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Early Dynastic/Old Kingdom Egypt and the Early Bronze Age Levant: The History of the 3rd and 4th Dynasties and New Radiocarbon Dates in Dialogue

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Abstract[1]
This paper aims to give an overview of the current state of research on (contemporaneous) inscriptional evidence for a historical chronology of the 3rd and 4th dynasties, to explore the impact of different modes of interpreting this evidence on radiocarbon dates from Egypt, and to consider possible synchronizations between Egyptian history and the transitions from Early Bronze Age III to IV in the Southern Levant. Therefore, the currently available data are re-evaluated, and a model for a biennial cattle count in the early Old Kingdom is proposed. In order to specify the EB III–IV transition, recent radiocarbon sequences from nine different sites in the Southern Levant are surveyed.

Keywords
Chronology, 3rd Millennium BCE, Old Kingdom, Early Bronze Age, Southern Levant, 3rd Dynasty, 4th Dynasty, Sneferu, Khufu, Palermo Stone, Turin Canon

1. Introduction

Reconstructing absolute (calendrical) dates for historical events and archaeological contexts of ancient Egypt and the ancient Near East can, at times, be a challenging task. While one should suspect that the application of radiocarbon dating, especially when coupled with Bayesian analysis, might be used as a powerful tool for unravelling still persistent chronological questions and uncertainties, observation of academic manners and customs in Egyptology and Biblical Archaeology in fact shows that more often than not scientific facts do not supersede academic fiction. Lengthy discussions around absolute dates for the Iron Age and Biblical Archaeology in the southern Levant,[2] the absolute date of the Santorini (ancient Thera) volcanic eruption,[3] and questions of absolute Middle Bronze Age chronology[4] are but few examples where scientific application of radiocarbon dating and Bayesian analysis is either outright rejected, ridiculed or simply ignored.

With this background in mind, it comes as a surprise that new absolute dating evidence for the Early Bronze Age that suggested major shifts of more than 100 years for relative chronological periods did not face major resistance in our academic disciplines. Since the initial publication by Johanna Regev and colleagues in 2012 that for the first time suggested a short (<100 years) Early Bronze II period and that the end of Early Bronze III should be dated to around 2500 BCE instead of ca. 2300/2200 BCE, as previously suggested,[5] several

other radiocarbon sequences were published that basically came to the same result.[6] Only a few years later, this new chronology was actually applied to our archaeological data at hand, and the impact on our understanding of Egyptian-Levantine relations in the Early Bronze Age explored.[7] Nowadays, the high Early Bronze Age chronology has become the standard chronology of modern textbooks.[8]

The application of radiocarbon dating in the field of Egyptology was also not easy from the beginning. After several early attempts in checking the historical dates with radiocarbon data,[9] it was only in 2010, when Christopher Bronk Ramsey, Michael Dee and others published their assessment based on over 200 new high-precision radiocarbon determinations. They found that Bayesian modelling based on (historically) reconstructed reign lengths actually provided a close fit between modelled radiocarbon determinations and historical assessments for the Old, Middle, and New Kingdoms.[10] Only modelled dates for the 5th and 6th dynasties seemed to be slightly older than historical assessments.

Since conclusive radiocarbon sequences for the Early Bronze Age southern Levant and for Old Kingdom Egypt were available, for the first time it was possible to provide a synchronized chronology based on independent radiocarbon dating. It was found that the now shortened Early Bronze II would be contemporary with the Egyptian 1st dynasty and that the end of Early Bronze III would fall approximately to the late 4th or early 5th dynasty.[11]

But how robust are these (modelled) dates and the Egyptian-Levantine chronological synchronization in light of recent research in the relative chronology of Old Kingdom reign lengths and can we still support a ca. 2500 BCE date for the end of Early Bronze III a decade after the initial publication? The following paper aims to explore some chronological issues of the Early Dynastic Period and the Old Kingdom in the light of re-evaluated and newly discovered material, including two case studies (cf. below, sections 4.2–3) and several chronological models (cf. below, section 5) that demonstrate how uncertain and open to re-consideration and re-interpretation Early Dynastic and Old Kingdom chronology still is today. Further, we will review existent radiocarbon sequences for Early Bronze III and will try to explore potential shifts in the synchronization with Old Kingdom Egypt.

2. The Egyptian Chronology

Ancient Egyptian chronography, like many pre-modern chronographic systems, is essentially a royal one—i. e., time is measured and periodized according to royal personage and royal activities.[12] Chronological research has had to adapt to these factors, especially in the case of two of the earliest epochs accessible by means of Egyptian philology, the so-called 'Early Dynastic Period'[13] and the 'Old Kingdom.'[14] Yet, given the relative paucity of textual sources, many aspects of those periods still remain obscure—among them chronological issues like the exact length of individual reigns, but also the very number of reigning kings or their names.[15] The results of this philological approach to Egyptian chronology may illustrate how great an impact seemingly small variations within the interpretation of textual material can have, even more so when connected to recent radiocarbon data used as a base of Bayesian modelling (on this, cf. below, section 7).

The two epochs in question cover a timespan of roughly 1,000 years, and comprise—at least—dynasties 0 to 6. [16] For a long time, Egyptology's internal periodization considered dynasties 0/1–2 as 'Archaic' or 'Early Dynastic Period', the Old Kingdom starting with the onset of the 3rd dynasty. This view began to shift markedly in the 1990s, most notably with the seminal work of Toby Wilkinson, *Early Dynastic Egypt*.[17] Throughout the present paper, this view will be adopted, although a clear-cut separation of the Early Dynastic Period and the subsequent Old Kingdom would be somewhat artificial, anyway.[18]

This paper will focus on the kings of the 3rd and 4th dynasties as an up-to-date starting point for further investigations. The kings of these dynasties have recently been subject to studies on onomastics[19] and later traditions regarding chronological questions[20] by Roman Gundacker, and the investigation can therefore rest on a sound philological fundament. Following the results of the aforementioned studies, the order of the kings of the 3rd and 4th dynasties according to their contemporaneously attested names[21] is to be reconstructed as shown in Table 1.

At the end of the 4th dynasty, the Turin Canon (x+III,16; name lost in a lacuna—column- and line count after Gardiner 1959) as well as the Manethonian tradition[22] (*Θαμφθίς*[23] 'Thamphthis') mention another king after Shepseskaf. So far, however, no contemporaneous evidence for this king has surfaced, so his historicity is questionable

Horus Name	*Nomen*[24]	Two-Ladies Name	Gold Name
3rd Dynasty[25]			
Horus Netjerykhet (*Ḥrw Nṯr.j-ḫ.t*)	(*Djoser *Ḏsr*)[26]	*Nṯr.j-ḫ.t-Nb.tj*	*Reading uncertain*[27]
Horus Sekhemkhet (*Ḥrw Sḫm-ḫ.t*)	Djosertety (*Ḏsr-ttj*)	*Ḏsr.tj-Nb.tj*[28]	*Unknown*
Horus Khaba (*Ḥrw Ḫʿi-bꜣ*)	*Unknown*[29]	*Unknown*	*Nṯr-nbw* (?)[30]
Horus Sanakht (*Ḥrw Zꜣ-nḫt*)	Nebka (*Nb-kꜣ*)	*Unknown*[31]	*Unknown*
Horus Qahedjet (*Ḥrw Qꜣi-ḥḏ.t*)[32]	Huni (*Njswt-ḥwi*(*.w*))	*Unknown*	*Unknown*
4th Dynasty[33]			
Horus Neb-Maat (*Ḥrw Nb-mꜣʿ.t*)	Sneferu (*Snfr.w*)	*Nb-mꜣʿ.t-Nb.tj*	*Bjk-nbw*
Horus Medjedu (*Ḥrw Mḏd.w*)	(Khnum-)Khufu ((*Ḫnmw-*)*Ḫwi=f-w*(*j*))	*Mḏd-r-Nb.tj*	*Bjk.wj-nbw*
Horus Kheper (*Ḥrw Ḫpr*)	Radjedef (*Rʿw-ḏdi=f*)	*Ḫpr-m-Nb.tj*	*Nṯr.w-nbw*[34]
Horus User-Ib (*Ḥrw Wsr-jb*)	Khafre (*Ḫʿi=f-Rʿw*)	*Wsr-m-Nb.tj*	*Sḫm-nṯr-nbw*
Unknown	Baka (*Bꜣ-kꜣ*(*=j*))[35]	*Unknown*	*Unknown*
Horus Ka-Khet (*Ḥrw Kꜣ-ḫ.t*)	Menkaura (*Mn-kꜣ.w-Rʿw*)	*Kꜣ-ḫ.t-Nb.tj*	*Nṯr.j-nṯr-nbw*
Horus Shepes-Khet (*Ḥrw Šps-ḫ.t*)	Shepseskaf (*Špss-kꜣ=f*)	*Šps-Nb.tj*	*Unknown*

Table 1: The names of the kings of the 3rd and 4th dynasties.

in the least.[36] He is therefore disregarded in the following.

The following discussion is, as far as possible, based on contemporaneous evidence, yet, in some cases, non-contemporaneous sources need to be considered, too.

3. The 3rd Dynasty

Although scarce, there are several groups of sources of inscriptional evidence for the chronology of the 3rd dynasty. As different texts serve different purposes, it is necessary to differentiate inscriptional evidence for the period with regard not only to their chronological (contemporaneous vs. non-contemporaneous), but also to their typological (~genre) features.

Non-contemporaneous source groups for the chronology of the 3rd dynasty include:

- King lists of the Greek, Latin, and Armenian literary traditions, above all Manetho;[37]
- Egyptian (historiographical-)annalistic records:[38]
  - The 'Turin Canon'[39]
  - The annals of the 5th dynasty[40] i.e., the 'Palermo Stone' and its associated fragments[41]

The Turin Canon (pTurin Cat. 1874 *vso.*) is a copy of an older systematic list of Egyptian kings[42] updated in the New Kingdom, covering the time from a supposed reign of gods and demigods down to (at least) the 17th dynasty. Nowadays largely fragmentary, the papyrus in its original state would have provided an extensive record of the names and

reign lengths of Egyptian rulers of the respective periods. The kings of the 3rd dynasty—as well as their successors of the 4th dynasty—are listed in column x+III, lines 4–16 (column x+III being only badly preserved), but not all of the recorded names conform to the ones attested in the contemporaneous material, i. e., they probably went through at least one stage of re-analysis and re-interpretation.[43] Furthermore, the figures given for the individual reigns of the 3rd and 4th dynasties very probably influenced one another, resulting in pairs of equals.[44] Despite the Turin Canon thus being riddled with problems, it is still an indispensable source especially for epochs lacking contemporaneous inscriptional evidence—if treated with due (that is: enormous) caution and criticism. Nevertheless, the only two things that possibly could be worse than using the Turin Canon for reconstructing the historical chronology of the 3rd and 4th dynasties would be (a) using it uncritically, or (b) not using it at all.

The term 'Palermo Stone' refers to a *corpus* of seven greyish-black fragments (only one of which is actually stored in Palermo) of a basalt stela. While the pertinence and date of the single fragments are debated, all of them contain information on individual regnal years of the kings of the 1st to the 5th dynasties in order of succession. The names of the kings and their mothers are listed in horizontal bands; below each band, the regnal years of the respective king are presented in individual rectangular compartments detailing royal activities and other major events of that specific year. Giving even more information in its surviving parts than does the Turin Canon, the list of the Palermo Stone in its original state would arguably have been the most detailed account of Egypt's first five dynasties. However, due to its poor state of conservation, only small scraps of evidence regarding the 3rd and 4th dynasties survive.

Of the 3rd dynasty, the beginning of only one reign is preserved (PS r.V.8–12,[45] most likely that of Netjerykhet ~ Djoser), and according to the drawing in Wilkinson 2000, fig. 4, only isolated signs survive from two further reigns that *per definitionem* must belong to the 3rd dynasty (CF 1, r.V).[46] From the 4th dynasty, only a few regnal years from four distinct reigns (PS r.VI.1–5[47] (Sneferu); v.I.1–3[48] (Menkaura – Shepseskaf); CF 2 r.I.1[49] (Khufu), CF 4 r.I.1–2[50] (Sneferu)) can be discerned. Being the product of a process of compilation and redaction that most likely took place in the 5th dynasty,[51] the inscriptions of the Palermo Stone and its associated fragments could draw from an unbroken stream of 'annalistic-historiographic' tradition,[52] at least as regards the 3rd and 4th dynasties, so, although no contemporaneous source *sensu stricto*, the annals of the 5th dynasty may nevertheless claim a higher degree of credibility than any other non-contemporaneous source for the chronology of the 3rd and 4th dynasties.

Direct contemporaneous evidence is still rather meagre in comparison. Out of an undoubtedly larger original corpus, only three hieratic jar inscriptions mentioning regnal years are known to date (*rnp.t šms.w-Ḥrw zp 11 ḥsb Jwnw pr-zr*, 'Year of the following of Horus; 11th occurrence of the "calculation" of Heliopolis, (namely) the House of the Ram'; (*rnp.t*) *šms.w-Ḥrw ḳd* (*m*) *jnr*, '(Year of the) following of Horus; building (in) stone'; *rnp.t ḫ*ˁ(*.w*) *njswt ḫ*ˁ(*.w*) *bj.tj zp 3* ˁ*ḥ*ɜ *ḫ*(*n*)*p.tjw*, 'Year of the appearance of the *njswt*-king and the appearance of the *bj.tj*-king; 3rd time of fighting the raiders').[53] However, as none of these inscriptions is to be attributed directly to any specific king, their immediate chronological value seems to be limited.

With so little information surviving from the pre-eminent sources of Egyptian chronology, and even the very number and order of rulers being (partially) uncertain, reconstructing the number of regnal years of the kings of the 3rd dynasty is little more than educated guesswork. Hence, the size and state of completion of the (funerary) monuments of that period[54] may serve as invaluable 'circumstantial evidence' for the regnal length of the respective king.[55] If necessary (see esp. below, section 5), the much later and more complicated Manethonian tradition will be drawn upon.

One specific feature of the 3rd dynasty—and the Early Dynastic Period in general—is the mode of counting regnal years. In contrast to the system used in the 4th dynasty (cf. below), regnal years were not *counted* in the strict sense, but rather *named* after a set of (perhaps pre-defined) eponymous events.[56] Out of these, the biennial 'Following of Horus' (*šms.w-Ḥrw*), still visible in the Netjerykhet compartments of the Palermo Stone, is probably the one most important for reconstructing the chronology of the 3rd dynasty. Whether this action is connected to the various counting events recorded in the Palermo Stone compartments of the 2nd, 4th, and 5th dynasties[57] is still a matter of debate.[58]

Model from	Mode of extrapolation	Length of the 4th dynasty	Absolute dates of the 4th dynasty[59]
Beckerath 1997	Biennial/irregular[60]	135 years	2639/2589–2504/2454 BCE
Nolan 2003	Regular[61]	*≈ 112 years[62]	-
Hornung et al. 2006a	Biennial/irregular[63]	107 years	2543–2436^{+25} BCE
Gundacker 2006	Biennial	152 years	2658–2506 BCE

Table 2: Chronological models for the 4th dynasty according to their mode of extrapolation.

4. The 4th Dynasty

4.1. Fourth dynasty sources

The non-contemporaneous sources for the chronology of the 4th dynasty are the same as those for the 3rd dynasty (cf. above, section 3), whereas direct contemporaneous evidence is to be found in a broader variety of further source groups,[64] viz.:

- Construction *dipinti*[65] (hieratic)
- Administrative documents[66] (hieratic; cursive hieroglyphs)
- Expedition *graffiti* ([cursive] hieroglyphs)
- Inscriptions in private tombs (hieroglyphs)

With their different backgrounds, contexts, layouts, and addressees—reflecting different scribal traditions, practices, and intentions—, all of these source groups have one feature in common: in contrast to the year designations of the 3rd dynasty, dates from the 4th dynasty until the end of the Old Kingdom strictly adhere to a counting system that is centred around the ruling king and allows for only one out of three year designations:

(a) *rnp.t*[67] *zmꜣ tꜣ.wj* — 'year of Joining the Two Lands'[68]
(b) *rnp.t zp N ṯnw.t* — 'year of the Nth occasion of the count'
(c) *rnp.t m-ḫt zp N ṯnw.t* — 'year after the Nth occasion of the count'

This 'count' certainly refers to an actual activity, the 'Counting of All Cattle and Livestock of Upper and Lower Egypt' (**ṯnw.t* (var.: *jp.t*) *jḥ.w ꜥw.t nb*(*.t*) *Šmꜥ.w Tꜣ-Mḥ.w*).[69] This event has been a matter of constant debate, the major questions being the count's character (cultic vs. administrative),[70] its regularity, and its abolition and replacement by a system based on continuously counting a king's regnal years (in the style of *rnp.t-zp* N, N+1, N+2, …) towards the end of the Old Kingdom.[71]

The count's regularity is of particular interest in this context as several studies have noted a certain imbalance between the numbers of attestations of years of the count and years after the count.[72] Additionally, the occurrence of a 7th and an 8th count in two successive years as displayed by the Palermo Stone (PS r.VI.3–4)[73] for Sneferu has given rise to certain suspicions regarding at least the reign of this king.[74] Hence, in the course of the last 150 years, very different theories have been put forward, ranging from a proposed stable biennial census cycle[75] to a system with regular (yet neither annual nor biennial)[76] or (partly) irregular[77] omissions of years after the count. Since the exact date of neither death nor accession of any individual ruler of the 4th dynasty is known, extrapolating regnal lengths based on inscriptional data remains the most important means of establishing the historical chronology of that period if sources like the Palermo Stone or the Turin Canon are excluded due to their anachronistic character. Different modes of extrapolation result in differing absolute dates and totals for regnal lengths, as can be shown in an overview of some of the extant (recent)[78] models Table 2).

Given the impact of extrapolation modes on reign-length calculations, a sound basis for a prospective reconciliation of written evidence and radiocarbon dates has to provide a plausible solution for the problem of census regularity. Arguably the best method for this is to return *ad fontes*, i.e., a) to integrate newly available material into the extant models, and b) to re-evaluate the known data—primarily with respect to their direct chronological value (~ dates and numbers), but also to their philological features (~ script, palaeography, lexicology, grammar, co(n)text, etc.). A first attempt for the latter has been made by Roman Gundacker,[79] who put the then-known inscriptional data from the time of Sneferu under severe scrutiny and especially questioned some of the readings of dated construction *dipinti* by Petrie

1910 and Posener-Kriéger 1991—however, single readings in that study must remain questionable due to limited access to the original material,[80] and are therefore precluded from the following case study I (cf. below, section 4.2). The actual potential of approach a) will be shown in case study II (cf. below, section 4.3).

4.2 The reign of Sneferu: Case Study I

For the reign of Sneferu, Gundacker 2006 as the most extensive study has compiled 76 different inscriptional dates; he is certainly right in correcting the reading of some crucial dates,[81] whereas others still remain doubtful. In 2017, Felix Arnold published 7 newly discovered dated construction *dipinti* from the 'valley' temple at the Bent Pyramid (Dahshur) with exact *facsimile* drawings;[82] doubtless, more are yet to be excavated at the various sites that are linked to Sneferu's reign. Until the definitive publication of the Meidum material (cf. below, endnote 80), the regnal years of Sneferu's reign as securely attested by inscriptions may be presented as seen in Table 3.[83]

Although frequently cited as a secure attestation,[84] the Dahshur *dipinto* supposedly mentioning Sneferu's 24th count[85] does not technically belong to this list, as it is damaged in the upper as well as in the lower part—only the cardinal number *2ʳ4¹* is still recognizable. Because the upper part of the *dipinto* is lost, it cannot securely be attributed to a *rnp.t zp* or a *rnp.t m-ḫt zp*; the damage in the lower part, however, prevents us from ascertaining the exact number of single strokes indicating the ones digit. The hieratic standard configuration of ones within year specifications being applied here, only a second row with 3 or 4 additional strokes below the surviving row, hence a figure **27/*28*, might be reconstructed here, **29* at the most if a further stroke is lost to the right of the 4 surviving strokes. Thus, the *dipinto* in question may serve a) as a proof of Sneferu's 24th census, and b) as a general warning not to stumble into the epistemological pitfall of confusing attested *counts* with attested *years of the count*.

Excluding, for the moment, a number of very doubtful *dipinti* for the moment, 16 distinct regnal years of Sneferu are attested directly from 25 single inscriptional sources (the Palermo Stone as well as construction *dipinti* from several pyramid construction sites).[86] Of those distinct regnal years, 9 belong to a specific year of the count, whereas 5 securely belong to distinct years after the count, the pertinence of another 3 remaining unclear. The appearance of years of the count and years after the count displays no obvious regularity. While this 9:5 (17:5:3) ratio is still (heavily) imbalanced, it nevertheless differs considerably from the 12:3 ratio given by Miroslav Verner.[87] With 25 single attestations, however, this is not surprising: the number of surviving clear attestations from Sneferu's reign is not even close to any kind of statistical significance. Keeping this in mind is all the more important as it shows the necessity of a careful philological treatment of the sources.

4.3. The Reign of Khufu: Case Study II

The reign of Khufu has so far not been subject to an individual study, although especially in its last phase, it may yield even better source material than that of his predecessor. A systematic overview of Khufu's inscriptionally attested regnal years therefore has to draw mainly from the compilations of Anthony Spalinger[88] and Miroslav Verner,[89] which need to be augmented and corrected in some instances, though (cf. Table 4). Those necessary improvements, on the other hand, are mainly due to the integration of new material recovered after 2008, viz. the Wadi el-Jarf papyri,[90] and the *dipinti* of the second boat pit[91] at the Great Pyramid published by Akiko Nishisaka and Kazumitsu Takahashi in their preliminary, yet ground-breaking 2016 report.[92] According to these sources, the regnal years of Khufu's reign seen in Table 4 are attested directly.

With *15 separate inscriptional attestations accounting for 10 distinct regnal years, Khufu's reign is among the best documented of the 4th dynasty, especially regarding the later years of his reign, the final six years of which are attested by at least one inscription each (if *zp 14* indeed *is* Khufu's last regnal year).[93] These last six—with the unattested year of the 11th count, nine—regnal years display a constant succession of years of the count and years after the count, suggesting a regular biennial census rhythm at least in the later phase of Khufu's reign.[94] In total, there are 6 securely attested years of the count versus 4 securely attested years after the count.

It is mainly the influx of new material that has made it possible to extend Khufu's known regnal length by a whole year, to reassess the extant material and hence to solve the debated matter of the date *dipinto* in the first boat pit.[95] Miroslav Verner[96] attributed this inscription to Radjedef,

Regnal year	Number of attestations + source(s)
zp 2	1 (CF 4 r.I.1)[97]
Year after *zp 2*[98]	1 (CF 4 r.I.2)
Year after year after *zp 2*	1 (PS r.VI.1)[99]
**m-ḫt zp 6*[100]	1 (PS r.VI.2)
zp 7	1 (PS r.VI.3)
zp 8	1 (PS r.VI.4)
year after *zp 8*	1 (PS r.VI.5)
zp 13[101]	1 (Meidum) = Posener-Kriéger 1991, pl. 7, A.9
zp 14	2 (Meidum) = Posener-Kriéger 1991, pl. 8, A.23-24
zp 15	2 (Dahshur) = Stadelmann 1987, 234, fig. 1; Stadelmann 2004, 17
m-ḫt zp 15	1 (Meidum) = Petrie 1910, pl. 5, no. 6
zp 16	2 (Dahshur) = Lepsius 1859, II.3, 1, g; Stadelmann 1993, 11
m-ḫt zp 16	1 (Meidum) = Posener-Kriéger 1991, pl. 7, no. A.3
zp 17	7 (Meidum) = Posener-Kriéger 1991, pl. 7, A.12-16; Petrie 1910, pl. 5, no. 3-4
zp 18	1 (Meidum) = Posener-Kriéger 1991, pl. 8, A.29
m-ḫt zp 18	1 (Meidum) = Posener-Kriéger 1991, pl. 8, A.28

Table 3: Attested regnal years (Sneferu).

Regnal year	Number of attestations + source(s)
zp 5	1 (Giza) = Boston MFA 38-2-5; Smith 1952, 118, fig. 6, top left side
zp 8	2 (Giza) = Junker 1929, 159, fig. 24, no. 10; Smith 1952, 119, fig. 7, bottom left side = HUMFA_C10906_NS
zp 10	3 (Giza) = Junker 1929, 159, fig. 24, no. 1–2. 161
m-ḫt zp 10	1 (Giza) = Steindorff 1906, 32
m-ḫt zp 11[102]	1 (Giza, first boat pit) = Abubakr and Mustafa 1971, 11, fig. 6, bottom left side
zp 12	3 (Giza) = Smith 1952, 118, fig. 6, bottom left side. 119, fig. 7, 3rd row, left side.[103] 119, fig. 7, bottom right side
m-ḫt zp 12	1 (Dakhla Oasis) = Kuhlmann 2005, 144, fig. 1
zp 13	2 (Giza; Wadi el-Jarf) = Smith 1952, 119, fig. 7, 2nd row, left side; Tallet 2017, 101, pl. 1, Fragment T - éch. 1/2[104]
m-ḫt zp 13	1 (Dakhla Oasis) = Kuhlmann 2005, 248, fig. 5
zp 14	1 (Giza, second boat pit) = Nishisaka – Takahashi 2016, 9, fig. 9

Table 4: Attested regnal years (Khufu).

chiefly because of the occurrence of basilophoric crew names construed on the basis of Radjedef's names on the roofing blocks, and the difficulty of discerning different working stages. However, this reason does not apply anymore. First, it is highly improbable to assume that Radjedef sealed both boat pits separately in the year after his 11th count and the year of his 14th count, respectively.[105] Second, as several observations from the second boat pit confirm, one has to assume at least two different stages within a complex working process,[106] the earlier one of which dates to the reign of Khufu—hence the *dipinti* containing crew names based on Khufu's name.[107] Third, the *dipinti* containing dates certainly belong to this earlier stage, that is, they were painted on the cover stones when still in the quarries.[108]

5. Synthesis and Chronological Models for Dynasties 3–4

While all of the above, of course, needs further exhaustive treatment—which is beyond the scope of the present paper—the implications of these two case studies are clear. First, we need to keep in mind that the direct chronological information of the 4th and in particular of the 3rd dynasties is disparate and incomplete; all the more care must be taken in evaluating single attestations in order not to draw erroneous conclusions. Second, while the rest of the 4th dynasty still suffers from a lack of contemporaneous written data, the evidence from the later years of Khufu's reign suggests a regular biennial rhythm of cattle counts, which may with all due caution be extended to the early, possibly the entire 4th dynasty. Third, the chronology of the 3rd dynasty is even more dependent on 'circumstantial evidence', reconstructions, and interpolations; due to a lack of source material, these problems are probably not going to dissolve in the foreseeable future. Fourth, as single inscriptions may still rapidly change our understanding of Old Kingdom and Early Dynastic chronology, the results of those necessary extrapolations can hardly be regarded as anything other than preliminary.

Considering all of these factors, it becomes clear that contemporaneous evidence alone does not, as of yet, suffice to establish a comprehensive historical chronology of the 3rd and 4th dynasties. Non-contemporaneous evidence, like the Turin Canon or the Manetho epitomes, may come to our aid, but is often lacunous and notoriously prone to errors, conflations, and re-interpretations. Based on these premises, three relevant models for use in combination with radiocarbon dates may be derived from the available numbers: a minimal (A), a maximal (B), and a critically assessed (C) model, each of which shall be detailed in the following. The main goal of these models is *not*, as already emphasized, to propose a steadfast chronology of the 3rd and 4th dynasties, but rather to illustrate the range of chronological possibilities that the available data allow. The actual impact of the different variants on radiocarbon models for the periods under consideration will be demonstrated in section 7.

For the sake of simplicity, the question of whether a king's accession year (*rnp.t zm3 t3.wj*) was identical with the first census year (*rnp.t zp 1 / tp.j*) shall remain untouched here as it can not *de facto* be answered with the available sources. Instead, this possible identity is presumed for model (A), whereas models (B) and (C) presuppose the two to have been different regnal years. However, reality surely was a bit more complex.[109] Except at the beginning of the 3rd and the end of the 4th dynasty, the proposed last regnal year of a king and the accession year of his successor are treated as *one single* calendar year.[110]

Model A: minimal regnal lengths

With few exceptions, the minimal model operates on the premises defined by Miroslav Verner (cf. above, endnote 62). While a consequent 'minimal' model in the strictest sense excludes all non-contemporaneous data, thus resulting in a series of reign-length estimations of 0/1 year(s) for the kings of the middle of the 3rd dynasty, this does seem rather unlikely for statistical reasons. Therefore, in order to account for incompletely documented reigns, in some cases—i. e., mainly Sekhemkhet, Khaba, and Sanakht, for whom virtually no securely attributable (semi-)contemporaneous data, either from the annals of the Palermo Stone or from other sources, exist—the figure of the Turin Canon (or a derivate thereof) has been chosen as minimal regnal length (cf. the respective endnote). However, in order to display the *utter* minimum, it would be possible to leave out the respective regnal years added to the reigns of Sekhemkhet (5), Khaba (5), Sanakht (8), Radjedef (7), Menkaura (3), and Shepseskaf (2) using the TC data. The length of the 3rd dynasty would thus be reduced to ≈ 33 years, that of the 4th, to ≈ 74 (Table 5).

King	Regnal years
Horus Netjerykhet ~ Djoser	19[111]
Horus Sekhemkhet ~ Djosertety	6[112]
Horus Khaba ~ ?	6[113]
Horus Sanakht ~ Nebka	9[114]
Horus Qahedjet ~ Huni	> 11[115]
∑dyn. 3	**≈ 47**
Horus Neb-Maat ~ Sneferu	30
Horus Medjedu ~ Khufu	18
Horus Kheper ~ Radjedef	8[116]
Horus User-Ib ~ Khafre	13[117]
Horus ? ~ Baka	< 1[118]
Horus Ka-Khet ~ Menkaura	18[119]
Horus Shepes-Khet ~ Shepseskaf	4[120]
∑dyn. 4	**86**

Table 5: The kings of the 3rd and 4th dynasties and their minimal regnal lengths.

King	Regnal years
Horus Netjerykhet ~ Djoser	29[121]
Horus Sekhemkhet ~ Djosertety	19[122]
Horus Khaba ~ ?	17[123]
Horus Sanakht ~ Nebka	28[124]
Horus Qahedjet ~ Huni	24[125]
∑dyn. 3	**113**
Horus Neb-Maat ~ Sneferu	49[126]
Horus Medjedu ~ Khufu	29[127]
Horus Kheper ~ Radjedef	17[128]
Horus User-Ib ~ Khafre	26[129]
Horus ? ~ Baka	2[130]
Horus Ka-Khet ~ Menkaura	28[131]
Horus Shepes-Khet ~ Shepseskaf	9[132]
∑dyn. 4	**154**

Table 6: The kings of the 3rd and 4th dynasties and their maximal regnal lengths.

King	Regnal years
Horus Netjerykhet ~ Djoser	29
Horus Sekhemkhet ~ Djosertety	7[133]
Horus Khaba ~ ?	7[134]
Horus Sanakht ~ Nebka	9[135]
Horus Qahedjet ~ Huni	14[136]
∑dyn. 3	**62**
Horus Neb-Maat ~ Sneferu	47[137]
Horus Medjedu ~ Khufu	29
Horus Kheper ~ Radjedef	16
Horus User-Ib ~ Khafre	21[138]
Horus ? ~ Baka	2
Horus Ka-Khet ~ Menkaura	28
Horus Shepes-Khet ~ Shepseskaf	8
∑dyn. 4	**145**

Table 7: The kings of the 3rd and 4th dynasties and their critically assessed regnal lengths.

Model B: maximal regnal lengths

The maximal model is based on the assumptions that throughout the 3rd and 4th dynasties, a consequent biennial census system was used, that the first count actually took place in the year after the respective king's accession, and that there was a year after the last count (**rnp.t m-ḫt zp* N*max*) in any individual reign. The single counts would then have been misinterpreted as regnal years in later annalistic records (most notably, the Turin Canon) (Table 6). For exceptions and further information, see the respective endnote.

Model C: critically assessed regnal lengths

The critically assessed model, operating on a regular biennial census rhythm (as is suggested by the data from the early 4th dynasty), is basically a slight modification of the 'maximal' model, but assumes a less extreme position towards unattested years after the count at the end of each individual reign. While being based principally on the contemporaneous record, substantiated reconstructions (like the 29 regnal years for Netjerykhet) and limitations (like the immediate succession of Sneferu's 7th and 8th counts) are accepted. In some cases, 'circumstantial

evidence' like the respective funerary monument's state of completeness is used to rule out implausibly short reigns (Table 7).

While the 'minimal' model with its 132 years proposes a lower chronology for the 3rd and 4th dynasties than does the lowest recent model (155 years) according to Hornung et al. (2006a, 490), the 'maximal' model (266 years) exceeds even the 215 years assigned to these two dynasties by Gundacker 2006, 379. The former mainly derives from a considerably lower number for the length of the 4th dynasty (86 vs. 107 years), the latter, from a significantly higher number for the length of the 3rd dynasty (113 vs. 63 years). The 'critically assessed' model with 206 years for both dynasties differs by only 3 years from the 203 years given by Beckerath 1997, 187 (yet with a different internal distribution), and by 9 years from Roman Gundacker's assumption of 215 years, but, again, yields a considerable difference from the 155 years suggested by Erik Hornung, Rolf Krauss, and David Warburton.[139] The figure of *≈ 112 years for the length of the 4th dynasty construed according to the model of John Nolan (cf. above, section 4.1, Table 2), differing from the 145 years of the 'critically assessed' model by multiple decades, is based on data and assumptions which are now largely obsolete, as has been demonstrated above in sections 4.1–2.

While both the 'minimal' and the 'maximal' models operate on debatable premises, (sometimes) not adequately applying methods of textual criticism, that is, either totally dismissing or blindly trusting the Turin Canon and its sources, and are therefore 'improbable', the 'critically assessed' model, in contrast, may claim a certain degree of legitimacy—at least according to the data currently available. Needless to say, this model will have to be re-considered, re-evaluated, and adjusted in the course of further research, especially since substantial parts of it still do not rest on (securely attributable) contemporaneous evidence and many chronologically valuable inscriptions still remain unedited.[140]

6. Outlook

Section 5 has shown the arithmetical impact that different modes of extrapolating the currently available data and different attributions of single attestations have on chronological models. While the comparison of these different models may serve as a means of illustrating the dynamics and the volatility of research on Early Dynastic and Old Kingdom chronology, it is also a mandate for future researchers to develop strategies and to define criteria to advance beyond chronologies based on the 'bare' face value of textual sources.

First and foremost, the internal features of textual sources need to be taken into consideration in their entirety. Criteria like palaeography, lexicology, grammar, or co(n)text (cf. above) have only occasionally been examined (or even described) when dealing with written sources for Egyptian chronology, especially as regards the Early Dynastic Period and the Old Kingdom. Second, non-royal chronological lines, like genealogies or succession and terms of office of high-ranking officials, have long since been recognized as means of chronological research,[141] but have not so far been collected and examined in a systematic way.[142] Reconstructing genealogies and lists of office holders may provide a(n independent) way to put established regnal lengths to the test and thus to corroborate chronological models.

While these different approaches to the inscriptional material of the Early Dynastic Period and the Old Kingdom and the chronological questions arising thence, even when combined, will not yet suffice in establishing a 'waterproof' historical chronology of the said epochs, it is nevertheless to be hoped that integrating newly discovered material, re-evaluating extant data, and, finally, piecing together the available scraps of evidence will continuously expand our secure chronological knowledge. Meanwhile, the results of natural-scientific methods, above all Bayesian radiocarbon dating, may further help to interpret inscriptional evidence and lend plausibility to extant chronological models.

7. Radiocarbon dates for Old Kingdom Egypt

For this contribution, we used Old Kingdom radiocarbon data as published by Bronk Ramsey, Dee and colleagues.[143] Our models follow essentially the Old Kingdom model as published in 2010, but are adapted to meet the requirements of the maximal, minimal, and critically assessed reign lengths for the 3rd and 4th dynasties as outlined above. No historical constrains were employed for the 5th and 6th dynasties as current research does not (yet) permit robust reign length estimates that

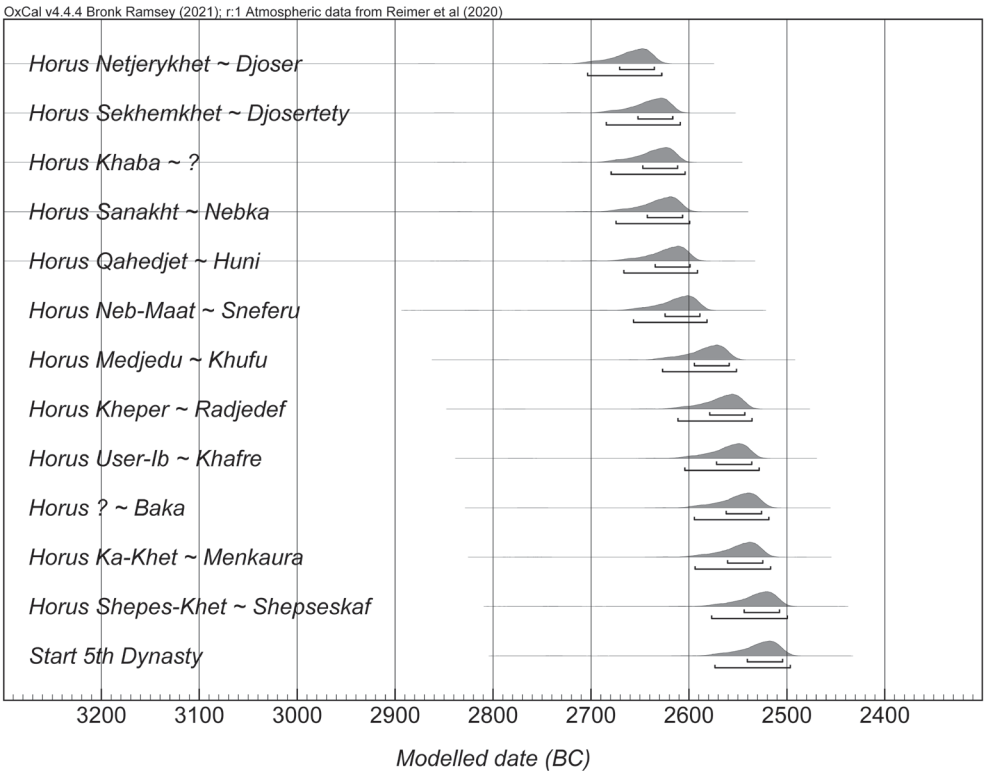

Figure 1: Modelled accession dates of 3rd and 4th dynasty kings based on the minimal model.

are actually based on published data. Instead, the only prior information used was the succession of kings. Further, we used a Student's t-distribution with five degrees of freedom (T(5)) as in the original model, except for the fact that we did not employ the factor of 5 to increase the degree of flexibility. Calibration and modelling were done using OxCal 4.4 and the current IntCal20 radiocarbon calibration curve.[144] Additionally a small regional offset of 19±5 radiocarbon years (Delta_R) was employed to account for different growing seasons for samples from Egypt and samples from European/North American trees upon which the IntCal curve is based.[145]

Figure 1 shows the modeled accession dates of the kings of the 3rd and 4th dynasties according to the minimal model outlined above. The start of the 3rd dynasty (accession of Horus Netjerykhet ~ Djoser) would fall in the mid-27th century BCE and would be very much in line with what the original study proposed. The start of the 4th dynasty (accession of Horus Neb-Maat ~ Sneferu) would fall to around 2600 BCE, also in line with what Bronk Ramsey and colleagues proposed in 2010. And also the beginning of the 5th dynasty falls to more or less the same period as in the original study, around, or just before, 2500 BCE.

Figure 2 shows the modelled accession dates according to the maximal model outlined above. Here, the modelled date for the start of the 3rd dynasty (accession of Horus Netjerykhet ~ Djoser) would be approximately a century earlier, in the mid-28th century BCE. The accession date of Horus Neb-Maat ~ Sneferu and the beginning of the 4th Dynasty would fall to the mid-27th century BCE, and the start of the 5th dynasty would fall to just after 2500 BCE. At first glance a later beginning of the 5th dynasty in the maximal model seems to be counter-intuitive, but since the prior information for this model is based on longer reign-lengths, the model has to allow for more calendar years between the beginning of the 3rd and the end of the 4th dynasty, which 'stretches' the overall model over time, resulting in older dates for the beginning and younger dates for the end.

Figure 3 shows the modelled accession dates based on the critically assessed model outlined above. In this model the beginning of the 3rd dynasty falls to

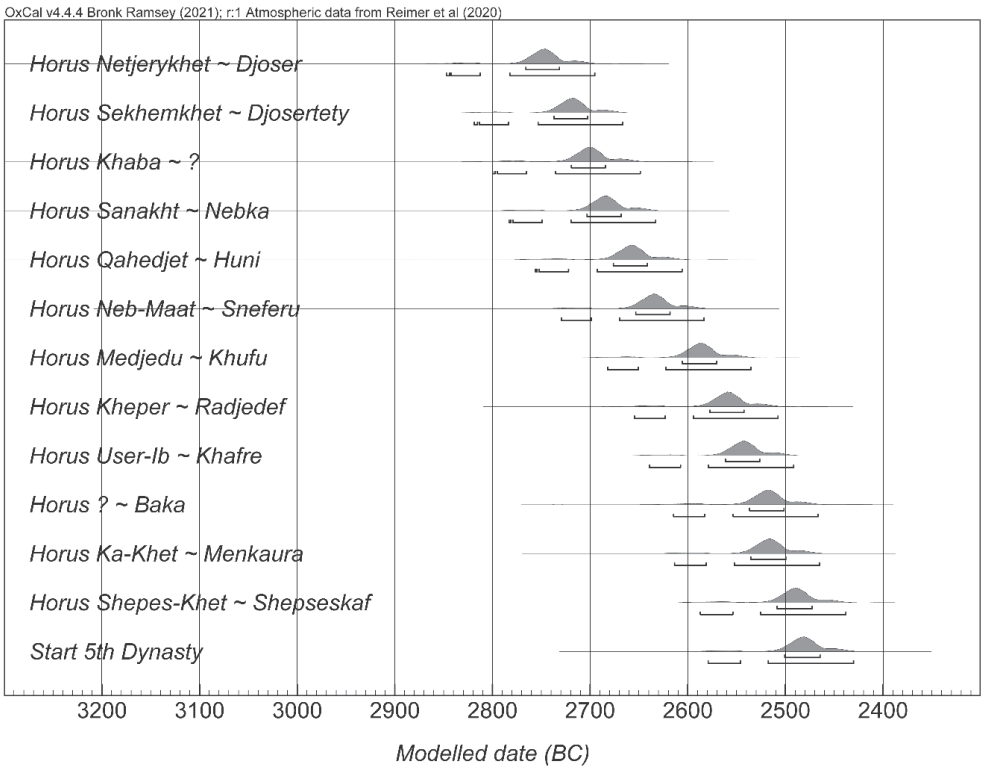

Figure 2: Modelled accession dates of 3rd and 4th dynasty kings based on the maximal model.

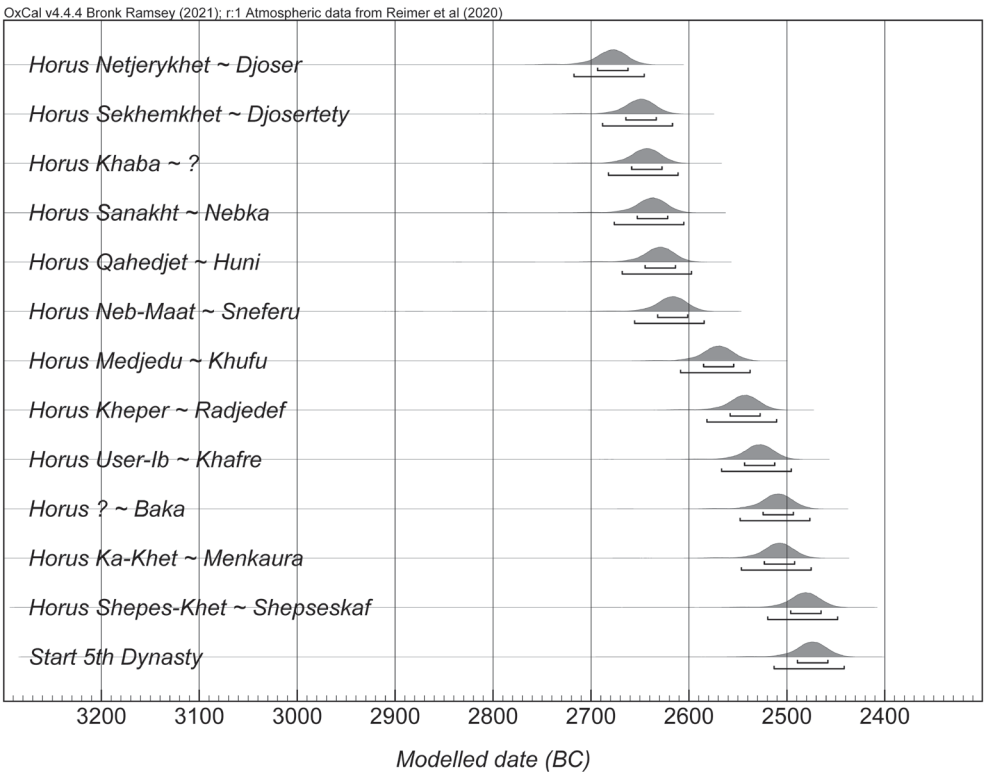

Figure 3: Modelled accession dates of 3rd and 4th dynasty kings based on the critically assessed model.

Site	EB I		EB II		EB III		EB IV	
	SL	*IBA*	SL	*IBA*	SL	*IBA*	SL	*IBA*
Tel Yarmuth	2	*1*	7	*8*	7	*11*		
Tel Yaqush	9.5		1.5	*4*	1			
Khirbet ez-Zeraqon			7	*8.5*	6	*6.5*		
Jericho	4	*6*	4	*9*		*12*		*2*
Megiddo	5	*1*			9			
Arad			23					
Tel Beth Yerah	3	*2*	9		2	*3*		
Tell Fadous Kfarabida			3		20		6	
Tell Abu en-Niʿaj							25	

Table 8: Levantine sites and their radiocarbon samples from EB I–IV (SL: short-lived samples; IBA: samples with in-built age, mostly charcoal).

just after 2700 BCE, the start of the 4th dynasty to just before 2600 BCE and again suggests a somewhat younger date for the beginning of the 5th dynasty, just after 2500 BCE.

These models show a distinct flexibility in the radiocarbon dates and suggest caution in arguing that the historical chronology as outlined by standard textbooks can be proven with radiocarbon dating. Using different reign lengths show that the modelled date for the beginning of the 3rd dynasty can shift by as much as a century and also the dates for the beginning of the 4th and 5th dynasties are far from fixed and can vary by several decades. Another issue is the fact that the Old Kingdom model is only based on few radiocarbon determinations: only 17 radiocarbon measurements were available for the Old Kingdom.[146] It also has to be stressed that precise data for the reign lengths of the 5th and 6th dynasties are still missing and/or disputed.

8. Radiocarbon Data for the Southern Levant

Where does this leave the chronology of the southern Levant and the chronological synchronization with the Egyptian Old Kingdom? Since the initial publication of Regev, de Miroschedji, and Boaretto,[147] a radiocarbon-derived ca. 2500 BCE date for the end of the Early Bronze III period has been widely accepted.[148] However, dating the transition from Early Bronze III to Early Bronze IV in the southern Levant is not easy: For most sequences (Tel Yarmuth,[149] Tel Yaqush,[150] Khirbet ez-Zeraqon,[151] Megiddo,[152] and Tel Beth Yerah)[153] no radiocarbon determinations for Early Bronze IV contexts are available and hence a modelled date for the transition from Early Bronze III to Early Bronze IV cannot be calculated. Only Tell Fadous-Kfarabida in the central Levant[154] and a recently published sequence from Jericho[155] provide data for both Early Bronze III and Early Bronze IV. Additional information can be gleaned from a substantial sequence of the Early Bronze IV site of Tell Abu en-Niʿaj in the Jordan Valley.[156]

Another limitation is the lack of short-lived samples that were used for radiocarbon dating. Table 8 shows that only the transition from Early Bronze III to Early Bronze IV at Tell Fadous-Kfarabida in Lebanon is based on short-lived data. Radiocarbon determinations from Jericho are exceptionally problematic as only samples with in-built age have been used for Early Bronze III and Early Bronze IV (Table 8).

Nevertheless, in the following we will make a short survey of Early Bronze III and IV dates of the available sequences.

Tell Abu en-Niʿaj in the Jordan Valley is a rural Early Bronze IV site with a substantial radiocarbon sequence.[157] Based on the available radiocarbon data, settlement at the site started around 2500 BCE (Fig. 4), thus a mid-third millennium BCE date for the end of Early Bronze III as proposed by Regev et al. in 2012 would be in agreement with this sequence.

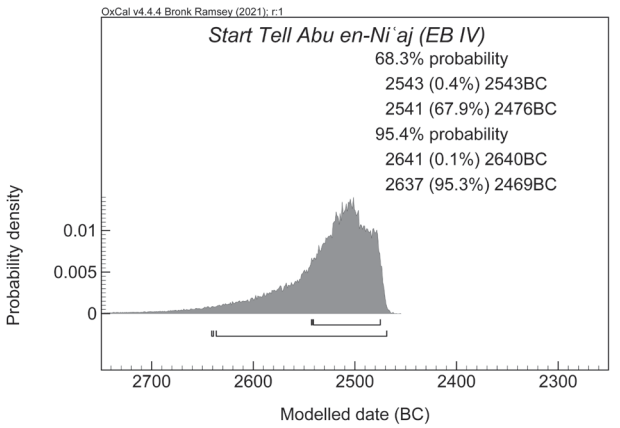

Figure 4: Modelled date for the start of the Early Bronze Age IV settlement at Tell Abu en-Niʿaj.

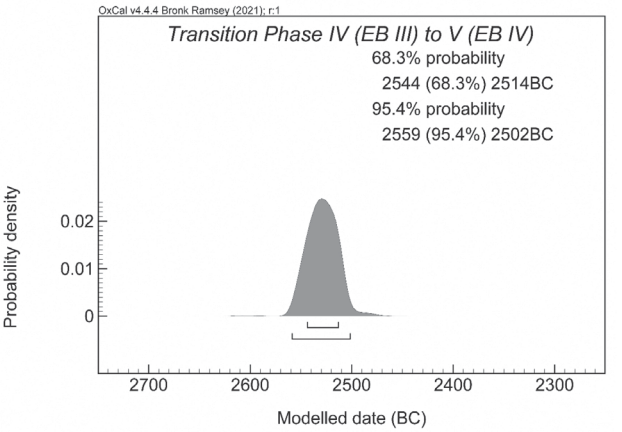

Figure 5: Modelled date for the transition from Phase IV (Early Bronze III) to Phase V (Early Bronze IV) at Tell Fadous-Kfarabida.

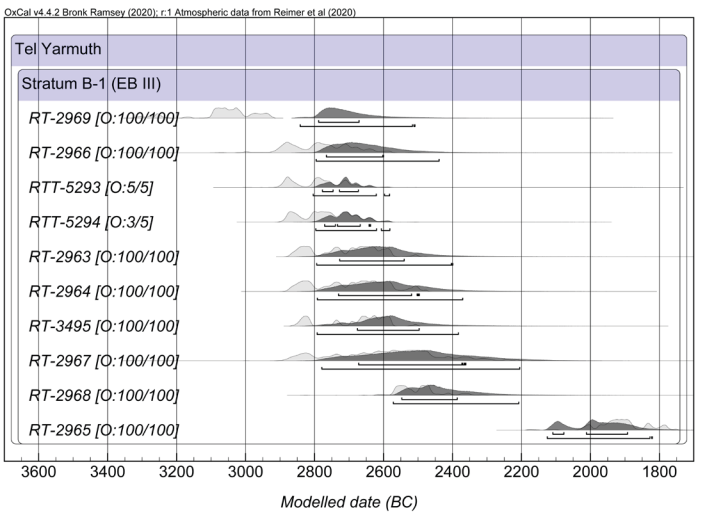

Figure 6: Modelled radiocarbon determinations for Stratum B-1 (Early Bronze III) at Tel Yarmuth.

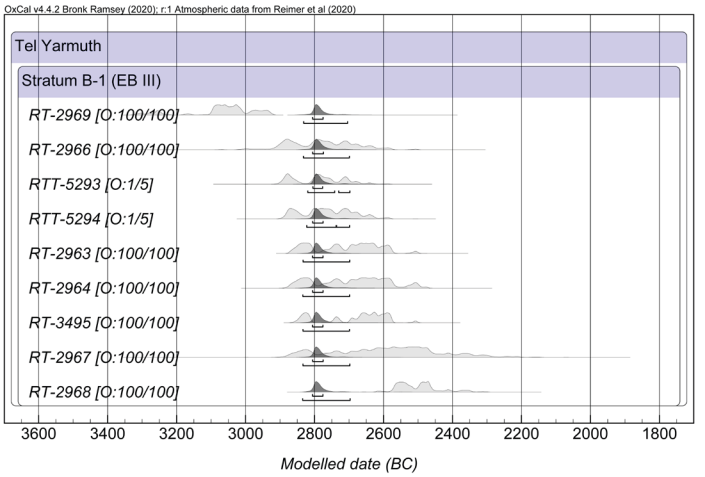

Figure 7: Modelled radiocarbon determinations for Stratum B-1 (Early Bronze III) at Tel Yarmuth (after exclusion of RT-2965).

Also, the transition from Phase IV (dated to Early Bronze III) to Phase V (Early Bronze IV) at the small site of Tell Fadous-Kfarabida in modern-day Lebanon would be in agreement with a general ca. 2500 BCE date for the end of Early Bronze III (Fig. 5).[158] Here, the modelled date for the transition to Early Bronze IV falls to just before 2500 BCE.

However, as mentioned above, finding suitable sequences for dating the transition in question in the southern Levant proper, is problematic. The sequence from Tel Yarmuth that served as a cornerstone for the high chronology of the Early Bronze Age is not as straightforward as it initially seemed. Figure 6 shows the modelled radiocarbon dates for Stratum B-1, dated to the late Early Bronze III period. The youngest date (RT-2965) was qualified as an outlier by the authors and thus they argued that the 'real' end date for Stratum B-1 should be around 2500 BCE, apparently represented by radiocarbon determination RT-2968. However, if the youngest sample is excluded from the OxCal model, also RT-2968 is qualified as an outlier (Fig. 7) and the model calculates the end-date of Stratum B-1 much earlier, at ca. 2800 BCE (Fig. 8).

But is such a shift of about 300 years for the end of Stratum B-1 at Tel Yarmuth feasible? Of course, this can only be checked through careful stratigraphic analysis, but the published model does indeed give an

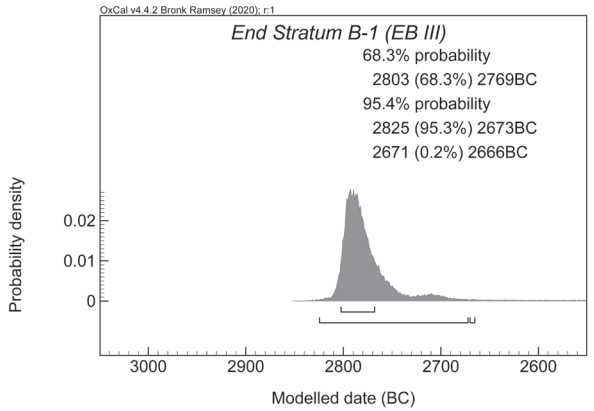

Figure 8: Modelled date for the end of Stratum B-1 (Early Bronze III) at Tel Yarmuth.

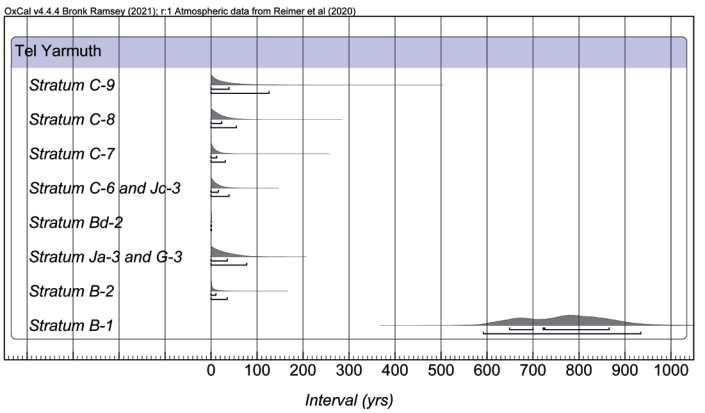

Figure 9: Calculated length of stratigraphic phases at Tel Yarmuth.

indication that some adjustment of the ca. 2500 BCE date might be in order. While the radiocarbon model calculates the duration of previous stratigraphic phases less than 50 years, the last Stratum B-1 would have been exceedingly long and would have lasted for 300 years if an end-date of 2500 BCE would be maintained and up to ca. 800 years if the youngest date (which is most likely an outlier) would not be eliminated (Fig. 9). Clearly, such a long-lived settlement phase would require an explanation and thus one should at least consider the possibility that the Early Bronze III phase at Tel Yarmuth ended significantly earlier than previously estimated.

Additionally, this would bring data for Early Bronze III Tel Yarmuth in the general date range of other modelled Early Bronze III dates from other site sequences. Early Bronze III dates at Tel Beth Yerah fall to the 29th and 28th centuries BCE,[159] at Megiddo Early Bronze III dates also fall from the 29th to the first half of the 27th centuries BCE,[160] and at Khirbet ez-Zeraqon, Early Bronze III is already attested around 2900 BCE.[161] It is only at Jericho, that a few questionable long-lived samples suggest a late date in the 24th century BCE for the end of Early Bronze III.[162] The end of the Early Bronze III period is thus still an open question – from the region of the southern Levant proper, there is currently no convincing evidence that a ca. 2500 BCE date is in order.

9. Conclusions

Where does this leave the synchronization between the southern Levant and the Egyptian Old Kingdom? If a ca. 2500 BCE date for the end of the Early Bronze III period is maintained, the onset of the de-urbanized Early Bronze IV period would fall to the late 4th dynasty based on the critically assessed and the maximal model. If the minimal model is employed, then the transition from Early Bronze III to Early Bronze IV would fall to the early 5th dynasty.

An earlier date for the end of Early Bronze III, maybe around 2700/2650 BCE (end of the Early Bronze Age III Stratum D at Tel Beth Yerah or Stratum J-6a at Megiddo) would coincide with the beginning of the 3rd dynasty if the critically assessed or the minimal model is employed. Employing the maximal model, such an end-date for Early Bronze III would coincide with the late 3rd dynasty.

As we can see, even with much more radiocarbon data at hand, there are still several open questions that need to be answered. One should also keep in mind that the relative chronological framework of the southern Levant is based on the axiomatic assumption that similarity in material culture (e.g., in the shape and decoration of pottery) equals similarity in (relative) date.[163] It is assumed that two archaeological contexts at two different sites showing the same or a similar set of material culture should be regarded as approximately contemporary. It has been shown in the past that this assumption cannot be upheld for the Early Bronze Age sequence.[164]

While this contribution necessarily leaves many questions open by exposing the weaknesses of our current chronological

frameworks, we hope that this contribution stimulates renewed research in both the historical basis for reign lengths for the Egyptian Old Kingdom, as well as the radiocarbon chronology of the Early Bronze Age in the southern Levant. Every new dataset, every new radiocarbon sequence and every new philological conclusion will refine our current understanding and ultimately may lead to a robust synchronized chronology of the 3rd millennium BCE in the ancient Near East.

Abbreviations

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Notes

[1] This contribution is based on data collected as part of the ERC Starting Grant 'Challenging Time(s) – A New Approach to Written Sources for Ancient Egyptian Chronology' (GA № 757951), which has received funding from the European Research Council under the European Union's Horizon 2020 research and innovation programme at the Austrian Archaeological Institute (Department of Classical Studies) of the Austrian Academy of Sciences. The results published are solely within the author's responsibility and do not necessarily reflect the opinion of the funding agencies or host institution, which must not be held responsible for either contents or their further use. The author would like to express his gratitude to Annik Wüthrich, Charlotte Dietrich, Roman Gundacker, Frank Simons, and Julian Posch for many helpful corrections and suggestions that significantly improved the quality of this contribution. All remaining errors and inconsistencies are those of the author.

[2] The number of academic publications in this field is legion. For current discussions, cf. the following publications with further references: Höflmayer and Streit 2019; Garfinkel et al. 2019; Boaretto et al. 2019; Asscher and Boaretto 2019; Mazar and Streit 2020; Finkelstein 2020.

[3] Manning et al. 2014; Manning 2014; Manning et al. 2020; Bietak 2013; Bietak 2021.

[4] Höflmayer 2022a; Höflmayer and Manning 2022; Bietak 2021; Höflmayer 2022b; Bruins and van der Plicht 2019; Ben-Tor 2016; Höflmayer 2017a.

[5] Regev, de Miroschedji, and Boaretto 2012; Regev, de Miroschedji, Greenberg et al. 2012.

[6] Regev et al. 2014; Höflmayer et al. 2014; Falconer and Fall 2016; Regev et al. 2017; Falconer and Fall 2017; Rotem et al. 2019; Tumolo and Höflmayer 2020; Regev et al. 2020; Fall et al. 2021.

[7] Höflmayer 2017c.

[8] Greenberg 2019.

[9] Höflmayer 2016; Bonani et al. 2001; Hassan and Robinson 1987.

[10] Bronk Ramsey et al. 2010; Shortland and Bronk Ramsey 2013.

[11] Regev et al. 2020; Höflmayer 2017b.

[12] Cf., e.g., Beckerath 1997, 3–4.

[13] Ca. 3032/3982–2707/2657 BCE according to Beckerath 1997, 187, or 2900–2545 BCE according to Hornung et al. 2006a, 490. For a historical overview of this period, see Wilkinson 1999.

[14] Ca. 2707/2657–2170/2120 BCE according to Beckerath 1997, 187–188, or 2543–2120 BCE according to Hornung et al. 2006a, 490. For a historical overview of this period, see Blumenthal 2019.

[15] Cf. Beckerath 1997, 160; Seidlmayer 2006, 116–117; see also especially Wilkinson 1999, 66–105 and Gundacker 2015, 85–108.

16 The question as to whether the 8th dynasty should be regarded as part of the Old Kingdom is debated (cf. Blumenthal 2019, 38–40 with further bibliography). For the sake of this article, the dividing line will be drawn with the end of the 6th dynasty, assuming the 7th dynasty to be either a short interregnum of a few weeks/months, or entirely fictitious (cf. Beckerath 1997, 151; Bárta 2017, 3. 12).

17 Wilkinson 1999—on this question, see especially pages 60–61.

18 Cf. Wilkinson 2014, 2.

19 Gundacker 2013.

20 Gundacker 2015.

21 On the multipartite titulary of the Egyptian kings, see in general Beckerath 1999, 1–33 and Leprohon 2013, 7–19. As during the 3rd dynasty, the king's Horus Name was arguably still the most important one out of the royal titulary, the primary challenge to philological and chronological research on this period is (a) to determine the number and the order of attested distinct Horus Names and (b) to link other royal names to the known set of Horus Names of a specific dynasty. In the following table, only the most common versions of the respective names are listed.

22 On both these source(group)s, cf. above, section 3.

23 On theories concerning the Egyptian source of this Greek rendering, see especially Gundacker 2015, 122–123.

24 On the names of the kings of the 3rd dynasty, see Gauthier 1907, 48–59, Beckerath 1999, 48–51, Leprohon 2013, 31–34 and Gundacker 2015, 95–108; for a broader compilation and an overview of the then-recent state of research, Swelim 1983, 4–13. Nowadays, Djoser = Netjerykhet is widely accepted as the first king of the 3rd dynasty (cf. Dreyer 1998, Kitchen 1999, 246, Wilkinson 1999, 94–95, Seidlmayer 2006, 118, Ćwiek 2008, 91, Wilkinson 2014, 2–3, Blumenthal 2019, 85), Djosertety = Sekhemkhet being considered his immediate successor. For the recent hypothesis of Nebka, not Djoser, being the first king of the 3rd dynasty, which has been put forward by Ilaria Incordino, see Incordino 2007, Incordino 2008, and Incordino 2010. The order of the subsequent kings Khaba and Sanakht, however, is less certain (cf. Wilkinson 1999, 94–95, Seidlmayer 2006, 118–121, Wilkinson 2014, 3). Following Seidlmayer 2006, 117–118, the alleged royal names *Z3* and *B3* are excluded from the present study.

25 The term *Nomen* is used here to designate what would later become the *Njswt-bj.tj* Name and the *Z3-Rˁw* Name, which cannot in all cases be differentiated, especially since the *Z3-Rˁw* Name, originally a royal epithet, is attested only from the reign of Radjedef onwards (cf. Beckerath 1999, 25–26).

26 It should be noted that the name **Ḏsr* 'Djoser' is not attested in contemporaneous sources. The identification of the cartouche name *Ḏsr* with the Horus Name *Nṯr.j-ḥ.t* is based solely on later inscriptions (on these, see Wildung 1969, 57–93)—cf. Wilkinson 1999, 95–96.

27 The Gold Name in question consists of a single circular sign, see Beckerath 1999, 49, no. 2, G2–3.

28 Pätznick 2005, 76 proposes the *Nb.tj* Name '*Nb.ty ḥtp rn*[…]' (**Ḥtp-rn-Nb.tj*?) for Sekhemkhet.

29 For the 3rd king of the 3rd dynasty, the name **Nfr-k3* 'Neferka' has been proposed (cf. Dreyer 1998, 34; Gundacker 2015, 104; see also Theis 2014), but so far, this proposition remains conjectural due to a lack of unequivocal contemporaneous attestations of that name.

30 The Gold Name in question consists of a single falcon-on-perch sign (see Kaplony 1963, vol. 3, 132, no. (805)); for the logographic value of this sign, cf. below, endnote 34.

31 Pätznick 2005, 79 assigns the *Nb.tj* Name '*Nb.ty ḏsr.t ˁnḫ*' to Sanakht.

32 Note, however, that Pätznick 2007 (among others) rejects the unprovenanced stela Paris Louvre E 25982 attesting the Horus Name *Q3i-ḥḏ.t* as a product of the 18th dynasty (first published and attributed to Huni or Nebka by Vandier 1968; on this object, see also Ziegler 1990, 54–57).

33 On the names of kings of the 4th dynasty, see Gauthier 1907, 61–103, Beckerath 1999, 52–55, Leprohon 2013, 34–37, and Gundacker 2013.

34 The Gold Name of Radjedef has mostly been read *Bjk.w-nbw*, 'Falcons of Gold' (thus, e.g., Beckerath 1999, 52 and Leprohon 2013, 36 [the latter, however, giving the alternative reading *Nṯr.w*]), but it should be noted that, unlike the Gold Names of Sneferu and Khufu, Radjedef's Gold Name is written either  (e.g., Kuhlmann 2005, 256, fig. 16–17, Nishisaka and Takahashi 2016, 6, fig. 6, no. 6–7) or  (e.g., Abubakr and

Mustafa 1971, 10–11, Nishisaka and Takahashi 2016, 6, fig. 6, no. 10; Beckerath 1999, 53, no. 3, G has  but this is incorrect, cf. Chassinat 1921, 63, fn. 2.), i.e., with the falcon-on-perch sign Gardiner G7  , which, just like the sign of the flag wrapped around a pole (Gardiner R8 ), may bear the phonetic value *nṯr* (cf. Wb 2, 358, Hornung 2005, 35)–instead of the 'simple' falcon Gardiner G5 . This suggests that the reading *Nṯr.w-nbw*, 'Gods of Gold', for Radjedef's Gold Name is in any case to be preferred over **Bjk.w-nbw* (but see also Kuhlmann 2005, 254, fn. 22, who treats terms like 'Gods', 'Falcons', and 'Forces' as synonyms, at least within the Gold Names of the Old Kingdom).

35 The so-far only contemporaneous evidence for this king's *Nomen* was found in workers' inscriptions on architectural elements of the unfinished pyramid of Zawiyet el-Aryan, and has been published as sketches by Alexandre Barsanti (see Barsanti 1907). Several hypotheses have been put forward regarding the reading of the disputed first hieratogramme; for an overview of the discussion, see Gundacker 2013, 79-80, fn. 325, and Theis 2014, 428-429. From a palaeographical point of view, the reading *nfr* seems most preferable (cf. particularly the shape of the respective sign within the name of king Sneferu from a workers' inscription in the Bent Pyramid at Dahshur in Fakhry 1959, pl. 21, a), but definitely needs further critical investigation. Meanwhile, the more or less well-established name '*Bꜣ-kꜣ*(*=j*)' shall be retained here.

36 On contemporaneous evidence for an immediate succession of Shepseskaf and Userkaf, cf. Dorman 2002, 109 and Gundacker 2015, 138–139. But see also Reisner 1931, 246, Beckerath 1997, 159, and Verner 2006, 136, all of whom treat Thamphthis as a historical king.

37 Named after the Egyptian priest Manetho (1st half of the 3rd century BCE); his work survives only as epitomized in the writings of other Classical authors. For modern editions of his main work *Αἰγυπτιακά*, see Waddell 1948, Jacoby 1958, Mosshammer 1984; for a general overview, see Gundacker 2018. Because of the very specific challenges that this Graeco-Roman-Armenian tradition poses onto research, it is largely excluded from the following considerations. For an *in extenso* treatment of the 3rd and 4th dynasties within the Manetho epitomes, see Gundacker 2015.

38 On this text genre in general, see Redford 1986; also Gozzoli 2006.

39 On pTurin Cat. 1874 in general, see (among others) Farina 1938, Gardiner 1959, Ryholt 2004, and Ryholt 2006; also https://collezionepapiri.museoegizio.it/en-GB/document/97/?inventoryNumber=1874. A comprehensive new edition is currently being prepared by Kim Ryholt.

40 On the dating, cf. Hornung et al. 2006b, 19–20. Attempts to date the surviving fragments stretch from the 4th (Черезов 1960) and 5th (e.g., Fischer 1976, 48 and Wilkinson 2000) down to the 25th dynasty (Helck 1970); those deviating from the Old Kingdom date adhered to in this paper should not uncritically be rejected. In any case, a thorough art-historical as well as philological examination of the surviving fragments still is necessary in order to narrow down the extant dating options.

41 The most important editions are Schäfer 1902 (on the main fragment 'PS'; Regional Archaeological Museum Palermo, inventory no. 1028), Gauthier 1915 (on Cairo fragments ('CF') 1–4 = Egyptian Museum Cairo J(ournal d')E(ntrée) 44859, 39735, 39734, and 44860), Cenival 1965 (on CF 5 = Egyptian Museum Cairo T(emporary) R(egisters) 15/1/75/2.), Stewart 1979, 6, pl. 3, no. 1 (*recto*) and Reeves 1979 (*verso*) (on the London Fragment ('LF') = UCL 15508), and Wilkinson 2000 (including an extensive further bibliography). On the numbering and terminology, see Wilkinson 2000, 13. A new edition of the individual fragments based on 3D scans is currently being prepared by Massimiliano Nuzzolo (Prague); meanwhile, see the preliminary studies Nuzzolo 2020, Nuzzolo 2021, and Nuzzolo et al. 2021.

42 Kim Ryholt proposes at least five different sources for the composition of the 'original' manuscript (cf. Ryholt 2004, 145–147; Ryholt 2006, 28–30).

43 Cf. (among others) Gundacker 2015, 137.

44 Cf. Gundacker 2015, 142.

45 Schäfer 1902, pl. 1; Wilkinson 2000, fig. 1.

46 Gauthier 1915, pl. 24; Wilkinson 2000, fig. 4. According to Wilkinson 2000, 209, who bases his assumptions on the width of the missing portion between PS and CF 1 (cf. Wilkinson

2000, 203), the compartments of the first reign do still belong to the reign of Netjerykhet ~ Djoser, the subsequent (rather short) reign, hence, to Sekhemkhet ~ Djosertety.

47 Schäfer 1902, pl. 1; Wilkinson 2000, fig. 1.

48 Schäfer 1902, pl. 2; Wilkinson 2000, fig. 3.

49 Gauthier 1915, pl. 30, fig. 1; Wilkinson 2000, fig. 7.

50 Gauthier 1915, pl. 31; Wilkinson 2000, fig. 9.

51 Cf. Fischer 1976, 48.

52 Cf. Redford 1986, 65–68, Clagett 1989, 47.

53 Edition by Dreyer 1987; see also Kahl et al. 1995, 168–171.

54 For an overview, see Ćwiek 2008, 87–88.

55 Cf. Baud 2002, 58–59; see also Stadelmann 1987, 230. 233.

56 Cf. Hornung et al. 2006a, 45.

57 I.e., the 'Counting of Gold and Fields' (*ṯnw.t nbw sḫ.wt*; PS r.V.3 and 5 (Schäfer 1902, pl. 1; Wilkinson 2000, fig. 1), LF r.I.1 (Stewart 1979, pl. 3, no. 1; Wilkinson 2000, fig. 11)), the 'Counting of Cattle' (*ṯnw.t jḫ(.w)*; PS v.II.2 (Schäfer 1902, pl. 2; Wilkinson 2000, fig. 3), CF 1 v.I.1 (Gauthier 1915, pl. 27; Wilkinson 2000, fig. 6) cf. above, section 4.1), and an undifferentiated 'Counting' (*ṯnw.t*; passim).

58 For a recent overview, see Warden 2015, who argues against a possible connection of taxation and 'Following of Horus'.

59 As absolute dates for the end and the beginning of the 4th dynasty depend not only on internal calculations, but also on external factors like the length of the following periods, those dates are not necessarily elaborated in every single one of the models mentioned here.

60 Giving a general overview, Beckerath 1997, 10 presumes a regular biennial census cycle for the period in question, only to revoke this later on (cf. Beckerath 1997, 158) for the reign of Sneferu with respect to PS r.VI.3–4 and the date *dipinti* from Meidum. As for the rest of the 4th dynasty, Jürgen von Beckerath more or less confines himself to the numbers of the Turin Canon.

61 According to Nolan 2003, 92–93, due to the necessity of intercalating a month in order to harmonize the lunar and solar calendars, every third—occasionally every other—census year (*rnp.t zp*) would have entailed an after-census year (*rnp.t m-ḫt zp*), thus arriving at a ratio of 1.7155 (*zp*) to 1 (*m-ḫt zp*), or, *realiter*, 20.88 ≈ 21 % fewer years after the count than years of the count. On this, see also Ciavatti 2019, 12, fig. 2.

62 This figure being construed according to the formula $x = 2(\mathrm{N}max) - \frac{1000(\mathrm{N}max)}{2088}$ (derived from Nolan's model, cf. endnote above) for each 4th dynasty king, respectively (N*max* = highest known count number—for recent data thereon, cf. section 5).

63 Hornung et al. 2006a, 45–46 assume a biennial rhythm throughout the Early Dynastic Period and the Old Kingdom but, like von Beckerath, make an exemption (at least) for the reign of Snofru on the grounds of PS r.VI.3–4. In the same volume, Miroslav Verner (Verner 2006, 127) proposes a reasonable model for calculating a reign length minimum (N*max* + ∑*Nm-ḫt*; *Nm-ḫt* representing a securely attested year after the count) that will also be adhered to in the course of this paper as far as it concerns minimal regnal lengths (cf. section 5). This strictly positivistic approach is of course especially prone to alterations induced by new archaeological discoveries.

64 Comprehensive collections of the relevant dated inscriptions are to be found in Smith 1952, Spalinger 1994, 281–294, Verner 2001, 365–385, Verner 2006, 128–136, and Verner 2008, 24–30.

65 For general information on this source group, see Arnold 1990 and van der Moezel 2016. In the following, the term *dipinti* (sg.: *dipinto*) is used for inscriptions painted with ink, as proposed by Ursula Verhoeven (cf. Verhoeven 2015, 30), whereas inscriptions incised into a surface are called *graffiti* (on the distinction, see also Salvador 2020, 434–435). As well as the dated construction *dipinti*, there are also a few specimens of dated construction *graffiti* from this period: (see Smith 1952, 118, fig. 6. 120, fig. 8. 127, no. 5; 7. 128, no. 12 (Boston MFA 25-3-310); 13 (JE 54940 = SR 2/15420); also Reisner unpublished, 720, (4), no. 3, and 720 (alternate version), (4), no. 4)).

66 Besides the better-known 4th dynasty papyrus *corpora* (e.g., the Gebelein or the Wadi el-Jarf papyri), for the sake of the present paper a few *ostraca* (most probably used as 'mummy tags' [cf. Fischer 1960, 188, fn. 2 and Haring 2020, 94]) are also subsumed under this category.

67 The correct reading of the logogram  (Gardiner M4) within dates is somewhat debated (for a brief overview of the discussion, see Fecht 1985 and Castle 1994, 188, fn. 2). Throughout this paper, the reading *rnp.t* will be employed.

[68] I.e., the respective king's accession year which covered the rest of the calendar year from his predecessor's demise to the next New Year's Day. This term was in use from at least the 1st to the 8th dynasties (cf. Hornung et al. 2006a, 45); for a 4th dynasty example of such a 'short' accession year (reign of Shepseskaf), see PS v.I.3 (Schäfer 1902, 32, pl. 2; Wilkinson 2000, fig. 3). The integer represented by *N* always refers to the *N*th count of a single king's reign and is reset to zero with every change in sovereign.

[69] For a 4th dynasty example of almost the entire formula (in slightly different word order), see e.g. expedition *graffito* II at the 'Oasis Bypath' near Dakhla (from the reign of Khufu; ed. Kuhlmann 2005, 248, fig. 5).

[70] Nolan 2003 and Nolan 2008 proposed a purely cultic function, whereas Gundacker 2006, 320–322, considering textual evidence from the 6th dynasty as well as administrative necessities, argued in favour of the count having an actual economical and administrative relevance. Also opting in favour of a fiscal character of the count is Brovarski 2016, 78–80.

[71] On this question, see Gundacker 2006, 331–338.

[72] Thus, e.g., Posener-Kriéger 1991, 19, Spalinger 1994, 318, Verner 2001, 372, Verner 2006, 124, Verner 2008, 24, Gundacker 2015, 91–92. Regarding the corpus of construction *dipinti*, Gundacker 2015, 92, however, also points out a double imbalance: 'It is not only the case that attested even years (*rnp.t sp* XY) outnumber attested odd years (*rnp.t m-ḫt sp* XY), but also in those biennia for which either year is attested, the numbers of attestations of the even year (*rnp.t sp* XY) usually outnumber the attestations of the odd year (*rnp.t m-ḫt sp* XY) significantly.' Accordingly, this corpus should be treated with additional caution.

[73] Schäfer 1902, pl. 1; Wilkinson 2000, fig. 1.

[74] See Smith 1952, 124, Arnold 1981, 27, Stadelmann 1987, 236, Krauss 1996, 47, Ciavatti 2019, 10; for an overview of the discussion up until 2006, see Gundacker 2006, 323.

[75] E.g., Sethe 1905, Gardiner 1945, Stadelmann 1987, Baud 2000, Gundacker 2006, and, most recently, Gundacker 2015.

[76] Nolan 2003 and Ciavatti 2019.

[77] Spalinger 1994, Krauss 1996, Krauss 1997, Krauss 1998, Beckerath 1997, Hornung et al. 2006a, Verner 2006, and Verner 2008.

[78] An extensive comparison of all of the substantiated models existing to date is highly desirable, but far beyond the scope of the present paper.

[79] Gundacker 2006.

[80] A further revision of the Meidum material on a larger scale will be part of the objective of the MERYT project (https://www.ifao.egnet.net/archeometrie/anr-meryt/). A preliminary study on this topic by Aurore Ciavatti (2022) has appeared in *BIFAO*. We would like to express our gratitude to her for providing us with the necessary information on this project's scope.

[81] Above all Petrie 1910, pl. 5, no. 6 (from 'year 17(?)' (Petrie 1910, 9, no. 6 / 'Year of the 15th occurrence' (Spalinger 1994, 282, no. (6)) / '*15*' (Verner 2001, 366, Verner 2006, 129, Verner 2008, 25) to *rnp.t* (*m-*)*ḫt zp 15*) and Posener-Kriéger 1991, pl. 7, no. A.3 ('year of the 16th occurrence' (Spalinger 1994, 319, no. (3)) / '*16*' (Verner 2001, 366, Verner 2006, 129, Verner 2008, 25) to *rnp.t m-ḫt zp 16*). These insights have so far not quite received the attention they deserve; neither Verner 2008 nor Nolan 2008 mention the proposed readings or their implications, e.g. on the census regularity. The palaeographical details of Gundacker's readings are, among others, to be discussed *in extenso* in the future.

[82] Arnold 2017.

[83] As we fail to discern edges, breaks, abrasions, etc. in many of the drawings in Posener-Kriéger 1991 and photographic material is not yet published, only a minority of them can be securely ascribed to a specific regnal year until the necessary revision is completed. Hence, the following table remains (at the very least) provisional insofar as it draws from Meidum material.

[84] E.g., Posener-Kriéger 1991, 19, Spalinger 1994, 283, Verner 2001, 367, Verner 2006, 130, Gundacker 2006, 54, Verner 2008, 26.

[85] Stadelmann 1987, 240, fig. 4.

[86] Also frequently cited as an attestation of Sneferu's 24th count (e.g., Stadelmann 1987, 235, and, following Stadelmann's reconstruction, Spalinger 1994, 282–283, Verner 2001, 367, Verner 2006, 130, Gundacker 2006, 54, Verner 2008, 26), but with all reasonable certainty a scientific *chimaera*, is a Dahshur *dipinto* briefly mentioned and sketched by Carl R. Lepsius (Lepsius 1859, Text, 1, 206) after Georg G. Erbkam (Erbkam unpublished, I, 85). Erbkam's rendering is only

a rough sketch, not a *bona fide facsimile*, and also differs from the version printed in Lepsius 1859. The traces do not support Rainer Stadelmann's proposition; rather, the *dipinto* as reproduced by Lepsius and Stadelmann should be turned clockwise by 90°—as had already been done by Sethe 1905, 85 and Maystre 1935, 96—the traces hence be read […] *ꜣbd 1 šmw sw 24* '[…] month 1 of the Shemu season, day 24' instead of *(*rnp.t zp*) *24 ꜣbd 3 ꜣḫ.t* […], '(year of the count) 24, month 3 of the Akhet season […]' (thus also Arnold 2021, 80, fn. 182). We are very grateful to Silke Grallert (BBAW, Berlin) for providing us with a digital scan of the relevant pages from Erbkam's sketchbook.

87 Cf. Verner 2001, 368, Verner 2006, 131, Verner 2008, 26. For yet another attestation model and a ratio of 4 (*zp*) : 6 (*m-ḫt zp*), see Gundacker 2006, 377–378. Considering the still-extant imbalance of single attestations, Paule Posener-Kriéger's suggestion of only occasional distinctions between *zp* and *m-ḫt zp* in the writing (cf. Posener-Kriéger 1991, 19) seems all the more plausible (cf. also Gundacker 2015, 92–93).

88 Spalinger 1994.

89 Verner 2001, Verner 2006, and Verner 2008.

90 See Tallet 2013, Tallet 2014, and Tallet 2017.

91 For further preliminary reports on this boat pit, see Nishisaka et al. 2011, Yoshimura and Kurokochi 2012, Kurokochi and Yoshimura 2013. For the first boat pit, see especially Nour et al. 1960.

92 Nishisaka and Takahashi 2016.

93 The attestation of a *rnp.t zp 14* for Khufu is apt to shed new light on the supposed inscription from the '17th year' that Petrie claims to have recognized in one of the relieving chambers of the Great Pyramid (cf. Petrie 1923, 60; on this *dipinto*, see also the article 'Dig's Days. The Secret Five Chambers' on the personal web page of Zahi Hawass: http://guardians.net/hawass/articles/secretchambers.htm). As Petrie's choice of words is ambiguous—'17th year' might point to **rnp.t zp 8* as well as **rnp.t zp 17*—and neither photographs nor facsimiles of the inscription are published, this supposed attestation remains dubious (see also Verner 2001, 373–374). In contrast, the Turin Canon might be read in support of 14 counts in the reign of Khufu. Column x+III, line 10 gives a number of 23+x regnal years for Sneferu's successor, with the papyrus breaking off after the 3rd stroke of the ones digit:  . Due to the structure of hieratic numerals in general as well as in the Turin Canon in particular (numbers higher than 4 and lower than 10 are expressed by ligatures rather than by a single row of distinct strokes, cf. Möller 1909, 59, nos 618–622), either *none* or exactly *one* further stroke may be reconstructed here. In the latter case, it would be possible to assume (a) that the scribe mistook Khufu's number of *counts* (*14) for his number of *regnal years* (similarly maybe already for Sneferu's reign, cf. Gundacker 2006, 65–67), and (b) that there occurred an error in the tens digit (*14→*24), which was apparently quite common in the later Manethonian tradition and maybe happened already to the account of Djoser's reign within the Turin Canon (cf. Gundacker 2015 *passim*, and 147, fn. 280; in general see also Ryholt 2004, 151, § 33), but in sum, this string of assumptions would be purely conjectural, of course.

94 This observation had already been made by Gundacker 2006, 329–330, but could not be substantiated further because of the previously insecure attribution of the date *dipinto* in the first boat pit.

95 The central question is whether the date *dipinto* belongs to the reign or Khufu or that of his successor Radjedef. For an overview of the discussion and general considerations on the construction history of the boat pits, see Verner 2001, 375–377 and Jánosi 2005, 71–72.

96 Verner 2001, 375–377, Verner 2006, 132, and Verner 2008, 27.

97 For the CF 4 inscriptions, see Gauthier 1915, pl. 31; Wilkinson 2000, fig. 9.

98 The two compartments following the one mentioning the 2nd count as well as the one following the compartment mentioning the 8th count are still visible and can be differentiated, but due to the loss of bigger portions of text within them, no proposition can be made as to whether or not they contained count numbers.

99 For the PS inscriptions, see Schäfer 1902, pl. 1; Wilkinson 2000, fig. 1.

100 No count is recorded in PS r.VI.2, but the compartment is immediately succeeded by another one mentioning the 7th count. Since on the Palermo Stone there is no hint as to two (or more) years after the count immediately

following each other, this attestation is regarded as the year after the 6th count, here.

[101] The instances of *zp 13* and *14* are especially uncertain.

[102] Although the hieratic writing is unambiguous in this case, this inscription from the first boat pit at the Great Pyramid has not been translated correctly in any of the major chronological studies on Old Kingdom inscriptions (exceptions being Valloggia 1997, 419 and Gundacker 2006, 85. 328, fn. 1738. 329): Spalinger 1994, 284, no. (8) reads '[y]ear of the 11th occurrence', Verner 2001, 375, '*rnpt sp* (or *m-ḫt sp* ?) *11* (or *10* ?)' (implicitly favouring *zp 11*), Verner 2006, 132, '*rnpt zp* 11 (or 10 ?)' (without alternative), and Verner 2008, 27, '*rnpt sp* (or *m-ḫt sp* ?) *11* (or *10* ?)' (again implicitly favouring *zp 11*). The traces of paint to the left of the number ten can hardly be anything else than the remains of a single stroke indicating a 1. Further traces to the left of this sign are neither recorded nor—due to the configuration and the alignment of the *dipinto*—to be expected, hence the reading *11* for the census number is reasonably secure. As the *dipinti* of the cover stones of the first boat pit have vanished since the 1971 publication of Abdel Moneim Abubakr and Ahmed Y. Mustafa (cf. Roth 1991, 127), the chances of verifying their facsimile in the future seem rather slim. On the pertinence of this inscription, see below.

[103] Following Reisner 1942, 73, this inscription—as well as another one mentioning a year of the 13th count (Smith 1952, 119, fig. 7, 2nd row, left side, cf. above on Table 3)—has usually been ascribed to the reign of Khafre (thus, e.g., by Smith 1952, 127–128, no. 11 (a), Spalinger 1994, 286, no. (2), Verner 2001, 378, Verner 2006, 133, or Verner 2008, 28), but according to Flentye 2007, 294–295. 303, the respective tomb G 7650 should be dated to the later reign of Khufu (cf. also Jánosi 2005, 71) due to its architectural features.

[104] Pierre Tallet's hieroglyphic transcription of the hieratic original suggests a year *after* the 13th count (*rnp.t* (*m-*)*ḫt zp 13*), but the traces above the number *13* belong to the sign  (*zp*, Gardiner O50), not to  (*ḫt*, Gardiner M3). Given the layout of the papyrus, the preposition *m-ḫt* is not to be expected above the *zp* sign, so the reading *rnp.t* ⌜*zp*⌝ *13* seems reasonably sure.

[105] Cf. Jánosi 2005, 71. However, cf. Verner 2001, 376 *contra*.

[106] Cf. Nishisaka and Takahashi 2016, 9–12.

[107] See Nishisaka and Takahashi 2016, 6, fig. 6, no. 8 According to Nishisaka and Takahashi, this earlier phase comprised the breaking of the stones in the quarry and their temporary storage in a repository before being brought to their final destination. In this phase, the Northern and Southern sides of the stones would have been inscribed with date *dipinti*.

[108] Cf. Arnold 1990, 19, Verner 1992, 184, Nishisaka and Takahashi 2016, 11–12, and Arnold 2017, 395.

[109] For an overview, see Verner 2006, 125 and Gundacker 2006, 321–322. The latter also gives plausible suggestions regarding the mechanisms of the choice of year designations.

[110] This results in the necessity of subtracting 1 year from the respective sum of ∑dyn. 3 + ∑dyn. 4 in each model.

[111] This figure according to the Turin Canon, x+III,5 (king ⟨*Ḏsr-jt*⟩).

[112] This figure according to the Turin Canon, x+III,6 (king ⟨*Ḏsr-jt*⟩).

[113] This figure according to the Turin Canon, x+III,7 (king *[⟨Ḥw-]*⌜*ḏ*⌝*[f]* <*3*> 1).

[114] The Turin Canon, x+III,4 gives a number of 19 regnal years for king ⟨*Nb-k3[-…1]*, which might be influenced by the (erroneous?) 19 years assigned to ⟨*Ḏsr-jt*⟩ (cf. Gundacker 2015, 108–109). Assuming a deliberately extreme point of view, it is possible to argue that these 19 years might be the result of a scribal error in the tens digit (on this phenomenon, cf. above, endnote 93), thus arriving at an original number of *9 years.

[115] If the jar inscription *rnp.t šms.w-Ḥrw zp 11 ḥsb Jwnw pr-zr* 'Year of the following of Horus; 11th occurrence of the "calculation" of Heliopolis, (namely) the House of the Ram' (Dreyer 1987, 99, fig. 1b, Kahl et al. 1995, 168, D3/E/I) is attributed to Huni, as has been done by Dreyer 1987, 103, one should assume at least 11 regnal years for this king.

[116] The highest date securely attributable to Radjedef is *rnp.t zp 1 3bd 3 pr*[*.t* …] 'Year of the count 1, month 3 of the Per[et] season, […]' from the substructure of his pyramid complex at Abu Rawash (Valloggia 1997, 426, fig. 8 and Valloggia 2011, II, 111, fig. 178). As the

actual pyramid must have been completed to a considerable degree (cf. Valloggia 2011, I, 6–7), it seems inappropriate to limit Radjedef's minimal regnal length to the figure of this single inscription. Hence, the 8 years of the Turin Canon, x+III,11 are applied here.

117 If the so-called 'will of Nikaura' and the Gebelein papyri are attributed to other rulers (cf. below, endnote 119), the highest date reasonably securely attributable to Khafre is *rnp.t zp 10 ꜣbd 4 šmw sw 24* 'Year of the count 10, month 4 of the Shemu season, day 24' from oLeiden J 429 (Goedicke 1968, pl. 5, no. 4). From three other *ostraca* from Helwan (cf. Verner 2006, 134) and a *dipinto* from the tomb of Meresankh III (G7530-7540) erroneously attributed to Khafre's year of the count 7, but actually dating from the year after the 10th (or, less probably, 2nd) count (photograph HUMFA_A4622_NS), three distinct years after the count are known.

118 For this ephemeral king, no date inscriptions mentioning regnal years are known.

119 If the date *rnp.t zp 12 jp.t* 'Year of the count 12' from the 'will of Nikaura' (from Giza tomb LG 87 = G 8158, Lepsius 1859, II, 15, a, Sethe 1903, 16–17, Goedicke 1970, pl. 3) is assigned to Menkaura, this would be the highest known count of this king. Adding three (cf. Verner 2006, 135) distinct years after the count, the result would be a minimal regnal length of 15 years. Assuming further that the tens digit of the figure of the Turin Canon is not to be reconstructed to **20*, an actual minimal regnal length of 18 years for Menkaura may be proposed.

120 This figure is taken from the Turin Canon. The highest contemporary date of Shepseskaf is *rnp.t m-ḫt zp tp.j* 'year after the first count' from the edict for the pyramid of Menkaura (Reisner 1931, pl. 19, b; Goedicke 1967, 17, fig. 1), which differs by only two years from the figure of the Turin Canon, so it seems reasonable to accept the latter as the minimal regnal length.

121 Assuming a scribal error in the tens digit in the Turin Canon, as is possibly indicated by the Old Kingdom annals (cf. Wilkinson 2000, 53, Hornung et al. 2006b, 22, Gundacker 2015, 108, fn. 106).

122 If the numbers of 19 years from the Turin Canon, x+III,4 and 5 do not refer to Sanakht ~ Nebka and Netjerykhet ~ Djoser, but instead to the first two kings of the 3rd dynasty, i.e., Netjerykhet ~ Djoser and Sekhemkhet ~ Djoserty, then the second instance (x+III,5), if taken at face value, may possibly be attributed to the latter.

123 Assuming that the 6 years given by the Turin Canon, x+III,7 are a scribal error in the tens digit for an original *16 complete regnal years, possibly with a few additional months of an incomplete last regnal year. Although suffering from an extensive re-interpretation of the names, the Manethonian tradition around the 3rd dynasty might support this number with the 17 years attributed to king *Μέσωχρις* by Sextus Julius Africanus and George Syncellus (cf. Waddell 1948, 42–43; Gundacker 2015, 87).

124 Manethonian tradition (according to Sextus Julius Africanus and George Syncellus) has 28 regnal years for king *Νεχερώφης* (cf. Waddell 1948, 40–41; Gundacker 2006, 86). Note, however, that this—fictitious though the 'maximal' model may be—would only function if Manetho's graecized name *Νεχερώφης* is *not* identified with king *(Nb-kꜣ[-…1]* from the Turin Canon, x+III,4 (since the 19 regnal years of the latter have been attributed to Netjerykhet ~ Djoser in this model), but only with the contemporaneously attested king Sanakht ~ Nebka, and has independently been misplaced at the onset of the 3rd dynasty.

125 The Turin Canon, x+III,8 attributes 24 (+1?) years to king *(Ḥwi[…]*, while Manethonian tradition (according to Sextus Julius Africanus and George Syncellus) has 42 years for king *Ἄχης* (cf. Waddell 1948, 42–43; Gundacker 2015, 87)—which might, however, be the result of a 'psychological' error (cf. Helck 1956, 56; Barta 1981, 21; Gundacker 2015, 109–110).

126 Assuming that the immediate succession of the 7th and the 8th counts as displayed on the Palermo Stone is a scribal error (cf. O'Mara 1979, 94).

127 Based on the highest known contemporaneous count (*rnp.t zp 14* 'year of the count 14', cf. above), not the Turin Canon.

128 The figure of 8 counts being taken from the Turin Canon, x+III,11.

129 If the date *rnp.t m-ḫt zp 11* 'Year after the count 11' of pGebelein IV (Posener-Kriéger 2004, pl. 30) is assigned to Khafre's reign (the Gebelein papyri do not mention a specific king's name and are dated to the reign of Menkaura only on grounds of the palaeography and the dates

themselves, cf. Posener-Kriéger 1975, 216), his highest known regnal year would be the 22nd in this model. This figure may then be rounded up to arrive at the *26 regnal years which has been proposed as the basis of later traditions around Khafre's reign (cf. Helck 1956, 52; Beckerath 1997, 158; Gundacker 2015, 126–127).

130 This figure according to Helck 1956, 53 and Gundacker 2015, 129. 148, both of whom reference Manethonian tradition.

131 Assuming that the tens digit of the number of regnal years from the Turin Canon, x+III,14 is to be reconstructed to **20*.

132 If the number of 4 regnal years from the Turin Canon, x+III,15 is interpreted as mistaken for 4 census cycles in a regular biennial system, with the last regnal year of Shepseskaf being a year after the 4th count.

133 The Turin Canon, x+III,6 gives a number of 6 years (king (*Ḏsr-jt*]). However, if the incomplete reign CF 1 r.V.11–13 is to be attributed to Sekhemkhet ~ Djosertety and the royal titulary (including the Horus Name, the *Nomen*, and the Gold Name as well as king's mother's name, with a width of approximately 7 year compartments (cf. CF 1 r.II–III)) is, as is the case with the account of Semerkhet's reign (1st dynasty; CF 1 r.III.4–10 *supra*), centred above the regnal-year compartments, then a total of *7 year compartments may be reconstructed.

134 The number of 6 years taken from the Turin Canon, x+III,7 (king *[(Ḥw-]ʿḏʾ[f] <3>*]). Immediately following this number, there is a lacuna, but traces of black ink that might well conform to an entry on months are still visible.

135 Assuming that the number of 19 regnal years from the Turin Canon, x+III,4 is a scribal error for an original *9 (thus aligning the number with Netjerykhet ~ Djoser's (erroneous?) 19 years), which itself might be derived from a roundup of *8 years and x months (cf. Gundacker 2015, 142. 147, fn. 280).

136 Since the highest probable year designation for Qahedjet ~ Huni may be an '11th occurrence of calculating' (indirectly attesting 11 distinct regnal years; cf. above, endnote 115) and the Turin Canon, x+III,8 has 24 regnal years for king (*Ḥwi[…]*], the latter may with all due caution be considered a scribal error in the tens digit for an original *14 regnal years (cf. Gundacker 2015, 142).

137 Assuming that the immediate succession of the 7th and 8th counts on the Palermo Stone has to be taken seriously.

138 The year designation *rnp.t* [*zp*] *12* from the 'will of Nikaura' being attributed to Menkaura in this model (cf. Gundacker 2010, 32–33).

139 This is mostly due to the rather 'conservative' approach of the editors, but it must also be noted that the part of the chronological table concerning the 3rd and 4th dynasties that is given in Hornung, Krauss and Warburton, 490–491 suffers from certain inconsistencies in comparison to the contribution from Miroslav Verner in the same volume (Verner 2006): the latter, e.g., attributes 14+x regnal years to Menkaura (cf. Verner 2006, 127), whereas the former assume an improbably low number of 5 years for the same king.

140 Cf. (among many others) Jánosi 2005, 51, fn. 134.

141 E.g., by Henige 1981, Beckerath 1997, 28, Gundacker 2006, 103–314, or Bierbrier 2006.

142 But see for the Old Kingdom, e.g., the overviews provided by Baer 1960 and Strudwick 1985.

143 Bronk Ramsey et al. 2010.

144 Bronk Ramsey 1995; Bronk Ramsey 2001; Bronk Ramsey 2009b; Bronk Ramsey 2009a; Reimer et al. 2020.

145 Manning, Kromer, Cremaschi et al. 2020; Manning, Wacker, Büntgen et al. 2020; Höflmayer and Manning 2022.

146 Dee 2013.

147 Regev, de Miroschedji, and Boaretto 2012.

148 Greenberg 2019.

149 Regev, de Miroschedji, and Boaretto 2012.

150 Rotem et al. 2019.

151 Tumolo and Höflmayer 2020.

152 Regev et al. 2014.

153 Regev et al. 2020.

154 Höflmayer et al. 2014.

155 Nigro et al. 2019.

156 Fall et al. 2021.

157 Fall et al. 2021.

158 Höflmayer et al. 2014.

159 Regev et al. 2020.

160 Regev et al. 2014.

161 Tumolo and Höflmayer 2020.

162 Nigro et al. 2019.

163 Renfrew and Bahn 2019.

164 Tumolo and Höflmayer 2020.