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An Ancient Egyptian Senet Board in the Arizona State Museum

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Summary: This article discusses a fragment of a rare, wooden slab-style Egyptian senet board that was given to the Arizona State Museum, University of Arizona (Tucson, Arizona) in 1922 by Lily S. Place, an American who lived in Cairo in the 1910s and 1920s and purchased ancient Egyptian objects from dealers and in the bazaars; it has no ancient provenience. Using a multi-disciplinary approach, the authors provide a reading and interpretation of the incised hieroglyphs, establish a radiocarbon date for the game board from 980 to 838 B.C.E., identify the wood as *Abies* (fir), probably *Abies cilicica*, demonstrate that the board was fashioned from freshly-cut wood, and identify the inlay substance as a green copper-wax pigment.

Keywords: Ancient Egyptian game boards – Arizona State Museum – radiocarbon dating – *Abies* (fir) – copper-wax pigment

Arizona State Museum's Ancient Egyptian Collection

The modest ancient Egyptian collection of the Arizona State Museum (ASM) at the University of Arizona (http://www.statemuseum.arizona.edu) of approximately 250 accessioned objects (as well as a large pottery typology collection assembled by George A. Reisner) is virtually unknown among Egyptologists, yet surprising gems have emerged in recent years as a result of closer study, student projects, and sharing information with visiting Egyptian scholars. The object presented here, a fragment of an inlaid wooden senet board, has been part of ASM's collection since the 1920s but has never been published or received the attention it deserves as an outstanding example of an Egyptian game board, often found as an accoutrement in an elite Egyptian tomb (Figure 1a, b).

It would be natural to wonder why a museum founded in 1893 on the campus of Arizona's first university with a mission that from its earliest history focused on the cultures of the American Southwest would have acquired an ancient Egyptian collection[1]. ASM's first director Byron Cummings (1860–1954) was instrumental in developing the museum's Old World collections in the early decades of the twentieth century[2]. Cummings was a classicist who, along with teaching Greek and Latin and directing the museum, taught archaeology courses in the newly founded Department of Archaeology (later Department of Anthropology, now School of Anthropology). These courses included Greek and Roman archaeology, American archaeology, as well as Egyptology. Cummings would become the "dean" of Southwest archaeology, a leader in the emerging field of American archaeology which had its roots in the study of Old World archaeology and ancient languages[3]. It is clear that this young museum and Cummings saw the importance of acquiring objects that illustrated the breadth and variety of worldwide cultures for teaching and for public interpretation. In addition, in those early decades of the twentieth century ancient Egypt figured prominently in theories of the diffusion of civilizations from Old World to New World, for example in the "hyperdiffusionist" theory propounded by the Australian-British anatomist Grafton Elliot Smith (1871–1937). Smith claimed that major inventions and innovations began with the ancient Egyptians and spread from Egypt to the rest of the world[4]. Scholarly discourse was rife with diffusionist arguments during the early twentieth century, at exactly the time of the acquisition of the majority of ASM's Egyptian antiquities.

Theorizing about the origins of civilization continued into the 1950s when a collection of Egyptian pottery was acquired by ASM as a transfer from the disbanded Gila Pueblo Archaeological Foundation in Globe, Arizona.

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1 Romano 2016.
2 Bostwick 2006.
3 Wilcox 2005, 386–394.
4 Smith 1911; Smith 1915; Elkin and Macintosh 1974.

Through its founder and director Harold Sterling Gladwin (1883–1983)[5] the foundation received these Egyptian objects as an exchange with the Peabody Museum of Archaeology and Ethnology of Harvard University in return for Native American collections. Gladwin saw in the decorative motifs and the technology of Egyptian Predynastic red-on-buff wares and Predynastic and Nubian black-topped red wares close similarities to Hohokam Preclassic (950–1150 C.E.) and Casas Grandes (1250–1450 C.E.) pottery (Figure 2). Gladwin was a passionate diffusionist who viewed pottery as the key to establishing worldwide cultural connections, and he linked the Hohokam of the American Southwest with eastern Libya and ancient Egyptians, a viewpoint that was not shared by most archaeologists[6].

Acquisition History of the Senet Board

The senet board was donated to ASM in 1922 by Lily Stafford Place (1857–1929) who lived with her sister Ada (d. 1920) in Cairo (as well as in Paris and London) during the 1910s and 1920s (Figure 3). She gave ASM approximately 195 unprovenienced Egyptian objects in 1922 and 1924, purchased in the bazaars of Cairo and other local shops[7]. These included mummy cartonnage fragments, amulets, beads, figurines, bronze and limestone statuettes[8], ceramic and bronze lamps, mostly of the Roman period, and miscellany, as well as some forgeries[9]. We know nothing else specifically about the acquisition of the senet board or its provenience. During her lifetime and in her will Place also donated over 3,000 objects to the Minneapolis Society of Fine Arts for the Minneapolis Institute of Arts, a large portion of which were Egyptian antiquities and ethnographic textiles from various parts of the world[10], some of which were deaccessioned in the 1950s[11]. In addition, she donated pieces from her collection in 1921 and 1923 to the Metropolitan Museum of Art, both ancient Egyptian and ethnographic textiles.

Lily S. Place was born in New York and was raised in Minneapolis: thus, the connections to the Metropolitan Museum of Art and the Minneapolis Institute of Arts are understandable. We are unclear, however, what the exact connection was to Arizona and ASM. We had surmised that there may have been a familial relationship to Roy W. Place (1887–1950), a Tucson-based architect who designed many of the brick buildings on the University of Arizona's campus beginning in the 1920s, including ASM's main building today. It is also possible, however, that the University of Arizona/ASM connection was made in the expatriate society of Cairo where a University of Arizona Professor of Agriculture Robert Humphrey Forbes (1867–1968) lived from 1918 to 1922, working as a consultant to the Egyptian government on arid lands agricultural issues[12]. Forbes was informally charged by ASM Director Byron Cummings (1860–1954) with identifying ancient Egyptian objects for ASM's developing collections that might be exchanged for objects from the American Southwest. In this pursuit Forbes and noted Harvard University archaeologist George A. Reisner (1867–1942) became close friends, resulting in ancient Egyptian ceramic acquisitions for the museum[13]. It may also have been in this context that Lily S. Place became aware of the desire of ASM to form Old World collections, including Egyptian, that might serve for comparative research and teaching purposes.

Measurements and General Description of ASM 12496

Max. P. L. 0.198; Max. P.W. 0.057; Max. P. Th. 0.004 m
Restored L. ca. 0.55–60 m
Gaming squares within incised divider lines:
No. 30 (at right edge): Max. P.H. 0.05; W. 0.05 m
No. 29: Max. P.H. 0.05; W. 0.051 m
No. 28: Max. P. H. 0.046; W. 0.053 m
No. 27: Max. P. H. 0.045; Max. P. W. 0.019 m

This thin wooden panel fragment preserves the decorated upper surface of the right lower corner of the game board, including the majority of its final three gaming squares (28–30 in modern numbering) and a small portion of 27, as well as the original back surface. The squares are bordered on all preserved sides by incised grooves, two horizontal along the bottom edge; two vertical at the right edge; and three vertical dividing each of the squares from one another. Each of the preserved squares is decorated with sunken hieroglyphs, leaving darkened (a substance? or secondary burning?) channels filled with the remnants of a degrad-

5 Haury and Reid 1985.
6 Gladwin 1947, 143; Gladwin 1979, 66–67.
7 Lily S. Place Obituary 1929.
8 Romano 2014.
9 Romano 2016, 204–208.
10 MIA 1930; personal communication Reanna Phillips, MIA, December 9, 2013, summary of archival documents.
11 Harer 2007, 115–116.
12 Colley 1977.
13 Romano 2016, 196–208.

ed material (see below for the identification of the inlay substance). The back of the fragment is a flat undecorated surface. There is no evidence for adhesive or of any holes for affixing this thin fragment to the top of a box or thicker board.

Identification of the Wood: *Abies* sp. (Fir)

In order to obtain a scientific taxonomic identification of the wood of ASM 12496, a small (ca. 0.5 x 0.25 x 0.25 cm) and undecorated fragment from the jagged left edge of the game board was sampled for anatomical evaluation (Figure 4). The specimen was initially evaluated by Pearce Paul Creasman in the University of Arizona's Laboratory of Tree-Ring Research, then sent to the Center for Wood Anatomy Research, Forest Products Laboratory (U.S. Forest Service) for identification. Thin sections from cross-sectional, radial, and tangential surfaces were prepared for viewing under a microscope. The thin sections were viewed at high magnification (10×, 40×, and 60×) in order to observe anatomical features, which were compared to known voucher specimens/images[14].

Due to the limitations of the sample available for identification (e.g., size), the genus is the most specific identification that can be made with confidence at this time[15]. Based, in part, on the following characteristics the wood was identified as *Abies* sp., commonly called fir[16]: longitudinal tracheids without resin canals (Figure 5), taxodioid ray pits (Figure 6), homogenous rays, ray parenchyma cells with nodular end walls (Figure 7), and crystals in ray parenchyma.

Abies sp. is not native to Egypt, nor is it commonly evidenced/identified in the archaeological record of Egypt. However, *Abies* sp. wood has been reported from a Fifth Dynasty archaeological context, and fir resin is also reportedly identified from pharaonic contexts, including in textual sources. The scarcity of *Abies* sp. wood in the pharaonic archaeological record, coupled with the uncertainty that surrounds correspondences between modern taxonomy and ancient terminology, would seem to indicate that fir was not a regular import before Graeco-Roman times[17]. The low percentage of *Abies* sp. from ancient Egyptian contexts, however, may also be the result of erroneous identification. Old fir surfaces sometimes exhibit a yellowish tint, and in association with a gradual transition from earlywood to latewood, may lead to its visual identification as cedar. Cilician fir [*Abies cilicica* (Ant and Kotschy) Carr.] is the most logical candidate for the wood of ASM's senet board and was used in the Egyptian construction industry, furniture-making, and boat building[18]. The main distribution area of Cilician fir is the Taurus Mountains of Turkey and in Syria and Lebanon at an altitudinal range of 1000–2000 m (Figure 8). Egypt had access to *Abies cilicica* via its entrepôt at Byblos at least as early as the Old Kingdom[19].

In order to get more information from the wood, we measured the senet board using a LINTAB platform with reflected-light microscopes and observed some wood anatomical details. Tree-ring widths were the measured parameter; 0.01 mm was the precision of measurement. The tree-ring series was registered on TSAPWin system. The average tree-ring width is 1.3 mm, indicating a slow growing tree. The tree-ring widths oscillate between 0.52 and 2.75 mm; intraannual density fluctuations are absent; the rings are normally developed and with distinct latewood. These features indicate a tree from a mid or high altitude. In addition, one ring shows distinct traumatic resin ducts (Figure 9). In the genus *Abies* vertical resin ducts are typically absent and are produced only after some wounding. According to Stoffel, the presence of resin ducts in fir wood is the result of geomorphic activity such as a rockfall or snow avalanche[20]. This further confirms that this tree was growing in a mountainous region. In addition, we observed that the board was cut precisely radially (Figure 10). The wavy form of fibers under mechanical pressure of woodworking tools suggests the processing of relatively fresh, unseasoned timber (Figure 11).

Analysis of Inlay Substance: Green Copper-Wax Pigment

Examination and analysis of the inlay material of ASM 12496 was undertaken by Christina Bisulca in the Conservation Laboratory of the Arizona State Museum. In examination with a stereomicroscope, the inlay itself is green with a white efflorescence at the surface (Figure 12). In order to characterize the nature of the inlay material, the wood and inlay were first examined non-destructively

14 Akkemik and Yaman 2012; Fahn *et al.* 1986.

15 See Wiedenhoeft 2006, 16 regarding the limitations of scientific wood identification.

16 Personal communication, Michael C. Wiemann, Botanist, Forest Products Laboratory, to Creasman, 20 October 2015.

17 Wittmack 1910, 190; Germer 1985, 7–8; Manniche 1989, 64–65; Davies 1995, 146–156, pls. 31–32.

18 Gale, *et al.* 2000, 334–371; Killen 2017, 3; for other species see Schweingruber 1990, 108–109 and Akkemik and Yaman 2012, 28–32.

19 Weinstein 2001.

20 Stoffel 2008.

with X-ray fluorescence spectroscopy (XRF). XRF was performed on a Bruker Tracer SD3 handheld XRF at 15 keV, 25μA under vacuum and 40 keV, 25μA. Small samples (~0.5 mm^2) of the substance were removed with a needle from the upper edge of square 28 and lower area in square 30 (Figure 4). FTIR was performed on these samples using a Thermo iS10 360 spectrometer with an ATR attachment, equipped with a He-Ne laser. Spectra were recorded in reflection mode, from 4000 to 650 cm^{-1}, 64 scans at 4 cm^{-1} resolution. Recorded spectra were then compared with ASM's ATR reference spectral database and the Infrared and Raman User's Group (IRUG) reference library[21].

The inlay material contains significant amounts of copper with minor amounts of calcium and iron in all areas analyzed by XRF. Based on FTIR, the inlay material is primarily a mixture of wax and copper carboxylates formed from the saponification of the wax esters. This is to say, the green color is due to this copper-fatty acid compound, and not copper-based mineral pigments (e.g., malachite or Egyptian green) embedded in wax. In the technical literature for museum artifacts, these are commonly referred to as "copper soaps." This identification is based on the n (C=O) band at 1736 cm^{-1} and n (C-O-C) at 1173 cm^{-1} which are due to wax esters. The methylene stretching vibrations at 1472 cm^{-1}, 1462 cm^{-1}, and 1378 cm^{-1} and twin bands at 720 cm^{-1} and 731 cm^{-1} are indicative of long chain hydrocarbons. The band at 1588 cm^{-1} is due to n (C=O) of a carboxylate soap formed from saponification, which is copper carboxylate based on the position of this band[22] and the presence of copper in XRF. Based on spectral correlation the wax is most consistent with beeswax, the use of which in ancient Egypt is well known[23]. The assignment of beeswax is demonstrated in Figure 13A which shows the fingerprint region of FTIR spectra of a green sample taken from the interior of the inlay, indicating a high correlation with reference spectra for beeswax and cupric palmitate, a copper soap.

A similar green wax material has been identified on other Egyptian artifacts of various periods. Examples are known from the Nineteenth, Twentieth, and Twenty-sixth Dynasties, as well as in the Late Period. However, in other reported cases the material was used as a paint or surface treatment rather than as an inlay[24]. Instances where this particular wax pigment is used as an inlay material are not reported in the literature.

It is not known if this green substance was intentionally created to be a colorant by heating wax in a copper vessel or with copper-containing minerals[25], or if it was formed as a deterioration product between copper pigments in the wax over a period of time[26]. Similar deterioration products (i.e., the formation of metal soaps) with copper-containing minerals like malachite and azurite have been found to form with the oil binder in paintings[27]. In microscopic examination of this wax inlay no pigment particles were observed. As Scott suggests, more research is needed to understand this unusual green wax colorant[28].

With regard to the white efflorescence observed on the surface of the inlay, the FTIR spectra of the sample removed from the surface showed some differences compared to the green sample taken from the interior (see Figure 13B). In the carbonyl region there is a shoulder at 1723 cm^{-1} due to free fatty acids, indicating partial hydrolysis of the wax ester, and copper carboxylate soaps are absent. This indicates that this white efflorescence is probably due to recrystallized wax at the surface. The surface sample also has broad bands at ~1030 cm^{-1} and ~1620 cm^{-1}. These are most likely due to contaminants on the surface (aluminosilicates, dust, wood char, etc.) that have become embedded in the wax.

The Senet Game and its Inscribed Squares

The gaming squares preserved on ASM 12496 belong to the Egyptian 30-square board game, known as "senet." The full variety of the different kinds of Egyptian board games has most recently been surveyed by Crist, Dunn-Vaturi, and de Voogt[29]. For the senet game, over a hundred game boxes and game boards survive from pharaonic Egypt, either complete or fragmentary. The fullest, most recent catalogue is that of Piccione[30]; the survey by Pusch[31] remains valuable, and Piccione did not aim to duplicate Pusch's substantial range of photographic illustrations. The playing-squares are arranged in three parallel rows of ten. There is general agreement that the game was of the "race" kind, that is, that it was akin to Snakes-and-Lad-

21 Price and Pretzel 2014.
22 Robinet and Corbeil 2003.
23 Lucas and Harris 1962, 352; Newman and Serpico 2000, 489–491; Serpico and White 2000, 422; Kritsky 2015, 104–114.
24 Daniels 2007; Liang and Scott 2014; Scott 2015, 10.
25 Daniels 2007.
26 Liang and Scott 2014.
27 Gunn *et al*. 2002.
28 Scott 2015, 10.
29 Crist, Dunn-Vaturi, and de Voogt 2016.
30 Piccione 1990, 382–451.
31 Pusch 1979, v. 1, 149–383.

ders, Ludo, or Backgammon[32], that it was for two players, and that the moves of the game-pieces (usually seven or, later, five per player) were governed by the fall of a set of four throw-sticks, or of a pair of knucklebones, or (rarely) of a pair of dice. The pieces moved over the board in a z-shaped path (Figure 14). A piece was only safely "home" when it had passed all 30 squares and left the board. The last five squares (26–30, as numbered by modern scholars) thus seem to have been crucial for the fate of a piece, and commonly only these last five squares (and not always all of them) were inscribed. Square 26 appears to have been in some way lucky, and 27 to have involved a penalty; squares 28–30 counted down to a piece's exit: 3, 2, 1 (possibly suggesting that an exact throw was needed for a piece to be allowed to leave). The surviving squares of ASM 12496 are the final squares of the game, 27–30. The lost square 26 may have been inscribed, but the others may well have been blank.

Senet games are attested archaeologically from all periods, from the Old Kingdom down to the early Roman period, and often survive because of their inclusion as part of elite tomb-equipment. Although the material is varied, certain broad changes in the form of the boxes or boards and in their inscribed squares are evident, as well as a shift, during the New Kingdom, towards an explicit interpretation of the senet game as mirroring the deceased's successful passage to renewed life. It is often possible to say roughly when a particular feature is first attested, but most of the material cannot be assigned a very firm or very precise date, especially as many examples lack provenience.

Whether ASM 12496 belonged to a game in the form of a game *box* or a game *board* cannot be firmly decided. Plainly, this fragile panel must have been attached to a stronger object. In broad terms, it is accepted that game boxes, common in the earlier New Kingdom, are not attested from after the Nineteenth Dynasty[33]. The only possibly later game in box-form known is an ivory example from Enkomi, Cyprus, perhaps from as late as the end of the second millennium, and this is generally thought to have been made in Cyprus[34], although, in its damaged state, whether or not it bore markings for the senet game is questionable[35]. The playing squares of the earlier New Kingdom boxes tend to be framed and held in place by thin dividing strips[36], or are modelled in imitation of this. The flat surface of ASM 12496 and the double and triple dividing lines inscribed between the squares are better paralleled in the slab-style game boards that are common from the Twentieth Dynasty onwards; a clear example is British Museum 102396[37] (Figure 15). These slab-style boards are mostly of stone, glazed stone, or glazed composition (faience). A single damaged fragment of one wooden example (British Museum EA 38429) appears to consist of a solid board, 1.5 cm thick[38]. It is, however, plausible that a board of inferior wood might be fitted with more costly panels — a technique certainly attested from Egypt[39] — though the method of attachment for ASM 12496 is not apparent.

For the final three or four or five squares of the senet game (the ones most commonly inscribed), the earliest markings were simply numbers, especially "three" and "two" applied to squares 28 and 29. By the early New Kingdom, two male human figures began to be used in square 29. Around the same time, the standard hieroglyphic grouping of three *ba*-birds began to be used for square 28. In the later New Kingdom, two and one figures of deities (or their symbol,) began to appear in squares 29–30, often alongside the *ba*-birds of square 28. By the late New Kingdom, the last three squares regularly show three, two, and one deities, or symbols for them[40].

In its inscriptions, the ASM fragment plainly belongs among the examples with figures or symbols of deities. It has, however, striking similarities to just one other example, the set of 30 detached game-box squares, unfortunately lacking any provenience, housed since 1922 in the Royal Ontario Museum as ROM 922.17[41] (Figure 16a, b). The squares are of glazed steatite, and five (26–30) are inscribed: "The hieroglyphs were carved in the steatite, and were inlaid with lapis lazuli after the squares had been glazed"[42]. They have been regularly discussed in the literature on the 30-square game since they were first pub-

32 Murray 1952, 4–5, 113–157 (for senet see 13–18); Bell 1969, v. 1, 1–46 (for senet see 26–29; cf. v. 2, 1–23); Parlett 1999, 8–106 (for senet see 66–68).

33 Thus, explicitly Piccioni 1990, 3–17, 426 (on his D. 210), 430 (on his D. 242); cf. Crist, Dunn-Vaturi, and de Voogt 2016, 60.

34 British Museum Greek and Roman Antiquities 1897, 0401.996: see for example Piccioni 1990, 430 (D. 242); Tatton-Brown 1997, 41.

35 Crist, Dunn-Vaturi, and de Voogt 2016, 76.

36 Compare the construction of the largest of the game boxes from the tomb of Tutankhamun, obj. no. 345: Tait 1982, 9; Plates III–IV, VII, XVII.

37 Cf. Pusch 1979, v. 1, 309–310; v. 2, Taf. 78–80 (no. 59); Piccioni 1990, 427 (D. 220), registered in the BM Department of the Middle East, but housed in the Department of Ancient Egypt and Sudan.

38 Cf. Pusch 1979, v. 1, 324–327; v. 2, Taf. 86–87 (no. 66); Piccioni 1990, 431–432 (D. 255), registered and housed in the BM Department of Ancient Egypt and Sudan.

39 Killen in Gale *et al*. 2000, 366–367.

40 See the summary table of Piccione 1990, 452–457 and his account 2007, 59; some typical markings are illustrated in Crist, Dunn-Vaturi, and de Voogt 2016, 46, fig. 3.2.

41 Needler 1953, 61.

42 Needler 1953, 60.

lished, at a time when they formed part of the MacGregor Collection[43]. In particular, their inscriptions have most recently been studied by Kendall[44], Pusch[45], and Piccione[46]. Needler briefly proposed an early-Nineteenth Dynasty date for ROM 922.17[47], and suggestions since have been within the limits of the late-Eighteenth to Nineteenth Dynasties. There are also some parallels between the inscriptions of ASM 12496 (especially squares 29–30) and those of a board from Heliopolis (perhaps of similar date to ASM 12496) housed in "one of the Matariya magazines," and recently published by Iskander as Mat. 3695[48]. For a summary of the contents of the squares 27–30 of ASM 12496, ROM 922, and Mat. 3695, see Figure 17.

ROM 922.17 and ASM 12496 share several features that set them apart from other game boards. In contrast to the simple images or symbols usually found, ROM 922.17 has complete sentences in hieroglyphic script in squares 26–30; ASM 12496 has coherent phrases in 28–29, while a trace of a hieroglyphic sign suggests that this was also the case in square 27. In square 28, ROM 922.17 refers to the "*Bau* of Heliopolis" (*Bau* being written with the  -group), and they also occur in the same square on ASM 12496. The "*Bau* (or "Powers" or "Souls") of Heliopolis" is a grouping of deities, whose members are often unspecified, and perhaps unspecific; however, they are also found in the *Book of the Dead* (end of Chapter 115), named as Ra^{c}, Shu, and Tefnut. In square 29, both ROM 922.17 and ASM 12496 feature two goddesses joining hands "in peace."

However, there are also differences. Most strikingly, ROM 922.17 consistently in 27–30 refers explicitly to "you" (i.e., the deceased): for example, "You shall cross the lake without wading" (square 27); the pronoun "you," however, does not similarly occur in the squares of ASM 12496. The sentences of ROM 922.17 are brief. Although they each reflect ideas in Egyptian mortuary texts (especially ideas in corpora of rather earlier dates (the *Pyramid Texts* and the *Coffin Texts*), they do not seem to duplicate known text passages, and there has not been complete agreement as to their meanings. Apart from other uncertainties, they can be translated either as wishes or as assertions. The differences between the material of ROM 922.17 and that of ASM 12496 are considerable. It would be inappropriate to try to analyse either version as more "corrupt" than the other — nor should any conclusions be drawn as to their relative dating.

The squares of the Egyptian 30-square game were traditionally true squares in format (although that, unusually, is not the case with the ROM 922.17 squares, which are all consistently taller than they are wide). When a game box bore both the senet game and the "Twenty-Square" game on opposite faces, the squares for senet usually remained square, while those for the "Twenty-Square" game (which had to fit a row of 12 of its squares along the length of the board) were narrowed to compensate. The tops of squares 28–30 of ASM 12496 are all broken away, but the natural restorations that may be made to the signs and images in squares 29–30 suggest that the areas of those two squares within their framing-lines were very close to square, while square 28 was slightly but noticeably wider than tall — which will surely have meant that squares 13 and 8 were also wider ones.

Reading of the Decorated Squares

All the hieroglyphic text preserved reads consistently from right to left.

Square 27 is almost entirely lost. At its bottom right corner, the traces of a Red-Crown hieroglyph () are clear: this would suggest that this square (like 28–29) may have contained hieroglyphic text and not only a substantial divine image.

Square 28 The precise arrangement of the signs in ASM 12496 demands that the text be read as arranged in two vertical columns:

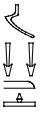
Thus, the draftsperson of the inscription evidently thought the text should be read in this way, but it presents difficulties: the standard expression *bꜣw Iwnw*, "*Bau* of Heliopolis" would have the genitival adjective inserted, and inserted in an anomalous feminine form, *n.t*, although confusion between the masculine and feminine forms becomes increasingly common from the later New Kingdom onwards.

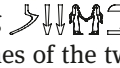
The "classical" reading of the  -sign is *ỉn*. However, to understand *ỉnt bꜣw Iwnw* , "bringing (by) the *Bau* of Heliopolis", in two horizontal lines of text, would go against the layout of the hieroglyphs, and the lack of any indication of *what* is brought seems harsh — a stairway (to

43 Wallis 1898, 8–9.
44 Kendall 1978, 26.
45 Pusch 1979, v. 1, 292–294; v. 2: Taf. 75 (no. 52).
46 Piccione 1990, 422; cf. 249–259 (D. 195).
47 Needler 1953, 73.
48 Iskander 2010.

the sky) is specified in ROM 922.17. This second objection would also apply to reading (as two vertical columns of text) *ỉn bȝw n{.t} Iwnw*, also understandable as "bringing (by) the *Bau* of Heliopolis". In later Egyptian,  can be used for the verb *pḥrr*, "hasten"[49], and "hastening by the *Bau* of Heliopolis", i.e., hastening to help the deceased, might suit the context here.

Square 29 In ASM 12496 two goddesses are depicted, facing each other. The goddess on the right wears the White Crown, the goddess on the left the Red Crown. They extend their left and right arms respectively to hold each other's hand. The right arm of the goddess on the left hangs down with her fist closed; the left arm of the goddess on the right similarly hangs down, but she holds an *ankh*,  . The goddesses stand on rectangles (resembling statue-bases), which merge completely with a *hetep*-hieroglyph,  , placed between their feet; or they could be seen as standing upon the *hetep*-hieroglyph which has been stretched to extend to almost the full width of the square. A vertical column of hieroglyphs runs between the pair of goddesses:



either *mȝ(ȝ) snsn m ḥtp*, "Seeing joining in peace", or *mȝ(ȝ) sn(.ty) m ḥtp*, "Seeing the two sisters in peace". In ROM 922.17, the two *sn*-signs may plausibly be read as the verb *snsn*, "to fraternize," "to join"[50], especially as they are followed by the suffix pronoun *=k*. In ASM 12496, the two figures of goddesses could be understood to form part of the "text" to be read, either as determinatives of *sn.ty*, "sisters" (i.e. understanding ), or, ideographically, as supplying the names of the two goddesses concerned. They surely reflect Isis and Nephthys, who, from the New Kingdom onwards, are increasingly associated with Nekhbet and Wadjet, and who are the most obvious goddesses to bear the White and Red Crowns[51]; they appear as vulture and cobra in the equivalent square of Mat. 3695.

Thus squares 28–29 of ASM 12496, despite their differences, share with the corresponding squares of ROM 922.17 an allusion to the roles (first attested in the *Pyramid Texts*) of the *Bau* of Heliopolis and of Isis and Nephthys in aiding the deceased to ascend to the sky[52].

Square 30 In ASM 12496 the Horus-falcon is depicted, wearing the Double Crown (); he stands upon a low shrine (). In front of him, rearing up from the top-surface of the shrine to about half the height of the falcon, is a cobra-goddess, wearing the Red Crown). Behind the falcon there are grouped a single leopard-head () and a *was*-sceptre (). These two hieroglyphs might be understood simply as symbols of power; it would surely be unwarranted to emend to read the common phrase  , *wsr-ph.ty*, "powerful in physical strength." The leopard-head is absent from the equivalent square of Mat. 3695, which otherwise shows a number of similarities.

Dating of the Senet Board

Radiocarbon dating of the wood of the senet board was carried out by the Accelerator Mass Spectrometry (AMS) Laboratory at the University of Arizona under the direction of Gregory Hodgins (Date no. AA-106816). A small sample of the wood was removed from the lower left corner of ASM 12496 (Figure 4). The visible ring structure indicated the sampling location contained the outer (youngest) wood in the board. The sample was extracted with a series of solvents: hexane, ethanol, methanol, and water, using a Soxhlet apparatus. It was then washed with mineral acids and bases to remove carbonates and absorbed contaminants, dried and combusted. Carbon dioxide was isolated from the other combustion products by cryogenic distillation. The carbon stable isotope value was measured offline on a dual inlet stable isotope mass spectrometer. The sample carbon dioxide was converted to graphite for radiocarbon measurement by accelerator mass spectrometry. All protocols utilized standard handling methods and NIST primary reference materials. The radiocarbon measurement was calibrated using the IntCal13 calibration data set and OxCal 4.2.4 software.

The results of the analysis are as follows:
δ13C (±0.1‰): –21.8‰
Fraction of modern carbon: 0.7085±0.0022
Uncalibrated Radiocarbon Age: 2768 ± 25 years BP
95% Calibrated Age Ranges: 994 to 987 B.C.E. (1.4%), 980 to 838 B.C.E. (94.0%)

49 Wb. I. 541. 2–13; cf. 14–18: Erman and Grapow 1926–1931, v. 1, 541; cf. Kurth 2009, v. 1, 128, item 5b.

50 So Piccione 1990, 252.

51 Münster 1968, 113–115; Troy 1986, 123; Russmann 1997, 271; Radwan 2003; Goebs 2008, 165.

52 Cf. Piccione 1990, 254–258.

The calibrated range of dates of 980 to 838 B.C.E. provided by the radiocarbon analysis represents an approximate *terminus post quem* of the senet board[53]. The "approximation" arises because the felling date of the tree from which the board was made is encoded in the radiocarbon content of the tree's outermost wood. When this wood was fashioned into the senet board, an unknown amount of outer wood was removed. Thus, the radiocarbon date of the senet board necessarily predates the felling of the tree and its manufacture into an object by some finite but indeterminate timespan. In the case of ASM's senet board, we know from the wavy form of the wood fibers that the senet board was made from relatively fresh, unseasoned wood and not from a reused wooden object or of older wood that had been stockpiled (see above, p. 73 and Figure 11). The calibrated *terminus post quem* for ASM 12496 of between 980 to 838 B.C.E, corresponding to late Dynasty Twenty-one into Dynasty Twenty-two, is not surprising for a slab-style board which, as discussed above, are common from the Twentieth Dynasty onward.

Conclusions

This finely-carved, inlaid game board made from imported fir wood was, presumably, for the ritual benefit for an elite Egyptian, seen as a contestant playing the game of senet, in hopes of ensuring a happy journey and transformation for the afterlife. Early tomb-scenes show the deceased playing against family, friends, or servants, but by the date of our board another tradition had long been established of depictions of play without any opponents being present[54]. The invisible adversary has been interpreted as Death, who simply could not be shown[55], or as the deceased's *ba* — his own "soul"[56]. Though this object is, sadly, lacking its original ancient context, we are pleased to bring this unknown example of a senet board to light using a multi-disciplinary approach that, along with a discussion of its history as a modern museum object, has provided a reading and interpretation of the hieroglyphs, established a scientific date against which similar senet boards can be compared, identified the wood as imported fir, probably Cilician fir, and attested for the first time the use of a green copper-wax pigment as an inlay substance in ancient Egypt.

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Bibliography

Akkemik, U.; Yaman, B. 2012, Wood Anatomy of Eastern Mediterranean Species, Regagen-Oberwinter.

Aston, David, 2009, *Burial assemblages of dynasty 21–25* (Denkschriften der Gesamtakademie LIV), Vienna.

Bell, Robert Charles 1969, Board and Table Games from Many Civilizations, vols. 1 and 2, 2nd ed., London.

Bostwick, Todd W., 2006, Byron Cummings: Dean of Southwest Archaeology, Tucson.

Colley, Charles C. 1977, The Century of Robert H. Forbes: The Career of a Pioneer Agriculturalist, Agronomist, Environmentalist, Conservationist and Water Specialist in Arizona and Abroad, Tucson.

Crist, W.; Dunn-Vaturi, A.-E.; de Voogt, A. 2016, Ancient Egyptians at Play: Board Games across Borders, London; Oxford; New York; New Delhi; Sydney.

Daniels, Vincent 2007, Analyses of Copper-and Beeswax-Containing Green Paint on Egyptian Antiquities, Studies in Conservation 52 (1), 13–18.

Davies, W. V. 1995, Ancient Egyptian Timber Imports: An Analysis of Wooden Coffins in the British Museum, in: W. V. Davies; L. Schofield (eds.), Egypt, the Aegean and the Levant: Interconnections in the Second Millennium BC, London, 146–156.

53 Tomasz Wazny in the University of Arizona's Laboratory for Tree-Ring Research examined the senet board to determine if the range of dates provided by the radiocarbon analysis could be narrowed by matching the 44-year-long tree-ring series on this fragment with any reference chronologies. Unfortunately, the number of tree rings is not sufficient to find secure correlation and cross-dating against other tree-ring series.

54 Piccione 1990, 261–262; Crist, Dunn-Vaturi, and de Voogt 2016, 55–56. It is instructive that game boards or boxes are generally not found in tombs of the period of our game board, as shown by their absence in Aston's comprehensive survey of tombs of Dynasties Twenty-one through Twenty-five (Aston 2009). Ours, therefore, may not be from a tomb.

55 See for example Piankoff 1974, 117–119, with the Appendix by Siadhal Sweeney on parallels for gaming for one's soul, pp. 120–124.

56 Piccione 1980, 58; 2007, 60.

Elkin, A. P.; Macintosh, N. W. G. 1974, Grafton Elliot Smith, the Man and his Work, Sydney.
Erman, Adolf; Grapow, Hermann 1926–1931, Wörterbuch der aegyptischen Sprache. 12 vols. Leipzig.
EUFORGEN (European Forest Genetic Resources Programme) 2011. http://www.euforgen.org (accessed 10 May 2017).
Fahn, A.; Werker, E.; Baas, P. 1986, Wood Anatomy and Identification of Trees and Shrubs from Israel and Adjacent Regions, Jerusalem.
Gale, R., Gasson, P.; Hepper, N.; Killen, G. 2000, Wood, in: P. T. Nicholson; I. Shaw (eds.), Ancient Egyptian Materials and Technology, Cambridge/New York, 334–371.
Germer, Renate 1985, Flora des pharaonischen Ägypten (DAIK, Sonderschriften, 14), Mainz.
Gladwin, Harold S. 1947, Men out of Asia, New York.
– 1979 Mogollon and Hohokam A.D. 600–1100. Medallion Papers No. XL. Santa Barbara, CA.
Goebs, Katja 2008, Crowns in Egyptian Funerary Literature: Royalty, Rebirth, and Destruction (Griffith Institute Monographs), Oxford.
Gunn, M.; Chottard, G.; Rivière, E.; Girerd, J.J.; Chottard, J.C. 2002, Chemical Reactions between Copper Pigments and Oleoresinous Media, Studies in Conservation 47 (1), 12–23.
Harer, W. Benson Jr. 2007, The Drexel Collection: From Egypt to the Diaspora, in: Sue D'Auria, (ed.), Servant of Mut: Studies in Honor of Richard A. Fazzini, Leiden, 111–119.
Haury, Emil W.; Jefferson Reid, J. 1985, Harold Sterling Gladwin, 1883–1983, Kiva 50 (4), 271–283.
Iskander, John M. 2010, A Recently Discovered Senet-board from Heliopolis, MDAIAK 66, 121–129.
Kendall, Timothy 1978, Passing through the Netherworld: the Meaning and Play of Senet, an Ancient Egyptian Funerary Game. Belmont, MA.
Killen, Geoffrey P. 2017, Ancient Egyptian Furniture Volume I: 4000–1300 BC, Oxford/Philadelphia (reprint of 1980).
Kritsky, Gene 2015, The Tears of Re: Beekeeping in Ancient Egypt, New York.
Kurth, Dieter 2009, Einführung ins Ptolemäische: eine Grammatik mit Zeichenliste und Übungsstücken, Hützel.
Liang, Jiafang; Scott, David A. 2014, Green-Copper Containing Waxy Paint on Two Egyptian Polychrome Artifacts: A Technical Study, Studies in Conservation 59 (6), 391–403.
Lily S. Place Obituary 1929, Bulletin of the Minneapolis Institute of Arts 18 (20), May 18, 1.
Lucas, Alfred F.; Harris, John R. 1962, Ancient Egyptian Materials and Industries, fourth edition, revised and enlarged, London.
Manniche, L. 1989, An Ancient Egyptian Herbal. London.
MIA 1930, Bulletin of the Minneapolis Institute of Arts 14 (4), October 4.
Münster, Maria 1968, Untersuchungen zur Göttin Isis: vom Alten Reich bis zum Ende des Neuen Reiches; mit hieroglyphischem Textanhang (MÄS 11), Berlin.
Murray, Harold James Ruthven 1952, A History of Board-games other than Chess, Oxford.
Needler, Winifred 1953, A Thirty-square Draught-board in the Royal Ontario Museum, JEA 39, 60–75.
Newman, Richard; Serpico, Margaret 2000, Adhesives and Binders, in: P. T. Nicholson; I. Shaw (eds.), Ancient Egyptian Materials and Technology, Cambridge/New York, 475–494.
Parlett, David 1999, The Oxford History of Board Games, Oxford.
Piankoff, Alexandre 1974, The Wandering of the Soul (ERT 6; Bollingen Series 40 (6)), Princeton, NJ.
Piccione, Peter A. 1980, In Search of the Meaning of Senet, Archaeology 33 (4) July/August, 55–58.
– 1990, The Historical Development of the Game of Senet and its Significance for Egyptian Religion, Ph.D. thesis, University of Chicago.
– 2007, The Egyptian Game of Senet and the Migration of the Soul, in: I. L. Finkel (ed.), Ancient Board Games in Perspective: Papers from the 1990 British Museum Colloquium, with Additional Contributions, London, 54–63.
Price, Beth A.; Pretzel, Boris (eds.) 2014, Infared and Raman Users Group Spectral Database. Web 20 June 2014. <www.irug.org>
Pusch, Edgar B. 1979, Das Senet-Brettspiel im alten Ägypten, Teil 1. Das inschriftliche und archäologische Material (MÄS 38), 2v., Berlin.
Radwan, Ali 2003, Nekhbet with Wadjet or Isis with Nephtys: the Lasting Concept of Two Goddesses in Ancient Egypt, in: N. Grimal; A. Kamel; C. May-Sheikholeslami (eds.), Hommages à Fayza Haikal, Le Caire, 217–224.
Robinet, Laurianne; Corbeil, Marie-Claude 2003, The Characterization of Metal Soaps, Studies in Conservation 48 (1), 23–40.
Romano, Irene Bald 2014, A Ptolemaic Royal Portrait in the Arizona State Museum, University of Arizona, Journal of Ancient Egyptian Interconnections 6 (4), 48–54.
https://journals.uair.arizona.edu/index.php/jaei/article/view/18376/18078.
– 2016, Old World Meets New World: Biography of an Egyptian Collection in the Sonoran Desert, Journal of the Southwest 58 (2), 189–235.
Russmann, Edna R. 1997, Vulture and Cobra at the King's Brow, in: E. Goring; C. N. Reeves; J. Ruffle (eds.), Chief of Seers: Egyptian Studies in Memory of Cyril Aldred, London/New York, 266–284.
Schweingruber, F. H. 1990, Anatomy of European Woods, Berne.
Scott, David A. 2015, A Review of Ancient Egyptian Pigments and Cosmetics, Studies in Conservation.
http://www.maneyonline.com/doi/abs/10.1179/2047058414Y.0000000162.
Serpico, Margaret; White, Raymond 2000, Oil, Fat and Wax, in: P. T. Nicholson; I. Shaw (eds.), Ancient Egyptian Materials and Technology, Cambridge/New York, 390–429.
Smith, Grafton Elliot 1911, The Ancient Egyptians and the Origin of Civilization, London/New York.
– 1915, The Migrations of Early Culture: A Study of the Significance of the Geographical Distribution of Mummification, Manchester. Reprinted London: Forgotten Books, 2013.
Stoffel, M. 2008, Dating Past Geomorphic Processes with Tangential Rows of Traumatic Resin Ducts, Dendrochronologia 25 (1), 53–60.
Tait, William John 1982, Game-boxes and Accessories from the Tomb of Tut'ankhamun (TTSO), Oxford.
Tatton-Brown, Veronica 1997, Ancient Cyprus, London.
Troy, Lana 1986, Patterns of Queenship in Ancient Egyptian Myth and History (Acta Universitatis Upsaliensis: Boreas. Uppsala Studies in Ancient Mediterranean and Near Eastern Civilizations, 14), Uppsala/Stockholm.
Wallis, Henry 1898, Egyptian Ceramic Art: the MacGregor Collection: a Contribution towards the History of Egyptian Pottery, London.
Weinstein, J. M. 2001, Byblos, in: D. B. Redford (ed.), The Oxford Encyclopedia of Ancient Egypt, Oxford, 219–221.

Wiedenhoeft, A. C. 2006, The Limits of Scientific Wood Identification, Professional Appraisers Information Exchange 4, 2.
Wilcox, David R. 2005, Creating a Firm Foundation: The Early Years of the Arizona State Museum, Journal of the Southwest 47 (3), 375–410.
Wittmack, Ludwig 1910, Untersuchung altägyptischer Holzproben aus Abusir, Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin IV, 181–192.

Figure 1a and b: Fragment of a wooden senet board, ASM 12496, front and back. Photographs by Jannelle Weakly. Courtesy of the Arizona State Museum.

Figure 2: Left: Predynastic red-on-buff vessel, ca. 3500–3100 B.C.E. ASM A-31242. Gift of Harold S. Gladwin, 1967. Right: Sacaton red-on-buff jar, Hohokam, Preclassic Period, ca. 950–1150 C.E., Four Mile Site, Gila River. ASM 97-194-345. Norton Allen Collection, Gift of Ethel Crane Allen, 1997. Photograph by Jannelle Weakly. Courtesy of Arizona State Museum.

Figure 3: Lily Stafford Place, U.S. passport photo, 1915. Photograph from Ancestry.com, 2007. U.S. Passport Applications, 1795–1925.

Figure 4: Fragment of Egyptian senet board, ASM 12496 showing locations of samples for inlay FTIR analysis (arrows), radiocarbon dating (red circle), and wood analysis (green circle). Photograph by Jannelle Weakly. Courtesy of Arizona State Museum.

Figure 5: Wood specimen at 10× magnification showing longitudinal tracheids and a lack of resin canals. Photograph courtesy of M.C. Wiemann.

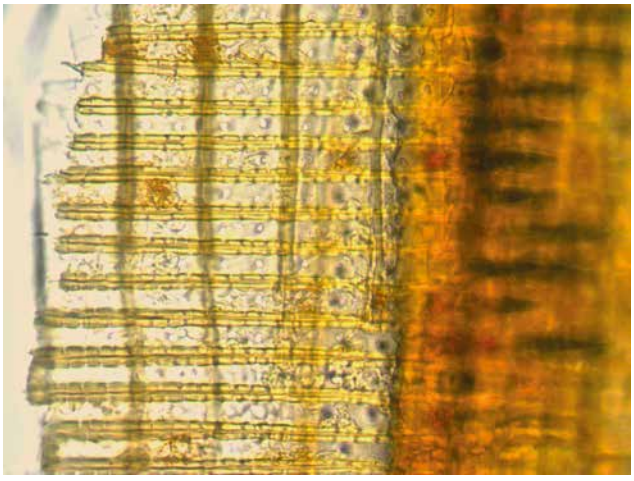

Figure 6: Wood specimen at 40× magnification showing taxodioid ray pits. Photograph courtesy of M.C. Wiemann.

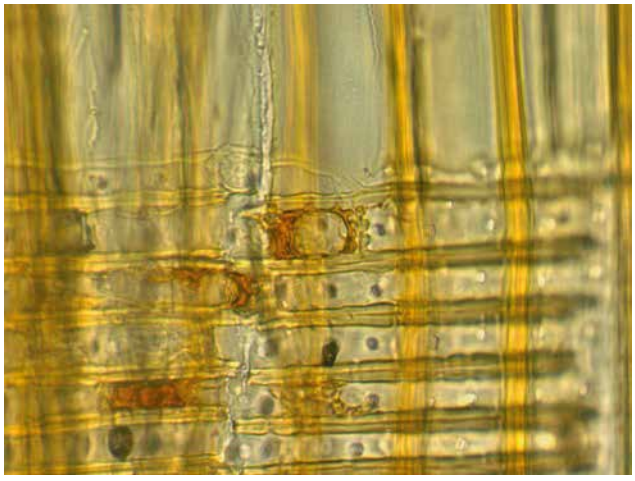

Figure 7: Wood specimen at 60× magnification showing ray parenchyma cells with nodular end walls. Photograph courtesy of M.C. Wiemann.

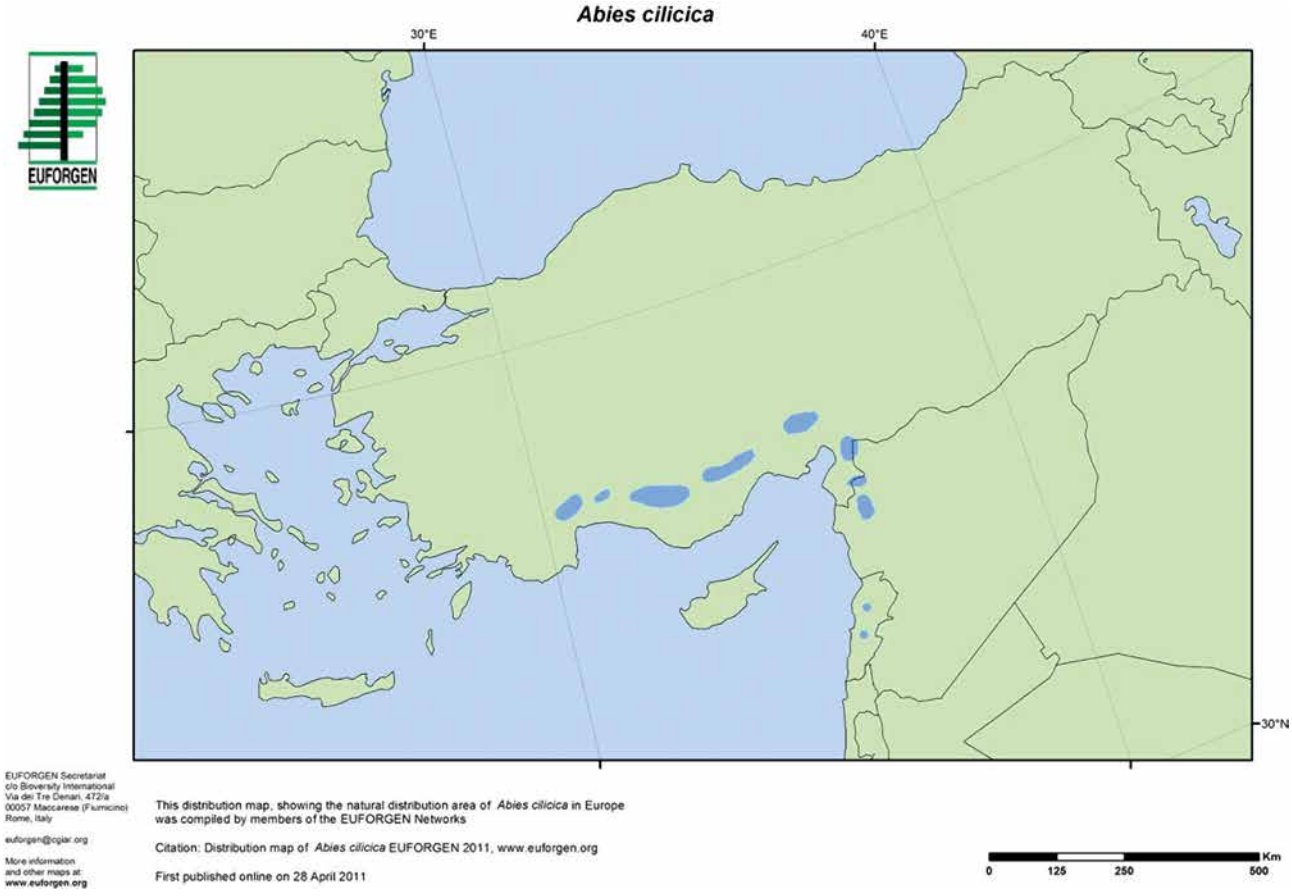

Figure 8: Map with distribution area of Cilician fir. EUFORGEN 2011.

Figure 9: Traumatic resin canals visible on the radial surface of board. Photograph courtesy of Tomasz Wazny.

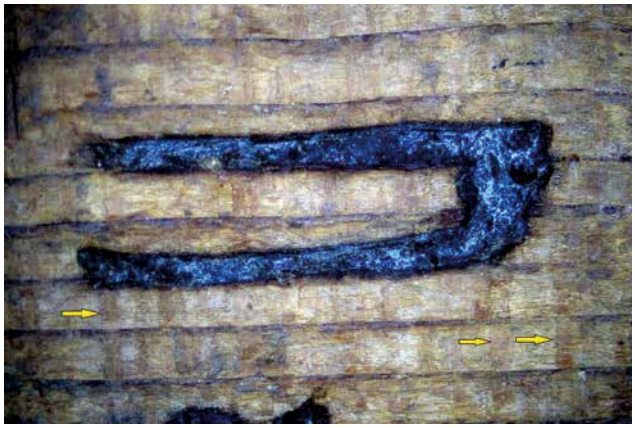

Figure 10: Surface of ASM 12496 with distinct visible long strips of longitudinally-cut rays shown by yellow arrows. Photograph courtesy of Tomasz Wazny.

Figure 11: Fiber of ASM 12496 deformed under pressure of wood-working tools. Photograph courtesy of Tomasz Wazny.

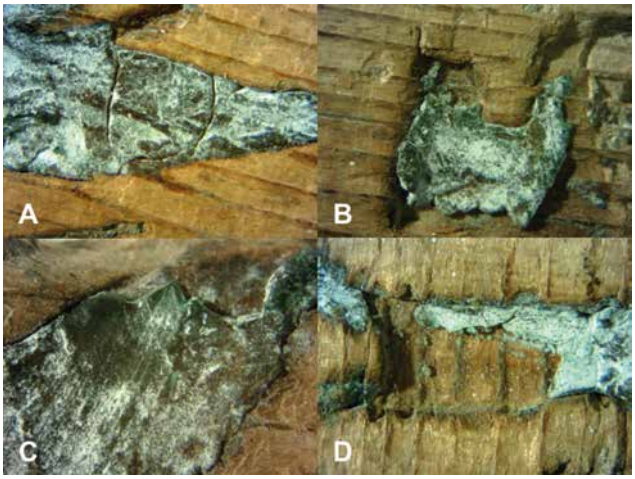

Figure 12: Microphotographs of the inlay showing its green coloration and white efflorescence at the surface. There are also several areas of loss as seen by the recessed areas of wood that are most apparent in (B) and (D). Images courtesy of Christina Bisulca.

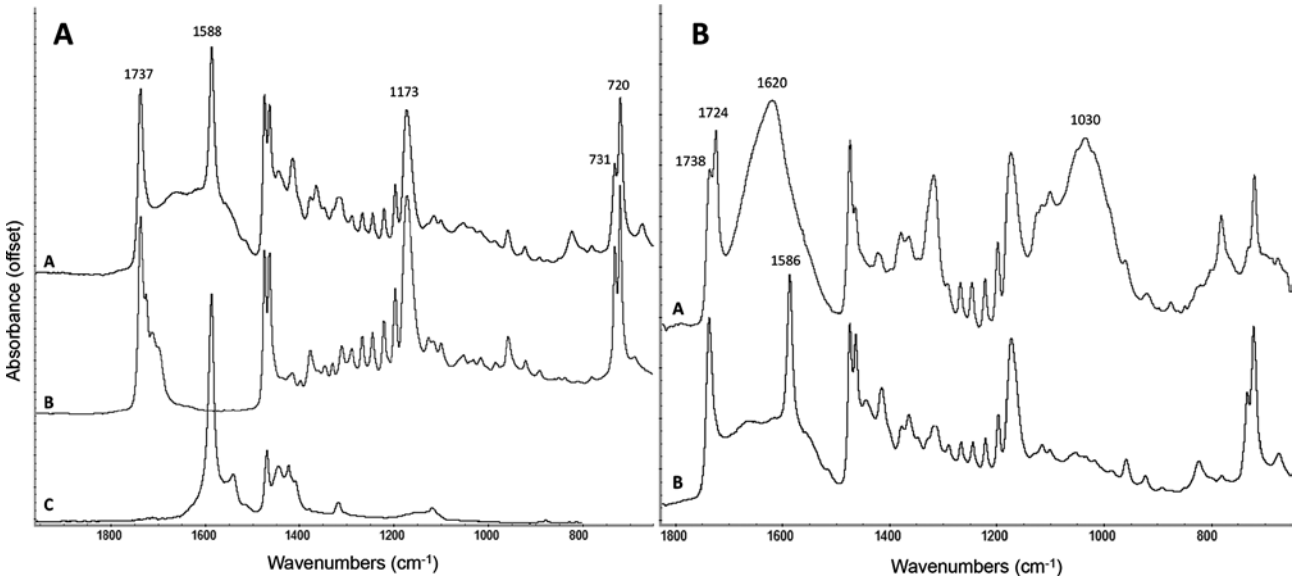

Figure 13: A. FTIR analysis of inlay (2000–600 cm^{-1}). (a) Fingerprint region of green sample from inlay, (b) reference spectrum for beeswax, ASM spectral reference library and (c) cupric palmitate reference spectrum, IRUG *IOF00044 cupric palmitate, P&B, PMA, tran. B. FTIR analysis of white efflorescence. (a) Fingerprint region of spectra from sample of white surface efflorescence (b) compared to spectra of green interior inlay.

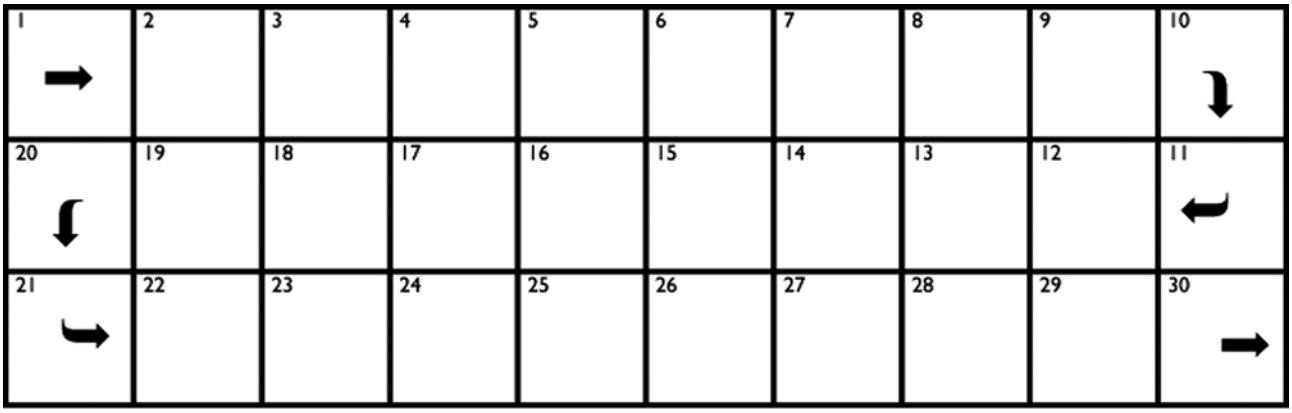

Figure 14: Drawing of direction of the path of game pieces in senet. Drawing by W. John Tait.

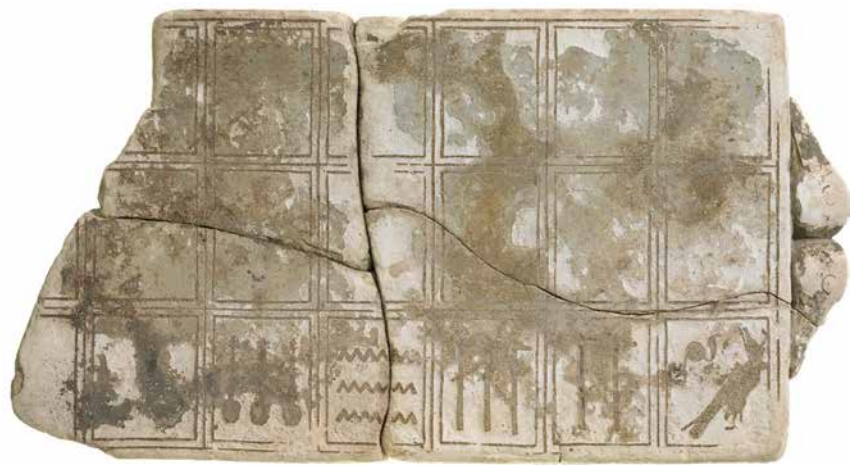

Figure 15: The senet (30-square) side of the glazed composition slab-style game board British Museum 102396. With permission of the BM department. © The Trustees of the British Museum.

Figure 16a and b: Inlaid, glazed steatite squares from game of senet (modern wooden board); b: detail of five inscribed squares, inlaid with faience and lapis lazuli. Dynasty Nineteen (Ramesside), ca. 1295–1190 B.C. ROM 922.17. With permission of the Royal Ontario Museum © ROM.

		Square 27	Square 28	Square 29	Square 30
ASM 12496	*Representations / symbols*	—	—	Two goddesses	Horus-falcon
	Text	(only traces)	"Hastening(?) by the *Bau* (Souls) of Heliopolis"	"Seeing (Isis and Nephthys(?)) joining in peace"	—
ROM 922 (cf. Figure 12)	*Representations / symbols*	—	—	Two goddesses	Horus-falcon
	Text	"You shall cross the lake without wading"	"You (will) climb the stairway of the *Bau* (Souls) of Heliopolis."	"You (will) join (Isis and Nephthys(?)) in peace"	"Your joy is/will be with Horus."
Mat. 3695 (Iskander 2010)	*Representations / symbols*	Fecundity Figure	Royal Sphinx, two captives	Nekhbet and Wadjet (to be identified with Isis and Nephthys)	Horus-falcon
	Text	—	—	—	—

Figure 17: Summary of the iconography and hieroglyphs of squares 27–30 of ASM 12496, ROM 922, and Mat. 3695. Courtesy of W. John Tait.