hughes
1998 A 396-Year Reconstruction of Precipitation in Southern Jordan. *Journal of the American Water Resources Association* 35 (1):49-59.

Touchan, R. and M. K. Hughes.
2009 Dendroclimatology in the Near East and the Eastern Mediterranean Region In *Tree-Rings, Kings and Old World Archaeology and Environment. Papers Presented in Honor of Peter Ian Kuniholm*, edited by S. W. Manning and M. J. Bruce, pp.65-70. Oxbow Books, Oxford.

Towner, R. H.
2002 Archeological Dendrochronology in the Southwestern United States. *Evolutionary Anthropology* 11(2):68–84.

Verner, M.
1998 *Die Pyramiden*. Rowohlt, Hamburg.

Vinson, S.
1994 *Egyptian Boats and Ships*. Shire Publications, Princes Risborough.

Ward, C.
2000 *Sacred and Secular: Ancient Egyptian Ships and Boats*. University Museum, University of Pennsylvania, Philadelphia.

2006 Boat-Building and its Social Context in Early Egypt. Interpretations from the First Dynasty Boat-Grave Cemetery at Abydos. *Antiquity* 80(1):118-129.

2012 Building Pharaoh's Ships. Cedar, Incense and Sailing the Great Green. *British Museum Studies in Ancient Egypt and Sudan* 18:217-232.

Ward, C., and C. Zazzaro
2010 Evidence for Pharaonic Seagoing Ships at Mersa/Wadi Gawasis, Egypt. *The International Journal of Nautical Archaeology* 39:1-17.

Webb, G. E.
1983 *Tree Rings and Telescopes. The Scientific Career of A. E. Douglass*. University of Arizona Press, Tucson.

Wetterstrom, W., and M. A. Murray
2001 Agriculture. In *The Oxford Encyclopedia of Ancient Egypt*, Vol. I, edited by D. B. Redford, pp.37-44. Oxford University Press, Oxford.

White, F.
1983 *The Vegetation of Africa*: *A Descriptive Memoir to Accompany the* UNESCO */AETFAT/UNSO Vegetation Map of Africa*. UNESCO, Paris.

Wittmack, L.
1912 Holz vom Porträtkopf der altägyptischen Königin Teje (18. Dynastie, ca. 1400 v. Chr.). *Berichte der Deutschen Botanischen Gesellschaft* 30:275-278.

Wb.= Erman, A. and H. Grapow
1926-1963 *Wörterbuch der aegyptischen Sprache.* 7 vols. J. C. Hinrichs, Leipzig.