

The Tomb Owner at the Offering Table:
A pilot Study on applying Statistical Analysis to Dating Old
Kingdom Memphite Tombs
VOLUME I: TEXT



John Burke – Student No. 31821065

BCom – University of NSW

MA – Macquarie University

A thesis submitted for the degree of Master of Research

Macquarie University -- Sydney

2015

Cover Image from:

W. K. Simpson, *The Mastabas of Qar and Idu: G 7101 and 7102* (GMas 2; Boston, 1976), fig. 39.

For Shyam

I certify that my thesis entitled “*The Tomb Owner at the Offering Table: A pilot Study on applying Statistical Analysis to Dating Old Kingdom Memphite Tombs*” has not been submitted for a higher degree to any other university or institution other than Macquarie University.

The research is my own work and the contribution of others is duly acknowledged where it has been used.

Dated this eighth day of October 2015.

A handwritten signature in black ink, appearing to read 'John Burke', enclosed in a light gray rectangular border.

John Burke

ABSTRACT

The (re-)construction of Old Kingdom Egypt requires a reasonable relative chronological framework, which has proven to be an elusive and often controversial endeavour. The analysis that has been done in tracing the evolution of tombs has in part been hampered by the necessity to use established dates, often controversial dates, to interpret and determine the stylistic development of tomb construction and decoration. While new technology has enhanced the study of ancient cultures through such applications as satellite archaeology, radio carbon dating, 3D imaging of mummies and other artefacts, the use of statistics and mathematical techniques has remained at a basic level. More recently new techniques have appeared, such as, using cladistics for Nubian pottery analysis, decision tree analysis for Middle Kingdom Egyptian stele dating, and correlation analysis for the use of royal regalia at Medinet Habu.

The study aims to determine if advanced mathematical methods, like cluster analysis, can refine the methods employed to date Old Kingdom tombs. IBM's SPSS package using Kohonen Network and TwoStep cluster analysis are applied to 113 Memphite examples of one scene type, the tomb owner seated before an offering table, using approximately three hundred features associated with the scenes on all walls of the offering chapels. The analysis, without reference to any currently considered dates, intends to determine if natural clusters exist and whether these correlate to currently accepted dates of individual Old Kingdom tombs. The initial results indicate that approximately 40 - 50% of the clusters fall within the "ranges" that had been proposed by various scholars. This study has indicated that using cluster analysis has some validity in dating tombs and results could be improved by selectively analysing smaller groups of criteria.

ACKNOWLEDGEMENTS

The construction of this project, like any construction project, was made up of many parts. The most important part of any construction project is the preparation and the people involved.

My preparation started in earnest by planning a trip to Egypt with friends, and a chance encounter with Gae Callender, who assisted a couple of strangers to plan a trip to Egypt with a detailed list of things to see and do to make the most of the world of Ancient Egypt. From that time my interest in Ancient Egypt has been augmented by many visits and the completion of a Master's degree in Egyptology, which began the preparation for the construction of this project. The support and encouragement from the staff at Macquarie over the years has been the corner stone of the construction of this project.

Special thanks go to my two supervisors, Dr Alexandra Woods, who managed the Egyptological aspects of this project, provided the clear direction and firm support that a project like this requires, and Dr Tania Prvan, my statistical supervisor, who introduced me to IBM's world of SPSS and cluster analysis, the key aspect of this study, and whose guidance has made these results possible.

Like many aspects of life, it is the people with whom you mix who provide support, and this is especially so with the community at Macquarie, and my thanks go to these people. Shyam Lee-Joe who has been my proof reader and critic on all things Egyptological is especially thanked. Leonie Donovan is thanked for her kind assistance with the final assembly of the thesis. My gratitude goes to Boyo Ockinga and Susanne Binder who provide a supporting environment for students at Macquarie along with the postgraduate students. In particular, the leadership of Professor Kanawati at Macquarie, his enthusiasm and encouragement is an inspiration to us all.

Finally, to my extended family who, to a degree shares my love of all things Egypt. Their interest has helped me enjoy what has been at times an overwhelming experience. To Sandra, my thanks for the support and understanding of the time it has taken to reach this point.

ABBREVIATIONS

The *JEA* Guidelines for contributors has been used as the standard for abbreviations and referencing for footnotes and the bibliography utilising both long and short references.

ÄA	Ägyptologische Abhandlungen
ACE Reports	Australian Centre for Egyptology Reports
ÄF	Ägyptologische Forschungen
AnOr	Analecta Orientalia
AS	Abusir South
ASAE	<i>Annales du Service des Antiquités de l'Égypte</i>
BACE	<i>Bulletin of the Australian Centre for Egyptology</i>
BdE	Bibliothèque d'étude, Institut français d'archéologie orientale, <i>Caire</i>
BIFAO	<i>Bulletin de l'Institut Français d'Archéologie Orientale</i>
BM	British Museum
BMFA	Bulletin of the Museum of Fine Arts
BsAE	British School of Archaeology in Egypt
BSEG	<i>Bulletin de la Société d'Égyptologie, Genève</i>
CASAE	Cashiers, Supplément aux ASAE
EES ASM	Egypt Exploration Society: Archaeological Survey of Egypt Memoirs
ERA	Egyptian Research Account
<i>Gdr.</i>	<i>Gardiner (when referring to Gardiner's sign list)</i>
<i>GM</i>	<i>Göttinger Miscellen, Beiträge zur ägyptologischen Diskussion</i>
GMas	Giza Mastabas
HdO	Handbuch der Orientalistik, Leiden, I. Abt.: Der Nahe und der Mittlere Osten
<i>JEA</i>	<i>Journal of Egyptian Archaeology</i>
<i>JNES</i>	<i>Journal of Near Eastern Studies</i>
LG	Lepsius: Giza Number
LS	Lepsius Saqqara Number
<i>MDAIK</i>	<i>Mitteilungen des Deutschen Archäologischen Instituts, Abteilung, Kairo</i>
MONAEG	<i>Monumenta Aegyptiaca</i>
N/R	No information recorded in <i>PM</i>
<i>PM</i>	Porter and Moss: <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings</i>
PPYE	Publications of the Pennsylvania-Yale Expedition to Egypt
SAOC	Studies in Ancient Oriental Civilization
SAK	Studien zur altägyptischen Kultur
TGA/MFA	The Giza Archives / Museum of Fine Arts
UCEA	University of California Publications: Egyptian Archaeology

List of Figures

Chapter 3

Figure 3.1	<i>Research Workflow</i>	23
Figure 3.2	<i>Geographical Spread of selected Tombs</i>	25
Figure 3.3	<i>Aspects of the Offering Scene Selection</i>	26

Chapter 4

Figure 4.1	<i>Process chart of the Analysis Phase</i>	35
Figure 4.2	<i>Data Normalisation Process</i>	38

List of Tables

Chapter 2

Table 2.1	<i>Criteria comparison between Cherpion and Swinton</i>	15
-----------	---	----

Chapter 3

Table 3.1	Memphite Necropoli and Minor Fields	25
Table 3.2	Feature Categories	27
Table 3.3	Major feature Groups	28
Table 3.4	Necropoli and Minor Fields	33
Table 3.5	Kings' Reins	34

Chapter 4

Table 4.1	<i>KohonenNet Cluster Initial Output sample</i>	40
Table 4.2	<i>TwoStep Analysis 30 Clusters Initial Output sample for 2 runs</i>	40
Table 4.3	Completed Cluster Result TwoStep 30 Cluster Sample	41
Table 4.4	Sample initial results table sorted by cluster	42
Table 4.5	KohonenNet Run 66 Clusters	43
Table 4.6	KohonenNet Run 63 Clusters	43
Table 4.7	KohonenNet Runs Necropolis Sort	44
Table 4.8	TwoStep Analysis 30 Clusters sorted by Cluster	44
Table 4.9	TwoStep Analysis 30 Clusters sorted by Necropolis	44

Chapter 5

Table 5.1	Two-Step Analysis 30 Clusters sorted by Cluster	48
Table 5.2	Cluster Panel Key Fields description	49
Table 5.3	Revised TwoStep Analysis 30 Clusters	66

Chapter 6

Table 6.1	<i>Cluster Disposition after Interpretation Process</i>	71
-----------	---	----

VOLUME I – TEXT

Table of Contents

Declaration		v
Abstract		vii
Acknowledgements		ix
Abbreviations		xi
List of Figures		xiii
List of Tables		xv
<u>PART ONE.</u>	<u>INTRODUCTION</u>	
Chapter 1	Preliminaries	1
Chapter 2	Previous Studies	5
Chapter 3	Methods and Aims	21
<u>PART TWO.</u>	<u>ANALYSIS</u>	
Chapter 4	The Statistical Analysis	34
Chapter 5	Interpreting the Results	47
<u>PART THREE.</u>	<u>CONCLUSIONS</u>	
Chapter 6	Conclusions	69
BIBLIOGRAPHY		73

VOLUME II – APPENDICES

In PDF Format

(See DVD attached to the inside of the back cover)

Table of Contents

APPENDIX 1. SUPPORT

- 1 Set 1: Prosopography
- 2 Set 2: Determination of Range of King's reigns

APPENDIX 2. FEATURES

1. Set 1: Initial Feature List
2. Set 2: Expanded Feature List

APPENDIX 3. ANALYSIS

1. Set 1: Kohonen Network Tables
2. Set 2: TwoStep Cluster Tables
3. Set 3: Major Cluster groups

APPENDIX 4. DATA COLLECTION

1. Set 1: Initial Data Collection Spreadsheet
2. Set 2: Final Data Collection Spreadsheet

PART ONE INTRODUCTION

Chapter 1: Preliminaries

Despite many years of excavation in Egypt, and the interpretation and documentation of its material culture,¹ the methodical approaches to dating of Old Kingdom tombs remains a contentious and highly debated issue amongst scholars.² The debate is not only about the fine detail of the dates of individual tombs, but also the sequence and interpretation of the kings' reigns, for example, the sequence of the third dynasty kings is still being debated.³

Archaeology,⁴ a scientific study of material remains of past cultures within their excavated context,⁵ makes use of residual remains of architecture, art, texts and artefacts of ancient

¹ S. Ikram, 'Interpreting Ancient Egyptian Material Culture.' in M. K. Hartwig (ed), *A companion to ancient Egyptian art* (West Sussex, 2015), 175-188, 'Material culture is the bedrock of our understanding of ancient Egypt as every artifact, whether large or small, forms part of a wider narrative.'

². For different approaches see: P. Jánosi, 'Old Kingdom tombs and dating – problems and priorities. The Cemetery en Échelon at Giza.' in M. Barta (ed), *The Old Kingdom Art and Archaeology* (Prague, 2006), 175-183; A. Woods, 'A Date for the Tomb of Seneb at Giza: Revisited', in A. Woods, A. McFarlane, S. Binder (eds), *Egyptian Culture and Society, Studies in Honour of Naguib Kanawati, Volume II*, (CASAE 38; Cairo, 2010), 301-331; A. McFarlane, *Mastabas at Saqqara: Kaiemheset, Kaipunesut, Kaiemsenu, Sehetepu and Others* (ACE Reports 20; Oxford, 2003), 19-23; A. Woods, 'Contribution to a Controversy: A date for the tomb of K3(=i)-m-ḥnh at Giza', *JEA* 95 (2009), 161-174; L. Flentye, 'The Mastabas of Ankh-haf(G7510) and Akhethetep and Meretites (G7650) in the Eastern Cemetery at Giza: A Reassessment' in Z. A. Hawass, J. Richards (eds), *The Archaeology and Art of Ancient Egypt, Essays in Honor of David B. O'Connor (Volume 1)* (CASAE 36; Cairo, 2007), 291-308; J. Swinton, *Dating the Tombs of the Egyptian Old Kingdom* (Oxford, 2014); E. Brovarski, 'False doors & history: the Sixth Dynasty', in M. Barta (ed), *The Old Kingdom Art and Archaeology* (Prague, 2006) 71-118.

³ Comparing the differences in the Third Dynasty kings lists in E. Hornung, R. Krauss and D. A. Warburton 'Chronological Table for the Dynastic Period', in E. Hornung, R. Krauss and D. A. Warburton (eds) *Ancient Egyptian Chronology* (HdO 83; Leiden, 2006), 490; J. Baines and J. Málek, *Atlas of Ancient Egypt* (Amsterdam, 1993), 36 and I. Shaw, 'Chronology' in I. Shaw (ed.), *The Oxford History of Ancient Egypt* (Oxford, 2000), 479-483, and N. Kanawati, *Conspiracies in the Egyptian Palace* (London, 2003), 2, comments "Both the beginning and the end of the Third Dynasty, for example are not clear."

⁴ A sub discipline of anthropology, C. C. Renfrew and P. Bahn, *Archaeology: Theories, Methods and Practice* (4th rev. edn; London, 2008), 579.

societies to interpret its culture and chronology. This establishes the dates of past events and is an essential component of the study of ancient cultures. Dating of the material culture in a sequence provides the background to understanding the development of human behaviour through the changes that occur in the material remains over time. This interpretation must, in part, rely on the assumptions made about the date or sequence in time of the various material aspects of the culture. Accordingly, given the essential and critical nature of chronology in understanding ancient cultures, scholars have discussed Egyptian chronology for many centuries.

Manetho in *Aigyptiaka*⁶ presented the idea of the dynastic approach to segregate the chronology of Egypt and this has been supplemented in modern times by the discovery of additional ancient sources of Egyptian history and associated kings' lists at Abydos, Karnak and Saqqara.⁷ These lists have been the basis of the understanding of Egyptian chronology, and have been used to develop current lists of kings and their tenure. Egyptian society did not have an ongoing calendar, instead they counted years from the crowning of each king and infrequently recorded these dates in their tombs. To overcome the lack of dateable information in tombs, archaeologists have utilised differing techniques - stratigraphy and stylistic analysis for estimating the dates of the elements of material culture of these tombs - by utilising techniques that are non-archaeological and making use of techniques borrowed from science.⁸ According to Biers, 'the age of an object must be established in relationship to the present by both relative and absolute means'⁹ and literature on dating of artefacts show a variety of approaches; both absolute and relative.

The aim of this research is to pilot an approach and to question if technological tools, like cluster analysis, can be applied to determine if a more accurate system of dating can be achieved. In theory to analyse a set of features in order to generate "natural" clusters formed by common attributes - of the features - which will also indicate existence over a common period. These features will be selected based on the work of previous tomb dating studies,

⁵ K. A. Bard, *An Introduction to the Archaeology of Ancient Egypt* (Malden, 2008), 12-13.

⁶ W.G. Waddell, tr., *Manetho* (Cambridge, 1964).

⁷ E. Hornung, R. Krauss and D. A. Warburton 'King-Lists and Manetho's *Aigyptiaka*', in E. Hornung, R. Krauss and D. A. Warburton (eds) *Ancient Egyptian Chronology* (HdO 83: Leiden, 2006), 33-36.

⁸ Dean, in Schiffer (ed.), *Advances in Archaeological Method and Theory* I, 224.

⁹ W. R. Biers, *Art, Artefacts, and Chronology in Classical Archaeology*, (London, 1992), 16.

especially that of Baud,¹⁰ Cherpion,¹¹ Harpur,¹² Kanawati,¹³ Strudwick,¹⁴ and Swinton.¹⁵ The difference of this study compared to those done previously, is twofold; the collection of data has a wider range for analysis by combining data previously only looked at in isolation;¹⁶ and past studies predetermined tomb dates that were used to sequence¹⁷ the features, whereas in this study dates are used only to attempt verification of the identified clusters.

In order to achieve this aim the study objectives are to:

- Gather a corpus of Old Kingdom, substantively complete, tombs from the Memphite cemeteries of Giza, Abusir, Saqqara, Dashur, and Meidum.
- Examine items from material culture, such as, chapel orientation, false doors, offering scenes and their surrounds, and select features from their decorative programs.
- Create a database containing observations and measurements of the selected features;
- Apply software, designed to handle big data sets, to process the collective features in order to determine natural clusters.
- Verify the clusters produced by comparing the results to the range of dating of tombs proposed by scholars and presented in the Leiden Mastabase Project.¹⁸

¹⁰ M. Baud, ‘À propos des critères iconographiques établis par Nadine Cherpion’, in N. Grimal (ed.), *Les critères de datation stylistiques à l’ancien empire* (Cairo, 1998), 31-95.

¹¹ N. Cherpion, *Mastabas et hypogées d’Ancien Empire : le problème de la datation* (Brussels, 1989).

¹² Y. Harpur, *Decoration in Egyptian Tombs of the Old Kingdom: Studies in orientation and scene content* (London, 1987).

¹³ N. Kanawati, *The Egyptian Administration in the Old Kingdom: Evidence for its Economic Decline* (Warminster 1977).

¹⁴ N. Strudwick, *The Administration of Egypt in the Old Kingdom* (London, 1985).

¹⁵ Swinton, *Dating*.

¹⁶ Titles, tomb orientation and false doors to some degree.

¹⁷ This has the potential to cause “circular dependency” issues where results will be biased, potentially unfavourably, by the initial tomb date selection.

¹⁸ R. van Walsem, *MASTABASE the Leiden Mastaba Project* (Leiden, 2008).

Chapter 2: Previous Studies

In the literature of ancient Egypt scholars¹⁹ have outlined methods adopted to organise the chronology of ancient Egypt, through analysing the remains of its material culture.²⁰ Typological sequencing, an example of relative dating, has been widely used in the study of the development of Egyptian society. The dating criteria derived by observing the progressive development of material culture, namely its architecture, art, and textual rendering has been established and has developed over time. The following section discusses the work that has been done in these studies in developing methodological and systematic approaches that have been fundamental in the understanding of tomb dating, particularly that of the iconography of the chapel within the tomb, and architectural aspects of the distribution of decoration in the tomb chapel and the false door.

Methodological and Systematic Approaches

2.1 Architecture

In 1942 in Volume I of *A History of the Giza Necropolis*,²¹ Reisner discusses his method of systematically grouping the mastabas on the two sides of Khufu's pyramid, the western and the eastern fields, sub-dividing them into nucleus cemeteries, and discussing their relationship to tombs from the other sites. He outlines several principles that he used for

¹⁹ Consider, W. Barta, *Aufbau und Bedeutung der altägyptischen Opferformel* (Glückstadt, 1968); Baud, in Grimal (ed.), *Les critères de datation stylistiques*; M. Baud, *Famille royale et pouvoir sous l'ancien empire égyptien* I–II (Cairo, 1999); Brovarski, in M. Barta (ed), *The Old Kingdom art and archaeology*, (Prague, 2006) 71-118; Cherpion, *Mastabas*; S. Hassan, *Excavations at Giza, V: with special chapters on methods of excavation, the false door, and other archaeological and religious subjects, 1933–1934* (Cairo, 1944); S. Hassan, *Excavations at Giza, VI: The Offering-List in the Old Kingdom.—Part II 1934–1935* (Cairo, 1948), Harpur, *Decoration*; Kanawati, *Administration*; G. Lapp, *Die Opferformel des Alten Reiches: unter Berücksichtigung einiger späterer* (ÄF 24; Mainz, 1986); G. A. Reisner, *A History of the Giza Necropolis: Volume I* (Cambridge, 1942); Strudwick, *Administration*, and Swinton, *Dating*.

²⁰ W. R. Biers, *Art, Artefacts, and Chronology in Classical Archaeology*, (London, 1992), 16, and Ikram, in M. K. Hartwig (ed), *Companion Ancient Egyptian Art*, 175-188.

²¹ G. A. Reisner, *History*, 6-9.

dating the tombs at Giza, for example, the typological dating of the mastabas,²² the stages of construction of each mastaba, and the use of the mastabas. Reisner dated the tombs by both inscriptional and archaeological evidence to the reign of a king.²³ The principle by which he grouped the mastabas was to assign type forms, Type I-XI²⁴ based on their architectural features, which he had found to coincide with different dynasties (when considered with their chapels). Though his collection of data is well laid out in tabulated form, supported by plans of the mastaba cores, he does not apply any special methods to his data to produce graphs to delineate each period change,²⁵ but supplements his findings with line drawings and photographs. Reisner's pioneering work on the archaeological technique of grouping tomb types into categories has become a standard reference for dating tombs by the architectural aspects of the mastaba and chapel, and is still referred to today.²⁶ However, excavations have revealed new evidence²⁷ which enhances and revises various aspects of Reisner's initial dating of monuments. János²⁸ comments that 'despite Reisner's ingenious reconstruction of the development of the western field there is no conclusive evidence for assigning core cemeteries or individual tombs to a certain date.'²⁹ János further comments that both Junker and Reisner believed that the *Cemetery en Echelon* were built later than G2100 and G4000, possibly in the reign of Khafra or Menkaura,³⁰ and proposes that it is likely that it was in fact built late in Khufu's reign.³¹

²² Reisner, *History*, 29.

²³ Reisner, *History*, 29-36.

²⁴ Reisner, *History*, 38-56, and included many sub-types.

²⁵ See Kanawati, *Administration*, for the application of graphical analysis methods to determine dating based on architectural development.

²⁶ As is demonstrated by; Swinton *Dating*, 9-10, A-L. Mourad, *The Tomb of Ptahhotep I* (ACE Reports 37; Oxford, 2015), 15, and M. Bárta, *Abusir V: The cemeteries at Abusir South I* (Prague, 2001), 190, The tomb of Kaaper.

²⁷ M. Bárta, *Abusir V* for dating of Ity's tomb Bárta refers to Reisner's typology but challenges Reisner's "idea that it was only the stone lined chapels that instigated development leading directly towards the stone mastabas", 15.

²⁸ P. János, 'Old Kingdom tombs and dating – problems and priorities. The Cemetery en Échelon at Giza.' in M. Barta (ed.), *The Old Kingdom Art and Archaeology* (Prague, 2006), 175-183.

²⁹ Janosi in Bárta (ed.) *Old Kingdom Art*, 175³.

³⁰ Janosi in Bárta (ed.) *Old Kingdom Art*, 177.

³¹ Janosi in Bárta (ed.) *Old Kingdom Art*, 182.

Bárta in his recent article³² focused not on individual monuments, as Reisner did for dating, but concentrated on more general trends of the society. For example, he claims that it was under the reign of Neuserre that ‘new types of tombs emerged,’³³ namely large tombs of wealthy officials and family tombs.³⁴ He also discussed the tomb of Vizier Ptahshepses at Abusir for the innovations in tomb development. Ptahshepses was probably the first vizier to adopt several aspects of royal monument architecture in his non-royal tomb, taking into account, amongst others, the monumental columned portico, a statue room with a bench along the northern wall, a boat room, and a pointed ceiling over the burial chamber.³⁵ Bárta also considered the substantial increase in the size of the tomb of the highest ranking officials and a large number of magazines³⁶ which likely set the precedence for tomb development during the sixth dynasty.³⁷

The increase in the size of tomb, and its dating was considered by Kanawati,³⁸ who used analytical methods for his research. He considered four categories of officials: viziers;³⁹ higher;⁴⁰ middle;⁴¹ and lower officials,⁴² and organised them into a chronological order. He then took the averages of the areas of their mastabas, chapels, shaft and burial chambers, and after plotting his results on graphs, concluded that tomb size was an indicator of the economic decline of the Old Kingdom. He started his research with conventional methods of dating the tombs but in the course of his analysis he refined the dating of some of the tombs⁴³ based on titles and architectural evidence. His dating criteria is incorporated into the Leiden Mastabase

³² M. Bárta, ‘Architectural Innovations in the development of the Non-Royal Tomb During the reign of Nyuserre’, in P. Jánosi, (ed.), *Structure and Significance. Thoughts on ancient Egyptian Architecture*, (Vienna, 2005), 105-130.

³³ Bárta, in Jánosi, (ed.), *Structure and significance*, 106.

³⁴ Bárta, in Jánosi, (ed.), *Structure and significance*, 121.

³⁵ Bárta, in Jánosi, (ed.), *Structure and significance*, 108.

³⁶ Bárta, in Jánosi, (ed.), *Structure and significance*, 108, 113.

³⁷ Bárta, in Jánosi, (ed.), *Structure and significance*, 121.

³⁸ Kanawati, *Administration*.

³⁹ Kanawati, *Administration*, 10.

⁴⁰ Kanawati, *Administration*, 15.

⁴¹ Kanawati, *Administration*, 23.

⁴² Kanawati, *Administration*, 27.

⁴³ Kanawati, *Administration*, 152-156.

project,⁴⁴ a database of three hundred and thirty seven of the Egyptian elite Old Kingdom non-royal tombs.

2.2 Tomb Chapel

Reisner observed that the burial shafts of the mastabas, chambers and decorated chapels intertwined closely together, and concluded ‘they must be dealt with as one.’⁴⁵ Considering the date of the completion of the mastabas, he concluded that the dating of the mastaba depended on four different parts of the mastaba and proceeded to categorise six groups of study,⁴⁶ of which the types of chapel and the decoration of the chapel is relevant to this study. He outlines the types of offering chapels and their combinations⁴⁷ and then described the types that belong to dynasty IV and dynasties V to VI, followed by the development of the offering chapel in dynasties IV-VI.⁴⁸ Reisner allocated the tomb designs to the reign of the kings, for example, he identified three main forms of chapels that had been in use since the first dynasty down to the reign of Sneferu.⁴⁹ New types of chapels, with increased wall areas, were introduced in the fifth dynasty, corridor chapels, and chapels with an EW offering room and other complex forms.⁵⁰ These new forms no longer utilised the SE corner of the mastaba as had been the case earlier.⁵¹ He followed this observation with discussion of the changing orientation of the chapel and indicated that the appearance of the E–W chapel was during the reign of Neuserre. In his dating criteria for tomb chapels, He considered various elements: the construction and the relative position of the mastaba; the slab stela affixed to the eastern side of the mastaba which provided a date to the reign of Khufu; the mason’s inscriptions found in the burial shaft and chamber in the time of Khufu; the inscriptions of the masons and

⁴⁴ van Walsem, *MASTABASE*.

⁴⁵ Reisner, *History*, 85.

⁴⁶ Reisner, *History*, 85. ‘the type of burial shafts and chambers; types of casing; types of chapel; the decoration of the chapel; the statutes and serdabs, and the types of burials.’

⁴⁷ Reisner, *History*, 183.

⁴⁸ Reisner, *History*, 183-304.

⁴⁹ ‘*The open-air chapel, the roofed exterior chapel, and the interior chapel of cruciform type.*’ Reisner, *History*, 292.

⁵⁰ Reisner, *History*, 301.

⁵¹ Reisner, *History*, 301.

quarrymen for the construction of the chapel and casing which, though rare, provided exact dates. However, Winlaw⁵² took the idea a bit further by making use of Reisner's classification system to study the transmission of the style of chapel. She did this by identifying the chapel types found in the Teti cemetery which fell into two categories, Type 5 with NS chapel orientation and Type 7 with EW chapel orientation. Winlaw then compared these types of tomb in the Teti cemetery with the same type of tomb at the other Memphite cemeteries which allowed for comparisons to be made regarding Reisner's original ideas about the dating of tomb chapel types. She observed that Reisner's types 1, 3, 4, 6, 8, 9, 11 and 12 do not appear after the fifth dynasty in Memphite cemeteries. Type 5a tombs which appear in the fifth dynasty continue to be used after this time. Types 5b-e, do not appear after the fifth dynasty while types 7c and 7d are still utilised until the times of Pepi I and Pepi II respectively. Other type 7 tomb chapels are rarely seen after the fifth dynasty. While chapel and mastaba type may be an indicator of the date of a tomb it would appear that type alone will not narrow down the date to a particular reign.

2.3 False doors

The study of the architectural structure and the themes depicted on the false doors is an integral part of dating Old Kingdom tombs and probably the earliest scholars to study and group the false doors according to its architectural style were Reisner⁵³ and Hassan.⁵⁴ Reisner proposed that the cemeteries were built for the "living *kas* of all members of the royal family and the court"⁵⁵ and postulates the sequence of the development of the cemeteries adjacent to the pyramids and their chapels. He indicated that the tomb chapels at Giza evolved from simple chapels built along the face of the mastaba at the "niche", or slab stele in the fourth dynasty, to complex courts and porticos with multiple "niches" or false doors.

⁵² S. Winlaw, 'The chapel types utilised in the Teti cemetery at Saqqara', in A. Woods, A. McFarlane and S. Binder (eds), *Egyptian Culture and Society, Studies in honour of Naguib Kanawati, Volume II*, (CASAE 38, Cairo, 2010), 281-299.

⁵³ Reisner, *History*, 294, 372.

⁵⁴ S. Hassan, *Excavations at Giza, V: with special chapters on methods of excavation, the false door, and other archaeological and religious subjects, 1933-1934* (Cairo, 1944), 74-168.

⁵⁵ Reisner, *History*, 27.

Reisner also pointed out that variations in the size of the “Ka” door varies in the fifth and sixth dynasties,” largely depending on the means of the owner”⁵⁶ and may only provide approximate dating information.

Hassan⁵⁷ made an attempt to group the structure of the false doors in a chronological sequence from the fourth to the sixth dynasties. Hassan’s⁵⁸ collection of false doors were from his own and other excavations, and in total he collected a corpus of one hundred and twenty two fourth dynasty false doors; one hundred and fifty two from the fifth dynasty; one hundred and twelve from the sixth dynasty. He listed the false doors with the tomb owners’ names, commented on their architectural form and identified each element of the false door, e.g., *Architrave* (upper lintel); *Tablet* (panel); *Cross-bar* (lower lintel); *Drum*; *Back of inner niche* (i.e. door-niche); *Sides of inner recess* (i.e. thickness of door-niche); *Back of inner recess* (inner jambs); *Sides of outer recess* (outer jambs),⁵⁹ and discussed their decoration and the position of the false doors in the tombs. He also commented on the ‘development of the offering table on the panel.’⁶⁰ Hassan’s purpose was to examine and compare the false doors with Reisner’s lists.⁶¹ However, it is Strudwick’s⁶² (1985) study of chapel design and the titles of the high officials, which he used as criteria for dating of the Old Kingdom tombs, which refined the dating of the Old Kingdom, and provided a better understanding of this period’s development of architecture, art and administration.

Strudwick’s study on administration, divided into two parts, discussed in the first part the chronology and dating criteria of aspects of development of false doors, types of offering lists and chapel design. In the second part he discussed, the administrative areas dealing with a list of high officials’ titles organised chronologically using various criteria in dating the officials. This study was an attempt to ‘pinpoint the dates of individual officials and monuments.’⁶³ The method for Strudwick’s study entailed a selection of a corpus of well dated false doors,

⁵⁶ Reisner, *History*, 379.

⁵⁷ Hassan, *Excavations at Gîza*, V, 65-180.

⁵⁸ Hassan, *Excavations at Gîza* V, 161-164.

⁵⁹ Hassan, *Excavations at Gîza* V, 149-157.

⁶⁰ Hassan, *Excavations at Gîza* V, 168-172.

⁶¹ Reisner, *History*, 294, 372-379.

⁶² Strudwick, *Administration*, 9-52.

⁶³ Strudwick, *Administration*, 2.

primarily from the sites of Giza and Saqqara, to identify each element of the false door, namely: the cornice and torus moulding; the jambs; the panel; the lintels and architraves. Strudwick based his criteria for dating of the false doors from his selected corpus, and also from other sources.⁶⁴ Strudwick used an Apple IIe computer for his data analysis.⁶⁵

Using his own and other scholars' criteria for dating, Strudwick commented on the different chapel types of the fourth dynasty, and the appearance of torus moulding and cornice in Saqqara in the early fifth dynasty, which appeared in Giza only at the beginning of the sixth dynasty.⁶⁶ He proposed the jambs as a useful criterion⁶⁷ for dating the fifth and the sixth dynasty false doors and discussed the unequal length of the false door jambs which began in the fourth dynasty and was in use until the middle of the fifth dynasty. The cornice and torus moulding which appeared in the mid fifth dynasty became the norm of the sixth dynasty and also brought the development of even length door jambs. During this period the size of the figures represented on the jambs decreased.⁶⁸ On the development of two pairs of jambs, Strudwick considered the depth between the panel and the decorated figures on chapel walls and concludes that two jamb false door that had evolved by the end of the fourth dynasty became a regular feature by the early fifth dynasty. However, the appearance of three jambs on the false door took place over a period of time⁶⁹ then the false door with cornice, torus moulding, and three jams of equal length with texts became the standard type for all officials⁷⁰ down to the early part of the reign of Pepy II. A change in the reign of Pepy II occurred when the jambs were simplified with false doors showing the narrowing of two or three jambs with one column of inscription each.⁷¹ With regards to the panel, Strudwick concluded it showed little change. The figure of the deceased was standardised with a few

⁶⁴ Strudwick, *Administration*, 13-14. He also referred to Baer's dating, and also by the presence of cartouches especially those of Wenis and Teti. 12.

⁶⁵ Strudwick, *Administration*, "A summary of the methods used will be found in the author's paper 'An Application of Information Retrieval and Analysis in Egyptology' in Proceedings of the 1982 Computer Applications in Archaeology Conference (Birmingham 1982), xv.

⁶⁶ Strudwick, *Administration*, 10.

⁶⁷ Strudwick, *Administration*, 17.

⁶⁸ Strudwick, *Administration*, 15.

⁶⁹ Strudwick, *Administration*, 15-16.

⁷⁰ Strudwick, *Administration*, 17.

⁷¹ Strudwick, *Administration*, 17.

exceptions, and the decorations were increased as time progressed.⁷² He also discussed the development of the wide panel apertures to narrow apertures which appeared to coincide with the appearance of cornice and torus moulding and the appearance of small apertures connected with the size of the jambs associated with different door types. His study revealed that early in the fifth dynasty the depiction of the tomb owner appeared on a lintel, but it was not until later in the fifth dynasty that the standing figure of the deceased was depicted on the lintel.⁷³ Brovarski⁷⁴ supplemented Strudwick's research by studying the decorative offering scene on the panel of false doors of the sixth dynasty viziers. He identified schemes I-VIII for the arrangement of offering tables, in particular, ewers and basins that appear on different walls of the offering rooms. Brovarski,⁷⁵ in his study of fourth and fifth dynasties, discussed the placement of ewers and basins around the tomb owner sitting at an offering table, and concluded that the position of the ewers and the basins changed from being depicted before the owner's face to being depicted under the table, and at the tomb owner's feet later in the fifth dynasty.

Strudwick and Brovarski's studies of the offering scene, its various decorative styles and its location within a tomb, on the panel of the false door and elsewhere on various walls have provided dating criteria that had also been observed by other scholars.⁷⁶ When similar scenes such as the offering scene are viewed across many tombs, they can exhibit clues which have enabled scholars to correlate the styles to those that are used during the reign of a particular king, thereby providing a system of relative dating.

2.4 Chapel decoration

Reisner considered many elements for the dating of decoration on the chapel walls: the names and titles of the tomb owner, names of his family and servants, (it should be noted that Reisner cautioned against the use of proper names compounded with royal names as a means

⁷² Strudwick, *Administration*, 21.

⁷³ Strudwick, *Administration*, 22-23.

⁷⁴ E. Brovarski, 'False doors & history: the Sixth Dynasty', in M. Barta (ed.), *The Old Kingdom art and archaeology*, (Prague, 2006) 71-118.

⁷⁵ E. Brovarski, in *Homages à Jean Leclant* Vol 1, 102.

⁷⁶ N. Cherpion, *Mastabas and Swinton, Dating*.

of dating a tomb);⁷⁷ the funerary estates; biographical information;⁷⁸ and the carved reliefs with figures; painted pattern decoration of palace façade; and the tomb owner seated at the offering table. However, he did not discuss the dating of reliefs and inscriptions to the fullest.

In her study Harpur⁷⁹ focussed on two principle topics - the layout of themes from the Old Kingdom tombs and the orientation of the figures depicted - to understand the chronological development of the depiction of the tomb owner and his family. She discussed tomb location and issues of kinship in her first two chapters, which can be used to support other dating determinations, before discussing chronology,⁸⁰ and referred to the publications of many scholars.⁸¹ In order to establish the method of dating the tombs, Harpur evaluated the works of Porter and Moss,⁸² Kanawati,⁸³ HESPOK,⁸⁴ Baer,⁸⁵ Strudwick,⁸⁶ and the relevant tomb reports. She used these dated tombs to evaluate the development of tomb decoration and orientation of the figures. Her evaluations, based on tomb locations, provide broad indications of dating of the tombs in general, and she followed the tombs of the pharaohs located from Maidum to Giza to Abu Sir to Saqqara, and then to the provinces, but without any definite or absolute pattern.⁸⁷ The references for royal and private tombs by Harpur⁸⁸ appear to provide a methodology to develop tomb dates through understanding kinship and family relationships that are depicted in tombs.⁸⁹ The definite analysis of dating through tomb decoration is not provided by Harpur, but the collected information should provide a

⁷⁷ Reisner, *History*, 33-34. 305.

⁷⁸ Reisner, *History*, 31.

⁷⁹ Y. Harpur, *Decoration in Egyptian Tombs of the Old Kingdom: Studies in orientation and scene content* (London, 1987), 1.

⁸⁰ Harpur, *Decoration*, 33-42.

⁸¹ Harpur, *Decoration*, 559-571.

⁸² B. Porter, and R. L. B. Moss, *Topographical bibliography of ancient Egyptian hieroglyphic texts, reliefs and paintings: Various Volumes*, Griffith Institute (Oxford, 1974-81).

⁸³ N. Kanawati, *Administration*, 152-156.

⁸⁴ W. S. Smith, *A History of Egyptian Sculpture and Painting in the Old Kingdom* (London, 1949).

⁸⁵ K. Baer, *Rank and Title in the Old Kingdom, The structure of the Egyptian Administration in the Fifth and Sixth Dynasties* (Chicago, 1960).

⁸⁶ N. Strudwick, *Administration*.

⁸⁷ Harpur, *Decoration*, 11-12.

⁸⁸ Harpur, *Decoration*, 13-31 and Appendix 2.

⁸⁹ This is also applied by Swinton, *Dating*, 5.

good fundamental methodology essential for further analysis of tomb decoration. This has been done by Swinton and is discussed below.

Cherpion⁹⁰ and Swinton⁹¹ employed similar analysis of scenes but applied differing methodologies to determine dating criteria. Cherpion derived her date ranges for criteria from the cartouches that were found in the tomb. Swinton, however, used what she considered as well dated tombs to determine date ranges for the criteria. Both scholars selected certain aspects of the tomb that had been seen to vary over time. Cherpion in her study based her observations on iconographic criteria alone, and selected sixty four criteria grouped into five major themes: seats, the offering table and its environment, clothing and accessories for men and women, aspects of the construction and decoration of false doors, and a few unrelated categories of specific motifs of the cartouches, the use of Tura limestone and some aspects of offering lists. Cherpion ordered her criteria in accordance with the cartouches that she had found appearing with those features mentioned above to allocate periods of activity for those features. Her process was flawed by the nature that the kings' funerary cults existed long after the reign of the king, and that the appearance of a cartouche together with a feature, does not necessarily limit that feature to that particular reign. In addition, Cherpion's method does not allow that a feature in a tomb, without a cartouche, could lie well outside those tombs with cartouches and the same feature.

Swinton used one hundred and four criteria in similar categories to Cherpion; the stools and chairs, the offering table and its environment, clothing and accessories for men and women but then added new features, such as the female presence in the tomb, priestly figures performing rites, banquet scenes and marsh scenes. She first established sets of dates for her selected corpus of tombs and assigned dates based on securely dated tombs and tombs dated by inference, and then ordered the periods of activity of her features based on those dates. In this way, she reduced the effect of circular dependency errors⁹² but did not eliminate them entirely.

⁹⁰ Cherpion, *Mastabas*, 21.

⁹¹ Swinton, *Dating*, 1-8.

⁹² Circular dependency errors are introduced by the initial tomb date selection. Any errors in the predetermined tomb dates will be transmitted to the results as errors in the date range of affected criteria.

Like Cherpion, Swinton's process was also flawed to some degree as her process was totally dependent on the selection of the dates of her tomb corpus, although the accuracy of the dating of the selected tombs can alter the outcome. Despite the issues related to these methods, both have advanced the determination of the dates of tombs by applying rigorous methods that have provided results that were improvements on previous methods, and will no doubt be improved on once more by other scholars with different approaches to the issue of tomb dating. Table 2.1 below lists a combined review of the criteria classifications used by Cherpion and Swinton.

Feature Group	Cherpion	Swinton
Appearance and Position: Men	15	24
Appearance and Position: Women	5	9
Offering Table and Environment	16	26
Seats	15	19
Other people interacting	1	9
False Door	8	0
Banquet Scene	0	6
Marsh Scene	0	11
Misc.	4	0
Total Criterion	64	104

Table 2.1 *Criteria comparison between Cherpion and Swinton*

In his review of Cherpion's work Michel Baud⁹³ indicated that with some differences her work is not fundamentally questioned. Baud's study identifies two hundred and eighty-seven cartouches, fifty-three more than Cherpion's study.⁹⁴ He offered extensions to thirty-three of her criterion as a refinement based on his additional work and cartouches.⁹⁵ However, as Cherpion's basic methodology of using cartouches to delineate date ranges is still being applied by Baud, his review did not break new ground in dating techniques.

2.5 Text

Fischer⁹⁶ and Brovarski⁹⁷ have indicated that there are many palaeographic and orthographic variations in texts in the Old Kingdom. Fischer cited variations in glyphs *dsr*, *m*, and *w*^{e98} that

⁹³ Baud, in N. Grimal (ed.), *Les critères de datation stylistiques*, 83.

⁹⁴ Baud, in N. Grimal (ed.), *Les critères de datation stylistiques*, 33.

⁹⁵ Baud, in N. Grimal (ed.), *Les critères de datation stylistiques*, Table 4, 91.

⁹⁶ H. G. Fischer, *Inscriptions from the Coptite Nome, Dynasties VI-XI* (AnOr 40; Rome, 1964), and H. G. Fischer, *Egyptian Studies III Varia Nova* (New York, 1996).

could be used for dating in the Old Kingdom and in *Dendera in the Third Millennium*⁹⁹ he charted seventeen glyphs that could also be used for dating. He also discusses many variations of phrases like *pr.t-hrw* voice offering,¹⁰⁰ and changes to the determinatives for *ntr* from a Horus on a stand to a seated god in the fifth dynasty.¹⁰¹

Many other indicators of dating were discussed by Brovarski; the form and arrangement of elements of offering invocations, *hṭp di nsw*, *Inp.w*, *im.y-wt*, *im3h.w* and *pri.t-hrw (n=f)* are cited.¹⁰² He also observed the variations in the epithets of Osiris, *Wsir m Dd.w* and *Wsir nb Dd.w*.¹⁰³

Bárta¹⁰⁴ studied offering formula throughout the pharaonic period and classified them into offerings to the King and to Gods, and he also discussed other offering / request types such as 'burial in the west', *ḳrs.t m hrt-ntr imnt*, "a good life", *ṛnh nfr*, "thousands of bread and beer" *h3 t hnḳ.t*. In relation to the gods, in the mortuary formula, he found that Anubis appeared 100% in the tombs of the fourth dynasty. Osiris first appeared in the fifth dynasty in 13% of the tombs studied, and as a consequence Anubis' appearance dropped to 85%. In the sixth to eighth dynasties, while Osiris' appearance increased to 30%, Anubis' presence declined to 67% in the same period.¹⁰⁵ There are other criteria for dating that have been observed to be periodic in nature, such as the rendition of goddess Maat in the Old Kingdom tombs where the goddess, in the beginning of the fifth dynasty, or earlier, is depicted in a standing pose on the tomb walls. However, this depiction later changes, while remaining standing, she is now equipped with an ankh and a sceptre. Following this, another change

⁹⁷ E. Brovarski, 'Akhmim in the Old Kingdom and the First Intermediate Period', in *Mélanges Gamal ed-Din Mokhtar*, (BdE 97; Cairo, 1985); 117-154, Brovarski, in *Homages à Jean Leclant* 99-118, and E. Brovarski, 'Abydos in the Old Kingdom and First Intermediate Period, Part II', in *For his ka: essays offered in memory of Klaus Baer* (SAOC 55; Chicago, 1994), 15-44.

⁹⁸ Fischer, *Coptite Nome*, 55.

⁹⁹ H. G. Fischer, *Dendera in the Third Millennium B.C.: Down to the Theban Domination of Upper Egypt* (New York 1968), 78-85.

¹⁰⁰ Fischer, *Dendera*, 23.

¹⁰¹ Fischer, *Dendera*, 23.

¹⁰² Brovarski, in *Mélanges Gamal ed-Din Mokhtar*, 134.

¹⁰³ Brovarski, in *Mélanges Gamal ed-Din Mokhtar*, 120,124.

¹⁰⁴ Barta, *Opferformel*, 223-225.

¹⁰⁵ Barta, *Opferformel*, 225.

takes place when the image is seen seated on the ground, with no limbs, ankh or sceptre visible (this seated iconography of goddess Maat is common in the later periods with minor changes). At some point in the sixth dynasty another change occurs in the iconography of goddess Maat when she is shown seated on a throne holding a long staff. The introduction of the forearm (Gdr. D36) in the writing of the word “Maat” is also observed with the changing of the image.¹⁰⁶ Another element of dating is the beautiful name “*rn nfr*” of the tomb owner. The addition of criteria “drawn from the epigraphy and palaeography of the tombs” would be a way to provide more definitive dating results.¹⁰⁷

The above review has identified various valid and useful dating criteria for the Old Kingdom tombs. However, some studies are based on already dated tombs which can, to varying degrees, lead to circular dependency errors. Circular dependency errors are where the initial dates selected will totally determine the ranges of the criteria, and if the dates are in error so will be the results. Swinton, by maximising the use of securely dated tombs, has minimised, if not eliminated, this type of error. It is also evident that the greater the number of discriminating criteria used, the better will be the results¹⁰⁸.

¹⁰⁶ Research undertaken by a colleague but not yet published.

¹⁰⁷ Swinton, *Dating*, 171, Chapter 5.4.

¹⁰⁸ Swinton, *Dating*, 171, Chapter 5.4.

2.6 Mathematical Methods

While the above studies have used qualitative methods for study, mathematical methods have recently been explored for the collection and analysis of the data for the dating of tombs.

Bright in 2005¹⁰⁹ in the *Dating of Funerary Stelae of the Twelfth Dynasty: A Statistical Study*, used decision tree analysis to date Middle Kingdom stelae by analysing firmly dated stela to set up a decision tree. Bright methodically analysed the characteristics of seventy stelae of the twelfth dynasty that were dated by the presence of a cartouche. Then, according to characteristics based on, for example, the shape of the stelae, the position of the texts, the *htp di nsw* formula, the book roll determinative, and the writing of the name of the god Osiris, developed a decision tree. His method was to ask for a “yes” or “no” type of answer that directed to new sets of questions, which in turn directed to a specific branching path to be followed to determine the date for the stela. This process can be likened to starting from the trunk of a tree and the answer to each question will guides you to a specific branch. The process is repeated until the branch reached represents the reign of a specific king. Bright then applied the decision tree (a program developed from program AnswerTree)¹¹⁰ to thirty seven undated stele of the twelfth dynasty to study the reign of the king in which the stelae were produced. Bright then explained that the decision tree contains 30 decision points (nodes) which separates the stelae in a “group with common characteristics that assigns them to a particular regnal period.”¹¹¹ The results when tested were consistent with other previous estimates which indicated that this approach was valid. This method requires predetermined outcomes at the end of the decision tree evaluation process, and, as Bright’s criteria had been based on known stele with known attributes, is consequently limited to just those criteria. Stele with variations on the original sets of criteria would either fail or be misdiagnosed.

More recently, in 2014, Amy Calvert in her study, *The Integration of Quantitative and Qualitative Research in a Study of the Regalia of Ramses III*,¹¹² in order to better understand the functioning of the temple and the role of the king, used advanced statistical technique to

¹⁰⁹ D. Bright, ‘Dating Funerary Stelae of the Twelfth Dynasty’ *BACE* 17 (2006), 7-22.

¹¹⁰ AnswerTree is an IBM SPSS program that was available in 2001.

¹¹¹ Bright, *BACE* 17, 13.

¹¹² A. M. Calvert *The Integration of Quantitative and Qualitative Research in a Study of the Regalia of Ramses III* PhD. (New York University, 2014) (via ProQuest.com, [<http://gradworks.umi.com/34/66/3466861.html>]).

analyse the regalia of Ramesses III in the temple of Medinet Habu. The package Calvert used was IBM's SPSS program and she utilised correlation analysis, factor analysis and cluster analysis in her study. This study was to understand the cultural implication of relationships between the location in the temple and the ritual associated with that location and the regalia the king wore. To this extent, it was successful,¹¹³ and although it is still early days, it has opened up a whole new analysis tool for the study of visual features, especially those seen in Egyptian tombs.¹¹⁴

In 1970, Hodson presented a paper on "Cluster Analysis and Archaeology" where he concludes that, although Cluster analysis has improved, and encouraging results have been obtained, it is still early days.¹¹⁵ Also, more recently, cluster analysis has been used to evaluate if any reorganisation of pottery production took place during Tarascan state formation over a one thousand year period with satisfactory cross checked results.¹¹⁶ In this process, other statistical techniques to determine the similarity of the features so that those features that had the greatest likelihood of being able to form clusters, were identified and used.¹¹⁷

Summary

This review of the literature associated with tomb reporting and dating techniques has found that there still remains a contentious and highly debated issue around the most suitable method or methods of dating Old Kingdom tombs, other than applying observation and personal experience that many excavators have gained in working in their particular concessions. This debate continues despite the gains made in developing systematic and methodical approaches by scholars like Cherpion and Swinton. Accuracy in dating tombs will require a large number of criteria to narrow down the prediction intervals and as Swinton

¹¹³ Calvert, *Regalia of Ramses III*, 270-272.

¹¹⁴ Calvert, *Regalia of Ramses III*, 272.

¹¹⁵ F.R. Hodson, (1970) 'Cluster Analysis and archaeology: Some new developments and applications', *World Archaeology*, 1:3, 299-320.

¹¹⁶ A. J. Hirsham, W. A. Lovis and H. P. Pollard, 'Specialization of Ceramic production: A sherd assemblage based analytic perspective', *Journal of Anthropological Archaeology* 29 (2010), 265-277.

¹¹⁷ Hirsham, Lovis and Pollard, *Journal of Anthropological Archaeology* 29, 266-267.

suggests,¹¹⁸ many hundreds of established criteria would be needed to cover the majority of tombs as not all will be found in every tomb. With sixty four criteria determined by Cherpion and one hundred and four by Swinton, and a number of similar criteria used by both, there will likely not be enough criteria to properly date all tombs even if the methods were completely accurate. There is a need, therefore, to develop more criteria, and a different approach using more advanced scientific methods, such as statistical analysis, and the application of new methods of identifying such criteria should be tested. The problems associated with using predetermined dates or just the cartouches that appear in a tomb to develop criteria can possibly be avoided by the application of a statistical technique that does not require initial date estimates. New techniques can identify repetitive features that occur in sets of data and group these repetitive sets based on similar iconographical themes in tombs and grouping the tombs containing these similar themes. These groups then represent the developmental stages of the iconography, representing a particular time period within that development, and can then be ordered and assigned dates.

¹¹⁸ Swinton, *Dating*, 3 and footnote 30.

Chapter 3: Methods and Aims

The purpose of this chapter is to outline the methods and tools used to examine and analyse a corpus of one hundred and thirteen tombs in the Memphite area of Egypt that is Giza, Abusir, Saqqara, Dashur and Meidum. The aims, objectives and scope of the study will be discussed in this chapter, along with the statistical methods applied to the analysis of the data. The research workflow will be documented covering: tomb selection; the features to be analysed; data determination and collection; processing the data and analysing the results. Included in this Chapter is the composition of the Prosopography and Appendices and its interpretation.

Objectives

The three principle objectives of this methodology are to:

1. Determine the aims, scope and the research strategy of the study.
2. Formulate a clear research workflow and document the process for statistical analysis.
3. Explain the composition of the Prosopography and Appendices and its interpretation.

3.1 Aims

The research aims to examine selected features of the offering scenes and architectural features found in the chapel of Old Kingdom tombs, and to evaluate the extent to which statistical analysis can provide a valid method of determining and refining dating criteria. The statistical analysis component of this research will utilise IBM's statistical software package "SPSS" to identify natural clusters¹¹⁹ of correlation between the features found in the one-hundred and thirteen tombs from the Memphite cemeteries. A broader range of scenes and features than previously used are included in this analysis. The subsequent results of this preliminary analysis could then be used to introduce the use of statistical analysis methods to develop new criteria as well as to improve existing ones for the purpose of providing relative dating of Old Kingdom tombs. The objectives and scope of this methodology are discussed below.

¹¹⁹ Clusters that are 'natural groups' that exist by nature of included tomb features not by externally applied processes.

3.2 Scope

The theme of this study is the offering scene that can appear multiple times in the chapel of Old Kingdom tombs located in the Memphite area. The reason for the choice of this theme was that it regularly appears on the false door and on a number of walls in the tomb. The data for analysis is gathered primarily from various iconography of this theme where the tomb owner is seated before his offering table, and the location of this scene is usually found within the tomb chapel, and on the false door on the west wall of the chapel. The linear alignment of the chapel and the position and structure of the false door was also studied. For this study, tombs from sites beyond the Memphite area, other scene types, palaeographic and epigraphical features are not discussed. Whilst the analysis of additional thematic data would improve the accuracy of the study results¹²⁰, it is not possible at this time to include this in the study.

3.3 Research Strategy

The literature review identified two opportunities that could be combined in a research study. The first, there had been no in-depth statistical analysis studies of Old Kingdom tomb dating, and the second, tomb dates had been pre-determined or applied in a restricted manner leaving the studies open to circular dependency errors¹²¹ or restricted periods of occurrence of criteria. Statistical analysis, through cluster analysis, could offer a method where there was no necessity to pre-determine tomb dates. This study utilises statistical techniques to analyse the selected Memphite tombs¹²² in order to determine if natural groupings of tombs can be identified without first assigning tomb dates. These natural groupings can, subsequently, be compared to the range of kings' reigns that have been based on dates assigned by other scholars, and drawn from various published sources,¹²³ to test their validity. To implement this strategy, a research program has been compiled to guide and control the study process.

¹²⁰ J. Swinton, *Dating*, 171, Swinton discusses the possibility of additional data types such as epigraphy and palaeography to improve the accuracy of dating.

¹²¹ Circular dependency errors are introduced by the initial tomb date selection. Any errors in the predetermined tomb dates will be transmitted to the results as errors in the date range of affected criteria.

¹²² The details of the selected tombs, their location, and sources used in this study are included in Prosopography Volume II Appendix 1Set 1.

¹²³ As detailed in MASTABASE the Leiden Mastaba Project dates sourced from; PM III¹ and III², Harpur *Decoration*, Cherpion *Mastabas*, Kanawati, *Administration*, Baud, in Grimal (ed.), *Les critères de datation*

3.4 Research Workflow

The workflow comprises seven parts and is discussed below.

1. Scene Selection.
2. Tomb Selection.
3. Feature Selection / Data Collection design.
4. Data Collection.
5. Evaluation of and Processing with IBM's SPSS programs,
6. Analysing output ranking and presenting results,
7. Interpreting and reviewing cluster results.

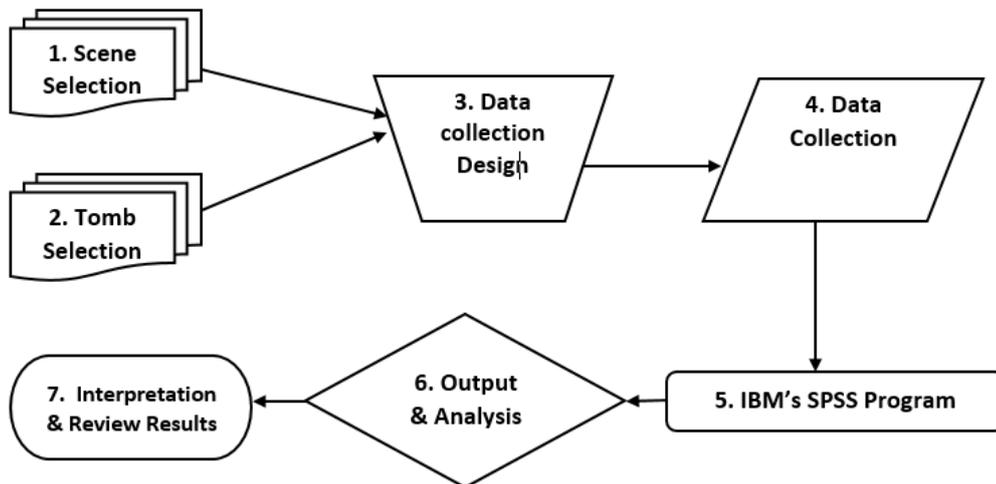


Figure 3.1 *Research Workflow*

stylistiques, and from Swinton, *Dating*. For tombs not referred to in these publications, dates were taken from the actual tomb reports as indicated in Prosopography. The table showing the compilation of these king's reigns is found in Volume II: Appendix 1 Set 2.

3.4.1 1. Scene Selection

The offering scene was selected as it was an essential part of the funerary ritual for Egyptians and was most likely to appear in all tombs throughout the Old Kingdom.¹²⁴ This scene type can be found on slab stele, false doors, and on all walls of the tombs at different times. The offering scene also provides various features¹²⁵ that can be analysed and includes a number of the criteria that has been developed by Cherpion¹²⁶ and Swinton.¹²⁷ Once the study theme was decided it became possible to consider the selection of tombs that contain these scenes.

3.4.2 2. Tomb Selection

An initial set of one hundred and forty tombs was assembled from various sources¹²⁸ with the principle requirements: first, the tombs were from the Memphite area, and second, the tombs contained a false door. The tombs were further vetted by evaluating the relevant tomb reports for each tomb, and weighing if sufficient information could be sourced to make it suitable for the study and, in addition, that the decoration to be studied was substantially intact. This process found that twenty seven tombs from the initial selection had to be culled because of the lack of a false door and/or the decoration in the tomb had badly deteriorated, which then left one hundred and thirteen tombs as suitable references for the study.¹²⁹ Table 3.1 below shows a list of areas of the Memphite necropoleis, with their full and abbreviated field names, selected for this study.

¹²⁴ M. K. Hartwig, *Tomb painting and identity in ancient Thebes 1419-1372 BCE* (MONAEG 10; Brussels, 2004), 86, 'The motif of the deceased seated before an offering table is one of the oldest images in Egyptian art.'

¹²⁵ See, M. Bárta, 'Archaeology and Iconography: bedja and aperet bread moulds and 'Speisetischszene' development in the Old Kingdom,' (SAK 22 (1995), 21-35; A. Kahlbacher, 'Bon Appetit! Bread and Reed in the Funerary Repast Imagery of the Old and Middle Kingdom' *BACE* 24 (2013), 7-20; Brovarski, in M. Barta (ed), *The Old Kingdom art and archaeology*, 71-118.

¹²⁶ Cherpion, *Mastabas* 25-82.

¹²⁷ Swinton, *Dating*, 54-67.

¹²⁸ Principally from van Walsem, *MASTABAS*, J. Swinton, *Dating*.

¹²⁹ The details of the selected tombs, their location, and sources used in this study are included in the *Prosopography Volume II: Appendix1Set1*.

Necropolis	Full Description
Abusir	South Abusir (SAS)
Dashur	South Pyramid complex of Snefru (SPCS)
Giza	Cemetery en Echelon (CeE), Central Field (CF), East Field (EF), South of Pyramid of Khufu (GIS), West Field (WF)
Meidum	Meidum North Cemetery (MNC) after Petrie (footnote);
Saqqara	South East of Teti Pyramid (SETP), East of Step Pyramid (ESP), North of Step Pyramid (NSP), North of Teti Pyramid (NTP), Unknown (UNK), Unis Pyramid Complex (UPC), West of Step Pyramid (WSP), North of Pepi II Pyramid (NP2P)

After Harpur *Decoration*.

Table 3.1 *Memphite Necropolis and Minor Fields*

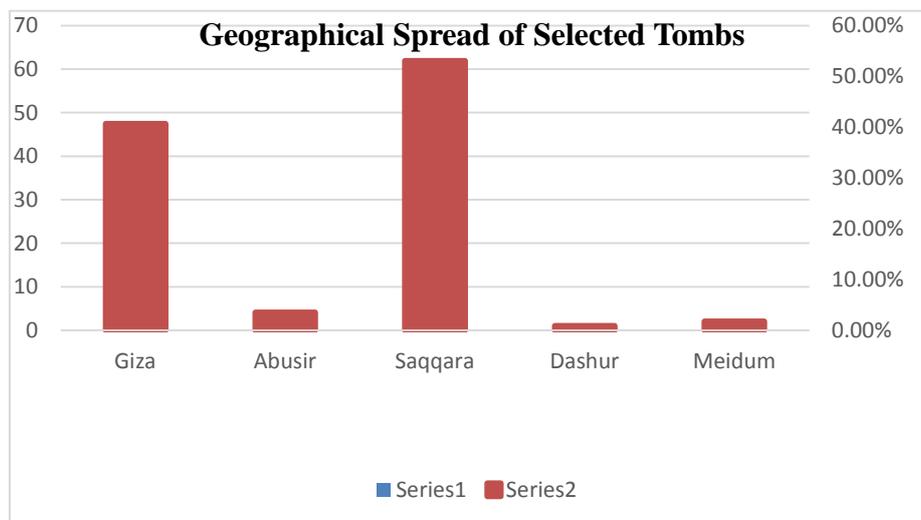


Figure 3.2 *Geographical Spread of selected Tombs*

Once the selection of the tombs and scene theme for this study was finalised the next step was to design the Data Collection process. The Data Collection design process started by selecting the individual features to be recorded from each scene.

3.4.3 3. Feature Selection / Data Collection design

An initial sample of offering scenes were subject to detailed visual analysis and scene breakdown as it was necessary to determine what features were to be collected later.

This process involved identifying a number of offering scenes and false doors features and their variations, and these were identified by dismantling the important aspects of scene compositions, guided by previous criteria that had been isolated in dating studies.¹³⁰ In order to facilitate analysis for input, all possible variations of a scene were identified and placed in five major categories; the tomb, the tomb owner, chair, offering table and architecture, and then sub-divided into smaller groups according to similar features. Table 3.2 below gives a breakdown of the division of the main five categories and their sub divisions into smaller groups. The complete list of features can be found in Appendix 1.

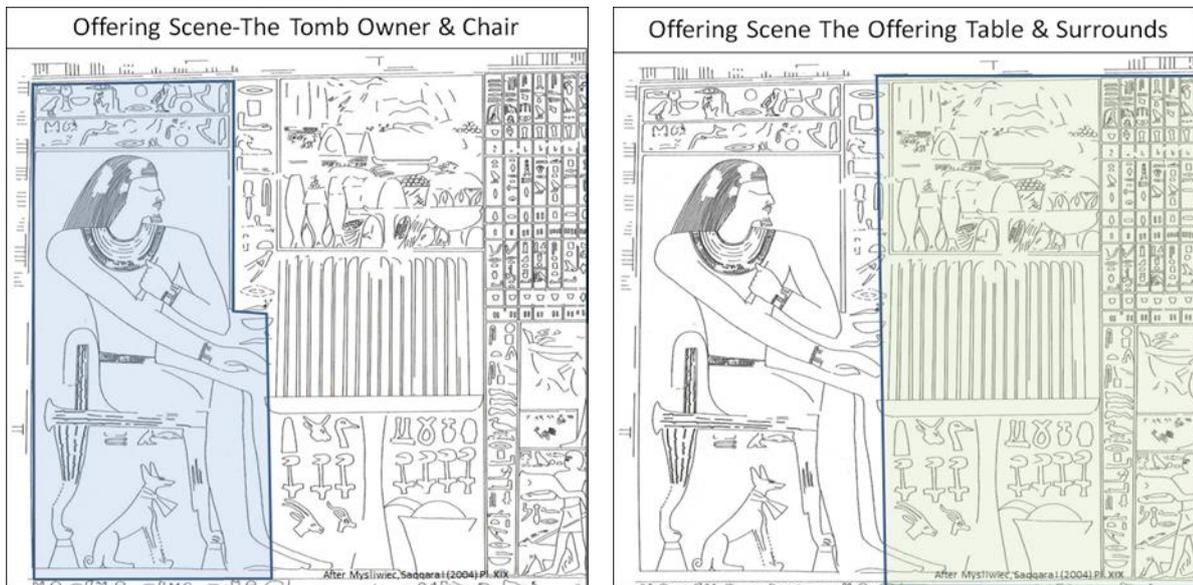


Figure 3.3 Aspects of the Offering Scene Selection

¹³⁰ Indicated by scholars' work such as Cherpion, *Mastabas*; Hassan, *Giza*; Strudwick, *Administration*; Swinton, *Dating*.

Categories	Features
1. The Tomb	1.1 King's name in a cartouche in the tomb, ¹³¹ associated with a pyramid or sun temple or within a personal name.
	1.2 tomb owner's titles indicated by <i>iry-pt</i> , ¹³² <i>h3ty-ε¹³³</i> and <i>t3yty z3b t3ty</i> ¹³⁴
	1.3 location of the tomb necropolis
	1.4 location of the offering scene/s on the walls
2. The Tomb Owner	2.1 gender
	2.2 grooming: wigs, jewellery; collars, chokers, wrist and ankle bands.
	2.3 clothing
	2.4 body posture, positioning of the arms, objects held.
3. Chair	3.1 type of construction
	3.2 type of cushion
	3.3 style of legs
	3.4 umbel or other decoration
4. Offering table	4.1 table style, plain or decorated
	4.2 number and style of bread loaves
	4.3 proportion of height of tomb owner to the height of the bread and table
	4.4 objects around the table especially offering lists and “ <i>h3</i> ” offerings and ewers
5. Architecture	5.1 chapel orientation
	5.2 false door features

Table 3.2 *Feature Categories*

All the features from the five categories were applied to each of the walls and to the false doors. This enlarged set of features became the model for data collection questionnaire. Based on this, a data questionnaire was structured to limit the number of west wall offering scene to two, and also to limit the false doors to two. Table 3.3 summarises the collection limits placed on the number of offering scenes to be examined on the walls and the false doors.

¹³¹ The names, titles and biographies found in the tomb were examined so that any king's names that may be included in a personal name or as part of a title or from the actual association of the tomb owner with the king mentioned in their biography were recorded.

¹³² Jones, *Index*, 315 [1157].

¹³³ Jones, *Index*, 496 [1858].

¹³⁴ Jones, *Index*, 1000 [3706].

No.	Wall	Offering Scene
1	The west wall	two offering scenes excluding the false door and its panel
2	The north wall	one offering scene
3	The south wall	one offering scene
4	The east wall	one offering scene
5	The false doors	two false doors

Table 3.3 *Major feature Groups*

The size of this questionnaire has meant that there was a considerable volume of data to be collected and analysed. The quantity of data to be collected from the west wall, independent of the false doors, had up to two offering scenes, while the west wall of the chapel could have up to two false doors. This collection gave between three to six offering scenes to be analysed in one tomb, with each offering scene containing approximately three hundred features to be evaluated and recorded. The initial data collection pro-forma contained around three thousand two hundred rows of feature variations for one hundred and thirteen tombs. The complete list of expanded features detailed for each of the walls and the false doors, can be found in Volume II Appendix 2. Set 2. Once the data questionnaire had been completed, the next step was to collect data for analysis.

3.4.4 4. *Data Collection*

Individual tomb reports were utilised extensively for the data collection phase where possible. However, other primary sources¹³⁵ by Mariette, Junker, Hassan, Borchardt and Lepsius were used in order to study and record the features of the iconography of the offering scene, both on the walls and on the panel of the false doors.

The data collected for all of the features which had been identified above, falls into two main mathematical categories: Continuous quantitative variables, and Categorical

¹³⁵ See Prosopography for the complete list of references for each tomb, Volume II Appendix 1 Set 1.

data. These data types need to be identified to IBM's SPSS program and are treated differently in the analysis.

1. *Continuous quantitative variables* - are variables, such as the ratio of bread height to table height or chair height and the number of loaves of bread on the table. Continuous variables can be any number between zero and infinity.
2. *Categorical data* - is a number that represents a category, for example, the presence or absence of a feature within the offering scene. Data entry used the following principles for this type of data: zero (0) represents that the feature was not present and two (2) represents that the feature was present. Where a feature that may have been present, but poor preservation prevents its positive identification, then every possible missing feature that could have been present in that missing portion of the scene was assigned one (1).¹³⁶

Data collected for the kings and their reigns was organised according to the kings' identifiers¹³⁷ that were found in the tombs, and these were recorded and annotated as follows:

- If the king's name has been used in a title or personal name it is indicated by ">" following the Reign identifier to signify a period of time during or after that king's reign,¹³⁸ i.e. V.1 > i.e. a "Terminus Post Quem," date and
- if the tomb owner was directly associated with a particular king, this is indicated by an "*" following the Reign identifier which signifies the reign of that king i.e. V.1* and
- if there is no mention of a royal name, this is indicated by a single "*".

In addition to the above list, a comparative list¹³⁹ of the range of kings' reigns that had been assigned by various scholars for each of the tombs was assembled from information contained in the Leiden Mastabas series and Swinton's and other

¹³⁶ It should be noted that during the analysis phase it was decided to remove this category.

¹³⁷ Such as Titulary or Pyramid and Sun Temple names.

¹³⁸ The correspondence between the King's reign labels and the King's name can be found in Prosopography of Study Tombs.

¹³⁹ To be found in Volume II Appendix1Set 2.

published sources,¹⁴⁰ to test their validity of the clusters produced by IBM's programs. The derivation of the range of king's reigns' list can be found in Appendix 1: Set 2.

3.4.5 5. Evaluation of and Processing with IBM's SPSS programs

The data set was processed by IBM's SPSS statistical software packages,¹⁴¹ and numbers of statistical methods supplied in the SPSS package were assessed for suitability to determine if the output is readable and clearly identifies the clusters. It was discovered that due to the data containing the combination of both continuous and categorical data, and a desire to include all data in the process, some of the algorithms were deemed not suitable. IBM SPSS' "K-Means" cluster analysis was an example of the process that could not handle both types of data simultaneously. The other modules of SPSS package to be assessed included C&RTree (Decision Tree Analysis), Principal Component analysis (Multivariate Analysis), Kohonen Network (Cluster Analysis) and TwoStep (Cluster Analysis). However, these programs required that the two types of data be split up into two groups - continuous and categorical, and identified as such for processing. Microsoft's Excel spreadsheet, which was used for collecting tomb data, had features in rows and tombs in columns. This needed to be transposed to suit the program. The evaluation will be discussed in detail in Chapter 4.

3.4.6 6. Analysing output ranking and presenting results

IBM's SPSS produces various outputs of information tailored to the program being run which range from dendrograms and component matrixes of covariance to lists of tombs against assigned clusters. Since the aim was to easily find natural clusters, the

¹⁴⁰ As detailed in MASTABASE the Leiden Mastaba Project dates sourced from; PM III¹ and III²; Harpur *Decoration*; Cherpion *Mastabas*; Kanawati, *Administration*; Baud, in Grimal (ed.), *Les critères de datation stylistiques*, and from Swinton, *Dating*. For tombs not referred to in these publications, dates were taken from the actual tomb reports as indicated in Prosopography. The table showing the compilation of these king's reigns is found in Volume II Appendix1Set 2.

¹⁴¹ IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. and IBM Corp. Released 2012. IBM SPSS Modeler for Windows, Version 14.2. Armonk, NY: IBM Corp. and product information can be found here, [http://www-01.ibm.com/software/analytics/spss/\(28-09-2015\)](http://www-01.ibm.com/software/analytics/spss/(28-09-2015)).

programs that initially provide simple relationships of tomb to cluster are favoured, as these could easily be assessed. The results from the selected SPSS package will be augmented by adding the tomb owner's name, followed by the king's reign information, tomb location and important titles, previously collected as part of the data collection. The range of kings' reigns' will be aligned with the tombs in each cluster. Then, for each cluster, the ranges shown will be evaluated to determine if at least one or more kings' reigns' was common to each of the range assigned to each tomb in that cluster. If this action shows at least one possible reign was common for each of the tombs in that cluster, then that cluster would be determined successful. Where there are no common reigns that could be fitted into each of the ranges presented for each tomb, this would be considered unsuccessful. Single tomb clusters, as they cannot be compared with any other tomb, do not provide any useful additional information and were excluded. Details of this analysis process will be discussed in detail in Chapter 4.

3.4.7 7. Interpreting and reviewing cluster results

Following the initial analysis of the output as per section 3.4.6 above, an additional vetting process, where the clusters were re-examined by using additional tomb dating resources to reassess in more detail cluster suitability, was carried out. At this time the clusters will be examined to identify what factors may have influenced the clustering and discussed. Details of this analysis process will be discussed in detail in Chapter 4.

The Methodology comprises the core of this analysis as it is the guiding principle regarding the collection and processing of the data. The actual processing of this data will be discussed in detail in Chapter 4, "The Statistical Analysis."

3.5 Prosopography Appendix 1: Set 1

The Prosopography in Volume II Appendix 1: Set 1 lists one hundred and thirteen tombs that were used in this study. The tomb selection for this study was based on substantially intact Memphite tombs with one or more false doors.¹⁴² They are presented in Necropolis sequence and sorted roughly in tomb owner's name sequence. The notation used in the prosopography is as follows:

Tomb number:	is indicated in square brackets []
Tomb Owner's name:	Egyptian transliteration font has been used
Location:	Major necropolis and necropolis field (see list below)
Tomb Identification:	Porter and Moss (<i>PM</i>) and other tomb identifiers. ¹⁴³
King's Name:	Actual references to a king in his monuments found in the tomb. (see list below)
Suggested Kings' reign:	Range of Kings' reign that has been put forward by scholars are consolidated in Appendix 1: Set 2.
Highest Rank and Titles:	Listing of the occurrence of these titles; <i>iry-p^ϕt</i> , ¹⁴⁴ <i>h3ty-^ϕ</i> , ¹⁴⁵ <i>t3ty z3b t3ty</i> . ¹⁴⁶
References:	Short bibliographic references, giving page numbers and image references are featured in this study. In addition, references are given to the prosopography numbers of the tomb in Swinton, <i>Dating</i> [], and van Walsem, <i>MASTABASE</i> [].

¹⁴² Section 3.4.2 above.

¹⁴³ Such as Giza G numbers et al as listed in *PM* III 360-365, *PM* III² 910-914, or as in new publication not yet incorporated into *PM*.

¹⁴⁴ Jones, *Index* 315 [1157].

¹⁴⁵ Jones, *Index* 496 [1858].

¹⁴⁶ Jones, *Index* 1000 [3706].

Necropolis	Field Abbreviated	Full Description
Abusir	SAS	South Abusir
Dashur	SPCS	South Pyramid complex of Snefru
Giza	CeE	Cemetery en Echelon
Giza	CF	Central Field
Giza	EF	East Field
Giza	GIS	South of Pyramid of Khufu
Giza	WF	West Field
Meidum	MNC	Meidum North Cemetery after Petrie
Saqqara	SETP	South East of Teti Pyramid
Saqqara	ESP	East of Step Pyramid
Saqqara	NSP	North of Step Pyramid
Saqqara	NTP	North of Teti Pyramid
Saqqara	UNK	Unknown
Saqqara	UPC	Unis Pyramid Complex
Saqqara	WSP	West of Step Pyramid
S-Saqqara	NP2P	North of Pepi II Pyramid

Table 3.4 *Necropoli and Minor Fields*after Harpur, *Decoration*

Although tomb dates are not being used in the cluster determination process, they are a vital part of the assessment of the validity of this process. Two sorts of King's reign information were collected for this study and are illustrated in two different ways to avoid confusion.

- The king's name found in tomb reports will follow Harpur's¹⁴⁷ notation, where the Dynasty is indicated by a roman numeral and the king is represented by an Arabic numeral to indicate the king's position in the dynasty. i.e. "V.2"
- The range of suggested reigns for a tomb will be designated in a similar manner. However, the Dynasty will be indicated by Arabic numerals. i.e. "5.1"

¹⁴⁷ Harpur, *Decoration*.

King After Oxford EAE	King's Name in Transliteration	King's Tomb Notation after Harpur, <i>Decoration</i>	Range of King's Reign Notation See Appendix 3
Dynasty 3			
Djoser	<i>Dsr</i>	III.1	3.1
Sekhemkhet	<i>Shm-ht</i>	III.2	3.2
Khaba	<i>H^cb3</i>	III.3	3.3
Nebka	<i>Nb-k3</i>	III.4	3.4
Huni	<i>Hwni</i>	III.5	3.5
Dynasty 4			
Sneferu	<i>Snfrw</i>	IV.1	4.1
Khufu	<i>Hwfw</i>	IV.2	4.2
Djedefre	<i>Dd=f-R^c</i>	IV.3	4.3
Khafre	<i>H^c=f-R^c</i>	IV.4	4.4
Menkaure	<i>Mn-k3w-R^c</i>	IV.5	4.5
Shepseskaf	<i>Špss-k3=f</i>	IV.6	4.6
???	???	??	??
Dynasty 5			
Userkaf	<i>Wsr-k3=f</i>	V.1	5.1
Sahure	<i>S3hw-R^c</i>	V.2	5.2
Neferirkare Kakai	<i>Nfr-ir-k3-R^c</i>	V.3	5.3
Shepseskare	<i>Špss-k3-R^c</i>	V.4	5.4
Raneferef	<i>Nfr=f-R^c</i>	V.5	5.5
Neuserre	<i>Ni-wsr-R^c</i>	V.6	5.6
Menkauhor	<i>Mn-k3-Hr</i>	V.7	5.7
Djedkare Isesi	<i>Dd-k3-R^c</i>	V.8	5.8
Unas	<i>Wnis</i>	V.9	5.9
Dynasty 6			
Teti	<i>Tti</i>	VI.1	6.1
Userkare	<i>Wsr-K^c-R^c</i>	??	??
Pepy I	<i>Ppy I</i>	VI.2	6.2
Merenre	<i>Mr-n-R^c</i>	VI.3	6.3
Pepy II	<i>Ppy II</i>	VI.4	6.4

Table 3.5 *Kings' Reigns*

PART TWO ANALYSIS

Chapter 4: The Statistical Analysis

The purpose of this chapter is to present the processes that were followed in the analysis phase in assessing IBM's SPSS programs, their usability, the quality of the results, and to assess the output clusters for useability by:

- reviewing the modifications to the data that were required for the programs to operate.
- Evaluating and identifying the individual packages of IBM's SPSS that were the most intuitive to use and produced suitable results.
- Analysing the output of the statistical packages, and identifying the rationale behind the ranking of the results.
- Presenting the output of selected runs.

In order to present the process for assessing SPSS program, the analysis phase was divided into three consecutive sections: Data Normalisation, Data Processing and Analysis of Results. The steps undertaken under each stage are indicated and described in detail in Figure 4.1 below.

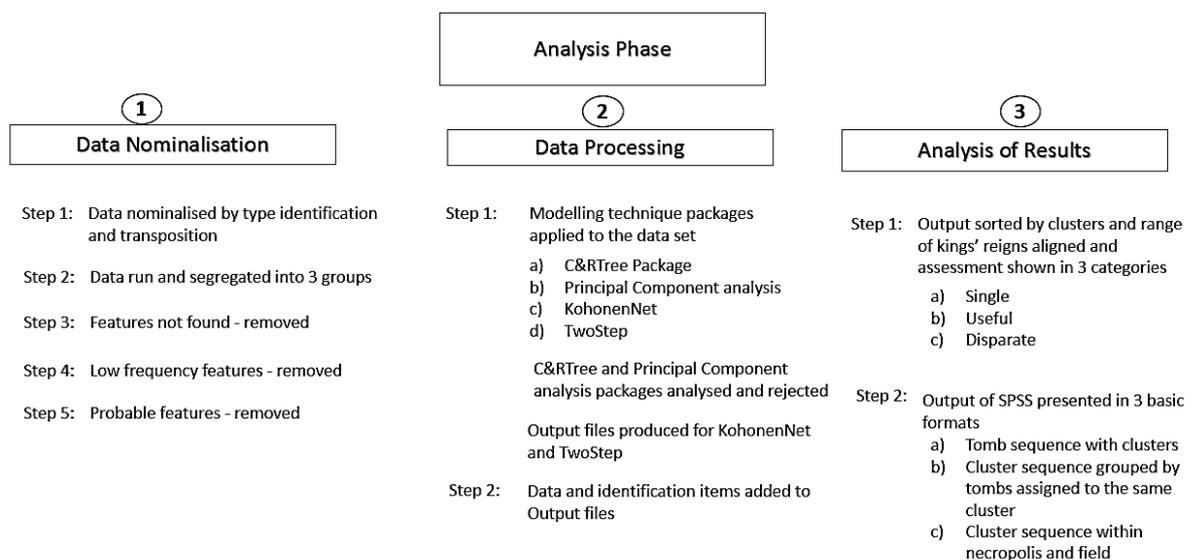


Figure 4.1 Process chart of the Analysis Phase

4.1 Data Normalisation

At the first attempt to process the data by IBM's SPSS program it became apparent the data had to be normalised, that is, by categorising and rearranging the data. The five steps undertaken for this process are described below.

Step 1: *Data nominalised by type identification and transposition.* The data was categorised and rearranged to conform to the software. This entailed the separation of continuous variables (numbers, that is, six loaves of bread, ratio of 1.25 for bread to table height), and categorical (yes or no answers, that is, 0 absent 2 present) data elements, and transposing the rows and columns so that the features were in columns and the tombs in rows.

Step 2: *Data run and segregated into 3 groups.* The initial run of the data also indicated that the data set was too large for the software to process. With around three thousand two hundred features, and one hundred and thirteen tombs being evaluated, this amounted to around three hundred and sixty thousand data points to be evaluated in the matrix. In order to facilitate processing, the full set of data was segregated into data collection groups according to the areas where offering scenes appear on walls and the false door, but excluding the east wall where only three offering scenes were found. The three groups were:

- West wall without the false door
- North and South walls
- False doors

Step 3: *Features not found – removed.* After processing the three groups of re-arranged data, additional data issues were identified and rectified. Those cases occurring where there were no occurrences of features,¹⁴⁸ and would have no impact on the analysis, were removed. For example, the north and south wall offering scenes for the tombs examined did not have any secondary figures in separate chairs at the

¹⁴⁸ See Chapter 3: Methodology & Aims 3.4.3 for the rationale of feature initial selection.

offering table. The revised data led to three thousand two hundred items of features being reduced to around one thousand nine hundred items.

Step 4: Low frequency features – removed. The data was again revised by considering the small impact that other low numbers of occurrences of some features would have on the results. Where only one positive or one to three probable occurrences were found, it was considered that these would have little, if any, statistical impact on the final results, and these were also removed.¹⁴⁹ This further reduced the features to around one thousand one hundred items.

Step 5: Probable features – removed. At the initial data entry stage all possible features, even vaguely visible, which included partially destroyed or damaged images were recorded and coded as (1) as opposed to the definite features which were assigned a (2). When it was found, by assigning all possible missing features of a sub-set with a value of probable¹⁵⁰ (1) caused a clustering of those tombs with missing features, it was decided to replace all of the remaining “one” (1) data points with “zero”. This resulted in features previously having only probable occurrences would now be showing no occurrences and step 3 above was repeated. The amended data ultimately reduced the lines of data to eight hundred and sixty two features for all walls and false doors.

After the above amendments, the full data set was able to be processed without segregation into groups. Figure 4.2 gives a diagrammatic view of the Data Normalisation process. The entire initial data base, and the final normalised data base that was used for the analysis, can be found in Appendix 4.

¹⁴⁹ The features where, there was only one definite occurrence or one to three probable were removed. Refer to Chapter 3 Methodology 3.4.4 item 2 for description of this terminology.

¹⁵⁰ For example, In the case of the body posture of the tomb owner at the offering table and the image of the arms was missing then all eight possible arm features were given (1) probable.

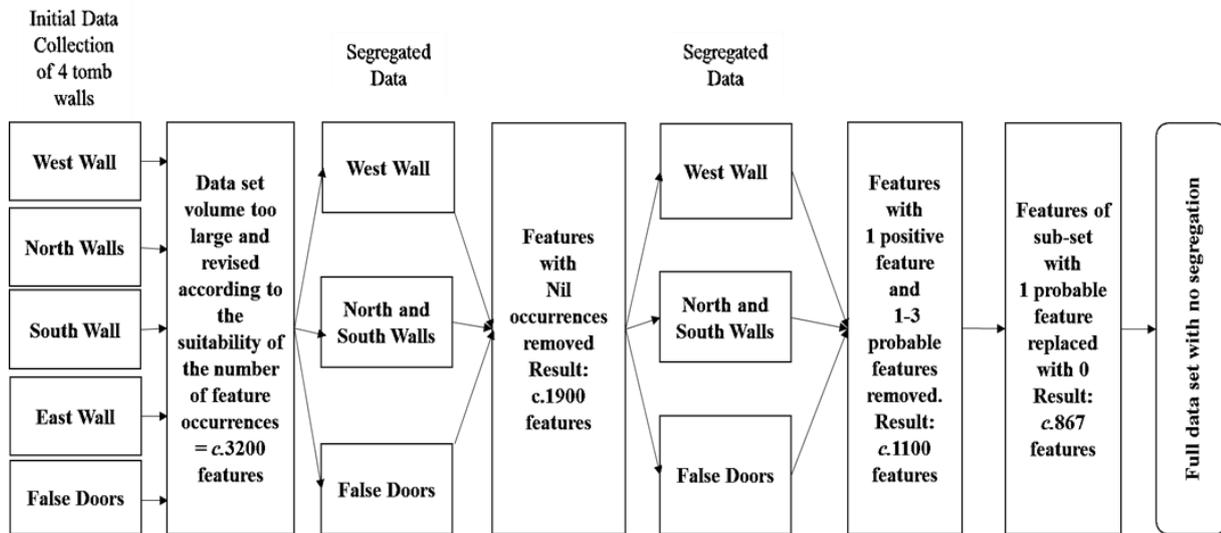


Figure 4.2 Data Normalisation Process

4.2 Data Processing

To assess the different packages offered by the IBM's SPSS program, the following steps were undertaken;

Step 1: *Modelling technique package applied to the data set.* In order to identify patterns in the data, the modelling technique packages provided by C&RTree, Principal Component analysis, KohonenNet, and TwoStep were applied to the data set.

- a) *C&RTree package:* a Decision Tree Tool for Predictive Modelling. This package needed response variables to produce decision trees, and these targets would have needed to be tomb date estimates, which was counter to the aim of this study, where estimates of tomb dates were not to be used to determine dating outcomes. Therefore, this package was eliminated from the study.
- b) *Principal Component analysis:* used to identify patterns in data by emphasising variation and combining groups of features into principal components. The results of this analysis were presented as the components of the calculated number of principal components, with a correlation coefficient relative to the features that were being examined. Turning these coefficients into "natural" clusters of tombs that share the same feature characteristics would have required an advance

knowledge of statistics which, at this stage, has not been acquired by the author. However, Principal Component analysis could possibly be used in future studies to refine features into significant groups and be utilised in cluster analysis, provided that this study sees value in using cluster analysis for this type of research. At this stage this package was also eliminated from this study.

- c) *Kohonen Networks*: this package uncovers patterns in the input data and clusters the patterns into distinct groups, and the number of clusters is determined by the program. When the program was run, the results were promising. The program produced an easy to read output that assigned clusters to each tomb, by producing a list of tomb numbers and their associated cluster number as coordinates against the X-Y axis, which were then converted to cluster numbers. A shortened sample of this output is shown in Table 4.1 below, the full results of which can be found in Appendix 3: Set 1, along with the verification results for the above runs.

With *Kohonen Networks* two data runs were carried out. The first, with the set of eight hundred and sixty two features¹⁵¹ of the full data set included, and the second, with a sub-set of data comprising all of the categorical data and the continuous data from the false doors. The rationale for the second run was to test if the way the continuous data was processed had a detrimental effect on the results. The continuous values for each feature for each tomb are averaged for analysis, for example, offering scenes do not appear for every tomb for the north wall, (as some appear on west walls and most are found on the false door) and for the other walls the continuous values are assigned zero. As a consequence, the number of zero data points for that feature could distort the averaging process and upset the cluster selection process. It was considered that this action could improve the clustering results by selecting continuous valued features only from the false doors. This is because the majority of tombs had false doors, and so the effect of the zero values would be minimised. (In fact it was found that the difference was minimal).

¹⁵¹ The full data set see 4.1 Data Normalisation Step 5 above.

X Co-ordinate	Y Co-ordinate	Cluster Number	Tomb Number
16	0	1600	T1
14	4	1404	T2
12	2	1202	T3
4	6	406	T4
2	6	206	T5
0	2	2	T6
8	7	807	T7
10	2	1002	T8
7	3	703	T9
6	7	607	T10
16	10	1610	T11
16	2	1602	T12
12	9	1209	T13
14	8	1408	T14
6	2	602	T15
8	11	811	T16

Table 4.1 *KohonenNet Cluster Initial Output sample*

- d) *TwoStep Cluster Component*: similar records are grouped into clusters but the user is able to determine the number of clusters desired. Thirty clusters were chosen for all of the TwoStep runs. This package was run using the same two data sets that were discussed above, and, like the Kohonen Net, provided promising results. The package also produced easy to read output that assigned clusters to each tomb by producing a list of tomb numbers and their associated cluster number as shown in Table 4.2 below. The full results can be found in Appendix 3: Set 2, along with the verification results for both the runs.

Tomb	Cluster All Data		Tomb	Cluster Categorical and FD
T1	29		T1	29
T2	29		T2	30
T3	26		T3	21
T4	3		T4	3
T5	6		T5	5
T6	22		T6	20
T7	1		T7	1
T8	21		T8	26
T9	1		T9	2
T10	1		T10	1
T11	12		T11	13
T12	18		T12	18
T13	9		T13	11
T14	8		T14	10

Table 4.2 *TwoStep Analysis 30 Clusters Initial Output sample for 2 runs*

Step 2: To prepare the output for initial assessment and subsequent interpretation, several additional items of identification data were added to the output files, a snapshot of which appears in Table 4.3 below. The additional data added were the tomb owner's name; the range of reigns assigned to the tomb; the terminus post quem king's reign that had been established from the tomb reports¹⁵²; the tomb's necropolis and field within the necropolis; and the presence of certain titles, namely: *iry-p^ct*,¹⁵³ *h3ty-^c*¹⁵⁴ and *t3ty z3b t3ty*.¹⁵⁵

TwoStep Tomb Sort All data									
Tomb Number	Cluster	Tomb Owner	Actual Reign Found	Range of Reigns Proposed	Necropolis	Field	<i>iry-p^ct</i>	<i>h3ty-^c</i>	<i>t3ty z3b t3ty</i>
1	16	<i>K3=i-^cpr</i>	*	4.1-5.3	Abusir	SAS			
2	16	<i>Ntr-^cpr=f</i>	IV.1>	4.1-5.9	Dashur	SPCS			
3	17	<i>Htp-ni-Pth</i>	V.8>	5.8-6.2	Giza	WF			
4	5	<i>T3sn</i>	IV.2>	4.2-6.4	Giza	WF			
5	5	<i>Tdw</i>	VI.2>	6.2-6.4	Giza	EF			
6	24	<i>Tri-n-3htl : Tri-n-Pth : Tri</i>	IV.5>	4.5-6.4	Giza	CF			
7	1	<i>Irrw</i>	*	5.4-6.4	Giza	CF			
8	15	<i>Tsn</i>	*	5.2-5.9	Giza	CF			
9	1	<i>Tw-nw</i>	*	4.2-4.4	Giza	WF			
10	1	<i>Iy-mry</i>	V.3>	5.3-5.9	Giza	WF			
11	9	<i>K3-hl=f</i>	IV.2>	4.2-6.4	Giza	WF			
12	21	<i>K3=i-m-^cnh</i>	*	5.8-6.4	Giza	WF			
13	14	<i>K3.w-nswt</i>	IV.6>	4.5-5.9	Giza	CF			
14	13	<i>K3=i-m-nfrt</i>	V.3>	5.3-6.4	Giza	CF			

Table 4.3 Completed Cluster Result TwoStep 30 Cluster Sample

4.3 Analysis of Results

In order to assess the different clusters produced by the IBM's SPSS, Kohonen Networks and TwoStep cluster programs, for initial suitability, the following steps were undertaken.

Step 1: *Output sorted by clusters and range of kings' reigns aligned and assessed into three categories.* After the additional information was added to output files, the amended output was sorted by clusters, and the ranges of king's reigns were aligned to assess the common periods of king's reign present for each tomb in that cluster.

¹⁵² Discussed in. Chapter 3: Methodology 3.4.6,

¹⁵³ Jones, *Index*, 315 [1157].

¹⁵⁴ Jones, *Index*, 496 [1858].

¹⁵⁵ Jones, *Index*, 1000 [3706].

The assessment to categorise the data into three categories was made and labelled as “Single”, “Useful” and “Disparate” accordingly.

2.1 “Single”: if the cluster had only one tomb. This does not provide any useful additional information.

2.2 “Useful”: if, for clusters with multiple tombs, the cluster contained one or more periods that correlated with all of the tombs in that cluster.

2.3 “Disparate”: if, for multiple tomb clusters, no periods were identified where the tombs shared a common reign.

In order to exemplify this process, Table 4.4 below outlines an example of a cluster sort with the assignment of clusters shown. The clustering had been determined by similarities in the clustered tombs and does not necessarily indicate that all the tombs in a cluster have the same date, but that the tombs in the clusters share common features with each other more so than other tombs that lie outside that cluster. Single tomb clusters did not add any value to the process, nor did those clusters, for example, cluster 1 below where estimates of king’s reigns show a wide range from 3.2 to 6.2. However, clusters 2 and 4 show a narrow range 4.3-5.9 - 5.9-6.4 and 5.3-5.9 - 5.6-5.9 respectively in the periods of correspondence, and as such, can be considered useful.

TwoStep Cluster Sort All data												
Tomb Number	Cluster	Tomb Owner	Actual Reign Found	Range of Reigns Proposed	Necropolis	Field	<i>iry-pꜣt</i>	<i>ḥ3ty-ꜣ</i>	<i>t3ty z3b ḥ3ty</i>	Single	Useful	Disparate
7	1	<i>Irrw</i>	*	5.4-6.4	Giza	CF						1
9	1	<i>Iw-nw</i>	*	4.2-4.4	Giza	WF						
10	1	<i>Iy-mry</i>	V.3>	5.3-5.9	Giza	WF						
15	1	<i>K3 = i-nfr</i>	*	4.2	Giza	WF						
17	1	<i>K3 = i-ni-nswt 11</i>	IV.2>	4.2-5.8	Giza	WF						
23	1	<i>Nfr-b3.w-Pth</i>	V.6>	5.4-5.8	Giza	WF						
27	1	<i>Rꜣ-wr 11</i>	*	5.6-5.9	Giza	WF						
44	1	<i>Wp-m-nfr.t</i>	*	4.2	Giza	WF						
57	1	<i>Ḥsy-Rꜣ.w</i>	*	3.1-3.3	Saqqara	NSP						
110	1	<i>Htpi</i>	*	3.2-3.4	Abusir	SAS						
35	2	<i>Ssm-nfr 1</i>	IV.3>	4.3-5.9	Giza	WF					1	
38	2	<i>St-k3 = i</i>	*	5.9-6.4	Giza	CeE						
46	3	<i>Ḥwfw-ḥꜣ = f 11</i>	V.6>	5.6	Giza	EF						1
86	3	<i>Pth-ḥtp 11 : Tfw</i>	V.8>	5.8-5.9	Saqqara	WSP						
76	4	<i>Nfr-irt-n = f</i>	V.3>	5.3-5.9	Saqqara	ESP					1	
101	4	<i>Ty</i>	V.6>	5.6-5.9	Saqqara	NSP						

Table 4.4 Sample initial results table sorted by cluster

Step 2: *Output of SPSS presented in 3 basic formats.* After the data was added and the clusters assessed, the results were presented in three basic formats.

- 2.1 *Tomb sequence* that listed all of the tombs with their assigned cluster;
- 2.2 *Cluster sequence* that grouped all of the tombs that were assigned the same cluster together;
- 2.3 *Cluster within necropolis and field* was carried out to assess if considering the location of the tomb had any significant impact on the suitability of the clusters. However, it appears that this has a detrimental effect on the percentage of useful clusters.

The tables that contain the Kohonen Net results can be found in Appendix 3: Set 1, and the TwoStep runs in Set 2 results are outlined above. A summary of these results is presented below.

4.3.1 *The Presentation of the Kohonen Net Results*

The first run produced 66 clusters for the complete set of data. A summary of the results is listed in Table 4.5 below.

Type of Data	All Data
Single clusters	34 (51.5%)
Useful Clusters	25 (37.9%)
Disparate clusters	7 (10.6%)

Table 4.5 *KohonenNet Run 66 Clusters*

The second run produced 63 clusters for just the categorical data and the false door data from the continuous data. A summary of the results is listed in Table 4.6 below.

Type of Data	Categorical Data plus FD continuous Data
Single clusters	27 (42.9%)
Useful Clusters	27 (42.9%)
Disparate clusters	9 (14.3%)

Table 4.6 *KohonenNet Run 63 Clusters*

The above tables demonstrate that the second run produced only a small increase in the number of suitable clusters, which indicates that the zeros included in the continuous data did not present a problem. The data was then sorted by cluster within necropolis / field, to see if this arrangement of the data would produce better results. The necropolis sort did not improve the number of useable clusters, rather they were reduced by more than 40% for both data sets being used. Table 4.7 below summarises the results of both the Necropolis sort runs.

Type of Data	All data	Categorical Data plus FD
Single clusters	66 (76.7%)	50 (65.8%)
Useful Clusters	17 (19.8%)	19 (25.0%)
Disparate clusters	3 (3.5%)	7 (9.2%)

Table 4.7 *KohonenNet Runs Necropolis Sort*

4.3.2 The *TwoStep Cluster analysis*

The runs were constrained to 30 clusters and the results shown below represent the same type of runs of the data performed by the KohonenNet process. (Refer to Tables 4.8 for the cluster sort run and 4.9 for the results of the necropolis sort). The cluster sort runs produced good results, that is, in the order of 50% of the clusters giving suitable results. As was the case with the KohonenNet runs, the TwoStep necropolis sorts did not produce any improvement in useful clusters.

Type of Data	All data	Categorical Data plus FD
Single clusters	4 (13.3%)	5 (16.7%)
Useful Clusters	15 (50.0%)	13 (43.3%)
Disparate clusters	11 (36.7%)	12 (40.0%)

Table 4.8 *TwoStep Analysis 30 Clusters sorted by Cluster*

Type of Data	All data	Categorical Data plus FD
Single clusters	18 (35.3%)	21 (42.0%)
Useful Clusters	25 (49.0%)	20 (40.0%)
Disparate clusters	8 (15.7%)	9 (18.0%)

Table 4.9 *TwoStep Analysis 30 Clusters sorted by Necropolis*

4.4 Summary

The analysis of IBM's SPSS computer statistical processing produced better than expected results for the first cut runs of the data. This result has been achieved without attempting to isolate features that could produce even better results by selectively analysing significant features.

The TwoStep analysis with 50.0% of suitable clusters offers significant potential. It needs to be demonstrated that these usable clusters can be shown to produce sensible groups of tombs when reviewed in the more conventional manner. This extra evaluation needs additional sources to double check the initial assessment. If this process of determining clusters for tomb dating purposes is to be considered as a valid process, confidence in the process is required. This will be done in the next chapter where these results will be critically examined to establish if the process of analysing tombs by Cluster analysis has any viability for additional work.

Chapter 5: Interpreting the Results

This chapter interprets the results of the All Data run produced by IBM's SPSS TwoStep program. The verification process was only applied to the “Useful” clusters of the TwoStep run of the full reduced data set that had shown meaningful results. Each cluster in the analysis phase was assigned an initial rating of either “Single”, (a single tomb in a cluster), “Useful” (tombs with common kings’ reigns period/s), or ‘Disparate’ (tombs where there were no common kings’ reign period/s). The clusters were reviewed to establish if the “Useful” classified clusters, on deeper analysis, continued to have common kings’ reign periods. After this analysis, some of the “Useful” clusters were reassigned to “Disparate”. In addition, any features, groups of features, or absence of features that appeared to be the reason for the cluster was discussed. A small sample of “Disparate” clusters was also reviewed. The process that was followed is outlined in the Interpretation Process below.

5.1 Interpretation Process

Step 1: The range of kings’ reigns was reviewed for each cluster as the ranges of the proposed dates, when concatenated, were sometimes broad. By closer examination, the aim was to establish if the common period/s that appeared in the cluster were still appropriate, and to remove any extreme proposals in order to further verify that the correlation of the cluster date ranges, original tomb reports and other discussions on the dates of the tombs in the clusters were also examined.

Step 2: A table of the data collected for each set of tombs aligned in their cluster was prepared to enable easy visual comparison. The tombs were reviewed to note the common set of features, the presence or absence of which could have enabled the clustering of the tombs. However, features that appear in most tombs were not commented on as they would not have been the reason for clustering. Because of the state of preservation of some of the tombs, the degree of contribution was not always consistent across all drivers of clustering.¹⁵⁶ There were four classes of contribution:

¹⁵⁶ These drivers are: West wall offering scenes (but not the false door panels), including reference to a second person who would be sitting across from the principle figure in a separate chair and also a separate table (i.e. a

full data; partial data; tiny amount of data; and no data. Where comments refer to some contribution from specific drivers, it refers to areas of the tomb that had partial or few numbers of features recorded and, as a result, lesser possible contribution to the clustering.¹⁵⁷

5.2 IBM's SPSS TwoStep Cluster Interpretation

The overall results of the TwoStep cluster run showed 30 clusters; 4 “Single” clusters, 15 “Useful” and 11 “Disparate” clusters. The summary is shown in Table 5.1.

Type of Data	All data
Single clusters	4 (13.3%)
Useful Clusters	15 (50.0%)
Disparate clusters	11 (37.9%)

Table 5.1 – *Two-Step Analysis 30 Clusters sorted by Cluster*

second table). The north and south wall offering scenes, and the south and north false doors including their panels, also with a second person and table representation as for the west wall scenes.

¹⁵⁷ Refer to Volume II Appendix 3 Set 3 for the Table of Major Cluster Groups.

The following Table 5.2 outlines the description of the key fields found in the Cluster Table.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014). 9–44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpiion	Kanawati	Other	Source of Other
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Field Number	Description of Field
1	The number of tomb as per Prosopography. ¹⁵⁸
2	The cluster number assigned by the IBM SPSS run.
3	The name of the Tomb owner
4	The main necropolis name (see Prosopography)
5	The necropolis field abbreviation (see Prosopography)
6	The latest cartouche that was found in the tomb (see Prosopography)
7	Study determination of the range of reigns based on estimates from Data listed after from R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014)., 9–44. See Appendix 2:2 for full derivation of this table
8	Estimates from Swinton, <i>Dating</i> .
9	Mastabase's estimate based on their collected data
10	Estimate from Porter and Moss Volumes
11	Estimates from Harpur, <i>Decoration</i> .
12	Estimates from Cherpion, <i>Mastabas</i> .
13	Estimates from Kanawati, <i>Administration</i> .
14	Other data estimates, source given and identified in column 15
15	Identity of source of column 14

Table 5.2 Cluster Panel Key Fields description

¹⁵⁸ See Volume II Appendix 1 Set 1.

The detailed cluster results are presented in tables with the grouping of ‘Useful’ clusters followed by ‘Useful’ reassigned to ‘Useful’ with new date, ‘Useful’ reassigned to the ‘Disparate’, and finally, a number of the ‘Disparate’ clusters. ‘Single’ tomb clusters were excluded.

5.2.1. “Useful” clusters

Cluster 7: “Useful” Common period 6.2.

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawati	Other	Source of Other
62	7	<i>Trits : Ty</i>	Saqqara	NTP	VI.1>	6.1-6.4	*	*	*	*	6.1	*	6.2-6.4	Kanawati
90	7	<i>R^c-wr</i>	Saqqara	E-SETP	*	6.2-6.4	6.2	*	6.4	6.2	*	*	*	
91	7	<i>Rmni : Mrwi</i>	Saqqara	NTP	VI.1>	6.1-6.2	6.1-2	*	*	*	*	*	*	

Reference Kanawati¹⁵⁹

Cluster 7 grouped tombs 62, 90 and 91. The result is in line with the scholars’ dates stated in tomb reports¹⁶⁰ and all the scholars support a likely 6.2 date for these tombs.

The common features of these tombs were multiple offering scenes on the west wall between multiple false doors. The offering scenes contained chairs with backs and cushions over the backs, lion’s legs with small rear umbels, matting/platforms under the chairs, and ewers under the table and with piled offerings in front of the tables. No offering scenes were depicted on the north or south walls, and all the chapels have a north south orientation with two sets of false doors with two sets of jambs and cavetto cornice and torus mouldings. Tomb

¹⁵⁹N. Kanawati, A. El-Khouli, A. McFarlane and N. V. Maksoud, *Excavations at Saqqara, I: North-West of Teti’s Pyramid* (Sydney, 1984), 47–58.

¹⁶⁰ Kanawati et al., *Excavations at Saqqara I*, 48; S. A. el-Fikey, *The Tomb of the Vizier Re-Wer at Saqqara* (Egyptology Today 4; Warminster, 1980), 44–46 and N. Kanawati, *The Teti Cemetery at Saqqara IX: The Tomb of Remni* (ACE Reports 28; Oxford, 2009), 18.

62 has reduced height apertures which support the later date, but tombs 90 and 91 have plain apertures. The chairs in the panels have lion's legs and small umbels.

Cluster 15: "Useful" Common period 5.9.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpuon	Kanawati	Other	Source of Other
8	15	<i>Tsn</i>	Giza	CF	*	5.2-5.9	*	*	5.4-5.9	5.6-5.8	*	5.2-5.6	*	
73	15	<i>Nbt</i>	Saqqara	UPC	V.9>	5.9	5.9	5.9	5.9	5.9	5.9	*	5.9	Baud
96	15	<i>Sšsšt : Idwt</i>	Saqqara	UPC	VI.1>	5.9-6.2	5.9-6.1	6.1	6.1-6.4	6.1-6.2	6.1	*	6.1	Baud

Reference Baud¹⁶¹

This cluster consists of tombs 8, 73 and 96. According to Kanawati¹⁶² the construction of tomb 96 was most likely during 5.9 and used in 6.1. Tomb 73 belongs to the *Nbt*, the wife of Unis¹⁶³ and has been dated to 5.9 or early 6.1 for the burial. Tomb 8 is uncertain as Hassan does not provide an estimate date, but *PM* has proposed 5.9 and placed it in the middle fifth dynasty or later, which could make 5.9 tenuous. Therefore, this cluster could be classified as "Useful" but doubtful at 5.9.

The common features of these tombs were few. The main areas for the cluster formation were the north wall and the southern false door where the tombs have cavetto cornices and torus mouldings. Preservation affected most of the other areas. Tombs 8 and 96 each have a west wall with independent offering lists to the north of false doors. On the north wall all tombs have 18 loaves, tomb 8 with flat base, the others with small necked bases. The chairs have backs with cushions over the backs. With the southern false door there was no consistent chapel orientation.

¹⁶¹ M. Baud, *Famille*, 489 [115] for tomb 73 and 564–565 [202] for tomb 96.

¹⁶² N. Kanawati, and M. Abder-Raziq, *The Unis Cemetery at Saqqara, II: The Tombs of Inyefert and Ihy (reused by Idut)* (ACE Reports 19; Oxford, 2003), 36–37.

¹⁶³ Swinton, *Dating*, 28 [50].

Cluster 17: “Useful” Common period 6.1–6.2.

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherption	Kanawati	Other	Source of Other
3	17	<i>Htp-ni-Pth</i>	Giza	WF	V.8>	5.8-6.2	*	*	6.1-6.2	6.1	5.8	*	*	
60	17	<i>Tn.w-Mn.w</i>	Saqqara	NTP	VI.2	6.1-6.2	6.1-2	*	*	*	*	*	*	
88	17	<i>Pth-šps I</i>	Saqqara	NSP	*	6.1-6.4	*	*	6.1-6.4	6.2	*	*	*	
108	17	<i>Hnti-k3 = I : ThhI</i>	Saqqara	NTP	VI.2>	6.1-6.2	6.1-2	6.2	6.2	6.2	6.2	6.1-6.2	*	

Cluster 17 contains tombs 3, 60, 88 and 108. Tomb 60 is clearly dated to the reign of early 6.2 by changes in a cartouche,¹⁶⁴ reflecting the change in the throne name of Pepy I, but most likely served under Teti as well. The same situation of working under Teti and Pepy exists for Tomb 108, which has the cartouches of both these kings in the tomb. Tombs T3 and T88 based on *PM* dates fit into the 6.1–6.2 range as well. Therefore, this tomb remains useful 6.1–6.2.

These tombs did not have any complete west or south wall offering scenes and the rest of the walls had deteriorated as well. All the tombs have north wall offering scenes, and all the tomb owners wore short kilts with belts. Only one false door was in the southern position, with the tomb owners seated in chairs with backs and with cushions at the back, but with nothing under the chairs that shows lion’s legs.

Cluster 19: “Useful.” Common period, 5.2.

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherption	Kanawati	Other	Source of Other
41	19	<i>TntI</i>	Giza	CeE	IV.2>	4.2-5.9	*	*	5.1-5.9	5.1-5.5	4.2	4.5	*	
81	19	<i>Nn-hft-k3</i>	Saqqara	ESP	V.2>	5.2-5.9	*	*	5.2-5.9	5.6	5.2	*	*	
83	19	<i>Ni-nh-Šhmt</i>	Saqqara	NSP	V.2*	5.2	5.2	*	5.2	*	*	*	*	

¹⁶⁴ N. Kanawati, *The Teti Cemetery at Saqqara VIII: The Tomb of Inumin* (ACE Reports 24; Oxford, 2006), 16–17.

This cluster grouped three tombs, 41, 81 and 83. Tomb 41 is placed at early fifth dynasty or later by *PM*. Tomb 83 is placed in Sahure’s reign by *PM* and Swinton based her date on his biography. Tomb 81 is dated to Sahure or later by *PM*. This cluster can remain classified “Useful” at 5.2.

The common features of this cluster were the southern false doors, all with secondary figures. There were no wall offering scenes in any of these tombs. The tombs have one southern false door with mixed jambs, except tomb 41 which has a second false door without a panel. The panel offering scenes in the southern false door have chairs with bull’s legs, with no matting and nothing under the chairs for both the primary and secondary figures at the table. The bread with flat base and the orientation of half loaves was the same for all tombs. The chapel axis orientation was not consistent, as some were N-S and others were E-W. All figures wore short collars but the female secondary figures also wore long plain wigs past their shoulders with ears showing; and long plain dresses with straps. Their left arm rested on their legs and the right arm reached for the offering.

Cluster 27: “Useful.” Common period 6.1–6.2.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	<i>PM</i>	Harpur	Cherpton	Kanawati	Other	Source of Other
102	27	<i>Wꜣtt-ht-hr</i>	Saqqara	NTP	VI.1*	6.1	6.1	6.1	6.1	6.1	6.1	*	6.1	Baud
103	27	<i>Wꜣꜥ-ḥꜥ-Tꜣ : Nfr-sšm-Pth : Šst</i>	Saqqara	NTP	VI.2*	6.1-6.2	6.1-2	6.1-6.2	6.1-6.3	6.1-6.2	6.1	*	6.1-6.2	Baud

Reference Baud.¹⁶⁵

Tombs 102 and 103 clustered together. Tomb 103 is clearly dated to the time of Teti and Pepy I as indicated by the cartouches in the owner’s titles (6.1 and 6.2).¹⁶⁶ Kanawati

¹⁶⁵ Baud, *Famille*, 434-435 [44] for tomb 102 and 440 [52] for tomb 103.

¹⁶⁶ A. B. Lloyd, A. J. Spencer and A. el-Khouli, *Saqqara Tombs III: The Mastaba of Neferseshemptah* (EES ASM 41; London, 2008), 1–2.

considered that it was possible that tomb 102 could have been decorated in the time of Pepy I.¹⁶⁷ This cluster should remain “Useful”.

The overall cluster was determined by the north and south wall offering scenes, with few similar features from the false doors. Tomb 103 has poor preservation so direct comparisons are difficult, however both the tombs have north and south offering scenes only. Both the tombs have the north–south walls; chairs with visible back; cushion over the back; have similar ratios of table bread that aligns to the height of the tomb owners. Tomb 102 has long necked bread while tomb 103 has short necked bread, and both the tombs have similar numbers of loaves. Also both the tombs have canonical offering lists above the table on the north wall (partly preserved T102: 104, T103: 21 at least). Only one false door with the east–west chapel axis is in both tombs. The main differences in these tombs were, tomb 102’s false door was decorated with palace facade and tomb 102 has a bust inserted into the location of the panel.

Cluster 28: “Useful.” Common period 6.1.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawati	Other	Source of Other	
70	28	<i>Mrw : Tt-snb : Ppy-snb : Mry-R^c-snb</i>	Saqqara	NTP	VI.2>	6.1-6.4	6.1-2	6.2-6.4	6.2-6.4	6.2	*	6.1-6.4	*		
93	28	<i>Sⁿhw-Pth</i>	Saqqara	NTP	VI.1>	6.1	6.1	*	*	*	*	*	6.1	Kanawati	

Reference Kanawati:¹⁶⁸

Tombs 70 and 93 form this cluster. It is clear that both tombs were probably started in the late reign of Teti.¹⁶⁹ The cluster should remain “Useful”. The main features that contributed to the formation of this cluster were from the west wall offering scene, the north wall scene and the southern false door. Several features of these tombs have similar artistic renditions. Both tombs have a west wall offering scene, south of the false door in a north south chapel.

¹⁶⁷ N. Kanawati, and M. Abder-Raziq, *Mereruka and his Family, II: The Tomb of Waatetkhetor* (ACE Reports 26; Oxford, 2008), 13–15.

¹⁶⁸ N. Kanawati, and M. Abder-Raziq, *The Teti Cemetery at Saqqara, III: The Tombs of Neferseshemre and Seankhuiptah* (ACE Reports 11; Warminster, 1998).

¹⁶⁹ See Kanawati and Abder-Raziq, *Teti Cemetery III*, 40–41 and Swinton, *Dating*, 24 [35].

The tomb owners have similar postures at the offering table with their left arm holding cloth near legs, and the right touching the offering. Similar objects under the offering table with ewers and vessels in stands. Canonical offering lists are shown above the table (T70: 96 and T93: 96). The north wall also has an offering scene. There is only one false door in each tomb, with two sets of jambs with cavetto cornice and torus mouldings.

Cluster 30: “Useful.” Common period 6.1–6.3.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Carouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Chepion	Kanawat	Other	Source of Other
52	30	<i>Ni-nh-nfrtm.w : Tmi</i>	Saqqara	WSP	VI.1>	6.1-6.3	*	*	*	*	*	*	*	Mysliwec
95	30	<i>Mr=f-nb=f:fj</i>	Saqqara	WSP	VI.1>	6.1-6.3	*	*	*	*	*	*	*	Mysliwec

Reference Mysliwec.¹⁷⁰

This cluster consists of two tombs, 52 and 95, and was determined by the data from the west and north wall scenes, with two false doors in each tomb. Both the tombs are from the same area at Saqqara WSP, side by side to the west of the step pyramid and sharing the same courtyard. The cluster should remain “Useful”.

Both tombs have north south chapels with the west wall offering scenes between the false doors. Both tomb owners have short beards, shoulder length plain wigs, broad collars and short kilts. Seat backs are shown with cushions over the back and both chairs have lion’s legs with small umbels. On the north wall offering scenes the tomb owner is similar in rendition as on the west wall, with the addition of both the offering scenes depicted with offering lists (tomb 52: 93 items and tombs 95: 96 items). The southern false doors have differing jambs (tomb 52: three sets and tomb 95 one set). Chair backs are concealed by cushions and the ratio of heights of table/bread/ tomb owner are similar for both the tombs. The northern false doors jambs are of two sets each.

¹⁷⁰ K. Mysliwec, and K. O. Kuraszkiewicz, *Saqqara IV: The Funerary Complex of Nyankhnepferem* (Varsovie, 2010), and K. Mysliwec, K. Kuraszkiewicz, D. Czerwik, T. Rzeuska, M. Kaczmarek, A. Kowalska, M. Radomska, Z. Godziejewski, *Saqqara I: The Tomb of Merefnebef* (Varsovie, 2004).

5.2.2. “Useful” reassigned to “Useful” with new date

Cluster 4: “Useful” Common periods 5.6–5.9, reassigned to “Useful” 5.8.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawat	Other	Source of Other	
76	4	<i>Nfr-irt-n=f</i>	Saqqara	ESP	V.3>	5.3-5.9	*	5.3	5.3-5.9	5.8-5.9	5.3	*	5.8-5.9	Decker	
101	4	<i>Zy</i>	Saqqara	NSP	V.6>	5.6-5.9	*	5.6-5.9	5.6-5.9	5.8-5.9	5.6	5.8	*		

Reference Decker¹⁷¹

Cluster 4 grouped tombs 76 and 101. For tomb 76 range of proposed dates span 5.3 (tomb dated by cartouche) to 5.9, with the majority extending to 5.9, but with 5.8 to 5.9 mentioned twice. For tomb 101, by again taking the most likely of the proposed ranges by the scholars, then 5.6–5.9 seems to be the common result. In *Administration* Strudwick dates 101 to late Neuserre,¹⁷² 5.6, which is in the bottom range of the proposals. Consequently, tomb 101 could be assigned 5.6 to 5.8 with a degree of confidence which would make the 5.8–5.9 for tomb 76 a useful match for this cluster. Therefore, this cluster is classified “Useful” at 5.8.

The strong areas of commonality for both tombs were the offering scenes, one on the south wall, along with the two false doors. The grooming of the primary figures on the west wall was difficult to assess due to poor preservation. The appearance of the tomb owner on the south wall and on the false door panels were the same. Bread styles were different but the orientation, symmetrical with straight sides facing in, was the same on both tombs. Apertures were decorated on the south false door for both tombs with palace façade on tomb 76 and text on tomb 101.

¹⁷¹ W. Decker and M. Herb, *Illustrated Atlas of Sports in Ancient Egypt. Corpus of pictorial sources to physical exercises, game, hunting, dance and related topics*. Part I: Text; Part II: panels, (Leiden, 1994), 388.

¹⁷² Strudwick, *Administration*, 159.

Cluster 12: “Useful” Common period 4.4–5.3, reassigned to 5.2–5.3.

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Haupt	Cherption	Kanawat	Other	Source of Other
26	12	<i>Nswt-nfr</i>	Giza	CeE	IV.4>	4.4-5.6	4.5-5.1	4.4	5.1-5.6	5.1-5.2	4.4	*	4.4	Baud
32	12	<i>Sstt-htp : Htt</i>	Giza	CeE	IV.2>	4.2-5.3	4.6-5.2	*	5.1-5.3	5.1-5.2	4.2	4.5-4.6	4.2-4.4	Baud

Reference Baud¹⁷³

Cluster 12 consists of tombs 26 and 32. Kanawati¹⁷⁴ is of the opinion that the two tombs were decorated by the same artist, or that the tomb owners were related, and suggests the date of 5.2–5.3 for *Nswt-nfr*. For tomb 32 Kanawati suggests a slightly earlier date of 5.2. It is interesting that, given Kanawati’s comment that this tomb was decorated by the same artist, that these two tombs formed a cluster. A range of 5.2–5.3 seems to be appropriate.

The tomb has many common features. There were no separate offering scenes on the west or north walls of either tomb. The south wall offering scenes were almost identical in features, to the degree of preservation, with the bread in tomb 26 having small necked cut-outs at the base which could indicate that tomb 26 is slightly later than tomb 32 as Kanawati proposed.¹⁷⁵ The two false doors in both tombs have a north south chapel axis, with one set of jambs each, but with an extra set of jambs of asymmetric design similar to tomb 6.¹⁷⁶

¹⁷³ Baud, *Famille*, 505–506 [135], for tomb 26 and 576–577 [219] for tomb 32.

¹⁷⁴ N. Kanawati, *Tombs at Giza, II: Seshathetep/Heti (G5130), Nesutnefer (G4970) and Seshemnefer II (G5080)* (ACE Reports 18; Warminster, 2002), 36.

¹⁷⁵ Kanawati, *Giza II*, 18.

¹⁷⁶ See footnote 191 under cluster 6 p. 59

Cluster 13: “Useful” Common period 5.6–5.9, reassigned to 5.6–5.8.

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawat	Other	Source of Other
14	13	<i>K3 = i-m-nfrt</i>	Giza	CF	V.3>	5.3-6.4	*	*	6.1-6.4	6.1-6.4	*	*	5.6-6.4	Baud
67	13	<i>K3 = i-m-snw</i>	Saqqara	NTP	V.6>	5.6-6.4	*	5.6-5.9	6.1-6.4	5.8-5.9	5.6	*	*	
80	13	<i>Ni-k3w-Rc.w</i>	Saqqara	UNK	V.3>	5.3-5.9	*	5.3-5.9	5.3-5.9	5.3-5.6	5.3	*	*	
105	13	<i>Wr-ir = n-Pth</i>	Saqqara	WSP?	V.3>	5.3-5.9	*	5.3-5.9	5.3-5.9	5.3-5.5	5.3	*	*	

Reference Baud¹⁷⁷

Four tombs formed this cluster. Tomb 14 has a 5.3 cartouche associated with the mastaba,¹⁷⁸ however *PM*, Harpur and Baud, as reported in *Mastabase*, show 5.6 to 6.4. Tomb 67 is dated 5.6 – 5.8 by McFarlane,¹⁷⁹ and Borchardt¹⁸⁰ only indicates fifth dynasty for tomb 80. The British Museum publication¹⁸¹ of tomb 105 refers to *PM*'s dating of 5.3 or later.¹⁸² To reconcile these different dates, the cluster should be reduced to 5.6 to 5.8, as this range is within all the proposed ranges, and classified as “Useful”.

The main drivers of the cluster were the two false doors in N-S chapels, except for tomb 80, whose chapel is unknown but likely N-S given that there are two false doors. The northern false doors all have secondary figures at the offering table in the panel, and the tomb owners have short collars, short tight kilts, chairs with no backs, with bull's legs, cushions only at the back and all the north false doors have two jambs. Tombs 14 and 105 have long offering lists on the southern false doors, and tomb 67 has an offering list between the two false doors. In the panel of the southern false door all four tombs have round topped bread with a flat base, with straight sides in.

¹⁷⁷ Baud, *Famille*, 589–590 [235].

¹⁷⁸ S. Hassan, *Excavations at Giza, VI: The Mastabas of the Sixth Season and their Description. Volume VI—Part III, 1934–1935* (Cairo, 1950), 19–29.

¹⁷⁹ A. McFarlane, *Mastabas at Saqqara: Kaiemheset, Kaipunesut, Kaiemsenu, Sehetepu and Others* (ACE Reports 20; Oxford, 2003), 70–72.

¹⁸⁰ L. Borchardt, *Denkmäler des Alten Reiches (Ausser den Statuen) im Museum von Kairo: Nr. 1295–1808, Teil I Text und Tafeln zu Nr. 1295–1541* (Berlin, 1937).

¹⁸¹ T. G. H. James (ed.), *British Museum: Hieroglyphic Texts from Egyptian Stelae etc.: Part 1* (2nd edn; London, 1961).

¹⁸² *PM III*² 699–700.

Cluster 23: “Useful,” Common period 6.2, reassigned to 6.1.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpron	Kanawat	Other	Source of Other
69	23	<i>Mrrw-k3=i : Mrrt</i>	Saqqara	NTP	VI.2>	6.1-6.2	6.1	6.1	6.1	6.1	6.1	6.1	6.1	Baud
71	23	<i>Mry-Tt : Mrt</i>	Saqqara	NTP	VI.2>	6.2	6.2	6.2	6.2	6.2	6.2	*	*	
87	23	<i>špsr-pw-Pth : Pth-špsr</i>	Saqqara	NTP	VI.1>	6.1-6.4	6.1	6.1-6.4	6.2-6.4	6.2-6.4	*	*	*	

Reference Baud.¹⁸³

The cluster includes tombs 69, 71 and 87. On examination, the 6.2 allocated to tomb 69 does not agree with Kanawati’s¹⁸⁴ dating as he allocates this tomb to late Teti evidenced from the construction of the tomb. Tomb 71 was constructed after tomb 69, so it is possible that tomb 71’s construction began in 6.1.¹⁸⁵ Accordingly, this cluster should be reclassified to “Useful” 6.1.

This cluster was based on north and south wall offering scenes and the southern south wall, with few similar features from the northern false door. The features in the north and south wall offering scenes and the southern false door were similar. The tomb owner wore a short tight kilt, the chairs had lion’s legs and small umbels, and chairs have their backs covered with cushions. All chapels were of E–W orientation with three sets of jambs on the false doors.

¹⁸³ Baud, *Famille*, 467 [83].

¹⁸⁴ N. Kanawati, A. Woods, S. Shafik and E. Alexakis, *Mereruka and his Family*, III:1: *The Tomb of Mereruka* (ACE Reports 29; Oxford, 2010), 32–33.

¹⁸⁵ N. Kanawati, and M. Abder-Raziq, *Mereruka and his Family*, I: *The Tomb of Meryteti* (ACE Reports 21; Oxford, 2004), 18.

5.2.3. “Useful” reassigned to Disparate

Cluster 2: “Useful” Common period 5.9, reassigned to “Disparate.”

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpiion	Kanawati	Other	Source of Other
35	2	<i>Sšm-nfr I</i>	Giza	WF	IV.3>	4.3-5.9	5.2-3	*	5.2-5.3	5.1-5.3	4.3	5.2-5.9	*	
38	2	<i>St-k3=i</i>	Giza	CeE	*	5.9-6.4	*	*	6.1-6.4	6.1-6.2	*	5.9	*	

Cluster 2 grouped tombs 35 and 38. For tomb 35 Cherpiion’s dating was considered, but discounted, as she followed the IV.3 cartouche, in contrast to all proposals by other scholars of 5.2–5.9. Kanawati,¹⁸⁶ in his tomb report, proposes 5.3–5.6, which is possibly a bit long, but as Neuserre’s reign was long, early 5.6 is possible. For tomb 38, the range of 5.8 to 6.2 seems to be more plausible. By taking the most likely of the proposals, the range of 5.9–6.1 seems to be the result for this tomb. However, this date range does not give a good match. Porter and Moss¹⁸⁷ indicate *St-k3=i* parents *Nfr* (I) and *Htpm3t*¹⁸⁸ were placed at the end of the fifth dynasty (5.8–5.9) which makes the range 5.9–6.1 more likely. As a result, this cluster cannot be classified as “Useful,” and therefore changes to “Disparate.”

The major factors that contributed to the clustering of tombs 35 and 38 were that both the tombs had two false doors and north south chapels, the west wall offering scene, and a second person with an offering table, was the only ones in this study.

¹⁸⁶ N. Kanawati, *Tombs at Giza, I: Kaiemankh (G4561), Seshemnefer I (G4940)* (ACE Reports 16; Warminster, 2001), 54–55.

¹⁸⁷ *PM* III, 160.

¹⁸⁸ *PM* III, 137.

Cluster 6: “Useful” Common periods 5.3–5.6, reassigned to “Disparate.”

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpuon	Kanawat	Other	Source of Other
36	6	<i>Ssm-nfr 11</i>	Giza	WF	*	5.2-5.6	5.6	*	5.6	5.6	*	5.2-5.6	*	
37	6	<i>Ssm-nfr 111</i>	Giza	WF	V.3>	5.3-5.8	5.8	5.3-5.8	5.8	5.8	5.3	5.8	5.3-5.8	Baud

Reference Baud¹⁸⁹

Cluster 6 grouped tombs 36 and 37. Tomb 36 is dated by Kanawati to Neuserre¹⁹⁰ 5.6 and he also comments on the firm dating of tomb 37 to the reign of Djedkare 5.8. As a consequence, this cluster cannot be classified as “Useful”, and changes to “Disparate.”

These two tombs have a high degree of correlation between all of the features of the tomb owner, the offering table scene on the two west wall scenes, and on both false doors, to the extent that they were almost identical. On the west wall offering scene the tomb owners both have short beards, short wigs to neck, animal skins from shoulder with claws at legs, tail shown behind the figure, the left arm holding skin tied at the shoulder, and right arm reaching to or touching the offering. A female is shown sharing the same seat as the tomb owner. The chair has lion’s legs and small umbels, and a cushion over its back. The table and bread features have the same number of loaves and height proportions for the relative size of the table / chair / bread with the tomb owner’s height. The bread has round top with flat bases and orientated in the same manner for both tombs. The false doors were the same with one set of jambs and an extra jamb set only on the left side.¹⁹¹ The panel also exhibited the above similarities.

¹⁸⁹ Baud, *Famille*, 557–558 [220].

¹⁹⁰ Kanawati, *Giza*, II, 53.

¹⁹¹ This situation occurs for a southern false door 9 times and only at Giza, 5 times in the West field, 3 times in the CdÉ and once in the EF. With only 2 sets added to the right. For the northern false doors there are 10 tombs with extensions to the right 8 being the same as the southern false door. This suggests planned symmetry rather than bad design.

Cluster 11: “Useful” Common period 5.1–5.3, reassigned to “Disparate.”

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawati	Other	Source of Other
16	11	<i>K3 = t-ni-nswt I</i>	Giza	WF	IV.2>	4.2-5.5	4.4-6	*	5.1-5.3	5.1-5.3	4.2	5.2-5.5	4.2-4.3	Baud
24	11	<i>Mrt-ib : K3-pw-nswt</i>	Giza	WF	*	4.2-5.3	*	*	4.5-5.3	4.6-5.1	4.2	5.1-5.3	4.3-4.4	Baud
25	11	<i>Nn-sgr-k3 = I I</i>	Giza	WF	IV.2>	5.1-5.9	5.2-3	*	5.1-5.9	*	*	*	*	
28	11	<i>R^c.w-h^c = f.^cnh</i>	Giza	EF	IV.4>	4.4-6.4	*	*	5.1-6.4	5.6	4.4	*	*	

Reference Baud¹⁹²

Cluster 11 grouped tombs 16, 24, 25 and 28. For these tombs, each scholar’s dating either does not cover all the tombs or gives disparate ranges. *PM* dated tomb 16 by quoting Reisner’s date of 4.5–4.6, and Junker proposed early fifth dynasty.¹⁹³ Swinton also proposed disparate dates for the two tombs that she considered. As these differences are not reconcilable, this cluster should be rated disparate. The common features of this cluster generation were the two false doors.

Cluster 26: “Useful.” Common period 6.1. Reassigned to “Disparate”

Tomb Attributes					Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table									
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawati	Other	Source of Other
19	26	<i>Mry-R^c.w-nfr : K3r</i>	Giza	EF	VI.2>	6.2-6.4	6.2-3	6.2-6.4	6.2-6.4	6.4	6.2	*	*	
34	26	<i>Ssm-nfr : Twft</i>	Giza	CF	*	5.9-6.4	*	6.1-6.4	6.1-6.4	6.1-6.4	*	5.9-6.1	*	
59	26	<i>Hst</i>	Saqqara	NTP	VI.1*	6.1-6.2	6.1	*	*	*	*	*	6.1-6.2	Kanawati
64	26	<i>K3-gm-ni : Mmi : Gm-n = I</i>	Saqqara	NTP	VI.1*	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	Baud
99	26	<i>Mrrt</i>	Saqqara	NTP	*	6.1-6.4	6.1-2	6.2-6.3	6.2-6.3	6.2	*	6.4	*	
109	26	<i>K3r</i>	Abusir	SAS	VI.1>	5.9-6.2	*	*	*	*	*	*	*	Bárta

Reference Kanawati,¹⁹⁴ Baud¹⁹⁵ and Bárta.¹⁹⁶

¹⁹² Baud, *Famille*, 480 [102] for tomb 16 and, 458 [73] for tomb 24.

¹⁹³ *PM* III, 78–79.

¹⁹⁴ N. Kanawati, and M. Abder-Raziq, *The Teti Cemetery at Saqqara, V: The Tomb of Hesi* (ACE Reports 13; Warminster, 1999), 15-16.

¹⁹⁵ Baud, *Famille*, 608 [244].

¹⁹⁶ M. Bárta, *Abusir XIII; Abusir South 2; Tomb Complex of the Vizier Qar, his Sons Qar Junior and Senedjemib, and Iykai* (Prague, 2009), 314-315.

The date of T61 and T19 cannot be reconciled, so this cluster must be reassigned to “Disparate”.

This cluster was based on north and south wall offering scenes and the southern south wall only. On the north and south walls the tomb owners are depicted with short, tight kilts, and the chairs have small umbels. The north wall chairs have backs, lion’s legs, and canonical offering lists on the wall. The south wall scenes have a mixture of bull’s and lion’s legs. There was a mix of chapel alignment and jambs, five tombs had three sets of jambs and only one had two sets, but all the tombs have cavetto cornices and torus mouldings with plain apertures.

5.2.4. “Disparate” clusters

Cluster 1: “Disparate” No common period

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherphon	Kanawat	Other	Source of Other
7	1	<i>Irrw</i>	Giza	CF	*	5.4-6.4	*	*	5.7-6.4	5.9-6.4	*	5.4-5.6	*	
9	1	<i>Iw-nw</i>	Giza	WF	*	4.2-4.4	4.2-4	*	*	*	*	*	*	
10	1	<i>Ty-mry</i>	Giza	WF	V.3>	5.3-5.9	*	*	5.6-5.9	5.3	5.3	5.6	*	
15	1	<i>K3 = i-nfr</i>	Giza	WF	*	4.2	4.2	*	4.2	*	*	*	*	PM
17	1	<i>K3 = i-n1-nswt 11</i>	Giza	WF	IV.2>	4.2-5.8	5.2-3	*	5.4-5.6	5.6	4.2	5.8	*	
23	1	<i>Nfr-b3.w-Pth</i>	Giza	WF	V.6>	5.4-5.8	5.6	5.6	5.4-5.9	5.6	5.6	5.6-5.9	*	
27	1	<i>R^c-wr 11</i>	Giza	WF	*	5.6-5.9	5.8-9	5.6-5.9	5.7-5.9	5.8-5.9	*	5.6	*	
44	1	<i>Wp-m-nfr.t</i>	Giza	WF	*	4.2	4.2	*	4.2	*	*	*	*	
57	1	<i>Hsy-R^c.w</i>	Saqqara	NSP	*	3.1-3.3	3.2	*	3.1-3.3	*	*	*	*	
110	1	<i>Htpi</i>	Abusir	SAS	*	3.2-3.4	*	*	*	*	*	*	*	Bárta

References PM,¹⁹⁷ Bárta¹⁹⁸

Cluster 1 grouped ten tombs 7, 9, 10, 15, 17, 23, 27, 44, 57 and 110. The results show that the kings’ reigns range from early third dynasty for tombs 57 and 110 to the late sixth dynasty for tomb 7. The group of early tombs, 9, 15, 44, 57 and 110, range from 3.1 to 4.4. The other group, tombs 7, 10, 17, 23 and 27, range from 5.3 to 6.4.

¹⁹⁷ PM III 57.

¹⁹⁸ M. Bárta, F. Coppens, H. Vymazalová and et al., Tomb of Hetepi (AS 20), Tombs AS 33–35 and AS 50–53 (ABUSIR XIX: Prague, 2010), 56.

The wide gap in the results from 3.1 to 4.4 and 5.3 to 5.6 clearly show that this was not a cluster of compatible tombs as the reigns could not possibly be aligned. This group was clustered from data mainly associated with tombs having one west wall offering scene; the south false door where there was a second person, opposite the tomb owner, and the north false door has a few similar features. It was interesting to note that the only slab stele included in the study was in this group.¹⁹⁹

Cluster 3: “Disparate” No common period

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawat	Other	Source of Other
46	3	<i>Hwfw-h^c=f 11</i>	Giza	EF	V.6>	5.6	5.6	5.6	5.6	5.6	5.6	*	5.6	Baud
86	3	<i>Pth-h^tp 11 : Tfw</i>	Saqqara	WSP	V.8>	5.8-5.9	5.9	5.8-5.9	5.8-5.9	5.9	5.8	*	*	

Reference Baud²⁰⁰

Cluster 3 grouped tombs 46 and 86. For tomb 46 Simpson proposed the earliest date of 5.6 to the latter part of fifth dynasty,²⁰¹ while the other scholars proposed 5.6. This could probably be based on the cartouche found in the tomb. For tomb 86, the date range proposed was 5.8 – 5.9, but as tomb 86 *Pth-h^tp 11 : Tfw*'s father, tomb 54 *3hti-h^tp*, is also dated²⁰² to 5.8–5.9, as a consequence this would put tomb 86 more to the latter part of the fifth dynasty or the early sixth dynasty. Therefore, this cluster remains “Disparate.”

The reason for the clustering of tombs 46 and 86 comes from one west wall offering scene, the south wall offering scene and the southern false door, with a few similar features from the northern false door. Both tombs have chairs with backs, cushions over backs and small umbels for the west and south wall offering scenes. Also, the bread style, with rounded tops

¹⁹⁹ Tombs 9, 15 and 44.

²⁰⁰ Baud, *Famille*, 541 [180].

²⁰¹ W. K. Simpson, *The Mastabas of Kawab, Khafkhufu I and II: G 7110–20, 7130–40, and 7150 and subsidiary mastabas of Street G 7100* (GMas 3; Boston, 1978), 21.

²⁰² Refer to Prosopography [54] and Table of king's reigns proposals in Volume II Appendix 1 Set 1& Set 2.

and flat bases, appear on the south wall offering scene and the southern false door, and the same orientation of the loaves with straight sides in.

Cluster 5: “Disparate” No common period.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpiion	Kanawat	Other	Source of Other
4	5	<i>T3sn</i>	Giza	WF	IV.2>	4.2-6.4	5.8-9	*	5.1-6.4	6.1-6.2	4.2	*	*	
5	5	<i>Tdw</i>	Giza	EF	VI.2>	6.2-6.4	*	6.2-6.4	6.2-6.4	6.3-6.4	6.2	*	*	
104	5	<i>Wn1s-ꜥnh</i>	Saqqara	UPC	V.9>	5.9-6.1	*	5.9	5.9	5.9	5.9	5.9	5.9-6.1	Baud

Reference Baud²⁰³

Cluster 5 grouped tombs 4, 5 and 104. Tomb 4 is much later than the 4.2 period of Cherpiion, as both Swinton and Harpur indicate a date of 5.9 as a possibility,²⁰⁴ but Harpur revised her dating to 6.1 to 6.2. Tomb 5 can be no earlier than 6.2 because of the cartouche found in the tomb. However, tomb 104’s consensus is 5.9 as, despite Baud’s proposal of 5.9–6.1, Onderka²⁰⁵ places the tomb at early to middle Unis, as do the other scholars. Therefore, this cluster remains “Disparate.”

The factors that contributed to grouping this cluster were the two west wall offering scenes, the southern false door with a second person opposite the tomb owner, and some similar features appearing on the northern false door which has deteriorated. These two tombs have a high degree of correlation between all of the features of the tomb owner and the offering table scene on the two west walls, and on both false doors where the features were preserved.

²⁰³ Baud, *Famille*, 422 [32].

²⁰⁴ See Swinton, *Dating*, 15 [3], and Y. M. Harpur, ‘zšš w3d scenes of the Old Kingdom’, GM 38 (1980), 53–61.

²⁰⁵ P. Onderka, *The Tomb of Unisankh at Saqqara and Chicago: Unis Cemetery North–West II* (Prague, 2009), 18.

Cluster 14: “Disparate” No common period.

Tomb Attributes						Data listed after R. van Walsem, <i>MASTABASE the Leiden Mastaba Project</i> (Leiden, 2008), and J. Swinton, <i>Dating the tombs of the Old Kingdom</i> (Archaeopress Egyptology 2: Oxford, 2014), 9-44. See Appendix 2:2 for full derivation of this table								
Tomb No.	Cluster	Tomb Owner	Necropolis	Field	Found Cartouches	Kings Reigns Variation List	Swinton Range	Most Likely period for tomb	PM	Harpur	Cherpton	Kanawat	Other	Source of Other
13	14	<i>K3.w-nswt</i>	Giza	CF	IV.6>	4.5-5.9	*	*	4.5-5.9	4.6-5.1	4.6	5.1-5.3	*	
29	14	<i>Snb</i>	Giza	WF	IV.3>	4.3-6.4	*	4.3	6.1-6.4	6.4	4.3	5.1-6.4	*	
49	14	<i>Nfr-M3't</i>	Meidum	NMF	IV.1>	4.1-4.6	4.1	4.1	4.1-4.6	4.1	4.1	4.1	4.1	Baud
50	14	<i>R'.w-htp</i>	Meidum	NMF	*	3.1-4.3	4.1-2	4.1	3.1-3.5	4.1-4.2	4.1-4.3	4.1	4.1-4.2	Baud
77	14	<i>Nfr-s3m-Pth / Shntyw</i>	Saqqara	UPC	*	5.6-5.9	5.6-8	*	5.7-5.9	5.9	*	*	*	
84	14	<i>Nt-nh-Hnmw / Hnmw-htp</i>	Saqqara	UPC	V.6>	5.6-5.8	5.6-8	5.6-5.7	5.6-5.7	5.6-5.7	5.6	*	5.6-5.7	Decker

Reference Baud²⁰⁶ and Decker²⁰⁷

Tombs 13, 29, 49, 50 77 and 84 are grouped in this cluster. It is likely that tomb 49 and tomb 50 belong in 4.1, according to the almost consistent proposals, while tomb 84 with a V.6 cartouche is placed at least in that reign. Tomb 29 has been placed from Djedefre to the end of the Old Kingdom, and a recent study has provided compelling reasons to consider the period 5.2 to 5.6²⁰⁸ as well. As these two tombs cannot be reconciled, this cluster remains “Disparate.”

5.3 IBM's SPSS TwoStep Cluster Interpretation Results

In the process of verification of the initial rating of the clusters, four clusters were downgraded from “Useful” to “Disparate” as reflected in the Table 5.2.1 below.

Type of Data	All data	Revised numbers
Single clusters	4 (13.3%)	4 (13.3%)
Useful Clusters	15 (50.0%)	11 (37.9%)
Disparate clusters	11 (37.9%)	15 (50.0%)

Table 5.3 Revised *TwoStep Analysis 30 Clusters*

²⁰⁶ Baud, *Famille*, 490 [117] for tomb 49 and 512 [143] for tomb 50.

²⁰⁷ Decker and Herb, *Sport*, 384–386.

²⁰⁸ See Woods, in Woods, McFarlane and Binder (eds), *Egyptian Culture and Society, Studies in Honour of Naguib Kanawati, Volume II*, 301-331.

Analysis of the data of the tombs in each cluster has identified six major components as the key drivers of the clustering, with four of the major components having additional sub sets. The major components were the west wall offering scenes (up to two), the north and south wall offering scenes and the southern and northern false doors. The sub-sets relate to positional and structural information with the primary figure at the offering table, and any secondary figures in the second chair. Other sub-sets relate to the offering table or tables and the table surrounds. The north and south wall offering scenes did not have these sub-sets. It seems clear that these components and sub-sets played a major part in the clustering, as each cluster has a unique combination set of these components. Clearly the southern or False Door 1 (FD1) would appear in every cluster, as having a false door was a reason for selection. However, there are combinations for the presence or absence for all of the other components. The absence of features from clusters was the element that led to the above analysis and this absence of features seems to have a lot of impact on cluster selection. For instance, all the offering scenes of tombs could be examined as a micro group, to analyse the critical clustering and to scrutinise how the different stages of development, clustered might show clear change points with the associated tombs. Beyond these factors, which had to be deduced, the system does not present any analysis that could lead to specific groups of features being identified, and this analysis is yet to be carried out. In this study, scrutinising the data to assess the reason for the clustering has been the method of interpreting the clusters. This scrutiny has yielded some interesting observations to the author. For example, see the the symmetry of extra panels added to two jamb pairs of doors on the left and right of separated false doors which had not been detected during the data collection, and the occurrence of north and/or south wall offering scenes with independent west wall offering scenes. It was of interest to note that all of the slab stele combined in Cluster 1, but other panels with linen lists did not, like Meten and Ra-Hotep's. Focusing on discrete sets of features may also be a way to produce better results, and, as mentioned above, a disparate cluster may show the period of its contained features and not a single point of occurrence. This offers possibilities and needs to be examined further. One further observation was that in the data collected there were no bull's legs on a north wall.

5.4 Summary

The process of interpretation of the output of TwoStep 30 Cluster run was carried out and the clusters for this process were critically examined. A summary of each “Useful” cluster was presented with selected “Disparate” clusters, the single clusters (Clusters 8, 9, 10 and 29 where comparisons could not be made) were not reviewed. Comments were made regarding the reign alignment of the tombs in the cluster, having common periods with all the other tombs in the cluster. This interpretation included extending the date reviewed to encompass publications outside of those of Swinton and the Leiden Mastabase Project, (the source of the initial analysis phase) tomb range of reign information. Also included were aspects of the tomb data which appeared, on the surface, to be generating the clusters. The analysis resulted in the reduction of four clusters from the “Useful” category and changed the success ratio from 50% to 40%. This is still a promising result for pilot study. The review has shown that a high degree of usefulness has been retained after careful evaluation of the individual elements of the clusters.

It seems clear that this method of analysis, which does not make use of any pre-conceived tomb dates to generate dating clusters, will avoid any issue associated with circular dependency errors. It remains for further analysis to take the next steps where time is spent analysing these initial runs to establish the more critical features that will refine the results and remove any disparate clusters. It was noted in the literature review that there was change in the tomb structure, decoration and text, and it is believed that these changes can be identified by clustering the changes in order to identify the tombs that contain these features, and to use that information to plot the period of those changes. It is possible that on further analysis the disparate clusters may reveal date ranges that were not expected when looking for narrow date ranges. Rather than taking the big picture as was done in this study, a number of micro studies with strict focus on individual elements of the tomb could produce much clearer and well defined results. When these micro studies are complete they should be combined to produce an overall group of features that may result in new criteria to better discriminate the date ranges of individual tombs.

PART THREE CONCLUSIONS

Chapter 6: Conclusions

Despite many years of excavation in Egypt, and the interpretation and documentation of its material culture, the methodical approach to dating of Old Kingdom tombs still remains a highly debated issue amongst scholars. This is evidenced from the volume of literature²⁰⁹ that has addressed this issue over the last one hundred years or so. The quest to improve our understanding of the dates of Old Kingdom tombs has progressed with the application of special skills like Reisner's architectural studies of the Giza tomb fields, to studies that make use of the elements of previous studies and forge new methodological approaches to the issue²¹⁰ of dating. The literature reviewed identified two opportunities that could be combined in a research study. The first, the lack of in-depth statistical analysis studies of Old Kingdom tomb dating, and second, tomb dates that had been pre-determined or applied in a restricted manner, leaving the studies open to circular dependency errors²¹¹ or restricted periods of occurrence of criteria. This study proposed that statistical analysis, through cluster analysis, could offer a method to determine tomb dates and eliminate the necessity to pre-determine tomb dates. This research utilised statistical techniques to analyse the selected Memphite tombs²¹² in order to determine if natural groupings of tombs can be identified without first assigning tomb dates. These natural groupings can, subsequently, be compared to the range of kings' reigns that have been based on dates assigned by scholars, and drawn from various published sources,²¹³ to test their validity.

²⁰⁹ See section 1.2 in Chapter 1: Literature Review for an over-view and discussion on this literature.

²¹⁰ See Strudwick, *Administration* for a view of the blending of architectural aspects of the false door and its relationship to the chapel with titles of officials, and also Swinton, *Dating* for a view of blending tomb iconography with differing themes in a structured and methodological manner.

²¹¹ Circular dependency errors are introduced by the initial tomb date selection. Any errors in the predetermined tomb dates will be transmitted to the results as errors in the date range of affected criteria.

²¹² The details of the selected tombs, their location, and sources used in this study are included in Prosopography Volume II Appendix 1Set1.

²¹³ as detailed in MASTABASE the Leiden Mastaba Project dates sourced from; *PM III*¹ and *III*², Harpur *Decoration*, Cherpion *Mastabas*, Kanawati, *Administration*, Baud, *Famille*, and from Swinton, *Dating*. For

IBM's SPSS statistical package was selected for this study and a number of the individual programs were identified for evaluation.²¹⁴ The evaluation rejected three of the SPSS programs. The first program was not suited for the type of data needed to be processed,²¹⁵ the second required tomb dates as targets which was against one of the aims of the study,²¹⁶ and the third produced results that were too complex for understanding and interpretation.²¹⁷ The two programs left for this study were, KohonenNet and TwoStep cluster analysis.

This study collected features from one hundred and thirteen tombs²¹⁸ in the Memphite cemeteries²¹⁹ relating to the offering scene²²⁰ located in the chapel of the tomb and the false door, taking particular note of the location within the chapel of the offering scene. Data was collected from the selected tombs²²¹ and processed.²²² The output results, after processing the data, were organised by program and run types, and, after the initial assessment of results, it became evident that the clusters formed resulted in "Useful" and "Disparate" clusters. The proportion of "Useful" results²²³ varied between 37.9% and 50.0%,²²⁴ for the runs. Considering that these runs were part of a pilot study, this result is better than expected.

In order to provide conclusive results, an extra verification process of the "Useful" clusters was considered necessary. The output of TwoStep 30 Cluster run was selected for additional verification. Each of the "Useful" and "Disparate" clusters was reviewed, and additional data

tombs not referred to in these publications, dates were taken from the actual tomb reports as indicated in Prosopography. The table showing the compilation of these king's reigns is found in Volume II Appendix 1Set 2.

²¹⁴ See section 3.4.5 in Chapter 3: IBM's SPSS Package – Processing the data.

²¹⁵ See section 3.4.5 in Chapter 3: IBM's SPSS Package – Processing the data.

²¹⁶ See section 4.2, Step 1(a) in Chapter 4: *C&RTree package*.

²¹⁷ See section 4.2, Step 1(b) in Chapter 4: *Principal Component analysis*.

²¹⁸ See section 3.4.2 in Chapter 3: Tomb Selection.

²¹⁹ Namely Giza, Abusir, Saqqara, Dashur and Meidum.

²²⁰ See section 3.4.3 in Chapter 3: Feature Selection.

²²¹ See section 3.4.4 in Chapter 3: Data Collection.

²²² See section 4.1 and 4.2 in Chapter 4: Data Normalisation and Data Processing.

²²³ For the derivation of the assessment categories see Section 4.3 in Chapter 4: Analysis of Results.

²²⁴ For the complete summary of all of the runs see Tables 4.5 to 4.9 in Section 4.3 in Chapter 4: Analysis of Results.

related sources were also used to validate and determine the assessment of the clusters.²²⁵ As a result, four clusters were reclassified from “Useful” to “Disparate” (Clusters 2, 6, 11 and 26), reducing the success rate from 50% to 40%. This result shows promise for further in-depth analysis of tomb dating by utilising clustering. Additional comments, on probable feature similarities in each cluster, were also included in these validated results.

Cluster Disposition After Interpretation Process					
Useful	Useful & Reassigned	Useful Downgraded	Disparate & Shown	Disparate & not Shown	Single
7, 15, 17, 19, 27, 28, 30.	4, 12, 13, 23.	2, 6, 11, 26.	1, 3, 5, 14.	16, 18, 20, 21, 22, 24, 25.	8, 9, 10, 29.

Table 6.1 *Cluster Disposition after Interpretation Process*

Analysis of the data, in each tomb, for each cluster, identified four major components that were key drivers for clustering, with some of the major components having additional sub sets. The major components were the west wall offering scenes, the north and south wall offering scenes, and the false doors.²²⁶

Using Cluster analysis to determine criteria for tomb dating can introduce the benefit of not requiring pre-determined tomb dates to analyse the features, and therefore avoids the issue associated with circular dependency errors.²²⁷ It remains for further studies to take the next steps to thoroughly re-analyse the results of the data runs in order to identify and establish the more critical features that would refine the results and produce viable criteria for dating. In the literature review, different types of architectural, artistic and textual innovations were noted, as well as the belief that these aspects of the Egyptian culture developed with the changing society and these changing aspects of society can provide additional sources of information for study. For example, the artistic decoration of the styles of the figures varied,

²²⁵ For results of this assessment see the discussion associated with each of the clusters, see Tables 5.2.1 to 5.2.19 in Section 5.2 in Chapter 5: IBM's SPSS TwoStep Cluster Interpretation.

²²⁶ See Appendix 3: Set 3Major Cluster groups for the distribution of these clustering drivers shown by cluster.

²²⁷ See Section 3.3 in Chapter 3: for discussion on circular dependency errors.

and it was observed in some clusters which contained more than two tombs that, once the similarities and differences were identified, some elements did not fit in either group and they appeared to have unique qualities particular to a tomb. These unique features need further evaluation. It may be that rather than taking the big picture, as was done in this study, and attempting to analyse large amounts of data, a number of micro studies with strict focus on individual elements of the tomb may produce much clearer and well defined results. Once the micro studies are complete they would be combined to produce an overall group of features, that could result in better discrimination in relation to determining the dates of individual tombs that would lead to providing a new list of criteria for dating the Old Kingdom tombs.

BIBLIOGRAPHY

Abder-Raziq, in *Mélanges Gamal ed-Din Mokhtar*

M. Abder-Raziq, 'Das Grab des Schepesj-Pu-Ptah in Saqqara, in *Mélanges Gamal ed-Din Mokhtar* (BdE vol. 97/1; Cairo, 1985), 219-230, pls I - VIII.

Alexanian, *Dahschur II*

N. Alexanian, *Dahschur II: das Grab des Prinzen Netjer-aperet. Die Mastaba II/1 in Dahschur* (Mainz, 1999).

Badawy, *The Tomb of Nyhetep-Ptah at Giza and the Tomb of 'Ankhn'ahor at Saqqara*

A. Badawy, *The Tomb of Nyhetep-Ptah at Giza and the Tomb of 'Ankhn'ahor at Saqqara* (UCEA: Occasional Papers 11; Berkeley, 1978).

Baer, *Rank and Title*

K. Baer, *Rank and Title in the Old Kingdom, The structure of the Egyptian Administration in the Fifth and Sixth Dynasties* (Chicago, 1960).

Bard, *Archaeology of Ancient Egypt*

K. A. Bard, *An Introduction to the Archaeology of Ancient Egypt* (Oxford, 2008).

Bárta, *SAK 22*,

M. Bárta, 'Archaeology and Iconography: bedja and aperet bread moulds and 'Speisetischszene' development in the Old Kingdom', *SAK 22* (1995), 21-35.

Bárta, *Abusir V*

M. Bárta, *Abusir V: The cemeteries at Abusir South I* (Prague, 2001).

Bárta, in Jánosi, (ed.), *Structure and significance*

M. Bárta, 'Architectural Innovations in the development of the Non-Royal Tomb During the reign of Nyusera', in P. Jánosi, (ed.), *Structure and significance: thoughts on ancient Egyptian architecture*, (Vienna, 2005), 105-130.

Bárta, *Abusir XIII*

M. Bárta, *Abusir XIII: Abusir South 2; Tomb Complex of the Vizier Qar, his Sons Qar Junior and Senedjemib, and Iykai* (Prague, 2009).

Bárta et al., *Hetepi* (AS 20)

M. Bárta, F. Coppens, H. Vymazalová and et al., *Abusir XIX: Tomb of Hetepi* (AS 20), Tombs AS 33-35 and AS 50-53 (Prague, 2010).

Bárta et al., *Neferinpu* (AS 37)

M. Bárta et al., *Abusir XXIII: The Tomb of the sun priest Neferinpu* (AS 37: Prague, 2014).

BIBLIOGRAPHY

- Barta, *Opferformel*
W. Barta, *Aufbau und Bedeutung der altägyptischen Opferformel* (Glückstadt, 1968).
- Baud, in Grimal (ed.), *Les critères de datation stylistiques*,
M. Baud, 'À propos des critères iconographiques établis par Nadine Cherpion', in N. Grimal (ed.), *Les critères de datation stylistiques à l'ancien empire* (Cairo, 1998), 31-95.
- Baud, *Famille*
M. Baud, *Famille royale et pouvoir sous l'Ancien Empire égyptien I –II* (Cairo, 1999).
- Bergman, in Hartwig (ed.), *Companion to ancient Egyptian art*,
D. Bergman, 'Historiography of ancient Egyptian art', in M. K. Hartwig (ed.), *A companion to ancient Egyptian art* (Chichester, 2015), 25-38.
- Biers, *Art, Artefacts, and Chronology*
W. R. Biers, *Art, Artefacts, and Chronology in Classical Archaeology* (London, 1992).
- Borchardt, *Denkmäler I*
L. Borchardt, *Denkmäler des Alten Reiches (Ausser den Statuen) im Museum von Kairo: Nr. 1295-1808, Teil I Text und Tafeln zu Nr. 1295–1541* (Berlin, 1937).
- Breasted, *Ancient Records 1*
J. H. Breasted, *Ancient Records of Egypt, Vol. 1: The First through the Seventeenth Dynasties* (Champaign, 2001).
- Bright, *Dating Funerary Stelae*
D. Bright, *Dating Funerary Stelae of the Twelfth Dynasty*, BACE 17 (2006), 7-22.
- Brovarski, in *Mélanges Gamal ed-Din Mokhtar*
E. Brovarski, 'Akhmim in the Old Kingdom and the First Intermediate Period', in *Mélanges Gamal ed-Din Mokhtar* (BdE vol. 97/1; Cairo, 1985), 117-54, pls I - VIII.
- Brovarski, in *Homages à Jean Leclant*
E. Brovarski, 'Abydos in the Old Kingdom and First Intermediate Period, Part I', in *Homages à Jean Leclant* (BdE Vol. 106; Cairo, 1994), 99-116.
- Brovarski, in *For his ka: essays offered in memory of Klaus Baer*, 15-
E. Brovarski, 'Abydos in the Old Kingdom and First Intermediate Period, Part II', in D. P. Silverman (ed.), *For his ka: essays offered in memory of Klaus Baer* (SAOC no. 55; Chicago, 1994), 15-44.
- Brovarski, in P. Der Manuelian (ed.), *Studies in Honor of William Kelly Simpson 1*, 117-155.
E. Brovarski, 'Studies in Egyptian Lexicography I: An Inventory List from 'Covington's Tomb' and Nomenclature for Furniture in the Old Kingdom', in P. Der Manuelian (ed.), *Studies in Honor of William Kelly Simpson I* (Boston, 1996), 117-155.

BIBLIOGRAPHY

Brovarski, *Senedjemib Complex I*

E. Brovarski, *The Senedjemib Complex Part I: The Mastabas of Senedjemib Inti (G 2370), Khnumenti (G 2374), and Senedjemib Mehi (G 2378)* (GMas 7; Boston, 2000).

Brovarski, in M. Barta (ed), *The Old Kingdom art and archaeology*, 71-118

E. Brovarski, 'False doors & history: the Sixth Dynasty', in M. Barta (ed.), *The Old Kingdom art and archaeology*, (Prague, 2006) 71-118.

Brunner-Traut, *Seschemnofers III*

E. Brunner-Traut, *Die altägyptische Grabkammer Seschemnofers III. aus Gisa* (Mainz, 1977).

Budge, *Hieroglyphic Texts*

E. A. Wallis Budge, *Hieroglyphic Texts from Egyptian Stelae, &c., in the British Museum* (London, 1922).

Calvert, *Regalia of Ramses III*

A. M. Calvert, *The Integration of Quantitative and Qualitative Research in a Study of the Regalia of Ramses III* (PhD. New York University, 2011) (via ProQuest.com, [<http://gradworks.umi.com/34/66/3466861.html>]).

Cherpion, *Mastabas*

N. Cherpion, *Mastabas et hypogées d'Ancien Empire : le problème de la datation* (Brussels, 1989).

K.A. Daoud, review of N. Kanawati, *Tombs at Giza I: Kaiemankh (G4561), Seshemnefer I (G4940)* (ACE Reports 16; Warminster, 2001), *JEA* 90 (2004), 8-9.

Davies, *Ptahhetep and Akhethetep I*

N. de G. Davies, *The Mastaba of Ptahhetep and Akhethetep at Saqqareh Part I: The Mastaba. The Chapel of Ptahhetep and the Hieroglyphs* (EES ASM 8: London, 1901).

Davies, *Ptahhetep and Akhethetep II*

N. de G. Davies, *The Mastaba of Ptahhetep and Akhethetep at Saqqareh Part II: The Mastaba. The Sculptures of Akhethetep* (EES ASM: 9; London, 1901).

Davies et al., *Saqqâra Tombs. I*

W. V. Davies, A. el-Khouli, A. B. Lloyd, and A. J. Spencer: *Saqqâra Tombs. I: The Mastabas of Mereri and Wernu* (EES ASM 36: London, 1984).

Dean, in Schiffer (ed.), *Advances in Archaeological Method and Theory I*,

J. S. Dean, 'Independent Dating in Archaeological Analysis', in M. B. Schiffer (ed.), *Advances in Archaeological Method and Theory I* (New York, 1978). 233-255.

Decker and Herb, *Sport*

W. Decker and M. Herb, *Illustrated Atlas of Sports in Ancient Egypt. Corpus of pictorial sources to physical exercises, game, hunting, dance and related topics. Part I: Text; Part II: panels*, (Leiden, 1994).

BIBLIOGRAPHY

Duel, *Mereruka I*

P. Duel, *The Mastaba of Mereruka Part I: Chambers A1-10, Plates 1–103* (Chicago, 1938).

Duel, *Mereruka II*

P. Duel, *The Mastaba of Mereruka Part II: Chambers A11-13, Doorjambs and Inscriptions of Chambers A 1-21, Tomb Chamber exterior, Plates 104–219* (Chicago, 1938).

Dunham and Simpson, *Mersyankh III*

D. Dunham and W. K. Simpson, *The Mastaba of Queen Mersyankh III: G7530-7540* (GMas 1; Boston, 1974).

el-Fikey, *Vizier Re-Wer*

S. A. el-Fikey, *The Tomb of the Vizier Re-Wer at Saqqara* (Egyptology Today 4; Warminster, 1980).

el-Khouli, and Kanawati, *Excavations at Saqqara II*

A. El-Khouli, and N. Kanawati, *Excavations at Saqqara, II: North~West of Teti's Pyramid* (Sydney, 1988).

Fischer, *Scribe of the Army*

H. G. Fischer, 'A Scribe of the Army in a Saqqara mastaba of the early Fifth Dynasty', *JNES*, Vol 18, No. 4 (Oct., 1959), 233-272.

Fischer, *Coptite Nome*

H. G. Fischer, *Inscriptions from the Coptite Nome, Dynasties VI-XI* (AnOr 40; Rome, 1964).

Fischer, in *Ancient Egyptian Epigraphy and Palaeography*², 29-50.

H. G. Fischer, 'Archaeological Aspects of Epigraphy and Palaeography', in *Ancient Egyptian Epigraphy and Palaeography* (2nd edn; New York 1979), 29-50.

Fischer, *Dendera*

H. G. Fischer, *Dendera in the Third Millennium B.C: Down to the Theban Domination of Upper Egypt* (New York, 1968).

Fischer, *Varia Nova*

H. G. Fischer, *Egyptian Studies III Varia Nova* (New York, 1996).

Firth and Gunn, *Teti Pyramid Cemeteries I*

C. M. Firth and B. Gunn, *Excavations at Saqqara: Teti Pyramid Cemeteries I Text* (Cairo, 1926).

Firth and Gunn, *Teti Pyramid Cemeteries II*

C. M. Firth and B. Gunn, *Excavations at Saqqara: Teti Pyramid Cemeteries II Plates* (Cairo, 1926).

BIBLIOGRAPHY

Gardiner, *Grammar*³

A. H. Gardiner, *Egyptian Grammar: Being an introduction to the study of hieroglyphs* (3rd edn; Oxford, 1957).

Gödecken, *Meten*

K. B. Gödecken, *Eine Betrachtung der Inschriften des Meten im Rahmen der sozialen und rechtlichen Stellung von Privatleuten im ägyptischen Alten Reich* (AA 29: Wiesbaden, 1976).

Goedicke, *MDAIK* 21,

H. Goedicke, 'Die Laufbahn des Meten', *MDAIK* 21 (1966), 1–71, pls 1-9.

Harpur, *GM* 38,

Y. M. Harpur, 'zšš w3d scenes of the Old Kingdom', *GM* 38 (1980), 53-61.

Harpur, *Decoration*

Y. Harpur, *Decoration in Egyptian Tombs of the Old Kingdom: Studies in orientation and scene content* (London, 1987).

Harpur, *Nefermaat and Rahotep*

Y. Harpur, *The Tombs of Nefermaat and Rahotep at Maidum: Discovery, Destruction and Reconstruction* (Prestbury, 2001).

Harpur and Scremin, *Kagemni*

Y. Harpur and P. Scremin, *Egypt in Miniature I: The Chapel of Kagemni: Scene Detail* (Oxford, 2006).

Harpur and Scremin, *Ptahhotep*

Y. Harpur and P. Scremin, *Egypt in Miniature II: The Chapel of Ptahhotep: Scene Detail* (Oxford, 2008).

Hartwig, *Tomb Painting*,

M. K. Hartwig, *Tomb painting and identity in ancient Thebes 1419-1372 BCE* (MONAEG 10; Brussels, 2004)

Hartwig, in Hartwig (ed.), *Companion ancient Egyptian art*,

M. K. Hartwig, 'Style', in M. K. Hartwig (ed.), *A companion to ancient Egyptian art*, (Chichester, 2015), 39-59.

Hassan, *Gîza*. 1929-1930

S. Hassan, *Excavations at Gîza: 1929–1930* (Cairo, 1932).

Hassan, *Gîza*. 1930-1931

S. Hassan, *Excavations at Gîza: 1930–1931* (Cairo, 1936).

Hassan, *Gîza* III

S. Hassan, *Excavations at Gîza III: 1931–1932* (Cairo, 1941).

BIBLIOGRAPHY

Hassan, Giza IV

S. Hassan, *Excavations at Gîza, IV: 1932–1933* (Cairo, 1943).

Hassan, Giza V

S. Hassan, *Excavations at Gîza: with special chapters on methods of excavation, the false door, and other archaeological and religious subjects, V 1933–1934* (Cairo, 1944).

Hassan, Giza VI: II

S. Hassan, *Excavations at Gîza: The Offering-List in the Old Kingdom. VI-Part II, 1934–1935* (Cairo, 1948).

Hassan, Giza VI: II Plates

S. Hassan, *Excavations at Gîza: The Offering-List in the Old Kingdom VI.-Part II Plates, 1934–1935* (Cairo, 1948).

Hassan, Giza VI: III

S. Hassan, *Excavations at Gîza: The Mastabas of the Sixth Season and their Description. VI—Part III, 1934–1935* (Cairo, 1950).

Hassan, Giza VII

S. Hassan, *Excavations at Gîza, 1935-1936 VII: The Mastabas of the Seventh Season and their Description.* (Cairo, 1953).

Hassan, *Excavations at Saqqara II*

S. Hassan, *Excavations at Saqqara, 1937-1938 Volume II: Mastabas of Ny-ankh-Pepy and Others* (revised by Z. Iskander, Cairo, 1975).

HESPOK

W. S. Smith, *A History of Egyptian Sculpture and Painting in the Old Kingdom* (2nd edn; London, 1978).

Hirsham, Lovis and Pollard, *Journal of Anthropological Archaeology* 29

A. J. Hirsham, W. A. Lovis and H. P. Pollard, ‘Specialization of Ceramic production: A sherd assemblage based analytic perspective’, *Journal of Anthropological Archaeology* 29 (2010), 265-277.

Hornung, et al., in E. Hornung, R. Krauss and D. A. Warburton (eds) *Ancient Egyptian Chronology* 490-495.

E. Hornung, R. Krauss and D. A. Warburton ‘Chronological Table for the Dynastic Period’, in E. Hornung, R. Krauss and D. A. Warburton (eds) *Ancient Egyptian Chronology* (HdO 83: Leiden, 2006), 490-495.

Hornung, et al., in E. Hornung, R. Krauss and D. A. Warburton (eds) *Ancient Egyptian Chronology*, 33-36.

E. Hornung, R. Krauss and D. A. Warburton ‘King-Lists and Manetho’s *Aigyptiaka*’, in E. Hornung, R. Krauss and D. A. Warburton (eds) *Ancient Egyptian Chronology* (HdO 83: Leiden, 2006), 33-36.

BIBLIOGRAPHY

- Ikram, in M. K. Hartwig (ed), *Companion to ancient Egyptian art*
S. Ikram, 'Interpreting Ancient Egyptian Material Culture.' in M. K. Hartwig (ed), *A companion to ancient Egyptian art* (West Sussex, 2015), 175-188.
- James, *Khentika*
T. G. H. James, *The Mastaba of Khentika called Ikhekhi* (EES ASM 13; London, 1953).
- James (ed.), *Hieroglyphic Texts: 1²*
T. G. H. James (ed.), *British Museum: Hieroglyphic Texts from Egyptian Stelae etc.:*
Part 1 (2nd edn; London, 1961).
- Jequier, *Tombeaux de Pepi II²*
G. Jequier, *Tombeaux de particuliers : Contemporains de Pepi II*, (Fouilles À Saqqarah ; 2nd edn Photographique; Cairo, 1983).
- Junker, *Giza I*
H. Junker, *Bericht über die von der Akademie der Wissenschaften in Wien auf gemeinsame Kosten mit Dr. Wilhelm Pelizaeus unternommenen Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Gîza. Die Mastabas der IV, Dynastie auf dem Westfriedhof* (Vienna, 1929).
- Junker, *Prince Kaninisut*
H. Junker, *The offering room of prince Kaninisut* (Vienna, 1931).
- Junker, *Giza II*
H. Junker, *Giza II: Bericht Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Giza Band II Die Mastabas der beginnenden V, Dynastie auf dem Westfriedhof* (Vienna, 1934).
- Junker, *Giza III*
H. Junker, *Giza III: Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Gîza, Band III: Die Mastabas der vorgeschrittenen V, Dynastie auf dem Westfriedhof* (Vienna, 1938).
- Junker, *Giza V*
H. Junker, *Giza V: Bericht über die von der Akademie der Wissenschaften in Wien auf gemeinsame Kosten mit Dr. Wilhelm Pelizaeus unternommenen Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Gîza. Band V, Die Mastabas der Snb (Seneb) und die umliegenden Gräber* (Vienna, 1941).
- Junker, *Giza VI*
H. Junker, *Giza VI: Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Gîza. Band VI: Die Mastabas des Nfr (Nefer), Kdfii (Kedfi), K3hjf (Kahjef) und die westlich anschließenden Grabanlagen* (Vienna, 1943).

BIBLIOGRAPHY

Junker, Giza VIII

H. Junker, *Giza VIII. Bericht Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Giza Band VIII Der Ostabschnitt des Westfriedhofs Zweiter Teil* (Vienna, 1952).

Junker, Giza XI

H. Junker, *Giza XI: Grabungen auf dem Friedhof des Alten Reiches bei den Pyramiden von Giza. Band XI: Der Friedhof südlich der Cheopspyramide Ostteil* (Vienna, 1953).

Kahlbacher, BACE 24

A. Kahlbacher, 'Bon Appetit! Bread and Reed in the Funerary Repast Imagery of the Old and Middle Kingdom' *BACE* 24 (2013), 7-20.

Kanawati, Administration

N. Kanawati, *The Egyptian Administration in the Old Kingdom: Evidence for its Economic Decline* (Warminster, 1977).

Kanawati, EL-Hawawish I

N. Kanawati, *The Rock-Tombs of EL-Hawawish: The Cemetery of Akhmim I* (Sydney, 1980).

Kanawati et al., Excavations at Saqqara I

N. Kanawati, A. El-Khouli, A. McFarlane and N. V. Maksoud, *Excavations at Saqqara, I: North~West of Teti's Pyramid* (Sydney, 1984).

Kanawati and Hassan, Teti Cemetery I

N. Kanawati, and A. Hassan, *The Teti Cemetery at Saqqara, I: The Tombs of Nedjet-em-pet, Ka-aper and others* (ACE Reports 08; Sydney, 1996).

Kanawati and Hassan, Teti Cemetery II

N. Kanawati, and A. Hassan, *The Teti Cemetery at Saqqara, II: The Tomb of Ankhmahor* (ACE Reports 09; Warminster, 1997).

Kanawati and Abder-Raziq, Teti Cemetery III

N. Kanawati, and M. Abder-Raziq, *The Teti Cemetery at Saqqara, III: The Tombs of Neferseshemre and Seankhuiptah* (ACE Reports 11; Warminster, 1998).

Kanawati and Abder-Raziq, Teti Cemetery V

N. Kanawati, and M. Abder-Raziq, *The Teti Cemetery at Saqqara, V: The Tomb of Hesi* (ACE Reports 13; Warminster, 1999).

Kanawati and Abder-Raziq, Teti Cemetery VI

N. Kanawati, and M. Abder-Raziq, *The Teti Cemetery at Saqqara, VI: The Tomb of Nikausesi* (ACE Reports 14; Warminster, 2000).

Kanawati, Tomb and Beyond

N. Kanawati, *The Tomb and Beyond: Burial customs of Egyptian officials*, (Warminster, 2001).

BIBLIOGRAPHY

Kanawati, *Giza I*

N. Kanawati, *Tombs at Giza, I: Kaiemankh (G4561), Seshemnefer I (G4940)* (ACE Reports 16; Warminster, 2001).

Kanawati and Abder-Raziq, *Teti Cemetery VII*

N. Kanawati, and M. Abder-Raziq, *The Teti Cemetery at Saqqara, VII: The Tomb of Shepsipuptah, Mereri (Merinebti), Hefi, and Others* (ACE Reports 17; Warminster, 2001).

Kanawati, *Giza II*

N. Kanawati, *Tombs at Giza, II: Seshathetep/Heti (G5130), Nesutnefer (G4970) and Seshemnefer II (G5080)* (ACE Reports 18; Warminster, 2002).

Kanawati, *Conspiracies*

N. Kanawati, *Conspiracies in the Egyptian Palace* (London, 2003).

Kanawati and Abder-Raziq, *Unis Cemetery II*

N. Kanawati, and M. Abder-Raziq, *The Unis Cemetery at Saqqara, II: The Tombs of Inyefert and Ihy (reused by Idut)* (ACE Reports 19; Oxford, 2003).

Kanawati and Abder-Raziq, *Mereruka I*

N. Kanawati, and M. Abder-Raziq, *Mereruka and his Family, I: The Tomb of Meryteti* (ACE Reports 21; Oxford, 2004).

Kanawati, *Tomb of Inumin*

N. Kanawati, *The Teti Cemetery at Saqqara VIII: The Tomb of Inumin* (ACE Reports 24; Oxford, 2006).

Kanawati and Abder-Raziq, *Mereruka II*

N. Kanawati, and M. Abder-Raziq, *Mereruka and his Family, II: The Tomb of Waatetkhethor* (ACE Reports 26; Oxford, 2008).

Kanawati, *Tomb of Remni*

N. Kanawati, *The Teti Cemetery at Saqqara IX: The Tomb of Remni* (ACE Reports 28; Oxford, 2009).

Kanawati, Woods, Shafik and Alexakis, *Mereruka III:1*

N. Kanawati, A. Woods, S. Shafik and E. Alexakis, *Mereruka and his Family, III:1: The Tomb of Mereruka* (ACE Reports 29; Oxford, 2010).

Kanawati, Woods, Shafik and Alexakis, *Mereruka III:2*

N. Kanawati, A. Woods, S. Shafik and E. Alexakis, *Mereruka and his Family, III:2: The Tomb of Mereruka* (ACE Reports 30; Oxford, 2011).

Lapp, *Opferformel des Alten Reiches*

G. Lapp, *Die Opferformel des Alten Reiches: unter Berücksichtigung einiger späterer* (ÄF 24; Mainz, 1986).

BIBLIOGRAPHY

Lashien, *The Chapel of Kahai*

M. Lashien, *The Chapel of Kahai and his Family* (ACE Reports 33; Oxford, 2013).

Lepsius, *DM*

K. R. Lepsius, *Denkmaeler aus Aegypten und Aethiopien*. Vol 1 & 2, (Leipzig, 1897-1913). Lepsius-Projekt, <<http://edoc3.bibliothek.uni-halle.de/lepsiuss/>>.

Lloyd, Spencer and el-Khouli, *Saqqara Tombs II*

A. B. Lloyd, A. J. Spencer and A. el-Khouli, *Saqqara Tombs II: The Mastabas of Meru, Semdenti, Khui and Others* (EES ASM 40; London, 1990).

Lloyd, Spencer and el-Khouli, *Saqqara Tombs III*

A. B. Lloyd, A. J. Spencer and A. el-Khouli, *Saqqara Tombs III: The Mastaba of Neferseshemptah* (EES ASM 41; London, 2008).

Lyman, in Pearsall (ed.), *Encyclopaedia of Archaeology*,

R. L. Lyman, 'Culture, Concept and Definitions', in Pearsall D. M. (ed.), *Encyclopaedia of Archaeology*, San Diego, 2008), 1070-1075.

Macramallah, *D'Idout*

R. Macramallah, *Le mastaba d'Idout* (Cairo, 1935).

Málek, *BSEG 6*

J. Málek, 'New Reliefs and Inscriptions from Five Old Tombs at Giza and Saqqara', *BSEG 6* (1982), 60-67.

Manuelian, *The Giza Archives G 2156*

P. Der Manuelian, Photo series tomb G 2156: 1993 TGA/MFA: <<http://www.gizapyramids.org>> accessed 12.10.2014.

Manuelian, *Slab Stelae*

P. Der Manuelian, *Slab Stelae of the Giza Necropolis* (PPYE 7; New Haven, 2003).

Manuelian, in S. E. Thompson and P. D. Manuelian (eds), *Egypt and Beyond, Essays Presented to Leonard H. Lesko*, 227-236

P. Der Manuelian, 'A "New" Slab Stela for Nefer from G 2110?(Giza Archives Project Gleanings: I)' in S. E. Thompson and P. D. Manuelian (eds), *Egypt and Beyond, Essays Presented to Leonard H. Lesko upon his Retirement from the Wilbour Chair of Egyptology at Brown University*, June 2005 (Charlestown, 2008), 227-236.

Manuelian *Nucleus Cemetery G 2100*

P. Der Manuelian, *Mastabas of Nucleus Cemetery G 2100 Part I: Major Mastaba G 2100-2220* (GMas 8; Boston, 2009).

Mariette, *Monuments*

A. Mariette-Bey, *Monuments divers recueillis en Egypte et en Nubie* (Paris, 1872).

BIBLIOGRAPHY

Mariette, *Monuments d'Abydos*

A. Mariette, *Catalogue général des monuments d'Abydos : Découverts pendant les fouilles de cette ville* (Paris: 1880).

Mariette, *Mastaba*

A. Mariette, *Les mastaba de l'Ancien Empire: fragment du dernier ouvrage* (Paris, 1889).

McFarlane, *Unis Cemetery I*

A. McFarlane, *The Unis Cemetery at Saqqara, I: The Tomb of Irukaptah* (ACE Reports 15; Oxford, 2000).

McFarlane, *Mastabas at Saqqara*

A. McFarlane, *Mastabas at Saqqara: Kaiemheset, Kaipunesut, Kaiemsenu, Sehetepu and Others* (ACE Reports 20; Oxford, 2003).

Mohr, *Mastaba of Hetep-her-akhti*

H. T. Mohr, *The mastaba of Hetep-her-Akhti: study on an Egyptian tomb chapel in the Museum of Antiquities Leiden* (Leiden, 1943).

Mourad, *Ptahhotep I*

A-L. Mourad, *The Tomb of Ptahhotep I*, (ACE Reports 37; Oxford, 2015).

Moussa and Altenmüller, *Grab des Nianchchnum und Chnumhotep*

A. M. Moussa, and H. Altenmüller, *Old Kingdom tombs at the causeway of King Unas at Saqqara Excavated by the Department of Antiquities: Das Grab des Nianchchnum und Chnumhotep* (Mainz, 1977).

Moussa and Junge, *Tombs of Craftsmen*

A. M. Moussa and F. Junge, *Old Kingdom tombs at the causeway of King Unas at Saqqara Excavated by the Department of Antiquities: Two tombs of craftsmen* (Mainz, 1975).

Munro, *Nebet und Khenut*

P. Munro, *Das Unas-Friedhof Nord-West I, Topographisch-historische: Das Doppelgrab der Königinnen Nebet und Khenut* (Mainz, 1993).

Murray, *Saqqara Mastabas I*

M. A. Murray, *Saqqara Mastabas: Part I* (ERA 10; London, 1905).

Murray, *Saqqara Mastabas II*

M. A. Murray, *Saqqara Mastabas: Part II* (BSAE 11: London, 1937).

Mysliwiec et al., *Saqqara I*

K. Mysliwiec, K. Kuraszkiewicz, D. Czerwik, T. Rzeuska, M. Kaczmarek, A. Kowalska, M. Radomska, Z. Godziejewski, *Saqqara I: The tomb of Merefnebef* (Varsovie, 2004).

BIBLIOGRAPHY

Mysliwiec and Kuraszkiewicz, *Saqqara IV*

K. Mysliwiec, and K. O. Kuraszkiewicz, *Saqqara IV: The funerary complex of Nyankhnefertem* (Varsovie, 2010).

Onderka, *Unisankh*

P. Onderka, *The tomb of Unisankh at Saqqara and Chicago: Unis Cemetery North-West II* (Prague, 2009).

Pearson, *Death and Burial*

M. P. Pearson, *The Archaeology of Death and Burial* (Phoenix Mill, 2006).

Petrie and Griffith, *Medum*

W. M. F. Petrie, and F. L. Griffith, *Medum* (London, 1892).

Petrie, *Prehistoric Egypt*

W. M. F. Petrie, *Prehistoric Egypt* (London, 1920).

Petrie and Murray, *Seven Memphite Tombs Chapels*

H. F. Petrie and M. Murray, *Seven Memphite Tombs Chapels* (London, 1952).

PM III

B. Porter and R. L. B. Moss, *Topographical bibliography of ancient Egyptian hieroglyphic texts, reliefs and paintings: III Memphis, Part I: Abú Rawâsh to Abúsir* (2nd ed. revised and augmented by J. Malek, Oxford, 1994).

PM III²

B. Porter and R. L. B. Moss, *Topographical bibliography of ancient Egyptian hieroglyphic texts, reliefs and paintings: III² Memphis, Part II: Saqqâra to Dashúr* (2nd edn revised and augmented by J. Malek, Oxford, 2003).

Quibell, *Hesy*

J. E. Quibell, *Excavations at Saqqara (1911-1912): The Tomb of Hesy* (Cairo, 1913)

Quibell, *Ramesseum... Ptah-hetep*

J. E. Quibell, *The Ramesseum and The Tomb of Ptah-hetep* (London, 1898).

Reisner, *BMFA 37*,

G. A. Reisner, 'A Family of Royal Estate Stewards of Dynasty V', *BMFA 37*; (1939), 29-35.

Reisner, *History*

G. A. Reisner, *A History of the Giza Necropolis: Volume I* (Cambridge, 1942).

Renfrew and Bahn, *Archaeology*⁴

C. C. Renfrew and P. Bahn, *Archaeology: Theories, Methods and Practice* (4th edn; London, 2008).

BIBLIOGRAPHY

Roth, *Palace Attendants*

A. M. Roth, *A Cemetery of Palace Attendants: Including G 2084-2099, G 2230+2231, and G 2240* (GMas 6; Boston, 1995).

Simpson, *Mastabas Qar and Idu*

W. K. Simpson, *The Mastabas of Qar and Idu: G 7101 and 7102* (GMas 2; Boston, 1976).

Simpson, *Mastabas Kawab, Khafkhufu*

W. K. Simpson, *The Mastabas of Kawab, Khafkhufu I and II: G 7110-20, 7130-40, and 7150 and subsidiary mastabas of Street G 7100* (GMas 3; Boston, 1978).

Simpson, *Mastabas Western Cemetery I*

W. K. Simpson, *Mastabas of the Western Cemetery. Part I: Sekhemka (G 1029); Tjetu I (G 2001); Iasen (G 2196); Penmeru (G 2197); Hagy, Nefertjentet, and Herunefer (G 2352/53): Djaty, Tjetu II, and Nimesti (G 2337 X, 2343, 2366)*, (GMas 4; Boston, 1980).

Simpson, *Chapel of Kayemnofret*

W. K. Simpson, *The Offering Chapel of Kayemnofret in the Museum of Modern Arts, Boston* (Boston, 1992).

Steindorff, *Das Grab des Ti*

G. Steindorff, *Veröffentlichungen der Ernst von Sieglin Expedition in Ägypten / Hrsg. Im Auftrage von Ernst von Sieglin Zweiter Band: Das Grab des Ti* (Leipzig, 1913).

Strudwick, *Administration*

N. Strudwick, *The Administration of Egypt in the Old Kingdom* (London, 1985).

Swinton, *Dating*

J. Swinton, *Dating the tombs of the Old Kingdom* (Archaeopress Egyptology 2: Oxford, 2014).

van de Walle, *Neferirtenef*

B. van de Walle, *La chapelle funéraire de Neferirtenef* (Brussels, 1978).

van Walsem, *MASTABASE*

R. van Walsem, *MASTABASE the Leiden Mastaba Project* (Leiden, 2008).

Waddell, *Manetho*

W.G. Waddell, trans., *Manetho* (Cambridge, 1964).

Wallis Budge (ed.), *Hieroglyphic Texts: VI*

E. A. Wallis Budge (ed.), *Hieroglyphic Texts from Egyptian Stelae &c., in the British Museum: Part VI* (London, 1922).

Weeks, *Cemetery G 6000*

K. R. Weeks, *Mastabas of Cemetery G 6000: Including G 6010 (Neferbauptah); G 6020 (Iymery); G 6030 (Ity); G 6040 (Shepseskafankh)* (GMas 5; Boston, 1994).

BIBLIOGRAPHY

Woods, *JEA* 95

A. Woods, 'Contribution to a Controversy: A date for the tomb of *K3(=i)-m-^cnh* at Giza', *JEA* 95 (2009), 161-174.

Woods, in Woods, McFarlane and Binder (eds), *Egyptian Culture and Society, Studies in Honour of Naguib Kanawati, Volume II*, 301-331.

A. Woods, 'A Date for the Tomb of Seneb at Giza: Revisited', in A. Woods, A. McFarlane, S. Binder (eds), *Egyptian Culture and Society, Studies in Honour of Naguib Kanawati, Volume II*, (CASAE 38; Cairo, 2010), 301-331.

Woods and Swinton, *BACE* 24

A. Woods and J. Swinton, 'Chronological Considerations: Fragments from the tomb of Hetepet at Giza', *BACE* 24 (2013), 127.

Ziegler et al, *BIFAO* 97

C. Ziegler, J. Adam, G. Andreu, C. Bridonneau, M. Étienne, G. Lecuyot, and M. de Rozières, 'La mission archéologique du musée du Louvre à Saqqara : Résultats de quatre campagnes de fouilles de 1993 à 1996', *BIFAO* 97 (1997), 269-292.

Ziegler, *Mastaba D'Akhetetep*

C. Ziegler, *Fouilles du Louvre à Saqqara I : Le Mastaba D'Akhetetep* (Paris, 2007).