THE WOR(L)DS OF LINEAR A

INTERDISCIPLINARY APPROACHES

TO DOCUMENTS AND INSCRIPTIONS

OF A CRETAN BRONZE AGE SCRIPT

Edited by Ester Salgarella and Vassilis Petrakis

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Cover Photo: Drawing of the inscription on **KN Zc 6** (image after SigLA: https://www.inscribercproject.com/SigLA/document/KN%20Zc%206/, with further processing).

The ASASA(RAME) logo has been drawn and composed by Vassilis Petrakis, based on the the following sources: the central 'eye' is based on CH 005 in the MinosSigns01 type font; drawings of individual signs are based on the following actual attestations (left to right: CH 042 on **CHIC #313**.a; CH 019 on **CHIC #030**.a; AB 31 on **KH 10**.3; AB 60 <ra> on **KN Np(1) 85** assigned to Hand 124-E; AB 13 <me> freely drawn in approximation to the style of Pylos Hand 1.

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Editorial • Εκδοτικό Σημείωμα

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Part of the AURA journal is the AURA Supplement series, comprising studies in Greek or English, which, due to their extent, cannot be published in the journal as articles. The series share the same areas of interest with the journal.

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K. Kopanias • Y. Papadatos ⌘ Κ. Κοπανιάς • Γ. Παπαδάτος

ATHENS STUDIES IN AEGEAN SCRIPTS AND
ADMINISTRATIONS (REINFORCING ARCHAEOLOGY-
MINDED EPIGRAPHY) • *ASASA(RAME)* 1

SERIES EDITOR • ΕΠΙΜΕΛΗΤΗΣ ΣΕΙΡΑΣ

Vassilis Petrakis (Athens)

It must be really true, as Pia de Fidio once perceptively observed, that interdisciplinarity is "part of the genetic code" of Mycenaean studies. From the earliest pioneering studies of Sir Arthur Evans, through the multifaceted approach which led to the monumental first 1956 edition of *Documents in Mycenaean Greek*, down to the increasing frequency of collaborative efforts among experts in archaeology, epigraphy, linguistics and textual interpretations in specialized articles, as well as edited works of synthesis, the integration of evidence from various fields has been part of the scope and aims of the study of Aegean Bronze Age texts and contexts.

John Chadwick's famous definition, in his keynote address at the Salzburg Colloquium, of the ideal scholar of Aegean scripts as someone able to command bodies of evidence as distinct as epigraphy, linguistics, economic history and archaeology is becoming increasingly difficult to realise. Our era of hyper-specialization and our finite lives compel us to realize such an ideal primarily through collaborative symbiosis of the different fields.

The purpose of this symbiosis is to allow a realm of mutual understanding to emerge. Knowing everything is utopian; but knowing what (and whom) to ask, what to expect, as well as the basic working assumptions, implications and limitations of an adjacent discipline is (or can be made) feasible. Mutual awareness, rather than panoptic expertise, can give birth to new academic environments that are of seminal importance in any meaningful progress. Separate monologues by polymaths, rare and far between, can be replaced by open-ended dialogues among experts.

It is in this spirit that *Athens Studies in Aegean Scripts and Administrations (Reinforcing Archaeology-Minded Epigraphy)* has been conceived. The series aspires to be a vehicle for distributing the fruits of such symbiotic endeavours. The series is designed to accommodate monographs offering high-quality, unique and original insights into Aegean Bronze Age texts and their material carriers, including, of course, the Cypriot members of the same family of scripts. Once the name of the monograph series begun to emerge, it almost spontaneously spawned the appropriate acronym, *ASASA(RAME)*, a homage to Jean-Pierre Olivier.

ASASA(RAME) includes monographs or edited volumes, published immediately in open-access and always with the print-on-demand option. Published by the Department of History and Archaeology of the National and Kapodistrian University of Athens, it specifically targets original topics and productively provocative approaches related to the study and better understanding of Aegean inscriptions and the contexts of their production and use.

We welcome proposals from colleagues at any stage of their career, to fuel discussions and rethink the problems and questions that the close study of Aegean and related scripts generates. Systematic promotion of the inclusive spirit in which *ASASA(RAME)* is conceived may, in the future, lead to the consolidation of multiple bridges across disciplinary boundaries -the ultimate goal being, hopefully, a continuum of fields.

Vassilis Petrakis ⌘ Βασίλης Πετράκης

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PREFACE

Yet, words are failing me now – failing to express in writing the joy of seeing this Volume out, with the multiplicity of worlds it contains. Each chapter, drawing its own world, takes us on a heuristic journey from cautious beginnings, through complex meanders of words, to enticing discoveries. This Volume stems from the Conference and round table titled *The Wor(l)ds of Linear A: An Integrated Approach to Linear A Documents and Script (a 2022 Assessment)*, held online on 24–26 May 2022, which I organized and convened during my time as Junior Research Fellow at St. John's College, University of Cambridge. *The Wor(l)ds of Linear A* has been the first ever Conference solely and fully dedicated to investigating the Linear A script of "Minoan" Crete in all its kaleidoscopic aspects, thus proving unique in its character and of paramount importance for the advancement of this research area as an independent, yet intertwined, disciplinary subject.

The Conference, ambitious as it were, brought together for the first time well-established senior scholars and early-career researchers alike working on Linear A across a broad range of subject areas, with a view to assessing the current scholarly understanding of Linear A. The Conference was aimed at exploring a wide variety of aspects, relating (but by no means restricted) to: administrative and writing systems, linguistic analysis, palaeography and semasiography, pinacology and epigraphy, script origin and connections, the archaeological record and socio-historical settings of the inscribed artifacts. The theme itself invited an "integrated" dialogue between different disciplinary perspectives in order to elucidate the complex subject of Linear A research in the broadest possible sense, thus providing a most comprehensive overview of aims, problems and possible future lines of inquiry. Methodological considerations and interdisciplinary approaches were particularly welcomed, which fostered further interdisciplinary discussion and helped to develop new challenging theoretical frameworks for understanding the many intertwined facets of Linear A writing and administrative systems (*Words*), and the socio-cultural systems that produced the documents (*Worlds*). By pinpointing the analytical problems scholars currently face when investigating all aspects of the *Wor(l)ds* of Linear A and by outlining new promising pathways, the goal of the Conference, as well as the present publication, is to revive the distinctive character of Linear A research and thus to integrate at our best the different disciplinary perspectives in order to break free of often too restrictive disciplinary boundaries.

The wor(l)ds uttered and created in the context of the Conference have now materialized in this much longed-for publication, jointly edited by Ester Salgarella and Vassilis Petrakis. The updated title *The Wor(l)ds of Linear A: Integrated Approaches to Documents and Inscriptions of a Cretan Bronze Age Script* was chosen to better reflect the contents of the submitted contributions (esp. "materiality" of writing and text-based analyses), herein appearing as individual thematic chapters. Featuring as the first Volume of a new series dedicated to the study

of Aegean epigraphy, *Athens Studies in Aegean Scripts and Administrations (Reinforcing Archaeology-Minded Epigraphy)*, aptly acronymed *ASASA(RAME)*, this work is hoped to pave the way to thriving and ever-growing research in this marvelous, as much as mysterious, multi-faceted disciplinary jewel.

Last but not the least, special thanks go to the Scientific Committee responsible for evaluating each contribution, that so kindly and willingly offered assistance in assessing the papers submitted for the virtual Conference: Matilde Civitillo (University of Campania), Brent Davis (University of Melbourne), Georgia Flouda (Hellenic Ministry of Culture and Sports), Barbara Montecchi (University of Bologna), Vassilis Petrakis (National and Kapodistrian University of Athens), Ilse Schoep (Katholieke Universiteit Leuven). To them all, to this Volume's brilliant contributors, to generous Vassilis, and to you dear passionate reader, go my most heartfelt thanks. And to all Cretans, of past, present and future: may your beloved Crete, with its rich history, live on until the End of Time.

Ester Salgarella

ACKNOWLEDGEMENTS

A NOTE ON JOHN YOUNGER'S ELECTRONIC RESOURCES ON LINEAR A

To everyone seriously or more casually interested in Linear A specifically, or Aegean scripts in general, John Younger's electronic resources on Linear A have been a truly invaluable working tool. It had been part of the *habitus* of those working on the script to check http://people.ku.edu/~jyounger/LinearA/ often, in order to retrieve conventional phonetic transcriptions (based on the *GORILA* readings and the axiom (but well supported, see Steele and Meißner 2017) of the Linear B>A "homography/homophony"), as well as information drawn from an index/lexicon of Linear A texts and an extensive bibliography on the script and related topics.

To cut what could be a very long description full of praises and euphemisms short, John's Linear A page was a first-rate, continuously updated and highly user-friendly resource. It was only natural that such resources were hosted at webspace afforded by John's home institution, the University of Kansas, in a website at a secondary server hosted by the University. In early 2024, and sometime following John's retirement from KU (30 June 2019), the precious URLs became unavailable and "not found" messages turned up on the screens of those who wished to consult these resources. Hearts stopped and breaths were held in the little realm of Linear A studies. To us, as editors of a volume *focused on* Linear A, these were definitely worrying news, not least because many of the papers in the volume cited these very URLs. Repeated attempts over several weeks showed this to be a non-temporary problem.

On 25 April 2024, John used another electronic offspring of his, the Aegeanet discussion list, to inform interested Aegeanists about the fate of this material. The title of the message appeared almost Messianic: "Linear A lives on". In this message, John plainly and succinctly confirmed the loss of the KU webspace. However, he assured that the material will be made available as downloadable PDF files from his personal Academia website. Not a sudden death then, but a rearrangement and transformation. One may entertain themselves in wondering if the fate of these resources might in fact echo the fate of the Linear A script itself. Since April 2024, as announced and promised by John, pertinent files have been uploaded to https://kansas.academia.edu/JYounger. In order to keep up with these developments, we had to eliminate the old unusable URLs from the texts of the papers, and replace them, whenever possible, with hyperlinks that the interested reader might in fact use.

Ester Salgarella and Vassilis Petrakis

CHRONOLOGICAL TABLE AND ABBREVIATIONS

Chronological Table: Absolute and relative dating. Absolute dates are presented here in a simplified manner integrating Warren and Hankey 1989, 169, Table 3.1 and Shelmerdine 2008, 4–5, figures 1.1–1.2. Cultural phases follow Dickinson 1994. The reference to scripts in use in the right column purposefully simplifies the picture, accepting a strict distinction between Cretan Hieroglyphic and Linear A and omitting certain "aberrant" examples (e.g. Phaistos Disk, Arkalochori bronze axe).

Absolute Chronology (in years BCE) different sets of dates indicate divergences between low (*left*) and high (*right*) chronologies		Pottery Phase (full spelling and abbreviations commonly used)		Cultural phase	Scripts in use
2200–2000		Early Minoan III	EM III	Late Prepapatial Period	'Archanes script'
2000–1900		Middle Minoan IA	MM IA		
1900–1800		Middle Minoan IB	MM IB	First Palace Period	Cretan Hieroglyphic Linear A
1800–1700		Middle Minoan II	MM II		
1700–1600		Middle Minoan III	MM III	Second Palace Period	Linear A Cretan Hieroglyphic
1600–1500	1700-1600	Late Minoan IA ≈ Late Helladic I	LM IA LH I		
1500–1450	1600-1450	Late Minoan IB ≈ Late Helladic IIA	LM IB LH IIA		
1450–1400		Late Minoan II ≈ Late Helladic IIB	LM II LH IIB	Third Palace Period (including Final Palatial/ Monopalatial and 'Post-palatial' periods)	Linear B?
1400–1370/1360		Late Minoan IIIA1 ≈ Late Helladic IIIA1	LM IIIA1 LH IIIA1		Linear A (non-administrative, residual?) Linear B
1370/1360–1320/1300		Late Minoan IIIA2 ≈ Late Helladic IIIA2	LM IIIA2 LH IIIA2		Linear B
1320/1300–1190/1170		Late Minoan IIIB ≈ Late Helladic IIIB	LM IIIB LH IIIB		

Chronological Abbreviations

EM   Early Minoan

MM   Middle Minoan

LM   Late Minoan

LH   Late Helladic (Mycenaean)

MC   Middle Cypriot

LC   Late Cypriot

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Getting to know Linear A

A historiographic introduction

Vassilis Petrakis

National and Kapodistrian University of Athens
ORCID ID: 0009-0003-4044-2313

Ester Salgarella

Aarhus Institute of Advanced Studies, Aarhus University
ORCID ID: 0000-0001-5091-5311

LOOKING BACK WHILE MOVING FORWARD: CONCEIVING AND PRESENTING AN AEGEAN "LINEAR" SCRIPT

The identification of a "Linear" class of scripts goes back, like the discovery of Bronze Age Crete itself, to Sir Arthur Evans' (1851–1941) early, pre-excavation studies of Aegean scripts, in which we witness the first unfolding of his genius, uncommonly adventurous and eager to explore new fields. Already a mature scholar in the fifth decade of his life and a recent widower, Evans gave himself to the study of Aegean Bronze Age cultures, a fascinating emerging lost world. Although he brought to the field an explorer's passion perhaps only properly paralleled to Schliemann's, his potential to reinvent himself methodologically was, at this point, limited. Despite his remarkable imagination and ability to produce comprehensive accounts out of disparate evidence (fully advertised in his 1890s works on Aegean writing), Evans remained, throughout his Aegean career, under the considerable influence of certain ideas current in late 19th century scholarship.

The quest to recover the lost literacy of prehistoric Greece was Evans' first Aegean affair. Already in his first systematic study of the topic, published in 1894 following a short article in the periodical *Athenaeum* earlier in the same year, he had established a firm scheme of an *antithesis* between a "pictorial" (for which he would use the terms "pictographic" and "hieroglyphic" before settling on the latter) and a "linear" class of writing in use in what he still described as "the Mycenaean world" (Evans 1894, 274 = Evans 1895, 5).

In this, as well as other passages from these fundamental early studies, we witness the emergence and, to some substantial degree, the consolidation of a scheme, in which "pictorial/pictographic/hieroglyphic" qualities are already well distinguished –even contrasted– with "linear" features and placed in a coherent scheme of development, almost certainly influenced by the contemporary ideas of Edward Burnett Tylor (1832–1917). Although not cited by Evans, Tylor's idea of "evolutionary relics", left-overs from earlier stages of (an assumed to be largely linear) development, must have influenced considerably his interpretation of the "pictorial" quality of a certain sign as such a "relic" from an earlier stage of true pictography or picture-writing (cf. also Bennet 2017, 62–3). The discovery of a fragment of what was to be termed a "libation table" from the Psychro (also Dictaean) Cave, now **PS Za 1**, was also critical in shaping his ideas of what a "linear" script was like (Evans 1897, 358–61, fig. 27).

The distinction of not one, but two "linear" classes of script occurred to Evans as excavations at Knossos progressed. Besides the tablets, other finds showed different varieties of sign-forms and the excavator was especially impressed by the discovery of the two Knossos cups (which we now date to MM IIIA) with inked inscriptions on their interior (**KN Zc 6** and **KN Zc 7**, Evans 1901–1902, 106–9, figs. 66a–b). Still, at this point, Evans is cautious enough not to differentiate between two "linear" classes. It is only with the excavation of the Temple Repositories, in 1903, that he finds evidence for "a linear class different from that of the later period of the Palace", in the tablet (**KN 1**) and no less than six roundels (**KN Wc 3**, **23**, **25**, **29**–**30** and **41**, of which at least four are accepted as inscribed in Linear A) discovered in the East Temple Repository (Evans 1902–1903, 41; see *GORILA* 2, 84‑5 and Hallager 1996, I: 54‑8 for the roundels). The idea of an "early system of linear script which may be conveniently termed Class A as opposed to Class B of the latest Palace Period at Knossos" (Evans 1902–1903, 52) has been born. Before the publication of the 1903 report, on 25 November of that year, Evans presented a paper on "The Pictographic and Linear Scripts of Crete and their Relations", in which some of his ideas on the development of Cretan scripts were also first expressed (summary in Evans 1903).

Beyond the discovery of the Temple Repository documents, several factors led to that birth at this specific point. Comparable inscriptions, in clay tablets, had been found in Ayia Triada during the previous year (which Evans had the privilege to study, courtesy of the excavator Federico Halbherr); Evans also found that the inscriptions of the Temple Repository were found alongside with fragments of what he recognized as "libation tables", recalling the example from the Dictaean Cave with the "linear" inscription, known to him since 1896. We may also note, as is relatively well known to those interested in the historiography of Minoan archaeology, that the 1903 Knossos report is the text in which the term "Minoan" (accented with an indication of the long vowel as "Minôan") takes strong precedence over "Mycenaean". For Evans, of course, all varieties of Cretan writing were equally "Minoan".

It is well understood, even from a cursory survey of Evans' early work, how gigantic the strides were in these exciting early days of Aegean epigraphy. We must constantly remind ourselves that all this flow of hypotheses was generated in a rapidly changing environment, when excavations of Knossos were modifying, with every season's report, our image of the prehistoric Aegean. Of course, Aegean epigraphy had not yet become a proper discipline, although the arrival of *Scripta Minoa* I (Evans 1909) would soon provide scholars with the first major publication in the field. Evans was, from the outset, *the major figure* in this realm as well as in all fields of Minoan archaeology. His authority was remarkable, and so it would remain for a great part of the 20th century – during his lifetime it would be nearly absolute. The reverence he enjoyed, especially in the field of Aegean scripts, is also reflected in the praising epigram that Ferdinand Chapouthier composed for Evans at the beginning of his own publication of the inscriptions from the Malia "Dépôt Hieroglyphique" (Chapouthier 1930). It is under the spell of such authority that we may occasionally forget how very basic assumptions about the *classification* of Aegean scripts (the "Pictographic"/"Hieroglyphic" and "Linear" classes) appeared at a *very* early stage. The momentum gathered in the first decade was outstanding. However, progress would not keep up with this pace in the next few years.

Evans intended the next two volumes of *Scripta Minoa* to be devoted to *both* "Linear" scripts, one with drawings, discussion and commentary on inscriptions, and one with photographic plates (Evans 1909, x). None of this was ever to take off the ground, as the pioneer's synthetic powers were soon consumed by the production of *The Palace of Minos*, a six-volume encyclopedia of all things Minoan, in which his discoveries at Knossos (beyond the epigraphic) were the protagonists. This major *opus*, along with a few related side-projects (e.g. Evans 1929), occupied Evans through the rest of his lifetime. Evans would return to the study of Aegean scripts only sporadically, in relevant sections of the first and last volume of *The Palace of Minos* and in the margins of the broader synthesis attempted there (Evans 1921, 612–46, focusing on the non-administrative "sacral" use of Linear A, followed, in pages 647–68, by a discussion of the Phaistos Disk; Evans 1935, 666–764 includes an extensive discussion of Linear B evidence hitherto known).

Sir John Linton Myres (1869–1954) was Evans' heir as far as the completion of *Scripta Minoa* was concerned and he lived just enough to see the first fruits of his efforts published. However, in 1945, before substantial work

on the next *Scripta Minoa* volume had begun, Giovanni Pugliese Carratelli (1911–2010) published a remarkable edition of the Ayia Triada Linear A "prehellenic" inscriptions, as well as those found on the Greek Mainland, such as the stirrup jars inscribed in Linear B (Pugliese Carratelli 1945) – effectively all Aegean epigraphic material available for study at the time outside Knossos and, of course, excluding Pylos, excavated yet for only one season (the Pylos tablets found were at the time studied through photographs by Emmett Bennett for his doctoral dissertation). It was this publication that made *Scripta Minoa* lose some of its momentum. Evans' plan had to be modified, and Myres decided to focus exclusively on the Linear B material from Knossos for what became *Scripta Minoa II* (Evans and Myres 1952, vi).

Although work on a *third* volume of *Scripta Minoa*, devoted to Linear Class A, had begun by the late 1940s (Fox 2013, 178, 188), this volume was never finished in the form Myres had drafted it. After his death, his (and Evans' own) relevant notes were handed to William Charles Brice (1921–2007), who produced the first corpus of *Inscriptions in the Minoan Linear Script of Class A* (Brice 1961). This had a much more extensive coverage than Pugliese Carratelli's previous edition, and it was also epigraphically much more focused, although it still contained inaccuracies that left much to be desired in the realm of *instrumenta* for the study of Linear A (cf. Del Freo 2023, 66). However, thanks to Olivier Masson's acknowledged input, Brice's edition saw the emancipation of Cypro-Minoan from that corpus (Brice 1961, v) and, even more than that, provided a consolidation of the *category of Linear A* script, its signary and the range both of palaeographic variants as well as the script's material supports (inscription types or classes). Brice would continue to promote the study of Linear A, either in his role as editor of the periodical *Kadmos* following Ernst Grumach's death in 1967, or through his collaboration with Nikolaos Platon (1909–1992), whose excavations in Kato Zakros revealed an "archive" with Linear A tablets in the West Wing of the palace complex (Platon and Brice 1975).

The period of next couple of decades that followed Brice's edition is one of remarkable diversity in the study of Linear A. While Mycenology had properly focused on discussions of Mycenaean Greek, its phonology and morphology, its lexicon and dialectal affinities, as well as, of course, textual interpretation, a proper presentation of the Linear A was (implicitly or explicitly) considered an indispensable step towards any progress that might lead to a better understanding of the script and, potentially, its decipherment. An environment of scholarly antagonism produced works such as the Linear A indexes and *transumerated* corpora by Maurice Pope (1924–2019) and Jacques Raison (1923–2010), published between 1971 and 1994 (Raison and Pope 1971, 1977, 1980, 1994). During that same critical period, a collaborative effort produced the first edited volume on Linear A by Yves Duhoux (1978a), which included review articles by Duhoux himself, Raison and Pope. The same period also saw the emergence of the first elaborate and comprehensive statistical approach to the Linear A material by David Packard (1974). Such diversity was definitely a step in the right direction, even if the different sign classifications and numberings used by Pugliese Carratelli, Brice and Raison-Pope (see further below) were at times confusing. We may appreciate that certain trends, which developed during that time, are still active in Linear A studies.

Having collaborated closely on the study of Linear B in Knossos and Tiryns, as well as on Linear A material discovered in Archanes and Chania, Louis Godart and Jean-Pierre Olivier (1939–2020) turned their attention to the realization of a full Linear A presentation. This work, which eventually spanned five volumes and took a decade to complete, was acronymed *GORILA*, standing for *G*(odart et) *O*(livier's) *R*(ecueil des) *I*(nscriptions en) *L*(inéaire) *A*, the first in a series of (truly memorable!) acronyms that Olivier would continue to invent. The editors defended the choice to term their substantial work a "recueil", a "collection", rather than a true corpus (*GORILA* 1, xi–xii). Equipped with very good photographs and facsimile drawings that were more accurate than anything had hitherto been presented, *GORILA* was a milestone publication. The first four volumes presented (as did Brice) inscriptions according to the types of their material carriers (tablets, sealings, other documents), while the flow of new publications in 1974–1976 prompted a supplementary presentation of tablets and sealings (from Archanes, Khania and Zakros) as the third volume in the series. The completion of *GORILA* in 1985 was an accomplishment that had implications beyond the provision of a technically superior presentation of the entire Linear A corpus. Its fifth volume contained, beyond the usual corrigenda and addenda features one

would anticipate, admirably complete tables of palaeographic sign variants in *microfiche* format and, perhaps most important of all, a new numeration of the Linear A signary following closely its homographs with the Linear B script.

Inscriptions published after 1985, now amounting to 107, have been meticulously collected and re-edited for more than a decade by Maurizio Del Freo and Julien Zurbach, who assumed the responsibility for a Supplement to *GORILA* (see Del Freo and Zurbach 2011 for an early report on this project), which appeared while this volume was under its final stage of preparation, under the title *Recueil des Inscriptions en Linéaire A. Supplément 1*, acronymed *RILA-S1*.

Yet, as the interdisciplinary nature of *WoLA* contributions clearly demonstrates, the Linear A script does not exist in and of itself, uprooted from its contextual uses and applications. Linear A inscriptions, in their quality of "textual artifacts" (alternatively put, "graphical objects"), are multifaceted entities, whose rigorous analysis necessarily requires (and is contingent upon) a thoughtful and oculate integration of several complementary approaches. For a sound and scrupulous interpretation, inscriptions need to be situated against their socio-historical backdrop and within their archaeological setting. With respect to Linear A, this was magisterially accomplished by Ilse Schoep in what we may well dub *the* "handbook" of Linear A (Schoep 2002). This highly influential work is still widely cited in the field (and beyond) and is a sure presence in libraries of Aegean scholars. Schoep's in-depth knowledge of Linear A contexts of use, and appreciation of how our theoretical interpretive frameworks influence (as well as shape) our historical reconstructions, are further discussed in her contribution to this volume.

Steady progress on the interdisciplinary study of Linear A is also eminent in the work of Helena Tomas, beginning with her doctoral dissertation *Understanding the Transition from Linear A to Linear B Script* (University of Oxford, 2003) and later work (Tomas 2010a, 2010b, 2011, 2012, 2017a, 2017b); Barbara Montecchi, in her monograph on the Ayia Triada records (Montecchi 2019), as well as earlier work (Montecchi 2008, 2010); and Brent Davis, in his monograph on inscribed "libation tablets" (Davis 2014), as well and in numerous relevant articles (Davis 2013, 2018, 2024, forthcoming). Such works stand at the forefront of Linear A research and represent not merely the marks of current progress in the study of the script and its use, but also excellent promises for its future.

Of sign classifications and sign numberings… into "reading" Linear A

Like all studies of Linear A inscriptions of the last three decades or so, *WoLA* was conceived, accomplished and concluded in a scholarly environment in which the AB numeration of Linear A signs is dominant, with a straightforward division between signs accepted as common between Linear A and Linear B (AB) and those that only appear in Linear A (A).

The recognition of signs of identical or sufficiently similar *form* (homomorphs or homographs) between Linear A and Linear B is as old as the identification of the Linear Classes themselves. However, Pugliese Caratelli's publication (Pugliese Caratelli 1945) provided a paradigmatic new classification and numbering of graphemes, based on his distinction between simple (L) and complex or compound/composite (Lc) and metric (Lm) signs. This was followed –albeit with modifications– by Brice (1961) and Raison-Pope (1971; 1977; 1980; 1994), while occasionally tables provided correspondences across the three variations (e.g. Raison and Pope 1971, 307‑9). In *GORILA* 5, Godart and Olivier revolutionized Linear A studies through their decision not to further correct or even revise this system, but by abandoning it in favor of one that revolved around the existence (or the lack thereof) of Linear A–B homographs. The fifth volume included surveys of sign variants (both summary and analytical, the latter in *microfiches*), as well as indexes (in both *transnumerée* and in *normalisée* hand-written mode) of all Linear A material known up to 1985, following the AB classification and numeration. A most important feature of this system is that it allowed the clear separation of AB homomorphs from A signs, the latter lacking commonly accepted correspondences to Linear A (**Fig. 0.1**; see also Del Freo 2023, 66‑7 for a recent account).

AB 01	⊢	AB 26	Ψ	AB 49	𝍃	AB 76	⁊⁊	A 306	𝆏	A 340	𝈱
AB 02	+	AB 27	Ψ	AB 50	𝈵	AB 77	⊕	A 308	◁	A 342	𝈻
AB 03	⧧	AB 28	Ψ	AB 51	𝈹	AB 78	⊙	A 310	ℭ	A 345	𝈩
AB 04	ψ	A 28b	ψ	AB 53	2	AB 79	𝈿	A 312	𝈷	A 349	ꟍ
AB 05	T	AB 29	𝈃	AB 54	𝈘	AB 80	⚠	A 314	⟫	A 350	𝈎
AB 06	⊺̄	AB 30	⚹	AB 55	𝈗	AB 81	⟩	A 315	⟆	A 352	𝈒
AB 07	𝈓	AB 31	Y	AB 56	𝈖	AB 82	𝈨	A 318	X	A 361	Ψ
AB 08	𝈄	AB 34	C	AB 57	𝈔	AB 85	℔	A 319	I	A 362	𝈾
AB 09	ꟽ	AB 37	∧	AB 58	⌐	AB 86	↩	A 320	Я	A 363	𝈺
AB 10	ℱ	AB 38	Å	AB 59	⌐	A 100/ 102	𝈙	A 321	𝈼	A 364	𝈑
AB 11	⟨	AB 39	𝈐	AB 60	𝈌	AB 118	𝈼	A 322	𝈀		
AB 13	𝈞	AB 40	⊞	AB 61	𝈍	AB 123	𝈬	A 323	𝈃		
AB 16	𝈟	AB 41	𝈕	AB 65	𝈎	AB 131a	𝈤	A 324	𝈰		
AB 17	𝈡	AB 44	✳	AB 66	𝈣	AB 164	𝈳	A 325	𝈟		
AB 21ᶠ	𝈅	AB 45	𝈲	AB 67	𝈢	AB 188	𝈝	A 327	𝈪		
AB 22ᶠ	𝈆	AB 46	Χ	AB 69	𝈛	A 301	Я	A 329	𝈫		
AB 23	𝈇	AB 47	✗	AB 70	𝈚	A 304	↑	A 331	𝈴		
AB 24	𝈈	AB 48	𝈉	AB 73	𝈜	A 305	⟨	A 333	𝈠		

Fig. 0.1: The current phonographic signary of Linear A (after Del Freo 2023, 81, Fig. 1; courtesy of Maurizio Del Freo).

Despite the elapsed time, the *GORILA* AB sign classification has hitherto seen only additions, not serious modifications: a most remarkable addition occurred with the discovery of sign AB 48 (Linear B value *<nwa>*) on **SY Za 4**, inscribed "libation table" from Kato Syme (Muhly and Olivier 2008, 207‒8; for this and other minor additions see Del Freo 2023, 67, n.15). Although not entirely surprising (it was *actually* anticipated in *Docs*, 40), this discovery showed how our knowledge of the Linear A script, even at the fundamental level of its signary, can still accommodate improvements.

Studies of Linear B have been using Emmett Bennett's signary, first formulated in his doctoral dissertation and then in his Linear B index (Bennett 1947, 1953) and first officially adopted by the Mycenological community as part of the "Wingspread Convention" in the Third Mycenological Colloquium in 1963 (Bennett 1964). It was with Bennett's signary (and subsequent adaptations) that Godart and Olivier integrated their own study of Linear A–B homomorphs. Promoted by *GORILA*, the AB numeration swiftly became dominant. Most importantly, it also led to a new appreciation of the relationship between the two classes of Aegean Linear scripts. It was on the basis of the AB signary that a flow of studies began, initiated already by James Hooker and, of course, Godart and Olivier in the mid-1970s, that managed to "read" Linear A signs by applying the Linear B values to them. Aided by various supplementary clues, most notably by the shared values of homomorphs (or quasi-homomorphs) between Linear B and the later Cypriot syllabary (which are not directly "genetically" linked), it has been possible to put forward substantial reasons for accepting that a considerable number of AB homomorphs could have similar phonetic correspondences (see most recently Steele and Meißner 2017, 108, fig. 6.11 [23 and 2 possible correspondences]; Del Freo 2023, 87, fig. 3 [32 correspondences]). Of course, the AB/A prefixation is always reversible and must be viewed as subject to critical analysis and revision.

The evidence seems to offer tangible hope for an eventual window into the linguistic structures that underlie Linear A inscriptions, namely its phonology. However, we must note that "reading" Linear A through such a projection of Linear B values still leaves an important gap: Linear A orthographic practice, the ways in which phonological realities map onto grapheme use. We can assume that Linear A orthography was similar to Linear B practices to a considerable degree. Except for the ultimately agnostic, few would take issue with such a working hypothesis, and it would also fit well with a now quite widely accepted scenario where there was considerable overlap of personnel and/or a degree of bilingualism on the part of writers around the time when Greek started to be written (and so what we call "Linear B" was born). However, it is unclear where the justifiably assumed "considerable degree" stops and where (and which) differences exist. This is a matter that we must treat with the highest caution, especially as one explores the possibility that Linear B orthographic choices that look "odd" with regard to the Greek phonology (e.g. common graphic rendering of liquids; graphic omission of final consonants) might hint at "canonical" features of the (or *a*) "Minoan" language (see already in *Docs*, 43, 67‒70). Our justifiable assumption of the existence of connections between Linear A and Linear B orthography clashes with our ignorance of the details of this connection (cf. Meißner 2024, 125; Steele 2024, 13‒20).

Significant and steady progress in our understanding of the linguistic features of the Minoan language (or set of dialectal variants of *a* "Minoan" or "Aegean" linguistic family) has been made by Brent Davis in a number of important works (Davis 2013, 2014, 2018, 2024, forthcoming). Promising novel approaches, supported by a sound methodological framework, has the definite potential to shed more light on the idiosyncratic features not only of the Minoan language encoded in Linear A, but also of the languages rendered by Cretan Hieroglyphic and Cypro-Minoan respectively. There will be a bit more to say about these works in the concluding section.

A LOOK AHEAD: DESIRABLE FUTURE PATHWAYS

Although much has been accomplished since the early beginnings of Linear A scholarship, we cannot hide there is still plenty of space for improvement. This volume (especially in its online, open-access format) presents itself as a stepping stone for making Linear A scholarship more accessible to the wider audience, at the same time

placing itself at the forefront of academic research in the field by presenting some of the latest developments and findings. Stemming from the very first Conference fully dedicated to the Linear A script, in its kaleidoscopic nature, we do hope that the present publication will set the foundations for, and promote, a steady streamline of future international collaborative events to foster the study of Linear A and related scripts as both a subject attracting interdisciplinary interest and with its own disciplinary identity.

In this respect, there are a number of *desiderata* in the field, from which both scholars and the wider public may benefit significantly. First and foremost, a digital, interactive and searchable corpus of all extant Linear A inscriptions (with high-resolution images, accurate phonetic transcriptions and commentaries) is highly needed, and a crucial tool steadily to advance the current state of the art. Even more so at this moment in time, after having witnessed (most regrettably) the shutting down of John Younger's masterful Website *Linear A Texts & Inscriptions in Phonetic Transcription & Commentary* (see above p. 17).

A new, digital corpus shall allow users to carry out a number of complementary analyses (e.g. linguistic, palaeographic, epigraphic, statistical, typological, chronological, geographical, material, just to name a few), whose results always need to be integrated for a nuanced and accurate understanding of Linear A inscriptions (both as carriers of textual data and material objects/ artefacts) situated against their socio-historical backdrop and within their archaeological setting. Needless to say, such a *desideratum* requires the collaborative cooperation of experts in different fields, and on an international level. We do hope this can be achieved in the relatively short term, given the fast pace at which the ever more digital, interconnected academic community is growing.

Recent and ongoing digital projects confirm that we are already moving in this much welcomed and promising direction. Among these, noteworthy are: the palaeographical database *SigLA. The Signs of Linear A: A Palaeographical Database* (Salgarella and Castellan 2021); and the interactive online catalogue *LAIF – Linear A Inscription Finder* (under ongoing development); the digitalization of Linear A inscriptions (among others) carried out by the *INSCRIBE Project* (University of Bologna) and the *PA-I-TO Project* (La Sapienza University of Rome). In recent years, the five volumes of the standard (printed) corpus of Linear A (*GORILA*; see above discussion) have also been made accessible online on the Website of the publishers (*ÉtCrét* 21). All this online material is the first step towards creating a unified (or inter-linked) online corpus of Linear A inscriptions. For, in this respect, Linear A is still lagging behind if compared to Linear B (see e.g. *CaLiBRA. The Cambridge Linear B Research Archive*, University of Cambridge; *LiBER. Linear B Electronic Resources,* by Istituto di Studi sul Mediterraneo Antico; *Dāmos. Database of Mycenaean at Oslo*, University of Oslo; *The Sir Arthur Evans Archive*, by the Ashmolean Museum, Oxford).

A way to go could be through the establishment of recurrent international and cross-disciplinary meetings on Aegean scripts with specific thematic foci, more intended to present and discuss progress in the study of undeciphered Aegean scripts, as pioneered by the 2022 *WoLA* event. These may stand as parallel to the quinquennial Colloquia on Mycenaean studies directed and sponsored by *CIPEM. Comité International Permanent des Études Mycéniennes*, which also cover all aspects of Aegean, as well as Cypriot epigraphy since 1956.

Last but not the least, another *desideratum* (partially overlapping and intertwined with the earlier two) would be to systematically produce more outreach material (and measures) to disseminate reliable, research-informed knowledge of Linear A to a wider –educated, yet not necessary specialist– audience. The last few years have in fact witnessed a growing interest in Aegean scripts (especially the undeciphered ones) from the general public, which however does not correlate with an increase in the proportion of adequate and reliable online resources. In this respect, there are two notable exceptions, as grounded in academic scholarship, but accessible to non-specialists. First, we may mention the concise, yet comprehensive volume *Writing in Bronze Age Crete: 'Minoan' Linear A* (Salgarella 2025b), part of the dissemination series *Cambridge Elements* (Cambridge University Press). This is the first outreach volume fully dedicated to Linear A, which considers Linear A within an investigative framework as well as narrative, shedding light on a number of burning questions in the field, often the subject of intense academic debate. Second, the podcast *Aegean Connections* (produced also by Salgarella), covering a wide range of topics related primarily (but not exclusively) to the Bronze and Iron Ages, and building

a bridge between scholars (both well-established and early-career) in Aegean-oriented academic fields and the wider audience to 'connect' the shared passion for the Aegean context.

So many prospects are generated by the contributions (and the contributors) in this publication. In particular, the exploration of digital approaches for field-specific knowledge dissemination is most promising (see also the concluding remarks, Petrakis and Steele, this volume, pp. 17). The Editors of this volume are also actively engaged in outreach (current and prospective) projects. For instance, a few recent projects moving in the direction of disseminating sound knowledge of Aegean scripts are Ester Salgarella's _Aegean Connections_ Podcast Series and her forthcoming short introduction to Linear A (Salgarella 2025b).

A TEMPORARY "PAUSE"

At this point, we need to pause for the time being. We have so far attempted to document only some aspects of the progress accomplished, until relatively recently, in our basic knowledge of the script we term "Linear A". This account was concerned with looking backwards, both at what has been achieved and what remains with us to this day. We thought it appropriate, as a reflection of the dynamic nature of the _WoLA_ event itself as well as that of Aegean epigraphy itself, to resume our more forward-looking observations following the individual articles that make-up the core of this volume.

This account will be resumed in the concluding article of this volume, which, together with this introductory overview, are the true bookends of this work. For now, the floor (in the form of electronic or printed page, depending on your preference) is given to our contributors, whose work forms the nucleus of the present volume.

As Editors of a publication fully dedicated to Linear A, a topic also engaged within the complex context of the origin(s) of writing in the Aegean, we have unquestionably developed a soft spot for beginnings. May this volume, marking as well as celebrating the end (and tangible outcome) of _The Wor(l)ds of Linear A_ Conference, set the foundations for a new starting point: at every journey's end, there lies the anticipation of a new departure.

1

Names on Roundels?

The "Special" Case of Neopalatial Roundels with Incised Numerals on the Faces

Maria Anastasiadou

University of Heidelberg
ORCID ID: 0000-0002-5262-1402

ABSTRACT

This paper discusses a curious "coincidence" observed in the Linear A inscriptions on four Neopalatial roundels with incised numerals. The roundels come from Agia Triada, Gournia, Malia and Kato Zakros. The numerals on the Kato Zakros specimen had not been recognized in GORILA *as numerals, but a more recent study has suggested that they are. The reading of the inscriptions on this roundel is problematic because there is no spatial division between the signs used. The structure of the inscriptions on the other three roundels with incised numerals could help with this problem. A pattern is noted in the sign sequences on these roundels as they all start with the Linear A sign <A>. This could support the suggestion that the initial A in Linear A sequences could constitute a prefix. It is possible that the sign-sequences on these roundels could represent names of some kind, perhaps anthroponyms or theonyms. However, caution is suggested as recent research on the Linear A (J)A-SA-SA-RA-ME does not support this interpretation.*

ROUNDELS

Roundels represent one of the main types of Minoan Neopalatial impressed nodules (sealings), i.e., lamps of clay that carry seal impressions and were used for administrative purposes. They are free-standing nodules, display the form of a disc and carry seal impressions on the rim (**Fig. 1.1**) (For roundels in general, see Hallager 1996, I: 79–120; Müller 1999, 362–65; 2002 80–1; Krzyszkowska 2005, 163; for Kato Zakros specifically, see Müller 1998, 273).

Often a Linear A inscription is incised on one or both faces of these objects. The profile (side-view) of the roundels can be disc-shaped (flat faces), lentoid (convex faces) or irregular plano-convex (one flat and one convex face) (Hallager 1996, I: 94; Müller 1999, 363; 2002, 80). Their diameter varies from 1.7 cm to 7–7.4 cm and the number of seal impressions on the rim from 1 to 15 . Objects with more than one seal impression are regularly stamped by the same seal face. Eight specimens attest to the use of up to four different seal faces for each (E.g. Hallager 1996, II: 164–65, **KN Wc 30** [HMs 345]).

About 180 roundels come from MM IIB to LM IB contexts (Hallager 1996, I: 84, tbl. 4). More than 150 specimens have been recovered in Neopalatial contexts. Among them, the vast majority, 118 examples, come from Chania. These are followed by 22 specimens from Agia Triada, which are of special importance, as they were found in deposits that also contained large numbers of Linear A tablets (numbers after Hallager 1996, I: 84, tbl. 4; Montecchi 2019, 228). Knossos has provided 11 specimens, only seven of which come, however, from
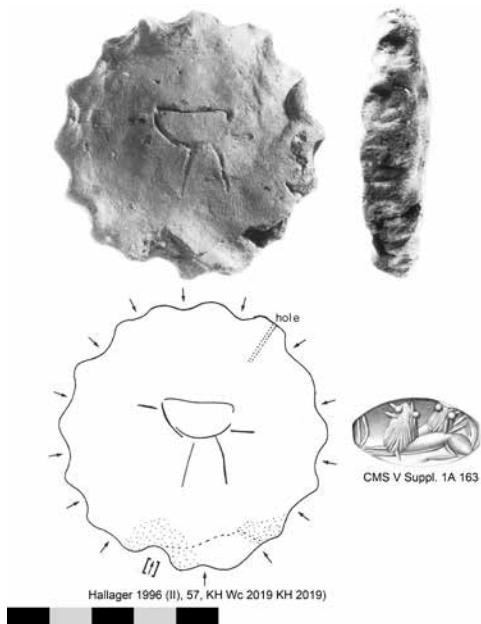
Fig. 1.1: Roundel from Chania and the seal that stamped it. Drawing of the seal face not in relative scale (Photographs and drawings of the roundel © Erik Hallager, with permission of B. Hallager. Drawing of the seal face © *CMS* Heidelberg).

a dated context, the Eastern Temple Repository (numbers from *CMS* II,8). Hallager (1996, I: 84, tbl. 4) lists 14 roundels from Knossos, but some of them are only reported to come from the site (see also Hallager 1996, I: 54–6; the data regarding Knossos presented were retrieved from the *CMS* Databases in Arachne: https://arachne.dainst.org/project/corpusminmyk, accessed on 1 December 2021). Three roundels come from Gournia whereas MM III Malia and Tylissos have produced two each (but note that only two of the five Malia roundels have a context: Hallager 1996, I: 58–61. Numbers from Hallager 1996, I: 84, tbl. 4; Younger in Watrous et al. 2015, 446–48, no. 2). Single finds come from Myrtos Pyrgos and Kato Zakros (numbers from Hallager 1996, I: 84, tbl. 4). A piece from Agia Eirini, Kea is dated by its context to MM II/IIIA and is, therefore, not included here (Hallager 1996, I: 45–6; 1996, II: 37, no. **KE Wc 2**). Roundels functioned as receipts recording the delivery of goods or also services (thorough discussions of roundels in Hallager 1996, I: 79–120; Montecchi 2019, 228–36). These are described by the inscription on their faces and counted by the number of seal impressions on the rim.

These nodules seem to have had some kind of administrative connection with Linear A tablets, although there is no evidence that the information documented by them was later transferred to the Linear A tablets (Hallager 1996, I: 117–18, 225–27; Schoep 2002, 195–96; Montecchi 2019, 233–34). The use of the same seals on roundels and other nodule types, except for *noduli*, is occasionally attested (Hallager 1996, I: 215–16). This constitutes an indication that the individuals involved in the administration that employed roundels were also active in the sealing administration in which other nodule types were used.

Hallager (1996, I: 85, 113) considered that roundels were made with the aim of mainly being kept into archives of a central administration. In his opinion, the same scribe/nodule maker wrote on roundels with impressions of different seals and different scribes/nodule makers on roundels impressed by the same seals (Weingarten 1988, 7–15; Hallager 1996, I: 94, 171). This indicates, according to him, that scribes/nodule makers and seal users were different individuals. He suggested that the deliveries recorded by the roundels were done from a central administration, represented by the scribe, to a party, which was the seal user (Hallager 1996, I: 116–20). By stamping the roundel in the number of the units (s)he received and leaving it with the administration as a receipt for the transaction, the seal user was protected against any possible future claim that (s)he took out a larger number of deliveries than those (s)he actually did. On the basis of the Agia Triada roundels, Montecchi noted that the identification of scribal/nodule maker hands is uncertain (Montecchi 2019, 228–36). This makes it, in her opinion, impossible to tell whether one or two individuals were involved in writing/making and

stamping the nodules. According to her it is, thus, not known whether the scribe/nodule maker was different from the seal user. Montecchi considered that there is not enough evidence as to whether the deliveries were made from or to the administration.

Both Hallager and Montecchi saw the seal users as individuals associated with the life in the building in which the objects were found, for example, non-administrative personnel (Hallager) and official administrators (Hallager, Montecchi) (Hallager 1996, I: 103–4; Montecchi 2019, 228–36). Montecchi (2019, 235) also suggested that, in the case of Agia Triada, external actors associated with other localities may also have occasionally been involved in stamping roundels that were found there. Of interest with respect to this point is Salgarella's observation that the palaeography of Linear A signs on some roundels from Hagia Triada is noticeably different from the sign variants observed on the tablets from the site (Salgarella 2025a).

ROUNDELS WITH INCISED NUMERALS ON THE FACES

The Linear A inscriptions on Minoan Neopalatial roundels and, consequently, the specimens discussed in this contribution are read by applying Linear B values to Linear A signs. Despite some unavoidable shortcomings, recent scholarship has discussed this approach as methodologically sound and legitimate for studying Linear A (Steele and Meißner 2017).

The numerals

Three Neopalatial roundels display incised numerals on their faces (Hallager 1996, II: 11, no. **GO Wc 1** (HM 83); 34, no. **HT Wc 3024** (HM 1110); 177, no. **MA Wc <5>** [HM now missing]). Previous studies on roundels with incised numerals include further examples that have not been included here (Perna 1994, 35–7; Hallager 1996, I: 100-1). One piece is a roundel from Agia Triada (Hallager 1996, II: 28, **HT Wc 3016** [HM 68]) which may be seen as a possible example with incised numerals, but it is not possible to know whether the elements that could possibly be read as the relevant incisions belong to numerals or are damages to the clay. Hallager has interpreted them as damages to the clay in the relevant drawing, but in the photograph of the object they appear similar to incised lines. Then there is **PH Wc 41** (Hallager 1996, II: 187, no. **PH Wc 41** [HM 1530]) which is not taken into consideration here because of its Protopalatial context. Finally, a small group of three roundels with incised lines and signs *supra sigillum*, have been identified by Hallager as numerals and fractions (Hallager 1996, I: 101, 229; also, e.g., Hallager 1996, II: 196–97, no. **PYR Wc 4** [ANM 12567]). These are exempted from this study because the signs are not inscribed on the faces.

The Neopalatial roundels under study are, therefore, one specimen from Gournia, which displays the numeral 5, one from Malia with the numeral 4 and the fraction A 704, as well as one from Agia Triada with the numeral 6 (**Figs. 1.2, 1.4**). A fourth roundel from Kato Zakros could possibly be incised with the numeral 2 (**Fig. 1.2** *bottom*; **Fig. 1.3**). However, here there is disagreement among the scholarly community as regards the identification of the last sign of the inscription.

GORILA and Hallager read the inscription on the Kato Zakros roundel as: Line 1 *A-TI-KA,* end of sequence, *A-*; Line 2 *DU-KO-*[[*MI*]] (For the inscription, see *GORILA* 2, 98, **ZA Wc 2**; Platon and Brice 1975, 89–91, *ILA* III 8 (HM 84); 155, no. HR; 173, Δισκίον H (ogarth) R(oundel). HM 84; Perna 1994, 32–3, 35–7; Hallager 1996, I: 207, **ZA Wc 2**). In this case, the last sign is read, possibly, as an erased [[*MI*]].

A different opinion has been expressed by Perna (1994, 32–3, 35–7). After inspection of the object, the scholar noted that the reading of [[*MI*]] is based on the incorrect perception of an elongated fissure on the surface of the clay as part of the last sign. In his opinion, the latter only consists of two clearly discernible vertical lines and should be read as the numeral 2. Hallager noted that Perna's suggestion "is possible but not absolutely certain" (**Fig 1.3-a**) (Hallager 1996, I: 101; II: 207 no. **ZA Wc 2**).

Fig. 1.2: Four roundels with incised numerals and the seals used to stamp them. Drawings of the seal faces not in relative scale (Photographs and drawings of the roundels from Gournia, Malia, Agia Triada and Kato Zakros [reverse and profile] and of the seal face on the roundel from Malia © Erik Hallager, with permission of Birgitta Hallager. Drawings of the remaining seal faces © *CMS* Heidelberg. Photograph of the roundel from Kato Zakros, obverse: Maria Anastasiadou © Archaeological Museum of Heraklion Hellenic Ministry of Culture and Sports – Hellenic Organization of Cultural Resources).
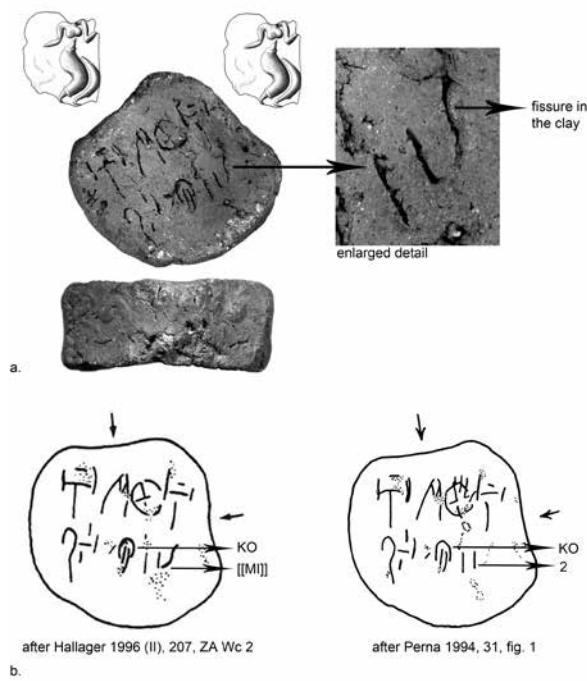
Fig. 1.3: The Kato Zakros roundel with (a) enlargement of part of its inscription and (b) two suggestions of reading the inscription (a: photographs of the roundel by Maria Anastasiadou © Archaeological Museum of Heraklion Hellenic Ministry of Culture and Sports – Hellenic Organization of Cultural Resources. Drawings of the seal face © *CMS* Heidelberg. b: after Hallager 1996, II: 207, ZA Wc 2 © Erik Hallager, with permission of Birgitta Hallager; after Perna 1994, 31, fig. 1: drawing M. Perna © De Gruyter Wissenschaftsverlag and Massimo Perna.).

After examination of the piece in question, the present author favors Perna's reading (**Fig 1.3-a**). The line read by *GORILA* as part of [[*MI*]] appears to indeed be a cleft in the clay. The last sign should accordingly be
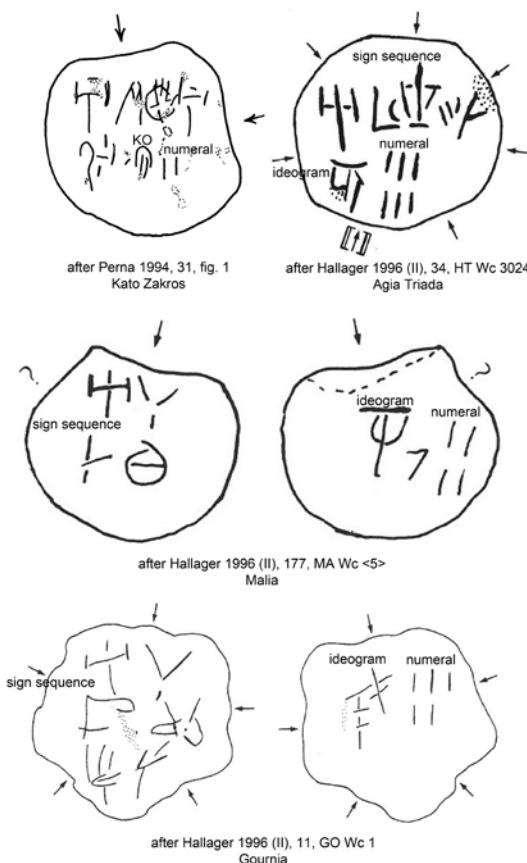
Fig. 1.4: The inscriptions on the four roundels with incised numerals (drawings of the roundels © Erik Hallager, with permission of Birgitta Hallager).

read as consisting of two vertical lines that represent the numeral 2. Perna observed that the number 2 of the incised numeral agrees with the number of seal impressions (*CMS* II,7 no. 25) on the rim of the roundel (Perna 1994). This also supports the reading of the elements in question as parts of the numeral 2, showing, as Perna noted, that this numeral and the number of seal impressions on the nodule refer to the commodity/service inscribed on it.

Based on the above, Perna's suggestion for reading the last sign in the obverse of the Kato Zakros roundel as the numeral 2 should be accepted.

Appearance

The Agia Triada and the Kato Zakros objects are identified by Hallager as disc-shaped (**Fig. 1.2**). The same scholar describes the shape of the Gournia specimen as indeterminable. The exact form of the Malia object is unknown, as the piece is now lost and no photograph of its profile is available. The diameter of the roundels under discussion ranges from ca. 2.5 to ca. 3.6 cm, with the Malia example being the smallest and the Gournia one the largest. One (possibly in all of the aforementioned cases Neopalatial) seal has been used to stamp each specimen (*CMS* II,6 nos. 21, 159; *CMS* II,7 no. 25). This shows a human figure in two cases and animals in the other two. The Malia roundel carries, according to Chapouthier who published it, at least one impression (Chapouthier 1948). However, the "pinched" appearance of part of its rim could suggest that it was stamped twice. The Kato Zakros roundel is stamped four (*CMS* II,7 no. 25), the Gournia five (*CMS* II,6 no. 159) and the Agia Triada (*CMS* II,6 no. 21) six times. The latter was initially stamped seven times, but a piece of clay was placed on top of the seventh seal impression to correct the number from seven to six.

The inscriptions

The inscriptions on the Agia Triada and the Kato Zakros specimen are only found on the obverse (**Fig. 1.4**). The Malia and the Gournia examples are inscribed on the obverse and the reverse.

The "reading" of the inscriptions in the Malia, the Gournia and the Agia Triada specimens does not cause particular problems. It is hinted at by both the type of signs used and also by the way these are placed on the surface of the script carrier. In the Gournia and Malia examples, a sequence of syllabograms is inscribed on one face of the roundel, whereas an ideogram and a numeral are seen on the other. This provides a clear spatial division of the inscription that denotes that the syllabograms belong together and the ideogram constitutes a separate entity. The placement of the numeral on the face with the ideogram constitutes a spatial visual hint, which suggests that the former refers to the latter. A similar spatial division is also observed in the Agia Triada roundel, despite the fact that all signs here are placed on one face of the roundel. In this inscription, the syllabograms occupy one line whereas the ideogram and the numeral are placed on the second line. This visually enhances the correct reading of the inscription according to which the syllabograms build one unit and the ideogram, to which the numeral refers, another.

Based on the above, it may be concluded that all three roundels in question are inscribed with signs belonging to three different categories: first, one or more sign-sequences of syllabograms; second, an ideogram for a commodity; and third, a numeral following the commodity. The sign-sequences are spatially separated from the ideograms and the numerals.

Turning to the Kato Zakros roundel, no clear spatial distinction of the type seen on the other specimens is observed. This is, perhaps, the reason that, despite separating the sign-sequence when transliterating the inscription (perhaps following *GORILA*), Hallager suggested that it should be read as one word (Hallager 1996, I: 207 entry **ZA Wc 2**). With the reading of the last sign as the numeral 2, the inscription would in this case read *A-TI-KA-A-DU-KO* 2. The editors of *GORILA* and Perna, on the other hand, read two separate sign-sequences in the inscription, suggesting that a second sign-sequence started after *A-TI-KA*. According to Petrakis (V. Petrakis, pers. comm. 30 October 2023), there is epigraphically no reason to break the sign-sequence after the *A-TI-KA*; given this and the absence of a spatial separation of the script signs on the Kato Zakros roundel, any division of their sequence by modern scholarship is bound to be arbitrary. *GORILA* and Perna probably did divide because of sign *A*, which is often (but not always) encountered at the beginning of sign-sequences. *GORILA* read *A-TI-KA*, *A-DU-KO* (*GORILA* 2, 98 entry for **ZA Wc 2**; Perna 1994). Here, we would then have two sign-sequences and a numeral: *A-TI-KA, A-DU-KO* 2. In this case, since the numeral follows the word *A-DU-KO,* it would possibly refer to it. This possible word is a hapax in Linear A, while the word *A-DU-KU-MI-NA* is encountered as a name on a list in a Linear A tablet from the Kato Zakros Palace (**ZA 10a**.3–4 (*GORILA* 3, 168–69, entry for **ZA 10a**; also Younger 2024a).

Finally, Perna read two sign sequences, one ideogram and a numeral in the inscription: *A-TI-KA*, *A-DU*, *KO* 2. The reading of the signs *A-DU* as a separate unit was proposed because *A-DU* is a word well-known in Linear A tablets (for this word, see Neumann 1960, 186, n. 1; Perna 1994, 33; Schoep 2002, 166; Montecchi 2008, 319–21; 2019, 84–5, 119–21, 172). In the tablets, it is commonly an initial word used as a heading and is never followed by numbers. For this reason, it has been suggested to be an important word in the economic vocabulary of Neopalatial administration, for example, a transactional term or, as is better argued by Montecchi (2019, 172, 339), even a name of some kind, for example, a toponym. Perna (1994, 33) suggested that the syllabogram *KO* that follows *A-DU* in the Kato Zakros roundel functions as an ideogram for the goods that are counted by the numeral two. According to this suggestion, the *A-DU* would behave in a manner partly similar and partly different to that in the Linear A tablets. As is common in the tablets, the sign sequence is placed before a sign followed by a numeral. However, in contrast to most tablets, it is not the first sequence in the inscription but it follows a word, *A-TI-KA*.

KO is not cataloged among Linear A ideograms. However, a possible ideogrammatic function for it in the specific roundel may be supported by the inscriptions on the other three roundels with incised numerals. The

arrangement one (?) sign sequence, one ideogram and one numeral on these roundels would also make sense in the Kato Zakros specimen, mainly because the latter also displays a numeral. The basic problem with this suggestion would be that *KO* is not spatially separated from the other syllabograms in the Kato Zakros roundel, as the ideograms are on the other roundels.

However, this is, perhaps, not significant in this specific example, since care for spatial separation of units may be seen as generally absent in the specific inscription. If, namely, *GORILA*'s and Perna's reading of *A-TI-KA* as an entity different from the sign-sequence that follows is correct, then the first sign of the latter at the upper line, *A-*, becomes spatially separated from the remaining part of the sequence, which continues at the lower line. This would suggest that the scribe used all the available space in the upper line to uninterruptedly write an inscription, caring neither to spatially separate the first sequence from the second nor write all the signs of the second together in one line.

The significance of the inscriptions

In three of the four roundels with numerals, the Agia Triada, the Kato Zakros and the Gournia specimens, there is a correspondence between the numeral incised on the objects and the number of seal impressions it carries. This clearly suggests, as others have also noted, that the numerals in these cases provide the same information as the number of the seal impressions. The Malia roundel displays a peculiarity in that it is inscribed by the numeral 4 and the fraction A 704, but is only stamped by one or two seal impressions. Plausible explanations for this possible discrepancy between the incised numeral and the number of seal impressions have been put forward by Olivier and Perna (for Chapouthier's, Olivier's and Perna's opinions, see Perna 1994, 36–7). However, we cannot elaborate on this more, since any solution to this problem requires knowledge of the exact number of seal impressions on the piece.

Notable is that all sign sequences on the faces of the roundels in question are starting with the same sign *<A>*. There is: *A-RA-TU-ME* in the Agia Triada roundel, *A-SA-SU-MA-I-SE* in the Gournia roundel, *A-SA-DA-KA* in the Malia specimen and *A-TI-KA(-)A-DU* (accepting that *KO* that follows could indicate a commodity) in the Kato Zakros specimen. If the signs on the Kato Zakros nodule are divided in two sequences, following *GORILA* and Perna, there would be: *A-TI-KA A-DU* … On the basis of this reading, one could even suggest that all words in the Neopalatial nodules with incised numerals start with the sign *<A>*.

The observation above might at first seem insignificant, since many words start with the sign *A* in Linear A (for the frequency of *A* as an initial sign in Linear A words, see Davis 2014, 263–64, with n. 1416). However, in at least the context of Neopalatial roundels it could, perhaps, be significant, as no other inscription on roundels starts with this syllabogram. The place of the sign *A-* at the start of the sign sequences could support the widely proposed suggestion that this sign in an initial position in Linear A constitutes a prefix (the initial *(J)A* in Linear A sequences is interpreted as a prefix in Godart 1976, 43–4; Duhoux 1978b , 110–11; 1989, 101; Valério 2007, 9; for a similar phenomenon in Linear B, see also Melena 1987, 222, n. 65). In the roundel in question it, could, accordingly, perhaps suggest that the words on these specific pieces belong, somehow, together. They could, for example, represent a specific word category that differs in some manner from words on roundels with no incised numerals on the faces.

It is difficult to find an explanation for this pattern and define this category. With the exception of the possible *A-DU*, all other words, the *A-RA-TU-ME*, *A-TI-KA*, *A-SA-SU-MA-I-SE* and *A-SA-DA-KA*, are hapaxes (see Younger 2024a). This could, perhaps, favor their identification as names of some kind. This idea could possibly be supported by the occurrence of the likely sign sequence *A-TI-KA* of the Kato Zakros roundel as a male anthroponym in Linear B from Knossos (**KN V(4) 831**.4: Aura Jorro 1985, 118–19; Davis 2014, 201, tbl. 51, no. 4; not included in Godart 1984 and Schoep 2002, 154–55 with tbl. 3.22). It is, of course, as Schoep (2002, 154) has noted, not possible to know whether the words overtaken from Linear A to Linear B retained their significance in the latter. Therefore, the possibility that *A-TI-KA* could have been an anthroponym in Linear A must remain open. Of some interest is also the fact that, despite its hapax status, the Agia Triada *A-RA-TU-ME*

is compared by Montecchi to the possible, in her opinion, anthroponym *A-RA-TU* on a Linear A tablet from Kato Zakros (Montecchi 2019, 231; recognized as hapaxes in Younger 2024a). The fact that *A-TI-KA* and *A-RA-TU-ME* may, each in its own way, be connected with anthroponyms could perhaps be seen as a possible clue that the words on the roundels in question were names of some kind. Of some significance to the discussion here is the Kato Zakros possible sign sequence *A-DU*. If this is a transactional or other similar term, as many suggest, the fact that it starts from an *A-* could be coincidental and constitute a possible indication that the line of reasoning followed here is faulty. On the other hand, Montecchi's suggestion that the sequence encodes a name of some kind, perhaps a toponym, allows for the possibility that the words in question may be rendering names of some kind.

Finally, of some relevance to the discussion could also be earlier suggestions that connected other sign sequences starting with an *A*, such as *A-RE-SA-NA* and the libation formula's *(J)A-SA-SA-RA-ME,* with names. Such suggestions are, however, based on very scarce to, in some cases, non-existent evidence. The Theran *A-RE-SA-NA* has been seen as a possible anthroponym (e.g., Duhoux 1989, 86, 89). However, it is only encountered once and by itself in the Linear A Corpus. Thus, its identification as a personal name remains highly hypothetical. Similarly, *(J)A-SA-SA-RA-ME*, has been suggested to constitute a possible theonym. Artemis Karnava (2016) has, however, pointed out that the indications for reading *(J)A-SA-SA-RA-ME* as a theonym are scarce to non-existent. More importantly, Brent Davis recently argued, using clear methodology, that the position of *(J)A-SA-SA-RA-ME* in inscriptions would suggest this was a generic term for an offering rather than a name (Davis 2014, 270–71).

CONCLUDING REMARKS

It is, unfortunately, not possible to conclude here with "real" results. It can only be stated that a pattern is noted in the inscription of roundels with incised numerals, which cannot, however, at this stage be adequately explained and, thus, evaluated. For a seal and sealings specialist, it would be tempting to connect, for example, the Kato Zakros *A-TI-KA* to a human or even deity somehow involved in the transactions recorded by the roundel. However, the exploration of this line of inquiry has shown that, as is unfortunately most often the case, the data do not provide the answers the researcher desires. They, instead, constantly generate more questions.

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2

Recent Linguistics-Based Advances in the Study of Linear A

Brent Davis

University of Melbourne
ORCID ID: 0000-0001-9471-2903

ABSTRACT

This paper outlines a number of recent linguistics-based advances in the study of Linear A. A brief overview of the region's linguistic landscape is followed by short discussions of (a) the practice of transliterating Linear A syllabograms using Linear B values, and (b) past attempts at deciphering Linear A. These are followed by more detailed discussions of (a) evidence for affixation in Linear A; (b) "Valério's Hypothesis", a hypothesis that incorporates a confluence of evidence at the peak sanctuary of Petsofas to interpret a phrase found on several offering tables there; and (c) indications of default word-order in Linear A, and ways in which this default word-order can be employed in conjunction with language universals to glean evidence as to the character of the language underlying the script.

INTRODUCTION: THE REGION'S LINGUISTIC LANDSCAPE

The aim of this paper is to present a number of recent linguistics-based advances that may advance the study of Linear A. To begin this discussion, it will be beneficial to examine the *linguistic landscape* in the eastern Mediterranean around 2000 BCE, shortly before Linear A came into being (**Fig. 2.1**):

Fig. 2.1: Languages of the eastern Mediterranean and Near East ca. 2000 BCE, classified by language family (Davis 2014, 157, fig. 104).

The colored areas in **Fig. 2.1** represent the language families that predominate in those regions. Pink shading marks the languages belonging to the Afroasiatic family, which includes Egyptian, and the Semitic languages Akkadian, Eblaite and the Northwestern Semitic dialects in the Levant.

Green shading marks the Indo-European languages in this region around 2000 BCE. Greek is almost certainly being spoken on the Balkan Peninsula by this time, and Indo-European languages are also being spoken in Anatolia: Hittite in south central Anatolia, Luvian throughout southwestern Anatolia, and Palaic in the north (Melchert 2003a, 8–22). The arrival of Greek-speakers in the Balkan Peninsula is tentatively dated to ca. 2100–1900 BCE at the latest (Woodard 2004a, 614). Few scholars nowadays would date this event later than Early Helladic III (Renfrew 1998, 242; the Early Helladic period is estimated to have ended ca. 2000 BCE or earlier: e.g., Rutter 1993, 756). As for Lydian, Lycian and Carian: these languages are not attested *in writing* until more than a millennium later, but linguists are now in fairly solid agreement that all the Indo-European languages of Anatolia differ from each other to such a degree that all of them must have begun as different dialects of Proto-Anatolian around 3000 BCE (e.g., see the glottochronological arguments of Melchert 2003b, 266–68). Therefore, early forms of Lydian, Lycian and Carian must already have been present in Anatolia around 2000 BCE (for for the placement of pre-Lydian, pre-Lycian and pre-Carian in **Fig. 2.1**, see Davis 2014, 158–59).

Finally, yellow shading marks areas dominated by languages that are neither Indo-European nor Afroasiatic–Hattic in north central Anatolia, and Hurrian, spoken throughout eastern Anatolia and down into northern Mesopotamia. Meanwhile, the Minoans are speaking their own language(s) on Crete; and sometime in the 19th c. BCE (Davis 2014, 144), the Minoans apparently invent Linear A as a way of writing this language, though the script appears to have been derived from Cretan Hieroglyphic in a way that still remains rather unclear.[1] Although for the time being it remains undetermined whether Linear A encodes one language or more than one, there are some fairly strong indications that the script most likely encodes a single language (Davis 2014, 179–81). In this paper, for convenience, I consider Linear A as encoding a single Minoan language, while remaining aware that the matter has not yet been incontrovertibly settled one way or the other.

TRANSLITERATING LINEAR A USING LINEAR B VALUES

Interestingly, when we use the phonetic values of the much later Linear B signs to transliterate words on Linear A documents (Steele and Meißner 2017), we end up with some names that closely resemble non-Greek names in Linear B, often differing only in their final vowel. For example: in Linear B at Knossos, we find the non-Greek (i.e., Minoan) names *da-i-pi-ta* (**KN Bk 799**), *pa-ja-ro* (**KN As(2) 1519**), and *ta-na-to* (**KN De 1618**) (see *Docs²*, 537, 567 and 583 respectively); and in the Linear A tablet **ZA 10** we have *DA-I-PI-TA*, *PA-JA-RE*, and *TA-NA-TE* (see the Appendix at the end of this chapter for references to these and all subsequent Linear A sign-groups cited below). So this tells us that we are probably on the right track when we transliterate Linear A words in this way, using the values of the Linear B signs – that is, we have some fairly strong evidence that the Mycenaeans did not change the original Minoan values of the signs very much when they borrowed them (see Davis 2014, 189 for a summary of the evidence).

The similarities between the two scripts do not end with the syllabograms, though: many Linear A ideograms were borrowed directly into Linear B, as was the Linear A system of numerals (Davis 2014, 145). Thus, on many Linear A tablets we can see quite clearly that the scribe is recording transactions in commodities like barley, wine, olives and olive oil.

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1 It is worth noting that Cretan Hieroglyphic and Linear A share a rather substantial number of homomorphic syllabograms (see Davis 2024, Table 2; Meißner and Salgarella 2024).

PAST ATTEMPTS AT DECIPHERMENT OF LINEAR A

Nevertheless, all attempts to decipher Linear A have so far been unsuccessful, as have all attempts to demonstrate any relationship between the Minoan language and any known language or language family. Yet, there has been some progress, especially in the last few decades.

Now, certainly, the primary key to deciphering Linear A is to discover which language it encodes; however, for most of the 20th century, scholars tried to decipher Linear A mostly by assuming that it encodes a language that we already know about – for example, Northwest Semitic (e.g., Gordon 1966, 1969; Woudhuizen and Best 1989; Best 1972, 2001), or Early Greek (e.g., Georgiev 1963, 1968; Nagy 1963, 1965; Tsikritsis 2001), or an Anatolian language such as Luvian or Hittite (e.g., Palmer 1958, 1968; Davis 1967; Brown 1990, 1992-1993; Finkelberg 1990-1991), and so on – and tried to make sense of the inscriptions based on these assumptions. The fact that, after more than a century, we have gotten almost nowhere with this strategy, suggests that this is the wrong approach. In the past few decades, scholars have begun stepping back and using linguistics-based methods to try to tease out various characteristics of the Minoan language based on the structure of Linear A alone, and then comparing these characteristics with those of neighboring languages in a search for similarities and differences to help us understand what kind of a language Minoan was – or was not, and this is when we began to make some progress.

AFFIXATION IN LINEAR A

I would like to demonstrate some ways in which these linguistics-based methods work. For example: like all human languages, all the languages in **Fig. 2.1** have grammar, including Minoan; while the most common way in which languages express grammar is through the use of suffixes, and sometimes prefixes. So let us reclassify the languages in **Fig. 2.1** according to the ways in which they use *affixes* – that is, prefixes and suffixes (**Fig. 2.2**):

Fig. 2.2: Languages in Fig. 2.1, re-classified by affixation method (Davis 2014, 173, fig. 108.5).

As you can see by the green shading, and by the key in the lower left corner, all the Indo-European languages in **Fig. 2.2** are classed as Strongly Suffixing – that is, they express grammar mostly through suffixes. Indo-European languages do have some prefixes, of course, but suffixes are far, far more common. The non-Indo-European language Hurrian, spoken in eastern Anatolia and northern Mesopotamia, is also strongly suffixing. By contrast,

the pink shading shows the Afroasiatic languages in **Fig. 2.2** (except for Egyptian) classed as Moderately Suffixing: they still prefer suffixes over prefixes, but there are more prefixes than in Indo-European languages, and this is largely because Afroasiatic languages regularly use prefixes (as well as suffixes) on their verbs. Egyptian is unusual in this respect, because it lost its verbal prefixes in prehistoric times, leaving it a Strongly Suffixing language, which is why it is shaded green. Finally, the yellow shading shows that the non-Indo-European language Hattic, spoken in central Anatolia, is the only one in this region to be classed as Moderately Prefixing: it moderately prefers prefixes over suffixes for expressing grammar, making it unlike any of these other languages (for a detailed description of the way in which all these languages were classified according to the affixation method, see Davis 2014, 165–67).

Linear A does yield some evidence of prefixes and suffixes in the Minoan language. Below are some pairs of words drawn from various Linear A inscriptions. In the first two pairs, we have some evidence for a suffix *-TI*, and in the last two pairs, some evidence for *-SE* and *-ME* as suffixes (with underdotted syllabograms indicating signs whose readings are less than entirely secure according to the authors of *GORILA*):

RI-RU-MA	*ṚỊ-RU-MA-**TI***
DA-KU-SE-NE	*DA-ḴỤ-SE-NE-**TI***
RU-MA-TA	*RU-MA-TA-**SE***
A-RA-TU	*A-RA-TU-**MẸ***

Some words such as the following show alternating endings, which also suggests suffixes at work in these words:

*MA-KA-I-**TA***	*MA-KA-I-**SE***
*A-MI-DA-**O***	*A-MI-DA-**U***
*U-TA-I-**SI***	*U-TA-I-**SE***

Sometimes, when endings alternate, one ending consists of a single syllable, while the other consists of more than one syllable, as in these examples:

*I-PI-NA-**MA***	*I-PI-NA-**MI-NA***
*JA-SA-SA-RA-**ME***	*JA-SA-SA-RA-**MA-NA***
*SU-KI-RI-**TA***	*SU-KI-RI-**TE-I-JA***
*JA-DI-KI-**TU***	*JA-DI-KI-**TE-TE***
312-TA***	**312-**TE-TE***

In the last example above, **312* stands for a Linear A sign whose phonetic value is still unknown, as this sign never appears in Linear B; but one can still see that the ending *-ta* appears to alternate with *-te-te*.

Sometimes, multisyllabic suffixes alternate with other multisyllabic suffixes:

*I-NA-JA-**RE-ṬẠ***	*I-NA-JA-**PA-QA***

Sometimes, we find the same multisyllabic suffix on more than one word:

*A-NA-NU-**SI-JA-SE***	*KI-TA-NA-**SI-JA-SE***

We also have substantial evidence for the presence of prefixes in Minoan. For example, there is substantial evidence for a prefix *a-*, as these pairs of words show:

PA-RA-NE	***A**-PA-RA-NE*
SI-KI-RA	***A**-SI-KI-RA*

TA-NA-TE	***A**-TA-NA-TE*
KI-DA-RO	***A**-KI-DA-RO*

There is also evidence for a prefix *i-*:

DA-MA-TE	***I**-DA-MA-TE*
***A**-SA-SA-RA-ME*	***JA**-SA-SA-RA-ME* (perhaps ***I-A**-SA-SA-RA-ME*)
***A**-DI-KI-TE-TE*	***JA**-DI-KI-TE-TE* (perhaps ***I-A**-DI-KI-TE-TE*)

We also have evidence of multisyllabic prefixes, as in the following examples (with **319* standing for another Linear A sign whose phonetic value is still unknown):

***A**-RI-NI-TA*	***I-ZU**-RI-NI-TA*
***WI-JA-SU**-MA-TI-TI-*319*	***NA-MA**-ṂẠ-TI-TI-*319*

There is also some evidence of both prefixes and suffixes at work on the same word, as in these pairs of words:

TI-TI-KU	*Ị-TI-TI-KU-**NI***
*ZU-ṚỊ-NI-**MA***	*I-ZU-RI-NI-**TA***
***A**-DU-ṚẸ-ZA*	*DU-RE-ZA-**SE***

In the following, more complex examples, we may be seeing multisyllabic prefixes and suffixes being applied to the same word, sometimes creating very long sequences of signs:

***A**-KU-MI-NA*	***A-DU**-KU-MI-NA*	*KU-MI-NA-**QE***
*JA-SU-MA-**TU***	***WI-JA**-SU-MA-**TI-TI***	
*KU-PA₃-**NU***	*KU-PA₃-**NA-TU***	*Ị-KU-PA₃-**NA-TU**-NA-TE*
U**-NA-KA-NA-**SI	***U**-NA-RU-KA-NA-**TI***	***U**-NA-RU-KA-ṆẠ-**JA-SI***

Importantly, Duhoux (e.g., 1978b) has done extensive work on Minoan affixation, and he has shown that the presence of affixes is most likely when they appear on different Linear A words sharing four or more consecutive syllabograms. Certainly not all the examples I have given so far share this many consecutive syllabograms – but some of them do (with shared consecutive syllabograms in bold):

*A-**SA-SA-RA-ME***	*JA-**SA-SA-RA-ME*** (perhaps *I-A-**SA-SA-RA-ME***)
*A-**DI-KI-TE-TE***	*JA-**DI-KI-TE-TE*** (perhaps *I-A-**DI-KI-TE-TE***)
*WI-JA-SU-**MA-TI-TI-*319***	*NA-MA-**ṂẠ-TI-TI-*319***
*KU-PA₃-**NA-TU***	*Ị-**KU-PA₃-NA-TU**-NA-TE*
*U-**NA-RU-KA-NA**-TI*	*U-**NA-RU-KA-ṆẠ**-JA-SI*

Thus, pairs like these constitute very strong evidence for prefixes and suffixes in Linear A, and in fact it has long been considered confirmed that *both* occur in the script, in particular the prefix *A-* (Duhoux 1978b, 126). So, having confirmed such affixes, we should expect them to show up on shorter words too.

And in this final extraordinary example, we appear to have a central root *I-*301* (**301* standing for yet another Linear A sign whose phonetic value is still unknown); and this central root (in bold below) *almost always* appears with both a multisyllabic prefix and a multisyllabic suffix:

    Ạ-TA-**I-*301**-WA-E

    A-NA-T**I-*301**-WA-JA

    A-TA-**I-*301**-WA-JA

    JA-TA-**I-*301**-U-JA

    TA-NA-**I-*301**-TI

    TA-NA-**I-*301**-U-TI-NU

    A-ṬẠ-**I-*301**-DE-KA

As I explain later in this paper, we have good reason to believe that what we are seeing here is a verb – that is, seven different forms of a Minoan verb; and you may recall that I mentioned earlier that Afroasiatic languages use both prefixes and suffixes on their verbs. So, could this be an indication that Minoan is an Afroasiatic language?

  Unfortunately, the answer is no, because Afroasiatic verbs have a very different structure than the seven Minoan forms listed above. Following are some examples from Biblical Hebrew and Akkadian, and as you can see, the different forms of an Afroasiatic verb are distinguished from each other in two ways: first, by the use of *monosyllabic* prefixes and suffixes, and second, by *changes in the vowels* contained within the root, which is shown below in bold (Huehnergard and Woods 2004, 244, 253–54; McCarter 2004, 350):

Bib. Hebrew	ʾe-**ktōb**	ti-**ktōb**	ti-**ktəb**-î	ti-**któb**-nâ
	"I write"	"you (m.sg.) write"	"you (f.sg.) write"	"they (f.) write"
	kātáb-tî	**kātáb**-tā	**kātab**-t	**kātəb**-û
	"I wrote"	"you (m.sg.) wrote"	"you (f.sg.) wrote"	"they (f.) wrote"
Akkadian	a-**parras**	ta-**parras**	ta-**parras**-ī	i-**parras**-ā
	"I decide"	"you (m.sg.) decide"	"you (f.sg.) decide"	"they (f.) decide"
	a-**prus**	ta-**prus**	ta-**prus**-ī	i-**prus**-ā
	"I decided"	"you (m.sg.) decided"	"you (f.sg.) decided"	"they (f.) decided"

By contrast: in the seven Minoan forms listed above involving the root *I-*301*, the prefixes and suffixes are almost all *multisyllabic*, while the root itself *never changes*.

  So in the end, judging by the evidence from Linear A, the Minoan language appears to have used prefixes and suffixes – even multisyllabic ones – in approximately equal abundance, and this tells us something important about the Minoan language: the use of prefixes and suffixes in Minoan is not consistent with it being either Indo-European or Afroasiatic. Instead, its abundance of prefixes, especially multisyllabic ones, make it look more like a pre-Indo-European indigenous language, as exemplified by Hattic in central Anatolia (as I discuss later in this paper).

"VALÉRIO'S HYPOTHESIS"

Now, if this is true – if the Minoan language was some sort of pre-Indo-European indigenous language with no currently-known relatives, then what sort of hope does this leave for eventual decipherment? In answer to this question: sometimes a study of *internal context* can be extremely valuable, and I would like to illustrate this fact with what I am going to call "Valério's Hypothesis", a hypothesis based on a confluence of evidence at the important Minoan peak sanctuary of Petsofas in eastern Crete.

The sanctuary at Petsofas has yielded several stone offering tables inscribed with the two words *A-DI-KI-TE-TE DU-PU₂-RE*, and in 2007, Miguel Valério grabbed the attention of the world of Linear A by using some of the evidence for Minoan prefixes and suffixes that I have just outlined to come up with a startling new interpretation of these two words (Valério 2007). In my account of his hypothesis, I provisionally transliterate the Linear A/B syllabogram *PU₂/pu₂* as *BU/bu*, one of its potential values (cf. Linear B *da-pu₂-ri-to-jo* = Da**bu**rinthoio = gen. sg. of λα**βύ**ρινθος: *Docs²*, 538), so as to make the comparanda that Valério draws upon more transparent.

One of the interesting things about this hypothesis is that Valério subsequently radically revised his interpretation of the second word, so this example is a good illustration of how interpretations of a particular element of Linear A can evolve over time. I will begin by describing his initial interpretation, followed by his revised interpretation with a basic explanation as to why he revised it. Let us begin with his initial interpretation.

Looking at the second word first, Valério observed that this word also forms the root of two Minoan names found in Linear B tablets at Knossos, ***du-bu-ra*-zo** (**KN Da 1173**, **KN V(3) 479**, see *Docs²*, 541) and ***da-bu-ra*-zo** (on inscribed stirrup-jar **EL Z 1**, see *Docs²*, 538; Raison 1968, 124; Petrakis 2014b) with the root shown **in bold**, indicating that the word must have positive connotations, or else people would not be attracted to the idea of using it in the names of their children. He then pointed out that this word also seems to form the root of the first word in a very famous phrase on a Linear B tablet recording divine offerings at Knossos:

> ***da-bu-ri*-to-jo *po-ti-ni-ja* *me-ri*** = Daburínthoio Potníai meli = "for the Lady of the Labyrinth, honey" (**KN Gg(1) 702**: *Docs²*, 310)

Thus, the Linear A word ***DU-BU-RE*** may in fact be related to the first part of the word ***labyrinth***, a non-Greek (perhaps Minoan) word that has been borrowed into Greek. Notice the alternation between *d* and *l*: *daburinth-* versus *labyrinth-*. This same feature is also found in other non-Greek Cretan words borrowed into Greek, such as δικ-εῖν "throw" / λιχ-άξαι (H.: Cretan; < *λιχ-άζω) "throw"; δίσκος (< *δίκ-σκος) "discus" / λίσκος (H.; < *λίχ-σκος) "discus" (Brown 1985, 77–8).

Valério then noted that this same root also seems to appear in several other cultures in the region. For example, two non-Greek Carian names containing this root (*s-m-**δ-w-b-r**-s*, *k-ś-a-**t-w-b-r***) were borrowed into Greek as Ζερμε**δύβερ**ος (Zerme**dúber**os) and Ξαν**δύβερ**ις (Ksan**dúber**is), while the non-Greek Lycian name ***Dapar*a** is borrowed into Greek as Λά**παρ**ας (Lá**par**as), once again displaying that characteristic alternation between *d* and *l*. Now, Caria and Lycia are fairly close to Crete; but the same root also seems to crop up in Hittite, far away in central Anatolia, in the word ***tabarna***, sometimes spelled ***labarna***, a title given to Hittite royalty – and again we see a consonant alternation, this time between *t* and *l*. And there is also a Hittite verb ***tapar***, meaning "to rule" – and now we seem to be getting some hints that this root may have something to do with power or authority.

And indeed, in Luvian, there is a word ***tapar*aya**, meaning "authority", and also ***tapar*ayali**, meaning "governor"; while Cypriot and Carian Greek both appear to have borrowed the *l*-form of this root to create two words that were used as epithets of Zeus, Λα**βρ**άνιος (**Labr**ánios) and Λά**βρ**ανδος (**Lábr**andos), which seems to confirm that this root does indeed have something to do with power or authority. Based on all these observations, Valério suggested that the Linear A word ***DU-BU-RE*** might mean "lord", or "master", or something similar.

Turning then to the first word on the offering tables, *A-DI-KI-TE-TE*, he first noted that the presence of a prefix *A-* in Minoan is already well established, as I demonstrated earlier; and there is also some evidence of an alternation between final *-TA* and *-TE-TE*:

PA-RA-NE	**312-**TA***
***A**-PA-RA-NE*	**312-**TE-TE***

So, by identifying both these phenomena as possibly at work in the word *A-DI-KI-TE-TE*, he was able to suggest a provisional reconstruction of what the word might look like without prefixes or suffixes:

PA-RA-NE	**312-**TA***	*DI-KI-**TA*** (reconstructed)
***A**-PA-RA-NE*	**312-**TE-TE***	***A**-DI-KI-**TE-TE***

Interestingly, the reconstructed word *DI-KI-TA*, perhaps pronounced Dikta, is a word that appears in *Linear B* in forms such as *di-ka-ta-de* "to Δίκτᾱ (Diktā)", Δίκτᾱ being the pre-Classical form of Δίκτη (Dikti), the famous sacred mountain on Crete. In the end, Valério suggested that the Linear A words *A-DI-KI-TE-TE DU-BU-RE* on these offering tables from the peak sanctuary at Petsofas might mean something like "to/for the Diktaian lord".

Now, one of the reasons that this interpretation so startled the world of Linear A is that the large and rich Minoan settlement at Roussolakkos at the foot of this very peak sanctuary later contained a Greek temple to "Diktaian Zeus" from the Archaic period onward (Bosanquet 1904–1905; 1939–1940, 66–8); also, in 1990, a spectacular chryselephantine (gold and ivory) statue of a youthful male figure, interpreted as a deity, was found in Late Minoan I levels in a shrine within this same settlement (MacGillivray et al. 1991, 141), suggesting that the settlement and its peak sanctuary were an important ritual centre for the worship of a young male god in Minoan times as well. So, it would make sense to find objects dedicated to a "Diktaian lord" at Petsofas. The confluence of all this evidence meant that Valério's interpretation was widely embraced.

Now, for Valério's revised interpretation of the second word, *DU-BU-RE*. Over the years following his initial publication in 2007, he began to have serious doubts about the various Anatolian comparanda he had used in his initial interpretation of this word, for the reason that phonologically, it is actually rather difficult to link these comparanda to the Linear A form *DU-BU-RE* (Valério 2015); and if one jettisons the Anatolian comparanda, one can no longer draw a link between Linear A *DU-BU-RE* and any word having a direct association with notions of power or authority. Valério is now much more predisposed to suggest that this word may instead be closely related to the word "labyrinth" itself, and may refer to something more akin to the earliest post-Mycenaean references to "labyrinth", the earliest of all being in Herodotus, where the word refers to a hypogeum or underground sanctuary in Egypt (Valério 2017a). Thus, *DU-BU-RE* may in fact be a reference to some sort of cave sanctuary or other type of shrine, perhaps underground, and the Linear A expression *A-DI-KI-TE-TE DU-BU-RE* may mean something more like "to/for the Diktaian **sanctuary**", or something similar.

However, regardless of the interpretation of *DU-BU-RE*, my main focus here is actually on the parsing of the first word in the phrase, *A-DI-KI-TE-TE*, for an important reason: it demonstrates that even if Minoan is an unknown indigenous language with no known relatives, advances toward decipherment are still possible – in this case, because indigenous names of *landscape features*, such as the name of Mount Dikti, tend to be remarkably persistent, surviving even when another culture comes to dominate the country (cf. also Schneider 2006, 138–39 with regard to English); this is exactly why we have such a wealth of indigenous place-names still in use in Australia (e.g., Uluru, Kata Tjuta, Wilpena, Kalkajaka, Tibrogargan, Ngungun, Yengo, Beerwah, Wollumbin, Coonowrin, while indigenous toponyms persist even in the names of many modern cities and towns, e.g., Canberra, Wangaratta, Wagga Wagga, Cootamundra, Parramatta, Wooloomooloo, Coolangatta, Mudgee, Mullumbimby, Coonabarabran). In the same way, many place names in the Aegean today clearly have their origins in the languages spoken there before the Greeks arrived, as these names have no plausible interpretations in Greek. Thus, even when a script is undeciphered, we can sometimes recognize a place-name that we are familiar with, such as Dikti – and after all, recognizing known place-names in Linear B was a key part of Ventris's decipherment of that script.

DEFAULT WORD-ORDER IN LINEAR A

More recently, I have been investigating the properties of the Minoan language from another angle – through a study of Minoan *word-order*. In human languages, the subject of a sentence (marked below as S), the verb of the sentence (marked below as V), and the direct object of the sentence (marked below as O) tend to occur in a particular default order. For example, in English, these elements usually occur in just that order: first the subject, then the verb, then the object:

> **S V O**
> Dan likes books.

So, English is called an "SVO" language; and in a recent worldwide survey of 1187 languages that have a default word order (Dryer 2023c), 41.1% of those languages were found to be SVO languages, like English. But there are five other possible default orders for S, V, and O, with the 1187 languages in the survey apportioned as follows amongst the six possible default orders:

> **S V O** = 41.1%   **V O S** = 2.1%
> Dan likes books.   Likes books Dan.
>
> **S O V** = 47.5%   **O V S** = 0.9%
> Dan books likes.   Books likes Dan.
>
> **V S O** = 8.0%   **O S V** = 0.3%
> Likes Dan books.   Books Dan likes.

As can be seen, a full 96.6% of these 1187 languages have one of the three default word orders on the left, while the remaining three default orders on the right are much rarer.

Importantly, although SVO languages like English are now very common, especially amongst Indo-European languages, that has not always been the case – because Proto-Indo-European, the prehistoric parent language of all Indo-European languages, was an SOV language; so naturally, we might expect *ancient* Indo-European languages to be more SOV than SVO. And in fact, this is exactly what we find. Ancient Greek, for example, right up through the Classical period – even though Greek word order is notoriously free – tended to prefer SOV order far above all the others, reflecting the default word order of Proto-Indo-European:

> *Word orders in Classical Attic* (Ebeling 1902)
>
> SOV = 44.5%   VOS = 7.1%
> SVO = 20.8%   VSO = 6.7%
> OSV = 15.0%   OVS = 5.8%

And this pattern is repeated in the other ancient Indo-European languages of the eastern Mediterranean and Near East: they all tend to prefer SOV word-order, like Proto-Indo-European. By contrast, ancient Afroasiatic languages such as Egyptian display VSO word-order, which was the default word-order in Proto-Afroasiatic:

> *zbj.n   ḥm.f   mšꜥ*
> sent   His Majesty   an army
> **V   S   O**
>
> "His Majesty sent an army".

Fig. 2.3 shows the default word-orders amongst the languages of the eastern Mediterranean and Near East around 2000 BCE. As you can see, most early Indo-European and Afroasiatic languages preserve the original word-order of their respective parent-languages:

Fig. 2.3: Languages in Fig. 2.1, re-classified by default word order (Davis 2014, 173, fig. 108.6).

All but two of the Afroasiatic languages on this map display the VSO order inherited from Proto-Afroasiatic, as shown by pink shading. The two exceptions are Akkadian and Eblaite, which are shown here as SOV languages, shaded green – and that is because Akkadian and Eblaite were highly influenced by the Sumerian language of southern Mesopotamia, which was an SOV language, as this Sumerian example shows:

lugal-e	*e*	*mu-n-du*
the king	a temple	built
S	**O**	**V**

"The king built a temple".

Thus, Akkadian and Eblaite, well before the earliest attested inscriptions in these languages, changed from VSO languages to SOV languages under the influence of Sumerian (Huehnergard and Woods 2004, 263). This is important: the default word-order of a language can change over time in response to contact with an influential culture.

Likewise, most of the Indo-European languages in **Fig. 2.3** display the SOV order inherited from Proto-Indo-European, as shown by green shading. The only exception is Lycian in southwestern Anatolia, which for some unknown reason changed from SOV order to VSO order well before the earliest attested inscriptions in this language (Melchert 2004, 598; Dryer 2023c, fig. 1), and so it is shaded pink. Also, on this map are two languages which are neither Indo-European nor Afroasiatic: Hurrian in eastern Anatolia, with SOV order, shaded green; and Hattic in central Anatolia, with VSO order (Goedegebuure 2008, 153–59), shaded pink. And in fact, all ancient eastern Mediterranean and Near Eastern Bronze Age languages that we currently know of have either SOV order, or VSO order. The other four orders are completely unknown in this region during the Bronze Age. So given this situation, we could make the following statement about Minoan:

> *Statistically, SOV and VSO are the likeliest candidates for default word order in Minoan,*
> *as these are the only default orders attested anywhere in the region during the Bronze Age.*

So, for example, when it comes to Minoan verbs: we should expect them to occur either at the very end of the sentence, or at the very beginning, but not in the middle.

But can we test this hypothesis? Well, fortunately, we do have a fairly large number of what appear to be full sentences in Linear A, because more than 50 Minoan offering tables are inscribed with a particular string of Linear A words that appears to be some kind of standardized ritual inscription; we might call it the "Minoan

offering formula". And while this string of words is similar from vessel to vessel, it also differs in certain ways from vessel to vessel, so we can compare these similarities and differences and see if they reveal anything interesting. The most common form of the "offering formula" consists of six words, as shown by this inscription on a ritual ladle from Troullos near Archanes (**TL Za 1**: *GORILA* 4, 58–9):

Ritual ladle from Troullos:

1	2	3	4	5	6
*A-TA-I-*301-WA-JA*	*O-SU-QA-RE*	*JA-SA-SA-RA-ME*	*U-NA-KA-NA-SI*	*I-PI-NA-MA*	*SI-RU-TE*

Word 1 is that word I discussed earlier, the one that appears to contain a central root *I-*301*, to which an array of variable prefixes and suffixes is attached. Now, if we focus on the character of Word 1, this type of construction is actually common in a large number of known languages in which the *verb* takes various affixes that indicate the functions of the other words in the sentence. For example, Hattic – an indigenous language of central Anatolia – is a language of this type. Hattic is a VSO language, so the verb comes first, and it consists of a central root, shown in bold in the example below (in this case, *tuḫ*, meaning "take") with various prefixes and suffixes:

$$\begin{array}{ccc} \textit{ān-āš-}\textbf{\textit{tuḫ}}\textit{-u} & \textit{kattē} & \textit{lē-fa-elianu} \\ \text{he-them-}\textbf{take}\text{-(present)} & \text{the king} & \text{his-(plural)-tool} \\ \textbf{V} & \textbf{S} & \textbf{O} \end{array}$$

"The king takes his tools".

Notice how the prefixes on the verb serve to *foreshadow* what is going to happen in the rest of the sentence. So the first prefix is *ān-*, meaning "he", referring to the Subject of the sentence, "the king"; then the second prefix is *āš-*, meaning "them", referring to the Object of the sentence, "his tools"; then comes the central root *tu*, meaning "take", and then a suffix denoting present tense – so the verb-construction all by itself means "He takes them", and the whole sentence literally means: "He takes them, the king, his tools" (for an overview of Hattic prefixes and suffixes, see Dunayevskaya and Dyakonov 1979). Now, Indo-European and Afroasiatic languages certainly do not construct verbs like this; but one must admit that this type of verb-construction bears a striking resemblance to the structure of Word 1 of the Minoan offering formula.

So, if Word 1 of the offering formula is a Minoan verb, which verb might it be? Well, it just so happens that a form of this same word, complete with prefixes and suffixes, also occurs in a clearly administrative inscription scratched onto a rather plain-looking pithos from a storeroom in the villa of Epano Zakros near the Minoan palace at Kato Zakro (*A-ṬA-I-*301-DE-KA* on **ZA Zb 3**.2: *GORILA* 4, 112–3), so this word is unlikely to have a specifically ritual meaning, like "dedicates" or "offers". It is much more likely that this word simply means something like "gives", as Duhoux (1989, 86–87, 90) suggested more than three decades ago, which would make the word appropriate for both ritual inscriptions and administrative ones:

Ritual ladle from Troullos:

Verb	2	3	4	5	6
*A-TA-I-*301-WA-JA*	*O-SU-QA-RE*	*JA-SA-SA-RA-ME*	*U-NA-KA-NA-SI*	*I-PI-NA-MA*	*SI-RU-TE*
gives					

As for Word 2 of the offering formula: this word is always different from vessel to vessel, and so Word 2 is considered very likely to be the name of the dedicant – that is, the person doing the giving, in this case someone named Osuqare, which makes Word 2 the subject of the sentence:

Ritual ladle from Troullos:

V	Subject	3	4	5	6
A-TA-I-*301-WA-JA	*O-SU-QA-RE*	*JA-SA-SA-RA-ME*	*U-NA-KA-NA-SI*	*I-PI-NA-MA*	*SI-RU-TE*
gives	Osuqare				

Now, let us compare this inscription to a second one: this one is on an offering table from the Minoan shrine at Kato Syme (**SY Za 2**: *GORILA* 5, 64–5), and as before, the inscription begins with what we are interpreting as the verb "gives", followed by the name of the giver, in this case Jasumatu. However, here we see something very interesting indeed:

Offering table from Kato Syme:

V	S	3	4	5	6
A-TA-I-*301-WA-JA	*JA-SU-MA-TU*	< olives >	*U-NA-KA-NA-SI*	< olive oil >	*A-JA*
gives	Jasumatu				

In this second inscription, Words 3 and 5 of the offering formula have been replaced by the Linear A ideograms for "olives" and "olive oil". So how might we interpret this? Well, here is where archaeology can be of assistance. After more than a century of excavating Minoan sites, we actually have almost no evidence that the Minoans consumed olives or olive oil as food (Hamilakis 1996, 23; 1999, 44–46); but we have a great deal of evidence that the Minoans were running an international trade-network in perfumed olive oil, and that this perfumed oil industry, probably palace-controlled and based on the diverse range of native Cretan spices and aromatics, was a source of great wealth and power for the Minoans (see Hamilakis 1999, 49). Thus, it is very tempting to think that the owner of this offering table had filled it with an offering of olives, perhaps as an *aparche*, a first fruits-offering, and was asking the gods for plentiful oil from the upcoming harvest. And we already know that the Minoans did offer up olives to the gods, because an offering-cup full of perfectly-preserved Bronze Age olives was found at the bottom of one of the wells in the Minoan palace at Zakro (Platon 1971, 197; **Fig. 2.4**):

Fig. 2.4: Offering cup of Minoan olives found at the bottom of a well in the palace at Zakro (Platon 1971, 197).

So, if this interpretation is correct, then the olives are what is being given, which makes them the Object of the sentence:

Offering table from Kato Syme:

V	S	Object	4	5	6
A-TA-I-*301-WA-JA	JA-SU-MA-TU	< olives >	U-NA-KA-NA-SI	< olive oil >	A-JA
gives	Jasumatu	olives			

And if abundant oil is what is being requested, then perhaps the short word *A-JA* after "oil" means something like "much", so that we have olives being given to the gods in return for "much oil" or something similar:

Offering table from Kato Syme:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	JA-SU-MA-TU	< olives >	U-NA-KA-NA-SI	< olive oil >	A-JA
gives	Jasumatu	olives		oil	much

Now, if the olives are what is being *given*, and are therefore the object of the sentence, then in the first example we should expect the corresponding word *JA-SA-SA-RA-ME* to be the object of the sentence as well, and to represent what is being given. This word *JA-SA-SA-RA-ME* is *usually* the third word of the offering formula on the majority of these inscribed offering tables, so perhaps this is simply some sort of *generic* term for what is being given, such as "an offering, a gift, a dedication", or something similar:

Ritual ladle from Troullos:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	O-SU-QA-RE	JA-SA-SA-RA-ME	U-NA-KA-NA-SI	I-PI-NA-MA	SI-RU-TE
gives	Osuqare	an offering			

Offering table from Kato Syme:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	JA-SU-MA-TU	< olives >	U-NA-KA-NA-SI	< olive oil >	A-JA
gives	Jasumatu	olives		oil	much

And in the second example: if the oil is what is being *requested*, then in the first example we should expect the corresponding word *I-PI-NA-MA* to represent what is being requested as well. This word *I-PI-NA-MA* is *usually* the fifth word of the offering formula on the majority of these inscribed offering tables, so perhaps this is some sort of *generic* term for what is being requested, such as "a favor, a blessing", or something similar:

Ritual ladle from Troullos:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	O-SU-QA-RE	JA-SA-SA-RA-ME	U-NA-KA-NA-SI	I-PI-NA-MA	SI-RU-TE
gives	Osuqare	an offering		a favor	

Offering table from Kato Syme:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	JA-SU-MA-TU	< olives >	U-NA-KA-NA-SI	< olive oil >	A-JA
gives	Jasumatu	olives		oil	much

And in the second example: if "oil *A-JA*" means something like "much oil", with Word 6 serving as an adjective modifying Word 5, then in the first example, perhaps the word *SI-RU-TE*, which is *usually* Word 6 on the majority of these offering tables, is *also* an adjective of some sort. For example, perhaps *I-PI-NA-MA SI-RU-TE* means something like "a divine favor" or "a sacred blessing" or some other generic term for what is being requested of the gods:

Ritual ladle from Troullos:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	O-SU-QA-RE	JA-SA-SA-RA-ME	U-NA-KA-NA-SI	I-PI-NA-MA	SI-RU-TE
gives	Osuqare	an offering		a favor	divine

Offering table from Kato Syme:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	JA-SU-MA-TU	< olives >	U-NA-KA-NA-SI	< olive oil >	A-JA
gives	Jasumatu	olives		oil	much

Finally: both examples would make perfect sense if Word 4, *U-NA-KA-NA-SI*, means something like "requesting, praying for", or something similar:

Ritual ladle from Troullos:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	O-SU-QA-RE	JA-SA-SA-RA-ME	U-NA-KA-NA-SI	I-PI-NA-MA	SI-RU-TE
gives	Osuqare	an offering	requesting	a favor	divine

Offering table from Kato Syme:

V	S	O	4	5	6
A-TA-I-*301-WA-JA	JA-SU-MA-TU	< olives >	U-NA-KA-NA-SI	< olive oil >	A-JA
gives	Jasumatu	olives	requesting	oil	much

And now we have complete sentences for both examples, and everything seems to make potential sense: in the first example, which contains the standard form of the offering formula found on many offering tables, we have a general dedicatory prayer: "So-and-so gives an offering, requesting a divine favor"; and in the second example, we have a more specific form of this prayer: "So-and-so gives olives, requesting much oil".

Now, without a doubt, the proposed meanings of many of the words in these two examples are little more than guesses – although I would make a case that they are at least *informed* guesses. But my purpose here is not so much to insist that these specific meanings are all entirely correct; instead, my purpose is (1) to show

that these inscriptions contain a coherent and consistent structure that enables us to make at least *provisional* sense of more than one inscription at the same time, and (2) to illustrate the very real possibility that these inscriptions are displaying VSO word order – and this would make sense, because as I pointed out earlier, all known Bronze-Age languages in this region have either SOV word order, or VSO word order.

Thus, in the end, perhaps we have discovered that Minoan probably had VSO word order. However, one might also wonder: why should this discovery be important? Well, since the 1960s, linguists have been compiling a large body of what we call "language universals", defined as "principles that are true of most or all human languages"; and so these principles are going to be true of the Minoan language as well, because (of course) Minoan was a human language. As an example, below is one of these language universals:

> **IF** a language has VSO word-order
>
> **THEN** the language is overwhelmingly likely to employ prepositions or adpositional prefixes, rather than postpositions or adpositional suffixes (Greenberg 1963, 78, Universal 3; Plank 2022, Universal 55).

This universal is confirmed by Dryer's (2023b, 2023c) survey of 85 VSO languages that employ either prepositions/adpositional prefixes or postpositions/postpositional affixes, in that 76 (89.4%) of these languages employ prepositions/adpositional prefixes. In other words: if a language has VSO word-order, then its prepositions are overwhelmingly likely to precede their nouns (rather than following them), and are often *prefixed* to their nouns. So then: if Minoan has VSO word order, and if Valério is correct that Linear A *A-DI-KI-TE-TE DU-BU-RE* means "to/for the Diktaian lord/sanctuary", then we would be entirely justified in interpreting the Minoan prefix *A-* as being a prepositional prefix meaning "to/for".

Meanwhile, a second universal is applicable here as well:

> **IF** a language has VSO word-order
>
> **THEN** with overwhelmingly more than chance frequency, adjectives occur after their nouns (Greenberg 1963, 85, Universal 17; Plank 2022, Universal 56).

This universal is confirmed by Dryer's (2023a, 2023c) survey of the order of adjective and noun in 89 VSO languages, which shows that the adjective follows its noun in 61 (68.5%) of them. Thus, our interpretations of *I-PI-NA-MA SI-RU-TE* = "a favor divine" (*vel sim.*) and < olive oil > *A-JA* = "oil much" (*vel sim.*) fit the pattern for VSO languages, in which the adjective usually follows its noun.

But if *A-DI-KI-TE-TE DU-BU-RE* means "to/for the Diktaian lord/sanctuary", is this not an instance in which an adjective (*DI-KI-TE-TE* = "Diktaian" *vel sim.*) is preceding its noun (*DU-BU-RE* = "lord/sanctuary" *vel sim.*)? In response, one can cite a third universal:

> **IF** descriptive adjectives ordinarily precede their nouns
>
> **THEN** there are no exceptions;
>
> **BUT IF** descriptive adjectives ordinarily follow their nouns
>
> **THEN** there may be a small number of adjectives that usually precede their nouns (Greenberg 1963, 87, Universal 19; Plank 2022, Universal 58).

The fact that *A-DI-KI-TE-TE DU-BU-RE* is actually written on the offering tables as *A-DI-KI-TE-TE-DU-BU-RE* (without a word-divider between the two words) may indicate that this is a special compound form, rather than a simple adjective and noun, which could account for the occurrence of the adjective before the noun in this instance.

Thus, knowing the default word order of Minoan serves as a valuable key to further knowledge about the language behind Linear A: there are dozens of language universals that will then tell us how the Minoan language is going to behave – how its sentences are going to be structured, how it is going to prefix and suffix its words, and so on. So identifying the default word order in Minoan is actually a major step forward in decipherment.

Finally, this discovery that Minoan probably had VSO word order has another fascinating implication. When an influential culture comes into contact with a less influential culture, the less influential one will naturally borrow words from the more influential one; this is a phenomenon that is familiar and well-documented. But what is less commonly known is that, aside from vocabulary words themselves, one of the next most common things that the less influential culture will borrow from the more influential one is its *word order* (Thomason 2001, 69–71) – that is, over time, the less influential culture will often change its *own default word order* to match that of the more influential culture. We see this in Akkadian and Eblaite: over time, as I mentioned earlier, these languages changed their word order from VSO, like other Afroasiatic languages, to SOV, because of their close contact with the very influential Sumerian culture to the south, which spoke an SOV language (Huehnergard and Woods 2004, 263). So it is very intriguing that the portion of the Anatolian mainland nearest to Crete was the home of an Indo-European language – Lycian – that at some point in prehistory changed its word order from SOV to VSO (Melchert 2004, 598; Dryer 2023c, fig. 1); for if Minoan had VSO word order, then this change suddenly becomes much easier to understand: in prehistoric times, pre-Lycian is very likely to have adopted VSO word order because of the strong influence of the neighboring Minoan culture.

CONCLUSION

Thus, these new linguistics-based approaches are beginning to give us some new and important insights into the *language* behind Linear A, which is the key to the eventual decipherment of the script. In other words: we are making progress, however slowly. The decipherment of this script is still a terribly difficult problem; but thanks to recent advances like these, we are now closer than ever to being able to understand the basics of the language that Linear A encodes, and perhaps eventually to hear the Minoans speak with their own voices at last.

APPENDIX: INDEX OF LINEAR A SIGN-GROUPS CITED IN THIS WORK

The list below contains all Linear A sign-groups cited in this work, with signs transliterated according to the standard convention of using the values of their Linear B homomorphs. Each sign-group is accompanied by a reference to the inscription it is found in, as well as a reference to *GORILA* (or, if the inscription was published after *GORILA*, a reference to the official publication of the inscription).

A-DI-KI-TE-TE: **PK Za 11** (*GORILA* 4, 32–4)

A-DU-KU-MI-NA: **ZA 10a**.3–4 (*GORILA* 3, 168–71)

A-DU-ṚẸ-ZA: **KH 11**.1 (*GORILA* 3, 38–9)

A-KI-DA-RO: **KH Wa 1002** (*GORILA* 3, 104)

A-KU-MI-NA: **ZA 10a**.1–2 (*GORILA* 3, 168–71)

A-MI-DA-O: **PH**(?) **31b**.5 (*GORILA* 1, 318–19)

A-MI-DA-U: **ZA 10a**.3 (*GORILA* 3, 168–71)

A-NA-NU-SI-JA-SE: **HT Zb 159** (*GORILA* 4, 66)

*A-NA-TI-*301-WA-JA*: **IO Za 8** (*GORILA* 5, 30–1)

A-PA-RA-NE: **HT 96a**.1 (*GORILA* 1, 156–57)

A-RA-TU: **ZA 7**.1–2 (*GORILA* 3, 160–3)

A-RA-TU-M̞E̞: **HT Wc 3024** (Hallager 1996, 34)

A-RI-NI-TA: **HT 25a**.3 (*GORILA* 1, 44–5)

A-SA-SA-RA-ME: **PR Za 1c** (*GORILA* 4, 46–9)

A-SI-KI-RA: **KH 20**.2 (*GORILA* 3, 52–3)

A-T̞A-I-*301-DE-KA: **ZA Zb 3**.2 (*GORILA* 4, 112–13)

A̞-TA-I-*301-WA-E: **PK Za 11a** (*GORILA* 4, 32–4)

A-TA-I-*301-WA-JA: **IO Za 2**.1 (*GORILA* 5, 18–9)

A-TA-NA-TE: **ZA 10a**.2 (*GORILA* 3, 168–71)

DA-I-PI-TA: **ZA 10a**.4–5 (*GORILA* 3, 168–71)

DA-KU-SE-NE: **HT 103**.4–5 (*GORILA* 1, 170–71)

DA-K̞U̞-SE-NE-TI: **HT 104**.1–2 (*GORILA* 1, 170–71)

DA-MA-TE: **KY Za 2** (Sakellarakis and Olivier 1994)

DU-RE-ZA-SE: **ZA 10a**.5 (*GORILA* 3, 168–71)

I-DA-MA-TE: **AR Zf 1** (*GORILA* 4, 142, 162)

I̞-KU-PA₃-NA-TU-NA-TE: **AP Za 2**.1 (*GORILA* 4, 4–5)

I-NA-JA-PA-QA: **PK Za 11d** (*GORILA* 4, 32–4)

I-NA-JA-RE-T̞A̞: **AP Za 2**.2 (*GORILA* 4, 4–5)

I-PI-NA-MA: **IO Za 2**.1 (*GORILA* 5, 18–9)

I-PI-NA-MI-NA: **PK Za 10** (*GORILA* 5, 30–1)

I̞-TI-TI-KU-NI: **HT 96**.1 (*GORILA* 1, 156–57)

I-ZU-RI-NI-TA: **PH 6**.2 (*GORILA* 1, 292–93)

JA-DI-KI-TE-TE: **PK Za 15** (*GORILA* 4, 41)

JA-DI-KI-TU: **IO Za 2**.1 (*GORILA* 5, 18–9)

JA-SA-SA-RA-MA-NA: **KN Za 10** (*GORILA* 4, 8–9)

JA-SA-SA-RA-ME: **PS Za 2**.2 (*GORILA* 4, 52–5)

JA-SU-MA-TU: **SY Za 2a** (*GORILA* 5, 64–5)

JA-TA-I-*301-U-JA: **AP Za 1** (*GORILA* 4, 2–3)

KI-DA-RO: **HT 117a**.9 (*GORILA* 1, 196–99)

KI-TA-NA-SI-JA-SE: **PE Zb 3** (Tsipopoulou and Hallager 1996, 31, 34–6)

KU-MI-NA-QE: **HT Wc 3014a–b** (*GORILA* 2, 76)

KU-PA₃-NA-TU: **HT 47a**.1–2 (*GORILA* 1, 90–1)

KU-PA₃-NU: **HT 1**.3–4 (*GORILA* 1, 2–3)

MA-KA-I-SE: **ZA 8**.4 (*GORILA* 3, 164–65)

MA-KA-I-TA: **ZA 5b**.2–3 (*GORILA* 3, 152–55)

NA-MA-M̞A̞-TI-TI-*319: **HT Zd 155** (*GORILA* 4, 130–31)

PA-JA-RE: **ZA 10b**.5–6 (*GORILA* 3, 168–71)

PA-RA-NE: **HT 115a**.4 (*GORILA* 1, 188–91)

RI-RU-MA: **HT 118**.4 (*GORILA* 1, 200–1)

ṚI-RU-MA-TI: **PH**(?) **31b**.4 (*GORILA* 1, 318–19)

RU-MA-TA: **HT 29**.1 (*GORILA* 1, 54–5)

RU-MA-TA-SE: **ZA 20**.3 (*GORILA* 3, 192–93)

SI-KI-RA: **HT8a**.4 (*GORILA* 1, 16–7)

SU-KI-RI-TA: **PH Wa 32** (*GORILA* 2, 90)

SU-KI-RI-TE-I-JA: **HT Zb 158** (*GORILA* 4, 64–5)

TA-NA-I-*301-TI: **PS Za 2**.2 (*GORILA* 4, 52–5)

TA-NA-I-*301-U-TI-NU: **IO Za 6** (*GORILA* 5, 24–7)

TA-NA-TE: **ZA 10a**.1 (*GORILA* 3, 168–71)

TI-TI-KU: **HT 35**.1 (*GORILA* 1, 66–7)

U-NA-KA-NA-SI: **KO Za 1c** (*GORILA* 4, 18–20)

U-NA-RU-KA-ṆA-JA-SI: **PK Za 12c** (*GORILA* 4, 35–8)

U-NA-RU-KA-NA-TI: **PK Za 11b** (*GORILA* 4, 32–4)

U-TA-I-SE: **KH 7b**.2 (*GORILA* 3, 28–31)

WI-JA-SU-MA-TI-TI-*319: **HT Zd 157+156** (*GORILA* 4, 132–35)

ZU-ṚI-NI-MA: **KN Zb 52** (Macdonald 2000, 64, fig. 39)

*312-TA: **HT 10b**.2 (*GORILA* 1, 20–1)

*312-TE-TE: **HT 26a**.1 (*GORILA* 1, 46–7)

3

Cycladic Linear A and connections between scripts

Cassandra Donnelly

University of Cyprus
ORCID ID: 0000-0003-2634-3469

ABSTRACT

This paper explores the possibility that overseas exchange conducted in and/or through the Cyclades occasioned script transfer from Linear A to Cypro-Minoan in the LC IA–IIA periods, sometime in the 17th and 16th centuries. Archaeological evidence for trade conducted between the two geographic areas is extremely limited, but analysis of the paleographic and material features of Linear A documents from the Cyclades and Cypro-Minoan texts evince exclusive commonalities absent from Cretan Linear A documents. Further evidence for possible sustained contact between Cypriot and Cycladic writers comes in the form of a single inscription likely written in the Cypro-Minoan script dated to the period of script transmission, a two-sign text on a vessel handle from Melos. While no single piece of evidence is compelling on its own, the aggregated evidence favors the Cyclades as a site for script transfer over Crete but suffers from extremely limited archaeological evidence of prolonged trade contacts as the Cretan theory of script transmission.

INTRODUCTION

The earliest centuries of script transfer from Linear A into Cypro-Minoan, characterized by the adoption of an undetermined selection of Linear A script signs into Cypro-Minoan, are obscured by limited data. The limited data takes two forms: one, the small number of early Cypro-Minoan texts and, two, the absence of archaeological evidence suggestive of enduring contact between Crete and Cyprus during the period of script transfer. The first evidence for the transfer of Cypro-Minoan from Linear A dates to the Late Cypriot IA or IB (for an overview of the early inscriptions, see Steele 2018, 11–31). In the Minoan chronology, LC IA corresponds to late MM IIIB/early LM IA. Only three Cypro-Minoan multi-sign texts date to the first two hundred years of the script's use from the LC IA–LC IB, ##095 **ENKO Apes 001** (LC IA or IB), ##001 **ENKO Atab 001** (LC IB), and **MI Zb 3** (Late Third City in the Phylakopi sequence). It is possible to exclude cylinder seal ##225, which Ferrara (2013a, 117) dates to LC IA following its excavator, Einar Gjerstad. Reevaluation of the tomb's chronology dates the context to the LC IB/IIA transition; the seal's features also fit an LC II date (Webb 2002, 114, n 2; Donald 2016, 234, cat. no. 30).

By LC IIB, there is a moderate increase in the number of Cypro-Minoan inscriptions, at which point Linear A has been out of use for at least a half-century. The result is a long window with very little evidence from which to reconstruct script transfer from Linear A.

The body of evidence grows if single-sign texts are admitted as evidence for script transmission alongside multi-sign texts. Here I use the term "text" in the contemporary use of the term, which encompasses graphic

content that may or may not record writing, like an emoji. "Text" encompasses both single-sign texts, which in the Late Bronze Age Cypriot context carry script and non-script signs, and multi-sign inscriptions. An indeterminate number of single-sign texts on vessels and other objects carry script and non-script signs from the LC I – LC IIA periods (50 single-sign vessel texts come from Enkomi, for instance, but the total number cannot be determined until a database of Cypro-Minoan potmarks and single-sign is completed). Though single-sign texts from Cypriot contexts do not necessarily record writing, and it is often impossible to say whether a single script sign records a phoneme or a non-phonetic mark (Ferrara 2012, 19), their production context has been shown to be a literate one (Donnelly 2021, 2022a). Single-sign texts should therefore generally be regarded as evidence for script transfer alongside the multi-sign text inscriptions.

Both the paleography and the material features of texts can provide evidence for reconstructing script transfer. Paleographic studies comparing the sign shapes of early Cypro-Minoan texts to Linear A ones have yielded mixed results because of the subjectivity involved in assessing sign shape. Some, such as Valério (2016), conclude that the earliest texts show ample continuities with Linear A, while others, like Steele (2018, 24), focus on the discontinuities, leading to differing conclusions about the extent of influence Linear A had on the earliest Cypro-Minoan documents. To sidestep the subjectivity involved in assessing sign shape, the present study privileges the evidence from the material features of texts, while also taking paleographic considerations into account. The material features of a text are reliable indicators of the institutional settings of text production (whether those institutions are formal or informal ones), since institutions promote habitual behaviors. They teach writers not only how to draw letter shapes but also the appropriate materials for writing on and with, the correct formatting of texts befitting specific genres, and the social uses of writing (i.e., the writing genres themselves). The material features of texts are physical manifestations of institutionalized practices, which are further reinforced by the readers of texts, whether identical to the community of writers or not, who develop expectations of what a document should like. In this way, the material features of texts become standardized and embody the institutional settings of script transmission. A focus on the institutional contexts has the added benefit of highlighting the human agency and interpersonal relationships implicated in the transmission of knowledge of how to construct, inscribe, and interpret a document.

Types of texts with standardized material features are called a "document form" in the Diplomatics branch of archival studies (Duranti 1991, 10). Scholars of diplomatics distinguish between the external and internal material features of a document form. The external material features of a text are independent of the text's content, making them a particularly useful analytical framework in the case of an undeciphered script such as Cypro-Minoan. External features of texts include their materials, shape, size, writing implement, formatting and other similar features, which can easily be studied without respect to an inscription's content.

By and large, Cypro-Minoan writers did not adopt the most common Linear A document forms, administrative clay tablets and libation tables, but as this study will show, the few cases where Linear A document forms or writing media made their way out of Crete are ones attested in the Cyclades. When treated as a group independent of Crete, Cycladic Linear A shows similarities to the Cypro-Minoan documents in their document forms and writing media and in their paleography. The meager evidence for sustained contact between Cyprus and the Cyclades and Crete during the period of script transfer frustrates attempts to reconstruct the institutional settings in which script transfer could have taken place (for a summary of the evidence, see Sherratt 2013). The hypothesis that the Cyclades were the region where script transfer took place runs into many of the same problems as the Cretan hypothesis. Nevertheless, small-scale trade conducted between individuals involved in informal institutionalized trade networks and merchant practices could explain the shared document forms, as would trade in perishable goods, such as textiles, that do not survive the archaeological record. Supporting this hypothesis is the observation that the few document forms held in common between Cycladic Linear A and Cypro-Minoan are associated with commercial exchange. There is also evidence for knowledge of script, if not writing, in textile settings that used discoid loom weights, which are generally regarded as "Minoanising" artifacts (Cutler 2019, 79).

SCRIPT TRANSFER

Script transfer is the process wherein a script is deployed to write a different language in a new context (Salomon 2021, 153). Script transfer can come at the hands of an inspired individual or group or result from a cumulative process called "script diffusion", where adjustments and additions to a script happen slowly over decades or centuries (Salomon 2021, 167). Often, script transfer results from a combination of both: a singular, conscious act of creativity followed by a long period of diffusion and reforms. The processes involved in script transfer are rarely transparent in the historical record. This is especially so in the cases of ancient scripts, since the archaeological record often collapses moments into decades and sometimes decades into centuries. Even when a script's earliest stages are documented, it can be hard to distinguish an inspired moment of innovation from intergenerational trouble-shooting efforts based on an analysis of early documents alone (Salomon 2021, 159).

Script transfer is highly variable. It can be conservative, adapting and applying the shapes, sounds, and document form of one script to write a new language, or changeable, adapting sign shapes without their accompanying sound values or document forms. When script transfer is conservative, it is almost always accompanied by the adaptation of the institutions pertaining to the script's production. An example of this is the adoption of cuneiform to write Hittite, where the institution of the scribal school taught its students not only the script, its writing conventions, and so on, but also which genres to write and how to physically construct and format tablets for writing. When a script is divorced from its original institutional settings in the process of script transfer, the sound values of the script are not always imported and applied to the new language.

Knowledge of how to draw a given script sign is a prerequisite for script transmission, but knowledge of the underlying sound value or phoneme is not. A famous example of sound values not being retained is in the adoption of a set of Greek alphabetic sign shapes to write Carian. Carian retained very few sound values of the consonantal letter shapes it adapted from the Greek script and only some of the vowel sounds (Elti di Rodeano 2021; for a contrary view, de Voogt 2012). Insistence that the Carian signs adapted from the Greek alphabet retained their original Greek sound values was a significant barrier to the script's eventual decipherment (Adiego 2007, 166–204). There are also several examples of script invention undertaken by individuals not literate in the script they adapted or otherwise illiterate, as in the famous case of Sequoyah and his invention of the Cherokee syllabary (for the general phenomenon, Salomon 2021, 181–82).

Script transfer can even involve more than one source, adapting signs from multiple scripts or even marks to create a new script (Kammerzell 2009, 297). The phenomenon of combining multiple scripts to create a new script is well documented, such as in the Carian script just mentioned or the Wulfila script, which "takes its signs from at least two source alphabets and the principles and ideas from three different writing systems" (Schulte 2015, 91). The combinatory nature of script transfer should serve as a reminder of the complexities often involved in the process of script transfer and that Occam's razor does not necessarily apply in the arena of scripts.

SCRIPT TRANSFER AND CYPRO-MINOAN

The association between the Aegean Linear scripts and Cypro-Minoan is longstanding, coterminous with the discovery of a Bronze Age script on Cyprus. Evans first proposed the script was derived from an Aegean Linear script in 1909 and his proposal has taken the dimension of orthodoxy in Cypro-Minoan Studies (Evans 1909, 68). Nevertheless, the fit has always been an uneasy one. Palaima's survey of the literature (Palaima 1989, 139) concludes that, "one has never spoken for Cyprus of a wholesale borrowing of script, with but minor alterations, in the manner of Mycenaean Linear B from Minoan Linear A," but rather, on analogy with the script transfer from Phoenician to the Greek alphabet, script transfer involving "a large number of independent, although culturally related, communities". Conservative script transfer from Linear A to Cypro-Minoan is usually, but

not always, doubted on the grounds of the many differences in paleography and document form between Linear A and Cypro-Minoan and the lack of evidence for sustained archaeological contact between Crete and Cyprus during the period of script transmission.

Most often, Linear A is proposed as the parent script for Cypro-Minoan although an intermediary but related Linear script is sometimes posited instead. The idea of an intermediary script was first proposed by Lejeune (1958, 327), who suggested that Cypro-Minoan and Linear A shared a common ancestor. Along a similar vein, Susan Sherratt (2013, 98) hypothesizes the existence of an as-yet-undiscovered script indigenous to either the Anatolian or Levantine littoral, which was either the parent to both Linear A and Cypro-Minoan or the parent to two offshoots that separately served as the sources for Linear A and Cypro-Minoan. Sherratt's inventive proposal suffers from many of the same problems as Evans's but inverts them; instead of two visually similar scripts, whose writers had few opportunities for contact, Sherratt identifies opportunities for contacts between writers of missing scripts.

Sherratt (2013, 80) ascribes her motivation to challenge the Linear A origins of the Cypro-Minoan script to the pervasive orientalist attitudes towards Cyprus she observed during her graduate studies. That experience has made her skeptical of Evans's Aegeo-centric narrative of script transmission. Sherratt (2013, 79–80) shows how Evans's entrenched belief in the superiority of European races resulted in his preposterous claim that European Minoans were the progenitors of the Phoenician alphabet. A similar orientalist impulse, she argues, was behind the ready acceptance and longevity of Evans's theory of script transfer from Linear A to Cypro-Minoan. Although Sherratt's alternate proposal of an unidentified Anatolian or Levantine Linear *Urschrift* for Cypro-Minoan is not, in my estimation, convincing, her incisive historiographic critique explains the contradiction inherent in the circumstance that Linear A is almost always regarded as the *sole* source for Cypro-Minoan, despite expressed unease over the poor paleographical and archaeological fit between Linear A and the earliest Cypro-Minoan inscriptions.

No more than half of Cypro-Minoan signs are argued to be derived from Linear A equivalents, even by scholars who posit Linear A as *the* Cypro-Minoan *Urschrift* (see **Fig. 3.1**). The number of Cypro-Minoan signs with equivalents in the Linear A script is strictly a matter of interpretation. First, there is no agreement on the total number of signs in the Cypro-Minoan script from which to calculate the proportion of signs in common. Proposed signaries range from a low of 57 (the minimum number in Valério 2016) to a high of 110+ signs (Masson 1974). Second, the assessment of identity and similarity in the shape of signs is ultimately subjective. Even a maximalist count of the Cypro-Minoan script signs derived from Linear A, such as Valério's, counts only 32 signs with possible Linear A origins. My own count of Cypro-Minoan signs derived from Linear A, for instance, is lower (see **Fig. 3.1**). I count 21 signs with definite or likely Linear A derivation. Of these, seven have simple geometric shapes that are common to many writing systems including contemporary regional ones (cf. CM 028, which is a common Luwian Hieroglyphic sign; Davis 2011). Both Valério's more maximal count and my lower one leaves a significant portion of the signs unaccounted for, validating Sherratt's attempt to seek contemporary sociohistorical explanations for the fixation on Linear A as the source of Cypro-Minoan.

Bombardieri and Jasink (2010, 142) are the only current scholars I know of to propose a non-Aegean script source for Cypro-Minoan script signs, relegating Linear A to a minor influence on the script, one of two sources for Cypro-Minoan. They accept Linear A as *a* source of some Cypro-Minoan signs, but suggest that other signs are derived from Cypriot decorative traditions or were otherwise local inventions. Bombardieri and Jasink restrict their search for additional source material for the Cypro-Minoan script to decorative motifs, but they need not have limited themselves to the decorative repertoire. Dikaios (1940, 139–45) had originally sought in the pre-firing marks incised on Early and Middle Bronze age pottery, some of which have shapes in common with later script signs, for instance, before siding with the dominant Linear A hypothesis. After-firing signs on pottery from the Late Bronze Age, often referred to as Cypro-Minoan potmarks, should also be considered as a possible source given their abundance in the LC I relative to multi-sign inscriptions and the fact that some bear recognizable script signs. The relative abundance of potmarks in the LC I as compared to the inscriptions makes
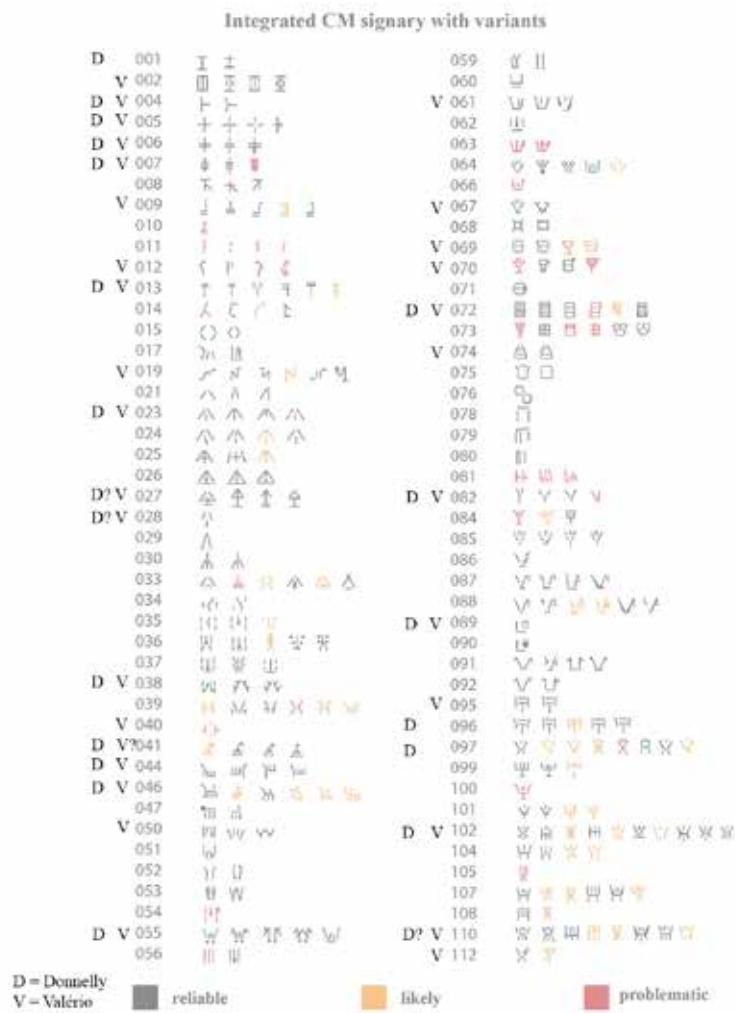
Fig. 3.1: Polig and Donnelly's Integrated Signary with possible Linear A antecedents indicated. V = Valério and D = Donnelly. I obtained Valério's list of Linear A antecedents according to Valério 2016. There is room for error in this count since no synthetic chart is provided and because the chart presented here uses Polig and Donnelly's integrated signary (Polig and Donnelly 2022), not one of Valério's proposed signaries.

them an eligible source. Bombardieri and Jasink (2010, 150) conclude their study by proposing that "Linear A was not the main source of the script that had its true roots in the island", a radical idea in its Cypro-centrism and one that Sherratt would regard as corrective. Though perhaps overstating the case, Bombardieri and Jasink's minimization of Linear A's role in the invention of Cypro-Minoan deserves serious consideration in future scholarship.

Even if Linear A was the primary source for Cypro-Minoan, there is no clear evidence that Linear A sound values were systematically inherited alongside sign shapes. There are around ten signs, whose sound values in the Iron Age Cypro-Syllabic script, itself derived from Cypro-Minoan, are consistent with the sound value of a similarly shaped sign in Linear A, indicating a retention of sound values (for conflicting counts, see Steele 2018, 37, table 1.6; Valério 2015, 158, table 3.2). The sound values for the remaining 10–20 signs potentially inherited from Linear A are not readily apparent, even though their sound values in both Linear A and Cypro-Syllabic are known (Linear A, while undeciphered, likely shares its core sound values with Linear B; Steele and Meissner 2017). The inability to decipher the sound values of more than half of the signs possibly adapted from Linear A might indicate that some Linear A signs were borrowed without their sound values, analogous to Carian's adaptation of Greek alphabetic signs. Certainly, the insistence on coupling Cypro-Minoan with Linear A and its sound values has not contributed to steady improvements in understanding Cypro-Minoan's phonology or its underlying language(s).

Fig. 3.2: Two discoid loom weights. Top: Photograph and drawing of ##095 by author. Bottom: Photograph and drawing of the Kalo Chorafi loom weight reproduced from Tzigounaki and Karnava 2020 with permission from authors.

All-in-all, script transfer from Linear A to Cypro-Minoan is poorly accounted for. The script could equally have arisen from a creative act followed by a period of script diffusion, or its invention could have been a slow and collaborative process from the outset. Most accept that Linear A is *a* source for Cypro-Minoan, but there is not sufficient evidence to suggest it is *the only* source of the script and the script may well incorporate signs from different sources. With that fact in mind, the present paper focuses on Linear A script transfer to Cypro-Minoan in the Cyclades, as one of several possible sources for the script, with the aim of suggesting plausible institutional contexts in which people might have adapted Linear A elements into Cypro-Minoan.

LOOM WEIGHTS AS DOCUMENT FORM

Since its discovery in 2020, all discussions of script transfer between Linear A and Cypro-Minoan must begin with a discussion of the discoid loom weight from Kalo Chorafi, Crete, which bears a single sign incised before-firing (see **Fig. 3.2**; Tzigounaki and Karnava 2020, 324–25). The loom weight was found in a mixed context of MM III and LM IA material, roughly corresponding to the beginning of the LC IA, the period of the earliest attestation of Cypro-Minoan writing. The sign, which is centered on the loom weight, is identical in shape to Cypro-Minoan sign 061. It was identified as a Cypro-Minoan script sign by Tzigounaki and Karnava (2020, 324). A single script sign on its own, however, is not sufficient evidence for determining that the person who incised it was knowledgeable in script or literate. It is only evidence that the person who drew it had the ability to render a sign with the same shape as a script sign. The script sign could have been encountered in non-script contexts, e.g., used as a non-phonetic mark or a decoration. For instance, Ayia Irini cylinder seal 3:88 bears a decorative "flower" (per Pecorella 1977, 32, fig. 76), similar in shape to CM 061. The Kalo Chorafi text can be considered a piece in the puzzle of script transfer, however, only if it is shown to be related to literate institutional settings related to either or both the Linear A or Cypro-Minoan scripts.

The "Minoanising" associations of discoid loom weights should implicate not only Crete and Cretans with their spread, but also the entire Southern Aegean and Western Anatolia, any of which regions could be

responsible for the technology's subsequent spread east to Cyprus (Muti 2024, 13). Bronze Age weaving practices are often considered the domain of women and their spread related to female mobility (for instance, through intermarriage) rather than economic exchange (Cutler 2019, 86 with references). But as Jack Davis (1984, 161) has argued for the spread of discoid loom weights to Ayia Irini on Keos, and Giulia Muti (2024, 11–2) has suggested for the spread of discoid loom weights to Cyprus, the spread of loom weights can be attached to the spread of technology and shifts in commercial markets.

The introduction of discoid loom weights to Cyprus has only recently received scholarly attention, but their introduction during the LC I is almost assured (Muti 2024). The coincident timing of the earliest Cypro-Minoan inscriptions and the discoid loom weight technology in the LC I could indicate that script transfer occurred in the context of textile production and/or commercial exchange (Muti 2024, 12). It could also implicate the role of women in the process of script transfer. A number of single-sign texts and inscriptions on discoid loom weights, including the Kalo Chorafi weight, are suggestive, but, in the case of single-sign texts, cannot be definitely linked to literate contexts, and, in the case of the inscription(s), cannot be linked to the discoid loom weights bearing single-sign texts.

One way to assess whether a single-sign text was produced in a literate context is to evaluate whether its external material features conform to a Cypro-Minoan or Linear A document form. If they do, then one can argue that the creator of the text was embedded in literate institutional contexts and therefore familiar with Linear A writing practices. The difficulty in making this assessment is the small number of loom weight texts, a difficulty which is heightened in the case of the Kalo Chorafi texts, which is a unicum *stricto sensu*. There are no other loom weights from Crete bearing possible Cypro-Minoan signs. There are, however, multi-sign and single-sign texts on loom weights in both the Linear A and Cypro-Minoan scripts to compare it to. If discoid loom weights could be said to be a document form used by writers of either Linear A, Cypro-Minoan, or both, then the Kalo Chorafi weight could be taken as evidence for literacy and the type of institutional context in which script transfer could have taken place.

Threading Crete to Cyprus through a hypothetical discoid loom weight document form is complicated by the limited number of loom weight texts and the wide geographic and chronological gap between them. The earliest Cypro-Minoan discoid loom weight text with single signs dates to the LCI and the latest possibly as late as the LC IIIB. All eight are from the two sites of Enkomi (3) and Ugarit (5), dating to the LC IIC or later. Two texts from each site bear script signs and the rest are non-script signs or marks of complex shape. In addition, there is one multi-sign Cypro-Minoan text on a loom weight, ##095, which is the earliest undisputed Cypro-Minoan inscription, dating to the LC IA or LC IB (Baurain 1980, 580), since the early tablet ##01 **ENKO Atab 001**, found in an LC IB context in fill with an LC IB *terminus ante quem*, is not written in the Cypro-Minoan script (we may also add that the tablet's script, however, is not necessarily a precursor to Cypro-Minoan, hence "CM 0" designation in *HoChyMin*; but cf. Valério 2018 for the argument the script is a precursor to Cypro-Minoan).

Single-sign texts from the Aegean with Linear A script signs are attested in meager numbers throughout the whole period of the script's use and texts with non-script signs date to the entirety of the Bronze Age but are most common in the MBA III–LB I and are found on Crete, the Cyclades and the Dodecanese (Ulanowska forthcoming). There is one Linear A inscription on a discoid loom weight, from Thera, which will be discussed below (Karnava 2019).

On the one hand, the small numbers and wide geographic and chronological spread of the discoid loom weights challenges the notion of institutional continuity implied by the concept of document form. For the practice of marking and writing on loom weights to be handed down across several generations within any institutional context, however informal, requires either (a) consistent application of the practice or (b) infrequent but reverent use of the practice. If the loom weight texts are not the same document form, the most straightforward inference would be that loom weight texts arose in response to local marking practices. A proposed project by Agata Ulanowska on the topic of loom weight marks will surely provide meaningful insights into the

latter possibility (for a summary of early results, see Ulanowska forthcoming). For my part in the present paper, I venture to weigh in only on the question of document form and leave the interpretation of local loom weight marking practices to Agata Ulanowska and other weaving specialists.

On the other hand, the geographic dispersal of the discoid loom weight texts, especially the presence of the two Linear A discoid loom weight texts discussed below, one from the Cyclades and the other the Dodecanese, represents a plausible route for the transfer of Linear A to Cypro-Minoan (Muti 2024, 13). The same people and institutions associated with the spread of discoid loom weights could have also cultivated a practice of writing on them. It would be a remarkable coincidence for the earliest attestations of a possible Cypro-Minoan script sign in the Kalo Chorafi texts and the earliest Cypro-Minoan inscription, ##095, to both be on discoid loom weights. Yet, dramatic differences in their material features suggest they are not a related writing practice or document form.

THE COMPARISON

What follows is a comparison of the Kalo Chorafi text's material features to other loom weight texts found in Linear A and Cypro-Minoan contexts. The comparison shows that Kalo Chorafi weight could be considered the same document form as the single-sign discoid loom weight texts from Cyprus, but not inscription ##095. Likewise, the single-sign discoid loom weights show no clear associations with literate contexts. Similarities between the Kalo Chorafi loom weight and a Linear A inscription from Thera (see below) are not sufficiently strong to suggest they are the same document form.

The external material features of the Kalo Chorafi weight are as follows (see **Fig. 3.2**). The single-sign text is incised before firing at the center of the disc underneath the suspension hole. The sign is read right-side-up when the loom weight is suspended. The sign's height, 3.7 cm, and its 0.5 cm thick incision lines indicate the sign would be visible to a viewer were the loom weight suspended (Tzigounaki and Karnava 2020, 324). The excavators do not speculate about the nature of the writing implement. Its clay's fabric is Cretan and is similar in appearance to local clay from the region, though it has not yet undergone petrographic analysis to determine its precise origin (Tzigounaki and Karnava 2020, 324). The loom weight is disc-shaped, and its typology is discoid. Its context dates it to the MM III/LM IA.

The external material features of the Linear A inscription from Thera (L36) are only broadly similar to the Kalo Chorafi loom weight (Karnava 2019, 501). The Thera inscription is made on a disc-shaped discoid loom weight pierced with two holes of non-local, likely Cretan fabric. The loom weight was found in an MC Phase C = early MM III context, making it the earliest Linear A inscription from Thera and potentially earlier than the Kalo Chorafi loom weight. The text is positioned upside-down vis-à-vis its suspension holes unlike the Kalo Chorafi weight. The text begins between the two holes and trails downward and off-center. The incision lines are slight, narrow, "almost superficial", and hence difficult to read (Karnava 2019, 501). The various features conspire to make the Thera inscription less readily visible than the Kalo Chorafi text. Their only formal similarity is in being before-firing texts, an important similarity when considering institutional context of production since the inscription would have necessarily been made at the time of production or shortly thereafter. Given the balance of similarities and differences between the two texts they should not be regarded as belonging to the same document form.

Trapezoidal discoid loom weight ##095 **ENKO Apes 001**, is the earliest certain Cypro-Minoan inscription found on Cyprus, dated to the LC IA by its excavator Courtois, though a broader LC I date is generally accepted (for an overview, Baurain 1980, 566–68; see also Ferrara 2013a, 51). The object's identity as a loom weight had been uncertain until the 2024 study of Muti (2024, 7, 8 fig. 8), which demonstrated its features conform to other loom weights from both Crete and Cyprus in its shape, weight and use-wear marks. Ferrara had identified it as a "label" on its typological similarity to economic labels in its shape and in possessing a hole (Ferrara 2012, 53–6),

but the closest parallel is found in Cretan Hieroglyphic not Linear A labels (Valério 2018, 120). No clay labels of any kind, uninscribed or otherwise, have been found on Late Bronze Age Cyprus to date. The loom weight identification is therefore assured.

Loom weight ##095 should not be regarded as the same document form as the Kalo Chorafi discoid loom weight. The 6-sign text is executed horizontally along the long edge of the trapezoid. The text would have been upside-down when the weight hung from a loom, contrary to the Kalo Chorafi text. Its placement on the weight and its effect on a viewer are also quite different. Whereas the Kalo Chorafi text is centered prominently on the weight and thickly incised, the Enkomi text's placement and the small size of the signs relative to the weight would have obscured it from a casual viewer's sight line. The similarities in the material features of the two texts are limited to the fact that they were both inscribed before firing on non-imported clays, meaning their inscribers must have had access to and influence over the weight's production.

The eight single-sign discoid loom weight texts from Enkomi (3) and Ugarit (5) are similar to the Kalo Chorafi text and to one another in their formatting and, often, in their ductus (see **Table 3.1**). I suggest that these should be regarded as the same document form. This suggestion is tentative because of the quality of the data set. The discoid loom weight texts are not all published and when they are published it is not always with sufficient detail to discern the measurements of the incision lines. It is also not always clear whether a text was made before- or after- firing. From the available data, the following profile of the discoid loom weight document form emerges. Single-sign discoid loom weight texts are before-firing texts (5/6 recorded) made with a wide utensil (6/8), centered on the surface of the discoid weight (8/8) below the suspension hole (8/8). The sign is usually oriented facing upwards with the weight suspended (6/8). Overall, the texts show remarkable consistency in their material features despite their scant number and wide-ranging chronology, which extends from the LC I to possibly as late as the LC IIIB period. Significantly, their material features match those of the Kalo Chorafi weight, suggesting they belong to the same document form.

Table 3.1. A comparison of the external material features of the discoid loom weights from Cyprus and Ugarit.

Cat. No.	BF/AF	Placement	Formatting	Script/Non-script + ID	Ductus	Site	Chronology	Museum ID and Publication
1	BF	Centered	Upside down?	Complex Non-Script	Thick	Ugarit	Unclear	RS 1701 Ugaritica II.5
2	BF	Centered	Upright	Complex Non-script	Thick	Ugarit	LCII?	Ugaritica II.8
3	BF	Centered	Upright?	Complex Non-script	Thick	Ugarit	None	Ugaritica II.9
4	BF	Centered	Sideways	CM 041	Thick	Ugarit	Unclear	RS 96.2006
5	AF?	Centered	Upright	CM 041	Thin	Enkomi	LCI?	CM 18.58
6	?	Centered	Upright	Complex Non-script	Thin	Ugarit	Unclear	RS 2423
7	?	Centered	Upright?	Complex Non-script	Thick	Enkomi	LCIIB?	CM 1961.11
8	BF	Centered	Upright	CM 023	Thick	Enkomi	Unclear	CM 30.324

Another discoid loom weight text with the same material features, and therefore arguably belonging to the same document form, comes from Telos in the Dodecanese. The single-sign text, bearing a fractional non-script
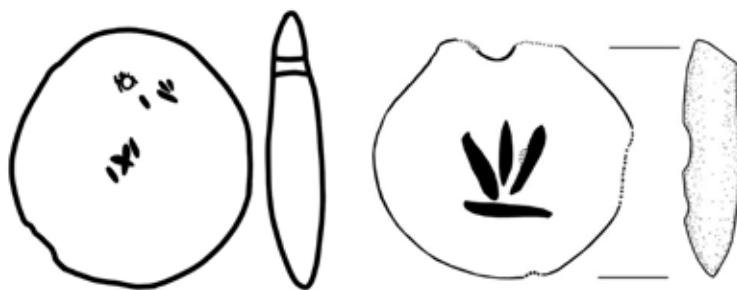
Fig. 3.3: A comparison of two discoid loom weights of the same document form. Left: Discoid loom weight 1961. Drawing by author based on Courtois 1984, cat no. 643. Right: Kalo Chorafi loomweight. See figure 3.

sign associated with the Linear A script, is on incomplete discoid loom weight, dated generally to Late Bronze I, roughly contemporary to period of Cypro-Minoan script transmission (Nikolakopoulou and Karnava 2022, 143–45). The text is incised prominently before firing on the surface in a thick ductus, placed slightly off-center below the suspension hole. Its features are remarkably consistent with both the Kalo Chorafi discoid loom weight text and the ones from Ugarit and Enkomi, suggestive of a shared document form.

The consistency of the material features of single-sign discoid loom weight texts over time can be indicative of institutional transmission, in which case institutions related to loom weights could have facilitated the exchange of script from Crete to Cyprus. The problems such a scenario presents for tying Kalo Chorafi to script transfer are the small number of texts dated over hundreds of years and, most objectionably, the fact that none of the single-sign texts from Ugarit or Enkomi, the Cypro-Minoan texts most similar to the Kalo Chorafi text, can be securely identified with literate contexts. A few bear script signs (3/8), including two texts with variants of the same sign CM 041 (nos. 4 and 5 in **Table 3.1**), but as already argued above, the presence of a single script sign on an object does not ensure that the producer of the text was literate or using the sign as a phoneme.

The only evidence potentially linking the discoid loom weight document form to literate contexts is a discoid loom weight from Enkomi excavated by Schaeffer's team, CM 1961.11 (**Fig. 3.3**; Courtois 1984, 67, cat. no. 643). Two of its features could indicate a connection to literacy. The first is that it potentially carries a secondary inscription in addition to its single-sign text, which is incised prominently on its surface below the suspension whole. The drawing of the sign published in *Alasia* III (Courtois 1984, fig. 21.32) shows a possible secondary text positioned upside-down vis à vis the suspension hole, above the single-sign text. While the drawing seems to depict the script sign, CM 023, preceded by a word-divider, no other drawings of the loom weight, including those from the excavation notebooks, show the secondary inscription, nor is it mentioned in the description of the object in the same publication. The discrepancy between the drawing with the secondary inscription and the other drawings and description without it, raises serious concerns. The secondary inscription has also not been mentioned, described or commented upon in any other discussion of Cypro-Minoan inscriptions I know of. Autopsy should be carried out in the future.

The second feature possibly connecting CM 1961.11 to literacy is its find context in a pit directly below where three inscribed balls (##42-##44) were found along with a clay spindle whorl. Given the nature of pit contexts, it is impossible to infer that loom weight and the balls were in contemporary use, but the building in which the pit was located, the Sanctuary of the Ingot God, has strong associations with Cypro-Minoan literacy. Uncovered in it were the greatest concentration of Cypro-Minoan inscriptions, 23 balls and an inscribed pithos ##111 **ENKO Avas 004**. The pit findspot is not convincing evidence that the inscriber of the loom weight in question was literate, but its inscriber could have had encountered writing previously in the sanctuary space. The late LC IIIA date of the inscribed material from the Sanctuary of the Ingot God, however, calls into question the relevance of its findspot for the much earlier Kalo Chorafi weight.

In sum, the Kalo Chorafi loom weight cannot be linked to literate contexts and is therefore not a piece of writing *stricto sensu.* Nevertheless, it matches a document form found at sites where Cypro-Minoan was written and some of the discoid loom weight texts contain script signs. Writers of Cypro-Minoan may have been involved in the institutional contexts, possibly commercial ones, related to the production and/or use of discoid loom weights, but there is no clear evidence they were involved in the process of script transfer from Linear A to Cypro-Minoan. Combined with other evidence suggesting shared writing practices belonging to the Cyclades and Cyprus, however, the Cyclades emerge as a possible setting for script transfer and commercial contexts relating to textile production may have been one of the institutional contexts where script transfer took place.

CYPRO-MINOAN AND CYCLADIC LINEAR A

The Linear A texts from the Cyclades show more similarities with Cypro-Minoan than the Linear A texts from Crete. The Linear A texts from the Cyclades are not a monolith, geographically nor chronologically, just as the texts from Crete are not. Nevertheless, I treat them here together under the hypothesis that texts generated in a distinct geographic region away from Crete were likely to have developed some regional peculiarities. Supporting this supposition is the observation that the Linear A writing media on the Cyclades show differences in the types, number and distribution compared to Linear A from Crete, 90% of which are clay tablets. Of the 25 Cycladic Linear A inscriptions, 14 are vessel texts (3 pithos texts, THE Zb1, Zb 6, Zb 13, the rest on a variety of vessel types) and one an ostracon (Karnava 2008). On Crete, vessel texts are a negligible proportion of all inscriptions, most of them pithoi inscriptions. The ostracon is the only one inscribed in Linear A and one of two written in an Aegean script, the other written in Cypro-Minoan. In the section that follows, I show that the Linear A from the Cyclades has more in common in its paleography and writing media with Cypro-Minoan than the Linear A from Crete does. I also show that an inscription from Melos on a jug handle is likely written in Cypro-Minoan and should no longer be grouped with Linear A inscriptions as it tentatively had been previously.

MI Zb 3, A Possible Cypro-Minoan Inscription from the Cyclades

MI Zb 3 is a jug handle bearing a post-firing inscription disposed horizontally across the face of the handle (**Fig. 3.4**). It comes from an unknown findspot on Melos. The jug is likely of local manufacture and is dated by Susan Sherratt (2000, 350–51), who rediscovered the handle in her publication of the Melian material held at the Ashmolean: "probably belongs to the Second or Early Third City", roughly equivalent to the LM IA. The handle has occasionally been included in lists of Cycladic Linear A documents but is not included in *GORILA* and is specifically marked as doubtful (**D 9**) in the newly published supplement to this publication (*RILA-S1*, 152). No Linear A reading for the handle has been proposed, and I am the first to propose a reading for it. I believe that the handle is best read as the Cypro-Minoan sequence CM 023-082. Both signs, although quite simple in shape, match Cypro-Minoan sign variants and occur in sequence together on another vessel handle inscription, ##115 **ENKO Avas 008**, vertically disposed, incised post-firing onto the handle of a Canaanite Jar dating to the LC IIC (the date here is in accordance with Olivier 2007 and contrary to Ferrara 2013a, which reports the excavation layer in place of the chronological period). Even though the shapes of both signs are quite simple, the presence of both signs in the Cypro-Minoan script and the recurrence of the same sign sequence and on the same document form strengthens the identification.

Handle ##115 **ENKO Avas 008** is not without complications. Nicolle Hirschfeld (pers. comm. 14 March 2023), in her autopsy of this handle, observed that the ductus of the two signs is not identical, with the first sign consisting of thin uncertain lines and the second thick, clearly incised lines. She infers from this either that the two signs were made with different tools or that they were incised at different times. In my own autopsy of the handle, I attributed the differences in the sign to the location of the signs on the handle, the first sign's place-ment at the bend of the handle causing difficulties for the handle's inscriber, resulting in thin, tentative lines,

Fig. 3.4: A comparison of ##115 **ENKO Avas 008** and **MI Zb 3**. Left: Drawing of ##115 based on autopsy. Thank you to the Cyprus Museum for permission to study the material. Right: Drawing of **MI Zb 3** based on Sherratt 2000, 350.

with second sign's placement on a flat area of the handle allowing for deeper, clearer incision lines. In any case, even if the signs were incised at separate times, the alignment of the signs appears to be intentional, suggesting that whoever placed the second sign on the handle was turning the single sign text into the meaningful sign sequence 023–082.

A Cypro-Minoan reading of the Melos handle is reinforced by the total absence of Linear A document form consisting of post-firing inscriptions on vessel handles and its prevalence among Cypro-Minoan texts. The material features of the text coincide with the later Cypro-Minoan document form of inscribed vessel handles. There are over forty post-firing incised handles in the Cypro-Minoan corpus, incised both horizontally and vertically across the face of jug handles. They represent just under 20% of the whole CM corpus. The horizontal handle inscriptions are similar in their formatting to the Melos text.

Cypro-Minoan handle inscriptions are found throughout Cyprus and abroad, including at Tiryns, Ashkelon and at Ugarit. Their broad distribution implicitly links the document form to contexts of overseas exchange, as does their similarity to Cypro-Minoan potmark texts. Whether or not the vessel texts record commercial matters themselves or, for instance, refer only to the vessel handlers involved in such matters, as has been suggested by Hirschfeld (2000, 183–84), the general context of overseas commercial exchange is assured. The presence of a Cypro-Minoan inscribed handle in the Cyclades, during a time in which Linear A was in use, fits within a broad narrative of commercial exchange, even though the archaeological evidence for sustained Cypro-Cycladic exchange is missing.

If the Cypro-Minoan reading of the handle is accepted, then the handle is the only direct archaeological link between Cypro-Minoan and Linear A, likely datable to the period of script transmission. Since the vessel is likely to be local, the text was probably produced in the Cyclades. Though made after firing, meaning the inscription could have been written anywhere, it is simpler to assume the text was produced on Cyprus than to imagine the vessel traveling from Melos to Cyprus, where it was inscribed and sent back to Melos.

Shared Document Forms and Writing Media

There are four examples of writing media or document forms shared exclusively or near exclusively between Cycladic Linear A and Cypro-Minoan. The first of these is inscribed vessel texts, which should not be considered a Linear A document form, as they are few in number and exhibit no regularity in their formatting or other material features. That said, the few Linear A inscriptions on vessels all come from the Cyclades. Inscribed vessel texts are not the only document form or writing media shared between Cycladic Linear A and Cypro-Minoan. Texts on three other writing media are either exclusive to the Cyclades and Cyprus or more similar to one another than to Cretan Linear A texts; pithoi, pithos lids and ostraca. Of these, only pithos texts can be considered a document form, since they are attested in enough examples both in Linear A and Cypro-Minoan to be the product of institutionalized practices. Pithos lids and ostraca are writing media attested only in the Linear A of the Cyclades and Cypro-Minoan, but are found in less than five examples total and therefore cannot be considered a document form. The fact that they are writing media attested only in the Cyclades and on Cyprus

takes on meaning only the broader context of the other evidence suggestive of Linear A-to-Cypro-Minoan script transfer.

Pithoi are one of the very few writing media common to Linear A and Cypro-Minoan in substantial numbers and the only shared document form. There are 18 Linear A inscriptions on pithoi, 14 found on Crete and four in the Cyclades (*GORILA* 5; Karnava 2008). There are 23 Cypro-Minoan inscriptions on pithoi, found mainly on Cyprus but also at Ugarit, all dated to the LC IIC or later, a significant gap in time from last use of Linear A. Of the 23 pithoi inscriptions, 16 are located on the pithos rim while there is continued debate over whether the majority are pre- or post-firing (see, for instance Ferrara 2013a, ##149-##152). At least two of pithos texts contain numerals, a meaningful feature of the document form given that only nine Cypro-Minoan inscriptions total contain numerals.

Linear A pithos inscriptions, which occur both on Crete and in the Cyclades, are not uniform in their material features, but recurrent features suggest they should be considered a single document form or several distinct but perhaps related forms. The most common placement of texts on Cretan pithoi is on the shoulder. In contrast, inscriptions on Cycladic pithoi were placed on the rim. This is true of inscribed pithoi found on the Cyclades and ones produced on the Cyclades but sent to Crete. The consistent placement of Cycladic Linear A texts on vessel rims indicates they should be regarded as their own document form distinct from Cretan pithos inscription. In contrast to the Cretan pithoi, the Cycladic pithos document form shares the predominant features of Cypro-Minoan pithos texts. This is the type of similarity we would expect to find in an institutionalized setting of script transmission.

The Cycladic Linear A pithoi can be situated in the context of overseas commercial exchange. Before-firing texts on imported pithoi are found both in Crete and the Cyclades, meaning that the texts were likely written on one island and sent to another. The pithoi may not necessarily have been the objects of exchange themselves, but nevertheless moved along with commercial goods. The texts of the pithoi hint at their trade context. Two of the three Cycladic manufactured pithoi found on Crete contain an ideogram for wine and the third the ideogram for olive oil and figs (Christakis 2010, 52). Perhaps contrary to expectation, the quantities of wine, oil and figs listed on the pithoi are either substantially too large or too small with respect to the capacity of the inscribed vessel. Ruth Palmer (1994, 37) accounts for the discrepancy by theorizing that the quantity of goods recorded in the inscription refers to the total amount stored *along with* the pithos in question, a suggestion supported by Christakis (2010, 52), who compares the inscriptions to commodity labels . It is perhaps equally, if not more, plausible that the inscriptions refer to the quantities requested in a shipment of goods that accompanied the pithos, since the amounts of good stored along with the pithos's several-decade life would almost certainly change over time.

The context of overseas exchange implicated by the Linear A pithos could provide a general setting where possible adaptation from one script tradition into the other burgeoning one could have taken place. The late date of the Cypro-Minoan inscribed pithoi, however, is a serious impediment to arguing for the continuity of the document form from Linear A into Cypro-Minoan, even with the similarities in formatting the numeric content of the some of the inscriptions are similar.

Shared Paleography

In addition to the shared writing media and document form, there are paleographical features common to Cycladic Linear A and Cypro-Minoan. In at least three cases, a Cycladic Linear A sign variant provides the precedent for a Cypro-Minoan sign or sign variant where a Cretan Linear A parallel cannot be found. Given the small number of Linear A Cycladic documents, the coincidence is remarkable, even if most of the variants in question are only attested a single time and it is therefore impossible to determine whether the given sign-variant is characteristic of a Cycladic Linear A tradition or a one-off oddity. Despite the uncertainty, the common paleographical features absent from Cretan Linear A but shared between Cycladic Linear A and Cypro-Minoan are suggestive of script transfer.

Fig. 3.5: A comparison of the sign shape of CM 041 and AB 50. Left: Photograph and drawing of ostracon **THE Zg 5** (photo courtesy of Dr. Anna Michailidou; drawing by the author based on photograph; the drawing in Michailidou 2001 should be taken as authoritative). Right Top: AB 50 from **HT 91** after SigLA. Bottom: CM 041 from ##004 **ENKO Abou 003** based on autopsy.

The first paleographical feature common to Cycladic Linear A and Cypro-Minoan is the "backwards" AB 50 (LB *<pu>*) sign form (**Fig. 3.5**). The sign's neck faces to the left in all Linear A examples except the one recorded here on the ostracon from Thera (**THE Zg 5**; Palaima 1981, 81 *contra* Owens 1990–1991). The sign is generally believed to have been adapted into Cypro-Minoan as CM 041. An exception is Miguel Valério (2016, 272), who hypothesizes the sign could derive from the rare Linear A syllabogram AB 49. Valério's phonological schema, which posits continuity between Linear A and Cypro-syllabic signs, assigned the sound value *<pu>* to CM 061 on account of its perceived similar shape to LA 29 and Cypro-Syllabic *<pu>*. An alternative Linear A antecedent for CM 041 was therefore proposed. The correspondence in shape between AB 50 and CM 041 is straightforward than the AB 49 correspondence. Not only are CM 041 and AB 50 otherwise identical in shape, except for the neck direction, but there are similarities in the details of the sign shapes, such as the shorter middle foot and the "booties" on the sign's legs (**Fig. 3.5**).

If AB 50 is the antecedent for CM 041, the switch in direction of the sign's neck from Linear A into Cypro-Minoan evinces contact between writers of Cycladic Linear A and writers of Cypro-Minoan. The change in the sign's neck direction is not a result of the simple flipping of the sign's direction, a change which could have happened independent of knowledge transfer, for example, by the inventor of incipient Cypro-Minoan observing the Linear A sign's shape from afar and redrawing it from memory. The change in the sign's shape is specific: the direction of the neck changes while the principle on which the body is drawn remains the same. This is exactly the change to the sign we see in the case of the "backwards" AB 50 on the Theran ostracon and in CM inscriptions. CM 041 is especially pertinent to reconstructing script transfer, because a variant of the sign is attested on a single-sign discoid loom weight text, Inv. no. 18.58, dating possibly as early as the LC IA (Courtois 1984, 68). The flipping of the sign's neck direction can perhaps also be reconstructed through single-sign Cypro-Minoan texts, including on vessels, where the sign's neck faces both directions.

Another sign with shared paleography is Cypro-Minoan sign CM 097. Although CM 097 is generally regarded as having "no antecedents whatsoever" in Linear A, a view also shared by Valério (2016, 267), who considers the sign a "Cypro-Minoan innovation", that analysis ignores a minor variant of the sign, which is also attested on as a single sign on various objects including vessels (Polig and Donnelly 2022, **Fig. 3.5**, CM 097 Variant 5). A sign of the same shape as CM 097 Variant 5 matches the shape of Linear A sign A 318, which is incised after-firing in a two-sign inscription on the shoulder of Theban amphora 1262 (published as **THE Zb**
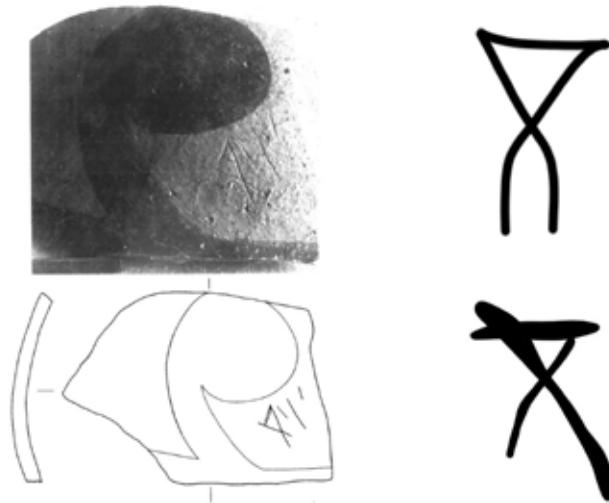
Fig. 3.6: A comparison of the sign shape of CM 097 and A 318. Left: Photograph and drawing of **THE Zb 14** reproduced from Michailidou 2001. Right Top: A 318 from **HT 94** after SigLA. Right Bottom: CM 097 from ##057 **ENKO Abou 054**, drawing based on 3-D model from Polig 2022.

14 in Michailidou 2000–2001, 12 and Karnava 2008, 378; as a doubtful inscription **D 14** in *GORILA* 4, xxi and *RILA-S1*, 157). Sign A 318 is rare in Cretan Linear A, where it is used twice as monosyllabic word, once as a transactional sign, and once as the first sign on a two-syllable word (**Fig. 3.6**; *GORILA* 1). The sign is classed in *GORILA* as an ideogram, but it is also used syllabically. Given the rarity of the sign and its use as a single-sign text in three of the four Linear A examples, it could be that the sign has its origins outside of either script.

Alternatively, variant 5 of CM 097 could have been adopted into Cypro-Minoan through the Canaanite Jar marking system. A sign with the same shape but turned on its side is the most repeated mark on Canaanite Jars dated to the Levantine Middle Bronze Age, incised before firing on the shoulder of three vessels. All three examples were on jars found in the Levant (Cateloy 2022, cat nos. 70-2). Returning to the Cyclades, the mark is present, oriented in the same direction as the Theran inscription, on two other vessels both found in the Cyclades, one a local jug from Thera (inv. no. 110) incised before-firing on its shoulder, and another "Melian" jug from Knossos incised on its handle (Michailidou 2000–2001, pl. VII). As Michailidou notes (Michailidou 2000–2001, 15), it is not just the use of a rare sign A 318 on the Theran jug that makes it unique but the fact that the text is made after-firing. Michailidou writes that the jug "acquires particular importance in that it does not conform with the general picture of its period" for a Linear A inscription. Instead, she compares the after-firing text to the Cypriot context of inscriptions and single-sign texts on vessels. Michailidou is certainly correct to associate the after-firing nature of the text with Cyprus, but the formatting of the text high on the jug's shoulder would be unusual in the Cypriot context too, though it matches the general placement of the Middle Bronze age marks on Canaanite Jars.

The last example of shared paleography is a sign on **THE Zb 15**, a locally manufactured lychnos incised after-firing with a three-sign text. Like the above inscription **THE Zb 14**, the after-firing nature of the text makes it more like Cypro-Minoan texts than Linear A ones. In terms of its paleography, its publisher Artemis Karnava (Tzachili and Karnava 2016, 36) regards the inscription as Linear A but notes that its second sign, which she identifies as the incredibly rare logogram A 332, "in fact […] resembles more the Cypriot sign CM 059 rather than its assumed Cretan sibling". She goes on to say that "the possibility of homomorphism between a sign attested in the Cypro-Minoan scripts (with evidence dating mostly to the 13th and 12th century BC) and one found in an inscription in Linear A incised in the pre-eruption Akrotiri bears, for the time being, no particular historical repercussions. It would require more evidence (both Linear A and Cypro-Minoan) in

order for this instance to be more than a justified coincidence)" (Tzachili and Karnava 2016, 37). I believe that cumulative evidence assembled here can be considered evidence with historical ramifications.

CONCLUSION

Though the dating of the Melos handle **MI Zb 3** is quite general, its reinterpretation as Cypro-Minoan would make it the strongest piece of evidence tying Cypro-Minoan script transfer to the Cyclades. For the first time, we have a Cypro-Minoan inscription from a Linear A context likely dating to the period of script transfer on a characteristic Cypro-Minoan document form, no less. Other examples of Cycladic Linear A influence on Cypro-Minoan, the shared pithos document form and Cypro-Minoan sign forms and variants with closer parallels in Cycladic Linear A rather than Cretan, also suggest contact points between the writers of both scripts in institutional settings. The discoid loom weight texts, too, though few in number, show similarities suggestive of being produced in the same settings. In another sense, the discoveries leave us back where we started. Shared script signs but little archaeological evidence for direct contact between their writers.

The institutional settings in which the Cycladic Linear A texts and the Cypro-Minoan text **MI Zb 3** were produced can broadly be associated with overseas commercial exchange. Palaima (1982, 17–8), in his study of Cycladic LA, characterized the texts as "commercial" and as evidence for contact with "Cretan centers". The commercial contexts of Linear A Cycladic writing provide a setting in which script transmission/adaption could have taken place, even if the archaeological evidence for Cycladic-Cypriot connection in the period of transmission is no better and probably even worse than for Crete and Cyprus. Aside from the notorious White Slip I bowl found in Theran destruction levels (for a discussion, see Manning 2014, 39), there is little archaeological evidence for Cycladic-Cypriot exchange. Nevertheless, the Cycladic LA documents show specific points of contact with CM texts, both in their distinctive paleographic features and in document forms, suggesting the distinct possibility of institutional script transmission from LA into CM in a Cycladic context.

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4

Creating a Network Graph from the Linear A Tablets

Robert Hogan

Independent Researcher
ORCID ID: 0009-0004-1099-9118

ABSTRACT

This paper describes the construction of an interactive online network graph (https://lineara.xyz/network/) based on the Linear A tablets found in a number of Bronze Age sites on Crete. As a basis for the graph, it proposes a classification of the tablets according to the type of 'transaction' each tablet is interpreted as recording. This interpretation is based on the identification of a series of syntactical patterns and common structures based on these patterns that are shared by the tablets across sites. The paper describes the syntactical patterns and gives illustrated examples of each. It finally describes the process used to construct the interactive network graph and closes with some tentative observations on the insights the graph may provide to the viewer.

INTRODUCTION

The Linear A clay tablets found in a number of Bronze Age Cretan sites and, occasionally, outside the island (c. 1800–1450 BCE) are generally considered to reflect socio-economic activity in the sites in which they were found. It is often proposed that the tablets represent a preliminary stage in information gathering by palace officials that ultimately resulted in economic records recorded on perishable documents (e.g., Schoep 2002, 25; Tomas 2010a, 347). The focus of this study has been on a specific type of document (the clay page-shaped *tablet*), which is the dominant type of Linear A inscription in most sites dated to the end of the Neopalatial period, especially the phase known as Late Minoan IB (c. 1500–1450 BCE). Their portable form, extensive evidence of erasure and re-use, as well as the frequency of ligatured signs suggests that the use of the documents may have been stenographic in nature (Schoep 2002, 30) and that, rather than acting as a permanent record in their own right, the information contained by the tablets was later collated elsewhere.

There are many possible activities the tablets could record in an administrative context. Nearly all the tablets, regardless of site or find-spot, are concerned with the recording of quantities of commodities. The identification (through respective signs conventionally known as 'ideograms') of specific commodities such as wine, oil, grain and other products in the tablets runs along a spectrum ranging from wide consensus to tentative speculation (Palmer 1995). As the economic nature of these documents seems commonly accepted, we may tentatively identify each Linear A entry as the result of a 'transaction' involving specific agents (*presumably* individuals) and commodities, alongside other possible relevant administrative information.

What is less clear, and can generally only be reconstructed hypothetically (i.e., on the bases of explicitly mentioned assumptions) from the internal structure of the tablets themselves, is the nature of the 'transactions'

the listed commodities were involved in. What we set out to do here is identify common patterns in the structure of the tablets and assign *hypothetical* 'transaction' types associated with each pattern, usually involving the movement of goods between two or more entities. We then use this classification to create a network graph (https://lineara.xyz/network/) that visualizes the movement of commodities between the entities across all classifiable tablets in the Linear A corpus. We consider our attempt at classification as provisional. The principal aim of this paper is to demonstrate how certain assumptions about the nature of the recorded 'transactions' can be used to construct a graphic representation of this material.

CLASSIFYING THE TABLETS

In order to construct a network map from the Linear A tablets, we must first develop a basis on which to recognize 'transactions' between entities. To do this we take an approach similar to the classifications of the tablets developed by Ruth Palmer and Ilse Schoep (Palmer 1995; Schoep 2001; cf. also Montecchi 2010), but with an emphasis on identifying entities (human agents or place) as well as commodities (items or objects counted or measured) in the tablets and proposing classes of transactional relationships reflected by consistent structural patterns in the tablets. Our analysis identifies basic units that can be used independently but appearing also as components of other units to construct records of specific 'transaction' type. We find evidence that these constructions appear across a number of tablets and across a number of different sites, where these documents have been found.

"Entity Lists" and "Commodity Lists"

The most basic syntactical pattern we find in the tablets is a list of entities (an "Entity List") or commodities (a "Commodity List"). Here, the working assumption will be that sign-groups (which are commonly identified as sequences of phonograms denoting "words") denote names of persons or places, while the so-called "ideograms" or "logograms" (signs used isolated and followed by numerals or fraction signs) represent commodities. The assumption is a working one (an axiom) and is here presented as a tool of heuristic value, aimed at constructing a provisional classification. Texts consisting of entries where the sign-groups ("words") are followed by fractional signs or numbers will be named here "Entity Lists" (e.g., **ZA 14**, **Fig. 4.1** and **Table 4.1**). In the same manner, any list consisting of "logograms" commonly identified as commodities (such as, for example, AB 131, interpreted as 'wine' and transliterated VIN in Linear B) and paired with a numeral as a "Commodity List". These terms are closely corresponding to classifications of Linear A entries proposed by Ruth Palmer and Ilse Schoep: "Entity Lists" correspond to Palmer's "Type B" or "Word+Number" entries, while "Commodity Lists" correspond to Palmer's "Type A" or "Ideogram+Number" (Palmer 1995, 136; cf. Schoep 2002, 80).

   Both "Commodity Lists" and "Entity Lists" are found in all the tablets we are discussing here, but some documents only include lists of entities or commodities. In most cases, "Entity List" tablets record whole numbers against the "Entities", so for the purposes of our network map we interpret them as involving a 'transaction' regarding the movement *or* allocation of people between the administrative center and what we interpret as an entity "name" (i.e., the sign-group) specified in the inscription (for example, a person or place). In our presentation, we have also used the conventional phonetic values of Linear A-B homomorphy signs indicated in capital italicized letters (e.g., *ME-KI-DI* instead of AB 13-67-07). This decision aims at facilitating the presentation, and is not related to any assumption of homophony or the identification of the language represented by the Linear A script. In the case of homomorphy Linear A "logograms" (signs for commodities), their identification with the same commodities in Linear B signs is also provisionally accepted. Similarly, as a convention, Linear A signs will be transliterated with their orthographic Linear B values (see Steele and Meißner 2017 for justification). All transliterated signs will appear without *italics* in the Tables accompanying this paper.

Fig. 4.1: **ZA 14** Transcription (facsimile drawing after *GORILA* 3).

Table 4.1: **ZA 14** – a simple "Entity List", possibly of named individuals.

Tablet Reading		Pattern
ME-KI-DI	1	Entity List
QI^f-*118	1	
PU-NI-KA-*363	3	
QA-TI-JU	8	
KU-PI	1	
TU-MI-TI-ZA-SE	45[	
PA-NU-QE	2	
JA-WI[	[	

There are a reasonably large number of such entity lists, mostly in a fragmentary state: **HT 108**, **HT 146**, **HT 25a**, **HT 29**, **HT 3**, **HT 39**, **HT 63**, **HT 98a**, **HT 99b**, **PE 2**, **ZA 10a**, **ZA 14**, **ZA 20**, **ZA 4a**, **ZA 5b**, **ZA 7a**. There is a disproportionately high incidence of them from Zakros (six examples) compared to Haghia Triada (ten examples), if one considers these occurrences against the total number of tablets found at each site (thirty-three and c. 140 respectively).

It is less obvious how to treat tablet 'transactions' that consist solely of lists of commodities ("Commodity Lists"), i.e., lists that contain only ideograms commonly recognized as denoting commodities such as grain, oil, wine or livestock. There are however no clear examples of a tablet containing *exclusively* "Commodity Lists" (instead we find the form contained within "Transfer Lists" in the next section). Of the four examples we might classify as isolated "Commodity Lists", two occur on documents of a relatively fragmentary state (**HT 24b**, **HT 127b**) and (since both documents are opisthographic) may be related to a text described on the other side of each tablet. **HT 130** contains a much damaged surface and an isolated commodity list of GRA (grain), *NI* (figs), and VIN (wine) at the lower third of the document, separated from the rest of the tablet by a horizontal line. This feature, listing the same commodities in the same order, is also found on **HT 27a** and **HT 89** (and possibly on the damaged **HT 110a**). In these three aforementioned cases, the same order of commodities is mentioned in the lower part of the tablet, following the "total" of other entries (in all cases indicated by the sign-group *KU-RO*, which is commonly agreed to have the meaning "total", see Duhoux 2011). It is not clear what the function of the "Commodity Lists" is in relation to the rest of the text on these tablets. However, they constitute our only evidence of isolated "Commodity Lists" on the Linear A documentation.

"Transfer List"

Commodity lists are by far most common, although not on their own, but as part of a larger syntactical structure we term a "Transfer List". A "Transfer List" consists of a "Commodity List" (with a variety of 'ideograms'

presumably representing commodities) as defined in the previous section, but this is preceded by an "Entity", an assumed movement or 'transaction' involving commodities between two entities, one of whom is implicit (perhaps the administrative center itself) and another, which is 'named' explicitly in the text. This is the format termed "Mixed Commodities Tablet" by Schoep (2002, 81-87). There is often more than one instance of this "Transfer List" structure on a single tablet. A common feature of these lists is that the "Entity is coupled with a "transaction sign" that may indicate to the scribe some additional feature of the transaction. For the purposes of constructing our network map our working hypothesis is that "Transfer Lists" are recording a 'transaction' in the listed commodities between the relevant administrative center and the entity named in the list.

Fig. 4.2: **HT 121** (facsimile drawing after *GORILA* 1).

Table 4.2: **HT 121** – two "Transfer Lists" from the Haghia Triada administrative center: One of a quantity of oil product to *KI-RI-TA2* and another of mixed commodities to *SA-RA2*.

Tablet Reading		Pattern Level 1	Pattern Level 2
KI-RI-TA$_2$		Entity	Transfer List
OLE+QE+DI	10	Commodity Entry	
SA-RA$_2$		Entity	Transfer List
GRA	5	Commodity Entries	
OLE	4		
NI	2		
VIN	3		
*23^m	3		
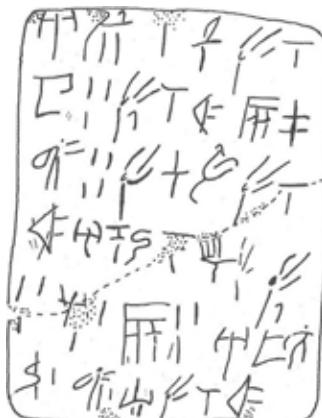
Fig. 4.3: **KH 11** (facsimile drawing after *GORILA* 3).

Table 4.3: **KH 11** – three "Transfer Lists" from the Khania administrative center, each of mixed commodities to *A-DU, A-TO-*349-TO-I*, and *A-TA-*350* respectively. Fractional values are as suggested by Corazza et al. (2021).

Tablet Reading		Pattern Level 1	Pattern Level 2
A-DU		Entity	Transfer List
[•]-ZA		Transaction Sign	
CYP	K (1/10)	Commodity List	
SU	3		
CYP+E	K L2 (3/20)		
VIN	A (1/24?)		
*306	4		
CYP	B (1/5)		
*348 CYP	K L2(3/20)		
A-TO-*349-TO-I		Entity	Transfer List
CYP+E	3	Commodity List	
NI	1		
VIN	3		
A-TA-*350		Entity	Transfer List
*301	1	Commodity List	
*306	1		
SI CYP	K L2 (3/20)		

A potential member of this group is **KH 5**, perhaps recording the same transfer to multiple entities: the same quantities of CYP+*E* and VINb+*WI* with each of *A-DA-KI-SA-KA*, *A-RA-U-DA*, and *WI-SA-SA-NE-E*. The rest of the tablet could then consist of two "Transfer Lists", one of an unspecified quantity of **301-NA* with *WI-NA-DU*, and quantities of CYP and *NI* to *KU-RA-ZU*.

The tablets we classify in this group include: **ARKH 3a**, **ARKH 3b**, **ARKH 5**, **HT 100**, **HT 101**, **HT 105**, **HT 106**, **HT 108**, **HT 116b**, **HT 12**, **HT 121** (**Fig. 4.2** and **Table 4.2**), **HT 123+124a**, **HT 125a**, **HT 125b**, **HT 129**, **HT 131a**, **HT 131b**, **HT 132**, **HT 133**, **HT 14**, **HT 18**, **HT 2**, **HT 21**, **HT 23a**, **HT 23b**, **HT 24a**, **HT 27b**, **HT 30**, **HT 32**, **HT 36**, **HT 40**, **HT 42+59**, **HT 44a**, **HT 58**, **HT 91**, **HT 92**, **HT 94a**, **KH 11** (**Fig. 4.3** and **Table 4.3**), **KH 4**, **KH 7a**, **KH 7b**, **KH 9**, **KNZb 35**, **TY 3a**, **TY 3b**, **ZA 15b**, **ZA 1a**, **ZA 6a**, **ZA 6b**, **ZA 9**.
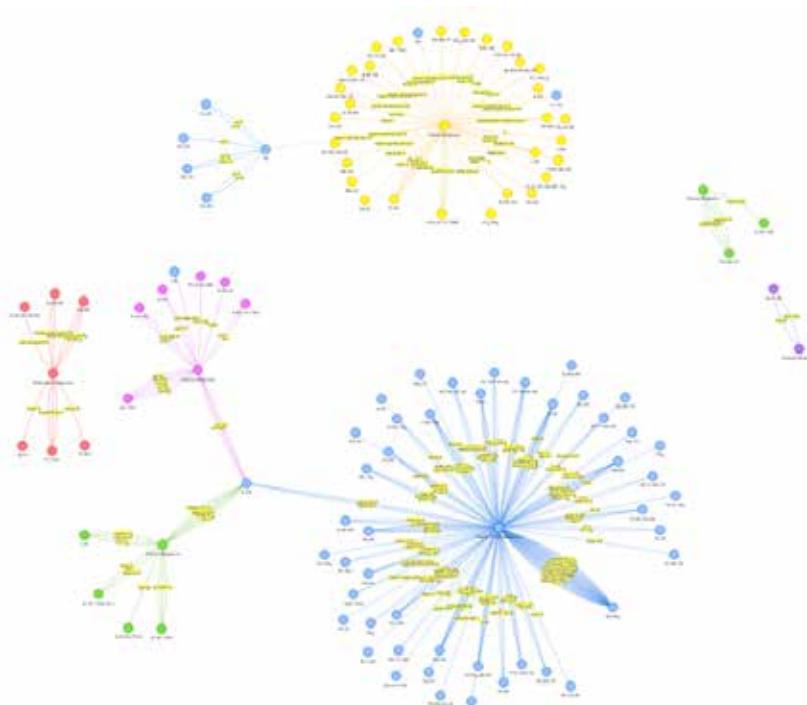
Fig. 4.4: "Transfer Lists" visualized (https://lineara.xyz/network/?search=["Transfer%20List"]).

Single-Commodity Transfer List

We find a more complex composition of a single-entry Commodity List and "Entity List" (together with a Named Entity and a 'transaction' Sign) used in a number of tablets in Haghia Triada. We propose that this structure is used to record the transfer of a single commodity to one or more entities from the administrative center.

In **HT 8a** for example (**Fig. 4.5** and **Table 4.4**) we read a transfer of OLE+*KI* from the administrative center to seven different entities, beginning with *JE-DI*. The commodity being transferred is only named once in the tablet, so remains implicit when the amounts are recorded against the remaining entities.
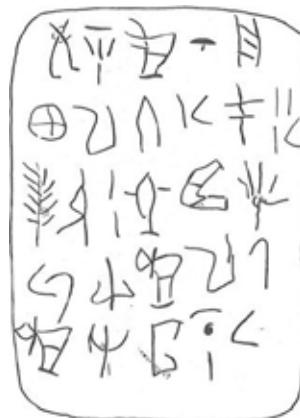
Fig. 4.5: **HT 8a** (facsimile drawing after *GORILA* 1).

Table 4.4: **HT 8a** – a transfer list of various quantities of the oil product OLE+*KI* between the administrative center and seven named entities.

Tablet Reading		Pattern Level 1	Pattern Level 2
JE-DI		Entity	Single-Commodity Transfer List
OLE+KI	10	Commodity List	
*56-KA-RA-TI	1½	Entity List	
PA	3 ½		
TE-*301	2		
QA-*310-I	¾		
SI-KI-RA	¼		
KI-RE-TA-NA	½		

HT 19 (**Fig. 4.6** and **Table 4.5**) has a similar structure to **HT 8a**, but with the addition of a "transaction sign", denoting some feature of the 'transaction' of interest to the scribe.

Table 4.5: **HT 19** – a transfer list of wine (VIN) between the administrative center and the three named entities: *RA-*164-TI*, *SA-RO*, and *DU-ME-DI*.

Tablet Reading		Pattern Level 1	Pattern Level 2
RA-*164-TI		Entity	Single-Commodity Transfer List
, TE ,		Transaction Sign	
VIN	30	Commodity List	
SA-RO	5½	Entity List	
DU-ME-DI	43½		
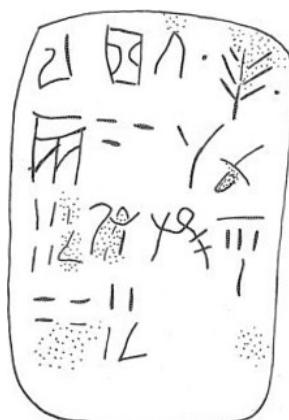
Fig. 4.6: **HT 19** (facsimile drawing after *GORILA* 1).

The tablets we classify in this group are: **HT 8a**, **HT 17**, **HT 19**, **HT 89**, **HT 97a**, **HT 103**, **HT 110a**, **KH 88**.
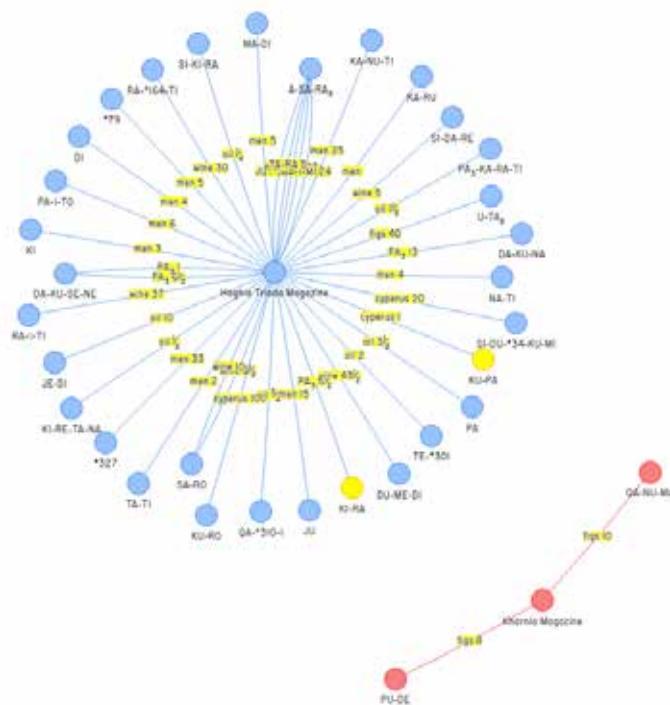
Fig. 4.7: Single commodity transfer lists visualized
([https://lineara.xyz//network/?search=["Single-Commodity%20Transfer%20List"]](https://lineara.xyz//network/?search=["Single-Commodity%20Transfer%20List"])).

Multiple-Commodity Inter-Entity Transfer List

This structure builds on the "Transfer List" by pre-pending an additional entity to the "Transfer List" structure. We assume that in this case the tablet is recording a 'transaction' between two third parties rather than a transfer of the same amount of goods between the administrative center and two distinct entities. Our basis for this preference is subjective: it will allow the graph we construct to explore the potential for relationships between entities rather than just with the administrative center. As with the Transfer List, this pattern can also accommodate the use of 'transaction' signs in its heading.
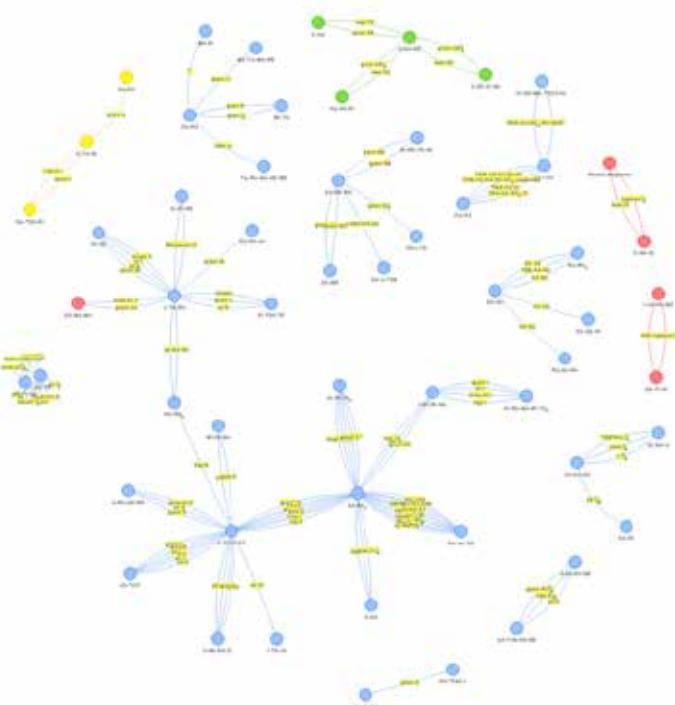
Fig. 4.8: **HT 114a** (facsimile drawing after *GORILA* 1).

Table 4.6: **HT 114a** – a transfer list of multiple commodities between *KI-RI-TA$_2$* and *SA-RA$_2$*.

Tablet Reading		Pattern Level 1	Pattern Level 2	Pattern Level 3
KI-RI-TA$_2$		Entity	Entity	Multiple-Commodity Inter-Entity Transfer List
SA-RA$_2$		Entity	Transfer List	
GRA	10	Commodity List		
OLE	7			
NI	1			
VIN	1			
*23$^{\mathrm{m}}$	3			

The tablets we classify in this group are: **HT 114a** (**Fig. 4.8** and **Table 4.6**), **HT 116a, HT 11b, HT 120, HT 125b, HT 128a, HT 16, HT 20, HT 28a, HT 28b, HT 31, HT 33, HT 34, HT 35, HT 43, HT 90, HT 91, HT 96b, HT 99a, KH 7a, PE 1, ZA 11a, ZA 11b.**

Fig. 4.9: Network diagram visualizing the relationships between entities included in the multiple-commodity group.
(https://lineara.xyz/network/?search=["Multiple-Commodity%20Inter-Entity%20Transfer%20List"]:

Single-Commodity Inter-Entity Transfer List

This is a syntactical pattern built on the "Entity List" pattern rather than the "Commodity List". It displays the same basic combinatorial pattern as the "Transfer List" of a named entity, but with an "Entity List" instead of a "Commodity List". As with the other structures we have so far encountered it accommodates the use of a 'transaction' sign in the headwords. For the purposes of our network map, we propose that this type of list is recording a movement of some sort between the entity named in the head words and the entities named in the list. In a common form of the pattern there is no indication of the commodity that is being transferred between the entities.
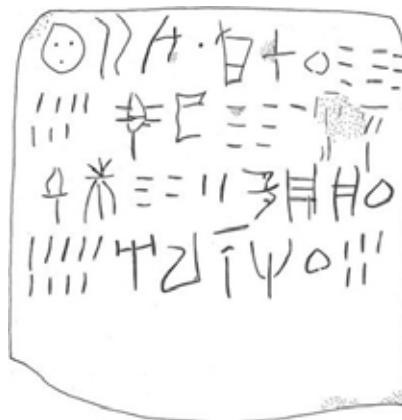
Fig. 4.10: **HT 1** Transcription (facsimile drawing after *GORILA* 1).

Table 4.7: **HT 1** – a transfer of an unspecified commodity between *QE-RA$_2$-U* and five named entities.

Tablet Reading		Pattern Level 1	Pattern Level 2
QE-RA$_2$-U		Entity	Single-Commodity Inter-Entity Transfer List
KI-RO	197	Entity List	
ZU-SU	70		
DI-DI-ZA-KE	52		
KU-PA$_3$-NU	109		
A-RA-NA-RE	105		

The tablets we classify in this group are: **HT 1** (**Fig. 4.10** and **Table 4.7**), **HT 104**, **HT 10a**, **HT 10b**, **HT 117a**, **HT 122a**, **HT 123+124b**, **HT 126a**, **HT 15**, **HT 20**, **HT 26a**, **HT 85b**, **HT 88**, **HT 94b**, **HT 95b**, **HT 9b**.

There is a distinct variation in the pattern that accommodates a commodity in the head words. In such cases we hypothesize that the tablet is recording the movement of this named commodity.

Fig. 4.11: **HT 13** (facsimile drawing after *GORILA* 1).

Table 4.8: **HT 13** – a transfer of wine between *KA-U-DE-TA* and six named entities. *KU-RO* is assumed to represent "total".

Tablet Reading		Pattern Level 1	Pattern Level 2
KA-U-DE-TA		Entity	Single-Commodity Inter-Entity Transfer
VIN		Commodity	List
, TE ,		Transaction Sign	
RE-ZA	5[ ]½[	Entity List	
TE-TU	56		
TE-KI	27 ½		
KU-ZU-NI	18		
DA-SI-*118	19		
I-DU-NE-SI	5		
KU-RO	130 ½		
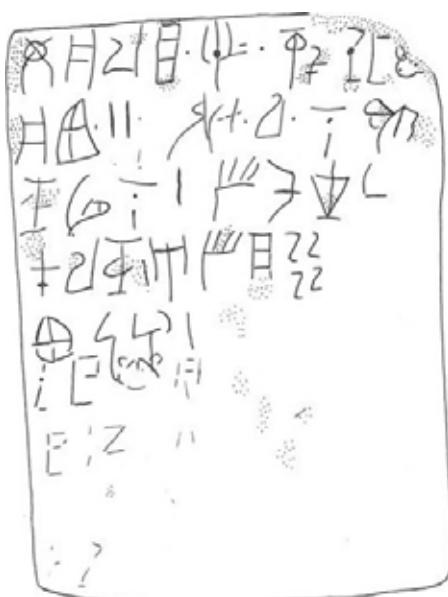
Fig. 4.12: **HT 115a** Transcription (facsimile drawing after *GORILA* 1).

Table 4.9: **HT 115a** – two transfers of quantities of GRA *22^m. The first between *47-NU-RA-JA and *RI-TA-MA-NU-WI*. The second between *301-U-RA and seven named entities. The fractions given are as suggested by Corazza et al. (2020).

Tablet Reading		Pattern Level 1	Pattern Level 2
*47-NU-RA-JA		Entity	Single-Commodity Inter-Entity Transfer List
, I ,		Transaction Sign	
GRA *22^m		Commodity	
RI-TA-MA-NU-WI	2	Entity List	
*301-U-RA		Entity	Single-Commodity Inter-Entity Transfer List
NA-*21^f-NE-MI-NA	1	Entity List	
SE-KU-TU	½		
PA-RA-NE	1		
A-SE-JA	2/3		
KA-PO-RU	1		
RI-SU-MA[	[ ]		
SU	2 1/6[		

The tablets we classify in this group are: **ARKH 2**, **HT 13** (**Fig. 4.11** and **Table 4.8**), **HT 102**, **HT 115a** (**Fig. 4.12** and **Table 4.9**), **HT 115b**, **HT 122b**, **HT 26a**, **HT 6a**, **HT 6b**, **HT 7a**, **HT 7b**, **HT 85a**, **HT 86a**, **HT 86b**, **HT 95a**, **HT 9a**, **ZA 10b**, **ZA 15a**, **ZA 5a**, **ZA 8**.
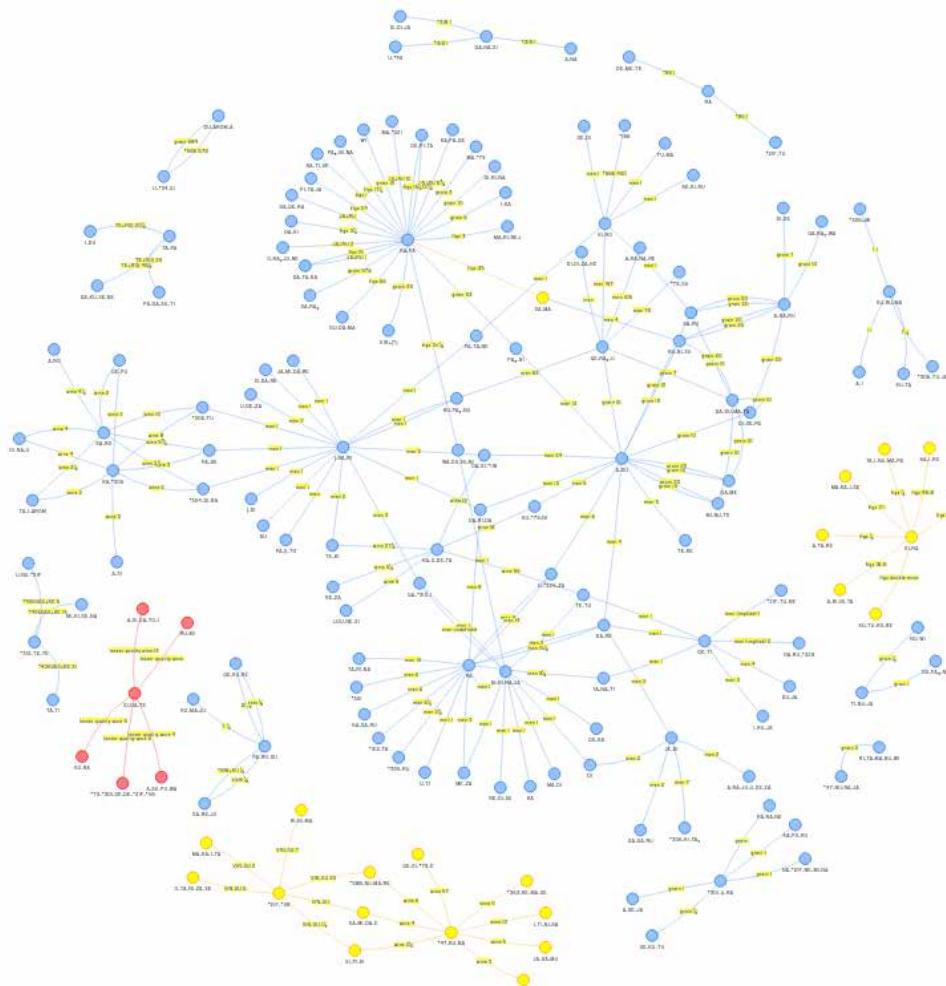
Fig. 4.13: Network diagram visualizing the relationships between entities included in the single-commodity group (https://lineara.xyz/network/?search =["Single Unnamed Commodity Inter-Entity Transfer List","Single Named Commodity Inter-Entity Transfer List").

Complex Structures

Tablets in this group display sufficient complexity to resist easy classification under any of our previous headings. This may be due to a difference in concerns from already classified tablets and for that reason we will treat each of them individually here.

HT 87 and **HT 117a** may list people by name and not reflect any 'transaction' function. In both cases the tablet contain "Entity Lists" with whole numbers assigned, preceded by multiple head word. **HT 88** (**Fig. 4.14** and **Table 4.10**) contains a Single-Commodity Transfer list, a Commodity combined with an Entity List, and a Single-Commodity Inter-Entity Transfer List.
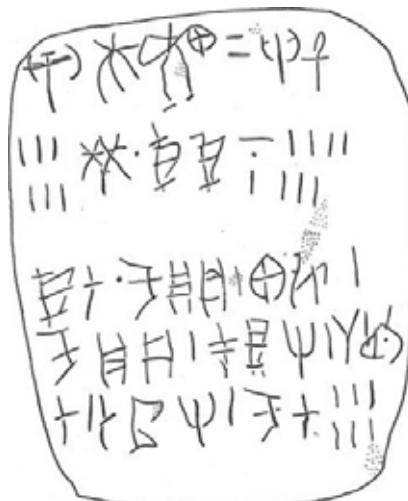
Fig. 4.14: **HT 88** (facsimile drawing after *GORILA* 1).

Table 4.10: **HT 88**.

Tablet Reading		Pattern Level 1	Pattern Level 2
A-DU		Entity	Single-Commodity Transfer list
VIR+KA	20	Commodity List	
RE-ZA	6	Entity List	
NI , KI-KI-NA	7	Commodity	Transfer List (?)
KI-RO		Entity	Single-Commodity Inter-Entity Transfer List
KU-PA₃-PA₃	1	Entity List	
KA-JU	1		
KU-PA₃-NU	1		
PA-JA-RE	1		
SA-MA-RO	1		
DA-TA-RE	1		
KU-RO	6		

We see a similar structure to "*NI KI-KI-NA* 7" in **HT 15**: "*188 , KI-RO* 400". Since it is not common, it may be a variation on the "Transfer List", e.g., "*KI-KI-NA , NI* 7". Also in **HT 103**. **HT 96a** contains 4 head words. If the first three are to be considered separately, then the text from *SI-MI-TA* to the dividing line may be read as a Single Commodity Transfer List. **TY 2** may be a list of commodities or entities (commodities seems more likely). If the entries beginning with *309 are indeed commodities, then the tablet consists of a Commodity List followed by a Transfer List (with *PA-DA-RU*).

The following tablets are too fragmentary to permit classification: **ARKH 4b, HT 110b, HT 137, HT 139, HT 140, HT 154a, HT 25b, HT 26b, HT 27a, HT 3, HT 38, HT 45b, HT 49a, HT 50a, HT 51a, HT 60, HT 62+73, HT 69, HT 82, HTZd 157+156, KH 12, KH 15, KH 21, KH 25, KH 26, KH 54, KH 55, KH 58, KH 6,**

KH 60, **KH 61**, **KH 63**, **KH 73**, **KH 75**, **KH 76**, **KH 8**, **KH 84**, **KH 91**, **KN 2**, **KN 28a**, **MA 4a**, **MA 6a**, **MA 6c**, **PH 3b**, **PH 8a**, **PK 3**, **THE Zb 5**, **THE 4**, **ZA 12a**, **ZA 12b**, **ZA 18a**, **ZA 1b**, **ZA 26a**, **ZA 4b**.

CONSTRUCTING A NETWORK GRAPH

In order to create a network graph that visualizes the 'transactions' between proposed entities (**Fig. 4.15**), we chose a third-party javascript library called "vis-network". This is a module of computer code written in the Javascript programming language that can be embedded in a website and used by the website to display an interactive network graph in the user's web browser. In order to achieve this, *vis-network* requires us to build a database of nodes (entities) with 'transactions' as the edges between the nodes. The most convenient way of doing this is to construct a simple text file for each tablet with the content formatted in such a way that it identifies the proposed nodes in the graph and includes metadata identifying the commodities and values for each 'transaction' between the nodes (https://github.com/mwenge/lineara.xyz/tree/master/network/transactions/final). An example of what this looks like for the pair of relatively simple "Transfer Lists" given in **HT 121** is as follows:
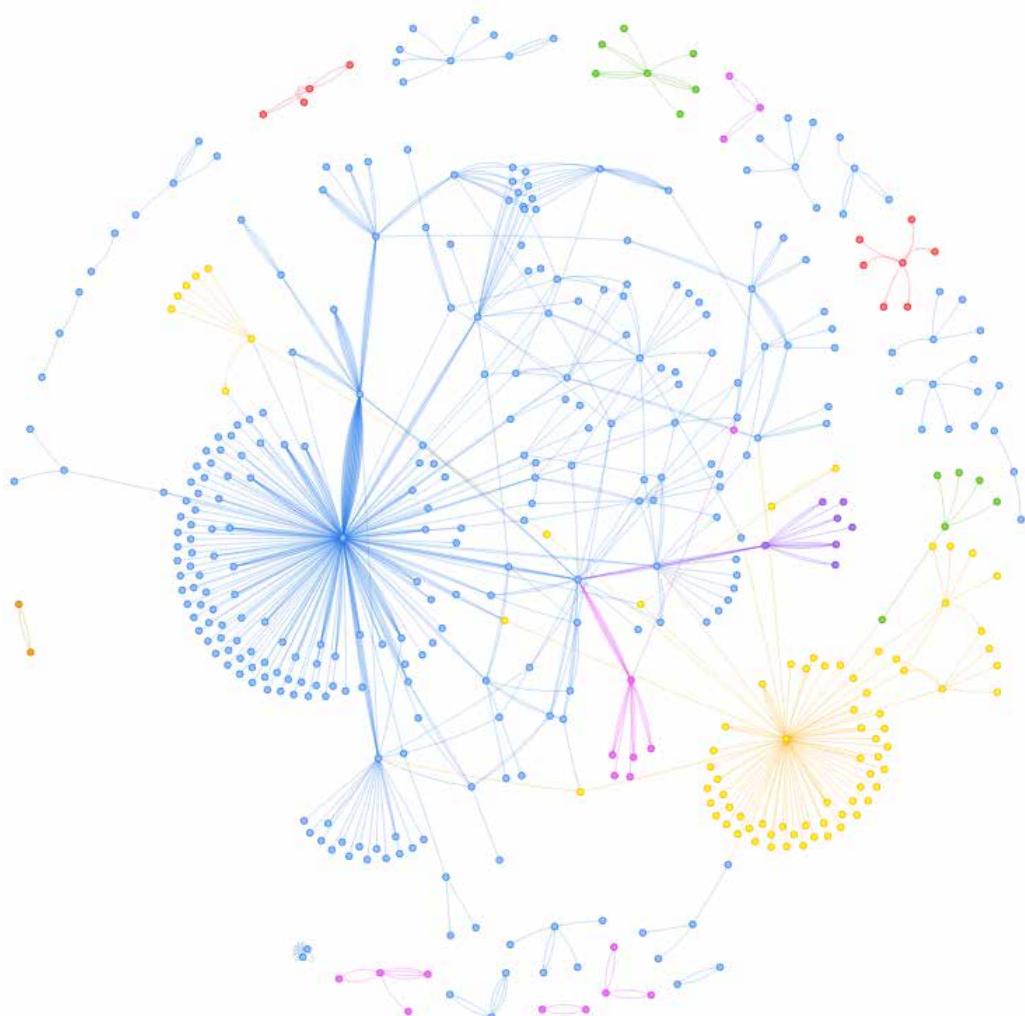
Fig. 4.15: A view of the complete network graph. The user can use the mouse wheel to zoom in and out of the graph. Haghia Triada is in blue, Zakros in yellow, Khania in pink, Tylissos in purple, Arkhanes in green, Petras in red.

```
{
    "name": "HT121",
    "transactions": [
        {
            "description": "sender",
            "transactionID": "HT121-1",
            "transliteratedWord": "Haghia Triada Magazine"
        },
        {
            "description": "sender",
            "transactionID": "HT121-2",
            "transliteratedWord": "Haghia Triada Magazine"
        }
    ],
    "words": [
        {
            "description": "recipient",
            "transactionID": "HT121-1",
            "transliteratedWord": "KI-RI-TA₂",
            "word": "𐘇𐙕𐘱"
        },
        {
            "commodityID": 1,
            "description": "commodity",
            "transactionID": "HT121-1",
            "transliteratedWord": "OLE+QE+DI",
            "word": "𐙗"
        },
        {
            "commodityID": 1,
            "description": "quantity",
            "transactionID": "HT121-1",
            "transliteratedWord": "10",
            "word": " – "
        },
        {
            "description": "recipient",
            "transactionID": "HT121-2",
            "transliteratedWord": "SA-RA₂",
            "word": "𐘼𐙼"
        },
```

```
    {
      "commodityID": 1,
      "description": "commodity",
      "transactionID": "HT121-2",
      "transliteratedWord": "GRA",
      "word": "𐄇 "
    },
    {
      "commodityID": 1,
      "description": "quantity",
      "transactionID": "HT121-2",
      "transliteratedWord": "5",
      "word": " 𐄭 "
    },
    {
      "commodityID": 2,
      "description": "commodity",
      "transactionID": "HT121-2",
      "transliteratedWord": "OLE",
      "word": "𐄷 "
    },
    {
      "commodityID": 2,
      "description": "quantity",
      "transactionID": "HT121-2",
      "transliteratedWord": "4",
      "word": " 𐄬 "
    },
    {
      "commodityID": 3,
      "description": "commodity",
      "transactionID": "HT121-2",
      "transliteratedWord": "NI",
      "word": "𐄌 "
    },
    {
      "commodityID": 3,
      "description": "quantity",
      "transactionID": "HT121-2",
      "transliteratedWord": "2",
      "word": " 𐄊 "
    }
```

```
    },
    {
      "commodityID": 4,
      "description": "commodity",
      "transactionID": "HT121-2",
      "transliteratedWord": "VIN",
      "word": "𐘝"
    },
    {
      "commodityID": 4,
      "description": "quantity",
      "transactionID": "HT121-2",
      "transliteratedWord": "3",
      "word": "𐄍"
    },
    {
      "commodityID": 5,
      "description": "commodity",
      "transactionID": "HT121-2",
      "transliteratedWord": "*23M",
      "word": "𐘇"
    },
    {
      "commodityID": 5,
      "description": "quantity",
      "transactionID": "HT121-2",
      "transliteratedWord": "3",
      "word": "𐄍"
    }
  ]
}
```

For each 'transaction' we designate "sender" and "recipient" nodes – these are conventional terms only since we are not presenting a directed graph and do not have a strong hypothesis on which direction the commodities are flowing in any given "Transfer List" (let us also remember that the idea of mobile commodities instead of static ones –i.e., a record of storage– is also a working hypothesis). For each commodity and value that we propose is passing between the nodes we assign a unique transactionID. Each combination of commodityID and transactionID will constitute a unique edge between the two nodes associated with that transaction. In the above example there are 5 edges between the administrative center (the "Haghia Triada Magazine") and the entity *SA-RA₂*. As we construct our graph in this way, the assumptions underlying our analysis of the tablets becomes strongly apparent. We assume the tablets included in the analyst contain a record of goods transfers between entities rather than a record of goods stored (for example). We may contend that this view is supported

by the relative absence of simple "Commodity Lists" we noted when seeking examples of "Commodity Lists" independent of other syntactic structures in the tablets, but ultimately it is an assumption guided by our objective to build a graph of potential relationships between entities.

Fortunately, it was not necessary to construct the entries for every tablet by hand. We wrote a computer program in the Python programming language that made an informed guess for the appropriate construction of the text file for each tablet, based on our proposed classification (https://github.com/mwenge/lineara.xyz/blob/master/network/transactions/030%20-%20Create%20Transactions.ipynb). Each entry was then reviewed and corrected as required, before being merged into a single file, transactions.js (https://github.com/mwenge/lineara.xyz/blob/master/network/transactions.js).

When a user loads https://lineara.xyz/network, the page constructs a full list of all nodes given in transactions. js and builds a network of edges that connect them. In order to help users to distinguish between the different geographies associated with the tablets, nodes for each site are assigned a unique color. We also annotate each edge with its commodity and value.

To assist the user in exploring the graph, we have made the nodes interactive. Clicking on a node will limit the displayed graph to just that node and other nodes connected to it. The user can in this way build up a graph of just the nodes and edges they are interested in. The graph also has a search function. Searching can be done on tablet name, entity name or site/find-place. Search terms are cumulative, again allowing the user to build up a cumulative picture of just the nodes that interest them.

We consider our interpretation of the tablets provisional, so it is important to allow the critical user view the source of any given relationship represented in the graph. It is important to bear in mind that these graphs have been constructed with specific working hypotheses as points of departure (the separation of "Commodities" and "Entities" and the concept of the "Transfer List" being the most significant). As such, they cannot reflect the viewpoint of someone who does not accept such axioms. In constructing the graph, I have set out a specific rationale for interpreting the individual tablets based on the common syntactic structures identified herein.

It is inevitable that this exercise will be partial rather than impartial. However, it may provide a stimulus, as well as the general framework for the readers to consider for themselves each relationship depicted. For this reason, when a user hovers over an edge in the graph, we display the tablet and the nodes and edge are sourced from with the relevant words in the tablet highlighted. This permits the users to easily assess if the relationship is a valid one according to their own interpretation of the tablet.

OBSERVATIONS ON THE NETWORK GRAPH

As might be expected, our graph is dominated by nodes from Haghia Triada (**HT**) (**Fig. 4.16**). Most prominent are transfers between the **HT** administrative center (designated the "Haghia Triada Magazine" in the graph) and other entities.

But we also observe a large tangle of connections ("network edges") between Haghia Triada nodes that do not involve the administrative center. This is based largely on those tablets we have classified as "Inter-Entity Transfer Lists" in our analysis. If our interpretation of the tablets is correct, and that is a very tentative "if", this would indicate a high degree of economic activity between entities around the Haghia Triada center. Some nodes are much more connected than others: *SA-RA₂, KA-RA, A-SI-JA-KA, A-DU* are highly connected for example. This may indicate that these are entities more economically active than the others found in the tablets, but it may also suggest that they are not entities but words with a specific administrative meaning or function, such as 'transaction' vocabulary. *A-DU*, for example, has been proposed as a word meaning "assessment" (Younger 2024: https://www.academia.edu/117949876/Linear_A_Texts_and_Inscriptions_in_phonetic_transcription, under §"9b. 'transaction' Words"; also Schoep 2002, 159), although, of course, other interpretations are possible.
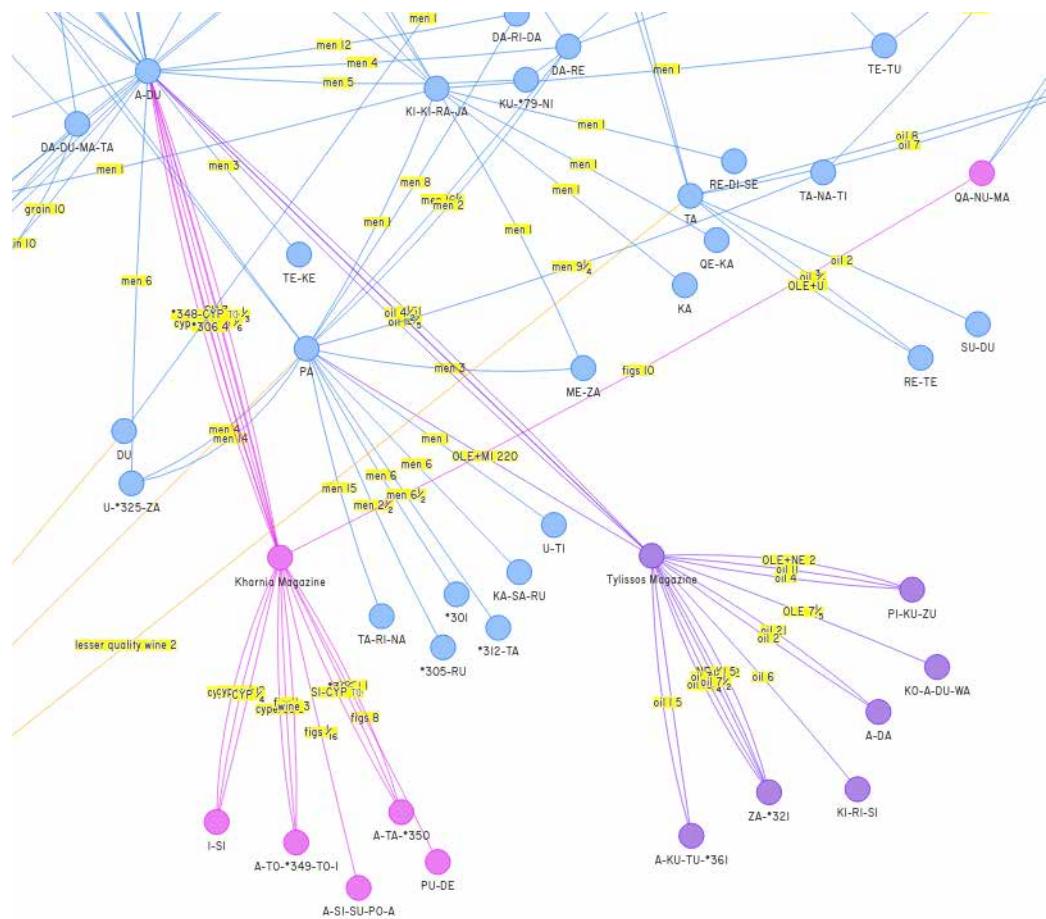
Fig. 4.16: A detail from the graph showing the nodes that connect Haghia Triada with Tylissos and Khania.

Such considerations aside, what is striking from this part of the graph is how many **HT** nodes have more than one edge, in other words they are involved in more than one 'transaction' with other nodes in the network.

However, the purpose of this graph is not for me to make inferences about Minoan economic activity, but to allow the reader to explore it for themselves and decide if it provides any useful insights. The basis for constructing the graph is inescapably provisional; the classification and interpretation of Linear A tablets is always a castle built on sand, and the system I have suggested here unquestionably has the limitation of assuming that the majority reflect relatively straightforward transactions. For this reason, the network graph is offered as a visualization tool for the interested reader to aid the ongoing inquiry in Linear A studies, championed in particular by Younger and Schoep, into what the purpose of each tablet may have been rather than what the individual words on the tablet may have signified.

5

Digital approaches to interdisciplinary datasets and resources for Minoan studies

Clelia R. LaMonica

Uppsala University
ORCID ID: 0000-0002-2587-6805

ABSTRACT

Digitally available data concerning Minoan language and culture is often generated from within individual disciplines. However, a collaborative effort to link or aggregate digitally available data from various disciplines –such as Linguistics, Archaeology, and Genetics– can contribute to our broader understanding of Minoan communications and contact. This paper examines the present state of digital data on the Minoan civilization in terms of its accessibility, reusability, and the ease of linking shared semantics. Additionally, it argues for better interdisciplinary shared data practices for the Early Bronze Age Aegean to further our understanding of the Minoan Linear A script and to uncover both similarities and divergences in the data sets. Ultimately, it is argued that combining or linking data sources and making resources and results accessible to different groups in an interdisciplinary manner could facilitate a deeper understanding of Minoan language and culture.

INTRODUCTION

Since Evans' early archaeological excavations of Knossos in the 1900s, interest surrounding Minoan culture and origins has received scholarly attention from many angles and disciplines, including linguistics, archaeology, and genetics –notably how the presence of the Minoan culture and its origins play a role in broader questions surrounding Mediterranean prehistory. However, despite such wide interest, the Bronze Age Linear A script used by the Minoan civilization of ancient Crete remains undeciphered and the language it renders unknown.

The strong Minoan influence on culture and trade around the Aegean has long been established through archaeological evidence (Renfrew 1972; Bellwood and Renfrew 2002 , 2011; Argyrou-Brand 2014 ; Kristiansen 2016), and recent DNA analyses have demonstrated genetic links to other ancient populations, giving insights into possible provenance for the ancient inhabitants of Crete (Lazaridis et al. 2017). While the origins of Minoan culture are difficult to determine with certainty, recent genetic work indicates an initial expansion of early inhabitants of Bronze Age Crete from Anatolia during the Neolithic stage ca 7000 BC. At this time, they likely brought with them agricultural techniques, as supported by archaeological evidence (Bellwood 2005). It is also evident that Minoans held wide-ranging cultural influence and communication with surrounding civilizations; pottery styles and imagery have been found, for example, as far as Egypt and modern-day Turkey. Some similarity to other Bronze-Age Mediterranean groups (Iberia, Sardinia) has also been posited (Hughey et al.

2013). Such evidence elucidates the Minoan presence in the ancient Aegean as that of an influential people, who were in contact and flux with other civilizations, as opposed to a static civilization that was lost to time.

Although Minoan cultural influence has attracted wide attention, linguistically, little is known about the languages spoken and used by those living on Bronze Age Crete or prior Neolithic populations (see Davis, this volume, for further discussion of progress in this line of research). At present, there are circa 1,400 Linear A "texts" and inscriptions listed in *GORILA* with just over 7,400 characters. The script itself shows visual similarity to the later, pre-Greek "Linear B" script, which encodes the Mycenaean Greek dialect belonging to the Indo-European linguistic family. Linear B was used by the Mycenaeans from mainland Greece, who co-existed with the Minoans during the late Bronze Age and later established themselves on Crete, where, consequently, the Linear B script and its associated language came to replace Linear A in written use. It has also been shown that the structural relationship between Minoan Linear A and Cretan Hieroglyphics required "substantial adaptation strategies" between the two writing systems (Ferrara et al. 2022). Early Cretan Hieroglyphic, which is still debated as a possible forerunner of Linear A, exhibits considerable differences from Linear A, such as in their relative formulaic written sequences – the Archanes formula (early Cretan Hieroglyphic) and the Libation formula (Linear A) (Ferrara et al. 2021).

Typological characteristics and comparisons are otherwise difficult to identify, given Linear A's undeciphered status and the scarcity of structured comparative linguistic data for surrounding languages. While a plethora of theories have existed proposing to tie Linear A to certain languages or language families, most lack convincing arguments based on concrete evidence. A typological approach has more recently been adopted, for example by Davis (2013; see also contributions in the present volume), who carried out a linguistic analysis that is both attentive and cautious, focusing primarily on phonology and word order. Digital work on a typological profile of the ancient linguistic landscape is also becoming clearer with more in-depth analyses of contemporary and neighboring languages (both chronologically and geographically), through projects such as the Diachronic Atlas of Comparative Linguistics (DiACL) (Carling et al. 2018).

Data from each given discipline contributes a unique perspective to our understanding of Minoan culture and its historical roots. When exploring the Minoan civilization, it is important to consider various aspects, including their interactions with neighboring cultures and their origins. To achieve a comprehensive understanding, it is beneficial to consider existing research data from genetics, archaeology, and linguistics. This multidisciplinary approach allows us to piece together the puzzle of Minoan history and relationships with greater clarity. Here, it is argued that better linkage among datasets and normalized data-sharing practices can be used to encourage combined research into Minoan language, culture and provenance. Exploration of this topic begins with a discussion of general availability of interdisciplinary aggregated or linked ancient data (specifically those encompassing the Bronze Age Aegean) and progresses to an examination of currently available open datasets relating to Minoan archaeology, genetics and language to discuss what future possibilities exist with the emergence of shared datasets and, eventually, open linked data.

With the wealth of data that exists from among genetics, archaeology and linguistics, a combined analysis should help to sharpen the picture regarding aspects of Minoan language and culture. Consequently, future research will be able to employ linked digital data to run combined analyses using interdisciplinary methods, such as GIS and network analysis, exploratory factor analysis, or phylogenetic analysis. To this end, the present work (1) examines the availability and accessibility of digital databases encompassing evidence for Minoan language(s) and culture through the perspectives of FAIR use (findable, accessible, interoperable, reusable; see Table 1) and Linked Open Data, and (2) explores the viability of available data to actually be used to address networks, interactions and linguistic environments surrounding the Minoan culture.

This work concludes that, although many of the digital resources mentioned herein are bound to change, adapt, and eventually fall out of use as technology evolves and research directions are critically reshaped, such an overview of the field brings to light the need for linked data and open collaboration among disciplines surrounding Bronze Age Cretan culture.

DIGITAL APPROACHES WITH AGGREGATED DATA

Independently, the three disciplines involved –genetics, archaeology, and linguistics– use similar methods and tools, such as GIS and machine learning, to address topics, and such shared methodologies and familiarity with data types should open the door for insightful collaborations among disciplines. However, the reality of merging complicated, non-standardized, sparsely reviewed datasets and materials can make combined analysis difficult and logistically demanding. Further challenges arise when considering the diverse expertise needed from different disciplines to offer constructive insight, as well as the obvious differences in conventions, for example relating to data description or what is considered "open", or differences in analytical objectives present in interdisciplinary or multidisciplinary work.

If the challenges that come to light when conducting mixed research using open datasets are surmounted, such large-scale, open, aggregated and linked datasets offer benefits that extend past individual researchers from select fields, and can foster data exploration, comparison and facilitate a wealth of contributions. Large-scale datasets allow scholars to approach the data from a distance, where one can take a step back from looking at the materials "too closely" and neglecting larger phenomena, patterns or influences. Such datasets also offer the possibility of combining and analyzing data in a way that individual scholars cannot, using tools such as machine learning and data visualization to extract information, which can either be used for their own analysis, or to supplement more discrete approaches. Datasets that are open and linked or aggregated also allow for the application of a wide variety of models and tools to explore and analyze them; one scenario can be discussed from very different perspectives, for example geographically and using clustering (e.g., Paliou and Bevan 2017 on geographical network analysis of settlements, geographical features and modern language variation on Crete, or Barbieri et al.'s 2022 inquiry into linguistic vs. genetic distance using open datasets).

The linking of datasets related to a specific topic and broadening access across different academic disciplines results in the potential for increased critique and a wider range of contributions and perspectives from beyond the confines of individual academic circles. It invites input from experts and enthusiasts who approach the subject from unique angles, such as historians, linguists, archaeologists, geneticists, and outside the academy with local communities or cultural preservationists. Their perspectives, insights,and critiques can bring fresh ideas and alternative interpretations, fostering a more comprehensive and multidimensional understanding of complex subjects. Such a collaborative and interdisciplinary approach transcends the limitations of individual academic specialties. Such diverse perspectives are not only welcome but also crucial when addressing challenging subjects like Minoan cultural origins and relations with contemporary civilizations, which, while not entirely uncharted territory, are often difficult to access.

DATA ACCESSIBILITY AND IDEAL DATASETS

Open-source, digital databases containing information related to the peoples of the Minoan civilization and Bronze Age Aegean exist online in varying degrees, from structured to unstructured formats, in their comprehensiveness and accuracy, and differ on whether geolocated information is present. Varying disciplinary conventions and resources dictate what data is present, analyzable and sharable, making a "one-size-fits-all" model for data not truly possible. This results in a data-scape varying greatly in (1) structure, (2) format, (3) accessibility, and (4) interoperability given ancient data for the region.

Structured datasets contain organized, labelled, categorized data in a tabular (spreadsheet) or tree-based formats (e.g., JSON), whereas semi-structure datasets contain data that has been annotated, marked-up or has some labelling, but is more or less in its original format (e.g., XML or HTML texts). Data that has not been defined, organized or changed in format (such as images, original texts or pdfs) is considered unstructured. The range of available data sources not only leads to such variety in terms of structure, format, accessibility

and interoperability, but also encompasses a spectrum of authoritative and peer-reviewed scholarly articles; institutional websites with varying degrees of scientific or governmental oversight, which can contain data sources ranging from controlled repositories to crowd-sourced platforms; unregulated/personal websites; un-published article manuscripts, which have not yet undergone peer review or for which there are no plans to publish in a scholarly venue. These sources also differ significantly in terms of their level of authority, the rigor of peer review and the accuracy of the information provided.

Ideally, data that adhere to principles of FAIR use can be made available to scholars: i.e., data that is Findable, Accessible, Interoperable and Reusable. Simply providing open-source data in a visual manner is a start, so that it is available and readable by users online (e.g., through images of artifacts, figures and tables, or interactive data exploration via networks or maps). Alternatively, providing structured data in tables offers prospective researchers more benefit to reuse and analyze; however, such open sharing of research data is less common in scholarly domains and brings risks online, when downloading spreadsheets or documents from private indi-viduals' websites or drives. One solution that is becoming more widespread is making data available in widely readable, non-proprietary or specialized formats, such as .txt or .csv, which allows for interoperability and editing, and which do not have macros built-in that can lead to interoperability, data corruption or malware.

With structured data tables, there also exist conventional differences across disciplines, including standards relating to what types of material and metadata should be included. Archaeological datasets, for example, may contain detailed information about a site, dates for particular periods or information about who excavated, yet combine other classifications, such as place-name and location. Similarly, digital typological linguistic databases already exist, some linked across the semantic web, yet information, which may be relevant to other disciplines, is often overlooked. Open-source genetic databases are also a standard convention in the discipline, yet the variety of file formats, structures, data types and meta-data that is included makes sharing such data with other disciplines more challenging.

Table 5.1. Summary of FAIR principles. For further details, descriptions and examples, see https://www.go-fair.org/.

Findable	Can data and metadata be found by humans and machines in a uniquely identifiable manner, through a searchable resource?
Accessible	Is any authorization required, or is data/metadata free and openly accessible?
Interoperable	Can the data/metadata be used, stored, analyzed, and processed using widely accessible, non-spe-cialized applications?
Reusable	Is replicability possible using metadata descriptions, which meet domain relevant standards?

Because of such disciplinary differences in what is considered "standard", joining data itself becomes difficult. Linked open data and networked knowledge organization systems (NKOS), wherein information about a certain datapoint is described and connected to another source, for example a website or article via a unique identifier –or even that updates are shared and synced among different resources– helps to remedy this issue by referencing sources that users can follow and obtain further information relating to their own interests, regardless of the original resource's purpose.

The Semantic Web plays a pivotal role in achieving this integration. It involves a system of describing data using semantic tagging (i.e., adding meaningful labels and information to data points) and linking it to other pieces of information using a standardized framework known as RDF (Resource Description Framework). RDF facilitates the attachment of properties and relations to subjects, such as their characteristics and how data points are related to each other, making data machine-readable and linkable through standardized ontologies. One can, for example, link a site such as Knossos to artifacts that are described in other databases. This makes sharing and relating data from different repositories possible and manageable, regardless of where the data originates.

However, while data that follows FAIR principles and is formulated for use within the Semantic Web is ideologically beneficial, the practical implementation is often more challenging, with changing technologies, ontological conventions and differences in semantic vocabularies, and the necessity for expertise in creating datasets that can be joined in this manner. Joining technical expertise in this field with scholars in the humanities falls under the scope of the digital humanities, with the aim of making such data more widely accessible to scholars with specific humanistic interests, such as the cultures of the Bronze Age Aegean.

Emerging tools designed to alleviate technical challenges and foster contributions hold promise in the context of Minoan culture and more generally across the ancient world. For instance, Recogito (Pelagios Network 2023), a digital platform for annotating texts or images and linking entities to people, events or places, can even incorporate public contributions and geographical mapping within ancient contexts. Nodegoat (Van Bree and Kessels 2013) is another online platform, which similarly contributes to the geographical mapping of historical, linked relational datasets for use within project analyses or for public engagement when published online. However, while such tools represent significant progress in data sharing, they also reveal persistent challenges –both technical and ideological– across disciplines. Practical issues emerge in locating accurate geographical maps and gazetteers for early periods, such as the Bronze Age or Neolithic, and in accessing comprehensive archaeological information, as well as inherent complexities in integrating genetic data effectively.

DIGITAL AVAILABILITY OF DATA

For the purposes of sharing ancient archaeological, genetic and linguistic data from the Aegean and wider Mediterranean, it is ideal that datasets from all three disciplines should include geocoded information that is readable across formats (e.g., latitude and longitude), and contain links to cited material, with a strong preference to those which have been reviewed in some manner. Furthermore, for increased availability and use, data formats following FAIR use, which can be combined and analyzed together (i.e., in structured and non-proprietary formats such as .csv or JSON) are beneficial to all. These formats enable data to be combined and analyzed together seamlessly. This not only enhances the accessibility of data, but also facilitates its interoperability, making it easier to share and collaborate on research across various platforms and disciplines. However, it is vital to approach the integration of such diverse data with care to avoid drawing misleading conclusions, particularly in the sensitive area of correlating ancient genetics and cultural heritage.

Ideally, datasets related to a specific "place" or location entity could share and link to information on a wide range of topics (**Fig. 5.1**). For example, archaeological information could include burial practices, ceramic cultures, information about agriculture or bio-archaeological information on diet, architecture, or links to other related archaeological sites. Genetic information could comprise time period and associated culture of the sample, along with processed information such as admixture proportions (denoting individuals' genetic relationships to different ancient categorical groups, e.g., Neolithic Anatolians and Western Hunter-Gatherers). Relevant linguistic data to be incorporated into a database, including both Minoan and contemporary languages, mainly involves typological information on e.g., word order, nominal morphology, verbal morphology, phonology or phonetic inventory, and the time period of language use. In the process of combining these complex datasets, it is important to maintain caution, to ensure that the integration does not inadvertently create misleading narratives or simplistic cultural interpretations.

Location

Archaeology
Burial practice
Ceramics
Agriculture
Architecture
Presence of Minoan writing
Time period
Trade relationship

Genetics
Time period
Culture
Age & gender
Haplogroup
mt/Y-chr DNA
Processed data: Admixture proportions

Languages
Word Order
Nominal Morphology
Verbal Morphology
Phonology
Time period of language use
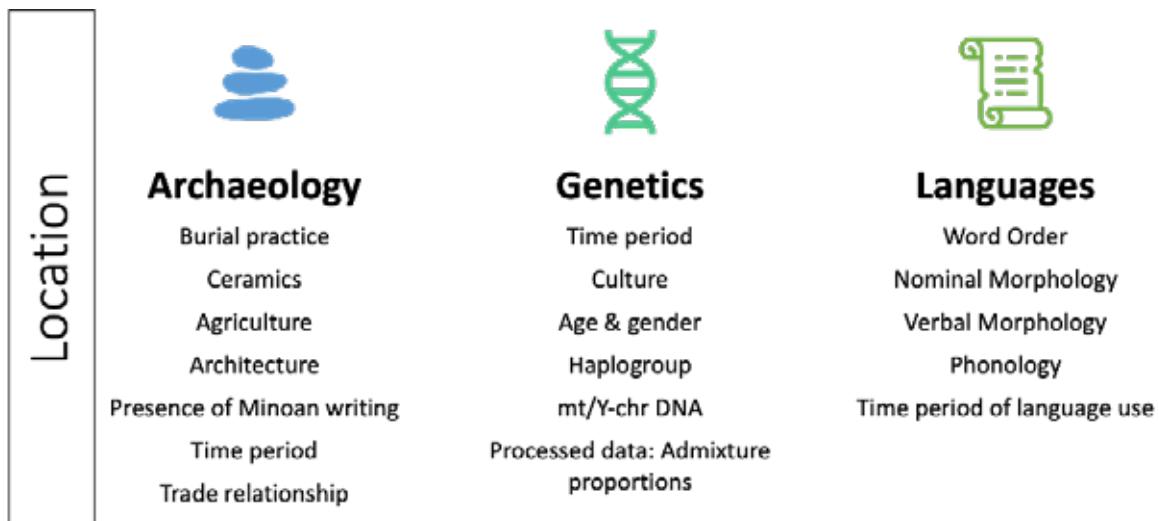
Fig. 5.1: Examples of types of information that could be linked among disciplines or aggregated into a larger dataset on Minoan culture and language.

Archaeological sources

For archaeological data in particular, geocoded locations of sites and artifacts, time periods, types of artifacts (e.g., burial practice, ceramics, architecture, inscription), in addition to trade relationships or notable external influences would provide information that could be useful for survey of Minoan presence and relationships in the Neolithic to Bronze-Age period. Descriptions of sites with evidence indicative of contact and trade provide links and relationships demonstrate a context for Minoan society and their interactions, for example early Cycladic-influenced burnished and incised jug pottery, obsidian from Melos, or Egyptian stone imports (which could have made their way via the Levant). These relationships, the complexity of which can also be documented via semantic tagging, can then be encoded and visualized to demonstrate the cultural milieu of the region via maps and networks.

Presently, available digital data related to Minoan sites and artifacts includes structured, GIS data available via gazetteers, chiefly Pleiades. The Pleiades gazetteer (Bagnall and Talbert sen. eds. 2024; see sample below in Table 2) is geocoded and annotated, explorable via online interface, includes a variety of downloadable formats (including .csv, JSON, and RDF) and can be linked to other semantic web tools, such as Recogito. It is also consistently updated, and community-built, but edited and supported by several institutions. However, due to the wide scope of the Pleiades gazetteer, which primarily focuses on ancient Greece and Rome, but is broadening to include the Near East and other surrounding areas, the detail and comprehensiveness of Neolithic and Bronze Age archaeological data related to the development of Minoan culture is not extensive at present, but may evolve in the future. Notably, in this case, it is primarily up to scholars of Minoan and Bronze Age Aegean archaeology to improve the database.

While a plethora of personal websites do provide detailed commentary and discussions regarding Minoan archaeology and Linear A tablets, even some with interactive maps, few unfortunately have in place rigorous review or accuracy checks, or provide enough information about the sources to check the quality of the material or impartiality of the source. This makes applying linked and aggregated archaeological data to research more difficult in practical terms.

Table 5.2: Example of selected data from Pleiades Gazetteer, containing data referring to "Minoan" spanning 2099–1600 BC. It includes the description, feature type, time periods, geolocation and unique ID. Some records contain "connection with" information linking to other datapoints.

Description	Feature Type	Geo Context	Has Conn	Repl LatLong	Time Periods	timePeriodsKeys	title	uid
Malia is a site on the northern coast of Crete that was the location of a major Minoan palatial center of the Middle Bronze Age.	settlement	Malia	891801761	35.2929766,25.14992624	2RL	2nd-millennium-bce, roman, late-antique	Malia	c588d2b16013c1d048b51e57f39cfddd
An ancient settlement on Crete where occupation began ca. 3000 B.C. Phaistos was a major center of the Minoan civilization and continued to be a Greek city of the first millennium B.C.	settlement, architecturalcomplex	Phaistos/ Ag. Ioannis	241160484	35.0511785,24.80081725	MLACHRL	middle minoan, late-helladic, archaic, classical, hellenistic-republican, roman, late-antique	Phaistos	fd40bc53efbc6b089402cb6a24110aa5
A settlement in east Crete in use from the Early Minoan period to the Late Minoan period.	settlement	Vasiliki	593460161	35.0876679,25.81010515	2MACHRL	2nd-millennium-bce, middle minoan, archaic, classical, roman, late-antique	Vasiliki	da0dbd21e32739be2780d7be1268c9f9

Minoanatlantis.com (Sheppard Baird 2007) has been a leading example of a website that combines aspects of scholarly attention with personal interests (editor's note: the website's link http://minoanatlantis.com appeared non-operative at the time of the latest review of this manuscript, June 2025) The site is "the official website of author, artist, and historian W. Sheppard Baird that serves as a platform for the presentation of his works in the arts and sciences" and includes several maps and writings regarding the Minoan civilization. One project, "The Aegean Minoan 3D GIS Project", or "The Archaeological Sites of the Aegean Minoans", is listed in the Electronic Tools and Ancient Near East Archives (ETANA 2002), and provides a KMZ file for plotting ca 250 points related to Minoan archaeological sites listed in scholarly sources as well as those described in text on Minoancrete.com (Swindale 2018). Each site is referenced and geolocated, with additional metadata relating to the type of site and other findings (Table 3). Another GIS project with a KMZ file available on the site, "End of Minoan Linear A Writing and LM IB Fire Destruction of Crete", provides geolocations for a further 85 sites –including peak sanctuaries, tholos tombs, Linear A sites, islands and Mycenaean sites– sourced from John G. Younger's publications and former website (currently Younger 2024c). While the references and data included in these resources are valuable and thoroughly detailed, with KMZ files being relatively easy to navigate and convert into .csv format, such resources are reliant upon individuals to continue to support and develop them.

Table 5.3: Selected data from MinoanAtlantis.com showing a peak sanctuary and settlement. Information includes the place-name, geolocation and a description including references. This example has been converted into .csv from .kml and cleaned to remove tagging.

Name	Place	Site type	Longitude	Latitude	Description
Aegean - Peak Sanctuaries	Naxos, Stelida 151	Peak Sanctuary	25.3457	37.0866	Peak Sanctuary: 151 Meters, 495 Feet Resources: Tristan Carter, et al. 2021. «A New Minoan-Type Peak Sanctuary on Stelida, Naxos». *Journal of Greek Archaeology* 6: 60–99 Source W. Sheppard Baird MinoanAtlantis.com
Aegean - Sites	Chios, Emporio	Settlement	26.0294	38.1922	Settlement: Resources: S. Hood. 1981. «Excavations in Chios, 1938-1955: Prehistoric Emporio and Ayio Gala». *British School of Archaeology at Athens*, Wikipedia «http://en.wikipedia.org/wiki/Chios» Chios Source W. Sheppard Baird MinoanAtlantis.com

Therefore, despite the progress made when it comes to developing digital resources and shared archaeological datasets, scholarly articles and books continue to lead in both scope and detail in terms of Minoan Bronze Age Aegean archaeology. There is an inevitable challenge with sourcing printed material that must be kept up-to-date, as new archaeological discoveries are made and new insights into contexts and nuances of social and political structures of the time (Nakassis 2022). However, while such material naturally takes time and expertise to scrutinize, its comprehensiveness, detail (including relationships with other cultures), and quality review preserve its necessity in the creation of more detailed digital Minoan datasets.

The ongoing development of specialist archaeological databases for Aegean and Near Eastern research is also promising, with museums and archives providing digitized images and metadata for a number of Minoan object types such as pottery sherds. By way of example, the British Museum's collections of artifacts and those of the Louvre or the Getty repositories, which are searchable and contain retrievable structured information for each item with varying levels of descriptive metadata. The development of such tools is promising, with steps to make material accessible, searchable and linked: for example, the iDAI portal for archaeological research (2022) and the iDAI objects archive, Arachne, employ linked open methods to connect archives, libraries and gazetteers, such as the Pelagios network's Peripleo gazetteer.

This allows scholars to obtain information about artifacts or sites that may be spread across a number of archaeological repositories. However, while specialized databases and large-scale digital archaeological databases are a growing resource, it can be difficult to obtain detailed metadata in structured format for search queries. Large scale, linked databases also remain under development or sparsely populated with Minoan artifacts, and hinge on participation and contributions from the scholarly community.

Table 5.4: Summary survey of contemporary online resources (2022) relating to Minoan archaeological datasets. Each one is summarized and evaluated according to usefulness in terms of FAIR principles and institutional oversight.

Example resources	Structured dataset	Accessibility/ proprietary	Others can reference	References and links provided	Institutional oversight
Pleiades	***	***	***	***	**
	Geocoded and annotated gazetteer of the ancient world. Crowd-sourced (but institutionally funded and overseen); little material present for Minoan Bronze Age or Cretan Neolithic.				
MinoanAtlantis	**	**	***	***	**
	Provides detailed and comprehensive metadata around archaeological sites; includes references. Data is structured in KML format; otherwise not easily reusable or interoperable.				
iDAI/Arachne	***	***	***	***	***
	Search queries through linked archives, GIS, and structured data through the German Archaeological Institute and connected universities and museums. Contains 51 Minoan artifacts, and the iDAI gazetteer includes 24 archaeological sites. CSV, JSON, XML and other formats available.				
British Museum	***	***	***	**	***
	Advanced search queries possible for artifacts. Results include images and metadata, and all information can be exported as CSV. Object descriptions, time period, and site name are included (but not geolocation).				

Genetic sources

The vast majority of newly published datasets concerning ancient DNA are made available via the European Nucleotide Archive as raw sequences and published in genome data collections. This has become especially important considering ethical guidelines for DNA research, notably that "researchers must ensure that data are made available following publication to allow critical re-examination of scientific findings" (Alpaslan-Roodenberg et al. 2021). Such widespread publication provides a boon for interdisciplinary research; for instance, the three studies on Minoan genotypes mentioned here (Hughey et al. 2013; Lazaridis et al. 2017; Clemente et al. 2021; Revesz 2021) can be found in the European Nucleotide Archive. Harvard University's David Reich ancient DNA laboratory further aims to serve as a digital repository for ancient DNA data, aggregating and curating currently published ancient genotypes as well as metadata whenever present. For some works, it additionally provides various stages of data analysis and metadata, including pre-prints of published data. When possible,

datasets are furthermore provided an individually citable page that is distinct from any article publication (for example, Lazaridis et al. 2022), further indicating the importance of making the data itself open, available and citable.

The rise of archaeogenetics in particular has fostered a growth of resources, bridging genetic information with archaeological context. The Allen Ancient DNA Resource, curated and produced by the Reich Lab, introduces a database that includes contextual archaeological metadata for genetic finds and paradata for the majority of publications concerning ancient DNA. However, even with such initiatives to make ancient DNA research more open and reproducible, releasing the raw sequencing data –but not standardising practices for sharing meta/paradata or archaeological context– creates a number of hurdles for researchers. This lack of standardization in data sharing not only hampers the interpretation of genetic data in its archaeological context, but also impedes the replicability of studies. Notably, processed research results that can provide insight for researchers from widespread disciplines, while sometimes mentioned in articles, are not always published in structured format.

Furthermore, as recognized by the Poseidon Project (2022), "The connection between individuals, contextual information, and genetic data becomes hard to maintain, bridging between very different repositories and sources (Excel vs. personal homepages vs. public repositories)." The Poseidon Project (2022), hosted at the Max Planck Institute for Evolutionary Anthropology, furthers the aims of the AADR and specifically targets reproducibility in archaeogenetics and FAIR principles of open data. Their public repository, deriving originally from the Allen Ancient DNA Resource, provides "packages" of data compiled through the project relating to specific publications as they are released. Each package contains information about find location, comments about the population from which a sample came, dating (either radiocarbon or through archaeological context), method for obtaining DNA, haplotypes, ENR accession number, and a reference for the publication from which the data came. Though some technological knowledge is needed to access the data contained in Poseidon in an easily workable, structured format, there is an R-package to ease accessibility as well as a simplified web-interface to find information from specific publications via their GitHub page.

Attempts to make such information accessible and user-friendly greatly clarify the usefulness of genetic research when combined with cultural and linguistic contexts. The Ancient Genome Atlas (ancientgenomes.com 2022) is a site designed to let users explore humanity's expansion genetically and culturally at a global scale, spatially and throughout time. This "spatial data platform" (to borrow terminology from Roose et al. 2021) draws genetic data from the Poseidon project's datasets, but provides an exploratory user experience using an interactive map interface. There, one may plot different layers throughout time (from 50,000 BC to modern times), including (1) individual points with added information on genetic haplotypes for specimens and links to relevant literature, in addition to (2) cultural and (3) language layers, which illustrate general regions for contemporary cultures and civilizations on the map. It is important to note, however, that while haplogroups and admixture proportions provide invaluable insights, interpretations must be made cautiously. Admixture analyses, in particular, involve complex statistical models and assumptions that can introduce biases, necessitating a critical and nuanced approach to correlating genetic findings with cultural or linguistic identities. While genetic information is provided and referenced in detail, linguistic and cultural information remains sparse for the ancient Aegean; however, such a resource effectively demonstrates the possibilities which exist for linking interdisciplinary data and its exploratory value.

Aggregated collections of structured genetic data, which include geographic locations of individuals, time periods, admixture proportions for different haplogroups, and information on archaeological/cultural context, are available in digital form. This availability is largely a result of the increasing popularity of genetics and DNA mapping, as seen on websites like Indo-european.eu (Quiles 2020) and Scaled Innovation's Tracking Back tool (2022). However, it's important to note that these examples are not governed by institutions and do not come from regulated sources. This highlights the necessity for ancient DNA research to rely on peer-reviewed and regulated data sources to ensure scientific accuracy and credibility. The sensitivity of ancient DNA studies to sample contamination, data processing methods, and interpretative biases further underscores

this need. Consequently, inaccuracies and mistakes are likely to occur in individually or community-collected, large-scale aggregated data, and one must consider the possibility of bias or external agendas when it comes to data presentation on the part of a source (Hakenbeck 2019). One such aggregated data sample, which includes several information points from Neolithic and Bronze Age Mediterranean sources (including Minoan), is found through indoeuropean.eu (Quiles 2020), which provides geolocation, date, detailed genetic metadata and admixture proportions for ancient individuals across a broad swathe of ancient Europe and the Near East, as well as the author's commentary regarding assessment of such (**Table 5.5**).

Table 5.5: Sample data selected from Quiles (2020). Illustrated here are colloquial name for individuals, time period, (geo) location, mtDNA haplogroups and admixture proportions from four groups: Anatolian (Neolithic), Iranian (Neolithic), Ancient North Eurasian, Western Hunter Gatherer. All samples come from Lazaridis et al. (2017).

Name	Lat	Long	Date	Location	mtDNA	Anatolia	Iran	ANE	WHG
Lassithi7	35.08	25.83	2400-1700 BCE	Lassithi Crete	H1bm	0.76	0.24	0.001	0.00
Lassithi2	35.08	25.83	2400-1700 BCE	Lassithi Crete	H13a1a	0.76	0.22	0.01	0.00
16V Tholos	35.05	24.81	2210-1680 BCE	Phaestos South-western Crete	U3b3	0.73	0.25	0.00	0.02
14V t2 Tholos	35.05	24.81	2210-1680 BCE	Phaestos South-western Crete	H+16311	0.74	0.24	0.01	0.00
Armenoi 503 S-EVA 1263	35.45	24.17	1370-1340 BCE	Armenoi Crete	U5a1	0.56	0.23	0.15	0.05

This example contains information about the original publications linked to the data and demonstrates an ambitious collection of open data that contains accessible, interoperable and reusable information for a range of disciplines. Yet, such data sources remain controversial, especially in genomics, as errors and research or social biases cannot be precluded as possibilities, and admixture analysis has been completed by the author, but should ideally be re-run when used for analysis and publication. Furthermore, because the database is itself reliant on open data that the author updates, only Minoan individuals from Lazaridis et al. (2017) and Hughey et al. (2013) are currently included in the database.

Discussion: Genetic data access and interdisciplinary use

As the practice of making genetic data public becomes increasingly common in the field, it remains crucial to recognize that public availability does not necessarily denote accessibility. The complexities of genetic data, involving its specific formatting and analysis, necessitate a high level of expertise, and raw formats are often not user-friendly for those outside the field. Processed data, on the other hand, requires an understanding of analytical methods and adept interpretation. This skill can be significantly supported through interdisciplinary collaboration, particularly with the social sciences and humanities (Sykes et al. 2019) As Hakenbeck (2019) emphasizes, there is also an urgent need for scholars in genomic population histories to engage more deeply with the broader social contexts of their research, acknowledging how archaeology and anthropology intersect with the histories of nationalism, colonialism and racism. This is especially notable in the realm of ancient DNA research, where the risk of data misappropriation to support biased narratives is a growing concern, as highlighted by Maran (2022) in the context of "Minoan" and "Mycenaean" cultures and by Parmenter (2023) in broader discussions of race in the ancient Mediterranean. As the field of ancient DNA research evolves, it is continuously confronting potential misappropriations of data to further narratives and social biases. Incorporating the rich

tradition of critical analysis from the humanities is thus largely beneficial for more nuanced interpretations of genetic data. Such an approach not only makes genetic research more comprehensible, but also ensures it is contextualized and explored from multiple perspectives to mitigate historical inaccuracies and biases.

For example, datasets that are reported in scholarly articles commonly describe a group's shared genetic traits and ancestry through admixture proportions, data which has already undergone extensive processing and analysis. Such genetic relationship proportions are an important quantification that demonstrates shared characteristics originating in a group from a certain geographical area, but they are not always available in numerical form, and one must understand the methodology used, as well as the occurrence of error rates within ancient genomics, to make effective use of such data. Other data presentations in such articles follow similar patterns wherein the source materials used are linked, but shared data from the results is not always made available or in a non-proprietary or non-specialized format, as demonstrated in the summary table below (**Table 5.6**).

Table 5.6: Summary survey of contemporary online resources (2022) relating to Minoan archaeological datasets.

Example resources	Structured dataset	Accessibility/ proprietary	Others can reference	References and links provided	Institutional oversight
David Reich Lab	**	*	***	**	***
	Raw, unanalyzed genomic data is available here, along with prior versions and some metadata. Datasets are given citable identifiers for referencing independently from articles.				
European Nucleotide Archive	**	*	***	**	***
	Raw, unanalyzed genomic data is available here, along with metadata and reference to publication.				
Indo-european.eu	***	***	**	***	*
	Detailed metadata available with structured result data. Downloadable as a large dataset that includes details and references, but data is not peer reviewed and unsupervised.				
Haplotree Information Project	*	*	***	*	*
	Explorative tool including GIS with data linked from Indo-european.eu				
Tracking Back, Scaled Innovation	*	*	***	*	*
	Explorative tool with data linked from Indo-european.eu, also FamilyTreeDNA				
Poseidon Project	**	**	***	***	***
	A collection of ancient genetic metadata with an aim of being open and FAIR. Data is accessible, structured, and reusable, but some technical know-how is needed to access material and download it in a structured format for reuse. Has institutional oversight.				
AncientGenomes	*	*	***	***	***
	Interactive map showing genomic points and cultural and linguistic area layers. Educational and user-friendly; DNA data is drawn from Poseidon, linguistic references and cultural information is sparse for Bronze Age Aegean and Linear A.				

Linguistic sources

Linguistic datasets containing ancient texts or information on ancient languages vary widely based on subdiscipline, e.g., whether they are for typological purposes or for the purposes of more focused textual studies. Ancient languages are especially underrepresented in typological databases, such as the World Atlas of Linguistic Structure (WALS), due to many factors including a lack of material or theoretical uncertainty and prudence when it comes to establishing linguistic categories. Another large-scale linguistic database, Glottolog

(Hammarström et al. 2022), makes use of unique identifiers known as "glottocodes" to link language varieties (including ancient, sparsely-described and endangered or extinct languages and dialects) to bibliographic reference information (Forkel and Hammarström 2022). The information provided for languages (geolocation, language family) has even been used recently in conjunction with genetic data through the GeLaTo dataset (Genetics and Language Together; Barbieri et al. 2022) to examine the relation globally between language families that are unrelated but spoken by genetically similar populations.

Still, for ancient data and sparsely described scripts, particularly in the case of Linear A –a script that reveals few linguistic features in the surviving texts and encodes a language that has not yet been successfully identified– datasets containing information such as language name, time period (including ancient and proto-varieties), and comprehensive typological data (encompassing aspects like noun morphology, verb morphology, word order, phonetic inventory and type of writing system) would be immensely valuable for those studying ancient language data. Such work as the Diachronic Atlas of Comparative Linguistics (DiaCL) is currently pursuing this goal, yet there remains an unavoidable lack of information regarding, for example, phonology. It currently features downloadable data for 150 Eurasian languages as a XLSX table and in JSON format, but few of these are contemporary with Linear A, and the downloadable language sets do not contain geocoded location information, which can instead be gathered from each individual language page. The datasets do, however, contain a wealth of detailed typological information pertaining to nominal and verbal morphology, tense and word order.

Especially for such writing systems as Linear A, for which we have little verifiable information, linguistic data is quite difficult to define. For example, a feature or innovation that is purported in Linear A and attested in other languages could be a result of shared change, a borrowing or simply occur by chance, and determining the cause may not be possible. Mapping similarities in language and linking information concerning archaeological and cultural histories can thus introduce new perspectives, adding contextual information that raises the possibility of clarifying aspects of Minoan language and highlighting instances where genetic data and linguistic theories or archaeological evidence do not match (Barbieri et al. 2022). Efforts to provide resources containing a combination of epigraphic and archaeological data can be demonstrated by the *SigLA* database (*SigLA*; see also Salgarella and Castellan 2021) and the Linear A Explorer (Hogan 2022), which deliver corpora of Linear A texts and signs. The texts are searchable, and for each text the explorer then links to transcriptions, further resources and commentary, with *SigLA* especially being a highly searchable database. In the case of the Linear A Explorer, additional notes are drawn from other scholarly references, such as Younger's (2024c) Linear A resources –which provide a wealth of textual and grammatical description, analysis and commentary– *GORILA*, and further archaeological information from, e.g., the French School in Athens.

A notable aspect of the "Linear A Explorer" (**Fig. 5.2**) is its accessibility: referenced datasets are made available, for example, in tagged JSON format. JSON (JavaScript Object Notation) is a hierarchical data format that is clear for humans to read and write, and simple for machines to parse and generate. Using tagged JSON format means that each piece of data (like text transcriptions, links to resources and commentary) is labeled with a "tag" that categorizes and identifies it, making it easier to search and retrieve specific information. This approach enhances the accessibility of datasets, including metadata and links to supplementary materials, such as links to sources of images for archaeological site maps where inscriptions were found, commentary from various linked sources, and commentary on word meaning and other metadata. However, as is clearly stated on the Linear A Explorer website, the primary purpose of the tool is "recreation", not scholarly research, and directs scholars to its aforementioned resource data.

In addition to its grammatical features, there are also the signs themselves, which can comprise their own visual database for analysis, further demonstrated in the *SigLA* database and Linear A Explorer. The *SigLA* digital Linear A database, with over 770 documents featuring Linear A inscriptions, contains an impressive collection of interactive, searchable, digitized samples and visual assortments of signs, as well as a map of sample locations. The digitized samples are based primarily on the span of Godart and Olivier's *GORILA* (1976–1985), and the *SigLA* corpus' scope is extensive. While the corpus presents an impressive and valuable digital dataset,

Fig. 5.2: Samples from Linear A Explorer (Hogan 2022). Note the illustration, transcription, typeset transcription, Latin transcription, description and location in *GORILA*, and site location and commentary regarding language. There are also references to source material and semantic tags.

which is searchable by –among other things– time period, site location, the material of the inscription (stone, clay, metal, or other) and type (architectural piece, libation table, etc.) and even the image identified on seal motifs, it is at present difficult to conduct more quantitative research using the dataset itself due to its online format, and with accessibility, ease and usability being a high (and worthy) priority.

Additional current linguistic resources for Linear A include datasets of signs and inscriptions, as well as the digitized publication of the original *GORILA* volumes from 1976–1985 at the repository of the French School of Athens (http://cefael.efa.gr/site.php), and many articles and webpages of varying reliability describing

decipherment theories, such as John Younger's aforementioned Linear A resources, which, even in their current form as a series of downloadable PDF files from https://kansas.academia.edu/JYounger, remain a well-established and reliable commentary regarding Linear A research Recently, many such sources are focused on a particular linguistic feature (e.g., morphology, onomastics, syntax), without making strong claims about the underlying language, a strategy more focused on scientific advancement than aiming at decipherment. Works such as these demonstrate how one can incorporate social context and the environment in which these languages and peoples existed, and draw on such information that informs hypotheses concerning grammar. For example, given the documented influence of Minoan culture in the Bronze Age Aegean, it is not unlikely that language features from Minoan were spread to other languages and could be evident in, for example, Lycian's distinctive SVO order (Davis 2013). With large-scale typological databases, such comparisons involve thousands of languages and an analysis of similar features. Of course, risks still exist for overinterpretation and biased assumptions; however, with the goal being the exploration of potential evidence regarding linguistic features –not a proven consensus regarding a certain linguistic theory over another– such comparisons could still prove beneficial. There are also further promising proposals regarding affixes and syntactical structure that can be explored. With these advances and proposals, a constructive exercise within Linear A research could involve putting aside a decisive perspective regarding language family and theories of decipherment and instead moving towards a large-scale analysis of surrounding and contemporary languages. This does not preclude discrete approaches to understanding the linguistic features of Linear A, but instead complements this research.

Table 5.7: Survey of contemporary online resources (2022) relating to Minoan linguistic and epigraphic datasets.

Example resources	Structured dataset	Accessibility/ proprietary	Others can reference	References and links provided	Institutional oversight
Younger Linear A	**	**	***	***	**
	Linguistic structure and site locations of Linear A are described, referencing scholarly articles, detailed online (html format), and organized, but not structured as machine-readable data; Institutional support is not currently present, though there has been review and support by the scholarly community.				
SigLA	*	*	***	***	**
	A searchable digital database of Linear A tablets and inscriptions, including location and metadata for epigraphic exploration. Data is visible, but not modifiable nor accessible for download in structured format. Institutional support is not currently present.				
DiaCL	***	***	***	***	***
	Typological database of ancient languages; little language data for relevant languages in Near/Middle East and Mediterranean (e.g. does not include Linear A, Linear B, Lycian, Hattic, Egyptian or other contemporary languages). Also, no phonological information is included. Institutionally supported and in development.				
Linear A Explorer	***	**	***	***	*
	A searchable linked database of Linear A tablets and Inscriptions. Inscription data is downloadable as javascript file, but needs to be converted for use. GitHub repository provided for site code and resources; data provides detailed citations, links to reviewed data, and references, but there is not otherwise institutional oversight or support.				

APPLICATIONS FOR MIXED MINOAN DATASETS

When joined, datasets such as those presented above can offer new knowledge-forming opportunities that support the interdisciplinary study of Minoan culture. In other knowledge fields, steps towards the creation of multidisciplinary platforms have already proven fruitful. For example, in the study of Uralic languages, such as Finnish and Hungarian, the URHIA (Uralic Historical Atlas; Roose et al. 2021) spatial data platform joins data on Uralic language typology and geographical spread, archaeological data, human genetic diversity and environmental ecology. This multi-disciplinary project was carried out with a strong emphasis on openness and collaboration. It featured a "user-centered design process", allowing users to control the display and layering of geographically mapped information, with the platform's design being driven by scholarly needs. Additionally, the site includes a database query ability, data download and map export. In order to facilitate further data exploration and information querying, measurement tools are also used to engage researchers more practically, resulting in new ways of exploring how Uralic culture and linguistic diversity interact with ecology and history. When coupled with an openly available database, such efforts benefit scholars and the public who are curious about spatial visualization, as well as accessing the underlying data.

The URHIA was created following the consideration of other multidisciplinary spatial data platforms (i.e., those involving some form of spatial data mapping or GIS; to be considered multidisciplinary they must cover 3 or more areas). Of the 21 platforms examined in Roose et al. (2021), only four were considered multidisciplinary – two primarily concerning languages, one related to ancient DNA and one related to the environment. The multidisciplinary dataset made available and downloadable for reuse provides scholars/users with the ability to conduct research both using specific queries as well as big-data analysis. This possibility lays the groundwork for future joint analyses using methods that are familiar to and used to some extent in all three fields, such as principal component analysis, data clustering and phylogeny.

To this end, a preliminary database with an interactive spatial data platform, based on input from those easily accessible sources reviewed above, is illustrated below (**Figs. 5.3, 5.4**) to provide an example of potential applications for joint digital Minoan datasets. This database is derived from information gathered from su-pervised, institutional locations and private locations, including Pleiades, Indo-European.eu, the Poseidon Project, Minoan Atlantis, as well as individual articles and books. However, due to the widespread nature of this database, references cited in the meta-data do not always include qualified references that meet "domain-specified community standards" (go-fair.org). The future development of this database would therefore benefit the scholarly community, to select datapoints with qualified references and links to relevant material.

This pilot platform allows users to visually explore data from the various disciplines, and in its completed form, to download the datasets for one's own analysis. The sample above (**Fig. 5.3**) demonstrates how archaeo-logical sites (red) and Linear A inscription sites (blue) are mapped alongside genetic data of Minoans (green), as well as other ancient DNA samples with haplotypes matching those of Minoan individuals dated 1350 BC at the latest (yellow). Locations containing some linguistic similarities or relationships are also mapped (**Fig. 5.4**). One essential aspect of this is to filter by time period, especially with respect to DNA, language and archaeology, to avoid generalizations being made with respect to time period.

Following the first steps of evaluating the present field of Minoan digital research sources, further work can be done to aggregate data and make it more widely available and accessible, but ultimately networked and linked open data systems would improve the accuracy and comprehensiveness of such endeavours. Future applications could therefore pull information from databases such as Poseidon Project or gazetteers such as Pleiades or iDAI, forming a more widespread and complete view of the period from multiple perspectives.
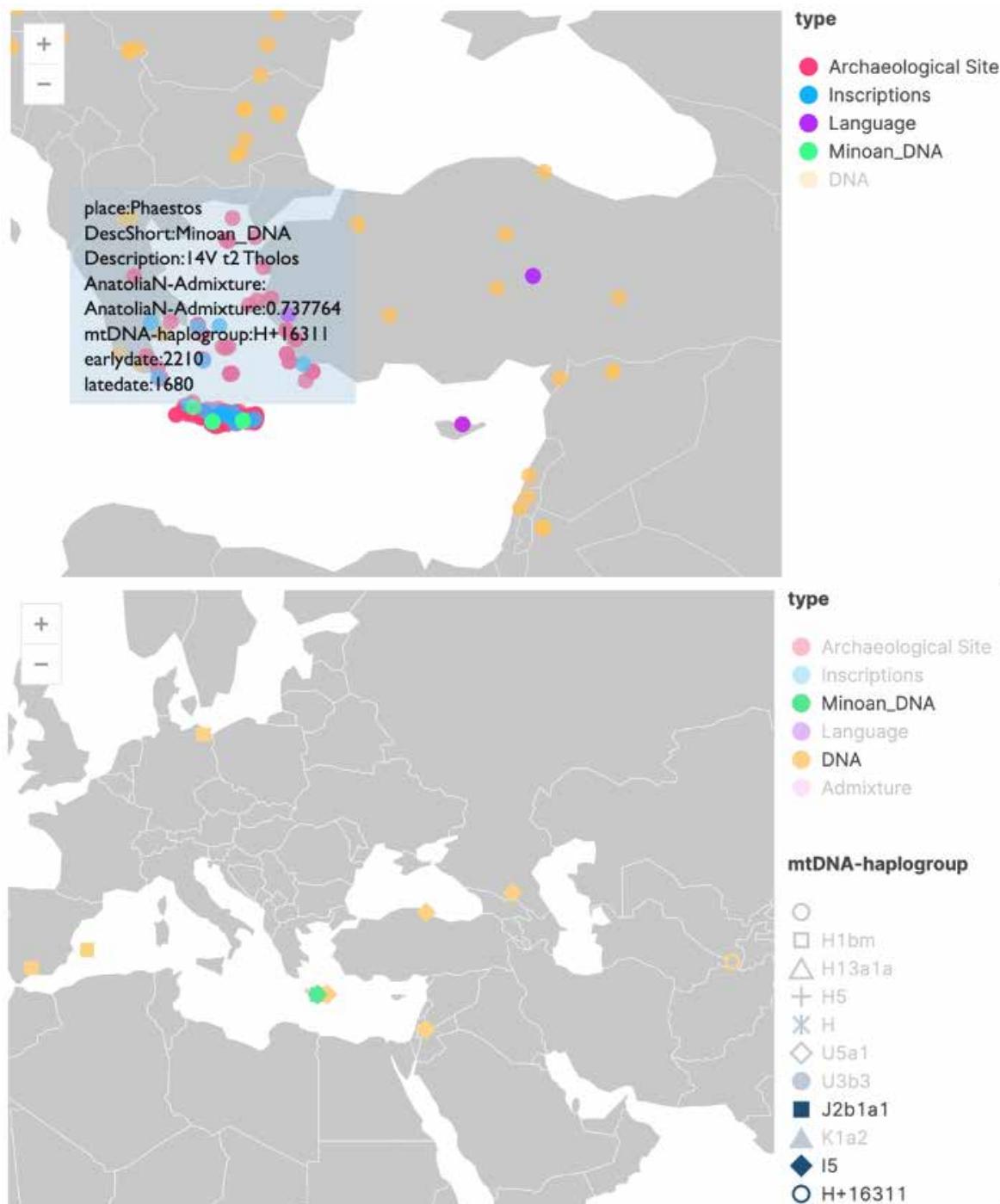
Fig. 5.3: Spatial visualization of geographically mapped data, illustrating filtered genetic information.
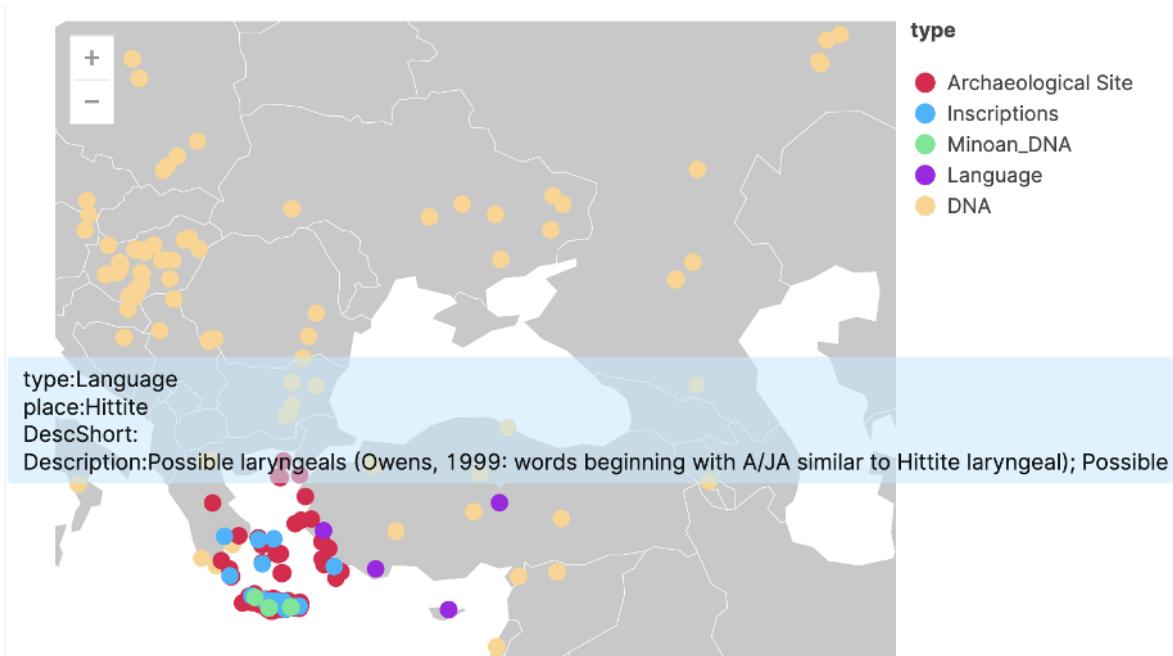
Fig. 5.4: Preliminary example of geographically mapped information highlighting linguistic features for a location.

CONCLUSIONS

When digitally available datasets on the Minoan Bronze Age are examined in terms of FAIR principles, open access and potential for data sharing, it becomes evident that resources attempting to bridge archaeological context with genetic information and contributing to the linguistic record are seldom pursued simultaneously or through academic avenues. Those that do exist and attempt a broad unification of data are commendable and valuable resources, yet they continue to face hurdles in accessibility, reusability and the extensiveness of data. Furthermore, risks of misusing genetic data in perpetuating social biases and creating ethnic identities underscore the need for a multidisciplinary approach to prevent oversimplification and misinterpretation. This reinforces the importance of careful, nuanced integration of genetic, archaeological and linguistic data to ensure accurate and responsible interpretations in ancient DNA research. Such issues can in turn lead to difficulties in data sharing, which is detrimental for both producers and users of research material.

In particular, those datasets, which are geocoded and contain detailed information about site/artifacts, language, time period, DNA and cite their own sources, are largely not scholarly published resources themselves, primary examples being minoanatlantis.com (no longer functional, as it appears) and indo-european.eu. More importantly, for Minoan data, there does not presently exist a standardized way to describe or link sites, texts, artifacts and genetic material, leading to difficulties in potential future linked open data resources.

In order to make better environments for scholars, researchers and interested parties in Minoan culture, a first step is to account for the data that is present from the array of domains, before addressing manners in which to either aggregate the data or, ideally, link it, so that material is updated simultaneously and shared. In order to facilitate standardized data-sharing practices among disciplines, scholars of Minoan culture and language can presently focus on (1) developing institutional links to structured genetic databases that are interoperable and reusable, (2) fostering contributions to archaeological crowd-sourced academic platforms and gazetteers that are relevant to the time-period, (3) expanding typological linguistic datasets for contemporary and chronologically neighboring ancient languages, and linking texts to locations and sites to relate the languages to real social contexts, e.g., those accounted for in the archaeological record.

While these issues surrounding open data sharing practices are especially important in cases, in which knowledge is obscure or incomplete, such as that surrounding the Minoan language and Minoans' cultural origins, they extend to current considerations of knowledge sharing on a broader scale. As per the EU Open Data Directive (EU 2019/2024: 27) "…it has become crucial and urgent to be able to access, bend, and re-use data from different sources, as well as across sectors and disciplines". Making data available across disciplines not only invites assorted perspectives from individuals, but fosters new partnerships, where expertise in a given field is necessary. In other words, scholars will be able to access the data, but ultimately such access necessitates collaborations among, for example, data scientists, bioinformaticians, archaeologists and linguists. Such openness allows scholars to be actively engaged with colleagues, who are knowledgeable in other fields and who are able to determine accuracy, completeness and reliability of datasets that are relevant to one's work.

When it is curated and democratized, sustainable digital scholarship can lead to exciting innovations and collaborations concerning promising areas of future research – such as those concerning the Bronze Age Cretan scripts and languages. Such work illuminates the similarities that are shared, when it comes to methodologies and interests across disciplines, and fosters novel perspectives and collaborative knowledge. As research progresses in each discipline, it is critical to be aware of avenues for joining traditional analyses with digital datasets, and moving together towards cooperative understandings of Minoan culture and linguistic relationships.

ACKNOWLEDGEMENTS

6

The Common Thread: Textiles and Wool Logograms in Linear A

Marie-Louise Nosch

Saxo Institute, University of Copenhagen
ORCID ID: 0000-0002-2104-1085

Jörg Weilhartner

University of Salzburg
ORCID ID: 0000-0001-9033-4036

ABSTRACT

Based on the Linear B evidence of the Mycenaean textile industry, we aim to provide evidence of what is known about the logograms for textiles and wool in Linear A. By linking our research to the wider framework of how logograms were created and to the importance of textile production in Minoan society in general, we attempt to address some of the major questions and hypotheses about the Linear A script and the language behind it, from a textile perspective. Thereby, we intend to use wool and textiles to explore and test Ester Salgarella's stimulating hypothesis that Linear A and Linear B are essentially one and the same script.

INTRODUCTION

Dress and textile metaphors have long been used to eloquently express the complex relationship between scripts and languages of the Aegean. "The Greek of the Cypriote inscriptions always seems to be *clothed* in a foreign *dress* ill-fitting at the best" wrote Arthur Evans (1895, 85), and Cyrus Gordon (1957) spoke of "Akkadian tablets in Minoan *dress*". With another textile expression, Tom Palaima and Elizabeth Sikkenga (1999, 599) argued that "the phonetic features of Linear B are the well-motivated and in many ways elegant results of *tailoring* the existing Linear A script to be able to represent the salient features of Greek".

   This paper discusses diachronically the logograms[1] rendering wool, textiles and perhaps clothing. Our aim here is twofold: an assessment of what we know about the logograms for textiles and wool in Linear A, and an

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1 On a discussion of the terms logogram, ideogram and sematogram, which are used (more or less) synonymously in Linear B studies, see recently Petrakis 2017a, 148–51 and Palaima 2020a, 6 n. 13 with further references. In these papers, Vassilis Petrakis makes a case for the use of the term sematogram, whereas Tom Palaima favors ideogram. Here we use the term logogram following, among others, Jean-Pierre Olivier and José Melena (see Melena 2014, 17, 128–29). Logograms are conventionally transliterated with the Latin name (or its abbreviation) for the object represented written in small capitals (e.g. TELA). If the interpretation of a logogram is open for discussion, it is indicated by a conventional three-digit number written in italics (e.g. *164*).

attempt to address some of the major questions and hypotheses about the script and the language behind it from a textile perspective.

At the beginning of the last century, Evans (1909, 38) observed that Linear A and Linear B "contain a large proportion of common elements". More than hundred years later, Philippa Steele and Torsten Meißner (2017, 109) concluded that "[t]he Linear A script was borrowed as a whole system". They strongly emphasize the continuity and overlap between Linear A and Linear B based on the syllabograms: "the correspondence between Linear A and Linear B is substantial" (Steele and Meißner 2017, 96). It is even possible to use phonetic values of Linear B syllabic signs for corresponding (homomorph or quasi-homomorph) Linear A signs, but this can be a tricky matter. Generally speaking, there are good arguments that it is legitimate in principle and as an approximation to apply Linear B phonetic values to corresponding Linear A signs in a substantial number of cases (e.g., Schoep 2002, 48–50; Meißner and Steele 2017, 99–102, tabs. 1–2; Steele and Meißner 2017 with many references; Tomas 2017a, 62–3). Although this practice will be applied in this paper (with such Linear A reading given in italics uppercase characters, e.g., *MA-RU*), some reservation should always be maintained, as some modification of phonetic values of borrowed signs is very likely (see Bennet 2008, 15).

The Mycenaeans adapted the Linear A script to their own language (Greek), and developed the script called Linear B. Evans (1909, 39) initially took Linear B as a "calligraphic variant" of Linear A restricted to Knossos, and most recently Ester Salgarella (2020) argued that Linear A and Linear B are better seen as essentially one and the same script in terms of a continuum (see below).

In the debate of whether Linear A and Linear B represent two different yet related scripts, or one and the same script (representing two separate, language-specific writing systems), it is important to keep in mind that in the transition from Linear A to Linear B, around 75% of the Linear A syllabograms were re-used in Linear B (Steele and Meißner 2017, 95), but around 80% of the approximately 180 Linear A logograms (including multiple variant forms) did not continue into Linear B and fell out of use (Schoep 2002, 29; see also Tomas 2017a, 61). Instead, many new logograms were created for the Linear B script (Palaima 1988; Schoep 2002; Bennet 2008). According to John Bennet (2008, 15) "[t]he creators and early users of Linear B devised a new logographic repertoire comprising around 140 signs and variants (e.g., *Docs²*, 50–1), among which are numerous representational or 'iconic' logograms, for example those for 'horse' and 'deer', for vessels, for 'chariots', and for a range of vessel forms, elements of armour, and weapon types". Interestingly, most of the logograms that are attested in both scripts belong to what Vassilis Petrakis terms "shared sematograms" (i.e. logograms), they are found on several sites on both Crete and the Greek mainland, and constitute the basic Linear B logographic repertory (see Petrakis 2017a, 134–46, tabs. 2–3). Textiles and wool, significantly, belong to this category, i.e., to those Linear A logograms that remained in the Linear B script and are attested in Linear B on Crete and the mainland (Nosch 2016).

Our paper aims to explore these logograms for textiles and wool, both of which can be traced back to Linear A, although attested in Linear A on a more restricted basis; in the Linear B script they continue as *159* TELA (Killen 1964, 1979; Duhoux 1974, 1975, 1976; Melena 1975; Nosch 1998; Del Freo et al. 2010; Petrakis 2012a) and *164*, respectively (logograms for textiles), and *145* LANA (logogram for wool). In dealing with these logograms, we follow the thread laid out by Vassilis Petrakis (2012a), who examined the Neopalatial ancestry of Linear B textile logograms. We intend to use wool and textiles to explore Salgarella's (2020, 28) hypothesis that Linear A and Linear B "are better seen as essentially one and the same script, slightly adapted over time to better accommodate a different language".

LOGOGRAMS IN LINEAR A AND LINEAR B – WHAT ONTOLOGIES?

Before examining these logograms in detail, we will provide a short overview of the logograms that are new creations in Linear B and of those that are shared between Linear A and Linear B. By contrasting the two

groups, we hope to illustrate the significance as well as peculiarities of the logograms for textiles and wool in both scripts.

Creation of new logograms

Among the new logograms of the Linear B script, one finds (1) single phonetic signs –which can be functionally considered logograms– used as acrophonic abbreviations of words of the Greek lexicon (e.g., *KO* for *ko-ri-ja-do-no*/coriander), and (2) compounds of two or three phonetic signs (called monograms) for commodities not easily depicted (e.g., *ME+RI* for *me-ri* "honey") – both of which refer to Greek words and therefore had to be new creations. This is demonstrated by the fact that monograms are at times accompanied by a full syllabic spelling of the Greek word expressed by the monogram. Correspondingly, (3) ligatured Linear B logograms, which include a syllabic sign as a phonetic abbreviation of a descriptive or identifying term, are mostly new creations; yet, among the rare exceptions are ligatures of the textile logogram TELA that have a Linear A ancestry (on these see below). Strikingly, the Linear B practice of using acrophonic abbreviations, monograms and ligatured logograms is inherited from Linear A. Whereas the use of the term monogram is standard practice for the Linear B script, Rachele Pierini reminds us (pers. comm. 8 February 2023) that, for Linear A, the term "composite sign" is to be preferred, as one cannot be sure that the single signs of such combinations represent complete words. In the case of the logogram for wool, however, which will be discussed analytically below, the term monogram seems justified for both Linear A and Linear B.

Most of the new Linear B logograms, however, are (4) pictorial in nature and allow easy recognition of clearly identifiable raw materials, finished goods, plants or animals; in other words, these signs have a corresponding referent in the material culture or in the natural world (**Fig. 6.1**). Looking at correlated representations in Aegean artwork, visual images are likely to have inspired individual scribes in the process of creating these new pictorial logograms (Palaima 1992, 71–4; Weilhartner 2014, 298–99, pl. LXXXVf–g; 2015, 258–67, 270, figs. 6–21). In principle, pictorial logograms appear also in Linear A; their appearance, however, is generally much less vivid than the pictorial logograms of Linear B, which regularly have good parallels in the iconographic record of the Aegean Late Bronze Age (Weilhartner, forthcoming a).
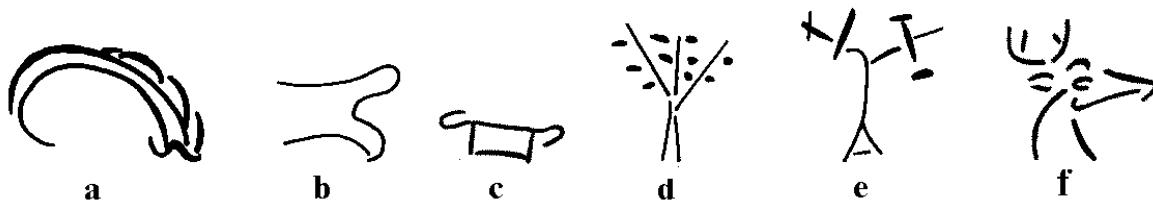
Fig. 6.1: Pictorial logograms for **a**: the horns of the wild goat (CORN), **b**: ingots (*167*), **c**: footstools (*220*), **d-e**: fruit trees (ARB), **f**: deer (CERV).

The creators of these logograms, such as the logograms for horns of the wild goat (Weilhartner 2012a, 67, fig. 14) (CORN: **Fig. 6.1a**), for ingots (*167*: **Fig. 6.1b**), for footstools (*220*: **Fig. 6.1c**), for various fruit trees (ARB: **Fig. 6.1d–e**), or for deer (Palaima 1992, 72–4; Palmer 2012, 363, 376; Weilhartner 2012a, 64–5, fig. 4) (CERV: **Fig. 6.1f**), did not aim to draw an exact copy of a single prototype based on detailed actual observation, but rather meant to communicate the concept of the object in a convincing way by concentrating on the features essential for recognition. Occasionally these logograms may feature variation that may be debated (e.g., Weilhartner 2017 on the insignificance of variation within logograms as opposed to Pierini's assessment of *220*a as "stool" and *220*b as "footstool" in Pierini 2021, 117–18), or actually meaningful (e.g., Weilhartner 2014, 299–301, pl. LXXXVi–j on the variation within ARB as indicating different kinds of fruit-trees, returning to *Docs²* 272–74, 456 for a distinction between *175* for olive-trees and *176* for fig-trees, unlike the generic *176*
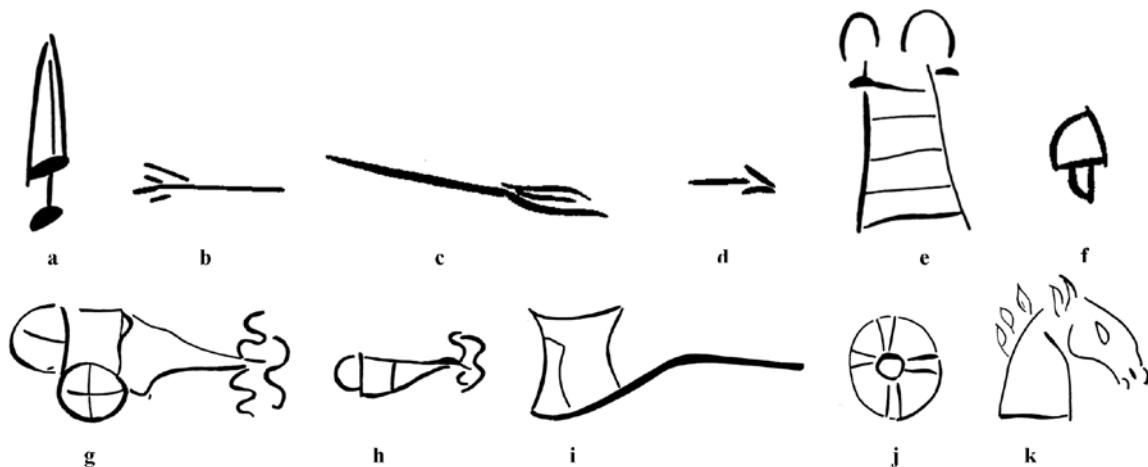
Fig. 6.2: "Military" Linear B logograms (including horses). **a**: sword/dagger (PUG), **b**: arrow (SAG), **c**: spear/lance (HAS), **d**: javelin (JAC), **e**: corselet/protective garment (TUN), **f**: helmet (GAL), **g-i** : chariot and parts of it (BIG, CUR, CAPS), **j**: wheel (ROTA), **k**: horse (EQU).

ARB "fruit-tree" of the Salamanca Convention, on the latter see Melena 2014, 146; on the differentiation between fig-trees and olive-trees see also recently Killen 2022, 81–3).

A large part of these new creations are logograms for weaponry and armor (**Fig. 6.2**; see Weilhartner 2015, 258–67, figs. 6–11, 17–21).

These "military" signs, all of which can be easily identified by means of clear counterparts in Aegean iconography, include logograms for offensive weapons (sword/dagger [PUG], arrow [SAG], spear/lance [HAS], javelin [JAC]: **Fig. 6.2a–d**), logograms for protective body gear (corselet/protective garment [TUN], helmet [GAL]: Fig. **6.2e–f**), logograms for vehicles (the fully assembled two-wheeled, horse-drawn chariot including the triangular traction system, yoke and four-spoked wheels [BIG] and various parts thereof, i.e., a complete chariot without wheels [CUR], a basic framework of a chariot box including the draught-pole [CAPS] and a four-spoked wheel [ROTA]: **Fig. 6.2g–j**), and the logogram for horse (EQU: **Fig. 6.2k**) which –with the exception of two tablets (**KN Ca 895** and **Ca 7788**; see Weilhartner 2012a, 63–4, 69–70, fig. 3)– appear exclusively in the context of chariots and can therefore be understood as a kind of "living military equipment". As the textual evidence shows, the manufacture, maintenance and distribution of military equipment was of a major concern for the central administration of Mycenaean palaces; the high numbers of the objects recorded clearly attest to their actual military use (rather than being simply objects of display) (see, e.g., Driessen 1996, 492–94). Most significantly, among the whole corpus of Linear A logograms there is one single logogram –the logogram for a helmet (AB 191: **Fig. 6.3**)– which belongs to this category for sure, attested only once in the whole Linear A corpus, on **KH Wc 2028** (see Palaima 1988, 325–26; Schoep 2002, 91).

Fig. 6.3: The single "military" Linear A logogram: the logogram for helmet (AB 191).

In a discussion during the conference, Ilse Schoep reminded us that some of the unidentified logograms of the Linear A corpus (including ligatures) may refer to military equipment. In addition, some of the more pictorial Linear A logograms may refer to items that could have been used in this way. For example, logogram

A 338 on **KH Wc 2068**, which obviously refers to some kind of boots (see Schoep 2002, 91), could belong to this category. However, without knowing/understanding the context in which this logogram occurs, the exact interpretation of this and other logograms must be left open. Even so, it seems certain that for the administrators of Mycenaean palatial centers it was much more important to keep strict control over the production, circulation and storage of military equipment than for their Minoan colleagues. The (assumed) different archival status of most of the extant Linear A records can only partly explain this phenomenon, not least because the differentiation between "domainal" Linear A administration and "palatial" Linear B administration (on this see Olivier 1987, 230–34; Weingarten 1988, 12–4) has been questioned (Palaima 1988, 327 n. 83; 1994, esp. 316–17; Schoep 2002, 89–90). Other factors, among them the different historical circumstances of these two administrative systems, have to be borne in mind: "For the Minoan system was internally developed and undoubtedly relied on transactional procedures with long and relatively constant histories among parties known to one another and trusted by one another. The Mycenaean system, however, was superimposed upon a subject Cretan population and the surviving skeleton of the Minoan administrative system by a controlling group that had every reason to be more careful, almost obsessive, about transactional information involving previously non-Mycenaean land, goods, materials and persons" (Palaima 1994, 308).

Linear A logograms adapted to Linear B

In contrast to these new graphical creations, which are generally of pictographic nature, there is also a considerable number of more abstract Linear B logograms that are adopted from Linear A. This is evident by the fact that a substantial number of Linear B logograms are recognizably similar in form to logograms in Linear A (Palaima 1988, 325–28; 1994, 317–22; Palmer 1995, 133–55, pl. XXI; Schoep 2002, 91–135). These signs clearly document the strong paleographic relationship between Linear A and Linear B. As we would like to suggest, almost all of them can be assigned to the following four categories:

(1) Logograms for basic agricultural commodities and processed products including figs (AB 30: **Fig. 6.4a**), olives (AB 122: **Fig. 6.4b**), wine (AB 131: **Fig. 6.4c**), wheat (or barley, see Palmer 1995) (AB 120: **Fig. 6.4d**), and, with some reservations, olive oil (for this interpretation, see Palaima 1994, 327–28 n. 62; Schoep 2002, 116–19) (A 302 = *130*: Fig. **6.4e**) and another grain or cyperus (A 303 = *121* or *125*: **Fig. 6.4f**). AB 171 (**Fig. 6.4g**), AB 38/*190* (**Fig. 6.4h**) and, maybe, AB 65/FAR (**Fig. 6.4i**) also belong to this group of agricultural commodities, their exact interpretation, however, is a matter of discussion (see Schoep 2002, 133–35). Some of these logograms –which were passed down from Cretan Hieroglyphic and/or Linear A to Linear B (Palaima 1990, 89–95; 1994, 318–21; Palmer 1995, 134–35, 139–44; Schoep 2002, 91–112, 116–19, 179–85; Weilhartner 2014, 297–98, pl. LXXXVa–e; 2015, 255–57, figs. 1–5)– especially the ones for wheat and olive oil, have a large number of variants, i.e., they are modified by attached syllabic signs or, in the case of Linear A, by attached logographic signs or even, occasionally, fractions (Palaima 1988, 322; 1994, 328 n. 63; Palmer 1995, 137 and n. 20, 139–41, 145 and n. 41; Schoep 2002, 29–35, 105–6). Unsurprisingly, with the single exception of Linear B OLE+*A* = Linear A sign A 609, particular variations are confined to one script (as one would expect with abbreviations of words from different languages).

(2) Logograms for domesticated animals, i.e., sheep (AB 21: **Fig. 6.5a**), goat (AB 22: **Fig. 6.5b**), cattle (AB 23: **Fig. 6.5c**) and pig (AB 85: **Fig. 6.5d**). Interestingly, all of these logograms are also used as syllabograms in both scripts (see below) (Palmer 1995, 141, 143–44; Schoep 2002, 120–23; Weilhartner 2012a, 65–9, figs. 6–13, 16–8; 2014, 302–3, pl. LXXXVId–f).

(3) Logograms for human beings, i.e., man/woman (A 100/102: **Fig. 6.6a**) as well as man (*100*: **Fig. 6.6b**) and woman (*102*: **Fig. 6.6c**) respectively. Whereas the Linear B signs in question, albeit of a less complex design, clearly differentiate between a logogram for man and another one for woman (by concentrating on features known from imagery), the Linear A sign does not allow for a clear differentiation between man and woman (Palaima 1994, 321–22; Palmer 1995, 139, 141–43; Schoep 2002, 113–16; Weilhartner 2012b, 288–94, pl. LXVI).

Fig. 6.4: Linear A and Linear B logograms for basic agricultural commodities and processed products. Logograms for **a**: figs (AB 30/*NI*), **b**: olives (AB 122 OLIV), **c**: wine (AB 131 VIN), **d**: wheat (AB 120 GRA), **e**: probably olive oil (A 302 = *130 OLE), **f**: another grain or cyperus (A 303 = *121 HORD or *125 CYP), **g**: AB 171, **h**: AB 38/*190, **i**: AB 65/FAR.

Fig. 6.5: Linear A and Linear B logograms for domesticated animals. Logograms for **a**: sheep (AB 21 OVIS), **b**: goat (AB 22 CAP), **c**: cattle (AB 23 BOS), **d**: pig (AB 85 SUS).
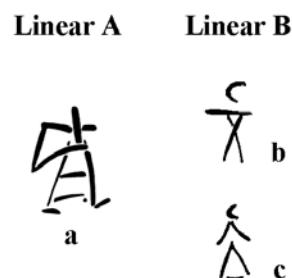
Fig. 6.6: Linear A and Linear B logograms for humans. Logograms for **a**: man/woman (A 100/102), **b**: man (*100 VIR), **c**: woman (*102 MUL).

The signs for (1) basic agricultural commodities and processed products represent the most frequently attested logograms in Linear A. Their prominence in this script seems to have been the main reason for their in-corporation into the logographic repertory of Linear B. Accordingly, the signs for (2) domesticated animals and (3) humans are also counted among the well attested Linear A logograms, although they occur on significantly fewer tablets than the logograms for (1) agricultural commodities and processed products. In addition to (1)

Fig. 6.7: Linear A and Linear B logograms for human-made, crafted objects or materials worked on. Logograms for **a-d**: vessels (A 409ᵛᵃˢ–411ᵛᵃˢ/*201ᵛᵃˢ, A 413ᵛᵃˢ/*205ᵛᵃˢ, A 405ᵛᵃˢ/*212ᵛᵃˢ, and A 407ᵛᵃˢ/*219ᵛᵃˢ), **e-f**: textiles (AB 54/*159 TELA, AB 164), **g**: hides (AB 180), **h**: wool (A 559/*145 LANA).

agricultural commodities and products, (2) humans and (3) domesticated animals, which are generally quoted as the common stock of the Linear A and Linear B logographic repertory (see, e.g., Palmer 1995, 134–35), there is a fourth category of Linear B logograms that can be traced back to Linear A:

(4) Logograms for human-made, crafted objects or materials worked on, which include, most notably, various types of vessels (**Fig. 6.7a–d**) and textiles (AB 54/*159, AB 164: **Fig. 6.7e-f**), as well as hides (AB 180: **Fig. 6.7g**) and wool (A 559/*145: **Fig. 6.7h**). The logogram for helmet (AB 191: **Fig. 6.3**) also belongs to this category (see Palaima 1994, 317, 322; Schoep 2002, 127–29, 131–33).

Conversely, the logograms of the last group (4) are rarely attested in Linear A. The Linear B logograms referring to vessels are by some scholars viewed as new creations by Linear B scribes modeled on the actual forms of contemporary vessels independently from Linear A signs (e.g., Schoep 2002, 29; Bennet 2008, 15); other scholars, however, leave the question open whether these signs were adopted or newly invented (e.g., Vandenabeele 1974, 7; Palaima 1988, 327–28). Some of them at least –such as the signs for tripods (A 409ᵛᵃˢ–411ᵛᵃˢ/*201ᵛᵃˢ: **Fig. 6.7a**) or certain single handled (A 413ᵛᵃˢ/*205ᵛᵃˢ: **Fig. 6.7b**) and two-handled vessels/

bowls (A 405[VAS], 407[VAS]/*212[VAS], *219[VAS]: **Fig. 6.7c–d**)– are of a design so similar to their Linear A counterparts that some kind of general influence from the Linear A forerunners in the course of creating signs for vessels for the Linear B script seems likely. The same holds true for the logograms for hides (AB 180: **Fig. 6.7g**), which bear a considerable resemblance to each other. In the case of the logogram for textiles (AB 54/*159 TELA, AB 164: **Fig. 6.7e–f**), there is no doubt about the Linear A pedigree of the Linear B signs. The sign for wool (A 559/*145 LANA: **Fig. 6.7h**) also belongs to the logograms which are attested in both scripts, Linear A and Linear B.

CHRONOLOGY OF LINEAR A LOGOGRAMS FOR WOOL AND TEXTILES

Although Linear A is attested over a long time period (c. 1850–1400 BCE, or MM II to LM IIIA), here we focus on the attestations of textiles and wool which date from MM IIIB (Phaistos) to LM IA (Akrotiri), LM IB (Khania and Hagia Triada) (see Salgarella 2020, 42–9), and, recently, to Neopalatial Knossos (see below).

Phaistos material includes reference to wool (**PH 3a**) and is dated to MM IIIB. Akrotiri material is dated to LM IA and includes possible reference to textiles/AB 54 (**THE 8**) and perhaps to wool/*MA*. Hagia Triada material is dated to LM IB and includes textiles/AB 54 (**HT 16**, **20**, **38** and **Wc 3019**) and wool/AB *MA+RU* (**HT 12**, **24**). Khania material is dated to LM IB and includes references to textiles/AB 164 (**KH Wc 2036–2045**, **2095**, **2111**) and wool/AB *MA+RU* (?) (**KH 43**). The date of the sherd from Tel Haror (**Zb 1**), if of relevance in this context (see below), is uncertain; a possible Middle Bronze Age date (either IIC or III) has been suggested (see Karnava 2005, 838).

THE LOGOGRAM FOR WOOL IN LINEAR A AND LINEAR B

The Linear B sign *145 LANA seems to belong to a small group of compound logograms called monograms (**Fig. 6.8**; see above for comments). Whereas Linear B monograms –such as *ME+RI* (for μέλι/honey) or *A+RE+PA* (for ἄλειφαρ/unguent)– are usually made up of two or three syllabograms representing a word known from the Greek lexicon, and are therefore, beyond any doubt, new creations of the Linear B script, the sign for wool is likely to have been brought over from Linear A, where it is attested at three Cretan sites: at MM IIIB Phaistos (**PH 3a**.1.2.3) and at LM IB Hagia Triada (**HT 12**.4, **24a**.1–5) and Khania (**KH 43**.1) (Nosch 2007; Petrakis 2012a; Salgarella 2020, 33). It seems that the creator(s) of the Linear B sign chose to deploy the Linear A logographic repertoire, despite the fact that this sign appears to bear direct reference to a "Minoan" word.
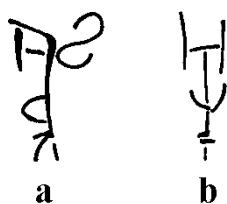
Fig. 6.8: Linear B monograms created by Mycenaean scribes. Logograms for **a**: honey (*ME+RI*) and **b**: unguent (*A+RE+PA*).

Fig. 6.9: The Linear A logogram for wool (A 559): *MA+RU*.

The Linear A sign in question (A 559) is probably made up of two syllabic signs (AB 80+26) that are likely to represent the "Minoan" word for wool (**Fig. 6.9**). Using the phonetic values of the equivalent signs in the Linear B script (although with the caveats noted above), one reads the word *MA-RU*, which seems to have survived in its Hellenized form μαλλός into later Greek (*Docs²* 434; Bennet 2008, 16; Steele and Meißner 2017, 107). The

survival of this word in Classical Greek indicates the strong impact and long tradition of Minoan expertise in the treatment of wool and the production of wool cloth (De Fidio 1998–1999, 41–2; see also Melena 1975, 115 and n. 1) along with other examples of borrowing Minoan toponyms, anthroponyms and technical vocabulary from Linear A (see Palaima and Sikkenga 1999, 602–3).

The corresponding Linear B logogram (**Fig. 6.10**) usually also seems to be made up of two syllabograms. However, any attempt to split up the different variations of the sign into different syllabic signs leads to different results: some examples look like a combination of the syllabic signs for *ma + ro* (**Fig. 6.10a**), others seem to be a combination of *ma + re* (**Fig. 6.10b**) (Nosch 2007). Looking at the Linear A logogram which –as we have seen– is likely to be read as *MA-RU*, the Linear B *ma-ro* / Linear A *MA-RU* variation seems to represent a monogrammatic version of a phenomenon that is attested among personal names: as observed by several scholars, some of the Linear A personal names are attested in Linear B in nearly identical form with the exception of the last syllable, which shows a Minoan *–u* / Mycenaean *–o* alteration (see Schoep 2002, 154–55, tab. 3.22; Steele and Meißner 2017, 105–7, tab. 6.8; Pierini 2024). This may suggest that in Late Bronze Age Crete, Mycenaean scribes were familiar with a Minoan word for wool, *MA-RU*, and some may have pronounced it, or written it, as **ma-ro*; others, however, wrote **ma-re*. The reasons for this variation are unknown to us. Nonetheless, Tom Palaima has tentatively suggested (pers. comm. 30 December 2022) that the answer may lie in the fact that both Linear B options are in vowel pronunciation areas weakly attested in Linear A (*e* and *o* signs are under-represented in Linear A). If most Knossian Linear B scribes were of Minoan ancestry (as Palaima believes), Minoan-ethnic, Linear B Greek-speaking scribes may have been driven to opt for *e* rather than *o* or vice versa. Interestingly, even though the ancient Greek lexicon has μαλλός as a word for wool, modern Greek has μαλλί (< Medieval Greek μαλλί(ν) < Hellenistic μαλλίον/μαλίον, hypocoristic of μαλλός).

Whatever the reason for this variation, many scribes –both in Crete (Knossos) and on the Greek mainland (Mycenae, Thebes)– chose at times to omit the upper syllabic element altogether. This results in a single phonetic syllable (*MA*) that stands for the word (**Fig. 6.10c**). In Knossos, scribes who were regularly engaged to record wool (e.g., Hands 103, 118, 120) rarely omitted the upper element of the sign. In contrast, scribes who were only occasionally entrusted to record wool (e.g., Hands 113, 115, 215) wrote *MA* comparatively often. On the basis of these variations, it has been argued that the former Minoan phonetic components were merged into an inextricable conjunction without any phonetic significance; if this is true, the sign may have been taken over *en bloc* from Linear A, having lost its original monogrammatic nature (see, e.g., Petrakis 2012b, 529–32; Steele and Meißner 2017, 107 n. 23; Weilhartner 2017, 170–71).
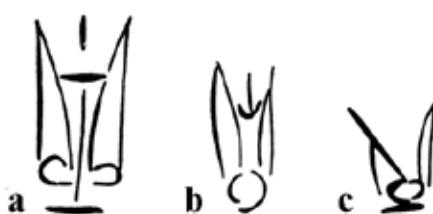
Fig. 6.10: Various forms of the Linear B logogram for wool (**145* ʟᴀɴᴀ) adopted from Linear A A 559 (*MA+RU*). **a**: *MA+RO*, **b**: *MA+RE*, **c**: *MA*.

Here, however, we suggest a new interpretation (see also Weilhartner, forthcoming b and contrary to Weilhartner 2017, 170–71). The Linear B administrators, who chose to access the "Minoan" logographic repertoire for the monogrammatic sign for wool, may have had problems with the exact pronunciation of the Minoan word underlying this sign. If this is the case, it may explain the variations of the Linear B sign for wool. In other words, the transfer of the Linear A monogram (based on a "Minoan" language) resulted in slightly different Linear B monograms (based on Greek), due to linguistic ambivalences caused by the process of Hellenization of a "foreign" word. The transfer of Linear A *MA+RU* (= A 559) –we would like to suggest– has resulted either in Linear B monograms *MA+RO* or *MA+RE*. Due to this ambiguous situation, some Mycenaean

scribes –driven by efficiency or simplicity– may have chosen here and there to write only the first syllable of this word: *MA* (as we will see in a moment, the use of a single syllable standing for the logogram is common practice in Linear B). If this assumption is not misleading, some Mycenaean scribes at least would have still perceived the sign as a deliberate combination of two syllabograms forming the loan word for wool. The alterations of the Linear B sign for wool, compared to its Linear A predecessor, may be viewed as a reflection of the modification caused by the adoption of a sign from a different script for a different language. If true, the Mycenaean scribes initially attempted to adopt a Minoan loan word for wool, *MA-RU*, which competed with the Mycenaean Greek *we-we-e-a*, "woolen" Gr. εἶρος (< *ϝέρϝος < *μeru-os), which is likely related to the Latin *vervex*, *-ēcis* (< *μeru-ē-) "wether, castrated male sheep" (see Chantraine et al. 2009, 309–10). There is, moreover, a third term for wool in the Greek lexicon, λῆνος "wool, fillet, fleece", which goes back to Proto-Indo-European *$h_2u\underset{.}{l}h_1$-n-, but is unattested in the Mycenaean corpus (Chantraine et al. 2009, 637; Beekes 2010, 857–58). Its formation *$h_2u\underset{.}{l}h_1$-n-éh_2 meaning "wool" can be found in most Indo-European branches (see Anatolian *ḫulana-* "wool", Indic: Vedic *ū́rṇā* (< *$h_2u\underset{.}{l}h_1$-n-éh_2), Iranian: Avestan *varənā* (< *$h_2u\underset{.}{l}h_1$-n-éh*)) and also in non-Indo-European languages, such as Akkadian: *ḫul(l)anu-* "a cloak, wool or linen wrap" (see also Nosch 2016, 107). The diverse terminology for wool suggests that this was a precious raw material of a range of qualities.

Another example of this phenomenon may be represented by Linear B textile logogram *161*, which occurs only on tablets from Knossos (Melena 1975, 94–117; Nosch 2012, 338–39). Although there is no consensus on the meaning of this logogram, its function as an additional qualifier for the cloth logogram TELA is suggested by their close association. Moreover, it is closely associated with the textile type *pa-we-a₂/pa-we-a*/TELA+*PA*. The logogram *161* consists of two elements: the first seems to come from –in most cases– the Linear B syllable *mi*, whereas the second element resembles either the Linear B syllables *i* (**Fig. 6.11a**) or *pu₂* (**Fig. 6.11b**). Along the same lines of what has been said about the logogram for wool, *161* may be interpreted as a Linear B monogram based on a word for a certain textile from the "Minoan" language, whose exact pronunciation in Greek was not clear, due to its foreign origin, resulting therefore in two different monograms. However, as neither **i-mi*/*mi-i* nor **mi-pu₂*/*pu₂-mi* can be linked to any known textile term from the Greek lexicon, and since we do not have a clear Linear A forerunner of this sign, the suggestion of *161* as a Minoan textile monogram must remain a somewhat speculative hypothesis (for the view expressed here, see also Weilhartner, forthcoming b). At any rate, as Ester Salgarella pointed out to us, sign A 551, which is composed of *MI+JA+I* in no clear reading order, may provide a possible comparandum.

Fig. 6.11: Various forms of the Linear B cloth logogram/monogram (?) *161*.

Next to the logogram for wool (and, perhaps, the logogram/monogram *161*), we have textual evidence for another material used in the production of textiles and whose logographic abbreviation clearly points to the strong Minoan legacy in the Mycenaean textile terminology. Although Mycenaean scribes wrote *ri-no*/λίνον if they wanted to refer to flax (or linen), they used the syllabic sign with the phonetic value *sa* as a logogram to convey the cultivated flax plant (*SA*). This schematic sign, which may denote any plant in its origin, seems to stand for the first syllable of a foreign –possibly Minoan– word for flax (Nosch 2016, 107). The same phenomenon can be observed on a couple of other syllabic signs in isolation used as logograms, among them the logogram for figs (*NI*) and the logogram for saffron (CROC); the latter –whose design closely resembles representations of the crocus flower in Minoan art (Day 2011a, 2011b; Weilhartner 2014, 301–2, pl. LXXXVIa-c)–

is used, among other things, as yellow dye for textiles. Usually, such isolated syllabic signs are abbreviations of Greek words based on the acrophonic principle: a clear example is provided by the syllabic sign with the phonetic value *ko*, which –if in isolation next to a numerical entry– stands either for the spice coriander (*KO* being the first syllable of *ko-ri-ja-do-no*) (Melena 2014, 138) or, in other contexts, for other words such as *ko-ru-to*/helmet (**PY Sh**) or *ko-ro*/piglet (**KN Ce**) (Melena 2014, 130, 136). However, for the logograms for figs and saffron the syllabic signs with the phonetic value *ni* and *ra₃* are used although these commodities were known by Linear B scribes by their Greek names σῦκον/fig (cf. *su-za*, *o-pi-su-ko*) and κρόκος/saffron. Again, *ni* and *ra₃* are in all likelihood the initial syllables for the non-Greek –possibly Minoan– word for figs and saffron, respectively. In the case of the logogram for figs, further evidence for this interpretation is provided by a gloss found in Athenaeus, which attests the word νικύλεον as the Cretan word for figs (see Neumann 1962; *Docs²* 563; Bennet 2008, 16; Petrakis 2017a, 139; Steele and Meißner 2017, 106–7). In the case of the logogram for crocus, however, it must be noted that, so far, *ra₃*/CROC is documented only in Cretan Hieroglyphic (H *23/*159bis) and not in Linear A (see Weilhartner 2014, 301–2; Petrakis 2017a, 141 and n. 22; Petrakis 2017b, 77; Palaima 2020a, 6–11). Other examples of this phenomenon include the logograms for domesticated animals (Weilhartner 2012a, 68–9; Nosch 2016, 107; Petrakis 2017a, 139) –sheep, goat, cattle and pig– as well as the logogram for flour *vel sim.* All these logograms are also used as syllabograms. Given that the phonetic values of these syllabograms do not agree with the first syllable of the Greek word for the respective animal / agricultural product, these signs, too, may hint at an abbreviation or the first syllable of a Minoan word (see Table 1). In case of the syllabograms used as logograms for the oxen, and –less likely– for the pig, *mu* and *au* respectively, these phonetic values may have alternatively originated from onomatopoeic sounds (Weilhartner 2012a, 68 and n. 38; Salgarella 2021, 71).

Additional evidence of the first syllables of Minoan words may be provided by syllabograms. Given that the phonetic values of most Linear B syllabograms have good chances to be projected to Linear A syllabograms (see above), the sound values of individual signs may represent the first syllable of the Minoan word that the sign represents, if the acrophonic principle was at work (on this principle, see recently Salgarella 2021, 72–83). For example, sign AB 54 with the phonetic value *wa* may represent the first syllable of the Minoan word for a textile or loom (see below), sign AB 8 with the phonetic value *a*, which clearly represents the stylized depiction of a double axe, may represent the first syllable of the Minoan word for the double axe. Along the same lines, AB 69 with the phonetic value *tu*, which represents most arguably the depiction of an ivy leaf, may hint at the Minoan word for ivy (see also Salgarella 2021, 74–5, fig. 8) and the saw-like design of AB 74 with the phonetic value *ze* may represent the first syllable for the Minoan word of saw. However, due to the difficulties in clearly defining the pictographic origin of phonetic signs –which is often a subjective and contentious matter– this is even more speculative.

Table 6.1: List of Linear B syllabograms used as logograms (*SA*, *NI*, CROC, OVIS, CAP, BOS, SUS, FAR).

Sign as logogram	Meaning	Same sign as syllabogram (phonetic value)	Non-Greek/Minoan word	Greek word (Mycenaean evidence, including words of non-Indo-European etymology)
SA (AB 31)	flax	*sa* (AB 31)	*sa-* ?	λίνον (*ri-no*)
NI (AB 30)	fig	*ni* (AB 30)	*ni-* ? (cf. νικύλεον)	σῦκον (cf. *su-za*)
CROC (*144*)	saffron	*ra₃* (B 33)	*ra₃-* ?	κρόκος
OVIS (AB 106)	sheep	*qi* (AB 21)	*qi-* ?	ὄις (cf. *o-wi-de-ta-i*, *o-wi-jo*)
CAP (AB 107)	goat	*mbi* (?) (AB 22)	*mi-* ? (cf. μίκλας)	αἴξ (cf. *a₃-ki-pa-ta*, *a₃-zo*)
BOS (AB 109)	ox	*mu* (AB 23)	*mu-* ?	βοῦς (*qo-o*)
SUS (AB 108)	pig	*au* (AB 85)	*au-* ?	ὗς/σῦς (cf. *su-qo-ta*)
FAR (AB 129)	flour (?)	*ju* (?) (AB 65)	*ju-* ?	

THE LOGOGRAMS FOR TEXTILES IN LINEAR A AND LINEAR B

The Linear B logogram *159 TELA "cloth" is attested in the palace archives at Knossos, Pylos, Thebes and Hagios Vasileios. It is a generic sign for textile that can be modified according to the textile types by inserting an endogram, e.g., TELA+*TE* for the logogram TELA with the syllabogram *te* inside. Mycenaean scribes also employ a series of other logograms to designate cloth: *146, *161, *164, *166 and, with some reservation, TUN(ica). *168, *158, and *178 are possibly also textiles.

In the early 20th century, Evans interpreted the textile logogram *159 TELA upside down and believed it to be the sign for "palace" (Evans 1909, 197–98; 1921, 358, fig. 257; see Burke 2010, 74–5). In the second volume of *Scripta Minoa*, the sign was classified under the heading "signs for containers" and termed "banner sign", which later became known as a textile (Evans and Myres 1952, 33; see also Evans 1935, 693).

Three Aegean scripts of the Bronze Age, Cretan Hieroglyphic, Linear A and Linear B, use textile logograms and these logograms form a common basis that is shared by all three scripts. The textile logogram hence represents a high degree of continuity and coherence within Cretan Hieroglyphic, Linear A and Linear B (Nosch 2012, 306).

The Cretan Hieroglyphic logogram *163 with numerous fringes on both upper and lower sides of the rectangle, is considered to be the equivalent to the Linear A and Linear B cloth signs, as exemplified on medallion *CHIC* #103 from the Dépôt hiéroglyphique at Malia (Oren et al. 1996, 101–2).

Linear B *159 TELA has its origin in the Linear A sign AB 54 (Del Freo et al. 2010, 338–73), attested at LM IB Hagia Triada (**HT Wc 3019**, **HT 16**.2, **20**.4 and **38**.3), at Knossos (see below), and at Thera (**THE 8**: Boulotis 1998, 407; 2008, 67–94). A fourth, yet uncertain example is on a graffito from Tel Haror (**TEL Zb 1**), a sign of rectangular shape yet without fringes, so both its identity as textile logogram or a syllabogram as well as its identity as Linear A or Cretan Hieroglyphic are contested (Karnava 2005, 838–41; Petrakis 2012a).

Whereas the Linear B sign (*159 TELA) functions as a stand-alone logogram, the Linear A sign (AB 54) functions both as a syllabogram and as a logogram for textile. AB 54, if read as a Linear B syllable, represents *wa*, and it is tempting to speculate that this syllable in Minoan would abbreviate a word for textile or loom (see above).

We find a similar example in logogram *164, attested at Khania (see Hallager 1996 [I], 110–17, tab. 17). In Linear A, it occurs both as a syllabogram (in Hagia Triada) and as a logogram (in Khania), possibly for textiles. We assume this, because a similar sign appears as a textile in Linear B, but in Linear B, the logogram *164 no longer has a syllabic homomorph counterpart. This could be explained by the graphical evolution of logograms and syllabograms in Aegean scripts and the need to differentiate more clearly between the syllabic and the logographic functions of homomorphs or quasi-homomorph signs; Petrakis (2012a) furthermore links this development to the amplification of the textile industry and the trends towards standardization, and the massive use of textile and wool logograms by the administration. Nevertheless, there is still a substantial number of syllabograms in Linear B used as logograms (see above Table 1).

The convention of identifying the type of textile by a ligature or endogram is common to both Linear A and Linear B. Usually, Linear A ligatures are not incorporated in the logographic repertory of Linear B. However, ligature AB 54+81 (**HT 38**.3) can be directly compared to the ligature TELA+*KU* of Linear B (Del Freo et al. 2010); ligature AB 54+A 312 (**HT 38**.3) can perhaps be compared to the ligature TELA+*ZO* of Linear B; and AB 54+0̞9̞ (**THE 8**) may be read as TELA+*S̞E̞* if the Linear B phonetic values are used. If the sign on the sherd from Tel Haror (TEL Zb 1) represents a logogram, it may be read as AB 54+04, which would have its counterpart in Linear B TELA+*TE*. On the whole, these (possible) adoptions may point towards a significant Minoan legacy in the area of textiles and textile terminology. While textile logograms TELA+*TE*, TELA+*KU* and TELA+*ZO* are clearly attested in Linear B, there is no evidence of *TELA+*SE*. However, in the Knossos **Pp** series from the West Wing, Hand 119 records the commodity *168+*SE*, which is probably a textile and which may be linked to Linear A AB 54+0̞9̞ (Nosch 2012, 343).

THE SHAPE OF THE TEXTILE LOGOGRAMS IN LINEAR A AND LINEAR B: LOOM AND TEXTILE

In Linear A, the textile logogram AB 54 seems quite fixed in its visual form. The logogram consists of a rectangular or square shape, with a fringe or warp threads hanging below. It is not clear whether logogram AB 54 depicts a textile or a loom. This dilemma is illustrated by logograms from Hagia Triada: in tablet **HT 20** and in roundel **HT Wc 3019** (**Fig. 6.12a**; see Hallager 1996 [I], 111, n. 433), the logogram clearly outlines the warp-weighted loom with hanging loom-weights attached to the warp threads. On other documents (**HT 16**: **Fig. 6.12b**; **HT 38** with AB 54+*KU*: **Fig. 6.12c**), however, the logogram shows more stylized shapes and conveys the image of a rectangular piece of cloth (Nosch 2012, 316). In his work on Linear A, David Packard (1974, tab. 6) transcribed logogram AB 54 not as TELA but as LOOM and AB 54+*KU* as LOOM+*KU*. This square shape seems iconic to the concept of loom and textiles in the Aegean Bronze Age graphic traditions. It is also found in other ancient scripts, such as cuneiform (**Fig. 6.13**).
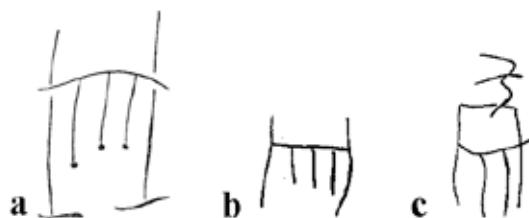
Fig. 6.12: Variations of logogram AB 54: textile or a loom?

Token (4th mill. BC)	Pictograph (end of 4th mill. BC)	Archaic forms of the cuneiform sign (3rd to 2nd mill. BC)	Standard form of the cuneiform sign (1st mill. BC)

Fig. 6.13: Textile signs and their developments in Mesopotamia through processes of abstraction and simplification, first as tokens and then on clay tablets. The cuneiform sign TÚG, textile, was then used in the Sumero-Akkadian cuneiform scripts in multiple ways (after Gaspa 2016, 86, tab. 1).

In Linear B, most textile types are recorded with a logogram/monogram (*161*), or a logogram (TELA, *146*, *164*: **Fig. 6.14**), often including a ligature positioned as an endogram designating the name (TELA+*TE*, TELA+*PU*, TELA+*KU*, *146* including *WE*). Only a few occasional hints are given concerning the full textile name that they abbreviate, but based on information elsewhere in the texts we know that TELA+*TE* stands for *te-pa* and TELA+*PU* for *pu-ka-ta-ri-ja*. Accordingly, we assume that logogram *146* includes the syllable *we* as an abbreviation for *we-a$_2$-no*, even though this term is only attested twice at Pylos (Nosch 2012).

In the earliest attestations of Linear B, in the *Room of the Chariot Tablets*, TELA and *161* appear as standardized as in the later parts of the Knossos archives, and we can hence observe that in LM IIIA1, the graphic types of *161* and TELA were readily fixed in their form, and perhaps also earlier.
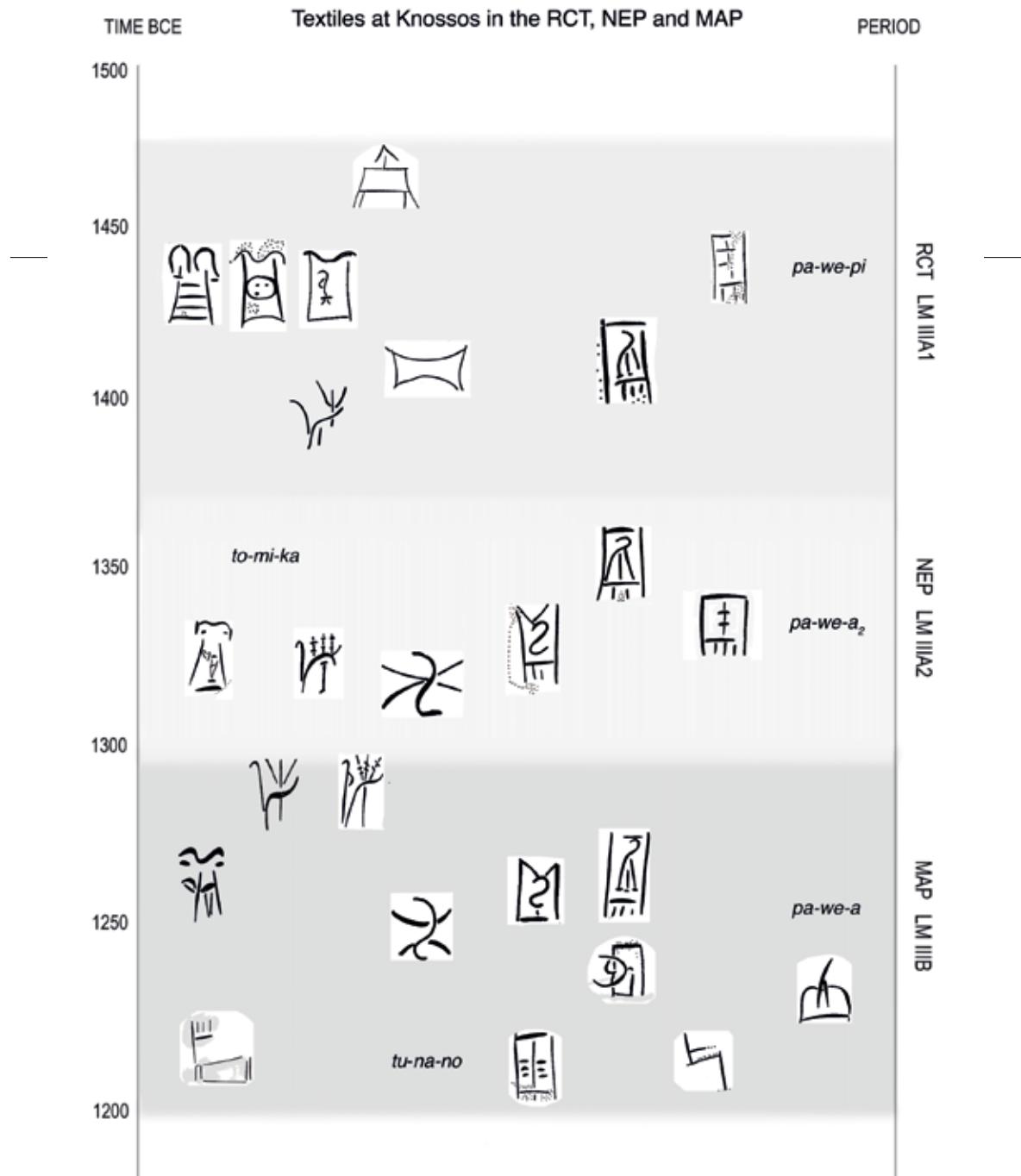
Fig. 6.14: Linear B textile logograms at LM III Knossos (RCT = *Room of the Chariot Tablets*; NEP = *Northern Entrance Passage*; MAP = *Main Archive Phase*) (after Nosch 2024).

The extensive use of ligatures seems to be a convention inherited from Minoan administrative practice. It stands in contrast to the developing Mycenaean administrative convention of *scriptio plena*, which writes the full name of the textile combined with the plain TELA logogram. Hence, *tu-na-no* and *to-mi-ka* cloth names are always written out, and *pa-we-a/pa-we-a$_2$* are, despite a few early attestations of TELA+*PA*, fully part of the *scriptio plena* convention (Nosch 2012, 323; 2022).

NEW EVIDENCE: MINOAN *KA* TEXTILES?

Recently, in the *Ivory Repository* at Knossos, an ivory object with rich Neopalatial Linear A inscriptions (**KN Zg 57**, **58**) came to light, and on face C there are textile logograms. The spectacular find has been the subject of a preliminary publication by the excavator Athanasia Kanta, Dimitri Nakassis, Tom Palaima and Massimo Perna (Kanta et al. 2024). This material was still unpublished when the paper was presented and first drafted and we are grateful for their permission to incorporate the new textile logograms at that stage.

As a preliminary observation, we note that there are five textile logograms on the new find; one with visible fringes above and below (similar to the sign *163 in Cretan Hieroglyphic) and even with fringes on the left and right sides; other textile logograms are incised with fringes only on the lower edge. All five look very standardized, with endograms neatly fitted inside the rectangular frames. They seem more regular than the Linear A textile logograms from Hagia Triada, and appear similar to the TELA *159 logogram of Linear B. Once fully published, the number of known Linear A textile logograms will double, both in terms of number and types. At least one of them is new, AB 54+77, and would correspond to *TELA+*KA* in Linear B – which is so far unattested. There is no known textile with a name starting with *ka* in Linear B. However, Palaima (2020b, 127) recently suggested interpreting Linear B *ka-zo* from the loan word *kalkʰā* (historical Greek κάλχη) used for the murex, the marine mollusk, and for the purple dye. This would yield a technical textile word beginning with *ka*, which could be a loan from Minoan. Accordingly, AB 54+77/*TELA+*KA* may possibly denote a purple-dyed textile. Purple dye technology with murex sea snails is well attested in Crete from the early Middle Minoan in MM I/IIB Kommos, MM I Petras, MM Kouphonisi, Palaikastro and Kato Zakro (Burke 2010, 36–7) and, as demonstrated by Brendan Burke (1999; see also Berger et al. 2020, 55–8), purple dye from murex is attested earlier in Crete than in Syria. It would hence not be surprising to have a Minoan term for purple-dyed textile.

Alternatively, *KA* could be related to a Minoan term found in composite signs on two Hagia Triada tablets, again with a relation to textiles: *JA+KA* (**HT 24b**.2) and *A+KA* (**HT 38**.2) seem thus to appear in large quantities and in contexts where textiles also appear. An alternation between *A* and *JA* in an initial position is not unusual in Linear A (Packard 1974, 79 n. 24), and composite signs could be read both upwards and downwards. However, Maurizio Del Freo (2020, n. 18) observes that the *KA* sign was possibly drawn after *JA* and *A* on the two tablets from Hagia Triada.

CHRONOLOGY

The documents with Linear A textile logograms from Hagia Triada and Khania belong to the LM IB period, and the Linear B tablets from the *Room of the Chariot Tablets* to LM IIIA1 (Salgarella 2020, 42–3). Jan Driessen (2000, 151–57) observed that some Linear A graphical features were more present amongst the writing styles of the scribes of the *Room of the Chariot Tablets* than in other Knossian deposits, and Helena Tomas (2017b) has demonstrated the proximity between Linear A tablets and the Linear B tablets found in the *Room of the Chariot Tablets* in terms of tablet shape and physical features.

Therefore, it is striking that none of the (potential) ligatured textile logograms in Linear A (AB 54+*TE*, AB 54+*KU*, *164, AB 54+*ZO*, AB 54+*KA*, AB 54+*ṢẸ*) occur as textiles in the *Room of the Chariot Tablets*, which is the nearest in time to the Linear A tablets. Instead, in the *Room of the Chariot Tablets*, other textile logograms occur (TELA+*PA*, TELA+*PU*, *161, *165/*166, *178, TUNica (*162) alone or with the endograms *QE* or *RI*) (Nosch 2024).

In the *North Entrance Passage* that some scholars believe could also be an older deposit (Driessen 1999; Firth and Skelton 2016a; 2016b; Skelton and Firth 2016; Mouthuy 2020; Pierini 2024), likewise, none of the ligatured Linear A textile logograms are attested in their Linear B counterparts.

Instead, the Linear A ligatured textile types AB 54+*TE*, AB 54+*KU* and *164* appear in the latest phase (LM IIIB) of the Knossos palace (Nosch 2024). Likewise, *168+SE*, which may correspond to Linear A AB 54+09, is attested in the LM IIIB phase of the *West Wing* by Hand 119 and not in the older phases. AB 54+*ZO* may correspond to TELA+*ZO* attested on three Linear B tablets in Knossos, yet with much uncertainty about find-spots, scribal hands and dates (Melena 1975, 109–10; Nosch 2012, 334; 2024, 325–26, n. 14). It is also worth noting that Linear B TELA+*KU* and *164* textiles are only known at Knossos, not on the mainland, so we could suggest that they are Minoan or Cretan types of textiles with a Minoan pedigree (Killen 1984, 51). The situation is different for TELA+*TE* because this textile type is widely known both on Crete and on the mainland and at an early stage as well, in the Pylos *Megaron* tablets (LH IIIA), and at Mycenae (LH IIIB) and Thebes (LH IIIB). We may suggest that TELA+*TE* represents a Minoan textile type that became very widespread in the Mycenaean palaces, or that it is a Mycenaean textile type (Nosch 2022). The latter interpretation would question the identity of AB 54+04 (**TEL Zb 1**) as TELA+*TE* and also cast doubt on the *TE* on the ostracon at Akrotiri (**THE Zg 5**) as evidence for a textile type.

There seems to be a quite seamless chronological script transition in Crete from the LM IB use of Linear A textile logograms to the painted textile of the skirt of the figurine bearing a Linear A painted inscription dated to LM IIIA1 from Poros near Knossos (**PO Zg 1**) (Dimopoulou et al. 1993) and the contemporary *Room of the Chariot Tablets* of Knossos with the fully established repertoire of wool and textile logograms of the Linear B script (TELA+*PA*, TELA+*PU*, *161*, *165/*166*, *178*, TUN, TUN+*QE* or TUN+*RI*). This was swiftly followed in LM IIIA2 in the Knossos *North Entrance Passage* with records of the same kinds of textiles, such as TELA+*PU*, TELA+*PA*, *161* TELA and some slightly altered or new types: *146*, *to-mi-ka*, *166+WE*, *pa-we-a₂*, and TUN+*KI* (Nosch 2024). At the same time, on the Greek mainland, textile logograms TELA+*TE*, *166*, and *166+WE* occurred in the Pylos *Megaron* tablets (LH IIIA). Later, in LM IIIB/LH IIIB, all Mycenaean palace sites used a range of the same textile logograms, such as TELA+*PA* and *146* from LH IIIB Hagios Vasileios (Vasilogamvrou et al. 2024). In LM IIIB1 Knossos, TELA+*PU*, TELA+*TE*, *pa-we-a* and *tu-na-no* TELA, TELA+*KU*, *158*, and *168+SE* were recorded. TELA+*TE* appears in LH IIIB2 Pylos, and on LH IIIB mainland sites Mycenae and Thebes TELA+*TE* is attested indirectly via the textile name and the occupational title for the women who wove *te-pa* (**MY Oe 107** *te-pa-i*, **TH Of 35** *te-pe-ja*, **PY Ad 921** *te-pe-ja-o*).

Some textile logograms are so far only attested at Knossos and are hence what Petrakis (2017a, 134–46, tabs. 2–3) terms "local sematograms" (i.e. logograms): *158*, *164*, *161*, *168*, and *178*. Likewise, *tu-na-no* and *to-mi-ka* seem to be Cretan local textile terms. Some of them may be Minoan textile types and names. It may be worth noticing that Knossos alone demonstrates more variety in textile logograms and names than all Mycenaean mainland sites together.

ADMINISTRATION OF TEXTILES AND WOOL FROM MIDDLE MINOAN TO LATE MINOAN I CRETE

In Middle Minoan Crete, there are several kinds of links between weaving, wool, textiles and administration: the MM IIB Malia Quartier Mu lamé has two Cretan Hieroglyphic P41 signs resembling a textile (Younger 2005). Brendan Burke suggests that some MM IB–II prism seal stones may depict discoid loom-weights on a warp-weighted loom (Burke 1997, 418–19; 2010, 44–7; see also Ulanowska 2017; Cutler 2021, 66). Loom-weights with seal impressions came to light in Middle Minoan Phaistos, Petras, Zakro, Amnissos and Malia (Burke 2006, 283; 2010, 43; Militello 2007, 41). Furthermore, there are possible iconographic links between textile production and Middle Minoan inscribed seals (Nosch and Ulanowska 2021).

Wool occurs on Linear A tablets with close links to noduli, as Maurizio Del Freo has demonstrated in Hagia Triada (Del Freo 2020). This slightly challenges the view that in Minoan administration, sealings and tablets do not represent consecutive stages of the same information processing and that tablets and sealings do not overlap

in their scope. According to Ilse Schoep (2001, 62) "Linear A tablets formed a more or less autonomous body of information, which existed independently from the sealed documents, and were kept in separate locations".

The Linear A sign for wool, AB *MA+RU*, occurs on tablets from Phaistos (**PH 3a**.3), Khania (**KH 43**.1) and Hagia Triada (**HT 12**.4–5, **24a**.1–5) (Cutler 2021, 67). On the basis of **HT 24**, it was demonstrated that the 45 units of wool recorded are linked to 45 noduli found nearby, all impressed by what was probably a gold ring with a seal image depicting a boat (*CMS* II,6, no. 20). The owner or bearer of this ring could have played an important role in the wool administration of Hagia Triada, who was monitoring the 45 units of wool delivered to the center. Del Freo (2020, 56) suggests that the wool on **HT 24** was received as already spun yarn, since very few spindle whorls have come to light within the Hagia Triada Villa. We believe this is less likely, since wool yarns should be spun according to what fabric quality was aimed at and whether they were meant for warps or wefts.

The Linear A cloth logogram AB 54 appears on two kinds of administrative documents in Hagia Triada: on roundel **HT Wc 3019** and on tablets **HT 16**.2, **20**.4 and **38**.3. These different Hagia Triada documents are all from the Villa but from different rooms: tablets **HT 16**, **20** and **38** are perhaps from Room 59 (Militello 1992, 412, n. 8), while roundel **Wc 3019** is probably from the area corresponding to Rooms 3, 11 and 13 (Del Freo et al. 2010). Linear A logogram AB 164 has its counterpart in Linear B textile logogram **164*. AB 164 appears on at least eleven roundels in Khania (**KH Wc 2036–2045**, **2095**, **2111**).

In Akrotiri, Linear A tablets recording 200 pieces of TELA+ṢẸ from Complex Delta were brought to light (**THE 8**: Boulotis 1998), and an ostracon from the same site, regrettably without secure context and date, records quantities next to single syllabic signs. It has been suggested that these syllabograms abbreviate textiles and wool: *MA* may stand for wool and *PU*, *TE*, *ZO*, and *TA* may stand for Minoan textile names (**THE Zg 5**: Michailidou 1992–1993; Boulotis 1998; Burke 2010, 49). As there is no sign of the textile logogram AB 54, the interpretation remains uncertain yet plausible.

The logogram for a basket (A 417ᵛᴬˢ) occurs on two roundels from Khania (**Wc 2006**, **2007**; see Hallager 1996 [I], 111; II, 44–5). Since it resembles a typical κάλαθος/*kalathos* known from Classical Greek art and text sources as a basket used to store wool (along with other uses), this basket may provide another possible, yet speculative reference to the textual evidence of the Minoan textile industry.

A salient feature of Minoan wool administration is that a unique measure exists for wool, as is the case in some contemporary Near Eastern palace administrations. Finds of archaeological balance weights along with comparison with Near Eastern texts demonstrate how the weight of the biological fleece of c. 750 grams had been synthesized into a wool measurement system in which four fleeces correspond to one wool unit (c. 3 kilos) of six minas, or one tenth of a talent (see Nosch 2014 and Del Freo 2020 for references). The wool units could be divided into thirds as M 1 (one double mina, c. 1 kg) or in 1/12th fraction (250 grams). The value of the fraction sign A 717 (**PH 3a**.3) is not known, but its shape is identical to the double mina (M) of the Linear B texts. On this, Del Freo (2020, 56 n. 13) concludes: "This seems to be a point of convergence with the Mycenaean weight system". The specialized wool unit system may be another Minoan legacy that the Mycenaeans adopted.

MINOAN TEXTILE TERMS CONTINUED IN LINEAR B

Apart from the wool and textile logograms, there are other indications of Minoan textile terms in the corpora of Linear A and Linear B. On **HT 24**, wool is associated with the syllables AB 67 (*KỊ*) and AB 13 (*ME*), which may abbreviate Minoan words for the wool type or quality, and Del Freo (2020, 57–9 and nn. 16, 26) associates *KI* with the frequent abbreviation *ki* on Linear B sheep tablets, and *ME* with substrate terms for cord or string. Some Mycenaean textile terms have no known correspondence in later Greek or in Semitic languages and may be inherited from Minoan; this was suggested for the textiles *tu-na-no* with the ending *-ano*; this ending is, however, also attested in *we-a₂-no*, which became integrated into the historical Greek clothing vocabulary as *heanos*.

It may be coincidental, but some Linear A syllabograms that become extremely rare in Linear B are often used for textiles: the syllabogram AB 34 continues to be in use in Linear B but is confined to the earliest deposits at Knossos, the *Room of the Chariot Tablets* and the *North Entrance Passage*, and this rare sign, whose phonetic value is not known, survives in terms for a textile type or quality, *a-*34-ka* in Knossos (Pierini 2024) and]*pu₂-*34-*[•] and perhaps *a-*34̣-ṭọ* in Pylos (*PoN IV*, 360). The syllabogram AB 56 continues to be in use in Linear B as **56* (the phonetic value is not known) in toponym **56-ko-we* and cloth decoration term **56-ra-ku-ja*, probably a color of a textile. The latter may be related to *pa-ra-ku*, σμάραγδος, that could be from the Semitic root **brq*, "to shine", cf. Hesychius βαρακίς, Akkadian *barrāqtu*, and Hebrew *bāreqet*, or from the Semitic root **wrq*, "of green color", from which derives the adjective *(w)arqu*, "green" and the name of a (green?) precious stone, *wa-ru₁₂-ga-tum*, attested in late 3rd millennium documents from Ebla (Piquero 2015, 43–54). In any case, Palaima and Sikkenga (1999, 603) suggest that "this term is a loan word probably borrowed from Semitic into Minoan and then from Minoan into Greek in order to describe a special colour of cloth".

Palaima (2020b, 126) likewise suggests that the term for purple attested in Mycenaean Greek as *po-pu-re-jo* and *po-pu-ro*, could be inherited from an Aegean language such as Minoan, because of its reduplication: "Porphurā has no convincing Indo-European etymology, and the proposal by Pierre Chantraine (Chantraine et al. 2009, 896–97, s.v.) –that it is likely a Semitic borrowing (albeit source unknown) from the Near East– is derived historically from the first edition of Chantraine's *Dictionnaire Étymologique de la Langue Grecque* (1968), published at the stage of scholarly research when the origin of the purple-dye industry was generally associated with the Phoenicians, and before the early existence of the Cretan dye industry was well documented. In fact, no convincing Semitic source word has been suggested. We should note that Robert Beekes (2010, vol. 2, 1223–4, s.v.) considers the word as coming from a Mediterranean language. In fact, the root has a feature that strongly suggests that it is Minoan in origin – reduplication in its morphology: pV1r-phV2r (Palaima and Bibee 2014, 354). The existence of a second term likely derived from an "Aegean" substrate leaves *porphur-* as a good candidate for "Minoan" origin."

TEXTILE TECHNOLOGY CONTEMPORARY TO THE LINEAR A LOGOGRAMS FOR WOOL AND TEXTILES

Extensive analyses of Bronze Age textile tools have been conducted in the past decade, and it is therefore possible to compare spindle whorls and loom-weights that are contemporary to –and from the same sites as– the Linear A records recording wool and textiles (Burke 2010, 50–63; Andersson Strand and Nosch 2015).

Regarding spindle whorls, "Minoan spindle whorls have been a source of quiet consternation among Aegean prehistorians for some time", writes Brendan Burke (2006, 282), highlighting the dilemma that so few spindle whorls are recovered in Crete compared to the numerous loom-weights (Militello 2007; Burke 2010, 50; Andersson Strand and Nosch 2015). Here, we briefly review the textile tools from the sites where Linear A inscriptions concerning wool and textiles have come to light.

In Phaistos, from MM IIB to MM IIIB, no loom-weights were recovered within the palace complex (Militello et al. 2015a, 215–28, especially 217; Cutler 2021, 111), but 34 loom-weights were found in the large building at Chalara below the palace in a LM IB deposit (Militello et al. 2015a, 223–24; Cutler 2021, 111). Most of them are spherical and could work in one set-up to weave a fabric of medium to coarse quality with 3–7 threads/cm and 20 grams warp thread tension (Cutler 2021, 111). Only one spindle whorl is preserved from the same building (Militello et al. 2015a, 226; Cutler 2021, 112).

In nearby Neopalatial Hagia Triada, several deposits of loom-weights were uncovered, and a total of 58 loom-weights (of which 43 are spherical and the rest discoid, cylindrical, spool or torus shaped) are dated to the LM I period (Militello et al. 2015b, 207–14). Spherical loom-weights came to light in Room 27 in the South-West

quarter of the *Villa Reale* (Militello 2007; Burke 2010, 49), and nearby 45 noduli and Linear A tablet **HT 24** with the wool logogram were found (Militello 2007, 38–9; Cutler 2021, 112). Likewise, in the northwestern quarter of the *Villa Reale* a deposit of 80 spherical loom-weights was discovered, and groups of spherical loom-weights also came to light in two elite houses, *Casa delle Sfere Fittili* and *Casa del Lebete* (Militello 2007, 42; Del Freo 2020, n. 38).[2] In the *Villaggio* and in *Casa della Mazza di Breccia* more groups of loom-weights came to light (Militello et al. 2015b, 210–13). Most of the spherical loom-weights at Hagia Triada could work to weave a tabby of medium to coarse quality with 3–5 threads/cm and 25–30 grams warp thread tension (Cutler 2021, 113). "The predominance of spherical loom-weights at the site suggests a focus on the production of more open and/or weft-dominant/-faced fabrics", as Joanne Cutler concluded (Cutler 2021, 113). Only one spindle whorl is preserved from a Neopalatial context at Hagia Triada (Cutler 2021, 113).

In Khania, in the houses excavated in the Hagia Aikaterini Square, 48 loom-weights were recorded in House I (dated LM IA–B), especially in the rooms M and E of House I. In room M, mainly spherical loom-weights were recorded, requiring c. 15–20 grams warp thread tension and suitable for open tabby cloth of medium quality with c. 4–7 threads; in room E, 32 loom-weights were recorded, of which 29 were spherical; they were suitable for thicker warp threads of 35–40 grams warp tension and a weave of c. 3–6 threads/cm. Only one LM I spindle whorl was uncovered in House I (Bruun-Lundgren et al. 2015, 197–206; Cutler 2021, 157–59).

In Knossos, the evidence for loom-weights is impressive and testifies to a shift in weaving traditions or production. In the MM IIB Protopalatial *Loom Weight Basement* of the palace more than 400 discoid loom-weights came to light, while in the following Neopalatial phase, no loom-weights have shown up inside the palace, but numerous loom-weights have been found in the surrounding sites and buildings, and they are dominantly spherical in shape, with a few cylindrical additions (Burke 2010, 50–63; Cutler 2021, 70–106). The loom-weights from the MM IIB *Loom Weight Basement* weigh 128–200 grams and are 1.5–2.5 cm thick and would work well with 10 grams warp thread tension in a weave of 13–20 threads/cm (Burke 2010, 56–8; Cutler 2021, 70–1). They are remarkably uniform in shape, weight, size and clay (Burke 2010, 57–8).

Spherical loom-weights are very well attested around the Knossos palace in LM IA/B. In the houses excavated by David Hogarth, mixed material of MM IIIB–LM I pottery and 69 loom-weights, most of which are spherical, were uncovered, useful for weaving a range of fabrics with thin to medium yarns in set-ups with 10–30 grams warp thread tension (Cutler 2021, 90–2). In the *House of Ivories*, 11 spherical or cylindrical loom-weights in a LM IA context and 23 spherical loom-weights dated LM IB of a weight range of 111–583 grams were uncovered; most of them were suitable for 10–25 grams warp thread tension (Cutler 2021, 75–7). In the LM IB layer of the *North Building,* 79 spherical loom-weights came to light, of a large weight range of 97–632 grams (Burke 2010, 54; Cutler 2021, 77–82). In the *Acropolis House* of LM IA/B date, 55 loom-weights were found, mostly spherical and a few cylindrical, suitable for a warp thread tension of 10–30 grams and working in a weave of 4–9 threads/cm (Burke 2010, 54; Cutler 2021, 85–9). In the *Unexplored Mansion*, 150 loom-weights in LM IA–LM II context were recorded; 137 of them can be dated to LM II and they are all spherical and of a wide range of weights (86–767 grams). The majority of them work with a 15 gram warp thread tension, but a group of them would work with 30–40 gram warp thread tension, for thicker yarns and coarser fabric (Burke 2010, 52–3; Cutler 2021, 92–8).

We can conclude that at Knossos, discoid, standardized, Protopalatial MM IIB loom-weights were used in loom set-ups with a 10 gram warp thread tension for fine and densely-woven fabrics. In the LM I Neopalatial period, in contrast, weavers used spherical and a few cylindrical weights of a larger weight range; this would enable them to weave a larger variety of weaves and to use different yarns of 10–30 gram warp thread tension. This practice seems to continue in the LM II Final Palatial period, as illustrated by the spherical loom-weights in the *Unexplored Mansion* (Cutler 2021, 10).

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2 *Sphere fittile* in Italian refers exactly to the spherical clay loom-weights.

In conclusion, the sites with Linear A inscriptions mentioning textiles and wool have long-standing weaving traditions. Phaistos, Hagia Triada, Knossos and Khania use quite similar spherical loom-weights and it is plausible that these loom-weights were used to produce textiles of the type *164 and AB 54.

Pietro Militello (2007, 36) envisions that "Minoan palaces were more textile consumers than textile producers", and, indeed, the epigraphical and archaeological evidence suggest a more decentralized and smaller Minoan textile production compared to the later large-scale Mycenaean textile industry. "Some centres, notably Knossos and potentially also Phaistos, Hagia Triada and Chania, appear to have been focusing on the production of more open-warped fabrics, many of which are likely to have been weft dominant/faced, in the Neopalatial period, while others (Kommos, Mochlos and Pseira) were weaving denser fabrics, that could have been more balanced" (Cutler 2021, 257). The yarn production for the textiles plausibly took place in other places, because so few spindle whorls have come to light in the palaces. Indeed, Militello (2007, 41–2, 44, 47) observed that in the period of the second palaces, contemporary to the Linear A inscriptions, textile tools are not found in the palaces but instead in the Villas, such as at Hagia Triada. In MM Malia, both spherical and discoid, as well as numerous other kinds of loom-weights, were in use (Cutler et al. 2013).

In Akrotiri, weavers did not use spherical but rather discoid loom-weights to weave. More than 800 such discoid loom-weights have come to light in archaeological excavations in the LM IA town (Tzachili 2007; Tzachili et al. 2015, 243–46; Vakirzi 2019; Cutler 2021, 219). Discoid loom-weights are also massively present in the Protopalatial Knossos palace, in particular in the MM IIB *Loom Weight Basement*. Jill Carrington Smith (1975, 275; see also Burke 2010, 56) considered these discoid loom-weights iconic and cultural diagnostic features of the Minoans; yet, outside the Knossos palace, weavers seemed to prefer spherical loom-weights instead, or both. This means that Cretans and Therans both used the same warp-weighted loom for weaving, yet chose different shapes for loom-weights.

A major textile innovation of the Bronze Age was the introduction of sails, probably from maritime technology of the Levant, with ramifications for the construction of deep-hulled and keeled vessels. Masts and sails appear in Aegean iconography from the end of the 3rd millennium and are famously represented on a miniature wall painting from the Late Bronze Age West House at Akrotiri. Cyprian Broodbank (2000, 99, 341–45) does not discuss sails as technology but hypothesizes that sailing ships "transformed interaction between the Aegean and areas to the east" and facilitated trade and contacts (Broodbank 2000, 341). Moreover, sails would have massively increased textile production; estimates from classical Greece suggest four years full-time work for one person to make a mast sail and a board sail (Spantidaki et al. 2023). It is therefore noteworthy that we do not have traces of sails and sail production in the written sources, neither in Linear A nor in Linear B.

CONCLUSIONS

The essentialist view of Greek culture and identity as a coherent and continued value system expressed in Classical Greece was challenged with the decipherment of Linear B. The decipherment expanded the idea of what Greek society means and added 500 years to the history of it. As John Bennet (2008, 5) puts it, "prehistoric Greece was now directly linked to classical Greece by the *thread* of a single language". Linking the Greek speaking Mycenaeans and the Classical Greeks was the late 20th century concern; in the 21st century, a new task is to explain *what threads* may connect the Minoans and the Mycenaeans.

While languages and scripts can work as diagnostic features to distinguish cultures or the groups that we term with the modern ethnic labels of Minoan and Mycenaean (see, e.g., Salgarella 2020, 22–6), textiles and wool seem to bridge these boundaries. Indeed, one could argue that textiles and wool form a bond and –metaphorically speaking– a "bundle" between Linear A and Linear B.

Salgarella (2020, 39) states that "[f]rom a palaeographical point of view, Linear A and Linear B are remarkably similar, the main difference being observable in the weights and measure systems and the logographic repertory".

Here we have argued that from the perspective of textiles and wool, these differences are minor, and our study can, to a large degree, confirm the continuity argued by Salgarella.

Bearing in mind the presence of various logograms for textiles in Linear A, we might question previous statements on Linear A administrations describing them as mainly concerned with agricultural commodities, and less with craft goods, focusing on the collection and distribution of agricultural commodities (Schoep 2001, 60–1). Moreover, given the substantial time needed for textile production, it is fair to qualify textiles as high-quality crafted products and to question the statement that "no real luxury products can be identified among the ideograms" (Driessen 1997, 216; see Palmer 1997). From the textile perspective, we can again ask the old, yet still relevant question of where Linear B was created. On the basis of the textual evidence, we can assume that the creators of the script knew the Linear A syllables well, and also knew Minoan textile types. They maintained the wool and textile logograms of the Linear A script, yet chose to re-design and create new logograms for other commodities; apparently, other Minoan logograms did not seem as functional to them as the Minoan textile and wool logograms, which they adopted with hardly any changes.

If created in a bilingual environment, there seems to have existed a shared knowledge and culture of syllabic writing, because so many signs were adopted and only few new added. And in this bilingual environment, there was also a shared knowledge of textiles and wool, of textile types and qualities. John Bennet (2008, 19) suggested that the adaptation of the script "can be seen as part of the appropriation of exotic materials and knowledge by the early Mycenaean elite, most prominent in the period of the Shaft Graves at Mycenae".

Indeed, the adaptations of the script must have been undertaken by people who knew Minoan syllables and textiles well, and this shared knowledge suggests Crete, and Knossos in particular, as the place where the Linear B script was created (see Petrakis 2017a, 146; Petrakis 2017b with further literature and arguments). The evidence assembled and discussed above allows us to suggest that those who transformed the use of Linear A into Linear B were people who knew and appreciated the Minoan textile and wool logograms and who also found them useful also for a new administration.

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7

The Impact of the Chronological Framework on the Study of Minoan and Mycenaean Writing and Sealing Practices

Ilse Schoep

University of Leuven
ORCID ID: 0000-0001-9236-8993

ABSTRACT

The Minoan chronological framework and the way time has been carved up in Pre-, Proto-, Neopalatial and Final palatial blocks of time has had a profound impact on the reconstruction of major cultural developments in Minoan society in general, and on the identification and characterization of script and administrative systems in particular. The main horizons of change in writing and sealing practice and the ways these have been explained are by and large products of these blocks of time. A block-time approach tends to situate change at the beginning and at the end of blocks, thus creating upheavals and masking the process of continuous change throughout the periods. These upheavals are then interpreted as the result of historical and cultural changes, while at the same time providing an explanation for the latter. In this paper, I will examine the so-called Third Upheaval, a term coined to designate the drastic changes in writing and sealing practices between the Neopalatial and the Final Palatial time blocks.

INTRODUCTION

The Minoan chronological framework is not a neutral tool but has shaped the discourse of cultural changes and the way the latter are explained. It goes back to Arthur Evans who, in order to make sense of the stratigraphic sequence at Knossos, adopted the Three Age System common in Europe in the 19th century, thus dividing the Cretan Bronze Age into an Early, Middle and Late stage, each which further tripartite divisions (Warren and Hankey 1989; Manning 2010). The problems regarding such tripartite structure, which was inspired by a biological metaphor and the concept of evolutionary progress, have been discussed elsewhere (e.g., *LM IB Pottery* 1-2; Momigliano ed, 2007; Macdonald and Knappett 2013; Warren and Hankey 1989). Because of the difficulties in relating what are in essence ceramic styles with cultural developments island-wide, an alternative system based on the biographies of the Minoan Palaces was originally proposed by Nikolaos Platon (e.g., 1956). In one of its currently accepted forms, the framework consists of five major blocks of time, each aggregating several ceramic periods (**Table 7.1**): (1) the period preceding the construction of the First Palaces (Prepalatial period, EM I–MM IA), (2) the construction of the First Palaces in MM IB, their use-life (MM II) and destruction in MM IIB/MM IIIA (Protopalatial period, MM IB–MM IIIA), (3) the construction of the New Palaces in MM IIIB and their destruction in LM IB (Neopalatial period, MM IIIB–LM IB), (4) the (re)use of the Palace of Knossos as the only remaining Palace (LM II to IIIA2) (Monopalatial or Final Palatial period) and

(5) the Postpalatial period, which is set to begin after the final destruction of the palace at Knossos (LM IIIA2 or LM IIIB, see Hallager 2010a).

Table 7.1: Chronological Table (after Manning, 2010, Table 2.2)

Cultural Phase	Ceramic Period	Script	Absolute Dates
Prepalatial Period	EM I		3100–2650 BC
	EM IIA		2650–2450/00 BC
	EM IIB		2450/00–2200 BC
	EM III	Archanes Script	2200–2100/2050 BC
	MM IA		2100/50–1925/00 BC
Protopalatial Period	MM IB	Linear A, Cretan Hieroglyphic	1925/00–1875 BC
	MM II		1875/50–1750/00 BC
	MM IIIA		1750/00-1700/1675 BC
Neopalatial Period	MM IIIB	Linear A	1750/00–1700/1675 BC
	LM IA		1700/1675–1625/00 BC
	LM IB		1625/00–1470/60 BC
Monopalatial or Final Palatial Period	LM II	Linear B	1470/60–1420/10 BC
	LM IIIA1		1420/10–1390/1370 BC
	LM IIIA2		1390/70–1330/15 BC
	LM IIIB		1330/15–1200/1190 BC
Postpalatial Period	LM IIIC		1200/1190–1075/50 BC

Such one-fits-all framework does not take into account regional trajectories (see Macdonald and Knappett 2013, 1–2), but even more problematic is the fact that these blocks of time and their chronological labels do not merely place developments in a chronological sequence but *shape* our arguments (Crellin 2020, 6; Griffiths 2017; Harris 2014). Blocks of time are characterized as having a certain set of characteristics that differ drastically from what came before and that which comes after, thus creating a history of big changes (Crellin 2017, 111). Because change is situated at the beginnings and at the ends of blocks (Crellin 2020, 6, 18), the process of continuous change throughout the time blocks is masked and change is presented as drastic, mono-causal and event-driven (see also Whitelaw 2022). The breaking up of the Cretan Bronze Age into Pre-, Proto, Neo- and Final Palatial blocks did not only create the impression of monolithic, static blocks interspersed by rapid change, but has also shaped the discourse of cultural developments. Despite the fact that it is widely understood that these labels do not accurately reflect the biographies of the Minoan Palaces (e.g., Momigliano 2007, 2; Macdonald and Knappett 2013, 1; Schoep 2012; Tomkins 2018) –leave alone other cultural developments– they are still widely used as handy short-hand labels. That this is not without danger is illustrated by the Prepalatial block, which suffered for many decades from being studied in opposition to the Protopalatial block, rather than on its own merits (cf. Day et al. 1997; Schoep 2012; Tomkins 2018). Another danger is illustrated by the discussion of MM IIIA, whether belonging in the Protopalatial or the Neopalatial block (Macdonald and Knappett 2013). If the former, MM IIIA runs the risk of remaining a transitional period or "intermezzo" (Macdonald and Knappett 2013), but if the latter, it becomes an act in itself "with important advances in the

areas of art, script and architecture", while MM IIIB then becomes "a phase of consolidation and dissemination of the Neopalatial traits that had begun to appear at Knossos" (Macdonald and Knappett 2013, 4). It is clear that what is transitional depends on and shifts with our analytical perspective (cf. Robb and Harris 2013, 19) and that the labels we give to chronological sequences provide *and* shape our explanatory models (Lucas 2005).

THE BLOCK-TIME APPROACH AND THE DISCOURSE OF WRITING AND SEALING PRACTICES

It should not come as a surprise that the discourse of changes in writing and sealing practices more or less follows the cultural developments implicit in the Minoan chronological framework (**Table 7.1**): the emergence of "real" administration and script in MM IB coincides with the Protopalatial period (Weingarten 1990; Palaima 1990; Karnava 2018, 197), the disappearance of Cretan Hieroglyphic (hereafter CH) and the island-wide proliferation of Linear A (hereafter LA) with the end of the Protopalatial and the beginning of the Neopalatial period (e.g., Schoep 1999) and the introduction of Linear B (hereafter LB) with the beginning of the Final Palatial Period (e.g., Bennet 2008). The pattern is clear: major changes in writing and sealing practices generally coincide with major cultural shifts, such as the MM IB emergence of the First Palaces in the Protopalatial period, Knossian expansionism in the Neopalatial period and the "Mycenaean" takeover of Knossos in LM II–IIIA1. Changes in sealing and writing practices are viewed from a punctuated equilibrium model: long periods of stability interspersed by rapid bursts of change, situated at the beginnings and ends of time-blocks; once installed, sealing and writing practices show little change in the middle of the time blocks. Change is viewed as abrupt, drastic and homogenous and is explained by singular causation, mostly changes in political and economic organization. This line of reasoning is clearly circular, since political and economic changes are also posited by reference to changes in sealing and writing practices.

Such a model runs counter to the results of recent archaeological studies of change, which have demonstrated that the dynamic reality of change is obscured by a time-block approach. Thus, for example, studying the Mesolithic and Neolithic in Britain as two opposed and separate blocks of time and ways of life, long obscured the fact that the emergence of the latter was the outcome of numerous small changes that built up over time. Neolithic assemblages did not wipe out all earlier practices (Fowler 2013; Harris 2014, 338–40; cf. Crellin 2020, 175, 221–23), but innovations were added to existing assemblages and should be understood "in the light of the worlds they enter into" (Crellin 2020, 172); once within an assemblage innovations "do, of course, then go on to produce all kinds of emergent and unpredictable changes and to reconfigure and shift the relations between components" (Crellin 2020, 172). Drawing on such insights into the nature of change, I will (re)assess one of the most drastic changes in writing and sealing practices, i.e., the so-called Third Upheaval (cf. Weingarten 1990).

THE "THIRD UPHEAVAL"

Changes in material Culture and Practices in LM II–IIIA1 (ca. 1470/60–1420/10 BC)

The Third Upheaval in sealing and writing practices refers to the drastic changes in sealing and writing practices between the end of the Neopalatial block, marked by the LM IB destructions, and the installation of a new regime at Knossos in LM II–IIIA1 (Weingarten 1990). These changes are considered to form part of a wider horizon of change that includes funerary practices, ceramics, settlement patterns, administration and language. Explanatory models have shifted from the actual conquest of Crete by people from Mainland Greece (Wace 1956; Hood 1985; Popham 1994; Driessen and Macdonald 1997; Wiener 2022) to a more moderate diffusionist model, in which changes are attributed not to the arrival of Greek Mainlanders but to a local, mainly Cretan elite group who took its inspiration from mainland practices (Preston 1999, 2004; Hatzaki 2016; Petrakis 2017b;

Alberti 2018; Driessen and Mouthuy 2022). At the same time, the number of studies arguing that there was considerably more continuity than previously assumed between LM IB (1625/00–1470/60 BC) and LM II–IIIA1 (1470/60–1420/10 BC) seem to be increasing (cf. Niemeier 1983, 217; MacGillivray 1997, 279; Macdonald 2010, 540; Galanakis et al. 2017; Andreadaki-Vlasaki 2022; B. Hallager 2016, 216; 2022; Galanakis 2022; Macdonald 2022), arguing that some of the new LM II–IIIA1 elements may actually find their origins not on the Greek Mainland but on LM I Crete. Because changes in writing and sealing practices cannot be seen in isolation from other practices and other types of material culture but emerge in relation to the latter, I will briefly summarize these recent findings.

Changes in the LM II Knossian funerary landscape of Knossos are now thought to have been less drastic than previously assumed and recent reappraisals suggest that the LM I funerary landscape was not static but highly dynamic, experimenting with and mixing elements that are neither Minoan and Mycenaean (Galanakis 2022). With regards to changes in pottery, Chania has yielded intriguing evidence for Mycenaean pottery shapes (e.g., squat alabastron, S-shaped bowl, piriform jar) and styles in LM I (*LM IB Pottery* 1–2; Andreadaki-Vlasaki 2022; B. Hallager 2022) and although the LM II Ephyraean goblet at present still lacks a clear LM I precedent, it must be stressed that its decoration is entirely Minoan (B. Hallager 2022, 216). Macdonald (2022) recently pointed out continuity in the architecture of the LM II South-West Houses and the LM II–III Palace at Knossos (for a different view, see Whitelaw 2022, 43). The recent reexamination of the Throne Room complex established a LM IB/II date for the latter's construction, but the inclusion of earlier elements such as the lustral basin (Macdonald 2022, 119), the benches and the iconography of the frescoes suggests a strong and intentional continuity (Galanakis et al. 2017; Macdonald 2022). The abandonment of sites following the LM IB destructions (Popham 1980; Rehak and Younger 1998, 148) may also have been less dramatic than previously assumed, as the current evidence for LM II occupation is limited since few sites have been excavated extensively and completely, and relevant ceramic assemblages are few (Whitelaw 2022, 38, 60). In addition, there is the complication that that deposits that look like LM IB may be LM II in date (Buell 2022; Whitelaw 2022, 38, 60).

When looking at the LH I/IIA Mainland, we see Cretan influences and changes in local material culture taking place at different times and in different places, which suggests a highly dynamic LM/LH I landscape that runs counter to the supposed polar geographical and cultural opposites of the Minoan and Mycenaean worlds (e.g., Maran 2011; Day et al. 2022, 380). We should view LM I similarly as a dynamic period with changes that did not all take place at the same time, for the same reason and in the same place. It is against this LM I/LH I background of regionality, fluidity, mobility and historical contingency (Day et al. 2022, 380) that we should (re)view the so-called Third Upheaval in sealing and writing practices.

It is widely accepted that the disappearance of Linear A implies the disappearance of its associated sealing system (against this term, see Panagiotopoulos 2014) and that the appearance of Linear B in LM II–IIIA1 went hand in hand with a new, Mycenaean sealing system. In other words, the current block-time approach led to the creation of two contrasting worlds, one ca. 1750/00–1470/60 BC (**Table 7.1**), where people were writing Linear A script on small page-shaped tablets, using Minoan sealing types and speaking a non-Greek language, and the other ca. 1470/60–1200/1190 BC, where people were writing Linear B on large page-shaped tablets and new palm leaf shaped tablets, using Mycenaean sealings and speaking Greek. What has happened here is that the block-time approach has disconnected these two worlds (see discussion in Salgarella 2020, 22–32), while producing a history structured by revolutions (cf. Crellin 2020, 172). By situating change at the beginnings and ends of the blocks, all the small and continuous changes that happen in the middle are ignored (Crellin 2020, 6, 18, 172).

Limitations of our dataset

Before embarking upon an assessment of the changes in sealing and writing practices between LM IB and LM II–IIIA1, it is imperative to point out that the creation of two radically different worlds (see above) relies upon a dataset that is chronologically and methodologically heterogeneous. Methodologically, the Minoan

administrative system is compiled on the basis of administrative documents from destruction horizons at multiple sites all over Crete (Ayia Triada, Chania, Gournia, Myrtos Pyrgos, Petras, Zakro, Palaikastro, Sklavokambos and Tylissos), whereas the Mycenaean administrative system is based on evidence coming from one site only, i.e., Knossos. Chronologically, both the LM I and the LM III horizons are less homogenous than generally assumed (see below) and it might be misleading to speak of *a* Minoan, Neopalatial and *a* Mycenaean, Final Palatial administrative *system* (cf. Panagiotopoulos, 2014, 299).

Contrary to earlier assumptions (e.g., Weingarten 1990; Palaima 1994; Hallager 1996; Schoep 1999; Montecchi 2019), the LM IB destructions at different sites do not form a contemporary horizon (), as many sites provide evidence of not one but two LM IB destructions (e.g. Platon 2011). This not only suggests that LM IB probably lasted longer than the 25 years originally suggested by Popham (1984), perhaps as long as a century (Manning 2010, Table 2.2., 23; for a recent view see Manning 2022), but also that the LM IB horizon may contain regional *and* chronological variation.

More and more sites have provided stratified evidence for two LM IB fire destructions and not all LM IB administrative documents come from the *final* LM IB destruction. At Ayia Triada, the Villa –which contained the majority of the administrative documents– was destroyed during the first of two LM IB destructions that were identified at the site and not rebuilt. A later LM IB destruction is attested in several houses in the *Villaggio* (Puglisi 2013, 2011a; Cucuzza 2011) but the destruction of the Casa del Lebete seems to be contemporary to that of the Villa. Recent investigations in Room 16B of the south-west wing of the palace at Gournia uncovered two superimposed LM IB destruction layers; the lower one was sealed by a paved floor and contained a fragment of a Linear A tablet (**GO 2**), an inscribed roundel (**GO Wc 3**), a flat-based nodule (Knossian clay?) and a single hole-hanging nodule (Watrous et al. 2015, 437). At Palaikastro, a Linear A inscribed tablet –the only one that displays ruling like later Linear B tablets– was found on a LM IB floor in Block B (room 13), which was sealed by a later LM IB floor (Bosanquet 1903). The tablets and sealings from the palace at Zakro are most likely to belong to the most recent of two LM IB destructions in the palace (Platon 2011). How they relate to the assemblage in Hogarth's House A is not clear, but the possibility that these contexts were not contemporary is real. According to its excavator, the destruction and abandonment of the Country House at Myrtos Pyrgos happened late in LM IB, after Marine Style sherds had been discarded (Cadogan 2011, 146) and at Chania, the documents from Odos Katre 10 were found in an LM IB destruction layer stratified on top of an earlier LM IB destruction level which contained Marine style pottery (Andreadaki-Vlasaki 2011, 2022). Thus, whereas at some sites, administrative documents are associated with an earlier LM IB destruction, at others they were found in the final LM IB destruction, suggesting that the LM IB administrative documents may have a wider chronological range than assumed. This implies that differences between different sites, previously thought to be regional or contextual (Weingarten 1990; Schoep 1999; Petrakis 2017b, 74), may also be chronological.

The absence of securely dated LM IB sealings from Knossos is a major hiatus, which –considering the regional variation in sealing and writing practices– cannot simply be filled in by the projection of sealing (or writing) practices attested elsewhere (Petrakis 2017b, 74). If the LM IB administrative horizon is diachronically more heterogeneous than assumed, then we may pose the question to which LM IB administration we best compare the earliest (LM IIIA1) Linear B administration at Knossos (Room of the Chariot Tablets, hereafter RCT): that at Chania (Odos Katré 10) and the Kato Zakro palace (where tablets greatly outnumber sealed documents), that at Hogarth's House A (Zakro), where there is only 1 tablet to more than 500 sealed documents, or that at the Villa at Ayia Triada, where sealed documents, and in particular single-hole hanging nodules, greatly outnumber the tablets?

Mycenaean administration is reconstructed on the basis of different deposits that most probably belong to different destruction levels (see summary in Whitelaw 2022, 40). The provenance of many Knossian sealings is unknown (Gill 2002) and even when known, they cannot always be dated due to the lack of associated ceramic material; most of them are dated by proxy of Linear B tablets found with them or nearby (in which case they are assumed to be strays from the LB deposit). Although it is widely accepted –and highly likely– that the RCT predates other deposits from Knossos, we do not know by how much and, in addition, there is no consensus

about the date of the latest tablets and the final destruction of the palace, whether LM IIIA2 or LM IIIB (see overview in Whitelaw 2022). Theoretically, documents may date anywhere between LM IIIA1, IIIA2 and LM IIIB, and some may even be earlier although the identification of an LM IB and an LM II phase in the Palace is problematic because very little pottery was retained from the Evans excavations (Hatzaki 2007, 275).

Minoan and Mycenaean sealing practice: two separate Worlds?

The attribution of distinct sealing types to the Neopalatial and Final Palatial time blocks has encouraged the notion of *a* Minoan and *a* Mycenaean administrative system (e.g., Weingarten 1986, 1988; Hallager 1996; 2015), the former incorporating noduli, roundels, single-hole (SH-) hanging nodules, two-hole (TH-) hanging nodules, flat-based (or parcel-) nodules and direct object sealings (Weingarten 1986; Hallager 1996; 2015, fig. 2; for a more diachronic approach see Müller 2002), the latter regular string nodules, irregular nodules, combination nodules, noduli and vase stoppers (Weingarten 1988; Hallager 2005, 2015, fig. 4; Tomas 2012; 2017a, 123). The different nomenclature used in Minoan and Mycenaean sealing typologies must be noted (Weingarten 1986; Hallager 1996; Müller 2002) and remains an issue to be comprehensively resolved (e.g., Montecchi 2017; Karnava 2018).

The perception of Minoan and Mycenaean sealing practice as two separate worlds (cf. Hallager 2015) was further encouraged by the –sometimes implicit, sometimes explicit– notion that sealing types are tied to a particular script and that when a script (dis)appears, its associated sealing types do too (but see Bennet 2005, 270; Tomas 2012; Petrakis 2017b, 70). The emergence of a new script is then connected with the emergence of new sealing types and such link is still widely accepted, although indications to the contrary have been noted: at Petras, an (uninscribed) roundel was found in the MM IIB CH archive (Tsipopoulou and Hallager 2010, 80), and a CH medallion was found on a LM IB floor (Tsipopoulou and Hallager 1996, 39–42); at Knossos, flat-based nodules were found in the Hieroglyphic Deposit, which also contained crescents inscribed with Linear A. Roundel **KN Wc 23** may also be inscribed in CH (see Petrakis 2017b, 81, table 5.3) and the same could be true of **KN Wc 42** and **KN Wc 43**.

It is not my intention in this paper to dispute that there are differences between the LM I and LM IIIA2/B sealings, but that change took place in one place (Knossos), at the same time (post-LM IB) and for the same reasons (implementation of a new political regime). Drawing upon recent research into archaeological change (see above), I will propose that change was not abrupt but continuous and that what we see in the latest deposits at Knossos (LM IIIA2/B, see Whitelaw 2022) is the outcome of a process of numerous small changes taking place over a longer period of time and perhaps in different places. As noted above the differences that exist between the LM I sealings deposits may be regional but also temporal. The time-blocks of LM I (1700/1675–1470/60 BC) and LM II–IIIA2/B (1470/60 BC – 1200/1190 BC) each cover more than two centuries and we are potentially dealing with at least 400 years of sealing practice. This is a long time and sustained engagement with sealings (and tablets) by many generations will undoubtedly have brought about small behavioral and cognitive changes, which then impacted on the material forms of sealings (cf. Malafouris 2013; Overmann 2016; see also Steele and Meißner 2017, 109).

The perception that Neopalatial and Final Palatial sealing practice constitute two different worlds is at least partly the result of the creation of two blocks of time, each with its own types, and has disconnected sealing practice and masked possible similarities (Hallager 2015, figs. 2, 4). In addition, building a typology implies the aggregation of specimens that show small variations into absolute types, thus making types appear more homogenous and rigorous than they were in reality, while "erasing" small differences (Fowler 2017, 95). Types are not unchanging, however, but emerge and change under specific circumstances and as a result of contingency (cf. Fowler 2017). The typological distinction between the LM I "two-hole hanging nodule" and the LM III "regular nodule" masks similarity in practice (cf. Bennet 2005); both were shaped around a knotted string that was attached to a commodity, thus effectively labeling the latter, presumably for transport (Müller 2002; Karnava 2018; Montecchi 2019), and seem to have functioned in the same way. Differences in size, inscriptions,
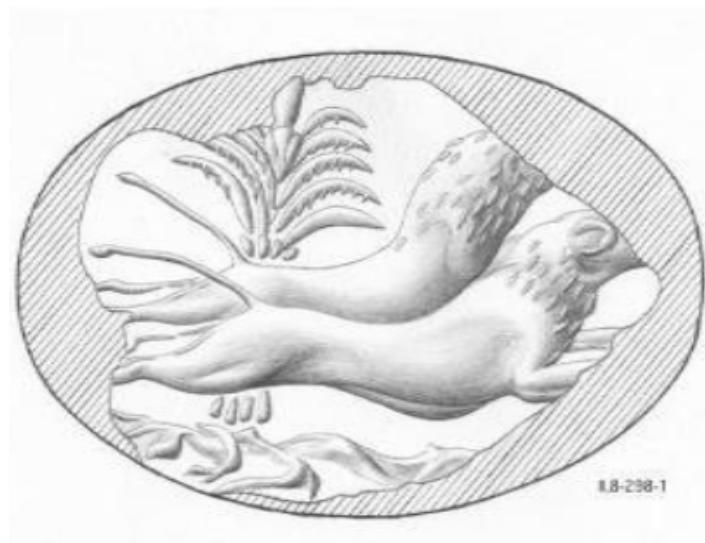
Fig. 7.1: *CMS* II,8 no. 298/1 (courtesy *CMS* Heidelberg).

countermarks and popularity have been noted between the LM I and LM IIIA2/B types (e.g., Hallager 2015, 146; for differences within LM III deposits at Knossos see Weingarten 1988), but these are less absolute than assumed: some LM I nodules were also inscribed with signs (Hallager 1996, 234; Montecchi 2017, 6-7), the practice of countermarking seal impressions finds a precedent on LM I roundels, sealings and noduli (Weingarten 1983, 107-8; Hallager 1996, 127; Montecchi 2018, 238) and the size of LM I nodules varies between, and within sites, with the nodules from Chania and Zakros considerably larger than those from Ayia Triada (Hallager 1996, 169). Although only 74 TH-hanging nodules have been identified, potentially there were more: some 150 single-hole nodules from Ayia Triada present two holes (see Montecchi 2017, 3) and could be TH-hanging nodules rather than SH-hanging nodules. Therefore, it cannot be excluded that they were a regional feature, and therefore not equally popular at all sites. There are four specimens from the Eastern Temple Repository, one from Akrotiri –sent there in LM IA from North-Central Crete, a handful from LM IB Ayia Triada and about fifty from LM IB Kato Zakro (Hallager 1996, 161, Table 40; Karnava 2018).

The "Mycenaean" irregular nodule, which was manufactured around a variety of string types and leather strips and attached to unidentified objects (Hallager 2015, 146, 149; Müller 2002, 59-64), is attested in the Temple Repositories at Knossos (MM IIIB/LM IA) (Hallager 2010b, 209; Petrakis 2017b, 89). Because it is so rare at LM I sites (the resemblance of one sealing *CMS* II,6, no. 289 from Ayia Triada to the Mycenaean irregular string nodules is noted by Montecchi 2019, 246), other irregular nodules from Knossos are automatically considered to be Mycenaean although they could be LM I in date. One obvious candidate is HMs 1445 (*CMS* II,8 no. 298) (**Fig. 7.1**), which is considered to be "Mycenaean" because of its shape (e.g., Weingarten 1994, 186; Weilhartner 2019) despite the fact that it was impressed by the same ring that was used on two TH-hanging nodules from Zakro (Hogarth's House A) and a flat-based nodule from Ayia Triada (Montecchi 2017, 4), both undoubtedly LM IB in date. The Knossian nodule is considered to be Mycenaean, i.e., post-LM IB, and the ring therefore an heirloom, but this argument may just as well be turned around: the Knossian nodule could be contemporary or very close in date (i.e., within the same generation) to the Zakro and Ayia Triada nodules, and the nodule type to already exist in LM IB. Such scenario may also apply to other nodules from Knossos that were impressed by LM I glyptic devices (for which see i.a., Weingarten 2022). The above example shows that by automatically attributing irregular nodules to the Final Palatial block, continuity in sealing practice is masked and change appears to be sudden and drastic.

The "Mycenaean" combination sealing, which has a string running through it and was pressed against a flat surface or basket, is not attested in LM I contexts, although it has been identified at MM IIB Petras (Tsipopoulou and Hallager 2010; Panagiotopoulos 2014, 109, fig. 40 also notes a possible combination nodule at Ayia Triada).

A combination sealing from Knossos (HMs 1375), also impressed by the ring with lions in flying gallop may well be LM IB (see discussion above and Fig. 2). Interestingly about 80% of the combination sealings *(CMS* II,8 nos. 109, 232, 268, 276, 287, 719) from the Doorway South of the Hall of the Colonnades at Knossos, which are stylistically dated to LM I–II (Gill 2002, 829–30), were made from the same clay as sealings from the Eastern Temple Repository (Krzyszkowska 2005, 277). Combination sealings were attached to various objects (wooden boxes, wooden pegs, basketwork) and are a type of direct object sealing, which is equally scarce in LM I deposits (Montecchi 2018, 244‑47; but see Sakellarakis and Sakellaraki 2000, 178). Possible explanations for the absence of the combination sealing from LM I contexts could be that, contrary to hanging nodules, noduli and roundels (which seem to have been preserved in rooms on the upper floor of elite architectural buildings, together with valuable and ritual objects, e.g., Zakro, Ayia Triada, Myrtos Pyrgos, Tylissos, Sklavokambos), this type of sealing was not kept after having been detached from the object sealed (the latter possibly related to the distinction made between securing and labeling by Müller 2002, 53). An alternative explanation could be that if the sealings from Doorway South of the Hall of the Colonnades at Knossos are closer in date to those from the Temple Repositories than hitherto assumed, the combination sealing was a regional, Knossian development.

Flat-based nodules continue to be used after the final LM IB destruction, as suggested by an example from an LM IIIA2 context from Chania *(CMS* V S3, no. 103) and those that were attributed to the RCT (Chania: E. Hallager 2010b, 154; 2015, 146; 2016, 387; Knossos: Evans 1909, 43–4). If the attribution of flat-based nodules to the RCT is correct, this would mean this nodule type continued until LM IIIA1 (Driessen 2000; Pini 2002, 8-9; Hallager 2015). A number of roundels from post-LM IB contexts at Chania are considered to be strays from LM IB deposits. When inscribed by the same scribal hand as attested in LM IB contexts (Odos Katré 10 and Ayia Aikaterini Square), this is justified, but if not, we should perhaps leave open the possibility that they post-date LM IB. **KH Wc 2123** is a good example since it shows a couple of particularities and was found in a later context (Andreadaki-Vlasaki and Hallager 2007, 13–5).

The disappearance of the LM I single-hole hanging nodule after LM IB is also considered to be a drastic change, but this needs contextualization. With the exception of Ayia Triada, where more than 900 specimens were found, this type is not that common (50 from all other LM IB sites, see Hallager 1996, 161, table 40). Two specimens from Knossos were impressed by the ring with the lions in flying gallop already mentioned higher up (**Fig. 7.1**), which also impressed 5 flat-based nodules from Ayia Triada, and must be close in date if not contemporary to the latter; the Knossian specimens were in non-local clay, probably from Ayia Triada, whereas one of the flat-based nodules from Ayia Triada was in Knossian clay (Hallager 1995, 11). Considering that the SH-hanging nodule seems to be mainly an Ayia Triada feature, its absence from LM III Knossos may be less significant than assumed.

Concluding, the Third Upheaval in sealing practice has, at least partly, been steered by the attribution of different sealing types to the Neopalatial and Final Palatial blocks of time, by a methodologically and chronologically incomplete dataset (the notorious LM IB and LM II "black hole" at Knossos), but also by poor knowledge of what LM II looks like at sites other than Knossos (cf. Whitelaw 2022, 38, 40). There are some cross-overs between the Neopalatial and Final Palatial blocks, which have either been emphasized (e.g., flat-based nodule) or dismissed (e.g., the irregular nodule), depending on the analytical perspective taken. These cross-overs, however, offer important information as to the nature and pace of change in sealing practice from LM I to LM IIIA2/B and link the two contrasting worlds of Minoan and Mycenaean sealing practice. Even with the limitations of the dataset, it is certain that changes in sealing practice did not all take place at the same time or at the same place and what we see at LM IIIA–B Knossos is likely to be the result of changes that took place over a longer period of time and in different places.

Minoan and Mycenaean tablets: from types to practices?

Although tablet shapes show considerable variation in MM II and MM III (page-shaped, elongated, three-and four-sided bars, see Schoep 2002; Karnava 2007; Petrakis 2017b; Tomas 2017b), it is widely accepted that in LM

Fig. 7.2: PYR 1 and PYR 2 (courtesy of *SigLA*). Photo by author.

I "all tablets are page-shaped" (Tomas 2017b, 116; cf. Schoep 2002, 16; but see Petrakis 2017b). Unfortunately, elongated tablets such as **PA 1**, **KN 22** and a four-sided bar from Palaikastro (Bosanquet and Dawkins 1923, 146, fig. 128, pl. XXIIIb; Brice 1961, pl. XXVII, IV6) cannot be dated with certainty but are either MM III or LM I in date.

The appearance in LM IIIA1 of palm-leaf tablets and large, ruled and well-organized page-shaped tablets is considered to be an innovation of the new Linear B administration (Bennet 2008; Palaima 2010; e.g., Tomas 2010a, 347; 2012, 38; 2017, 116). Helena Tomas (2015, 118), after thorough and thoughtful pinacological examination of both LA and LB tablets, concludes that "there is almost no [such] correspondence between Linear B and the latest presumably closest Linear A".

I will argue, however, that by classifying all LM I tablets as page-shaped tablets, this type becomes essentialist, unchanging and as a result, variation and particularities are erased. A closer look shows that there is considerable variation in LM I page-shaped tablets between and within sites, which points towards experimenting with shapes, sizes and ways of manipulating and inscribing tablets.

There is a substantial difference between the shortest (vertical axis) LA tablet **KN 1** (3,90 x 5,20 x 0,90 cm) –actually rather label-sized– and the tallest one, **ZA 6** (8,90 x 15,90 x 1,30 cm). The tablets from Chania are amongst the tallest (**KH 6**: 8,30 x 13,70 x 1,80 cm, **KH 7**: 11,10 x 8,70 x 1,40 cm, **KH 11**: 8,20 x 11.20 x 0.80 cm and **KH 20+48** (10,30 x [10,10 x 1,00 cm]) and, in comparison, the majority of the Ayia Triada tablets are fairly short, with only a few taller than 10 cm (**HT 93**, **HT 100**, **HT 117**, **HT 123**, **HT 13**). Tablets from Chania also tend to be wider (horizontal axis) than elsewhere, some of them wider than tablets from Ayia Triada are tall (**KH 5**: 9,70 x 8,10 x 1,20 cm; **KH 7**: 11,10 x 8,70 x 1,40 cm; **KH 10**: 10,20 x [6,40] x 1,10 cm; **KH 20+48**: 10,30 x {10,10 x 1,00 cm} (all measurements are based on *GORILA*). Considering the highly fragmented state of most Chania tablets, some may originally have been even wider and taller. Considering their late LM IB date (see above), it could be argued that there was an evolution within LM I towards larger tablets.

Not only the physical shape of the LM I tablets, but also their manipulation practices must be considered, since they throw light on cognitive developments and changing needs. The practice of cutting tablets (Schoep 2002, 77; Tomas 2013, 178–79), most common at Chania, is particularly interesting because it demonstrates experimentation with sizes and shapes of tablet. Occasionally, the cutting resulted in elongated shapes, such as **PYR 1** and **PYR 2** (**Fig. 7.2**) or **KH 19** (**Fig. 7.3**). Although thinner than the LB palm-leaf tablets, they do illustrate a need for smaller and perhaps elongated pieces of clay to use as simple or summarizing documents (for terms see Tomas 2017b, 118). This need clearly also existed at Ayia Triada (**HT 133**, **HT 154B**, **HT 43**, **HT 65?**, **HT 92**) and although the resulting shape is nothing like a palm leaf shaped tablet, it does suggest an interesting cognitive development.

It is also interesting to compare **KH 19** (4,90 x 4,60 x 0,90 cm) and **HT 21** (4,60 x 6,7 x 0,90 cm (**Fig. 7.3**), which both display two cut sides and were cut from larger tablets. Whether we call the original tablet tall, page-shaped or long, elongated depends on the way the tablets were held and rotated, but what is interesting is that they were rotated in a different way. **HT 21** was cut along its *lat. sin.* and *lat. dex.* and **KH 19** along its *lat.*

Fig. 7.3: KH 19 (left) and HT 21 (right) (courtesy of *SigLA*).
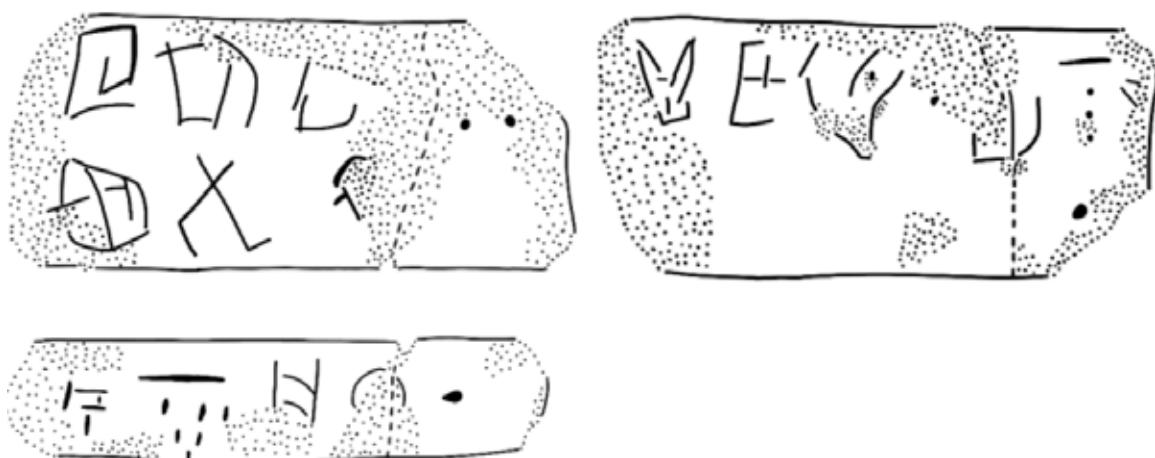
Fig. 7.4: KN 22, elongated tablet (courtesy of *SigLA*).

sup. and *lat.inf.* (**Fig. 7.3**). If the original was a page-shaped tablet, **HT 21** was rotated 90° for inscribing but if intended as an elongated tablet, it was not. The opposite is true of **KH 19**, which was rotated if the original tablet was (conceived of) an elongated tablet. This is interesting because it could provide insights into how the person who shaped the tablet and the person who inscribed it conceived of what a tablet should look like.[1]

The question of what tablet shapes were prevailing at contemporary Knossos cannot be answered with certainty. With the exception of 2 small page-shaped tablets (**KN 1–2**) and a fragment (**KN 28**), there are no datable Linear A tablets. A tablet attributed to the Hieroglyphic deposit, but possibly inscribed with Linear A

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1 It is likely that **HT 21** was inscribed after having been cut, otherwise the scribe would probably not have split up the numerical signs for ten and 1 units following A 610 (see also Tomas 2013, 178‑79). The sequence of cutting and inscribing cannot be established with certainty for **KH 19**.
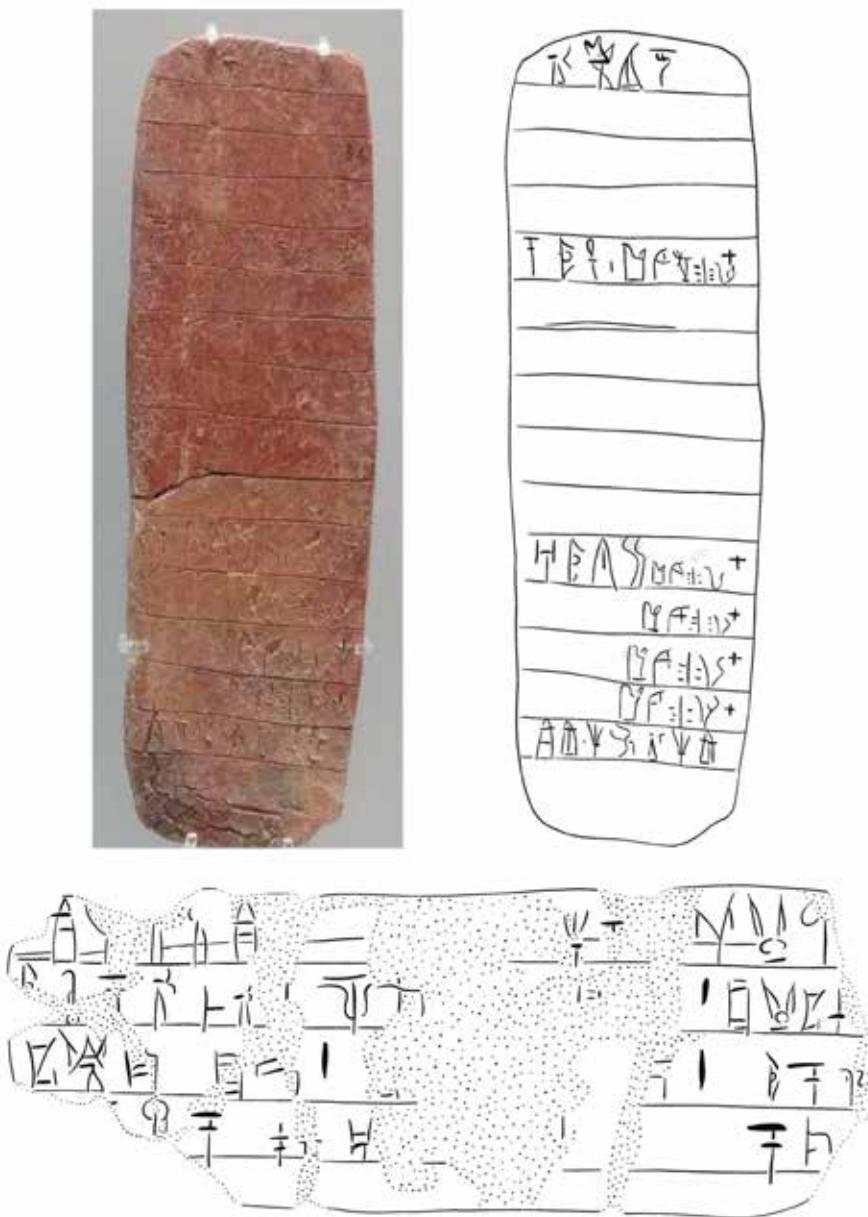
Fig. 7.5: Linear B tablets KN V(2) 280 (top) and KN V(3) 655 (bottom) (drawings by E. Salgarella after *CoMIK* I, 115; photo by author).

(*CHIC* ##122 = **KN Hi 01**), is elongated (Tomas 2017b, 118). This is also the case for **KN 22** (**Fig. 7.4**), which was discovered amongst the Linear B tablets in the Heraklion Museum (Bennett 1958b, 35–49), and which is not dissimilar to a palm leaf shaped tablet. It cannot be excluded that amongst the fragmentary Linear B elongated tablets without secure provenance or attribution to a known scribal hand, some Linear A tablet fragments are hiding, but this needs to be examined in detail. Considering the regional variation in tablet shapes and sizes discussed above, we should not fill in the LM IB lacuna at Knossos by reference to what is happening elsewhere (cf. Petrakis 2017b).

The earliest Linear B tablets from Knossos (RCT, LM IIIA1) also show more variation than allowed for in most narratives, and the page-shaped/elongated typology is too simplistic (V. Petrakis, pers. comm.). Salgarella notes a considerable number of non-standard tablets in the RCT, which are neither palm-leaf-shaped nor page-shaped (Salgarella 2020, 188, note 4: some are very wide palm-leaf tablets that show ruling and are more like short page-shaped tablets (e.g., **KN V(2) 60**; **F(1) 157**; **Fp 7707**; **KN V(3) 655**), whereas some page-shaped

tablets are so narrow (**KN V(2) 147**; **F(1) 153**; **V(2) 280**; **Ap 5077**) (examples are illustrated in **Fig. 7.5**) as to resemble palm leaf tablets that were rotated by 90 degrees (Salgarella 2020, 189). This suggests experimentation with shapes not unlike what we see in LM IB (see above). Salgarella (2020, 189) suggests that the origins of the palm-leaf tablet may perhaps be found in the shapes that sit at the middle stage between these shapes. The "invention" of the post-LM I palm-leaf tablet may have had less to do with the creation of a new shape for a new, so-called Mycenaean administration than with cognitive developments. The need for short texts and a preference for a horizontal lay-out of information, which undoubtedly promoted clarity as entries would not be split over different lines, may be one of such developments. What we see in the final destruction deposits (LM IIIA2/IIIB) at Knossos is best viewed as the result of the sustained engagement and interaction of people with tablets over a period of perhaps more than 400 years; such interaction impacted on thought processes which then had an influence on the material forms of the writing media (cf. Malafouris 2013, 68). The above discussion makes clear that on the one hand, there was no such thing as a quintessential LM I, Linear A page-shaped tablet, and that on the other, the earliest tablets from Knossos also show more variation than allowed for in current narratives. The degree of experimentation with tablet shapes that we see in LM IB is not dissimilar to that also seen in the RCT.

Linear A and Linear B: different scripts?

A final result of the time-block approach discussed in this paper is the identification of different scripts as a result of the attribution of different manifestations of writing to different time blocks (**Table 7.1**). The so-called "Archanes Script" is a good example of this, as its attribution to the Prepalatial period initially created the impression of it being a separate script from Protopalatial LA and CH (Yule 1980; Sbonias 1995). Nowadays, it is widely accepted to be an earlier manifestation of Linear A (e.g., Godart 1999) or Cretan Hieroglyphic (e.g., Younger 1996–1997; Karnava 2021, 246) and not a separate script.

Similarly, manifestations of writing were respectively attributed to the Neopalatial and the Final Palatial blocks, and widely accepted to constitute different scripts, i.e., Linear A and Linear B (e.g., Duhoux 1989; 2006; Schoep 2002; Bennet 2008; Palaima 2010; Tomas 2010a; Steele and Meißner 2017). The disappearance of the Linear A script (and the use of the language it notated for record-keeping purposes) and the appearance of Linear B have since the 1950s been causally linked to the "Mycenaean" take-over of Knossos (Wace 1956; Hood 1985). Salgarella (2020, 374) recently challenged the view that Linear A and Linear B are different scripts. Instead she argues that LB, as we know it from LM III Knossos, is a chronologically later variety of LA (Salgarella 2020, 359). Besides phonetic continuity (cf. Steele and Meißner 2017), she points towards structural and palaeographical continuity and suggests that LB is likely to have started off under the influences of local LAs (probably at Chania and Zakros). The suggestion that the LAs at Chania and Zakros may already be developing in the direction of LB (Salgarella 2020, 370) is interesting given the fact that the tablets from these sites can be dated to the latest of two LM IB destruction, which –at least a Chania– is very close in time to LM II (Andreadaki-Vlasaki 2022). Put differently, Salgarella argues that what we call Linear A and Linear B are not actually different scripts but manifestations of one script, the "Aegean Linear Script", to which adaptations were made to accommodate the needs of the Greek language (Salgarella 2020, 372). Of course, such adaptations need not all have been synchronous, but could have taken place at different moments in time and be the result of incremental rather than sudden change (see also Steele and Meißner 2017 for creation of new signs).

This hypothesis has interesting implications and apart from implying more continuity in writing (structural and paleographic) than hitherto assumed, it would also suggest that Linear B may have been created late in LM IB or very early in LM II (Salgarella 2020, 372, 369; see also Bennet 2008, 20).

Salgarella's analytical approach of decoupling *script* and its constitutive elements, such as syllabograms, logograms, from *writing system* and the language specific rules that govern use of a script, is perhaps also useful to think about the relationship between Cretan Hieroglyphic and Linear A. Although widely accepted to constitute different scripts (but see Evans 1909), the structural similarities (logograms, syllabograms, numerals and fractions) are so pervasive (see Salgarella 2020, 333, fig. 39; Ferrara et al. 2022) that they cannot be independent

creations (Schoep 2020). Ferrara, Montecchi and Valério (2022) recently made a convincing case for LA to have been created on the basis of CH, and the latter to be the oldest of the two. However, keeping in mind Salgarella's proposal for LA and LB, it cannot be excluded that CH and LA are manifestations of a single script that was adopted in different regions, at different times and perhaps to notate different languages.

CONCLUSIONS

In this paper I argue that the way time has been carved up in Pre-, Proto, Neo- and Final Palatial time-blocks has influenced and steered archaeological research into writing and sealing practices. The characterization of the Neopalatial block as having a certain set of characteristics that differ drastically from what came before (Protopalatial) and after (Final Palatial) has given rise to the perception of a drastic rupture between LM IB and LM II–IIIA1. This rupture has causally been linked to an island-wide LM IB destruction and the subsequent installation of a new "Mycenaean" regime at Knossos, which brought about profound changes in all aspects of society (funerary, administrative, pottery production, settlement patterns and administration). Combined with an incomplete and methodologically flawed dataset, the block-time approach disconnected the Neopalatial and the Final Palatial blocks, cutting all connections between them, while producing a history structured by revolution. This allowed contrasting Minoan administration ca. 1750/00–1470/60 BC with people writing Linear A on small page-shaped tablets, using Minoan sealing types and speaking a non-Greek language, and Mycenaean administration ca. 1470/60–1200/1190 BC with people writing Linear B on new types of tablets, using Mycenaean sealing types and speaking Greek.

Reassessing the evidence for the so-called Third Upheaval in writing and sealing practices, it is argued that change was not drastic, sudden, synchronous and spatially restricted to Knossos. The changes that we see between LM I and LM IIIA2/B sealings were distributed in time and space and did not necessarily take place at the same time as changes in tablet shapes, as usually assumed. Some Mycenaean sealing types already existed –or had functionally similar precursors– in the Neopalatial period, while there is evidence that some Minoan types (hanging nodules, flat-based nodules and perhaps roundels) could have persisted into LH II–IIIA1. Typologies tend to make types appear more homogenous and rigorous than they were in reality, while "erasing" small differences and variety. This is not only true of sealings but also of tablets. The change from LM I page-shaped tablets to LM II–III palm leaf and page-shaped tablets, also appears to have been less abrupt than allowed for in most current narratives. There is considerable variety in shaping, cutting, manipulating and rotating tablets at LM I sites and the same is true of the earliest Linear B tablets from Knossos (RCT), suggesting that change is more complex than appears at first sight, and cannot be pinned down to one place and explained by the creation of a new, "Mycenenaean" administration at LM II Knossos. Change in tablet shapes can at least partly be attributed to the interaction of generations of people with clay tablets over a sustained period of time, which brought about small behavioral and psychological changes that in turn impacted on the materiality of the writing supports. Already in LM I, a need was felt for smaller tablets (i.e., through cutting) and perhaps a horizontal lay-out of text, which may ultimately have resulted in the LM III palm-leaf tablet.

Despite the fact that, on account of the uneven distribution of written and sealed documents in time and space, the evidence is perhaps less conclusive than one might like, I believe there is enough evidence to suggest that the changes in writing and sealing practices between LM I to LM IIIA2/B are the result of a process, rather than a sudden upheaval at the beginning of the Final Palatial period, which saw the replacement of Minoan sealings and tablet types by new, Mycenaean types.

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8

Coded in clay

Understanding the relationships between the Linear A, Cretan Hieroglyphic and Linear B administrative systems through the application of phylogenetics

Emily Tour

University of Melbourne
ORCID ID: 0000-0001-5212-1427

ABSTRACT

Three different administrative systems are known from the Aegean Bronze Age period – Cretan Hieroglyphics, Linear A and Linear B. Recently, there has been more intensive discussion of the types of devices (tablets, nodules, sealings etc.) associated with each of these systems, exploring what potential commonalities can tell us about their relationships, and the broader implications of these connections for our understanding of Minoan and Mycenaean history. This paper will propose that comparative work on the administrative devices to date, whilst thought-provoking, has been lacking any experimental framework to test its hypotheses. Phylogenetics is presented as an alternative approach to the analysis of these devices; originating in the field of evolutionary biology, phylogenetics can be used to analyze the "genealogical" relationships between entities, and is increasingly being applied to archaeological research. The merits of this approach are considered, as well as the suitability of employing a method intended for biological research to questions of material culture. The paper concludes with an introduction to the author's ongoing research project, which will pilot the use of phylogenetics on Aegean administrative devices, looking at what insights it can provide about the development of these objects over time, and the connections between the different systems.

INTRODUCTION

Comparison is one of the most central tenets of everything we do in archaeology. We use concepts of similarity and difference to arrange elements of the past according to different typologies, order them into chronological sequences, and associate them with different cultural and regional entities; all underpinning our understanding of developments and relationships across time and space. Given its fundamental importance, we perhaps do not give enough attention to the inner workings of the comparative method, as it is traditionally used in our discipline. Some recent struggles with comparison and classification in my own research into the Bronze Age Aegean administrative systems has led me to consider this issue more closely.

My ongoing PhD project through the University of Melbourne, titled "Coded in clay", focuses on exploring the connections between the three different administrative systems from the Bronze Age period in the Aegean: Cretan Hieroglyphics (CH), Linear A (LA) and Linear B (LB). We have named these systems after the scripts they are respectively associated with, but in reality, writing is only one component of any administrative system. Modes of authentication (such as sealing practices) and of organization (like filing and labeling) are also key

elements that can be detected in the archaeological record. My research focuses on examining questions surrounding the origins of the LB administrative devices (separate from the LB script) by looking at correlations with devices from the CH and LA systems. This is a topic that has generated several intriguing hypotheses in recent years; however, I feel that the way these analyses have handled comparisons between devices from each of the different systems has been lacking in transparency and experimental rigor, as will be discussed further below.

This has led me to explore the use of phylogenetics, a method originally borrowed from the field of biology, which is being increasingly applied in archaeological research. In this paper, I will first provide a brief history of administration in the Bronze Age Aegean, and the fragmentary evidence that remains today, as well as introducing the most recent scholarship on the origins of the LB administrative devices. Following this introduction, I will discuss the limitations of these studies, particularly in the way they handle comparative analysis, and suggest why a different approach is warranted. I will then introduce phylogenetics as a possible alternative, considering its merits, but also examining the criticism that it has received as a method adopted from the field of biology. In addition, I will look at the suitability of phylogenetics for exploring questions specifically about Aegean administration, evaluating two recent studies that used phylogenetics to investigate chronological relationships within the LB tablet corpus, and responding to several critiques of their approach. I will then conclude by considering how phylogenetics will be applied in my own project, as well as the projected outputs from this research.

Please note that the following discussion will use the relative chronological divisions generally applied in Aegean Bronze Age archaeology, as described by Shelmerdine (2008). The relevant abbreviations used throughout the discussion are "MM" for "Middle Minoan", "LM" for "Late Minoan" and "LH" for "Late Helladic", where "Minoan" refers to the chronology of Crete, and "Helladic" to the Greek mainland. Any mention of absolute dates correlating to these relative dating periods use the low chronology.

ADMINISTRATIVE SYSTEMS OF THE BRONZE AGE AEGEAN

An "administrative system" in the context of my project encompasses the tools and practices involved with the day-to-day running of ancient economies – whether that is a large-scale palace bureaucracy, small-scale local mercantile operations, or something in between. This can involve a number of different facets, including both written and verbal communication, usually in a shared language; systems of weights and measurements for calculating goods and services; systems of authentication (e.g., sealing practices, where a piece of clay is molded and stamped with a seal, whether to protect the contents of a container, or to validate a transaction as a type of signature); and modes of organization, such as filing and labeling. But at its core, it's all about facilitating, controlling and recording economic transactions.

My work focuses on the physical forms of the administrative devices that carry these inscriptions and impressions – the various distinctive types of documents, labels, dockets, tokens and sealings that were associated with each of these systems. Whilst there have been earlier, somewhat piecemeal efforts to formally classify the different devices found across CH, LA and LB (most notably by Weingarten 1986, 1988; Hallager 1996; *CHIC*; Müller 1997, 1998, 1999, 2002), only recently has this particular aspect of administration received more intensive focus, particularly regarding what it can tell us about the relationships between the three systems. Although CH, LA and LB were each associated with their own repertoire of device types, there are some notable crossovers, which have led to some interesting theories in recent years regarding exactly how the different systems are related. But before delving into the details of this issue, a brief overview of what we currently know about these three systems is required.

The CH and LA administrations both appear in the archaeological record on Crete around MM IB–MM II. The nature of their co-existence is not entirely clear. CH is generally associated with sites in the north and east

(Malia, Knossos and Petras), and LA with the south (Phaistos, and possibly nearby Monastiraki) throughout this time. However, interaction between the two systems is evidenced by the presence of both CH and LA inscriptions at some locations, as well as some overlap in their signary (including syllabograms, logograms and fractional signs), device types, scribal features and even a few rare instances of possible "hybrid" documents (Schoep 2002, 18, 23, 28; Tomas 2010a, 341–42, 350; Petrakis 2017b, 80–90).

It is broadly agreed that CH disappears from the archaeological record before LA, likely at some point from MM III to early LM IA, although a more precise date is difficult to determine. The latest attestations of CH are most often considered to be from either the *Dépôt hiéroglyphique* (DH) at Malia or the Hieroglyphic Deposit (HD) at Knossos, both deposits containing a mixture of CH and LA documents. However, there remains significant debate as to the nature and unity of each group of documents, including whether HD as a "deposit" was largely manufactured from devices found in the wider area, and if DH was an accumulation of devices over a significant period of time (Pini 1990, 39, 43; Hallager 1996, 57, 60–1; *CHIC*, 28; Gill 2002, 103; Krzyszkowska 2005, 111). Problems also persist with assigning firm dates to the deposits. Questions of unity aside, the latest dates that have been proposed are MM IIIB for DH, based on a re-examination of stratigraphic and ceramic evidence (Pelon 1983, 701), and the MM IIIB/LM IA transition for HD, as determined via glyptic analysis (Pini 1990, 43–4). I will return to the significance of these dates further on in this paper.

A CH-inscribed medallion found on an LM IB floor amongst destruction debris at Petras has also been put forward as evidence for a late continuation of the CH system (e.g., Tsipopoulou 1997, 272; 2012, 55; Warren 2012, 358; Petrakis 2017b, 90–1). However, others have treated the discovery with caution, due to the uniqueness of the find as the only known CH administrative document from an apparent LM IB context (Schoep 2002, 19). Aside from this contentious medallion, LA appears to continue on as the sole remaining Cretan administrative system during LM I, having proliferated across the island. It does not last beyond the end of LM IB however, disappearing along with the hallmarks of an elite Minoan presence on Crete during the wave of destructions that concluded this period (Schoep 2002, 18–20; Tomas 2012, 36; for a few possible non-administrative attestations of LA after LM IB, see Bennet 2008, 12–3).

LB does not emerge in the record until sometime later, in association with the Mycenaean tradition on both Crete and mainland Greece. However, similar to the aforementioned issue with the end date of CH, it is not known exactly when the system was first developed. On the mainland, the earliest established date for the emergence of LB is LH IIIA2, based on tablets uncovered in recent excavations at the Petsas House site in Mycenae, and at Iklaina (Shelmerdine 1998, 294; 2010, 76; Shelton 2002–2003, 392). On Crete, the material is either much later (LM IIIB1 at Khania), or has significant dating issues, particularly at Knossos. The Room of the Chariot Tablets (RCT) deposit is generally thought to contain the earliest examples of LB writing on Crete, dating to LM IIIA, based a compelling hypothesis by Driessen (2000; although there are some who still disagree with this date, notably Hallager 2005, 251, n. 18). However, Driessen's proposed dating relies predominantly on palaeographic and pinacological arguments, due to a lack of stratigraphic evidence from the original excavations, therefore the dating remains open for debate (Palaima 2010, 361). We can be more certain of the end date of LB, with the administrative system not appearing to outlast the destruction of Mycenaean sites on the mainland by LH IIIC (Palaima 2010, 362).

ACCIDENTS OF PRESERVATION

As is evident from this summary, we are far from understanding the exact histories of each of these administrative systems, which in turn complicates our ability to interpret the relationships between them. There are a number of factors contributing to the patchy nature of the administrative record from the Aegean Bronze Age. A key reason is that the clay devices, which make up the bulk of our evidence, were unfired by their creators – presumably as they were only intended as temporary records. The majority of surviving devices have therefore only been

preserved by chance through fires associated with destruction events, and we have no real understanding of what is missing from those unburnt layers in between (Hallager 1996, 19; Krzyszkowska 2005, 1–2). This makes it very hard to say for certain when things begin and end, as highlighted above for the CH and LB administrations, although new discoveries (such as those at Mycenae and Iklaina) continue to reshape our understanding.

Published material also has some significant issues, particularly from sites excavated in the early half of the twentieth century, when standards and practices of fieldwork and documentation differed greatly (Palaima 2010, 361; although as noted by Petrakis, there were some exceptions, with the 1939 season at Pylos being meticulously recorded (pers. comm.)). Devices are known to have been lost in wet conditions (Evans 1909, 43; Weingarten 1990, 108; Krzyszkowska 2005, 226), misplaced in subsequent storage (Krzyszkowska 2005, 226), and potentially even overlooked during excavations (Krzyszkowska 2005, 285). Excavation notes and publications of these important early finds are often plagued by inaccuracies and omissions concerning findspots and stratigraphy, making dating and interpretation difficult (Hallager 1996, 60; Krzyszkowska 2005, 165, 168–69, 178–79, 216–17).

The most significant issues relate to the Knossos deposits, which is incredibly unfortunate as it is also the one site where all three systems are attested, and would likely have provided the best chance of understanding the relationships between them. In particular, we are unable to definitively date and interpret two deposits that potentially contain our latest attestations of CH and earliest of LB – the HD and RCT deposits respectively (Driessen 2000, 12; Krzyszkowska 2005, 80, 112–16; Palaima 2010, 361). Furthermore, it is unclear whether the lacuna in evidence from LM IB Knossos is due to its avoidance of a fiery destruction, or whether the palace was not fully functioning in an administrative capacity at this time, thus leaving a gap in the period most crucial to determining whether LA developed directly from LB (Krzyszkowska 2005, 189–91; see Driessen and Macdonald 1997, 138–70 for evidence of limited occupation and ongoing repairs at the LM palace). As this information is likely irretrievably lost, we must look to other methods for unpicking the relationships between these systems – including comparing and contrasting their different elements, in order to better understand the level of relatedness between them.

THE MURKY ORIGINS OF THE LINEAR B DEVICES

The significant gap in evidence between the latest attestation of the LA system and the earliest of LB has led to some intriguing discusssions regarding the latter's development. By extension, this has implications for the exact relationship between the Minoan and Mycenaean administrations. Today, it is generally agreed that the LB script is directly related to LA, given that they share such a large portion (up to 72%) of all their currently known signs (e.g., Bennet 2005, 270; Palaima 2010, 356; Hallager 2011, 324, arguing that CH should be seen as the origin point for both LA and LB; Olivier 2012, 20; Meißner and Steele 2017, 95–6, regarding the proportion of shared signs; Tomas 2017a, 71). Given this, and their relatively close chronological proximity in the archaeological record, many scholars have reasonably claimed that the creators of the LB administrative system also adapted the LA system's associated repertoire of devices to suit their own politico-economic realities – apparently adding new types and discarding or modifying others, where necessary (Palaima 1988a, 315; Weingarten 1990, 113–14; 2010, 325; Driessen 2000, 224; Schoep 2002, 9; Bennet 2008, 52).

However, this understanding of the administrative devices has received some notable pushback in recent years. Hallager (1998, 221) first proposed in the late 1990s that the creators of the LB system instead adopted their device types from CH, based largely on new evidence coming out of the Petras excavations at the time. The following decades have seen this theory expanded upon significantly, with contributions by Erik Hallager, Helena Tomas, and most recently, Vassilis Petrakis. Notably, each has taken a substantially different approach in their characterization of the relationship between the two administrative systems: Hallager (2011, 2015) argues that *both* the LB script and administrative devices were adopted from the CH system; Tomas (2010b, 2012,

2017a) asserts that the LB system had two sources, with its script deriving from LA, and its devices from CH administration; Petrakis (2014a, 2017b) proposes that both the LB script and device types were in fact sourced from a North Cretan variant of administration that combined features from both the Minoan systems and centered on Knossos. These differences aside, there appears to be a general consensus by all three that the correlations between the device types typically associated with LA and LB are not particularly strong, and instead there are notable crossovers between CH and LB that require explanation.

A summary of the distribution of devices across the three systems is provided below (Table 1). Based on this distribution, Tomas and Hallager have both argued that there are no common device types between the LM I LA system and LB, apart from *noduli*, which are also shared with CH, a view also supported by Petrakis (2017b, 75–6). Tomas convincingly proposes that page-shaped tablets in both systems served entirely different functions, whilst both scholars consider the flat-based nodules in the RCT too short-lived to be significant (Hallager 2005, 252; 2015, 146; Tomas 2010b, 122–30; 2011; 2012, 38–42). Petrakis holds a similar view regarding the flat-based nodules, although he does note that their presence in the Knossos HD means that they should also be considered CH documents (Petrakis 2017b, 76, n. 8). Tomas and Hallager particularly emphasize the parallels between CH and LB, which both apparently utilized elongated tablets, combination nodules, irregular string nodules and direct object sealings (Hallager 2011, 322; 2015, 150; Tomas 2012, 43–4). Both scholars even propose that the LB gable-shaped nodules directly evolved from CH crescents (Hallager 2011, 322; 2015, 150; Tomas 2017a, 66). This evidence, they conclude, suggests that the LB device types were directly inspired by the CH system, rather than LA (notwithstanding their apparent separation by well over a century, as discussed below).

This proposal is highly intriguing, and if supported, would have significant impacts on our understanding of Aegean history, such as a much earlier date of creation for LB (possibly altering our timeline for mainland literacy), or a later date of use for CH (thereby challenging current ideas about its relationship with LA in Minoan administration). However, it is also incredibly difficult to reconcile with our current chronological evidence for these administrations. Hence, it has become a focal point for my research.

Table 8.1: Different document types attested in the CH, LA and LB administrative systems. Based on information from CHIC, Hallager (1996 [I], 31–7; 2005; 2015), Tomas (2010b; 2012, 38–44; 2017a, 65–7), and Petrakis (2017b, 73–88), unless otherwise specified in the "Notes" section.

Device type	CH	LA	LB	Notes
Written documents				
Elongated tablet	R	L	●	**CH:** Rare, with only 5 known examples across all sites. **LA:** Limited to pre-LM I deposits.
Page-shaped tablet	-	●	●	**LA vs LB:** Considered very different document types by Tomas (2010b, 122–30; 2011).
2-sided bar	L	-	-	**CH:** Limited to Malia (both palace and Quartier Mu).
3-sided bar	R/L/U	R/L	-	**CH:** Rare and limited, with single example in HD; script uncertain and possibly LA, according to Olivier and Godart (1996, 18). **LA:** Rare and limited, with a single example in DH.
4-sided bar	●	R/L/U	-	**LA:** Rare and limited, with single example from Palaikastro); script uncertain, as considered LA by Brice (1961, 21, pl. xxvii: no. iv 6), but a *dubitandum* by Petrakis (2017b, 80).
Medallion	●	-	-	

Device type	CH	LA	LB	Notes
Written documents				
Cone	L	-	-	**CH:** Limited to Quartier Mu.
Sealed documents				
Noduli	●	●	●	
Roundel	R/L	●	-	**CH:** Rare and limited, with only one example from Petras.
Nodules and sealings				
Crescent	●	-	-	
Direct object sealing	●	L	●	**LA:** Limited to pre-LM I deposits.
Irregular string nodule	U	U	●	**CH:** Uncertain ID at Petras. **CH/LA:** Uncertain ID in HD and ETR, with one possible example from each.
Flat-based nodule	-	●	L	**LB:** Limited to RCT, approx. five examples.
1-hole hanging nodule	-	●	-	
2-hole hanging nodule	-	●	-	
Combination nodule	L	-	●	**CH:** Limited to Petras, but abundant.
Gable-shaped nodule	-	-	●	
Label	-	-	●	
KEY				

Distribution:	**Deposits:**
● = Common	**DH** = *Dépôt hiéroglyphique* (Malia)
R = Rare across entire administrative system	**HD** = Hieroglyphic Deposit (Knossos)
L = Limited to certain site or time-period	**ETR =** Eastern Temple Repository (Knossos)
U = Uncertain or contested	**RCT** = Room of the Chariot Tablets (Knossos)
- = Not attested	

THE LIMITATIONS OF TRADITIONAL COMPARISON

One obvious problem with this proposal is the significant gap between the attested dates for CH and LB. Even if one was to accept the latest proposed dates for CH (the MM IIIB/LM IA transition, ca. 1600 BCE), and the earliest for LB (LM II, starting from 1450 BCE), this would still potentially leave a gap of around 150 years. However, as noted above, preservation and publication issues make such lacunae less than certain.

Another issue is that this idea of "commonality" between device types may be subjective, oversimplified or even misleading. Hallager and Tomas in particular present their arguments about shared devices without any real interrogation of how we define those types, and why the examples across the systems should truly be considered related. To raise some objections, whilst some devices may be comparable in both appearance and function, others could share broad physical features (and perhaps even the same name as a result), but serve different purposes in both systems – as Tomas (2011) has in fact already noted for the page-shaped tablets. Alternatively, their purposes may be aligned, but their appearances are very different. And in each of these instances, the devices could be directly related, or they may instead have developed independently under similar contextual stimuli in both systems. These issues around resolving whether similarities are the result of kinship,

cross-cultural borrowing, or have arisen independently through convergence are a long-recognized problem in archaeological comparative studies – something we still refer to as Galton's problem (Mendoza Straffon 2019, 153).

Furthermore, the typologies that we use to classify devices are not universal, particularly for sealed documents and nodules. The two systems of classification most commonly used at present are those established by the *CMS* team in their landmark volumes on the Heraklion Museum collections (e.g. *CMS* II,6; *CMS* II,7; *CMS* II,8,1‑2), and another outlined by Hallager, using English-language labels, but still taking significant influence from the *CMS* system (Hallager 2005, 2015). Whilst there is broad alignment in the way known devices are categorized across the two typologies, there remains disagreement over particular examples, indicating the subjectivity that remains with this type of classification. For example, the *CMS* label "Päckchenplomben" is generally equivalent to what Hallager and others refer to as "flat-based nodules". However, Hallager (2005, 252–53) disputes the inclusion and exclusion of certain nodules by the *CMS* in this category.

A final matter complicating our ability to fully understand these categories and make informed comparisons of device types is the lack of relevant published material. Most publications regarding the administrative devices to date focus predominantly on inscriptions (e.g., *GORILA, CoMIK*) or seal impressions (*CMS*). Basic device dimensions (generally length, width, height) are provided in many of these studies. In limited cases, some description regarding shape, clay type, reverse and string impressions and find condition are also given, most notably in *CHIC,* the newer *CMS* volumes, and relatively recent publications of the Mycenae, Pylos and Petras nodules (*CHIC*; Müller 1997, 1998, 1999, 2002; Müller et al. 1998; Tsipopoulou and Hallager 2010). However, this information is certainly not available for all devices. And even in the more detailed volumes, there is a distinct lack of clear, multi-angle images for each of the devices, to aid comparison and independent verification of claims around similarity.

This situation has precipitated the creation of the "Coded in clay" project for my dissertation, which aims to re-examine some of these proposed relationships (and underlying typologies) among devices in the three systems, but with a more transparent, objective approach. To do this, I have been exploring tools associated with phylogenetics, which are increasingly being employed for the purposes of archaeological comparison and classification.

WHAT IS PHYLOGENETICS?

Phylogenetics is an area of study focused on determining ancestor-descendant relationships amongst species by identifying the nature and extent of shared heritable traits between them (Charleston 2013, 324; Wiley 2013, 18; Mendoza Straffon 2016, 2). It was established as a formal method in biology during the 1950s and 60s, most notably by Willi Hennig (1950, 1965). Hennig's work came in the wake of several advances in our understanding of evolution and genetics, where it became apparent that classification couldn't solely be based on a criterion of similarity and difference (a method associated with its predecessor, phenetics), and that paths of information transfer also needed to be taken into account (García Rivero 2016, 52–3).

The primary output of phylogenetic modelling is the cladogram, a tree-like diagram that maps the most likely kinship relationships between different species of organism, based on input data regarding their morphological "characters". Characters are the attributes of form, structure or composition shared by particular entities undergoing comparison. The different possible "states" of these characters are determined (e.g., variations in color, size or bone morphologies), and each assigned a different value. The specific character states for each example being considered in the comparison are then determined, and collated into a character matrix. It is this matrix that is used to produce the phylogenetic model, determining the potential paths of inheritance for these characters in order to reconstruct the most likely potential relationships between the organisms being analyzed.

This focus on genetic relationships distinguishes phylogenetics from phenetics, where organisms are instead classified based on shared traits – arguably the method we predominantly use for traditional archaeological comparisons (Rohlf 2013, 293; O'Brien et al. 2018, 14–5). By focusing on paths of inheritance, rather than just appearance, phylogenetics has the ability to counteract Galton's problem by distinguishing actual genetic correspondences from cases of "convergent evolution" – where similar traits can emerge in unrelated species, often in response to similar environmental conditions and pressures, such as the commonly cited example of the independent evolution of flight in birds, pterosaurs, bats and insects (Gabora 2013, 178; García Rivero 2016, 49–53). An additional strength of phylogenetics over traditional comparative methods is that it offers both a theoretical and experimental framework, through which we can test certain hypotheses. Where traditional comparative methods arguably tell us little more than whether an individual considers two things to bear some physical and functional similarities, phylogenetics enables a more systematic and objective approach, driven by quantitative data and experimental modeling, where the process is both transparent and repeatable for others engaging with the research.

CAN THIS METHOD ACTUALLY BE APPLIED IN ARCHAEOLOGY?

Since the 1990s, phylogenetic methods have been increasingly employed by archaeologists and anthropologists to understand cultural traits and artifacts of all descriptions, from stone tools to snow skis (for a more complete list, see García Rivero 2016, 64). This has generated ongoing pushback regarding the applicability of phylogenetics (and evolutionary theory more generally) to questions of culture change, with responses ranging from the outright dismissive (Moore 1994) to the insightful and constructive (Tëmkin and Eldredge 2007). At their core, these critiques are based on the premise that the processes behind cultural change are too different to those governing biological evolution, and thus invalidate any application of phylogenetic methods to researching human culture.

However, as a number of evolutionary archaeologists have pointed out, biological and cultural change share some fundamental principles. Darwinian evolution – the process being analyzed through phylogenetic modeling – is all about "descent with modification", defined by the processes of variation, selection and transmission. Mendoza Straffon and others stress that these concepts are equally as valid to the development of material culture as they are for biological entities (García Rivero 2016, 46; Lycett 2016, 77; Mendoza Straffon 2016, 3; Gjesfjeld and Jordan 2019, 161). Darwin never specified the mechanisms by which variation, selection or transmission must happen, nor does the phylogenetic method prescribe anything on this front, thus from this viewpoint it can be considered a suitable tool in both arenas.

In biology, variation and transmission take place in biological organisms through their genetic material; in culture, analogous processes occur through the transmission of ideas. This can be via a range of paths, including observation or emulation, direct teaching or apprenticeship, spoken or written instruction – all mechanisms of information transfer that produce variation and are affected by selective forces, thereby shaping trends in material culture (Lycett 2016, 76; García Rivero 2016, 47). It is important, however, that we do not underplay the significant differences between mechanisms of biological change and those driving cultural evolution, as the latter are certainly complex and manifold, and their behavior does not always align with the way phylogenetics is typically carried out in biological research.

Three main issues can be highlighted when examining the key differences between biological and cultural evolution. The first is that cultural change often occurs at much faster, or more variable, rates than in biological evolution (Mace and Holden 2005). The second is the likelihood for higher rates of "homoplasy", i.e., the independent invention of the same trait or solution in response to a common problem, resulting in multiple instances of convergent evolution – an issue dubbed the "Hannah Principle" in archaeology, arguably just another name for Galton's problem (Tëmkin and Eldredge 2007; García Rivero 2016, 57). "Extinction" is also

less final in cultural evolution, with far greater potential for traits to re-emerge after periods of absence or dormancy (Mendoza Straffon 2016, 3; Prentiss et al. 2016, 114). And the third (and arguably the most complex) is the fact that cultural transmission regularly occurs in a non-Mendelian or "reticulate" fashion, where traits are not restricted from being passed vertically between ancestor and descendant. Rather, they can be exchanged laterally within the same generation, and can be drawn from multiple sources, resulting in potentially significant amounts of horizontal transmission and hybridisation (Mace and Holden 2005, 117; Tëmkin and Eldredge 2007 148–51; Greenhill et al. 2009, 2299; García Rivero 2016, 57–8;). All of these differences have the potential to create significant issues during phylogenetic analysis, as the tools and techniques have typically been developed with a vertical, tree-like model of descent in mind, and are less well-equipped to model fast or variable rates of change with regular instances of homoplasy and reticulation.

It is promising that supporters of cultural phylogenetics confront the limitations that such differences place on this method just as fervently as its critics. Researchers on both side of the debate are experimenting to determine the method's robustness to the realities of cultural evolution, and seeking solutions (e.g., Tëmkin and Eldredge 2007; Greenhill et al. 2009). Also important to note is that none of the above issues are unknown in biology – for example, microbiologists make significant use of phylogenetics in their studies of viruses and other microorganisms, where rapid change, mutation and reticulation are prevalent (García Rivero 2016, 57). Such differences can be accommodated through new or modified methods of analysis, since, as highlighted by García Rivero (2016, 58) and O'Brien et al. (2002, 135), they should be considered *methodological*, rather than theoretical. Tools incorporating network diagrams, rather than strictly tree-like models, are proving useful in handling non-vertical transmission (Makarenkov and Legendre 2004, 195; Huson and Bryant 2006, 255). And other modifications to settings in existing phylogenetic programs can be made to accommodate rapid or varied rates of evolution (Mace and Holden 2005, 120).

A further discussion of the suitability of phylogenetics to tacking archaeological research, and ways of mitigating potential methodological issues will be conducted in the following section, focusing specifically on two recent applications of phylogenetics to the study of LB.

PREVIOUS APPLICATIONS OF PHYLOGENETICS TO AEGEAN ADMINISTRATION

A summary of past studies

The potential of the phylogenetic method for specifically researching Aegean administration has already received some preliminary testing, with two studies released over the last 15 years by Skelton and Firth (Skelton 2008; Firth and Skelton 2016a, 2016b; Skelton and Firth 2016; where the latter three are components of the same series). These studies use phylogenetics to tackle the thorny issue of dating LB tablets, aiming to establish a chronology by reconstructing the potential "genetic" relationships between different scribal hands.

In their initial 2008 study, Skelton focuses on producing a relative chronology for various scribal hands from Knossos, Pylos, Khania, Thebes and Mycenae, as well as the controversial Kafkania pebble (Skelton 2008, 162–63). Some of these hands (e.g., the one responsible for tablet MY Ui 01 from Petsas House) could be securely dated, adding some chronological certainty to the resulting tree; however, the dates for a significant number are unknown or contentious, particularly the various Knossos examples (Skelton 2008, 162–63). The tablets, as a subset of the administrative devices I discussed above, are affected by those same contextual issues regarding uncertain findspots and stratigraphy. These problems with dating originally prompted Skelton to explore phylogenetics as a potential avenue for reconstructing a chronology, in the absence of more traditional means (Skelton 2008, 158). The input data of the study is focused on sign variants commonly produced by the chosen hands, with "characters" designated as the abstract conception of a particular sign variant (e.g., the presence or absence of a certain stroke in AB 16 *ru*), and "character states" as different expressions of this

sign variant (e.g., where a "0" may represent the absence of that stroke in the aforementioned example, and a "1" the presence of the stroke) (Skelton 2008, 166–67). This relies on the assumption that sign variation holds chronological value, as discussed further below.

In the resulting tree, it is noteworthy that scribal hands from same deposits tended to cluster together, suggesting that groups of scribes operating at the same time in close proximity could be identified through this technique (potentially due to mechanisms of change such as similar training regimes and mutual influence between scribes, resulting in similar handwriting styles). There is also a strong correlation between the resulting tree and existing hypotheses regarding the dating of certain tablets, which have usually been reached via more traditional methods of palaeographic analysis, e.g., the early date for both the RCT hands from Knossos (Driessen 2000); an early date for Pylos hands 13 and 91, as distinct from the other Pylos hands and associated tablets, which are generally dated to LH IIIB (Palaima 1983, 1988b); and the development of a "mainland *koiné*" around the end of LH IIIA (Driessen 2000, 152–54). This association is promising, suggesting that the phylogenetic approach was successful in uncovering patterns in the handwriting data that hold some true chronological value.

Skelton's work is extended upon in a three-part publication by Skelton and Firth. Part I makes little change to the underlying methodological approach from the original 2008 study, but modifies the data set, particularly in increasing the number of hands from Knossos to help develop a better understanding of different scribal groups at the site (Firth and Skelton 2016a). Part II interprets the results from Part I, reconciling the phylogenetic results with existing archaeological and palaeographic data, and presenting an interpretation of what these results suggest about the socio-economic history at Knossos (Firth and Skelton 2016b). In Part III, Skelton and Firth trial a date estimation method called non-parametric rate smoothing (NPRS), which proposes absolute dates as a part of the tree output (Skelton and Firth 2016). They suggest that the "plausible" dates proposed by this analysis support the use of phylogenetics in constructing accurate histories of writing systems (Skelton and Firth 2016, 227).

One of the primary outputs of the analysis is the characterization of "Early", "Middle" and "Late" Knossian hands, as well as the identification of "conservative" and "progressive" variants within these groupings (Firth and Skelton 2016a). The researchers assign "Early", "Middle" and "Late" labels to the Knossos hands before running the analysis (based on the results from Skelton's 2008 study), although they claim they are not attempting to impose any chronological value by doing so (Firth and Skelton 2016a, 162). By and large, these labels do prove to correlate to relative positions in the output trees, although there are some problematic results, touched on further below, that receive little explanation by the authors. Based on the trees, "conservative" and "progressive" sub-groups are then identified by the authors within each of the larger categories. Analyzing the signs associated with each of these categories, and their proposed chronological relationships, Skelton and Firth are able to build a broad picture of sign simplification over time, which aligns with observations made by researchers conducting more traditional palaeographic studies (e.g., Palaima 1988a, 320; Driessen 2000, 151)

The reason for presenting Skelton and Firth's approach and results in such detail is not only to demonstrate some of the preliminary successes of their analysis, but also to provide some context to the subsequent responses that have been made regarding their use of phylogenetics, particularly by Salgarella (2019, 2020), Judson (2020) and Petrakis (2022). These critiques will be evaluated in the following section.

A response to critiques of these studies

Whilst acknowledging some of the merits to the phylogenetic approach undertaken by Skelton and Firth, Salgarella, Judson and Petrakis all raise a number of concerns, which they suggest may undermine the integrity of these studies. Broadly, these relate to perceived assumptions around sign simplification in the study, the question of whether variants can be assigned any chronological significance, the inability of the approach to handle the complexities of script evolution, and finally, a question as to what phylogenetics can uniquely contribute to this area of study. I will summarize and respond to these critiques below, along with introducing a

potential solution to a number of these concerns in the form of Bayesian phylogenetics – the specific approach that I will be applying in my own research.

Salgarella (2019) praises the use of characters and character states in Skelton and Firth's studies as a "very useful and objective approach", and suggests that similar methods of abstracting sign variation could be incorporated into traditional palaeographic approaches (Salgarella 2019, 64). However, she also suggests some underlying flaws in the analysis: "Firth and Skelton based their analysis on the assumptions of sign standardi-sation (in the Linear A to Linear B transmission process), sign simplification over time (within Linear B) and sign evolution. These assumptions, although perhaps viable at times, do not appear to be widely applicable" (Salgarella 2019, 64).

I would suggest that this critique potentially represents a misunderstanding of the way the analysis was carried out – as discussed above, the identification of a trend towards sign simplification was based on the *outputs* of the phylogenetic analysis (analyzing the sign variants associated with different chronological positions and groupings in the results tree), as opposed to any conditions that were imposed on the data before running the analysis.

However, Judson (2020, 218–19) raises some valid concerns regarding the inputs to the tree, noting that whilst Skelton and Firth discuss why they have selected their range of characters from a phylogenetic standpoint, they have not provided any palaeographic justification. Judson, upon examining the data provided, suggests that particular types of variation that are "clearly diagnostic" have not been included, whereas non-diagnostic examples have been in certain instances, "making it questionable how far the selection of these character states is based on actual palaeographic data relating to the different variants' attestations".

Another valid concern raised by both Judson and Salgarella is the extent to which one can place any chronological significance on palaeographic variation. In Judson's in-depth palaeographic analysis of undeci-phered LB signs (Judson 2016, 202–3, 240–41), her results suggest a lack of chronological significance in the variation between different sign forms, as well as low levels of similarity within deposits. Salgarella (2019) has also recently demonstrated that, by analyzing several LA and LB deposits, not all signs conform to the trend of sign simplification over time, with many instead showing trends towards elaboration. These studies challenge the assumptions that have often been held about broad stylistic groupings and chronological trends in Aegean palaeography.

I would, however, suggest that the strong correlations between Skelton and Firth's results and both traditional palaeographic dating and archaeological evidence indicates that there must be at least some chronological significance to the characters selected for the analysis, even if they only tell a smaller part of a more complex story. It would be difficult to explain the coherence of the results otherwise. Similarly, the general clustering of hands by deposit on the output trees is hard to rationalize without acknowledging a certain degree of stylistic coherence within groups of scribes operating during the same period. These outcomes provide considerable support for the capacity of phylogenetics to detect trends in the LB data with some archaeological and historical basis.

However, the results of the 2016 study in particular indicate a level of heterogeneity within these groupings that needs to be taken into account. This is particularly evident amongst the hands ascribed to the North Entrance Passage (NEP) deposit from Knossos. Although they cluster together in the relevant results trees, the various NEP hands apparently include a combination of "Middle" and "Late", as well as "progressive" and "conservative" features, as defined by Firth and Skelton (2016a, 162). I agree with Judson that the appli-cation of these different labels is unclear and confusing (e.g., how does one distinguish between a "Middle progressive" and a "Late conservative" style); and I also take issue with the fact that these inconsistent results are not specifically explained by the authors (Judson 2020, 220–21). The first problem regarding Skelton and Firth's classification system reflects the analysis and interpretation, rather than a methodological or theoretical problem regarding the applicability of phylogenetics. And whilst the second issue would have benefited from more specific discussion by the authors, they do acknowledge more broadly the underlying complexities of the evolutionary scenario being examined in their study.

Firth and Skelton (2016a, 164) recognize that not every sign will follow the same path, or even a linear path of progression "from newer to older forms", and that certain states can come in and out of fashion over time. But they do emphasize that, given the large number of characters captured in the model, the broad trend of change over time is captured in the results, even if there are nuances and discrepancies for certain individual characters. This is a key strength of phylogenetics – the ability to process and synthesize large amounts of data at a level arguably beyond the capacity of an individual researcher, and identify overall trends. Of course, the results are only as good as the data provided; therefore detailed analyses by palaeographers are still a vital part of the process, with phylogenetics simply acting as a tool that can be employed alongside other techniques.

This highlights a further advantage of phylogenetics, as noted by Skelton (2008, 159) – phylogenetics cannot aim to be entirely objective, but the human decisions that go into each analysis are made as transparent as possible. This can be seen in the explicit and digestible nature of a character matrix in representing what data has been included, and the equally explicit statement of the criterion against the data is run, which allows other scholars with relevant expertise to "focus on the data and methods used" in their critiques and provide valuable feedback – as both Salgarella and Judson have done with their informative responses regarding issues of palaeographic significance in the character selection, and chronological value more broadly. Furthermore, as phylogenetics is a computer-based analysis, new information can be iteratively fed back into the model to continue experimenting with and eventually improving the overall results (Skelton and Firth 2016, 221). It would therefore be entirely possible, and likely very informative, to re-run Skelton and Firth's analysis including data from both Judson and Salgarella's recent work, to see what changes this brought to the overall results.

Petrakis (2022, 419) raises a strong objection to Skelton and Firth's application of phylogenetics, highlighting the apparent inability of the method to handle the complexities of the way writing systems develop over time: an analytical tool that helps a scholar working on the history of writing (Aegean or elsewhere) should be able to accommodate conservatism, the concurrence of both embellishment and simplification, the varying degrees of interaction and cross-fertilization (a term borrowed from life sciences) amongst different palaeographic entities (Hands, classes, schools, styles or *koinai*), as well as diverging, converging and even anastrophic trends.

Judson (2020, 217) holds similar concerns, noting "the use of a form of analysis developed for biological evolutionary taxonomy naturally assumes that writing systems evolve in a similar way, but more complicated forms of development are clearly possible". She also cites the issue of lateral transfer of information, which Skelton acknowledges is a possibility between contemporaneous scribes, but also notes that it is not accommodated in their analysis when discussing the results of Pylos Hand 91 (Judson 2020, 217–18; Skelton 2008, 159, 172).

This suggestion that phylogenetic systematics is not an appropriate tool for handling the nuance and complexities in cultural evolution is understandable, given the choice by Skelton and Firth to use maximum parsimony in their analyses. This sub-method of phylogenetics is driven by the core condition of "parsimony", which assumes that the simplest solution (i.e., the tree that fits the data with the least amount of character changes) is the best representation of the evolutionary reality (Baum and Smith 2013). Only minor modifications can be made to this sub-method, namely weighting the perceived "evolutionary significance" of different characters based on the number of times they change across the tree, using somewhat controversial methods such as *consistency indices* (Skelton 2008, 171; Swofford 1998, 501–3). The principle of parsimony is in direct conflict with more complex forms of evolution, including homoplasy, and the method has also been shown to perform poorly when faced with highly variable rates of change (Holder and Lewis 2003, 276). I would therefore suggest that it is ill-suited to handle the specific scenarios raised by Petrakis and Judson above. "Model-based" approaches, however, including maximum likelihood and Bayesian phylogenetics, have been shown to better accommodate complex evolutionary patterns, and may be worth considering as viable alternatives.

An alternative approach: Bayesian phylogenetics

Model-based approaches search for trees that have the highest probability of producing the observed data, given a specified evolutionary model (also known as an "optimality criterion") – unlike maximum parsimony, where one is restricted to the criterion of searching for the shortest tree-length. Bayesian phylogenetics (being based on Bayes' Theorem, in contrast to the more traditional statistic approach taken in maximum likelihood phylogenetics) additionally requires researchers to incorporate prior knowledge of the data into the analysis – as noted by Baum and Smith (2013, 258), this is something we generally do when conducting any analysis or experiment, but Bayesian phylogenetics has the advantage of making these assumptions explicit (for a more in-depth discussion of the philosophical and methodological distinctions between maximum likelihood and Bayesian phylogenetics, see Baum and Smith 2013, 239–59).

In the field of biology (and, increasingly, in historical linguistics), Bayesian phylogenetics is increasingly overtaking maximum likelihood in popularity due to its philosophical distinctions, particularly around the use of priors, as well as the development of user-friendly programs and powerful models of data analysis to assist in the process (Baum and Smith 2013, 258; Gjesfjeld and Jordan 2019, 164). And both Bayesian phylogenetics and maximum likelihood tend to outweigh maximum parsimony, with model-based approaches generally producing more accurate results. However, the uptake has not been the same in analyses of material culture, which continue to almost exclusively employ maximum parsimony (O'Brien et al. 2018, 10–1). For archaeological researchers, the requirement to specify an evolutionary model is seen as a barrier – this was certainly the case for Skelton (2008, 170–71), who acknowledged that the principles underlying maximum parsimony may not be the most accurate representation of reality, but felt that it was not possible to produce an evolutionary model for the development of the LB script.

I would suggest that the idea of using a model-based approach – particularly Bayesian phylogenetics – should be revisited, as it has the potential to address a number of the aforementioned concerns by Judson, Petrakis and Salgarella. The ability to set an explicit evolutionary model would offer the ability to introduce the increased levels of nuance that are required, particularly over the rate and nature of change. Models can be selected with very general characteristics, where all characters are treated to same; but they can also be made more specific, varying rates of change across different characters or character states in instances where they may be either more susceptible or more resistant to change, or where a trait is more likely to be gained rather than lost during the evolutionary process (and vice versa) (Greenhill et al. 2020, 229). This potential for character-level control over evolutionary change may assist in addressing the concerns around accommodating the concurrence of both simplification and elaboration in LB sign development, as well as varying levels of conservatism and progressivism. The setting of specific model parameters would greatly benefit from the level of palaeographic detail provided in both Judson and Salgarella's recent publications on LB (Judson 2020; Salgarella 2018, 2020).

The possibility of incorporating prior knowledge into the model for Bayesian phylogenetics – such as fixed dates of divergence where scribal hands and tablets have more certain dating – also holds great potential for improving the overall chronological accuracy of the final model. Greenhill et al. (2020, 231), discussing the use of Bayesian phylogenetics in historical linguistics, note that priors in their area of research include historical evidence, such as the specific dates of ancient texts or the dates of certain events to assist with chronological calibration, as well as information on phonological innovations to inform subgrouping inferences. Using the archaeological and traditional palaeographic information currently available, there would be scope to include similarly informative priors if a Bayesian phylogenetic analysis was to be undertaken focusing on the LB texts.

Exploring alternative sub-methods to parsimony may also offer solutions to the very legitimate concerns held by both Judson and Petrakis regarding the high likelihood of non-vertical modes of transmission amongst scribes throughout the history of LB. As noted in the previous section of this paper, reticulation is a broader concern for both proponents and critics of cultural evolution, but to reiterate, it is a methodological problem rather than a theoretical one, and therefore has the potential to be overcome through developments in phylogenetic tools and techniques. Recent research by Greenhill et al. (2009) has demonstrated that, for linguistic case

studies, Bayesian methods appear to be relatively robust to the effects of horizontal, non-systematic borrowing, even at substantial (yet still realistic) levels. Unfortunately, not enough non-linguistic studies applying Bayesian methods to aspects of culture have been undertaken to verify if this applies more widely – however, case studies like the LB texts, as well as my own work on administrative devices more broadly, offer a prime testing ground, as there is some scope to verify the results against archaeological data and the outputs from more traditional methods of comparison.

Finally, I will briefly comment on two additional critiques of Petrakis (2022, 419) regarding Firth and Skelton's phylogenetic study: first, that "it adds little that has not been supported by the archaeological evidence", and second, that "some deviations of it have no solid foundation". Regarding the first statement, Greenhill and Gray (2009, 16) highlight the same criticisms leveled at applications of phylogenetics in their own field of historical linguistics. However, they counter that these phylogenetic methods (particularly Bayesian approaches) are incredibly valuable in assessing hypotheses reached by more traditional methods of comparison and analysis, using a transparent and empirical process. I would stress that, rather than seeing phylogenetics as a method designed to replace existing approaches to researching material culture, we should consider it complementary, allowing researchers to experiment with different parameters and data inputs, and test out competing hypotheses, in a way that is otherwise lacking in archaeological research. In the particular case of Skelton and Firth's research, it may be true that their results largely aligned with existing hypotheses, but this is arguably just as valid a result as one where the phylogenetic tree completely turned our understanding of LB palaeography on its head.

Petrakis' (2022, 419) assertion that "some deviations [from what can be confirmed through archaeological evidence] have no solid foundation" underestimates the value of this tool in highlighting particular relationships and trends that may not have not been previously considered – particularly as it is bringing a different perspective to that of individual human analysis, with its capabilities in synthesizing large amounts of data and evaluating myriad possibilities against set criterion. Re-examining both the input data driving these results, as well as the archaeological evidence that may either support or challenge those outputs, can provide fresh perspectives on well-trodden data. And if, upon re-examination, it is thought that such results are erroneous, mitigations and modifications can often be fed back into future runs of the phylogenetic modeling, helping to improve the overall quality.

As noted by Greenhill and Gray (2009, 4), the history of phylogenetics in evolutionary biology was not one of quick and easy success, but rather several decades of working through initially poor results and methodological challenges to transform the field into the leading method for testing evolutionary hypotheses, as it is today. It is natural to expect that similar efforts will be required to adapt this tool to the specific requirements of analyzing cultural evolution, which we can only achieve through continued experimentation on and evaluation of as wide a range of data sets as possible. I hope that the lengthy discussion of alternative approaches covered in this section highlights the range of avenues available to continue improving on the initially promising results produced by Skelton and Firth's phylogenetic analysis. Their work, and the critiques it has received, have both been highly informative for my own project, where I will be shifting focus to the physical forms of the documents and other devices of the Bronze Age Aegean, and examining whether this aspect holds any chronological information to help better construct the history of administration in the region.

THE "CODED IN CLAY" PROJECT APPROACH AND ASPIRATIONS

I have discussed above my reasoning for exploring the uses of phylogenetics in my own work, particularly its advantages over traditional comparative methods when conducting analysis around issues of classification and chronology. But how will this analysis be undertaken, and what can such research actually achieve in the context of Bronze Age Aegean administration? Although the "Coded in clay" project is still in its early stages, I can outline its overall approach and aims below.

In terms of approach, I will be selecting a number of case studies that focus in on better understanding the relationships between the three systems – combination nodules, which have been identified in both CH and LB deposits; the flat-based nodules from LA and LB; and *noduli*, which span all three systems. I will be using the Bayesian approach outlined in the previous section, given the greater level of control and precision it offers in terms of setting a tailored evolutionary model and priors, as well as its superior performance over maximum parsimony when faced with evolutionary scenarios such as reticulation and homoplasy. At the most fundamental level, it is hoped that the phylogenetic models produced in the course of this research will help us more fully understand the level of relatedness between the types across different systems, which may better illuminate whether CH or LA (or perhaps both) had a stronger impact on the development of the LB devices. These models also have the potential to provide a view of how standardized the devices are *within the same systems*, allowing us to better interrogate the adequacy of our current systems of classification, and perhaps provide more detailed guides to such typologies.

It should be acknowledged that this relies to a great degree on the level of chronological value (if any) that can be attributed to the physical form of the different types of documents. The importance of the shape for many of these devices has been highlighted by both Schoep (2002, 9) and Finlayson (2013, 137), who suggest that the distinctive forms of each of the Aegean document types acted as visual markers to distinguish their varying purposes. Weingarten (2007, 135) has further suggested that "seal-users tend to betray their 'hands' almost as much as scribes: they have a strong tendency to mould the clay in a repetitive manner, making their sealings or *noduli* of much the same size and of very similar shapes". Whether this focus on form during the production of the devices goes beyond individual idiosyncrasy remains to be seen, but it is plausible that similarities will be detected amongst administrators who worked and shared knowledge in close proximity, presumably undergoing the same or similar training programs, and that particular trends evolved over time. Alternatively, and although disappointing in terms of answering my original questions about the origins of the LB devices, a negative result in this regard will be just as informative in establishing the types of information we can expect to glean from these devices.

A secondary output from this project will be the data collated during the research process, which will attempt to pull together currently published information into a single source, as well as fill any necessary gaps. This will include information on the devices regarding dimensions, clay type, seal impressions, inscriptions, string and reverse impressions, find condition (i.e., the state of a device at the time of its discovery – either complete, damaged or broken – providing clues to its function and to its status as either functioning or discarded at the time of deposition) and find context. Furthermore, high-quality photographs and 3D photogrammetric models will be produced for each of the examples included in the study, fully capturing the physical forms of the devices (where photogrammetry is the process of generating 3D models from photographic images via specialized software, see Luhmann 2006, 1–15). It is hoped that this information, along with data related to the phylogenetic modeling, can be shared in an open-access format at the conclusion of the project, so that others working in the field can harness and build on this body of information, supporting further research into the Aegean administrative devices in their own right.

Through better illumination of the relationships between these administrative systems, we stand to gain a far greater understanding of the worlds of the administrators who worked within them, in particular the extent to which administrators from the Minoan tradition played a direct role in the formation of the LB system. Going forward, there is also scope to use phylogenetics when examining other issues, including the relationship between CH and LA, or whether elite groups on Crete and the Greek mainland drew influence from further afield than the Aegean when developing their administrations, indicating wider cultural interactions and influences. I look forward to providing updates regarding the outcomes of this project as it develops in coming years.

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9

The Wor(l)ds of Linear A

Concluding thoughts

Vassilis Petrakis

National and Kapodistrian University of Athens
ORCID ID: 0009-0003-4044-2313

Philippa M. Steele

University of Cambridge
ORCID ID: 0000-0003-3109-265X

There is more than one way in which a conclusion to the *Wor(l)ds of Linear A* can be meant, beyond the obvious composition of a pertinent text, such as this one. This chapter revolves around (but is not restricted to) topics raised during the concluding discussion section of the conference, on whose proceedings this volume is based, so meticulously organized by Ester Salgarella. In this sense, this text may offer a (necessarily selective) survey on the topic and a few reflections on the theme of the conference, the writing system we have come to name, since Sir Arthur Evans first invented this nomenclature, as "Linear script of Class A" or, in short, "Linear A".

This is a happy conclusion to the first international meeting devoted entirely to this script and leading to the first international multi-author publication of the same focus. We trust it was a happy occasion for all involved, either as members of its scientific committee (mentioned and kindly acknowledged in the Foreword) or even as attendants and active participants in the stimulating discussions that followed. Moreover, each conclusion is happy because, in scholarly adventures, each end is simultaneously also a point of departure: our highest hope is that *WoLA* (as we suggest that the event and the volume itself be abbreviated) will stimulate further research, effectively preparing the ground for a second international meeting on Linear A, so as to establish the study of the Linear A script in its multifaceted nature as an independent (yet inter-connected) field of academic enquiry.

The title's meaningful "word/world" interplay may make one immediately think of Ludwig Wittgenstein's famous quote: "The limits of my language mean the limits of my world" ("Die Grenzen meiner Sprache bedeuten die Grenzen meiner Welt", preposition 5.6 in his *Tractatus Logico-Philosophicus*, quoted here from the 1922 English translation by F.P. Ramsey and C.K. Ogden). In the months preceding and following the event, the word/world pun was brought up repeatedly, and even more so when the event's organizer, Ester Salgarella, offered us the stimulating task of concluding this volume. In this role, we had to conclude both the "words" and the "worlds" of Linear A, while keeping in mind that these two conclusions may well be one and the same: the *words*, the sequences of Linear A signs, had specific pragmatic references as this script (like all writing systems) was born out of *real* communicative necessities related to specific socio-political contexts. It is a rather tautological statement that the Linear A (or any) script did not exist outside its realm of use: its "words" were its "world(s)". To *paraphrase* Wittgenstein again (specifically, his preposition 5.6.1: "what we cannot think, that we cannot think") we may say of Aegean (and other) script-users that "what they could not <u>write</u>, they could

not <u>write</u>" ("was sie nicht <u>schrieben</u> können, das können sie nicht <u>schrieben</u>"). Or, to put it outside the realm of the Wittgenstein-ean theses, separating different *aspects* of the script is feasible only in theory: praxeologically, writing is a coherent, indivisible whole system, comprising of sign-forms (our beloved signaries), "rules" of how these are used to convey meaning through various means (phonographic or non-phonographic), specific material supports and their signification and, certainly not least, the content of the messages that writing was used to convey. These all compose the writing *praxis*.

Similarities between Wittgenstein's "world", as encompassing all one might think, and the "world" of a script end here. There were also "worlds" beyond what writing systems express: *vast* illiterate realms of human action, in which the practice of writing was unknown or, at best, marginally known, as an arcane (conceivably even "magical") information technology. The limits of a writing system may be, for practical purposes, finite, but are remarkably open: scripts can change (through specific agency, of course), and *do* change. Yet, in this process of change, different "entities" may emerge. As scholars who try to study such systems thoroughly, we must deal with the question of the point when a script *variety* begins to exist as a different script altogether. The shift from one entity to another, however gradual or abrupt, however subtle or dramatic, is always both an end and a beginning.

That might lead to another interpretation of the "conclusion" of the "wor(l)ds" of Linear A. The last chronological horizon of a specific *realm of script use* in the Bronze Age Aegean and the passage to a new environment, in which script (now Linear *B*) became –almost exclusively– a specialized tool of palatial bureaucracy, introducing new "words" (expressing verbally a Greek dialect or sociolect for the first time), but, just as importantly, a new "world" – new political economies. The "conclusion" of *both the world and the word of Linear A* can be argued to mark a remarkable episode in the development of Aegean Bronze Age scripts and literacy, a point to which we shall return.

Some of what follows has been prompted from attending the conference papers and the discussions that followed, although, almost inevitably, all this experience has been mapped onto (even immersed into) our own interests and ideas.

"LINEAR" A WITHIN THE GRAPHIC LANDSCAPE OF THE BRONZE AGE AEGEAN (AND BEYOND)

In our introductory essay (Petrakis and Salgarella, this volume) we stressed how "Linear A" was defined as a category already in 1909 (but going back to observations made in 1903 or even during the 1890s). Following this, and with the pertinent epigraphic material repeatedly presented in various forms and in a systematic way since 1945, one may think that we have a good idea of what Linear A is and what it looks like. Such a view is indeed promoted in many general accounts, brilliant in structure and excellent in their discussion. One such account, originally composed in 2007 but the latest to appear in print at the time of writing this chapter, is authored by the late Jean-Pierre Olivier (1939-2020) and is included in the first volume of *The New Documents of Mycenaean Greek*, the third installation of the grand handbook of Mycenaean studies, initially authored by Ventris and Chadwick and now thoroughly revised in a new multi-author format edited by John Killen. There, Olivier offers a neat and well-structured discussion of the script (Olivier 2024, 61-70), whose duration of use is clearly outlined. There is an explicit rejection of the caution exercised by Ilse Schoep in classifying **KN 49**, a tablet fragment from the Knossos Southwest Houses, as *possibly* Linear A (Schoep 2007), identified categorically as the earliest Linear A inscription known and formally included in the Linear A corpus (*RILA-S1*, 34-5). The Linear A signary is quite well-defined, and the range of its material carriers is laid out in a comprehensive way. Moreover, Olivier lays out the evidence that singles out Linear A as the most prolific Aegean script, having spawned both Linear B and the Cypriot syllabic scripts of the Late Bronze Age known, since Evans' time, as Cypro-Minoan. The "words" and the "worlds" of Linear A are very rigidly and clearly outlined.

Recent studies, some authored by the volume's editors, have tried to blur the boundaries of such a categorization of Linear A. These have been (directly or indirectly) influenced by approaches to the material that acknowledge the systemic and integrative nature of scripts, the very fact that they are writing *systems* and, as such, they inherently contain a number of qualities, material and immaterial, but all related to *practice*.

It is heuristically useful to think of those features that relate to the "inner" workings of script (the form and function of graphemes, the occurrence of variation and the interrelationship of the various *types* of graphemes and their correspondence –or lack thereof– to linguistic entities), and those that we may justifiably label "external" features, such as the typology of the material carriers of text, the way the interaction between writing practice and material affect the direct material outcome of text production (the ductus) including, of course, all those features that relate to inscribed documents as artifacts: their condition, context of production and use, their variform contextual association and their chronological and spatial/geographic distribution. We might term such features "script-internal" and "script-external" respectively (cf. Meißner and Salgarella 2024).

Relatively recently, Petrakis (2014a, 2017b) and Salgarella (2020) focused on *both* such features to reassess the place of the Linear A *category* within our understanding of the development of Aegean Bronze Age scripts. Although the balance tilted differently in those studies, they both attempted to *question the rigidness* of the separation of Linear A from Cretan Hieroglyphic and Linear B respectively.

Petrakis focused mostly (albeit not exclusively) on document typology and function, following observations by Erik Hallager (2011, 2015) and Helena Tomas (2011, 2012, 2017), in which the differences between the apparatus of the *administrative systems using* Linear A and Linear B were stressed, while also acknowledging interesting similarities in document typology and use between the *systems using* Cretan Hieroglyphic and Linear A.

Exploring a seemingly different issue, that of the context in which Linear B administrations were shaped, he was led to a preliminary reexamination of those assemblages where inscriptions classified as (certainly or probably) Linear A occur alongside inscriptions classified as Cretan Hieroglyphic: the well-known case of the Malia "Dépôt Hiéroglyphique", as well the Knossos "Hieroglyphic Deposit", which may date (although there is debate about this) in the mature Neopalatial period (MM IIIB or the MM IIIB/LM I transition). The identification of some probable Linear A inscriptions in the Knossos "Deposit" (*CHIC*, 18) has been critical. During the *WoLA* conference, it was refreshing to attend Louis Godart's paper (published now as Godart 2024), in which he returned to the identification of the Linear A inscriptions in the Knossos deposit, although, unfortunately, this paper could not be included in the present volume.

Petrakis further suggested that the issue is not merely one of Linear A co-presence with Cretan Hieroglyphic in the same assemblages. Taking into account "script-internal" features as well, such the occurrence of signs hitherto exclusively associated with Linear A, such as klasmatograms (Corazza et al. 2021; see even further Perna 2023), on these (and no other) deposits, he put forward the idea that the two "Deposits" at Knossos and Malia represent a different regional entity, both in terms of "script-internal" and "script-external" features tentatively named "north-central Cretan Neopalatial administrative system". This proposal may lead to a thorough new study of all aspects in these assemblages, which is designed for the near future. Some questions may, however, already be raised: how did such a regional system –if we accept that the evidence can be interpreted in such a way– come about? Was it the result of some fusion between two otherwise well-defined categories? Or do we have to rethink, in the light of these findings, the way we have so far classified Aegean scripts? This approach intended to highlight the various shades of grey that still exist in our classification of Aegean material as "Hieroglyphic" or "Linear".

Further exploration of that gray area was also addressed by the paper presented in *WoLA* by Barbara Montecchi, Maria Streccioni and Silvia Ferrara. Although this work appeared elsewhere (Montecchi et al. 2024), it enriched the perspectives of attendants by focusing on (and questioning) the relationship between the seemingly well-defined Linear A corpus and material commonly classified as "aberrant", such as the Phaistos Disk and the inscribed bronze axe from Arkalochori.

Salgarella (2020) took on the task of exploring the palaeographic variation of Linear A phonograms, which had for such a long time been a desideratum in Aegean epigraphy. However, her approach included both "script-external" and "script-internal" features, as she focused on the geographic distribution of signs and palaeographic variants which, in turn, supported certain patterns arguing against a monolithic view of Linear A as being a single, undifferentiated entity. This approach is compatible with the regionalism that Petrakis' approach suggested and a potentially useful corrective to the quantitative domination of Late Minoan IB Ayia Triada material on Linear A studies. This may well encourage the need to examine signaries in a regional (even site) scale (cf. Bennet and Petrakis 2024 for the same point as relevant to Cretan Hieroglyphic; also Notti 2021 for Linear A on Thera).

Salgarella proposes to accommodate also the emergence of Knossian Linear B (arguably, the earliest Linear B known) within the documented variation of Linear A, as a later (post-LM IB) variety of it, developed foremost under the influence of Neopalatial Linear A varieties in the area in which it is first attested (north Crete) (summarized in Salgarella 2020, 369‑70; see also Bennet 2022). This view threw another bridge across the Linear A-B "divide", suggesting a transition that might have been smoother than the "killing" that John Bennet has argued (Bennet 2008, 22). Although born during Evans' exploration of Knossos (see above), the distinction between Linear Classes A and B has arguably grown far and wide after the decipherment of Linear B, whose demonstrable "Greekness" ensured the deepening of a kind of historical chasm between the two Aegean "linear" scripts.

Relevant here is the important point made by Ilse Schoep in her contribution, namely of how visualizing the development of a culture through time through temporal "blocks" influences the way we understand the pace and periodization of cultural practices – *including* writing and sealing (Schoep, this volume; cf. also Whitelaw 2022). The decipherment of Linear B was a dramatic paradigm shift in many aspects of Aegean prehistory, whose effect was multiplied by its association with the dramatic upheaval associated with the Late Minoan IB/II "divide".

Although one should not overstress the distinction, we cannot afford to lose sight of the important changes that came with the appearance of Linear B. Changes in literacy, namely the contextual restriction of script use to the realm of the administration, are often stressed and with good reason (see the recent treatment of Steele 2024, 79–147, focusing on the shift from high to low vitality in writing). Recently, Torsten Meißner observed that the bulk of what we may term "non-administrative" Linear A inscriptions seem to be associated with specific contexts of Neopalatial Cretan (not generally Aegean) religious practice, therefore hinting that the difference between Neopalatial and later (i.e., Third Palace Period or "Mycenaean") script use may specifically relate to institutional changes related to religious behavior. Although this does not necessarily revolve around the literacy of priests and or other cult specialists (cf. Meißner 2023, 216), as we observe the same lack of religious inscriptions in post-LM IB Crete, where syncretized cults (e.g., of a Diktaean Zeus on **KN Fp(1) 1**.2) may be attested, we may tentatively suggest that the apparent restriction of script use may have more to do with a withdrawal of inscribed text from cult practice –the inscription on the LM IIIA1 figurine from Poros (**PO Zg 1**: Dimopoulou et al. 1993) can be the exception that proves the rule.

However, there may be more to the passage to Linear B than the discontinuity of certain categories of inscriptions. One may observe that the emergence of Linear B brings an abrupt end, perhaps not to the Linear script, but certainly to the degree of palaeographic diversity that can be documented in the Neopalatial period (Salgarella 2021). In another of the *WoLA* papers that does not appear in the present volume, since its content has already been published elsewhere (Steele 2024, 29‑78), Philippa Steele stressed the changes in "logographic" writing (or "non-phonographic" writing) apparent between the Minoan and Mycenaean writing traditions. Although Linear A "logograms"/"non-phonograms" have typically been assumed to "work" in the same way as their homomorphs in Linear B, there are some significant differences, most obvious in the layout of longer texts. Unlike in Linear B, where signs for commodities usually have clear "slots" beside associated numerals and measurement signs, in Linear A they occur alongside syllabographic signs without any visual separation. This could be considered a "tidying up process" (Salgarella 2020, 150), mainly relevant to the visual layout of infor-
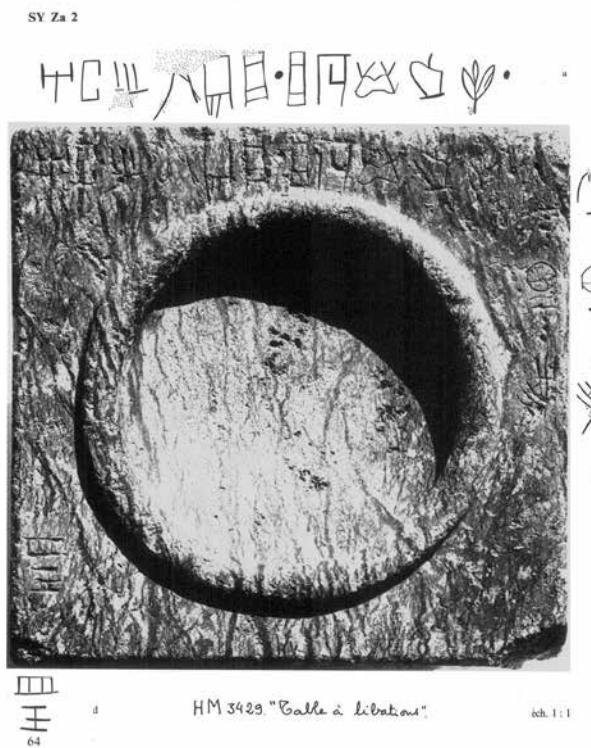
Fig. 9.1: **SY Za 2**, photograph and facsimile, after GORILA 5, 64 (courtesy of L. Godart and J.-P. Olivier).

mation. However, in one libation table (**SY Za 2**), we may have indeed a somewhat "curtailed" (as John Younger terms it, see Younger 2024b: unnumbered page 108) version of the so-called "libation formula", where whole sign-groups (as spelled out in syllabograms) appear to alternate with "logograms" *302 and *122 "olive oil" and "olives" respectively (Steele 2024, 62–4) (**Fig. 9.1**).

Although isolated, this instance might suggest that commodity-signs may have a wider functional range in Linear A than in Linear B. Indeed, it is clear from the diverse types of such "logograms" (on which see also Petrakis 2017a –preferring to call them "non-phonographic" signs) that they were derived in different ways from a range of different precursors in Linear A, even though for Linear B writers they still performed the same role whatever their individual origin: there is no functional difference in Linear B between a highly iconic grapheme, such as a vessel sign and one derived from a compound (such as *MA+RU* = LANA, "wool"). Again, such divergences in practice between Linear A and B probably have practical motivations, for example changes in bureaucratic practice as well as a language shift in administration that may have affected such arguable logographic representation.

One may observe that the transition to Linear B occurs across a divide *overloaded with dramatic shifts*. We may duly record the innovations in administrative structures, craft production, mortuary practice, whose radical character seemingly supports the "Mycenaean conquest" narrative (e.g., Wiener 2015), whose historiographic background is, however, much more complex (Galanakis 2022). It looks tempting to understand the genesis of the Linear B system as part of that innovation. However, Late Minoan II–IIIA1 Knossos offers us a fascinating mixture of traditionalism and radical innovations. Linear B has a little bit of both aspects of the Knossian elite culture of the time: it is both a further development of a script used in an administrative milieu that had strong precedents in the region; but it is also innovative, if we take into account the innovations observed in the signary, document typology and script use.

Being more precise is considerably difficult. One reason the transition between Linear B and its ancestral system is so difficult to study in its details may be the "black hole", as Olga Krzyszkowska (2005, 189) once

called the lack, not just of sealing practices (to which this term originally referred), but of Cretan palaeography too: but of *any* administrative documents from Late Minoan IB Knossos. The issue came up again during the discussion that followed Schoep's thoughtful paper (Schoep, this volume). Although this looks, at first sight, like an unimpressive argument from silence, both Salgarella and Petrakis have provided interesting clues suggesting Neopalatial north (or even north-central) Crete as the region that has been most "relevant" to the making of Linear B and the Linear B-using apparatus as we know it.

To come back to Linear A, the question of the palaeographic and linguistic unity can now be tackled anew. A recent treatment of the topic by Yves Duhoux (2020) supported a plurality of languages, which seems to be in agreement with palaeographic diversity. However, the application of syllabotactics (more below), as championed by Brent Davis' analyses (Davis 2018, 2024, forthcoming) may suggest that more linguistic unity might lurk underneath the variety of graphic variants.

Another way of looking at Linear A is "sideways", as it were, in relation to the development of writing on Cyprus – where Linear A was borrowed in the form of the distinctive system labeled by Evans as "Cypro-Minoan" because of its clear connection with Cretan writing (a line of descent widely accepted, although alternative views have been expressed, e.g., Sherratt 2013). Indeed, the earlier decipherment of the first millennium Cypriot Syllabary, used for a dialect of Greek, had been instrumental in the decipherment of Linear B, showing the connectedness of the Aegean and Cypriot writing traditions. However, Cypro-Minoan is not as well attested as Linear A and also has a very different appearance, with idiosyncratic palaeography and inscription types that share similarities with both the Aegean to the west and the cuneiform-using areas to the east, yet remain distinctively Cypriot (see Steele 2018, 35-44). This has led to numerous difficulties in identifying the exact signary of Cypro-Minoan, from Émilia Masson's division into three styles (CM 1-3: e.g., Masson 1974) to more recent attempts to unify the signary and try to understand its internal variation (e.g., Ferrara 2013b; Valério 2018; Polig and Donnelly 2022). The perceived distance between Linear A and Cypro-Minoan palaeography has discouraged attempts to develop a sign-by sign identification, although Miguel Valério has presented a convincing synthesis of many of the signs (see for instance his discussion of the early Cypriot clay tablet, **ENKO Atab 001**, the unusual likeness of whose signs to Linear A equivalents he tries to situate in long-term developments: Valério 2017b).

The most recent treatments of the development of Cypro-Minoan use a different approach, in which palaeography as defined from the longer texts (cf. Olivier 2007, where only multi-sign texts are considered inscriptions) is only one piece of the jigsaw. Here context is key, as the use of writing by Bronze Age Cypriots can be considered as a wide "scriptworld", in which single signs, commonly found on Cypriot manufactured vessels for example, were also part of the wider literate environment (see Donnelly 2021, 2022b, 2024). A significant advance is to be found through an in-depth study of the Cycladic examples of Linear A, which have already attracted attention because of their peculiar features not shared with Cretan Linear A (e.g., Karnava 2008, 2018; Nash 2021). As Donnelly (this volume) shows, it is not only the discovery of a Cycladic Cypro-Minoan inscription that points towards new connections: the similarities in palaeographic features and in inscription types and contexts strongly suggest that it was in the Cyclades that writing was mediated via Cypriot traders. This is an important observation that will have a great impact on studies of Cypriot writing.

THEMATIC AND TYPOLOGICAL FOCUSES

It is customary -although imprecise *sensu stricto*- to refer, in editions of Linear B transcriptions, to all documents from a site as "tablets" as if other types of documents were negligible. It has been customary for editions of Linear B texts to include not only tablets, but also labels, and various types of nodules (and, in the case of Knossos, noduli as well), although not inscribed vases, which have been treated as a distinct category, as most, unlike other document types, were not produced necessarily in the site (or region) in which they

were discovered. These decisions are clear to Aegean epigraphists, who use their disciplinary *instrumenta* in an expert, but ultimately habitual way.

The quantitative dominance of the inscribed tablet is a fact in the Linear A corpus too. Still, one of the most important contributions of the last decade focused explicitly on what we would term the non-administrative use of the script, on the stone vessels termed "libation tables" (Davis 2014). That documents other than tablets could provide meaningful focal points of study is exemplified by Maria Anastasiadou's (this volume) preliminary assessment of inscribed roundels. She offers her observation that sign-sequences beginning with AB 08 <*A*-> occur on roundels with incised *numerals* (or arithmograms), which might hint at the possibility that A- functions as a prefix that is somehow related to the fact that the entities represented by these sign-groups are followed by numerals (so apparently counted), but the small sample is not sufficient to demonstrate this. This problem is a recurring one in Aegean epigraphy, not restricted to Linear A, but actually to all material other than Linear B (see more comments on the quantitative aspect of Linear A material overall further below).

Thematic studies may also revolve around the *subject-matters* of the inscriptions themselves. Of course, despite valiant and sound attempts to propose classifications of Linear A material of refinement analogous to that seen in Linear B (e.g., Montecchi 2010 on the Ayia Triada tablets), we may only afford to dwell on rather general classifications (still without established prefixes), based on the identifications of certain recorded commodities.

In this respect, Marie Louise Nosch and Jörg Weilhartner (this volume, and see also above) have offered an exemplary study of Linear A "logograms" for wool and textiles. This material has been discussed before, still chiefly in studies focused more on the Linear B material (e.g., Del Freo et al. 2010; Petrakis 2012a). Their discussion of the various trajectories, in which "logogram" repertoires are shaped, has been refreshing; their study documents for the first time in some detail the relationship between the Linear A and Linear B non-phonographic repertoires *a propos* the thematic focus on the management of woolen textile production. Most importantly, its explicitly anti-essentialist viewpoint provides a stimulating background for assessing the subtleties involved in the "transition" towards the Linear B system. We may lament that Rachele Pierini's paper on olives and olive oil in the Linear A records could not be submitted for publication in this volume.

HOW TO LOOK INTO LINEAR A? TOOLS AND (RE)PRESENTATIONS

At the beginning of this concluding chapter, extensive reference was made to how Linear A was defined, classified and presented in the past century. This was prompted by the interestingly recurring focus on analysis and method that was observed across *WoLA* papers and the discussions that followed. Still, the new ways to look forward with regard to Linear A and Aegean epigraphy are not limited to conceptual realignments. Recent tools and *instrumenta*, building on advances in technology, have provided us with an array of new tools.

Some of them used to be startling innovations some years ago but now tend to become part of a protocol of presenting Aegean Bronze Age epigraphic material, include the generation of non-static illustrations based on Reflectance Transformation Imaging, and constructed out of the integration of a large number of static images of the inscribed object with equally diverse light properties, able to recreate as much as possible the experience of the autopsies, as well as showing up details that are easily missed with the naked eye. Within Aegean interests, these were initially applied to the small collection of Linear B documents in the Ashmolean Museum in Oxford in 2012 (https://sirarthurevans.ashmus.ox.ac.uk/collection/linearb/images.html), with the team of scholars working on the final publication of the Pylos tablets swiftly following (Nakassis and Pluta 2017; Nakassis et al. 2021). Although apparently these cannot be fully accommodated in the conventional format of two-dimensional (and inherently static) printable editions, they can be already used as *essential* supplementary material of such publications. Other modes of representation, such as 3D modelling, although less widespread, may occasionally provide fascinating insights too.

Let us turn to papers included herein. Robert Hogan presented a series of working assumptions related to the structure of Linear A tablets that he has used when generating network graphs for his "Linear A Explorer" (see https://lineara.xyz/network; Hogan, this volume). Such visualizations are based upon the notion of degree centrality (Freeman 1978), where "central" indicates well-connected nodes in a network. Visualization of such connections has the potential of being a very useful tool when assessing the strength (a notion based largely on recurrence rate) of ties between analyzed entities. For the visualization of network patterns, other force-directed algorithms, such as ForceAtlas 2 (Jacomy et al. 2014) can be used, building upon the principle of linear attraction/repulsion (linked nodes attracted, unconnected pushed apart).

Visualization of node relations is one way in which digital applications can enhance the study of Aegean scripts. In her paper in this volume, Clelia LaMonica explores the potential of datasets and other resources based on overarching principles through the perspective of FAIR (Findability – Accessibility – Interoperability – Reuse of digital assets, see https://www.go-fair.org/). As she surveys evidence presented in known published datasets (including Robert Hogan's "Linear A Explorer", or in even more specialized datasets, such as the palaeographic database *SigLA*, Salgarella and Castellan 2021), she proposes links between archaeological, genetic and linguistic datasets to produce "joint" digital resources (LaMonica, this volume). Such links must, indeed, not be discouraged, but extreme caution is needed to discourage essentialist (even perhaps primordialist) conceptions of ancient cultures (see e.g., Maran 2022).

NEW ANALYTICAL TOOLS

The last remark on the previous section must not be understood as a discouragement over crossover methodology altogether. It has commonly and often been noted how Aegean studies are *inherently* cross-disciplinary. In recent years, there has been a flourish of the applications of phylogenetics and statistical approaches. The former, championed in the pioneering study of Christina Skelton (2008; Skelton and Firth 2016; Firth and Skelton 2016a, 2016b), has had an interesting impact in discussions about the development of Aegean scripts, especially the internal development of Linear B (for some reservations see the discussion in Petrakis 2022, 419–20). While itself an ingeniously conceived application of phylogenetics, one may wonder to what extent our fascination with it is not related with the infamous quest for "objectivity" that the method apparently provides.

As so many important results are at stake, it has been very fortunate that Emily Tour (this volume) has decided to study the relationship among the main categories of Aegean writing (Cretan Hieroglyphic, Linear A and Linear B) through phylogenetics. Her project, meaningfully named "Coded in Clay", is intended to focus not just on sign-forms, but also on those features that have been called "script-external", most notably document typology.

The other offshoot of the cross-disciplinary methodological opening of Aegean epigraphy in recent years has been the one pioneered by the analytical work undertaken by Brent Davis (2014), himself the author of a more conventional (but still exemplary) study of inscribed "libation tables". On the strength of his considerable linguistic and analytical background, Davis has sought to apply a novel statistical approach to ask new questions and attempt to answer them in innovative ways.

It was fortunate that Davis was able to give not one, but two papers at *WoLA*. One of them is destined to form a chapter of a forthcoming work and is not included herein (Davis forthcoming). It forms part of a remarkable series of innovative contributions that follow on the track so brilliantly initiated by David Packard's (1974) impressive statistical analysis of the Linear A material. Davis has focused on *syllabotactics*, a statistical assessment of constraints and trends on the combinatory possibilities of syllables. Being grounded in phonology, syllabotactics tend to be language-specific. He provides a test of the validity of the method by comparing the syllabotactics of known linguistic relatives and known linguistic "aliens" in the Aegean-Cypriot syllabographic material: his approach confirms things we know, that Linear B and the Classical Cypriot syllabary record Greek

dialects, as well as that Linear A and Linear B render different languages. Davis has produced a startling result by proposing that syllabotactics support the statistical likelihood that the language of the notoriously "aberrant" Phaistos Disk may be the same or very close to the one on the Linear A inscriptions (Davis 2018). Since then, he has moved forward by arguing, on similar grounds, for the statistical likelihood that all Linear A inscriptions from throughout the island record the same language, and so is also likely for Cretan Hieroglyphic and Linear A (Davis 2024; forthcoming).

Such findings, if confirmed by further tests or alternative methods, may suggest a remarkable linguistic uniformity of the pre-Linear B inscriptions. This would be a major discovery by itself. It is laudable that Davis has been so lucid about the range of possibilities under the "same language" rubric of his statistical assessment: same language, two very closely related languages, dialects of the same language or two different stages in the development of the same language / closely related dialects. His findings have an obvious considerable bearing in any reconstruction of Aegean prehistory. We should not necessarily view the regional diversity proposed by Petrakis and Salgarella as contradictory to Davis' conclusions.

DECIPHERMENT PROSPECTS

"I can read Linear A; I just don't know what every inscription says."
John G. Younger posted in the *Aegeanet* discussion list, 25 April 2024

Last, but *certainly not least*, we must come to the question that may lurk somewhere in the mind of most Aegean epigraphists, and is one of the questions we most often encounter when making public statements about Aegean inscriptions. The question revolves around the language rendered by Linear A or some other undeciphered Aegean script. Through the years, this has been phrased in many ways, often awaiting confirmation or rejection of a specific decipherment attempt that has been in vogue. Let us phrase it in the way we would like it to be asked: *How close are we to deciphering Linear A?* Of course, there is no short and simple answer.

Let us be clear that this volume (or the event that this volume stems from) accommodated no startling new proposals for the "Minoan" language(s). Formally, we could dance around the topic or stay in the comfort zone of agnosticism – which is, ultimately, honest. However, one of the papers in this volume assumes a brave attack on the issue in a surprisingly direct manner and this invites also some comment on the issue of the *Minoan language* – as we may conventionally call the language(s)/dialect(s) underlying the pre-Linear B epigraphic material from the Aegean.

Davis' second *WoLA* paper –the one that appears in this volume– is a highly readable assessment of what we may know (or we may cautiously hypothesize) about various features of the Minoan (Davis, this volume). Drawing on the linguistic geography (the distribution of the main linguistic entities hitherto recognized) of the eastern Mediterranean in the early second millennium BCE, Davis surveys features that are more or less *likely* to have been part of the Minoan morphology, namely *apparent* affixation (the presence of segments added before or after a "nucleus", namely prefixation and suffixation), as well as syntactic features, such as word-order.

This is certainly not the place to make an extensive summary of Davis' chapter, which interested readers would like to read in full. Assuming the transliteration of Linear A with their homograph Linear B orthographic values (see above), Davis uses examples of alternate types to suggest that the affixation patterns in Linear A sign-groups are not consistent with either Indo-european or Afroasiatic patterns. This lends support to the possibility that Minoan is not related to any language family known to be historically used in the area.

This appears to be a merely negative conclusion, a source of potential discouragement. That it may be, but, as it is the sound conclusion of the analysis of some well discussed evidence, we may use it as a tentative starting point. When juxtaposing the "deciphered" scripts of the Aegean (or Aegean-Cypriot) scripts, namely Linear B

and the Cypriot (or Cypro-Greek) syllabary, to their undeciphered cousins (the pre- or non-Linear B Aegean scripts, including Cypro-Minoan) one is struck by the differences in the *quantity* of the available material, a difference expressed both in the number of inscriptions, as well as the number of signs and sign-groups (see most recently the overview in Olivier 2012, 16–8, fig. 2). The size of the published Linear A "corpus" is almost equal to the amount of text assigned to the most prolific "scribe" in Pylos, Hand 1 (J.-P. Olivier, pers.com. to V. Petrakis, 27 February 2010).

It is often suggested that, alongside the lack of bilingual inscriptions (of which one script/language will be a known one), this relative paucity of material is the main reason why Linear A, as well as other scripts from Proto- and Neopalatial Crete remain, to this day, untamed beasts.

The limited quantity of inscribed material before Late Minoan II/IIIA is a plain fact. But this is not the main reason why progress in sorting out the features (more or less likely) of the Minoan language has been (and *will be*) slow. The reason is the possibility, suggested also very comprehensively by Davis' discussion, that Minoan has no extant historical relative, quite unlike the Mycenaean *Greek* rendered by the Linear B script.

Let us pause and wonder if Mycenaean philology and textual interpretation would have had the amazing –almost explosive– progress it had, especially in the first two or three decades after the decipherment, if Mycenaean was not Greek, one of the most intensely studied languages in human history. What would have happened if the deciphered script had turned out to be a far less documented language? What if there were no waves of specialists (such as the Hellenists and Indoeuropeanists that took immediate interest in the 2nd millennium BCE Greek material) to dwell on the new material and without a deep scholarly tradition (including phonology, morphology, syntax, lexical studies, dialectology) against which the newly discovered Mycenaean evidence would be assessed? Although Michael Ventris certainly did not decipher Linear B because it was Greek (this was, as has been well known, a surprise to him as well), we may well speculate that, if the language had not been a language he had already studied well, he would not have so instantly recognized the fruit of his success.

Such "what-if" considerations, one may argue, are more akin to "alternative history fiction", rather than academic discourse. However, as a thought experiment, it might be interesting to note that the pace and solid appearance of the post-decipherment progress with Linear B has been less a matter of sheer quantity, *and more a matter of the quality* of the evidence available (cf. for a similar comment regarding Cretan Hieroglyphic, see Bennet and Petrakis 2024).

One might note that there is not necessarily a "critical" point in which the mass of Linear A inscriptions will start to generate more reliable results. It is not special pleading if we, once more, stress the state of our ignorance: we do not know what linguistic structures underlie the use of Linear A (or Cretan Hieroglyphic) phonograms.

This is not to deny that more discoveries are highly desirable, and some of them may well be critical. The publication of the longest Linear A inscription hitherto known, that on the ivory "scepter" from the so-called Cult Center in the Anetaki plot at *Bougada Metochi* at Knossos is eagerly awaited as a major contribution that will boost innovative discussions of Linear A and the epigraphic landscape of pre-Linear B Crete, particularly Knossos (see preliminary publication by Kanta et al. 2024). Still, what we most certainly need is novel insights into the extant material, published or new. Recent assessments such as Brent Davis' stand at the helm of such advances.

We may hope that concluding the *Wor(l)ds of Linear A* can be visualized as a sequence of steps towards a better understanding of the script and the contexts it was made to serve. The aforementioned steps, some small, some larger, were made in rather dark (or, at least, imperfectly lit) areas and were often tentative, with feet testing the safety of the ground. Not all of them were in the same direction, but, perhaps, this is the strength of a collective scholarly effort such as the one represented by *WoLA*. If military metaphors may be permitted, Linear A's formidable problems may actually begin to crack under attacks from as many sides as possible. *WoLA*'s blow was not the first one, but is intended to be one in a series of prolonged engagements. May there be many more.

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