A Star's Year:
The Annual Cycle in the Ancient Egyptian Sky

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Introduction

This paper discusses the yearly cycle of a star in the Egyptian sky based on the evidence presented in various types of 'star clocks' and astronomical diagrams. The relationship between these astronomical representations and the civil calendar are explored, including the cycle of updates to the diagonal star clock tables proposed by Neugebauer and Parker. Content and classes of diagonal star tables are discussed, the triangle and epagomenal column, and some aspects of the origin and function of the tables. Finally, key conclusions are summarised.

Sources and definitions

Diagonal star tables are usually painted on the inside surface of wooden coffin lids which date from the IXth to XIIth dynasties. One exception is a fragment of a diagonal star table on a ceiling in the Osireion at Abydos which dates from the XIXth dynasty. *Egyptian Astronomical Texts Volume 1*[1] contains details of twelve diagonal star tables on coffin lids (labelled 'Coffin 1' to 'Coffin 12') plus the table from the Osireion.[2] Eight further sources are now known. All twenty-one sources (T1 to T12 and K0 to K7 plus an empty grid) are listed in Table 1.[3] All are from Asyut unless otherwise noted. Schematic diagrams for each of the sources which contain decans are given in Tables 9 to 28 as an appendix to this paper.

The star tables have in the past been known as 'star calendars'[4] but are currently called 'diagonal star clocks'. The term 'clock' is, however, problematic and misleading. Strictly, the word can only properly be used for a mechanical timekeeping instrument that sounds the time but, most importantly, the application of the word 'clock' to the star tables encourages the perception that the intended function of the tables was as hourly timekeeping devices. This perception has been questioned by many researchers.[5] Avoiding the word 'clock' would allow the tables to be viewed with a more open mind concerning their construction and purpose, so this paper will use the term *diagonal star table*.

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[1] NEUGEBAUER and PARKER (1960).

[2] Full details of these thirteen sources will be found in NEUGEBAUER and PARKER (1960) pp. 4-23, together with references for each.

[3] S1X, which WILLEMS (*Chests of life* list of coffins) identifies as the coffin of *Ḥny*, (which is source 1 in *Egyptian Astronomical Texts* 3) is not a star clock, but an astronomical diagram. However, LESKO (*Index of the spells*) states S1X is an entirely different coffin belonging to *Ḏfꜣ.i-ḥꜥpy* whose texts have no references to decans.

[4] POGO (1936).

[5] POGO (1936) and DEPUYDT (1998), for example.

Label	N&P[6]	Coffin[7]	Name of owner, date, and provenance	Orderly?	Date Row?	Rows x Columns + List Columns	Vertical Band Order	Horizontal Strip Order
T1	Coffin 1 (I)	S1C	*Msḥt* IX-Xth dynasty	Y	Y	12 x 36+4	NFOS	FNO
T2	Coffin 2 (I)	S3C	*Ỉt-ib* IX-Xth dynasty	Y	Y	12 x 32	NFOS	FNOS
T3	Coffin 3 (I)	S6C	*Ḫw-n-Skr* usurped by *Ḫty* IX-Xth dynasty	Y	N	12 x 20	NFOS	FNO
T4	Coffin 4 (I)	S1Tü	*Ỉdy* date unknown	Y	Y	12 x 19	NFOS	FNO
T5	Coffin 5 (I)	S2Chass	*M3ꜥt* IXth-Xth dynasty	Y	Y	12 x 16	NFOS	FNOS
T6	Coffin 6 (II)	T3C	*ꜥ3šyt* XIth dynasty, from Thebes	Y	N	12 x 36+3	SOFN	FNO
T7	Coffin 7 (II)	G2T	*Ỉḳr* First Intermediate Period or XIth dynasty, from Gebelein	Y	Y	12 x 36+3	SOFN	NOFS
T8	Coffin 8 (II)	A1C	*Ḥḳ3t* date unknown, from Aswan	Y	Y	12 x 36+3	SOFN	NOFS
T9		S1Hil	*Nḫt* XI-XIIth dynasty[8]	Y	Y	12 x 27	NFOS	FNOS
T10		S16C	Name and date unknown, probably from Asyut[9]	Y	N	12 x ?	?	?
T11		S2Hil	Name and date unknown, probably from Asyut[10]	Y	Y	10 x ?	SOFN	?
T12	Coffin 9 (III)	S3P	*Ḫw-n-Skr* usurped by *Nḫt* usurped by *Ḫnn* IX-Xth dynasty	Y	Y	12 x 21	NFOS	FNOS
K0			The sloping passage star table from the Osireion at	Y	Y	12 x ?	-	-
K1	Coffin 10 (IV)	S9C	*Ṯ3w3w* XIIth dynasty	N	N	8 x 23	SOFN	OF
K2	Coffin 11 (V)	S5C	*Ṯ3w3w* date unknown	N	N	12 x 24	SFON	FN
K3	Coffin 12 (V)	S11C	*Šms* XIIth dynasty	Y	N	12 x 17	SFON	OS
K4		S#T	Name and date unknown[12]	Y	N	12 x 19	NFOS	FNO
K5		X2Bas	Name and date unknown, probably from Asyut[13]	Y	N	8 x 12	NFOS	OFN
K6			British Museum EA47605. Name and date unknown[14]	?Y	Y	13 x ?	-	-
K7			British Museum (no EA number). Name and date unknown[15]	?	?	?6 x ?	-	-
		T3L	*Sbk-ḥtp* (British Museum EA29570), from Thebes			6 x 40	SOFN	OF

Table 1: Diagonal star table sources. In the columns 'vertical band order' and 'horizontal strip order', N stands for Nut, F for Foreleg, O for Orion, and S for Sirius.

A diagonal star table consists of a grid containing the names of individual stars and, perhaps, asterisms (groups of stars forming small patterns). The particular stars and asterisms which appear in the context of star tables and astronomical ceilings are known as *decans*. The set of decans within any one source is called a *decan list*. Decan lists vary somewhat, but some decans occur in many or most lists (for example decans called

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[6] Designations used in NEUGEBAUER and PARKER (1960) where bibliographies for these sources can be found. Neugebauer and Parker's Group number follows in brackets.

[7] For coffin designations see LESKO (1979).

[8] Inv. Nr. 5999 in the Pelizaeus-Museum in Hildesheim. See EGGEBRECHT (1990) pp. 58-61 (including plates) and EGGEBRECHT (1993) pl. 33 pp. 41-43.

[9] See LOCHER (1998).

[10] See LOCHER (1998).

[11] FRANKFORT (1933).

[12] See LOCHER (1983).

[13] First published in LAPP (1985) then by LOCHER (1992).

[14] First published in SYMONS (2002b).

[15] First published in SYMONS (2002b).

ḥry-ib wỉꜣ, *ẖꜣw*, and *knmt* are regular members). Although we know the names of the decans, and in some cases can translate the names (*ḥry-ib wỉꜣ* means 'in the centre of the boat') the locations of the decanal stars and their relationships to modern star names and constellations are not known. This is due to many factors, but key problems are the uncertainty surrounding the observation methods used to develop and populate the diagonal star tables and the criteria used to select decans (brightness, position, relationship with other stars, and so on).

The main body of the diagonal star table grid usually has twelve *rows* and thirty-six *columns.* Each column represents one of the thirty-six *decades* (10-day periods) which make up the twelve months of the civil year.

Epagomenal days	LIST COLUMNS			Last decade	Middle decade	IV Shemu First decade	Last decade	Middle decade	III Shemu First decade	Last decade	Middle decade	II Shemu First decade	Last decade	Middle decade	I Shemu First decade	Last decade	Middle decade	IV Peret First decade	Last decade	Middle decade	III Peret First decade	DATE ROW	Last decade	Middle decade	II Peret First decade	Last decade	Middle decade	I Peret First decade	Last decade	Middle decade	IV Akhet First decade	Last decade	Middle decade	III Akhet First decade	Last decade	Middle decade	II Akhet First decade	Last decade	Middle decade	I Akhet First decade
A	25	13	1	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	V	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
B	26	14	2	A	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	E	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
C	27	15	3	B	A	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	R	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
D	28	16	4	C	B	A	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	T	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
E	29	17	5	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	25	24	23	I	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
F	30	18	6	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	25	24	C	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6
											OFFERING											A									TEXT									
G	31	19	7	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	25	L	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7
H	32	20	8	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26		25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8
I	33	21	9	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	B	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
J	34	22	10	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	A	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10
K	35	23	11	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	N	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11
L	36	24	12	K	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	D	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12

Table 2: Idealised layout of a diagonal star table.

Table 2 shows the layout of a hypothetical, idealised diagonal star table. The main body of the table caters for 360 days, and is often headed by a *date row* listing the thirty-six decades. The numbers 1 to 36 and the letters A to K which appear in the main body of the table each represent a decan name. The decan names represented by the letters A to K are usually called the *triangle decans*, after the shape they make in the table. The decans 1 to 36 can be called *ordinary decans*. The distinctive diagonal pattern created by the decan names distinguishes this type of table from the two other types of 'star clock' – the Ramesside star clock and the so-called 'transit star clock' in the *Book of Nut* (also present in the Osireion at Abydos).

The four columns on the left of the table contain a list of all decans: the ordinary decans are in the first three *list columns* (which may have served as a reference list of decans used in the table), and the eleven triangle decans A to K plus one extra triangle decan L in the final or *epagomenal column.*[16]

[16] A written heading for this column is only preserved in two sources T7 and T8 and will be discussed presently.

The table is divided into quarters by a horizontal *offering text* and a vertical *band* containing figures of deities associated with the sky.

Grouping systems

Neugebauer and Parker extensively analysed twelve star tables (T1 to T8, T12, and K1 to K3) and remarked that most tables are in some way corrupted.[17] Copyists' mistakes are rife in the main part of the table and many of the sources are incomplete. Neugebauer and Parker identified five groups of diagonal star tables, which they labelled Group I (consisting of sources T1 to T5), Group II (T6 to T8), Group III (T12), Group IV (K1), and Group V (K2 and K3).

Neugebauer and Parker stated that three layout elements contributed to their classification system (date row, vertical band content, and offering strip content) and that if these factors were considered, the coffins 'readily group themselves into five lots'.[18] This is far from true. The major grouping factor is the content of the tables: the lists of stars used. We can for now simplify the consideration of decan lists by noting that tables either start with decans in the *ṯmꜣt* area or the *knmt* area. Detailed discussion of decan lists is left until the next section.

Neugebauer and Parker's Group I contains five coffins from Asyut, IX-Xth dynasty, all having *ṯmꜣt*-style decan lists. They may or may not have date rows, but always have the order Nut, Foreleg, Orion, Sirius[19] in the vertical band and Foreleg, Nut, Orion, and (sometimes omitted) Sirius in the offering strip.

Group II consists of three coffins which are *not* from Asyut, but like Group I tables date from the IX-Xth dynasty, may or may not have date rows, and have *ṯmꜣt*-style decan lists. The major factors which appear to distinguish Group II tables is the order of figures in the vertical band: Sirius, Orion, Foreleg, Nut. The order of offerings varies.

Groups III and IV each contain only one coffin. The Group III coffin differs from the Group I standard by slight variations in the decans used. Similarly, the Group IV coffin differs in content from the Group V coffins, but in this case the order of figures in the vertical band is also different.

Finally, the two Group V coffins are distinguished by provenance, the lack of a date row, order in the vertical strip (the same as Group II), and decan lists which start in the *knmt* area. The characteristics of the five groups are summarised in Table 3.

Any successful classification system must be capable of incorporating all objects in its field. Neugebauer and Parker's grouping scheme can be easily tested against this criterion, because eight new tables have been published since their system was devised.

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[17] NEUGEBAUER and PARKER (1960) p. 23.

[18] NEUGEBAUER and PARKER (1960) p. 29.

[19] Most researchers agree that the two identifications of *spdt* with Sirius and *sꜣḥ* with stars in the region of modern Orion are the only correspondences between ancient and modern names within the decans which are supportable. The precise extent, composition, and orientation of the ancient constellation *sꜣḥ* (that is, which stars formed various parts of the 'figure' of *sꜣḥ*) is, however, not known.

Group	Date and provenance	Date Row?	Vertical Band Order	Horizontal Strip Order	First decans
I	IX-Xth dynasty, Asyut	Y or N	NFOS	FNO[S]	*ṯmꜣt*
II	?XIth dynasty, not from Asyut	Y or N	SOFN	Any	*ṯmꜣt*
III	IX-Xth dynasty, Asyut	Y	NFOS	FNOS	*ṯmꜣt*
IV	XIIth dynasty, Asyut	N	SOFN	OF	*knmt*
V	?XIIth dynasty, Asyut	N	SFON	Any	*knmt*

Table 3: Criteria for Neugebauer and Parker's grouping systems, reconstructed from Neugebauer and Parker (1960). Epigraphical considerations are not taken into account.

Table 4 demonstrates that not one of the new sources can be securely located in Neugebauer and Parker's scheme. Three sources are not complete enough nor well enough documented to allow them to be grouped, but the remaining five sources establish very clearly that the layout features of date row, offering text, and vertical band do *not* support the group system and are *not* features which can be used to distinguish trends or relationships in diagonal star tables.

Label	Coffin	Date and provenance	Date Row?	Vertical Band Order	Horizontal Strip Order	First decans	N&P Group
T9	*S1Hil*	XI-XIIth dynasty, Asyut	Y	NFOS	FNOS	*ṯmꜣt*	I or III, except that date is wrong
T10	*S16C*	Date unknown, ?Asyut	N	?	?	*ṯmꜣt*	Not enough known
T11	*S2Hil*	Date unknown, ?Asyut	Y	SOFN	?	*ṯmꜣt*	II, except for provenance
K4	*S#T*	Date unknown, Asyut	N	NFOS	FNO	*knmt*	NFOS + *knmt* = no match
K5	*X2Bas*	Date unknown, ?Asyut	N	NFOS	OFN	*knmt*	NFOS + *knmt* = no match
K6		Date unknown, Asyut	Y	-	-	*knmt*	IV or V – except for date row
K7		Date unknown, Asyut	?	-	-	*?knmt*	IV or V – not enough known
E1	*T3L*	Thebes	N	SOFN	OF	-	Perhaps II

Table 4: Fitting new sources into Neugebauer and Parker's groups.

Importantly, no table in Group IV or V has a date row. Neugebauer and Parker implied and Leitz stated explicitly[20] that 'later' star tables (indicated by *knmt*-type decan lists) would never have had a date row. Leitz even speculated that *knmt*-type tables started at a different point in the year from *ṯmꜣt*-type tables. The publication of British Museum object EA47605[21] disproves this theory and others which are based on it.[22]

It should be noted that no classification system has successfully incorporated many newly identified sources without modification.[23] The impracticality of the schemes has

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[20] LEITZ (1995).

[21] SYMONS (2002b).

[22] See section 'Rising or Setting' below.

[23] This point has been demonstrated in the series of papers LOCHER (1983), LOCHER (1992), and LOCHER (1998). In the first paper, a diagram positioning each of the known sources (T1 to T8, T12, and K1 to

meant that no system has supplanted Neugebauer and Parker's grouping method and become accepted by other researchers. This is an indication that the number of examples of star tables which have survived is not sufficient for a meaningful classification system to be devised which incorporates *all* points of layout, epigraphy, place of origin, and age. Such systems tend to the reduction of groups into individual sources. Kahl's stemma[24] at least had the virtue of showing some evolutionary or taxonomical arrangement of the star tables.

With a growing number of star table sources, some organisational structure is undoubtedly useful. Drawing experience from the previous attempts at classification leads to the conclusion that decan lists are the key features of these tables.

Decan lists in diagonal star tables

Each diagonal star table which has survived presents us with a decan list. However, this decan list may be fragmentary or disordered or both. Errors can occur at each re-writing. Errors which may have been present in a 'master copy' can be seen across several star tables, but each table compounds these common errors with idiosyncrasies of its own. Even so, we can attempt to reconstruct decan lists and, while doing so, find that the tables display similarities and differences which group them naturally into two classes.

In the discussion above, it was noted that decan lists in diagonal star tables began either with the *ṯmꜣt* decans or the *knmt* decans. This means that the decans occupying the cells in the top right-hand corner of an orderly star table are either *ṯmꜣt ḥrt* and *ṯmꜣt ẖrt* (for *ṯmꜣt*-class[25] or '**T**' tables, of which there are twelve) or *tpy-ꜥ knmt* and *knmt* (for the eight *knmt*-class or '**K**' tables). Most tables preserve the top-right-hand area, making their class obvious. Those which are damaged or disordered, can still be placed into one of the two classes with certainty. The only source which cannot be placed in this system is the empty table T3L.

Sixty-eight[26] individual decans appear within the twenty **T** or **K** tables. Several observations which differentiate classes of decan lists should be noted:

1) *Wšꜣt bkꜣt* splits into two separate decans *wšꜣti* and *bkꜣti* in T12 and K1 to K6.

2) Conversely, *ḳdty* becomes (or perhaps is replaced by) *spty* and "*ẖnwy*" becomes *ḥnwy* (the writing differs) in K0 and K1, then the two new decans merge to a

K4) within a nest of intersecting lines. The lines separate factors such as date, provence, and epigraphical details, but omitting mention of the date row and the offering text. Two further tables (K5 and E1) were added in LOCHER (1992) by bending some of the lines. Locher abandoned the diagram in LOCHER (1998).

[24] KAHL (1993).

[25] As we will see, there is some uncertainty about whether the *ṯmꜣt* decans should head these tables or whether they are there by mistake. This group could arguably be designated the *wšꜣti* or **W** class instead. The labels **T** and **K** are based on the sources as they stand and have the benefit that they can be used to class new sources on first inspection.

[26] NEUGEBAUER and PARKER (1960) pls. 26-29 listed seventy rising decans but two of these do not appear in any of the tables (*ṯs ꜥrḳ*[26] and *sꜣḥ*), as Neugebauer and Parker themselves noted in their Additions and Corrections to Volume 1 which appeared in NEUGEBAUER and PARKER (1969) p. 272.

single decan *spty ḫnwy* in K2, K3, K4, and K5.

3) “*Crew*” changes writing to *sšmw* from K0.

4) *Tpy-ꜥ smd* is absent in all the **T** tables.

5) *Smd srt* contracts to *smd* (both writings appear in T12).

6) The triangle decans, in particular *sꜣbw*, will be discussed presently.

7) The decans in the *sꜣḥ* area are confused and problematic. T1 to T9 and T12 have three decans: *rmn ḥry*, *ꜥbwt*, *ḫrt wꜥrt*. *Rmn ḫry* (which we might expect as a pair with *rmn ḥry*) only appears at the top of the penultimate column of T1 between *rmn ḥry* and *ꜥbwt*.

Order of *ꜣḫwy* and *bꜣwy* decans in T

An important point about decan order is not visible in Tables 5 and 6. Neugebauer and Parker made a significant change in order of decans in one area of the list, despite the order being consistently demonstrated in the **T** sources. The area in question contains potentially four decans: *tpy-ꜥ ꜣḫwy*, *ỉmy-ḫt ꜣḫwy*, *ꜣḫwy*, and (omitted, but perhaps intended) *bꜣwy*. Neugebauer and Parker put them in the order *tpy-ꜥ ꜣḫwy*, *ꜣḫwy* (always omitted, but assumed intended), *ỉmy-ḫt ꜣḫwy*, and *bꜣwy* (mistakenly written as *ꜣḫwy* throughout). Neugebauer and Parker stated[27] that ‘*ỉmy-ḫt*’ means ‘following’ and in order to support this translation stipulate that the decan written *ꜣḫwy* must be emended to *bꜣwy* throughout the main body of the tables, as the difference in writing between *bꜣwy* and *ꜣḫwy* is only a matter of the type of bird drawn ( for *bꜣ* and  for *ꜣḫ*).

There is some evidence that there should be four *ꜣḫwy*/*bꜣwy* decans as all four appear in K1. Unfortunately, in K1 the decans are in disarray, so cannot be used to decide order. *Bꜣwy* does not appear in any of the **T** class tables. In later decan lists, *ꜣḫwy* and *bꜣwy* are consistent and distinct members, so the restoration of the fourth decan is reasonably secure. Returning to the question of order, the surviving sources must be our primary guide. Here, there is not a good enough reason for Neugebauer and Parker’s convoluted change. The translation issue is not evidence: *ỉmy-ḫt* can mean[28] ‘in the entourage of’ or ‘accompanying’. Neither rendering prevents *ỉmy-ḫt ꜣḫwy* from preceding *ꜣḫwy*. Additionally, we have no idea how the ‘figures’ which these star names represented were depicted or arranged.

The list columns also do not support Neugebauer and Parker’s theory. In T1 two instances of *ꜣḫwy* appear, one before and one after *ỉmy-ḫt ꜣḫwy*. The second of these instances was probably a poorly-written *bꜣwy*. In T7 and T8, *ꜣḫwy* follows *ỉmy-ḫt ꜣḫwy* exactly as it does in the body of the table.

This detailed examination of the *ꜣḫwy* and *bꜣwy* area leads inevitably to the conclusion that there is nothing to be gained by changing the order of these decans. We also have seen that *bꜣwy* is a likely candidate for a ‘missing’ decan, which we will discuss below.

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[27] NEUGEBAUER and PARKER (1960) p. 23.

[28] For example in the dramatic text from the *Book of Nut* see NEUGEBAUER and PARKER (1960) pls. 51-54.

Order of *ṯm3t* decans in T

T1, T6, T7, and T8 are our most complete sources, but each one contains just thirty-four ordinary decans in the main body of the table, where we would expect thirty-six. The thirty-fourth decan is followed by a repetition of the two *ṯm3t* decans, and then by the first triangle decan *smd rsy*. Repeating the *ṯm3t* decans is an odd mistake, given that this is not a single writing error but two diagonal lines of decans spanning the width of the table. That the list should be missing two ordinary decans is not exceptional, but that the mistake should be noticed and corrected mid-way through the table, so that the triangle decans, in the most 'difficult' part of the table, are correctly placed is thought provoking.

As the mistake of omitting two ordinary decans and of repeating the *ṯm3t* decans appears uniformly across the **T** tables, the error was almost certainly present in the master source or sources from which these tables were copied. This points strongly to all these tables, including the slightly differing T12, having a common ancestor. This ancestor may or may not have been a faulty copy of a 'perfect' original star table (possibly there never was such a table) but in reconstructing the relationships between the star tables and the circumstances and process of their development, identifying where in the table the mistake occurred is important.

The copyist, who perhaps did not fully understand the text on which he was working, may have started at the right-hand end of the table (a typical direction for writing), with *ṯm3t ḥrt* and *ṯm3t ẖrt* correctly placed, then continued working leftwards, diagonal by diagonal. He missed two decans without noticing, then, mid-table, at a point which indicates some understanding of the structure of the triangle decans (even though these are never marked in any way to distinguish them in the existing sources from ordinary decans), he corrects his error by inserting two full diagonals of *ṯm3t* decans before filling in the triangle. This process would mean that the first appearance of the *ṯm3t* decans is the correct placing, and the second is erroneous.

If instead the first pair of *ṯm3t* decans is incorrect, this could have happened in at least two ways. If the copyist worked from left-to-right, which is reasonable but not the more usual direction, then the two missing ordinary decans would only be noticed when all but the three top-right-hand corner cells of the table were yet to be filled. By placing two instances of *ṯm3t ẖrt* and just one instance of *ṯm3t ḥrt*, the mistake could be covered up. However, it might be that this small area was instead damaged or unreadable in the master copy. The same process of filling in three *ṯm3t* labels might apply, and the table could be completed working right-to-left instead.

Each explanation of the *ṯm3t* error implies that the person who was creating, copying, or repairing the 'ancestral source' of the *ṯm3t* group tables knew the difference between triangle decans and ordinary decans. The mistake was therefore made by an educated, knowledgeable person rather than by a tradesman working quickly to decorate and sell quantities of funerary equipment. It seems unlikely that the error occurred during the invention of the tables as it resembles a scribal rather than an experimental error.

NP	T		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
1	35	*ṯmꜣt ḥrt*	X	X	X	X	X	X	X	X	X			X
2	36	*ṯmꜣt ḫrt*	X	X	X	X	X	X	X	X	X	X		X
3	1	*wšt bkꜣt*	X	X	X	X	X	X	X	X	X	X		-
3a	1a	*wšꜣti*	-	-	-	-	-	-	-	-	-	-		X
3b	1b	*bkꜣti*	-	-	-	-	-	-	-	-	-	-		X
4	2	*ipḏs*	X	X	X	X	X	X	X	X	X	X		X
5	3	*sbšsn*	X	X	X	X	X	X	X	X	X	X		X
6	4	*ḫntt ḥrt*	X	X	X	X	X	X	X	X	X	X	X	X
7	5	*ḫntt ḫrt*	X	X	X	X	X	X	X	X	X	X	X	X
8	6	*ṯms n ḫntt*	X	X	X	X	X	X	X	X	X	X	X	X
9	7	*ḳdty*	X	X	X	X	X	X	X	X	X	X		X
10	8	*"ḫnwy"*	X	X	X	X	X	X	X	X	X	X	X	X
11	9	*ḥry-ib wiꜣ*	X	X	X	X	X	X	X	X	X		X	X
12	10	*"crew"*	X	X	X	X	X	X	X	X	X		X	X
13	11	*knm*	X	X	X	X	X	X	X	X	X		X	X
14	12	*smd srt*	X	X	X	X	X	X	X	X	X		X	X
14a	12a	*smd*	-	-	-	-	-	-	-	-	-		-	X
15	13	*srt*	X	X	X	X	X	X	X	X	X		X	X
16	14	*sꜣwy srt*	X	X	X	X	X	X	X	X	X		X	X
17	15	*ḥry ḫpd srt*	X	X	X	X	X	X	X	X	X			X
18	16	*tpy-ꜥ ꜣḫwy*	X	X	X	X	X	X	X	X	X	X	X	X
20	17	*imy-ḫt ꜣḫwy*	X	X	X	X	X	X	X	X	X	X	X	X
19	18	*ꜣḫwy*	X	X	X	X	X	X	X	X	X	X		X
21	19	*bꜣwy*												
22	20	*ḳd*	X	X	X	X	X	X	X	X	X			X
23	21	*ḫꜣw*	X	X	X	X	X	X	X	X	X		X	X
24	22	*ꜥrt*	X	X	X	X	X	X	X	X	X		X	X
25	23	*ḥry ꜥrt*	X	X	X	X	X	X	X	X	X	X	X	X
26	24	*rmn ḥry*	X	X	X	X	X	X	X	X	X			X
27	25	*rmn ḫry*	L											
28	26	*ꜥbwt*	X	X	X	X	X	X	X	X	X			X
29	27	*ḫrt wꜥrt*	X	X	X	X	X	X	X	X	X			X
30	28	*tpy-ꜥ spd*	X	X	X	X		X	X	X	X			X
31	29	*spd*	X	X	X	X		X	X	X	X			X
32	30	*knmt*	X	X	X	X		X	X	X	X			X
33	31	*sꜣwy knmt*	X	X	X			X	X	X	X			X
34	32	*ḥry ḫpd n knmt*	X	X				X	X	X	X			
35	33	*ḥꜣt ḫꜣw*	X	X				X	X	X	X			
36	34	*pḥwy ḫꜣw*	X	X				X	X	X	X			
1	35	*ṯmꜣt ḥrt*	X	X				X	X	X	X			
2	36	*ṯmꜣt ḫrt*	X	X				X	X	X	X			
A	A	*smd rsy*	X	X				X	X	X	X			
B	B	*smd mḥty*	X	X				X	X	X	X			
C	C	*nṯr ḏꜣ pt*	X	X				X	X	X				
D	D	*rmn ḥry*	X	X				X	X	X				
E	E	*ḫꜣw*	X	X				X	X	X				
F	F	*tpy-ꜥ spd*	X	X				X	X	X				
G	G	*imy-ḫt spd*	X	X				X	X	X				
H	H	*ꜣḫwy*	X					X	X	X				
J	I	*ḫꜣw*	X					X	X	X				
K	J	*nṯr ḏꜣ pt*	X					X	X	X				
M	K	*pḥwy sꜣbw*	X					X	X	X				
L	L	*sꜣbw*						L		L				

Table 5: Decans in class T diagonal star tables. 'X' indicates a decan is present in the star table. 'L' indicates that the decan only occurs in the epagomenal or list columns of the table and '-' that the decan is not expected to occur. Grey shading represents parts of the decan list that are missing owing to loss or damage, rather than to omission.

Although there is no certain resolution of the dilemma of which pair of *ṯmꜣt* decans is correctly placed, the simplest interpretation, which requires the least adjustment or the fewest implied writing errors, is that the pair at the end of the ordinary decans is in the intended location.[29]

The next question about this decan list is the position and identity of the two missing decans. In the analysis above, one suggestion has already been raised: the two missing decans were at the head of the table and were lost when three cells were destroyed. This is unlikely. Comparing this decan list with others, in other star tables and in later astronomical ceilings, no decan list indicates that the order *ṯmꜣt ḥrt*, *ṯmꜣt ẖrt*, *wšꜣti* (or *wšt bkꜣt*) could be interrupted by two unknown decans in the sequence *ṯmꜣt ḥrt*, *ṯmꜣt ẖrt*, unknown decan A, unknown decan B, *wšꜣti*.

The most likely explanation is that two of the decans which appear intrusively in the list columns were the missing ordinary decans. One, discussed above, is *bꜣwy*. We have also already mentioned the other candidate, *rmn ẖry*, in point 7 above. Both these decans are very reasonable suggestions for the missing ordinary decans, with perhaps the caveat that *rmn ẖry* adds to an already over-burdened *sꜣḥ* area of the list.

Order of decans in T

The list **T** of thirty-six ordinary decans can now be reconstructed with *bꜣwy* (19) and *rmn ẖry* (25) proposed as the two missing ordinary decans:

1)	*wšt bkꜣt*	13)	*srt*	25)	*rmn ẖry*
2)	*ipḏs*	14)	*sꜣwy srt*	26)	*ꜣbwt*
3)	*sbššn*	15)	*ẖry ẖpd srt*	27)	*ẖrt wʿrt*
4)	*ẖntt ḥrt*	16)	*tpy-ʿ ꜣẖwy*	28)	*tpy-ʿ spd*
5)	*ẖntt ẖrt*	17)	*imy-ẖt ꜣẖwy*	29)	*spd*
6)	*ṯms n ẖntt*	18)	*ꜣẖwy*	30)	*knmt*
7)	*ḳdty*	19)	*bꜣwy*	31)	*sꜣwy knmt*
8)	"*ẖnwy*"	20)	*ḳd*	32)	*ẖry ẖpd n knmt*
9)	*ḥry-ib wiꜣ*	21)	*ẖꜣw*	33)	*ḥꜣt ẖꜣw*
10)	"*crew*"	22)	*ʿrt*	34)	*pḥwy ẖꜣw*
11)	*k*(*n*)*m*	23)	*ẖry ʿrt*	35)	*ṯmꜣt ḥrt*
12)	*smd srt*	24)	*rmn ḥry*	36)	*ṯmꜣt ẖrt*

[29] Neugebauer and Parker estimated (NEUGEBAUER and PARKER (1960) p. 81) that the **T** class tables were created around 2150-2100 BC by noting that Sirius (assumed to be equivalent to *spd*) appeared in the 12th hour in the last decade of II Peret in T1 to T8. However, they noted (again NEUGEBAUER and PARKER (1960) p. 81) that this estimate was problematic due to the two omitted ordinary decans which may push the real date of 12th hour to the middle decade of III Peret and hence would make the tables eighty years younger. Given that the decan lists could not have been compiled *after* the coffins were painted, this suggests that *spd* is correctly placed and that the two missing decans should instead be inserted at some point before *spd* so that *ṯmꜣt ḥrt* and *ṯmꜣt ẖrt* would indeed be pushed off the beginning of the table (which would then be headed by *wšt bkꜣt*). This supports the discussion above regarding the placing of the *ṯmꜣt* decans. However, the date of Sirius marking the 12th hour of the night might not be the date of heliacal rise, as Neugebauer and Parker assumed. The 'decanal night' may have finished some time before the time when Sirius would first appear. This would mean that heliacal rise might take place one or even two decades before the star marked the 12th hour.

The decan list used in T12, a disordered source, differs primarily in that *wšt bkꜣt* is split into two distinct decans *wšꜣtỉ* and *bkꜣtỉ* (1a and 1b in Table 5) and that *smd srt* became simply *smd* (12a). The reason for the *wšt bkꜣt* split is not clear from this sole source, but the same feature appears in the second class of diagonal star tables, discussed below. T12 could indicate that another class of tables with a decan list similar but not identical to **T** existed. If more sources appear, the formation of a sub-class **Ta** might be supportable, but at present there is insufficient data: the differences in T12 could be unique to that table.

Order of decans in K

No table complete up to the list columns is present in our second group of sources: those which appear to have *knmt* decans at the head of their lists. Several sources have unusual numbers of rows, some are jumbled, others are fragmentary. A single ancestor like that of the **T** tables is not as apparent. Generally, the eight **K** sources display the same major features in their decan lists and seem to have been designed from a similar source. The Orion area, where the evidence from extant sources begins to fall away, holds the greatest uncertainty. A possible reconstruction of **K** is:

1) *tpy-ꜥ knmt*
2) *knmt*
3) *ẖry ẖpd n knmt*
4) *ḥꜣt ḏꜣt*
5) *pḥwy ḏꜣt*
6) *ṯmꜣt ḥrt*
7) *ṯmꜣt ẖrt*
8) *wšꜣtỉ*
9) *bkꜣtỉ*
10) *sšpt*
11) *tpy-ꜥ ẖntt*
12) *ẖntt ḥrt*
13) *ẖntt ẖrt*
14) *ṯms n ẖntt*
15) *spty ẖnwy*
16) *ḥry-ib wiꜣ*
17) *sšmw* or *šsmw*
18) *knm*
19) *tpy-ꜥ smd*
20) *smd*
21) *srt*
22) *sꜣwy srt*
23) *ẖry ẖpd srt*
24) *tpy-ꜥ ꜣẖwy*
25) *ꜣẖwy*
26) *bꜣwy*
27) *ẖntw ḥrw*
28) *ẖntw ẖrw*
29) *ḳd*
30) *sꜣwy ḳd*
31) *ẖꜣw*
32) *ꜥrt*
33) *rmn ḥry sꜣḥ*
34) *rmn ẖry sꜣḥ*
35) *rmn sꜣḥ*
36) *spd*

K0 and K1 retain certain distinct features, and it is possible that (again, with the support of new sources) they could form a sub-class **Ka**. **Ka** would include *spty* (15a in Table 6) and *ẖnwy* (15b) as separate decans. More speculatively, *sšpt* may be missing from the ordinary decans whereas *ỉmy-ẖt ꜣẖwy* might be present as an ordinary decan.

NP	K		K0	K1	K2	K3	K4	K5	K6	K7
31a	1	*tpy-ʿ knmt*		X	X	X			X	[X]
32	2	*knmt*		X	X	X		X	X	X
34	3	*ḥry ḫpd n knmt*		X	X	X	X	X	X	X
35a	4	*ḥ3t ḏ3t*		X	X	X	X	X	X	
36a	5	*pḥwy ḏ3t*		X	X	X	X	X	X	
1	6	*ṯm3t ḥrt*		X	X	X	X	X	X	
2	7	*ṯm3t ḫrt*		X	X	X	X	X	X	
3a	8	*wš3ti*		X	X	X	X	X	X	
3b	9	*bk3ti*		X	X	X	X	X	X	
4a	10/C?	*sšpt*			X		X	X	X	
5a	11	*tpy-ʿ ḫntt*		X	X	X	X	X	X	
6	12	*ḫntt ḥrt*		X	X	X	X	X	X	
7	13	*ḫntt ḫrt*		X	X	X	X	X	X	
8	14	*ṯms n ḫntt*		X	X	X	X	X		
9a	15a	*spty*	X	X	-	-	-	-		
9b	15	*spty ḫnwy*	-	-	X	X	X	X		
10a	15b	*ḫnwy*	X	X	-	-	-	-		
11	16	*ḥry-ib wi3*	X	X	X	X	X	X		
12a	17	*sšmw*	X	X	X	X	X	X		
13	18	*knm*	X	X	X	X	X	X		
13a	19	*tpy-ʿ smd*	X		X	X	X	X		
14a	20	*smd*	X	X	X	X	X	X		
15	21	*srt*	X	X	X	X	X	X		
16	22	*s3wy srt*		X	X	X	X			
17	23	*ḥry ḫpd srt*		X	X	X	X			
18	24	*tpy-ʿ 3ḫwy*		X	[X]	X	X			
19	25	*3ḫwy*		X	X		X			
21	26	*b3wy*		X	X	X	X			
21a	27	*ḫntw ḥrw*		X	X	X	X			
21b	28	*ḫntw ḫrw*		[X]	X	X	?			
22	29	*ḳd*		X	X	X	X			
22a	30	*s3wy ḳd*		X		X	X			
23	31	*ḫ3w*			X		X			
24	32	*ʿrt*			X					
26a	33	*rmn ḥry s3ḥ*			X					
27a	34	*rmn ḫry s3ḥ*			X					
27b	35	*rmn s3ḥ*			X					
31	36	*spd*			X					
31b	A?	*štwy*			X					
4	B?	*ipḏs*			X					
4a	10/C?	*sšpt*			X		X	X	X	
5	D?	*sbšsn*			X					
20	E?	*imy-ḫt 3ḫwy*		X						

Table 6: Decans in class K diagonal star tables. 'X' indicates a decan is present in the star table. '[X]' or '?' indicates a damaged or possible reading and '-' that the decan is not expected to occur. Grey shading represents parts of the decan list that are missing owing to loss or damage, rather than to omission.

Table 7: Decan lists from New Kingdom astronomical diagrams. Triangle decans (lower section of the table) are always separated graphically from 'ordinary' decans in astronomical diagrams. Full details of all of these diagrams can be found in Neugebauer and Parker (1969).

Senenmut's tomb KV[30] tombs: Ramesses VI, Ramesses VII (N)[31], Ramesses IX (N)	Karnak water-clock Mortuary temples: Ramesseum, Medinet Habu	Abydos temples: Seti I, Ramesses II KV tombs: Seti I, Tausert, Ramesses VI, Ramesses VII (S), Ramesses IX (S)
tpy-ꜥ knmt	*tpy-ꜥ knmt*	*tpy-ꜥ knmt*
knmt	*knmt*	*knmt*
ẖry ḫpd knmt	*ẖry ḫpd knmt*	*ẖry ḫpd knmt*
ḥꜣt ḏꜣt	*ḥꜣt ḏꜣt*	*ḥꜣt ḏꜣt*
pḥwy ḏꜣt	*pḥwy ḏꜣt*	*pḥwy ḏꜣt*
ṯmꜣt ḥrt	*ṯmꜣt ḥrt*	*tmꜣt ḥrt*
ṯmꜣt ẖrt	*ṯmꜣt ẖrt*	*tmꜣt ẖrt*
wšꜣtỉ	*wšꜣtỉ*	*wšꜣty bkꜣty*
bkꜣtỉ	*bkꜣtỉ*	*sbꜣw mḥw*
tpy-ꜥ ḫntt	*tpy-ꜥ ḫntt*	*tpy-ꜥ ḫntt*
ḫntt ḥrt	*ḫntt ḥrt*	*ḫntt ḥrt*
ḫntt ẖrt	*ḫntt ẖrt*	*ḫntt ẖrt*
ṯms n ḫntt	*ṯms n ḫntt*	*ṯms n ḫntt*
sꜣptỉ ḫnwy	*sꜣptỉ ḫnwy*	*sꜣptỉ ḫnwy*
ḥry-ỉb wỉꜣ	*ḥry-ỉb wỉꜣ*	*ḥry-ỉb wỉꜣ*
sšmw	*sšmw*	*šsmw*
knmw	*knmw*	*knmw*
tpy-ꜥ smd	*tpy-ꜥ smd*	*tpy-ꜥ smd*
smd	*smd*	*smd*
sỉt	*sỉt*	*srt*
sꜣwy sỉt	*sꜣwy sỉt*	*sꜣwy srt*
ẖry ḫpd srt	*ẖry ḫpd srt*	*ẖry ḫpd srt*
tpy-ꜥ ꜣḫ(*wy*)	*tpy-ꜥ ꜣḫ*(*wy*)	*tpy-ꜥ ꜣḫwy*
ꜣḫwy[32]	*ꜣḫwy*	*ꜣḫwy*
bꜣwy	*bꜣwy*	*bꜣwy*
ḫntw ḥr(*w*)/*ḥrt*	*ḫntw ḥr*(*w*)	*ḫnt*(*w*) *ḥrw* *ḥry-ỉb ḫnt*(*w*)
(*ḫntw*) *ẖrw*/*ẖrt*	(*ḫntw*) *ẖrw*	*ḫnt*(*w*) *ẖrw*
ḳd	*ḳd*	*ḳd*
sꜣwy ḳd	*sꜣwy ḳd*	*sꜣwy ḳd*
ḫꜣw	*ḫꜣw*	*ḫꜣw*
ꜥrt	*ꜥrt*	*ꜥrt*
ḥry rmn sꜣḥ	*ḥry rmn sꜣḥ*	*ỉwn sꜣḥ*[33] *rmn ḥry sꜣḥ*
ẖry rmn sꜣḥ	*ẖry rmn sꜣḥ*	*msḏr sꜣḥ*[33] *rmn ẖry sꜣḥ*
sꜣḥ	*rmn sꜣḥ*	*ꜥ sꜣḥ*[33] *sꜣḥ*
spdt	*spdt*	*spdt*
štwy	*štwy*	*štwy* *sỉꜣtw*
nsrw	*nsrw*	*nsrw*
šspt	*šspt*	*šspt*
ỉpds	*ỉpds*	*nhs*
sbšsn	*sbšsn*	*sbšsn*
nṯr wꜣš	*nṯr wꜣš*	*nṯr wꜣš*

[30] Valley of the Kings.

[31] (N) and (S) indicate the north and south parts of paired astronomical diagrams.

[32] Missing in the KV tombs.

[33] Possibly triangle decans.

Astronomical diagrams and diagonal star tables

Neugebauer and Parker chose to include astronomical diagrams in their discussion of decan lists, in particular the list in the ceiling of Senenmut. There are several links between star tables and astronomical diagrams over and above the obvious celestial theme. Astronomical diagrams survive from later periods in history but there is some evidence that they evolved from representations on coffin lids.[34] Most astronomical diagrams are found in funerary contexts, in functionally identical locations to star tables: undersides of lids and ceilings. Most astronomical diagrams also contain decan lists which start with *tpy-ʿ knmt*, the same decan which leads the second group of star tables.

The decan lists in typical astronomical diagrams[35] display less variation than those in the two groups of star tables. Table 7 shows decan lists taken from astronomical diagrams in the New Kingdom. The astronomical diagrams add a further element to the list which does not appear clearly in any of the surviving second group sources: the triangle. The triangle is never complete, but we can gather that each astronomical diagram contained a fairly consistent set of triangle decans with a maximum of seven members.[36] We must also note that one family of decan lists consistently contains thirty-nine decans. Three of these could possibly be triangle decans. No decan list in a surviving New Kingdom astronomical diagram contains exactly thirty-six ordinary decans.

The extent to which we can rely on the later astronomical diagrams to help us construct a decan list for the second class of diagonal star tables is debatable. Since *Egyptian Astronomical Texts*, what Neugebauer and Parker saw as a clear link between the Senenmut list and their Group IV and V star tables has been clouded and the issue must be revisited.

In astronomical diagrams, *sšpt* is a well-attested triangle decan. It is never one of the ordinary decans. Among Neugebauer and Parker's thirteen diagonal star clock sources, *sšpt* appeared solely in the disorderly K2. Considering the astronomical diagrams as guides, Neugebauer and Parker plausibly labelled *sšpt* as an out-of-place triangle decan. However, *sšpt* has since appeared as an ordinary decan in three of the new sources (K4 and K5, which are orderly tables, and K6 which is only a fragment). The weight of evidence now places *sšpt* as an ordinary decan.

Neugebauer and Parker focussed on the similarities between astronomical diagram decan lists and diagonal star clock decan lists. With *sšpt* now forcing a divide between the two areas, it is worth noting that decan lists set in an astronomical diagram display

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[34] Such as the coffin of Heny (?IXth dynasty) described in NEUGEBAUER and PARKER (1969) p. 8-10.

[35] 'Typical' astronomical diagrams include the decans, the planets, and the circumpolar group. Other representations with astronomical content include ceilings based on funerary texts such as the *Book of Nut* and the *Book of the Night*.

[36] The list of seven occurs in KV9 (Ramesses VI), see NEUGEBAUER and PARKER (1969) pp. 30-31.

other characteristics which differentiate them from star table lists. These include their format (a list instead of a table), the association of names of 'deities of the decans' who never appear in diagonal star tables, the addition of humanoid figures representing these deities, other figures representing constellations, and numbers of 'stars', circles or star-symbols, relating to each decan name.

While it is still possible to say that astronomical diagram decan lists resemble **K** more than **T**, and that astronomical diagrams still are the best evidence for the composition of the **K** triangle, the association must now be considered a secondary one.

The T and K class system

The sources have been divided into two traditions or classes, **T** and **K**, each of which retains a degree of flexibility, rather than stringently discriminating between sources which display slight dissimilarities. The lists **T** and **K** are not definitive, but are based on evidence derived from the diagonal star tables, but also drawing a little on astronomical diagrams. During its development,[37] the system has successfully incorporated the sources published recently.

The schematic diagrams of all twenty diagonal star tables which contain decans presented here in Tables 9 to 28, with the decans numbered in the **T** and **K** system as described in Tables 5 and 6. Using the **T** and **K** system compares favourably with Neugebauer and Parker's decan numbering system, especially in the **K** class tables, where clarity and recognition of patterns is improved by the new system.

The **T** and **K** class system reflects family trends present in the creation of the sources under scrutiny rather than following a traditional 'ancestral tree' approach and, it is hoped, will be successful in incorporating further sources.

Significance of the triangle

The triangle presents a major challenge in diagonal star table research. The ordinary decans represent an 'ideal state' and hint at the perfection of a group of thirty-six stars which should be sufficient for star table purposes. The inclusion of the triangle decans marks the impact of the real world – the physical model we now understand as the relationship between our planet, our sun, and the star sky – on the theoretical concept of the star table. If the tables were merely representations of a pattern or an ideal, the triangle would not be necessary and would certainly not have been invented. However, the triangle does exist, and there are only two ways of explaining why it is there: either because its existence was derived from an understanding of star motion and year length (that is, a theoretical model which allowed someone to calculate that 'star 1' would definitely not suffice after 'star 36'; an unusual idea in the context of ancient Egyptian thought in general but not impossible), or, more simply, because the table was based on observation of the real stars. For these reasons, the present author views the creation of

[37] The system was developed (SYMONS (1999) Section A) based on Neugebauer and Parker's twelve coffins plus the Osireion, with subsequent publications being incorporated without changing the structure behind the system.

the triangle as one of the most important and suggestive astronomical activities in ancient Egypt.

The triangle is a direct result of just two factors: that the tables were based on ten-day periods, and that it takes a star 23 hours, 56 minutes, and about 4 seconds to perform one complete (apparent) revolution. This period is called ‘a sidereal day’ and is a fundamental astronomical concept. We can model decanal stars by imagining ideal observing conditions and stars being available exactly where we want them, but making no further assumptions about the way the tables were developed and used, to demonstrate the relationship between the 365-day civil year and the triangle.

We imagine making an observation of a certain star labelled ‘star 1’ (we can imagine a star on the celestial equator, but another location makes no difference to the outcome) at a certain place in the sky (say a point relative to a mountain peak when viewed from a particular location) at a known time of day on, say, the first day of the year (I Akhet 1). From this notional fixed point in time and space, we continue to make similar observations at the ten-intervals specified by the diagonal star tables. The next observation, on I Akhet 11, will show that a new star (‘star 2’) will be in our chosen location at the same time of day. To quantify the distance between the two stars ‘1’ and ‘2’, we deduce that a star moves at a certain speed, taking 23 hours, 56 minutes, and about 4 seconds to move the full 360° of a circle to return to our chosen observation point. Over the course of ten days, we calculate that the angular distance between the two stars will be about 9.9 degrees.[38] As we progress through the year, further stars will be found at ten-day intervals, but the angular distance between two consecutive stars will always be 9.9 degrees. When the 36th star is seen it will be IV Shemu 21, 350 days after our observations started, and 345.0 degrees total angular difference from ‘star 1’. Ten days later, which in the Egyptian civil year would be the first epagomenal day, the total angular difference would be 354.8 degrees (that is, well after ‘star 36’ but somewhat before ‘star 1’). The imagined star at this position, ‘star A’ is analogous to the first triangle decan which we see in the existing diagonal star tables. Five days after that, on I Akhet 1, the total angular difference would be 359.8 degrees, just a quarter of a degree away from ‘star 1’. ‘Star 1’ is a good enough fit to use and so the table would work for the next year adequately. This model matches the top row of an Egyptian diagonal star table. The second row would follow a similar pattern, but would of course add another triangle decan ‘star B’ on the first epagomenal day. The ideal location of ‘star B’ would be at a total angular difference of 364.7 degrees (= 4.7 degrees past ‘star 1’, that is, between ‘star 1’ and ‘star 2’). The other ‘triangle’ decans follow similarly.

The quarter of a degree difference between the ‘ideal’ star for the new I Akhet 1 and the old ‘star 1’ reflects the fact that 365 days is only an approximation to the length of

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[38] Angular movement is 360/(23^h 56^m 4.09^s) = 0.25 degrees per minute. Slippage per day (sidereal time versus solar time) is 24^h - 23^h 56^m 4.09^s = 3^m 55.9^s per day = 39^m 19.1^s over ten days. 39^m 19.1^s travelling at 0.25 degrees per minute results in an angular separation of 9.856 degrees.

the solar year. It would take several years before tables based on a functionally similar model became observationally inaccurate.

Despite the existence of the triangle and the triangle decans in the earliest diagonal star tables, it is however clear that the ‘ideal’ of thirty-six decans, the ordinary decans, had already become entrenched. Although the triangle was never divided graphically in the main body of the table, a label in the final column of T1, at the end of the list of decans, reads “*the total of those who are in their places … the gods of the sky* [decans]*: 36*”.[39] The concept of the distinct ‘thirty-six decans’ lasted until the Greco-Roman Period.

The epagomenal column

On page one of *Egyptian Astronomical Texts Volume 1* (which throughout treated the tables as corrupt copies of a functioning ancestor) it is conjectured that originally the diagonal star clock had thirty-seven useful columns. The thirty-seventh column represented (or was used in) the five epagomenal days at the end of the Egyptian civil year. At some point, the other list columns were added, giving this area of the table conjecturally the dual function of listing all the decans used and also being serviceable during the epagomenal days.

Evidence for the epagomenal days’ explicit presence in the tables is contained in two of Neugebauer and Parker’s thirteen sources, Coffins 7 and 8, here designated T7 and T8, in the form of a short text or label placed in the date row above the list columns.

T8 has the label showing clearly in the cells above the first two list columns: *rnpt 5 ḥrw* ‘five (days) upon the year’ followed at a short distance by the festival determinative sign . The number ‘five’ is written cursively. The label in T7 in the plates of Neugebauer and Parker (1960) is not so clear. Neugebauer and Parker, following de Buck,[40] stated that this lid had been lost. This is not correct: the lid is on display (as viewed in November 2004) in the Museum of Ancient Egypt in Turin. Traces of the label, written in red on a richly-coloured wood, are now barely visible. However, photographic records[41] (perhaps taken using coloured filters to bring out the contrast) show that the label, in this case broken up by the large star motifs interspersed between the columns of text across the table, was of a similar format to that of T8.

However, the epagomenal label is not necessary to prove that these tables were based on a 365-day year. Using our model described above, we can test what would happen if the civil year had, for example, only 360 days. Everything would be the same up to and including the observation on IV Shemu 21. Ten days later, the ‘360-day-year’ would begin again, but ‘star 1’ would be impossible to use, being about five degrees away from where it was needed. We would still therefore need to designate a new star

[39] Lacau (1906) pp. 101-128 and pl. 9, reproduced in Clagett (1995) fig. III.86.

[40] Neugebauer and Parker (1960) p. 12.

[41] Oriental Institute photograph P.26759/N.13354.

‘A’, but this time it would need to replace ‘star 1’ at the head of the table. Ten days later, the total angular difference would be 364.7 degrees, and again, a new star ‘B’ (as before half way been ‘star 1’ and ‘star 2’) would be needed. This would continue across the whole table. In other words, the usable lifetime of a table created under these conditions would be only one year. Any ability to ‘predict’ star motions or ‘record’ a continuous state would be lost. The tables would probably not have existed in their present form at all. The 365-day Egyptian civil year is implicit in the tables and is responsible for their format and content.

These findings are true whether or not the epagomenal column was ever a functioning part of the table. The labels lend support to the theory that the area was functionally associated with the epagomenae, but do not settle the question unequivocally. For example, both the remaining labels span more than one list column and are therefore not solely associated with the triangle decans which the hypothetical thirty-seventh column would contain. Neugebauer and Parker theorised[42] that the other three list columns (those containing the list of thirty-six ordinary decans) represent an expansion of the thirty-seventh column. No astronomical or calendrical theories have been put forward concerning the extra list columns. Space considerations in many tables mean that the list columns are often not present at all, and when they are, they are squashed into fewer than four columns. The motive for expansion therefore was surely not artistic.

An important requirement of Neugebauer and Parker’s thirty-seven-column theory is that the column requires one more decan. A twelfth triangle decan must be postulated in order for the epagomenal column to record or model the sky in those five days in the same format as the rest of the table. The extra decan would occur only in the final cell of the epagomenal column. Demonstrating the existence of this decan, and therefore the validity of the epagomenal column as part of the main, functional body of the table (rather than as a non-functional member of the list columns) presents a problem which Neugebauer and Parker did not address.

The composition of the triangle in T and K

The triangle for the **K** family of tables is largely unknown, with no **K** tables containing any list columns nor indeed a single complete set of thirty-six ordinary columns. A fragmentary and questionable list of triangle decans can be reconstructed from the body of the tables and misplaced decans, with the possible aid of later astronomical diagrams: *štwy, sšpt, ipḏs, sbšsn,* and *imy-ḫt ꜣḫwy*. However, we have four sets of list columns from the **T** family (shown in Table 8), as well as some partial triangle areas, which provide a sufficient basis to discuss the epagomenal columns of *ṯmꜣt*-type tables.

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42 NEUGEBAUER and PARKER (1960) p. 1.

T1	T6	T7	T8
35	35	35	23
36	36	1	1
1	1	2	2
2	2	3	3
3	3	4	4
4	5	5	5
5	5	6	23
6	6	7	24
7	7	8	8
8	8	9	9
9	9	10	10
10	10	13	11
11	11	14	12
12	12	16	26
13	13	17	14
14	14	18	16
15	15	20	17
16	16	23	18
18	17	24	20
17	20	26	C
18	22	27	D
20	23	28	26
21	24	30	27
22	26	31	28
23	27	32	30
24	28	33	27
25	30	34	32
26	31	35	33
27	32	A	34
28	33	C	35
29	34	D	A
30	35	J	F
31	29	K	A
32	A		J
33	B		L
34	C		K
35	D		K
2	E		
A	F		
B	L		
C	J		
D	K		
E			
F			
G			
J			
I			
K			

Table 8: Contents of the list and epagomenal columns of T class tables, the only tables to preserve these columns. The T class decan numbering system from Table 5 is used.

The (reasonably secure) triangle for **T**, derived from the main body of **T** tables, is *smd rsy, smd mḥty, nṯr ḏꜣ pt, rmn ḥry, ẖꜣw, tpy-ꜥ spd, ỉmy-ẖt spd, ꜣẖwy, ẖꜣw* (a second spelling indicating a different decan), *nṯr ḏꜣ pt* (again), and *pḥwy sꜣbw*.

Neugebauer and Parker listed twelve triangle decans belonging to the *ṯmꜣt*-type decan lists, but their analysis of the final triangle decans is unconvincing as they had to postulate that the extra decan (which of course only occurs in the list columns) was always written out of order. In the main body, the eleventh triangle decan is *pḥwy sꜣbw*, yet Neugebauer and Parker labelled this the *twelfth* triangle decan and placed an otherwise unknown and difficult to read *sꜣbw* as eleventh decan. *Sꜣbw* is only attested in coffins T6 and T8.

The writing of the extra decan *sꜣbw* in T6 shows it in the final position in the table, following *pḥwy sꜣbw*, whereas in T8, it is a tiny, intrusive label, written differently from all other decans in the table. This list finishes with *pḥwy sꜣbw* written twice.

Neugebauer and Parker explained the habitual appearance of *pḥwy sꜣbw* in eleventh place in four tables and T7's list column as a mistake, and preferred to interpret *sꜣbw* as the eleventh triangle decan, with the rather slim support of T8. Whether they insisted on transposing the order because the word *pḥwy* 'hindquarters' suggests it was not stated, but this must surely have been the reason. The evidence for a functioning epagomenal column is therefore far less conclusive than Neugebauer and Parker suggested.

Astronomically, the decans within the triangle should be in the area of the first eleven decans in the ordinary list. This is true for any theory of star tables, whether as clocks or almanacs, whether based on rising stars or other astronomical phenomena. However, the triangle decans in the *ṯmꜣt*-type tables certainly do not. They include *ꜣẖwy*, *ẖꜣw*, and decans around *spd*. In other words, the **T** triangle seems to relate roughly to the third quarter of **T**, rather than the expected first third.

By the time the decans were used in astronomical ceilings (the New Kingdom onwards), we have seen that lists similar to **K** had become standard, and that a fragmentary triangle was usually present. This list contained up to seven triangle decans: *štwy, siꜣtw, nsrw, sšpt, nhs* or *ipds, sbšsn,* and *nṯr wꜣš*. These decans are from the correct region, the first third, of the ordinary list.[43]

This implies that the astronomical diagram lists are closer to functioning decan lists. If the relationship between astronomical diagrams and **K** is considered to be valid, even if not strong, the **K** tables are, surprisingly, closer to functioning star tables than **T** tables.

Neugebauer and Parker saw the **T** tables as earlier than the **K** tables. Being 'earlier' is usually synonymous with being more genuine or 'uncontaminated' than later examples. Neugebauer and Parker reinforced their theory of the time-dependence of

[43] The locations of decans such as *ipḏs* and *sbšsn* in relation to certain ordinary decans are known via the **T** group of tables and the decan list in the *Book of Nut*.

the decan lists by calculating[44] when the **T** triangle may have been constructed: 2780 BC (the early dynastic period). The confused state of the triangle in the surviving sources make even estimates of the date of the development very difficult to argue, even though the theory of an older triangle is credible.

However, the existence of the triangle, the epagomenal label, and the tentative existence of a twelfth triangle decan makes it likely that Neugebauer and Parker were right to conclude that the epagomenal period was, at some point, fully accounted for in the diagonal star tables. This point alone raises these tables above the schematic, and places them as a high achievement in early astronomical activity.

If we review the place of diagonal star tables in the context of Egyptian astronomical activity we find that not only are they the only star tables to exhibit revisions, they are also the only ones to attempt to incorporate the entire length of the Egyptian civil year.

It has previously been argued[45] that the so-called ‘transit star clock’ is not a development of the diagonal star table, as Neugebauer and Parker claimed, but is instead its precursor. The ‘transit star clock’ text could describe an almanac of the events in the year of a decanal star and was formed with the intention of recording the movements of stars which had periods of invisibility of seventy days, similar to the ‘ideal’ decan Sirius and argued that seventy-day invisibility, with its funerary connections, provided a strong motive for the observations on which such a list must be based. Perhaps this motivation could also help explain the need for the greater detail displayed in the diagonal star table. If seventy days is an important factor, the ‘transit’ list would be inaccurate during the period when invisibility fell over the ignored epagomenal days. Following from the reasoning that the seventy-day period was the most important element, it can now be conjectured that this may be why the triangle was so carefully calculated or observed at some point in the history of the diagonal star table prior to the copying of the examples which still survive. Its subsequent descent into confusion is understandable both due to the complexity or imbalance of the area to the symmetrical Egyptian mind and the impact of uncomprehending copyists.

Hours and the Osireion star table

A schematic diagram of the surviving part of the Osireion star table is shown in Table 21. The third column is headed by a month name ‘I Peret’ and the label ‘Hour Name’. In the six cells below, the names of the first six night ‘hours’ are listed.

Neugebauer and Parker showed[46] that this table is of the same nature as the diagonal star tables, but arranged differently. The fragment which survives contains eight decans.

The standard name for the tables, ‘diagonal star clocks’, indicates that the process of

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[44] NEUGEBAUER and PARKER (1960) Chapter 3, section D.

[45] SYMONS (2002a).

[46] NEUGEBAUER and PARKER (1960) p. 32.

rising is thought to be strongly linked with time: the first star in the column performs its activity in (or at the beginning or end of) the first hour of the night, the second star in the second hour, and so on. However, a column of labels for the rows of the table is *not* present in the coffin-lid star tables. Row labels, analogous to the date row which labels the columns and allows us to associate these tables with the Egyptian year, would help enormously to identify the intended purpose of the tables.

Neugebauer and Parker's interpretation of the tables as 'clocks' was embedded throughout *Egyptian Astronomical Texts Volume 1*[47] where the word 'hour' was used on page one without discussion. Recently, researchers[48] have been questioning the assumption that these tables' primary use is timekeeping, and even whether the rows are related to hours at all. Perhaps the most obvious link to hours is that most tables contain twelve rows, however some tables have eight (K1 and K5), ten (T11), or even thirteen (K6) rows.

The Osireion star table represents a very important piece of evidence in this discussion, providing the only explicit link between diagonal star tables and time periods. In addition to the month name, the third cell in the first row of the surviving portion also contains the text *rn n wnwt* 'name of hour'. In the rest of that column, there are some labels which apparently give names to certain hours of the night, using the word *sp* 'period' in most cases and numbers two, three, and four in some of the cells: enough to show that time periods following sequentially from top to bottom are related to each of the 'rows' in the diagonal star table.

The Osireion star table tells us two things. First, that the structure of the table was known in the New Kingdom, emphasising the existence of source documents over and above the coffins which we know about. Second, that the understanding of the table in the New Kingdom was that it was related to periods of the night.

The Osireion table could provide the missing row labels for our First Intermediate Period coffin-based star tables if we are able to discount the possibility that the 'hours' relationship is a New Kingdom (or at least post coffin lid) development, perhaps borne out of a better understanding of the table after centuries of progress.

The fragmentary decan list in the Osireion table indicates that is closely related to some of the coffin-based diagonal star tables, but is separated by centuries from them in its execution. If a functioning, hour-based clock (with hours indicated in a column), was a New Kingdom development, it makes no sense for the old decans to be used. The date relationship would be, as we shall see, many decades wrong. Whoever added the hour names to this type of document did so on the understanding that hours were what the rows represented, and perhaps had always represented. It is therefore difficult to divorce this one column from the earlier tables, given the close relationship of the other

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[47] NEUGEBAUER and PARKER (1960) p. 1.

[48] LEITZ (1995), DEPUYDT (1998). In contrast, CLAGETT (1995) does not question the interpretation of Neugebauer and Parker.

three columns. Any theory which states that the rows or 'vertical axis' in the diagonal star tables does *not* represent time over the course of the night would also have to explain why this representation certainly *does* make that relationship. So far, such a theory has not been advanced.

Accepting that the rows of a diagonal star table are related to the hours of the night does not necessarily mean that the tables are clocks. Despite the New Kingdom use of the word 'hour' in connection with these tables, it is not the present author's current understanding that they should be considered 'clocks' in the sense of objects being designed and used primarily to tell the time.

Rising or Setting

Neugebauer and Parker also assumed from the first page of *Egyptian Astronomical Texts Volume 1* that diagonal star tables were based on stars rising above the eastern horizon during the hours of darkness. They later stated that only by considering rising, could the date of the rising of Sirius within the tables be correlated with the historical dates of the painted star tables.[49] This assumption has recently been challenged by Leitz[50] who considered the *setting* of the stars to be the defining astronomical event of the tables.

Leitz based his setting theory on the position of Sirius in *ṯmꜣt* group tables. If settings are recorded, Sirius would set for the last time seventy days before I Akhet 1. Taking Sirius' period of invisibility to be seventy days,[51] Sirius would rise heliacally on I Akhet 1. The diagonal star table would therefore record an 'ideal' sky in an 'ideal' year. Although this is conceptually in keeping with Egyptian funerary texts, there are some problems with Leitz's argument.

First, Sirius is only positioned in this way in *ṯmꜣt* group sources. Leitz argued that one cannot know for certain that the columns in *knmt* group tables refer to the same decades as those in the *ṯmꜣt* group tables. However, this point has now been settled by the publication[52] of a fragment of an ordered *knmt* group table complete with date row showing that the first column is indeed headed by I Akhet First Decade.

Second, all *ṯmꜣt* group sources are missing two decans which Leitz agreed should be *before* Sirius, moving Sirius down the table and away from the I Akhet 1 position. Neugebauer and Parker considered[53] the possibility that Sirius was correctly positioned and that other decans should be moved to keep Sirius as the decan of the 12th hour in II Peret Final Decade. However, they suggested this amendment specifically to match the heliacal *rising* of Sirius with the historical date of the coffin lids – the opposite of what

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[49] NEUGEBAUER and PARKER (1960) p. 101.

[50] LEITZ (1995).

[51] As recorded in the Dramatic Text from the *Book of Nut*.

[52] SYMONS (2002b).

[53] See footnote 29.

Leitz intended – so the two theories are not mutually supportive even if they require the same method of emendation of the tables.

The question of whether the tables were created based on settings or risings raises other points. As Leitz noted, setting horizons are different from rising horizons. That is, stars which rise together (forming a line on our celestial sphere) do not set together. The line of setting stars drawn on the celestial sphere is at a considerable angle to that of co-rising stars in the same region of the sky. The question of where to look for decans (on the east or west horizon) has a large impact on possible identifications of decans.

Leitz looked for setting decans and produced a scheme of decanal identifications. As always, these identifications rely heavily on the assumptions made concerning how the diagonal star tables were produced. The more assumptions that are made, the weaker the validity of any proposed identifications becomes. Yet raising new possibilities often sheds clearer light on old hypotheses as well.

Considering Leitz's setting theory, the difference between rising lines and setting lines in the Orion-Sirius region is striking. In **T**, there are seven Orion- or *s3ḥ*-related decans (including *rmn ḥry*) between *ẖ3w* and *spd*. In **K**, there are only four, with one being a possible triangle decan. In discussing problems with decan lists, previous researchers have theorised that human observational factors (such as tradition, eyesight, and personal preference) combined with practical observational factors (such as calibration methods and differences in location) could account for differences between decan lists such as splitting and combining decans. This type of explanation makes sense for the earlier parts of the decan lists **T** and **K** which agree to within a one-decan shift down to *ẖ3w*, but cannot account for the severe discrepancy in the *ẖ3w* to *spd* region.

Given that *ẖ3w* and *spd* are each fixed objects (or in *ẖ3w*'s case, perhaps a fixed group of objects: the name *ẖ3w* means 'thousands' and could refer to an open cluster of stars like the Pleiades or Hyades), only a drastic explanation would solve the problem. Investigating rising and setting lines on a star map, one such theory presents itself: one decan list could have been based on rising stars, the other on setting stars. The lines of simultaneous settings cross the Orion region, as they do the rest of the sky, at a different angle from those of simultaneous risings. Fewer setting decans would be needed to span the region than rising decans.

This new theory of a pair of rising and setting lists, challenges another of Neugebauer and Parker's, and indeed all other researchers', assumptions. It has always been accepted that the two groups of diagonal star tables were a) objects of the same fundamental nature and b) separated by time with the *knmt* group being somewhat later than the *ṯm3t* group. The time separation is supposed to account for both the different starting decans and also the compositional differences between the **T** and **K** decan lists.

The paired rising and setting theory is unlikely, despite being attractive in the light of the Egyptian fondness for duality, due to the impact on the date of origin of the *knmt* group tables. Since its historical appearance sets a limit to the date of a decan list, **K** would have to be dated three hundred years *before* **T**. While it could be argued that greater antiquity could be responsible for the disorder of some *knmt* group tables, and that later monuments returned to the earlier and therefore more 'authentic' list (instead of continuing with the 'newer' list **T**), a theory of both rising and setting star tables is still a proposal that is as impossible to prove conclusively as a theory of solely setting diagonal star tables, or indeed, of solely rising tables. Only the discovery of further examples of diagonal star tables can elucidate the Orion area, perhaps refining the number of decans and their disposition in the complete decan lists. However, the identification of a factor other than time as the basis of the two different classes is an important possibility which we will now discuss.

Revisions of the Diagonal Star Table

Neugebauer and Parker analysed both the date of the star tables[54] and the revisions which would have been necessary to keep the tables 'up to date', to counter the discrepancy between the solar year and the Egyptian civil year.[55] Their system was based on the fact that if the diagonal star tables record real astronomical events and could be used to generate 'time' during the night (the tables 'tell the time' not 'record the situation') the main body of the tables would be out of date in just forty years. If the epagomenal column was also to be kept up-to-date, the period between revisions would have to be as short as twenty years. So far, we have seen that star tables come in two broad 'families', strong evidence that at least one variant was produced. We have also noted that some star tables contain decan lists which are slight modifications of one of the major lists, perhaps suggesting some sort of interim adjustment. However, we have also seen that modification of the observing method could be responsible for major changes to the decan lists. Is it possible to distinguish between changes caused by revision over time and those brought about by other factors such as change in observing conditions?

If we assume that revisions were based solely on the passage of time, the effect on the diagonal star table can be predicted accurately. This allows us to compare the existing sources with the theoretical revisions.

To summarise Neugebauer and Parker's 'revision over time' theory, a revision which took place in twenty years after the date of the initial table would mean replacing each decan in the table (thirty-six ordinary decans numbered 1 to 36 and twelve triangle decans A to L) with a decan which had performed the defining action[56] five days *earlier* in the original table. The list of ordinary decans 1-36 would be replaced by twelve former triangle decans A to L plus new decans xii to xxxv. The triangle decans would be replaced by one new decan xxxvi plus original decans 1 to 11. The order of rising of

[54] NEUGEBAUER and PARKER (1960) p. 31.

[55] NEUGEBAUER and PARKER (1960) p. 108-109.

[56] For this examination the nature of the action, perhaps rising or setting, is not important as long as it is taken to be unchanging.

the decans would be A, 1, B, 2, C, 3, D, 4, E, 5, F, 6, G, 7, H, 8, I, 9, J, 10, K, 11, L, 12, xii, 13, xiii, 14, xiv, and so on through to xxxiv, 35, xxxv, 36, xxxvi, A, 1, etc.

After another twenty civil years had passed, the table would once again be out of date. The next revision would have decan 36 in the first cell of the table. The main body of the table would be subject to another 'half-decan shift' with decan B being replaced with decan 1 and so on. The epagomenal column would have to be rewritten as 36, A, B, C, D, E, F, G, H, I, J, K.

This new table resembles the original star table of forty years before. The only difference is that a new decan, xxxvi,[57] now marks the first hour of the first decade of the year, and all other decans are shifted along one space diagonally. Decan L does not appear anywhere in the table, and decan K only appears once: as the final decan in the epagomenal column.

The change in lead decan is therefore the most noticeable indicator of the 'revision over time' theory. New lead decans ideally should not be drawn from the set of original decans. However, in the real sky, bright stars are not evenly distributed. Throughout the revision process, 'convenient' or well-known stars, or naturally darker regions of the sky might upset the rigid rules of revision. Regardless, the distance in star table cells between two decans should not vary by more than one cell from revision to revision if the observing method remains fixed.

We are now ready to look at the available star tables and compare them with this revision scheme. We have two classes of decan list **T** and **K** plus lists with minor variations as data. The first observation to make is that none of the sources currently known shows the major change in decans that would have occurred after a twenty-year revision. Second, the change in leading decan is consistent with the 'revision over time' theory. Some of the decans at the head of **K** are indeed different from those in **T**, indicating that intermediate decans could have been used. Third, that the 'distance' between decans is usually the same (to within one cell) except in the Orion area, the *ḫꜣw* to *spd* distance mentioned above. Even though **T** and **K** are themselves only reconstructions, the discrepancy stretches the 'revision over time' mechanism to the limit. Fourth, that changes occur between the decan lists in areas where change is not required by the process, for example the splitting and joining of decans *wšt bkꜣt* and *spty ḫnwy*. In addition, comparison with the archaeological record shows that the relatively short period over which the coffins appear also lends little or no support to the 'revision over time' theory.

The process which resulted in the different classes of diagonal star tables seems to have been more variable and observationally-based than Neugebauer and Parker's system suggested. Factors other than the slippage of the Egyptian civil year against the

[57] The process of updating the table at twenty civil year intervals could in theory continue to keep this timekeeping method viable over the centuries, using a total of seventy-three decans: 1 to 36 (36 decans) plus A to L (12 decans) plus xii to xxxvi (25 decans) making 73 decans.

observable sky are undoubtedly present. These factors could have included major changes using different events (rising, setting, or other actions of stars), or minor ones such as the location of the observations (perhaps indicating localised decan lists or competing traditions of lists, or perhaps variations in the horizon used), human and atmospheric observational factors, and unquantifiable pressures such as certain decans being aesthetically or symbolically favoured.

These remarks demonstrate that the assumption that the different decan lists representing a 'chronology' of observations is nowhere near as secure as Neugebauer and Parker's work indicated. The evidence does not support their deductions unequivocally. Once again, a hitherto accepted theory is shown to be only one of the available possibilities.

Summary of conclusions

The following major points have been argued, described, or noted:

1) The corpus of diagonal star tables now numbers twenty-one sources.

2) Leitz's theory of a different date-basis for the later group of table has been disproved.

3) The inadequacy of previous attempts, primarily that of Neugebauer and Parker, to group or classify the tables has been demonstrated. Furthermore, classifications which include layout and epigraphy have been shown to be unlikely to produce appropriate and useful outcomes.

4) A system of classes based on decan lists has been proposed, currently having two main members **T** and **K**, and permitting variants such as **Ta** and **Ka**. Possible restorations of **T** and **K** have been presented and discussed. Notably, the order of decans *tpy-ꜥ ꜣḫwy*, *ỉmy-ḫt ꜣḫwy, ꜣḫwy* is deduced, contrary to Neugebauer and Parker, and the position of the *ṯmꜣt* decans at the head of tables has been questioned.

5) The relationship between 'later' or **K** class decan lists and lists in New Kingdom astronomical diagrams has been re-evaluated.

6) The importance of the existence of the triangle has been emphasised.

7) The independent existence of *sꜣbw* is queried and the weakness of the '37th column' theory has been demonstrated.

8) The existence of the hour label in the Osireion table must be explained if any theory of star tables which argues against the use of hours or time as the reason for rows in the tables is to be accepted.

9) A theory of the **T** and **K** list being a 'pair' rather than one being a re-working of the other has been introduced.

10) The revision history of the tables does not definitively indicate a system of revisions based solely on the passing of time, more complex or observationally-based scenarios such as that described in 9) above are consistent with the differences between decan lists.

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				IIII Shemu			III Shemu			II Shemu			I Shemu			IIII Peret			III Peret				II Peret			I Peret			IIII Akhet			III Akhet			II Akhet			I Akhet		
	27	14	1	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F
A		13	36	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18	17		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36	35
B	26	14	1	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36
C	27	15	2	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20		18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
D	28	16	3	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21		20	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
E	29	18	4	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22		21	20	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
F	30	17	5	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23		22	21	20	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
G	31	18	6	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24		23	22	21	20	18	17	16	15	14	13	12	11	10	9	8	7	6	5
J	32	20	7	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26		24	23	22	21	20	18	17	16	15	14	13	12	11	10	9	8	7	6
I	33	21	8	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27		26	24	23	22	21	20	18	17	16	15	14	13	12	11	10	9	8	7
K	34	22	9	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28		27	26	24	23	22	21	20	18	17	16	15	14	13	12	11	10	9	8
to	35	23	10	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29		28	27	26	24	23	22	21	20	18	17	16	15	14	13	12	11	10	9
tal	2	24	11	K	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30		29	28	27	26	24	23	22	21	20	18	17	16	15	14	13	12	11	10

Table 9: Layout of T1 (S1C, 'Coffin 1'). Shaded cells indicate damage. In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers and letters are those in list **T**, shown in bold in Table 5.

III Shemu		II Shemu			I Shemu			IIII Peret			III Peret				II Peret			I Peret			IIII Akhet			III Akhet			II Akhet			I Akhet		
M	F	L	M	F	L	M	F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F
32	31	30	29	28	27	26	24	23	22	21	20	18	17		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36	35
33	32	31	30	29	28	27	26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36
34	33	32	31	30	29	28	27	26	24	23	22	21	20		18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
35	34	33	32	31	30	29	28	27	26	24	23	22	21		20	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
36	35	34	33	32	31	30	29	28	27	26	24	23	22		21	20	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A	36	35	34	33	32	31	30	29	28	27	26	24	23		22	21	20	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
B	A	36	35	34	33	32	31	30	29	28	27	26	24		23	22	21	20	18	17	16	15	14	13	12	11	10	9	8	7	6	5
C	B	A	36	35	34	33	32	31	30	29	28	27	26		24	23	22	21	20	18	17	16	15	14	13	12	11	10	9	8	7	6
24	C	B	A	36	35	34	33	32	31	30	29	28	27		26	24	23	22	21	20	18	17	16	15	14	13	12	11	10	9	8	7
E	24	C	B	A	36	35	34	33	32	31	30	29	28		27	26	24	23	22	21	20	18	17	16	15	14	13	12	11	10	9	8
F	E	24	C	B	A	36	35	34	33	32	31	30	29		28	27	26	24	23	22	21	20	18	17	16	15	14	13	12	11	10	9
G	F	E	D	C	B	A	36	35	34	33	32	31	30		29	28	27	26	24	23	22	21	20	18	17	16	15	14	13	12	11	10

Table 10: Layout of T2 (S3C, 'Coffin 2'). In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers and letters are those in list **T**, shown in bold in Table 5.

20	17	18	15	14	13	12	11		10	9	8	7	6	5	4	3	2	1	36	35
21	20	17	18	15	14	13	12		11	10	9	8	7	6	5	4	3	2	1	36
22	21	20	17	18	15	14	13		12	11	10	9	8	7	6	5	4	3	2	1
22	22	21	20	17	18	15	14		13	12	11	10	9	8	7	6	5	4	3	2
23	22	22	21	18	17	16	15		14	13	12	11	10	9	8	7	6	5	4	3
24	23	22	22	20	18	17	16		15	14	13	12	11	10	9	8	7	6	5	4
26	24	23	22	21	20	18	17		16	15	14	13	12	11	10	9	8	7	6	5
27	26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9	8	7	6
28	27	26	24	23	22	21	20		18	17	16	15	14	13	12	11	10	9	8	7
29	28	27	26	24	23	22	21		20	18	17	16	15	14	13	12	11	10	9	8
30	29	28	27	26	24	23	22		21	20	18	17	16	15	14	13	12	11	10	9
31	30	29	28	27	26	24	23		22	21	20	18	17	16	15	14	13	12	11	10

Table 11: Layout of T3 (S6C, 'Coffin 3'). The decan numbers are those in list **T**, shown in bold in Table 5.

	II Peret			I Peret		IIIIA		IIII Akhet			III Akhet			II Akhet			I Akhet	
L	M	F	L	M	F	L		M	F	L	M	F	L	M	F	L	M	F
16	14	15	12	11	10	9		9	8	7	6	5	4	3	2	1	36	35
18	16	14	15	12	11	10		10	9	8	7	6	5	4	3	2	1	36
17	18	16	14	15	12	11		11	10	9	8	7	6	5	4	3	2	1
20	17	18	16	14	15	12		12	11	10	9	8	7	6	5	4	3	2
21	20	17	18	16	14	15		15	12	11	10	9	8	7	6	5	4	3
23	21	20	17	18	16	14		14	15	12	11	10	9	8	7	6	5	4
24	23	21	20	17	18	16		16	14	14	12	11	10	9	8	7	6	5
26	24	23	21	20	17	18		17	16	15	14	12	11	10	9	8	7	6
27	26	24	23	21	20	17		18	17	16	15	14	12	11	10	9	8	7
28	27	26	24	23	21	20		20	18	17	16	15	14	12	11	10	9	8
29	28	27	26	24	23	21		21	20	18	17	16	15	14	12	11	10	9
30	29	28	27	26	24	23		22	21	20	18	17	16	15	14	12	11	10

Table 12: Layout of T4 (S1Tü, 'Coffin 4'). Shaded cells indicate damage. In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers are those in list **T**, shown in bold in Table 5.

II Peret		I Peret			IIII Akhet				III Akhet			II Akhet			I Akhet	
F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F
14	13	12	11	10	9	8		6	6	6	4	3	2	1	36	35
15	14	13	12	11	10	9		8	5	5	5	4	3	2	1	36
16	15	14	13	12	11	10		9	8	7	6	5	4	3	2	1
17	16	15	14	13	12	11		10	9	8	7	6	5	4	3	2
18	17	16	15	14	13	12		11	10	9	8	7	6	5	4	3
20	18	17	16	15	14	13		12	11	10	9	8	7	6	5	4
21	20	18	17	16	15	14		13	12	11	10	9	8	7	6	5
22	21	20	18	17	16	15		14	13	12	11	10	9	8	7	6
23	22	21	20	18	17	16		15	14	13	12	11	10	9	8	7
24	23	22	21	20	18	17		16	15	14	13	12	11	10	9	8
26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9
27	26	24	23	22	21	20		18	17	16	15	14	13	12	11	10

Table 13: Layout of T5 (S2Chass, 'Coffin 5'). In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers are those in list **T**, shown in bold in Table 5.

31	13	35	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18	17		15	13	13	12	11	10	9	8	7	6	5	4	3	2	1	36	35
32	14	36	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36
33	15	1	B	A	36	35	34	33	32	31	30	29	28	28	26	21	23	22	21	20		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
34	16	2	C	B	A	36	35	34	33	32	31	30	29	29	28	24	21	23	22	21		20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
35	17 20	3	24	C	B	A	36	35	34	33	32	31	30	30	29	27	24	24	23	22		21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
29	22	5	E	24	C	B	A	36	35	34	33	32	31	27	27	28	27	26	28	23		22	21	20	17	13	15	14	13	12	11	10	9	8	7	6	5	4
B A	23	5	F	E	24	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24		23	22	18	20	17	16	15	14	13	12	11	10	9	8	7	6	5
C	24	6	G	F	E	24	C	B	A	36	35	34	33	32	31	30	29	28	27	26		17	23	21	21	18	17	16	15	14	13	12	11	10	9	8	7	6
D	26	7	H	G	F	D	24	C	B	A	36	35	34	33	32	31	30	29	28	27		24	17	22	22	20	18	17	16	15	14	13	12	11	10	9	8	7
E	27	8	I	H	G	E	E	24	C	B	A	36	35	34	33	32	31	30	29	28		26	24	23	23	21	20	18	17	16	15	14	13	12	11	10	9	8
F J L	28	9 10	J	I	H	F	F	E	24	C	B	A	36	35	34	33	32	31	30	29		27	26	24	17	22	21	20	18	17	16	15	14	13	12	11	10	9
K	30	12 11	K	J	I	G	G	F	E	D	C	B	A	36	35	34	33	32	31	30		16	27	26	24	17	22	21	20	18	17	16	15	14	13	12	11	10

Table 14: Layout of T6 (T3C, 'Coffin 6'). The decan numbers and letters are those in list **T**, shown in bold in Table 5.

			IIII Shemu			III Shemu			II Shemu			I Shemu			IIII Peret			III Peret				II Peret			I Peret			IIII Akhet			III Akhet			II Akhet			I Akhet		
5 days			L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F
31	13	35	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18	17		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36	35
32	14	1	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36
33	16	2	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20		20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
34	17	3	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21		21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
35	18	4	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22		22	21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A	20	5	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23		23	22	21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4
C	23	6	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24		18	23	22	21	20	17	16	15	14	13	12	11	10	9	8	7	6	5
D	24	7	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26		24	18	23	22	21	20	17	16	15	14	13	12	11	10	9	8	7	6
J	26	8	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27		26	24	18	23	22	21	20	17	16	15	14	13	12	11	10	9	8	7
K	27	9	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28		27	26	24	18	23	22	21	20	17	16	15	14	13	12	11	10	9	8
	28	10	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29		28	27	26	24	18	23	22	21	20	17	16	15	14	13	12	11	10	9
⚹	30		K	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30		29	28	27	26	24	18	23	22	21	20	17	16	15	14	13	12	11	10

Table 15: Layout of T7 (G2T, 'Coffin 7'). In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers and letters are those in list **T**, shown in bold in Table 5.

			IIII Shemu			III Shemu			II Shemu			I Shemu			IIII Peret			III Peret				II Peret			I Peret			IIII Akhet			III Akhet			II Akhet			I Akhet		
5 days			L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F	L	M	F	L	M	F	L	M	F
27	26	23	31	13	35	36	35	34	33	32	31	30	29	28	24	22	21	20	18	17		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36	35
32	14	1	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	36
33	16	2	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21	20		20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
34	17	3	C	B	A	36	35	34	33	32	31	30	29	28	27	26	24	23	22	21		21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
35	18	4	24	C	36 35	B	A	36	35	33	32	31	30	29	28	27	26	24	23	22		22	21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A	20	5	E	D 24	36	35	B	A	36	35	33	32	31	30	29	28	27	26	24	23		23	22	21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4
F	C	23	6	F	E	D	C	B	A	36	35	34	33	32	31	30	28	27	26	24		18	23	23	22	21	20	17	16	15	14	13	12	11 10	9	8	7	6	5
A	D	24	7	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27	26		24	18	23	22	21	20	17	16	15	14	13	12	11	10	9	8	7	6
L J	26	8	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28	27		26	24	18	23	22	21	20	17	16	15	14	13	12	11	10	9	8	7
K	27	9	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29	28		27	26	24	18	23	22	21	20	17	16	15	14	13	12	11	10	9	8
	28	10	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30	29		28	27	26	24	18	23	22	21	20	17	16	15	14	13	12	11	10	9
K	30	12 11	K	J	I	H	G	F	E	D	C	B	A	36	35	34	33	32	31	30		29	28	27	26	24	18	23	22	21	20	17	16	15	14	13	12	11	10

Table 16: Layout of T8 (A1C, 'Coffin 8'). In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers and letters are those in list **T**, shown in bold in Table 5.

I Shemu			IIII Peret			III Peret			II Peret				I Peret			IIII Akhet			III Akhet			II Akhet			I Akhet		
L	M	F	L	M	F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F	L	M	F	L	M	F
27	26	24	23	22	21	20	18	17	16	15	14		13	12	11	10	9	8	7	6	5	4	3	2	1	36	35
28	27	26	24	23	22	21	20	18	17	16	15		14	13	12	11	10	9	8	7	6	5	4	3	2	1	36
29	28	27	26	24	23	22	21	20	18	17	16		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
30	29	28	27	26	24	23	22	21	20	18	17		16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
31	30	29	28	27	26	24	23	22	21	20	18		17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
32	31	30	29	28	27	26	24	23	22	21	20		18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
33	32	31	30	29	28	27	26	24	22	22	21		20	18	17	16	15	14	13	12	11	10	9	8	7	6	5
34	34	32	31	30	29	28	27	26	23	23	22		21	20	18	17	16	15	14	13	12	11	10	9	8	7	6
35	35	33	32	31	30	29	28	27	26	24	23		22	21	20	18	17	16	15	14	13	12	11	10	9	8	7
35	36	34	33	32	31	30	29	28	27	26	24		23	22	21	20	18	17	16	15	14	13	12	11	10	9	8
A	36	35	34	33	32	31	30	29	28	27	26		24	23	22	21	20	18	17	16	15	14	13	12	11	10	9
B	A	36	35	34	33	32	31	30	29	28	27		26	24	23	22	21	20	18	17	16	15	14	13	12	11	10

Table 17: Layout of T9 (S1Hil). Shaded cells indicate damage. In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers and letters are those in list **T**, shown in bold in Table 5.

																		1	36	
																		2	1	
																		3	2	
																		4		
																	6	5		
23																8	7			
								17												
								18		16										
									18											
											17	16								
																		12		

Table 18: Layout of T10 (S16C). Shaded cells indicate damage. The decan numbers are those in list **T**, shown in bold in Table 5.

II Peret			I Peret			I Peret	IIII Akhet			III Akhet			II Akhet			I Akhet		
L	M	F	L	M		F	L	M	F	L	M	F	L	M	F	L	M	F
											6							
																5	4	
22	21		16			14				11	10	8			8			
23	22	21	17	16		14				12	11	9		10	9			
	23	22	21	17						13	12	10			10	9		
		23	22							14		11						
			23				16				14						10	9

Table 19: Layout of T11 (S2Hil). Shaded cells indicate damage. In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers are those in list **T**, shown in bold in Table 5.

III Peret			II Peret			I Peret				IIII Akhet			III Akhet			II Akhet			I Akhet		
L	M	F	L	M	F	L	M	F		L	M	F	L	M	F	L	M	F	L	M	F
18	17	15	16	14	13	12	11	10		9	8	7	6	5	4	3	2	1b	1a	36	35
20	18	17	15	16	14	13	12a	11		10	9	8	7	6	5	4	3	2	1b	1a	36
21	20	18	17	15	16	14	13	12a		11	10	9	8	7	6	5	4	3	2	1b	1a
22	21	20	18	17	15	16	14	13		12a	11	10	9	8	7	6	5	4	3	2	1b
23	22	21	20	18	17	15	16	14		13	12a	11	10	9	8	7	6	5	4	3	2
24	23	22	21	20	18	17	15	16		14	13	12a	11	10	9	8	7	6	5	4	3
26	24	23	22	21	20	18	17	15		15	14	13	12a	11	10	9	8	7	6	5	4
27	26	24	23	22	21	20	18	17		16	15	14	13	12a	11	10	9	8	7	6	5
28	27	26	24	23	22	21	20	18		17	16	15	14	13	12a	11	10	9	8	7	6
29	28	27	26	24	23	22	21	20		18	17	16	15	14	13	12a	11	10	9	8	7
30	29	28	27	26	24	23	22	21		20	18	17	16	15	14	13	12a	11	10	9	8
31	30	29	28	27	26	24	23	22		21	20	18	17	16	15	14	13	12a	11	10	9

Table 20: Layout of T12 (S3P, 'Coffin 9'). Shaded cells indicate damage. In the date row, the decades are denoted by F for first decade, M for middle decade, and L for Last decade. The decan numbers and letters are those in list **T**, shown in bold in Table 5.

Third decade	Second decade	I Peret Name of Hour	First decade
ḥry-ib wiꜣ ⚹	*ḫnwy* ⚹	*sp=s n ḫꜣw*	*sꜣpty* ⚹
šsmw ⚹	*ḥry-ib wiꜣ* ⚹	*sp 2=s m bkꜣt*	*ḫnwy* ⚹
knmw ⚹	*šsmw* ⚹	*sp 3=s m bkꜣt*	*ḥry-ib wiꜣ* ⚹
tpy-ꜥ smd ⚹	*knmw* ⚹	*sp 4=s m bkꜣt*	*šsmw* ⚹
smd ⚹	*tpy-ꜥ smd* ⚹	*?=s wšꜣw*	*knmw* ⚹
srt ⚹	*smd* ⚹	*sp=s nfr m wšꜣw*	*tpy-ꜥ smd* ⚹

I Peret		
Last	Middle	First
16	15b	15a
17	16	15b
18	17	16
19	18	17
20	19	18
21	20	19

Table 21: Layout of K0 (the star table in the sloping passage of the Osireion). The actual layout is shown on the left. On the right, the layout has been re-arranged into typical diagonal star table format. The decan numbers are those in list **K**, shown in bold in Table 6.

	21	20	15b	16	15a	9	8	13		12	11	13	12	11	9	9	5	4	3	1	2	7	
23	22	21	20	17	15b	15a	9	8		13	12	11	13	12	11	9	9	5	4	3	1	2	7
24	23	22	21	20	17	15a	15b	15a		8	13	12	11	13	12	11	9	9 8	5	4	3	1	2
	24		22	21		18	17	15b		9	8	11	13	8	9	9	11	9	9	5		4	1
	25	24	24	20	24	3	17	30		14	15a	12	8	9	11	15a	8	9	8	8	5	4	
	25	25	25	21	25	24	18	29		15b	15a	14	9	11	15a	15b	12	11	9	9	6	5	
28	29	26	26	22	E	E	20	20		15a	15b	15a	11	8	15b	16	13	12	11	8	7	6	
	30	29	27	23	25	25	29	29		16	16	15b	12	9	16	8	15b	13	12	9	8	7	

Table 22: Layout of K1 (S9C, 'Coffin 10'). Shaded cells indicate damage. The decan numbers are those in list **K**, shown in bold in Table 6.

24	23	22	21	20		17	16		5	5	5	10	13	12	11	6	8	8	7	6	10	3	2	1
23	22	21	20	16		16	14	5	4	4	4	10	13	12	1	8	2	3	3	10	9	2	1	2
	21	20	16	4		14	15	4	10	10	10	8	2	2	8	2	7	10	10	9	8	1	4	4
	20	16	4	5		15	16	10	8	2	8	13	12	11	2	7	6	9	9	8	2	4	5	5
20	16	4	5	10		16	17	8	13	2	13	12	11	10	7	6	9	8	8	2	1	6	6	6
16	4	5	10	15		17		13	2	13	12	11	10	6	6	9	2	2	2	1	2	7	7	7
	16	20	D	36		4	8	10	6	6	18	18	19	21	22	2	1	25	26	27	28	4	5	31
16	20	17	36	35		8	10	6	7	7	19	19	20	22	2	1	25	26	27	28	4	5	31	29
	17	D	35	A		10	6	7	2	2	20	20	21	2	1	25	27	27	28	4	5	31	29	32
	D	36	A	B		6	7	2	18	19	21	21	22	1	25	27	28	28	4	5	31	29	32	33
	36	35	B	32		7	2	18	19		2	2	2	25	27	28	2	2	5	31	29	32	33	34
	35	32	32	8		2	18	19	20		22	22	1	27	28	2	6	6	31	29	32	33	34	29

Table 23: Layout of K2 (S5C, 'Coffin 11'). Shaded cells indicate damage. The decan numbers and letters are those in list **K**, shown in bold in Table 6.

18	17	16	15	14	13	12		11	9	8	7	6	5	4	3	2	1
19	18	17	16	15	14	13		12	11	9	8	7	6	5	4	3	2
20	19	18	17	16	15	14		13	12	11	9	8	7	6	5	4	3
21	20	19	18	17	16	15		14	13	12	11	9	8	7	6	5	4
22	21	20	19	18	17	16		15	14	13	12	11	9	8	7	6	5
23	22	21	20	19	18	17		16	15	14	13	12	11	9	8	7	6
24	23	22	21	20	19	18		17	16	15	14	13	12	11	9	8	7
26	24	23	22	21	20	19		18	17	16	15	14	13	12	11	9	8
27	26	24	23	22	21	20		19	18	17	16	15	14	13	12	11	9
28	27	26	24	23	22	21		20	19	18	17	16	15	14	13	12	11
29	28	27	26	24	23	22		21	20	19	18	17	16	15	14	13	12
30	29	28	27	26	24	23		22	21	20	19	18	17	16	15	14	13

Table 24: Layout of K3 (S11C, 'Coffin 12'). The decan numbers are those in list **K**, shown in bold in Table 6.

19	18	17	16	15	14	13	12		11	10	9	8	7	6	5	4	3		
20	19	18	17	16	15	14	13		12	11	10	9	8	7	6	5	4	3	
21	20	19	18	17	16	15	14		13	12	11	10	9	8	7	6	5	4	3
22	21	20	19	18	17	16	15		14	13	12	11	10	9	8	7	6	5	4
23	22	21	20	19	18	17	16		15	14	13	12	11	10	9	8	7	6	5
24	23	22	21	20	19	18	17		16	15	14	13	12	11	10	9	8	7	6
25	24	23	22	21	20	19	18		17	16	15	14	13	12	11	10	9	8	7
28	25	24	23	22	21	20	19		18	17	16	15	14	13	12	11	10	9	8
27	27	26	24	23	22	21	20		19	18	17	16	15	14	13	12	11	10	9
29	28	28	25	24	23	22	21		20	19	18	17	16	15	14	13	12	11	10
30	29	28	28	25	24	23	22		21	20	19	18	17	16	15	14	13	12	11
31	30	29	28	28	25	24	23		22	21	20	19	18	17	16	15	14	13	12

Table 25: Layout of K4 (S#T), Shaded cells indicate damage. The decan numbers and letters are those in list **K**, shown in bold in Table 6.

13	12	11	10	9		8	7	6	5	4	3	2
14	13	12	11	10		9	8	7	6	5	4	3
15	14	13	12	11		10	9	8	7	6	5	4
16	15	14	13	12		11	10	9	8	7	6	5
17	16	15	14	13		12	11	10	9	8	7	6
18	17	16	15	14		13	12	11	10	9	8	7
20	18	17	16	15		14	13	12	11	10	9	8
21	20	18	17	16		15	14	13	12	11	10	9

Table 26: Layout of K5 (X2Bas). Shaded cells indicate damage. The decan numbers are those in list **K**, shown in bold in Table 6.

I Akhet First
1
2
3
4
5
6
7
8
9
10
11
12
13

Table 27: Layout of K6 (EA47605). The decan numbers are those in list **K**, shown in bold in Table 6.

1
2
3

Table 28: Layout of K7 (no number). The decan numbers are those in list **K**, shown in bold in Table 6.