

POCA 2008

Ariane JACOBS & Peter COSYNS (eds.)

**CYPRIT MATERIAL
CULTURE STUDIES
FROM PICROLITE
CARVING TO
PROSKYNITARIA
ANALYSIS**

Proceedings of the 8th Annual Postgraduate Cypriot Archaeology
Conference Held in Honour of the Memory of Paul Åström
at the Vrije Universiteit Brussel (Belgium), 27th – 29th November 2008

© 2015 Uitgeverij VUBPRESS Brussels University Press
VUBPRESS is an imprint of ASP nv (Academic & Scientific Publishers nv)
Keizerslaan 34
B-1000 Brussels
Tel. +32 (0)2 289 26 50
Fax +32 (0)2 289 26 59
E-mail: info@vubpress.be
www.vubpress.be

ISBN 978 90 5487 974 9
NUR 654
Legal deposit D/2015/11.161/097

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Bibliographic Abbreviations

<i>ABSA</i>	<i>Annual of the British School at Athens</i>
<i>ArchEph</i>	<i>Archaiologikè Ephèmeris</i>
<i>AJA</i>	<i>American Journal of Archaeology</i>
<i>AJPA</i>	<i>American Journal of Physical Anthropology</i>
<i>AmerAnt</i>	<i>American Antiquity</i>
<i>ANRW</i>	<i>Aufstieg und Niedergang der Römischen Welt</i>
<i>Ä&L</i>	<i>Ägypten und Levante</i>
<i>ARDA</i>	<i>Annual Report of the Department of Antiquities</i>
<i>BAR IS</i>	<i>British Archaeological Reports – International Series</i>
<i>BASOR</i>	<i>Bulletin of the American School of Oriental Research</i>
<i>BCH</i>	<i>Bulletin de Correspondance Hellénique</i>
<i>BibO</i>	<i>Bibliotheca Orientalis</i>
<i>Bics</i>	<i>Bulletin of the Institute of Classical Studies of the University of London</i>
<i>BMQ</i>	<i>British Museum Quarterly</i>
<i>BSA</i>	<i>British School at Athens</i>
<i>BSL</i>	<i>Bulletin de la Société de linguistique de Paris</i>
<i>ByzZeit</i>	<i>Byzantinische Zeitschrift</i>
<i>CahArch</i>	<i>Cahier Archéologiques</i>
<i>CBRL</i>	<i>The Bulletin of the Council for British Research in the Levant</i>
<i>CCEC</i>	<i>Cahier du Centre d'Etudes Chypriote</i>
<i>CorisRav</i>	<i>Corsi di cultura sull'arte ravennate e bizantina</i>
<i>CretChron</i>	<i>Cretika Chronika (=Κρητικά Χρονικά)</i>
<i>DOP</i>	<i>Dumbarton Oaks Papers</i>
<i>ÉtCrét</i>	<i>Études Crétoises</i>
<i>ICA</i>	MICHAELIDOU-NICOLAOU, I. 1963-2003. <i>Inscriptiones Cypriae Alphabeticae</i> , Nicosia.
<i>ICS</i>	MASSON, O. 1983 ² . <i>Les inscriptions chypriote syllabiques</i> , Paris.
<i>IGRR</i>	LAFAYE, G. & GAGNAT, R. 1964. <i>Inscriptiones Graecae ad Res Romanas pertinentes</i> , Rome.
<i>IJNA</i>	<i>International Journal of Nautical Archaeology</i>
<i>IK</i>	MITFORD, T.B. 1971. <i>The Inscriptions of Kourion</i> , Philadelphia.
<i>JAS</i>	<i>Journal of Archaeological Science</i>
<i>JEa</i>	<i>The Journal of Egyptian Archaeology</i>
<i>JHE</i>	<i>Journal of Human Evolution</i>
<i>JHS</i>	<i>Journal of Hellenic Studies</i>
<i>JMA</i>	<i>Journal of Mediterranean Archaeology</i>
<i>JNES</i>	<i>Journal of Near Eastern Studies</i>
<i>JPR</i>	<i>Journal of Prehistoric Religion</i>

JRA	<i>Journal of Roman Archaeology</i>
Ktèma	<i>Ktèma: civilisations de l'Orient, de la Grèce et de Rome antiques</i>
OBO.SA	<i>Orbis Biblicus et Orientalis, Series Archaeologica</i>
OGIS	DITTENBERGER, W. (ed.) 1903. <i>Orientis graeci inscriptiones selectae</i> , 2 vols., Leipzig.
OJA	<i>Oxford Journal of Archaeology</i>
OLA	<i>Orientalia Lovaniensia Analecta</i>
OpArch	<i>Opuscula Archaeologica</i>
OpAth	<i>Opusculia Athieniensia Opuscula Romana</i>
OpRom	<i>Opuscula Romana</i>
PPC	MICHAELIDOU-NICOLAOU, I., 1976. <i>Prosopography of Ptolemaic Cyprus</i> , Gothenburg.
RAN	<i>Revue Archéologique de Narbonnaise</i>
RDAC	<i>Report of the Department of Antiquities Cyprus</i>
SCE I	GJERSTAD, E., LINDROS, J., SJOQVIST, E. & WESTHOLM, A. 1934. <i>The Swedish Cyprus Expedition. Finds and Results of the Excavations in Cyprus 1927-1931, I</i> , Stockholm.
SCE II	GJERSTAD, E., LINDROS, J., SJOQUIST, E. & WESTHOLM, A. 1935. <i>The Swedish Cyprus Expedition II. Finds and Results of the Excavations in Cyprus</i> , Stockholm.
SCE III	GJERSTAD, E., LINDROS, J. & WESTHOLM, A. 1937. <i>The Swedish Cyprus Expedition. Finds and Results of the Excavations in Cyprus 1927-1931, III</i> , Stockholm.
SCE IV:1A	DIKAIOS P. & STEWART, J.R. 1962. <i>The Stone Age and The Early Bronze Age in Cyprus. Swedish Cyprus Expedition Vol IV Part 1A</i> , Lund.
SCE IV:1B	ÅSTRÖM, P. 1972. <i>The Middle Cypriote Bronze Age</i> , Lund.
SCE IV:1C	ÅSTRÖM, P. 1972. <i>The Swedish Cyprus Expedition IV:1C. The Late Bronze Age. Architecture and Pottery</i> , Lund.
SCE IV:1D	ÅSTRÖM, L. & ÅSTRÖM, P. 1972. <i>The Swedish Cyprus Expedition IV:1D. The Late Bronze Age. Architecture and Pottery</i> , Lund.
SCE IV:2	GJERSTAD, E. 1948. <i>The Swedish Cyprus Expedition IV:2, The Cypro-Geometric, Cypro-Achaic and Cypro-Classical Periods</i> , Stockholm.
SCE IV:3	VESSBERG, O. & WESTHOLM, A. 1956. <i>The Swedish Cyprus Expedition, IV:3. The Hellenistic and Roman periods in Cyprus</i> , Stockholm.
SEG	<i>Supplementum epigraphicum graecum</i> , since 1923
SMEA	<i>Studi Micenei ed Egeo-Anatolici</i>
SIM4	<i>Studies in Mediterranean Archaeology</i>
SIM4-PB	<i>Studies in Mediterranean Archaeology Pocket Book</i>
WorldArch	<i>World Archaeology</i>
ZPE	<i>Zeitschrift für Papyrologie und Epigraphik</i>

Acknowledgements

Both editors would like to acknowledge a number of people who made the POCA 2008 conference to a success.

First of all, we are grateful to all participants of the POCA 2008 conference who contributed to both a high standard programme and fun socialising moments in a relaxing atmosphere. Special thanks goes to the keynote lecturer, Dr Priscilla KESWANI, who emphasised the need to study material culture before drawing to conclusions.

Scholars in the field chaired on a voluntary basis the seven sessions held, and we wish to thank all of them for their presence and contribution to the programme. Jos VANDENBROECK, university assistant and professional guide, organised a city walk through the historical centre of Brussels and shared a few local legends.

We also wish to thank each one of the many anonymous reviewers, without whom the publication would not have been possible and helped significantly in achieving an outstanding work.

In particular, we wish to thank the POCA organising committee, including Jan COENAERTS for maintaining and updating the POCA website, Dr Peter COSYNS, Ariane JACOBS and Hilde WOUTERS for their assistance in all practical and financial matters. Additional support was granted by Michel DE ROUCK from the Vrije Universiteit Brussel, who advised, assisted and encouraged from start to finish. We also wish to thank the undergraduate students who offered their help during the POCA conference, including Daan CELIS, Karmen MIDDERNACHT, Jemma PONT, Sofie SCHELTJENS, Nelson VANHERLE and Barbora WOUTERS.

All of us are very grateful to Prof. Karin NYS for her continuous involvement, efforts and guidance in the organisation of the POCA 2008 conference.

We also wish to thank Alison SOUTH for providing our publication with a summarizing cover cartoon of the POCA conference.

Finally, we would like to thank all sponsors who made it possible to realize the POCA conference:

Ariabel, Brussels Hoofdstedelijk Gewest, Cyprus Airways, Douwe Egberts, Embassy of the Republic of Cyprus, Equinox, Ever-Art'-Designs, Flachdach Technologie, Jules Destrooper, Knauf, Koninklijke Musea voor Kunst en Geschiedenis, M. & J.M. – J. Eyers & Partners N.V., Renault, Sara Lee, Soprema, Tarkett and Xella together with the Vakgroep Kunstwetenschappen en Archeologie (Vrije Universiteit Brussel), Faculteit Letteren en Wijsbegeerte (Vrije Universiteit Brussel), Vrije Universiteit Brussel

Preface

Introduction

These are the proceedings of the Postgraduate in Cypriot Archaeology (POCA) 2008 conference held at the Vrije Universiteit Brussel (Belgium) from the 27th-29th of November 2008.

All papers have been peer reviewed by senior scholars in order to enhance and guarantee the quality of the papers. The publication format both presents work-in progress and finished works. We have chosen to organise the papers on a largely chronological basis, since some papers were not included in the final publication. The publication has suffered from a long delay due to a number of practical, editorial and professional reasons. The papers incorporated in this volume represent the research presented in 2008 (and submitted in 2010) and should therefore be read accordingly. The reference lists and affiliations of the contributors have been updated and when relevant the affiliation in 2008 is stated in a footnote. Also referred to in a footnote, and the reference list of the author, is when the researcher has obtained a PhD-title.

In 2008 POCA was held for the first time in Belgium. The conference was organised at the Vrije Universiteit Brussel by the new research team of the Mediterranean Archaeological Research Institute (MARI), which was founded in May 2007 under the direction of Prof. Karin NYS. MARI is a research centre within the department of Art Studies and Archaeology and the Faculty of Arts and Philosophy at the Vrije Universiteit Brussel. The research interest of MARI focuses in particular on Cyprus and the Near East during the Bronze and Iron Ages. By viewing the material cultural of Cyprus and the Levant in relation to the material culture of the entire Mediterranean world, MARI aims at contributing to the elucidation of the socio-economic and cultural history of the Mediterranean world in antiquity. Some of MARI's research projects, however, have a broader chronological and geographical scope as they centre on the study of the *chaîne opératoire* of two particular glass categories in northwestern Europe and the Mediterranean during, respectively, Roman and medieval times.

Our University organises Doctoral Schools in order to offer PhD students the opportunity to develop skills supporting their research as well as their teaching abilities, which at a later stage also can prove valuable outside their discipline and the academic environment. Therefore, we felt privileged to organise POCA 2008 to welcome a gathering of graduate students and young scholars active in the field of Cypriot archaeology, anthropology, history, social science or related subjects dealing with the material culture of Cyprus, without any chronological limits. The yearly postgraduate conference of POCA has proved to be beneficial for many postgraduates, hence their participation to several successive conferences. POCA indeed provides an easy accessible platform for presenting preliminary results and exchange ideas with senior scholars. In some cases, international relations are established between researchers of different universities. Equally important is the fact, that since the last years, the organising POCA committees work hard on publishing the proceedings of the conference. This is of major importance, since young researchers are

more and more encouraged to publish before completion of their dissertation. Many universities and funding agencies require international publications as a critical condition. We were very pleased that the then dean of the Faculty of Arts and Philosophy, Prof. Jean Paul VAN BENDEGEM, accepted to open the POCA conference and to have his notes published in this volume.

Cypriot Material Culture Studies

The call for papers purposely did not contain a conference theme, in order to invite as many as possible participants and attendants. However, the keynote lecture ‘Storage and Political Economy in Late Bronze Age Cyprus’, presented by Dr Priscilla KESWANI had multiple objectives. Over the years, Dr Priscilla KESWANI has demonstrated her well-established aptitude and quality to thoroughly analyse material culture, and to relate these observations to some of the larger socio-economic and political questions in the Late Bronze Age Mediterranean. Her lecture, which we are very pleased to incorporate in the proceedings, exactly comprises both components: the study departs from material culture, pithoi, in order to reconstruct the political economy in Late Bronze Age Cyprus.

The conference presented a wide variety of research topics related to Cypriot material culture. Young scholars presented twenty papers and two posters in sessions arranged by topic in order to enhance the discussion between the participants who are frequently confronted with similar methodological questions. All papers were of a very high standard and demonstrated that there is a new generation of young scholars keen to challenge long-held assumptions and to raise new questions. Some papers dealt with archaeometric data and interdisciplinary research which allowed to re-evaluate assemblages. Other papers departed from new-collected archaeological data and presented original contributions. Moreover, some papers clearly sought to understand how Cyprus interacted with its neighbours in different time periods.

The first session set the tone of the POCA 2008 conference by presenting a variety of research topics from different periods: we started with a review on cultural heritage in Cyprus during the period of 1963-1974. Next, we went back until Chalcolithic times to examine the health status from the cemetery at Souskiou-*Laona*. A re-assessment of Middle Bronze Age evidence illustrated the need to consider this period preliminary to the opening of the Late Cypriot period, while the fourth paper concentrated on regional exchange in southeast Cyprus in that period.

The second session grouped papers that presented long distance relations between Cyprus and other areas within the eastern Mediterranean: two papers dealt with the connectivity with Levantine areas in the Bronze and Iron Age —respectively Anatolia and Syria— whereas, a third paper concentrated on Cypro-Archaic and Cypro-Classical relations between Marion and Athens.

In the third session, figurine traditions were put in retrospect: the technology of picrolite figurines was explained in order to better appreciate a very specific section within the Chalcolithic material culture. Bronze Age anthropomorphic and zoomorphic figurines were

considered to shed light on how the social and political structure, tradition connections, expressions of individual and group identity changed over time. Specifically, the last paper sought to understand how to interpret the “goddesses with upraised arms” which bear strong similarities to the Cretan examples.

The fourth session continued to explore the previous theme by examining Hathoric figures from Amathous and how this “Egyptian deity” was perceived in the Archaic city of Amathous. Statues of Roman emperors, their inscriptions and context were viewed in order to understand the roles that statues played in the imperial cult and imperial representation. Two more papers contributed by considering sculptural and architectural types of material culture: both the early Christian marble tables and Islamic *Proskynitaria* are significant for their time period.

Pottery was the central theme of the fifth session: four papers dealt with archaeometric data in order to answer larger questions on ceramic production, technology and provenance determination. In addition, a few Cypriot finds from Carthage were presented.

The sixth session grouped inscriptions, linguistic and epigraphical evidence from different periods in order to reconsider some of the long held views on the people and their society.

The last session included the search of the *Gymnasium* of Nea Paphos, whose existence is corroborated by inscriptions. The last paper also concentrated on architecture, more specifically, on the political motivations of water control through a number of public works and aqueducts.

Finally, two posters were briefly commented and again illustrated the variety of research topics: from Egyptian Scarab-shaped seals to archaeological window glass from Cistercian abbeys.

In addition to the 22 presentations, we were very happy with the participation from two of our Belgian colleagues from the Katholieke Universiteit Leuven and the Universiteit Gent. Prof. Joachim BRETTSCHEIDER (Katholieke Universiteit Leuven, now Universiteit Gent) presented Cypriot material from the excavations at Tell Tweini in Syria, while Prof. Roald DOCTER (Universiteit Gent) contributed by discussing the Cypriot facies found in Phoenician-Punic Carthage.

Ariane JACOBS & Peter COSYNS

Foreword

As Dean of the Faculty of Arts and Letters of the Vrije Universiteit Brussel (VUB, Free University of Brussels), I feel quite honoured to be here among you for the opening session of this conference. I am quite convinced that all of you know on the basis of years of academic practice and experience, that the task of a Dean of a Faculty (not necessarily of Arts and Letters) is not a pleasant one. Sometimes I have the belief that occasions such as this one have been intentionally ‘invented’ to soften the pain and the agony and to allow the poor Dean to continue on his path of sorrow and misery. Being here means that I am given the opportunity to be among other scholars and to feel reintegrated within the scientific community. Of course, that feeling would be a lot stronger if our fields or domains of expertise would overlap. But, alas!, we all know that a perfect match between a Dean’s academic training and the specialty of the members of the conference he is addressing, occurs on an extremely rare basis, very few and far between, as the expression goes. And so it is, I am afraid, in this particular case. By training I am a mathematician and a philosopher (and the latter has become my professional occupation although the subject of my philosophical reflection is the former) and, notwithstanding the existence of mathematical branches in archaeology and some indications of the beginnings of a philosophy of archaeology, it is a hard and challenging task to find direct links and connections. Of course, I could claim that philosophical problems are perennial and that mathematical answers are meant for eternity, so at least in time span, philosophers and archaeologists understand one another, but, nevertheless, we all feel this amounts to no more than a rather weak, if not pretentious defence to establish a connection. However, one failed attempt does not constitute defeat. Fortunately there are many ways to reflect on time and space, so let me try a different approach.

Where are we? Philosophers have spent ages trying to find answers to that tricky question, but my own personal favourite is inspired by the beautiful short movie by Charles and Ray Eames, *Powers of Ten*. As the title indicates, one travels from the largest structure known to us all, the universe, down to the atomic scale, until all vanishes and we are left with a void. Let me consider eight stages in that journey: (1) the universe, (2) the Milky Way, (3) the Sun, (4) the Earth, (5) Europe, (6) Belgium, (7) Brussels, (8) the place where we are gathered here today. I assume that it is very tempting to see in this progression an increase of detail and of locality. True, it is worth noting that of these eight places four are shared by all of us and only the second half concerns places that seem to be more specific. But, at the same time, one must realize that to a certain extent one is no longer tied to a particular place. Wherever an internet connection is available, sphere (4) is always within reach (although I must add here straight away that the density of the connections shows a huge variance that is clearly determined by socio-economic and political parameters). There is thus a strange loop present here, to use Douglas Hofstadter’s favourite expression —his latest piece of scientific-philosophical musings is entitled *I am a Strange Loop*— but, wherever I consult the internet, it will always be in a particular location. I will not pursue this philosophically pleasing exploration any further, but instead ponder a few moments on the particularities of topoi (6) and (7).

Let me ask the question one more time: where are we? Perhaps locus (6), Belgium, is a good place to start, but, in all honesty, I have strong hesitations. I have no clear ideas about the perception abroad of this curious country, coming into existence after an opera performance, as common history wants it, counting three communities, each with their own language (Dutch, although some will claim it is Flemish, French and German), counting three regions, that do and do not coincide with the communities, unified by a monarchy (though an idea not shared by everyone), divided by a language barrier (whereof the existence itself is a philosophical conundrum of first order), therefore requiring a staggering six governments (with partial overlaps) and I will not mention the number of ministers apparently necessary to populate them all. The most curious aspect of this staggering complexity is that normally it is supposed to lead to a total and complete immobility but not always so. Occasionally it offers unique opportunities. In particular I am thinking of intellectual environments such as universities and other academic institutions that are subject to so many conflicting rules, coming from equally many different governmental sources, that a certain form of freedom emerges for, let us admit it freely, that we, as intellectuals, are quite well-trained to reason with contradictory and inconsistent data and nevertheless succeed to the most interesting conclusions.

Speaking as a logician and mathematician, it is a well-known and accepted fact that properties of a whole need not necessarily hold for the parts. Although water is wet, a single water molecule definitely is not. However, in the case of the city of Brussels, the capital of Belgium, unfortunately, it does hold. So forgive me if I do not enter into the details of the complexities of this extraordinary place, complexities that are the result of the above mentioned national complexities. Let me just say that it becomes quite understandable why some inhabitants of this country and of this city in particular prefer to leave out place (6) and move straight from (5) to (7) or, in other words, who see Brussels as the capital of Europe. I will not abuse the space accorded to me here in this introduction, but I myself tend to believe that on the one hand the statement “Brussels is the capital of Europe” is strictly speaking false and that on the other hand it is perfectly alright to claim that it is so *de facto*. The evidence that this place is truly an international melting pot is, as far as I am concerned, overwhelming. It offers thereby unique opportunities to the universities and other places of higher education for establishing international networks, as this conference itself demonstrates by its mere existence.

Now that we have come down to the level of Brussels, this is perhaps the perfect moment in my exposé to say a few things about my university that so far was only briefly mentioned in the first paragraph and, to be honest, only to raise your sympathy for my particular situation (known in argumentation theory as a classic rhetorical device, namely the *argument ad misericordiam*). The Vrije Universiteit Brussel was officially erected in 1969-1970. Before that date, there was of course the Université Libre de Bruxelles (ULB), which in English translates as Free University of Brussels as well. The ULB was founded in 1834, quite soon after the independence of Belgium, supported financially mainly from the Freemasons movement in order to create a place where scientific research would be “free” or, as the beautiful French expression states it, where the “libre examen” would be practised. Inspired by the thoughts of Henri Poincaré, the “libre examen” proposes to let the facts do the

talking, as it were, and not accept whatever idea solely on the basis of an authority, whatever its source. It also implies that in principle no topic, no subject is to be excluded from scientific questioning and analysis. This attitude is most clearly reflected in the university's motto, namely "*Scientia vincere tenebras*" ("To conquer darkness through science"). Note that it is not science itself that will drive away the darkness, but rather we ourselves with the help of the sciences. But back to harsh reality. Originally French-speaking, the ULB turned into some kind of bilingual institution but eventually, due to all sorts of political, social and economical developments in Belgium, it would lead to a separation that however never turned into an opposition, although it must be acknowledged that the Belgian present-day situation did not particularly help to reduce tensions. At present thoughts and ideas are circulating to establish a University of Brussels, where VUB and ULB will be partners (again).

The VUB is thus a special university, not only in its specific relation to the ULB, but also among the other universities in the Flemish Community: the University of Ghent, the Catholic University of Louvain, the University of Antwerp and the University of Hasselt. In terms of the subsidies that each of these institutions receives from the Flemish government, based on a complex model that translates into financial parameters the impact of teaching and research, it turns out that all but the VUB receive a sum of money, made up of 55% for the educational part and 45% for the research part. Not so for the VUB however where the sum is composed in exactly the opposite way: 45% for education and 55% for research. So I am tempted to say: welcome at our research university!

So far I have not said much about the specific research done at the VUB in relation to the theme and topic of this conference. I am quite convinced that the choice to organise this meeting here, is no accident, rather the contrary, once one takes into account the following facts and figures:

- In the first half of the seventies my Faculty decided to launch a course on "Archaeology of Ancient Cyprus". Worldwide there were only a few other places that dedicated some attention to the archaeology of Cyprus. So it is right to say that in this case the VUB has played a pioneering role.
- Since then about 22 master theses and 3 PhD dissertations have been presented and defended that focus on different aspects of the material culture of Cyprus. 2 Master theses and no less than 5 PhDs are in preparation that deal specifically with Cypriot archaeology.
- In 1990 the VUB on a suggestion of my Faculty has decided to award Prof. Vassos KARAGEORGHIS, the then director of the Department of Antiquities of Cyprus, the title of *doctor honoris causa*. My University thereby acknowledged the importance of his work as to the pivotal role of Cyprus on the socio-economic and cultural level within the whole of the Mediterranean world during different stages in history.
- Of equal importance, what I should mention as well are the collaborations within the educational field. On the one hand the bilateral Erasmus exchange programs in the area of archaeology and material culture with the University of Cyprus and Sheffield

University should be mentioned. In this connection, I wish to welcome in particular Prof. Demetrios MICHAELIDES (University of Cyprus) and Prof. Patrick QUINN (formerly Sheffield University, now UCL London). On the other hand, I am happy to inform you that in the very near future a new road will be opened for PhD students and researchers, namely to obtain a “simultaneous” PhD diploma from the VUB and another participating university.

As you are all eager to get started with the conference itself, allow me to end my presentation with a philosophical note. The famous 20th century Austrian philosopher Ludwig Wittgenstein defined in his famous treatise, the *Tractatus Logico-Philosophicus*, an object as something equipped with all possible connections it could form with other objects. So any object was “surrounded” by a host of potential relations with the rest of the world. The important term here is “potential”. If an object is to be a part of the actual world then at least some of these connections have to be realized. A chair can have many colours, but in this real world it has a particular colour, excluding thereby other possibilities. Although I am going beyond Wittgenstein’s intentions here, it is perhaps a nice thought experiment to see a university as an “object” of some kind, with many possible, potential connections. But in order to be perceived as real, some of these connections need to be realized. I think that this conference today and for the days that follow, will make both my university, the research community of which all of you are part and the world surrounding us, preferably up to an including place (4), a bit more real. I thank you.

Jean Paul VAN BENDEGEM

Paul ÅSTRÖM,
The Mentor of Several Generations of Archaeological Students
and an Inspiration for Generations to Come

When the MARI team started planning POCA 2008, we could not think of a scholar more appropriate than Paul ÅSTRÖM to reflect on the colloquium's contributions and on Cypriot archaeology in general. Hence, I was delighted that he accepted the invitation to deliver the closing lecture. Alas, his sudden illness decided otherwise.

Thus, I felt very moved and honoured when, on the morning after his passing, his wife, Elisabet, told me that, on his last day, he had dictated to her the text which he wanted to be read at the POCA 2008 conference: "Cypriot Archaeology: A Prospering Story" (see this volume, XXII-XXIII).

One characteristic of Paul ÅSTRÖM was his genuine interest in the research of young scholars. My own career in Cypriot archaeology received a tremendous boost from the moment I met Paul ÅSTRÖM on 17th May 1993 at the *Cypriote Stone Sculptures* conference in Belgium. I was then a master's student preparing a thesis on the use of masks in Cypriot antiquity. Before the start of the conference, everyone was having coffee in the big front hall at the University of Liège. I was very impressed, as it was as if a major part of my bibliography had come to life; there they stood: Vassos KARAGEORGHIS, Antoine HERMARY, Annie CAUBET, Marguerite YON, Robert MERRILLEES, and ... Paul ÅSTRÖM. They were having very interesting conversations with each other, and they were completely ignoring the few students who were standing timidly in a corner... except for Paul ÅSTRÖM! He detached himself from the distinguished researchers and came to us, asking us in his kind way where we were from and what we were studying, thereby showing a real interest in our replies. During the pauses, he came again to talk to us, giving useful advice and references, to me and to my friend, who prepared a thesis on the Middle Comedy in the ancient history department. As we desired to participate in an excavation in Cyprus, we conferred with each other about whom we should approach at the end of the conference. I argued that we should first ask Paul ÅSTRÖM, as, if he replied negatively, at least he would do so in a friendly way. However, the reply we received was not at all negative: "Students who attend a full congress are very welcome at my excavation!". This was the start of my collaborations with Paul ÅSTRÖM at Hala Sultan Tekke.

It is important to stress that Paul ÅSTRÖM's attitude towards these two Belgian master's students was not a unique occurrence. Most archaeologists of my generation can tell similar stories. This story is also corroborated by the praising words which Prof. WEINBERG wrote in his evaluation report on Paul ÅSTRÖM's work as a visiting associate professor at the University of Missouri in 1963-1964:

... The many students who studied with him have given a unanimously favourable report on the courses and have expressed much enthusiasm both for the man and the subjects which taught; nothing speaks better for a professor. The one M.A. thesis which he supervised to completion was given very quick publication in a leading archaeological publication in Switzerland. Even the work of one of the undergraduate students in the course in Cypriote Archaeology was published in a Cypriote journal. This is

indicative of the great attention which Dr ÅSTRÖM gave to his students, and for which they were most grateful...

Prof. WEINBERG's words show that, even as a young professor, Paul ÅSTRÖM attached great importance to encouraging young researchers to publish their work. When Paul ÅSTRÖM started his own publishing house, Paul Åströms Förlag, he offered many young scholars the opportunity to publish their master's and/or PhD work as an article in the *Journal of Prehistoric Religion*, in SIMA-PB, or even as a genuine volume in the red SIMA series – the *nec plus ultra* of archaeological publications.

Paul ÅSTRÖM is well known for the excavations he conducted in Cyprus and Greece: the Middle Cypriot sites at Kalopsidha and Ayios Iakovos (1959), the Late Cypriot harbour town west of Hala Sultan Tekke (1971-2005), and the Mycenaean citadel at Midea (1983-1997), the latter of which he led along with Katie DEMAKOPOULOU. His name will also remain associated with the discovery of a Mycenaean cuirass in one of the chamber tombs at Dendra (1960-1963), which he explored together with Nicolaos VERDELIS. Less well known is that during his time as director of the Swedish Institute in Rome (1967-1969), he excavated the Etruscan settlement at San Giovenale. It is therefore not a surprise that his publication list includes an article on Etruscan material culture:

ÅSTRÖM, P. 1974. "Un'urna etrusca con iscrizione dipinta e con scena in relieve raffigurante la lotta tra Eteocle e Polinice", *OpRom* 8, 29-32.

Moreover, he even tackled a *conundrum* in Roman studies:

ÅSTRÖM, P. 1969. "Iter populo debetur ped. tot", *OpRom* 7, 84-88.

As a Mediterranean archaeologist, Paul ÅSTRÖM was particularly eager to solve yet another *conundrum*: the chronology of the ancient Mediterranean world. Although this is still a matter of debate, the archaeological community is grateful to Paul ÅSTRÖM for his contributions to this discussion:

ÅSTRÖM, P. 1978. "Methodological Viewpoints on Middle Minoan Chronology", *OpAth* 12, 87-90.

ÅSTRÖM, P., PALMER, L.R. & POMERANCE, L. 1984. *Studies in Aegean Chronology* (SIMA-PB 25), Gothenburg.

ÅSTRÖM, P. 1986. "The Middle Minoan Chronology Again", in *Pepragmena tou E' diethnous kretelogikou synedriou* 1, Heraklion, 36-34.

ÅSTRÖM, P. (ed.) 1987. *High, Middle or Low? Acts of an International Colloquium on Absolute Chronology Held at the University of Gothenburg 20th-22nd August 1987* 1-2 (SIMA-PB 56-57), Gothenburg.

ÅSTRÖM, P. (ed.) 1989. *High, Middle or Low? Acts of an International Colloquium on Absolute Chronology Held at the University of Gothenburg 20th-22nd August 1987* 3 (SIMA-PB 80), Gothenburg.

ÅSTRÖM, P. 1992. "Implications of an Ultra Low Chronology", *Ä&L* 3, 19-21.

Obviously, Paul ÅSTRÖM's bibliography comprises many publications on different aspects of Greek and Cypriot material culture. For his innovative investigations on finger- and

palm-prints, he teamed up with Swedish police officers Sven A. ERIKSSON and Karl-Erik SJÖQUIST:

ÅSTRÖM, P. 1972. "Fingerprints on Cypriote Bronze Age Pottery", in *Praktika tou protou diethnous kyprologikon synedriou, Leukosia, 14-19 Aprilou 1969*, Nicosia, 1-3.

ÅSTRÖM, P. & ERIKSSON, S.A. 1972. "Fingerprints and the Indo-Europeans in Greece", in *Acta of the 2nd International Colloquium on Aegean Prehistory "The First Arrival of the Indo-European Elements in Greece", Held in Athens, April 5-11, 1971*, Athens, 72-75.

ÅSTRÖM, P. 1973. "Fingerprints on Middle and Late Minoan Pottery", in *Pepragmena tou G' diethnous kretelogikon synedriou I. En Rethymno, 18-23 Septembriou 1971*, Athens, 13.

ÅSTRÖM, P. & ERIKSSON, S.A. 1980. *Fingerprints and Archaeology* (SIMA 28), Gothenburg.

ÅSTRÖM, P. & SJÖQUIST, K.-E. 1985. *Pylos: Palmleaves and Palmprints* (SIMA-PB 31), Gothenburg.

ÅSTRÖM, P. & SJÖQUIST, K.-E. 1987. "The Scribes and their Helpers in the Palace at Pylos", in R. Hägg & N. Marinatos (eds.), *The Function of the Minoan Palaces. Proceedings of the Fourth International Symposium at the Swedish Institute in Athens 10-16 June, 1984* (*ActaAth-4°* 35), Stockholm, 317-320.

ÅSTRÖM, P. & SJÖQUIST, K.-E. 1991. *Knossos: Keepers and Kneaders* (SIMA-PB 82), Gothenburg.

He also devoted research to ancient textiles and dress:

ÅSTRÖM, P. 1965. "Remains of Ancient Cloth from Cyprus", *OpAth* 5, 111-114.

ÅSTRÖM, P. & GULLBERG, E. 1970. *The Thread of Ariadne. A Study of Greek Dress* (SIMA 21), Gothenburg.

His studies on ancient sculpture include work on the Lion Gate at Mycenae, Archaic statues. He even proposed a reconstruction of the Laocoon group which was much lauded by specialists as a highly plausible hypothesis.

ÅSTRÖM, P. & BLOMÉ, B. 1965. "A Reconstruction of the Lion Relief at Mycenae", *OpAth* 5, 159-191.

THAFVELIN, H. & ÅSTRÖM, P. 1965. "Drawings of the Moschophoros from Photographic Measurements", *OpAth* 6, 165-170.

ÅSTRÖM, P. 1969. "Una nuova ricostruzione del gruppo di Laocoonte" *Archeologia. Problemi, ricerche, scoperte* 8, 54.

ÅSTRÖM, P. 1972. "Suggerimento per una nuova ricostruzione del Laocoonte", in *Colloqui del Sodalizio, Sodalizio tra Studiosi dell'Arte*, seconda Serie 2, Rome, 11-20.

ÅSTRÖM, P., NORDBERG, B. & RENFORS, L. 1978. "An Unfinished Kouros Statue on Naxos", *OpAth* 12, 111-116.

ÅSTRÖM, P. & BLOMÉ, B. 1994. "The Laocoon Group. A Tentative Reconstruction", *Opus Mixtum. Essays in Ancient Art and Society* (*ActaRom-8°* 21), Stockholm, 7-24.

Paul ÅSTRÖM's text for the POCA 2008 conference reflects his keen interest in applying exact science to archaeology. In his bibliography, the variety of topics which he dealt with in this domain is astonishing:

- *Acoustic Research*

ÅSTRÖM, P. & KLEINER, M. 1989. "Kan krukor tala?", in *Mycket mänskligt* (Humanistisk forskning vid Göteborgs universitet 2), Gothenburg, 28-31.

ÅSTRÖM, P. & KLEINER, M. 1993. "The Brittle Sounds of Ceramics – Can Vases Speak?", *Archaeology and Natural Sciences* 1, 66-72.

- *Geophysical Prospecting*

ÅSTRÖM, P. 1967. "Electrical Prospecting at Calatia, Caserta", *Prospezioni archeologiche* 2, 81-83.

- *Palaeobotanical Research*

ÅSTRÖM, P. & HJELMQUIST, H. 1971. "Grain Impressions from Cyprus and Crete", *OpAth* 10, 9-14.

ÅSTRÖM, P., ENGELMARK, R. & WENNERBERG, B. 1985. "Paleobotanical Investigations at Hala Sultan Tekke in Cyprus", in *In Honorem Evert Baudou* (Archaeology and Environment 4), Umeå, 277-282.

- *Physical Anthropology*

BORRMAN, H., FJÄSTAD-SEGER, M., ENGSTRÖM, E.U. & ÅSTRÖM, P. 197-1998. "A Dental Radiographic Examination of a Late Bronze Age Skull from Kition", *OpAth* 22-23, 53-56.

- *Residue Analysis*

ÅSTRÖM, P. 1969. "A Red Lustrous Wheel-made Spindle Bottle and its Contents", *Medelhavsmuseet Bulletin* 5, 16-21.

His classical training explains his love of issues in Greek and Latin epigraphy, papyrology and even numismatics:

ÅSTRÖM, P. 1951. "A Greek 'Mummy-label'", *Eranos* 49, 109-116.

ÅSTRÖM, P. 1952. "Roman Amphora Stamps from Monte Testaccio", *OpArch* 7, 166-171.

ÅSTRÖM, P. 1955. "Une inscription d'Aigion", *OpAth* 2, 4-9.

ÅSTRÖM, P. 1967. "Two Unguentaria and an Obol", *OpAth* 7, 187-190.

ÅSTRÖM, P. 1968. "L'épithaphe de Vera Clandia", *Latomus* 102, 40-43.

ÅSTRÖM, P. 1968. "Roman Amphora Stamps and a Graffito in the National Museum, Copenhagen", *OpRom* 6, 197-199.

ÅSTRÖM, P. 1968. "Two Inscriptions from Caunus", *OpAth* 8, 167-169.

ÅSTRÖM, P. 1976. "The Coins of Calatia", in *Studia romana in honorem Petri Krarup septuagenarii*, Odense, 38-40.

ÅSTRÖM, P. 1990, "Greek Inscriptions from Seleukeia in Cilicia", in *Greek and Latin Studies in Memory of Cajus Fabricius* (Studia Graecia et Latina Gothoburgensia 54), Gothenburg, 55-58.

ÅSTRÖM, P. 2001. "An Isopsephic Inscription from Iasos, *La Parola del passato. Rivista di studi antichi* 56, 5-8.

Although the ancient Mediterranean world was Paul ÅSTRÖM's preferred study domain, he was also very interested in the history and culture of his home country. As a young scholar he made an unassuming contribution to Swedish history:

ÅSTRÖM, P. 1962. "Om den varbergska kulknappens ursprung", *Varbergs museum – årsbok*, 85-88.

This article actually reads as a detective story, as it reveals another of Paul ÅSTRÖM's predilections: the whodunit. This does not come as a surprise, for every archaeologist is actually a detective:

ÅSTRÖM, P. 1980. *Arkeologiskt detektivarbete* (SIMA-PB 11), Gothenburg.

Undoubtedly, his detective skills helped him trace back the steps of past Swedish travellers in Cyprus:

ÅSTRÖM, P. 1960. "A Swedish Description of Cyprus Written in 1733", *Kypriakai Spoudai* 24, 33-47.

ÅSTRÖM, P. 1961. "Two Swedish Visitors to Cyprus, Truls Kåhre and Johan David Åkerblad", *Kypriakai Spoudai* 25, 75-80.

ÅSTRÖM, P. 1997. "Michael Eneman's Visit to Cyprus in 1713", in *Mélanges Olivier Masson. CCEC* 27, 45-46.

Outside Sweden, it is probably not well known that Paul ÅSTRÖM made a tremendous contribution to the research on Swedish literature with publications on Karin BOYE, Johannes EDFELT, Gunnar EKELOF, Ellen KEY and Östen SJÖSTRAND. In particular his *magnum opus* on Gunnar EKELOF (ÅSTRÖM 1992) was highly praised in the Swedish press.

- *Karin BOYE*

ÅSTRÖM, P. 1994. *Karin Boye, Resedagbok I Grekland. Från Hitlers Berlin til Apollons Olympia* (SIMA-PB 128), Jonsered.

- *Johannes EDFELT*

ÅSTRÖM, P. 1989. *Johannes Edfelt och antiken* (SIMA-PB 89), Jonsered.

ÅSTRÖM, P. 1991. "Johannes Edfelt", *Hellenika* 58, 3.

- *Gunnar EKELOF*

ÅSTRÖM, P. 1989. "Gunnar Ekelöf och Parthenon", *Hellenika* 50, 12-13.

ÅSTRÖM, P. 1990. *Gunnar Ekelöf och Gottfrid Walldén. En brevväxling* (SIMA-PB 90), Jonsered.

ÅSTRÖM, P. 1990. "Ekelöf och Orestes", *Tidskrift för Litteraturvetenskap* 19:1, 59-62.

ÅSTRÖM, P. 1991. *Brev från Gunnar Ekelöf* (SIMA-PB 102), Jonsered.

ÅSTRÖM, P. 1991. "Gunnar Ekelöf and the Lascaux Cave", *JPR* 5, 5-6.

ÅSTRÖM, P. 1992. *Gunnar Ekelöf och antiken* (SIMA-PB 91), Jonsered.

ÅSTRÖM, P. 1994. "Gunnar Ekelöf och Kjell Espmark", *Medlemsblad för Gunnar Ekelöfs Sällskapet* 5:1, 6-8.

ÅSTRÖM, P. 1997. "Ekelöf och Epidavros", *Parnass* 3, 16-18.

ÅSTRÖM, P. 1997. "När Gunnar Ekelöf längtade till ljuset I Grekland. Några okända brev", *Ariel* 79:1-2, 51-57.

ÅSTRÖM, P. 1998. "Två ord hos Gunnar Ekelöf", *Gunnar Ekelöfs sällskapets medlemsblad* 9:9, 5.

- Ellen KEY

ÅSTRÖM, P. 1987. "Ellen Key och Jonsered", *Partillebygden* 4, 2-4.

- Östen SJÖSTRAND

ÅSTRÖM, P. 1995. *Östen Sjöstrand och antiken* (SIMA-PB 131), Jonsered.

Finally, he also wrote about two of his favourite non-Swedish authors, Rainer Maria RILKE and Joyce Carol OATES, which probably helped to better grasp their work.

- Rainer Maria RILKE

ÅSTRÖM, P. 1987. "Rainer Maria Rilke och Selma Lagerlöf m. fl.", *Artes* 13:2, 107-111.

ÅSTRÖM, P. 1987. "Ernst Norlind och Rainer Maria Rilke", *Transit* 15, 3-13.

RAUSING, B. & ÅSTRÖM, P. (eds.) 1989. *Rainer Maria Rilke. Briefe an ToraVega Holmström* (SIMA-PB 66), Jonsered.

ÅSTRÖM, P. 1989/90. "Rilke in Schweden: Borgeby und Jonsered", *Blätter der Rilke-Gesellschaft* 16/17, 129-139.

- Joyce Carol OATES

ÅSTRÖM, P. 1999. "Ett antikt ödesdrama I modern miljö", *Medusa* 20:3, 26-29.

The above mentioned publications are only a fraction of the more than 700 titles that Paul ÅSTRÖM authored or co-authored.

May his brilliant career, versatile interests and inspiring mentorship remain an inspiration for many generations to come.

Karin NYS



Cypriot Archaeology: A Prospering Story

In the fifties, there were very few Cypriot archaeologists: DIKAIOS, STEWART, KARAGEORGHIS, CATLING and a few others. When I published *Who is Who in Cypriote Archaeology* in 1971, the number of people mentioned was already about 600, who in one way or another were dealing with Cypriot archaeology. Vassos KARAGEORGHIS's efforts in inviting people from all over the world to carry out excavations in Cyprus had a tremendous effect. At some time nearly twenty foreign missions worked in the island. On many occasions, people asked me to make an update of the *Who is Who in Cypriote Archaeology*. However, by now this would mean a sheer impossible undertaking.

Today, Cypriot archaeology has a leading position in modern archaeological research. It is a pleasure to note that Cypriot archaeology is exercised all over the world from Australia to America. This POCA conference with its so many outstanding papers is a good example.

The old generation of scholars of Cypriot archaeology did not use computers, hence Jim STEWART sat in a German prison camp and composed an awkward classification system of Early Cypriot Bronze Age pottery. When I wrote my thesis in 1957 it was still before the computer. It was David FRANKEL who used the digital possibilities to an extreme extent in his doctoral dissertation *Middle Cypriot White Painted pottery* of 1973¹. Now we have the digital possibilities to help us enormously.

New Techniques

In the time of the SCE, the technical help from the natural sciences was not available. I started to use the help of natural sciences when I worked with the material from Kalopsidha in 1959. Eight different specialists contributed to the final publication with studies on plant remains, residue analysis, fingerprints, human and animal bones, charcoal analysis, pollen, molluscs and geological determinations of stone fragments.

50 years later, the scientific knowledge has significantly enhanced. So it is exciting to observe that new techniques are developed such as direct dating of pottery from its organic residues published in volume 82 of *Antiquity* by BERSTAN *et al.*², and the method of the Belgian archaeological project documented in HST 12³ for pottery provenance detection by comparing lead isotope signatures in pottery and sediments.

Nevertheless one should also use one's own senses: one Roman archaeologist was able to date Roman tiles by just feeling them with her mouth.

Younger generations of archaeologists develop new theories and methodologies with the results of the work of the older generations as a basis. Sometimes young archaeologists

¹ FRANKEL, D. 1974. *Middle Cypriot White Painted: an Analytical Study of the Decoration* (SIMA 42), Gothenburg.

² BERSTANAL, R., STOTT, A.W., MINNITTA, S., BRONK RAMSEY, C., HEDGES, R.E.M. & EVERSHEDE, R.P. 2008. "Direct Dating of Pottery from its Organic Residues: New Precision using Compound-Specific Carbon Isotopes", *Antiquity* 82, 702-713.

³ ÅSTRÖM, P. & NYS, K. 2007. *Hala Sultan Tekke 12* (SIMA 45:12), Sävedalen.

express a negative view on the cultural historical approach of the previous generation of archaeologists. Of course their classifications, typologies and chronologies must be refined in the light of new finds. But for the pioneers it was necessary to build up classifications, typologies and chronologies as a basis for future research.

New methods are o.k. but the theoretical approach can go too far. An example of this is to make a new relative chronology of the Cypriot Bronze Age periods. The result is confusing. The present general classification is not perfect, but at the moment there is no better one.

So we must stress: Documentation first – interpretation afterwards.

Paul ÅSTRÖM, 3 October 2008

Olive Production, Storage, and Political Economy at Late Bronze Age Kalavassos, Cyprus

Priscilla KESWANI¹

Abstract

The scale and characteristics of storage practices varied considerably among the major towns of the Late Cypriot period. The largest known storage complex is found at Kalavassos-Ayios Dhimitrios, where pithos magazines associated with Building X had a total capacity of c.50000 litres, much of it probably used for the storage of olive oil. In this paper I review the material evidence for storage and olive oil production at Kalavassos as a starting point for the reconstruction of political economy. I then consider the land and labour requirements associated with olive production and processing, the uses of olive oil in antiquity, and estimates of ancient consumption levels. Using the statistics that emerge from this analysis, along with catchment studies and population estimates, I assess the viability of alternative models of trade, staple finance, and redistribution as explanations for the Kalavassos storage complex. I conclude that a large-scale redistributive system may be represented.

Introduction

An important distinction observed among settlements that we might classify as primary centres of the Late Cypriot period is the extent to which their elites were concerned with the manipulation of agricultural surplus and storage.² At some sites, such as Enkomi, Kition, and Hala Sultan Tekke in eastern and southeastern Cyprus, large storage complexes have yet to be discovered (**Figure 1**). At other sites such as Maroni, Alassa, and Maa in the south central and southwestern parts of the island and at Toumba tou Skourou in the northwest, numerous *pithoi* have been found, but the overall storage capacities represented appear to have been much lower than the total of 50000 litres estimated for Building X at Kalavassos-Ayios Dhimitrios. Disparities in the relative importance of storage at different centres may be partly explicable in terms of variable elite strategies of wealth and staple finance (KESWANI 1993, 76-80). The size of the Kalavassos storage complex, however, raises the question of whether a radically different system of political economy is represented at this site.

¹ contact: priscilla_keswani@hotmail.com

² I am extremely grateful to Ariane JACOBS and Karin NYS of the Vrije Universiteit Brussel, Belgium for the invitation to speak at POCA 2008 and to contribute this paper to the conference publication.

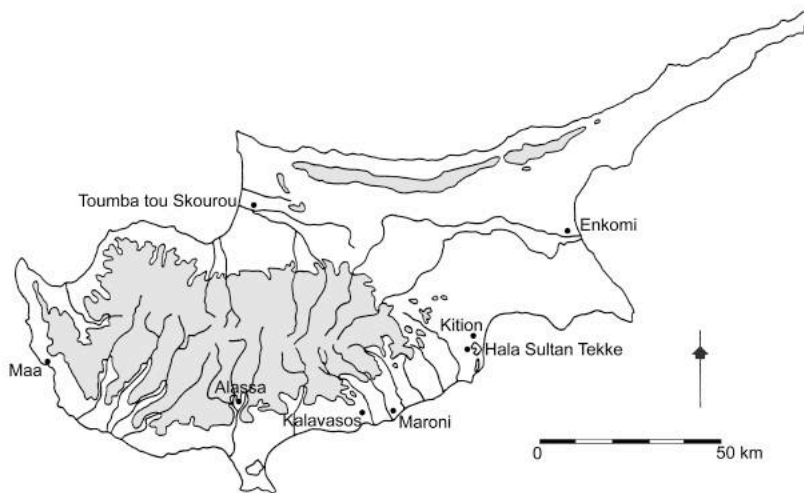


Figure 1: Map of Cyprus showing Late Bronze Age sites mentioned in the text (Drawn by KESWANI)

The site of *Ayios Dhimitrios*, excavated by SOUTH as part of the larger Vasilikos Valley Project directed by TODD, is located approximately 8km from the Kalavassos copper mines and 4km from the coast in the south central part of the island. Evidence from tombs in the northeast area of the site attests to the presence of rich elite groups with far-flung Mediterranean trade contacts in the LC IIA-B periods, or the 15th-14th centuries BC (SOUTH 1997, 159-167; 2000). The settlement, which covers an area of about 11.5 hectares, was clearly the principal population centre of the Vasilikos Valley in the Late Bronze Age. The extant architectural remains date mainly to the LC IIC period (late 14th-13th centuries BC), and the site was abandoned *c.*1200 BC.

Building X (**Figure 2**), an extremely impressive tripartite building with an area of just under 1000m², was also located in the northeast area (SOUTH 1996, 39-43). Originally constructed in LC IIB or early LC IIC, Building X was rebuilt with ashlar masonry probably in mid LC IIC (SOUTH 1997, 172-173). Other ashlar structures and buildings with industrial functions were located nearby in the northeast area (SOUTH 1997, 158-159). A number of modest houses were excavated in the west part of the site, and somewhat larger, multiroomed buildings with evidence for domestic and industrial activities were found in the central, east, and southeast areas. Copper slag and other evidence for metallurgical activity are dispersed throughout the site (SOUTH 1980; 1982; 1983; 1984, 12-14; 2012).



Figure 2: Plan of Kalavasos-Ayios Dhimitrios Buildings X and XI and other structures in the northeast area of the site (Drawn by SOUTH and reproduced with permission from SOUTH 1997, 152, fig.1)

In this paper I consider what the purpose of the Kalavasos Building X storage complex may have been. What commodity or commodities were stored there, and in what kind of system of political economy were these resources deployed? I use the term "political economy" because the Kalavasos storage halls were found within a monumental building located in an area of the site where very rich tombs were concentrated. Presumably, therefore, the Building X storage facilities and associated activities were controlled by a political elite. But what did this elite do with the stored commodities?

There are at least three possibilities:

- (1) The ruling elite may have collected and stored surplus agricultural products primarily for the purpose of long-distance trade within the island and beyond.
- (2) The elite may have established a system of staple finance involving the collection and disbursement of agricultural produce as compensation to institutional dependents and the workers in industries such as copper mining and bronze-working.
- (3) The elite may have operated a large-scale, quasi-communistic, redistributive system in which everyone in the local domain contributed, voluntarily or otherwise, to the elite's central stores, and everyone got something back in return.

Elements of one or more of these possibilities might sometimes have operated simultaneously, *i.e.*, some proportion of the commodities stored may have been

exported occasionally, even if the principal rationale of the system was staple finance or large-scale redistribution. My concern, however, is to elucidate the main purpose of the storage complex and also to address the question of how agricultural products were accumulated. Were the stores filled through the collection of tribute or taxes from the general population of *Ayios Dhimitrios* and its environs, or do they represent the produce from privately controlled elite estates?

I will begin by examining the direct archaeological evidence for the kinds of agricultural products stored at Kalavassos, which indicates (as the reader may gather from my paper's title) that olive oil was the principal, although not necessarily the only, commodity stored. I will next consider the land and labour requirements associated with large-scale olive production and processing, the uses of olive oil in antiquity, and the problem of estimating ancient oil consumption levels *per capita*. Taking the statistics that emerge from this analysis, along with agricultural catchment studies and population estimates, I will then discuss the viability of alternative models for the politico-economic organisation of olive oil production, storage, and deployment as a critical resource in the Kalavassos region. In the end, I will argue that the third model described above—a system of large-scale redistribution, which we might initially be inclined to dismiss as the most extreme hypothesis—may in fact be the best explanation of the Kalavassos storage complex.

The Evidence for Olive Oil Production and Storage at Kalavassos

In the west *pithos* hall of Building X, approximately 47 *pithoi* were set on the stone stands arranged in rows along the floor, and six more jars were set in pits cut beneath the floor. A second storeroom filled with somewhat smaller *pithoi* was also discovered at the north end of Building X. Volumetric calculations based on the profiles of restored *pithoi* show that these vessels had capacities ranging between 580 and 1200 litres. On the basis of these estimates, the number of vessels present, and other considerations, SOUTH has estimated the total capacity of the west storage magazine at 33500 litres and that of the north *pithos* magazine at roughly half that amount, for a total of 50000 litres of storage in Building X overall (SOUTH 1989, 321; 1996, 42).

Multiple lines of evidence lead us to conclude that olive oil was one of the principal commodities stored in Building X. Gas chromatography-mass spectroscopy (GC-MS) analyses revealed the presence of olive oil residues in 15 out of 19 *pithos* samples from the west *pithos* hall (KESWANI 1992). In Building XI, just to the west of Building X, a 3.5 ton sandstone tank with a capacity of 2000

litres was found, set in a sloping pebble floor with ridged channels leading into the tank. GC-MS analyses of a stone sample from the tank also showed the presence of olive oil. Numerous carbonized olive pits, along with grinding and crushing equipment, a stone weight, and a ceramic basin with a hole near its base, were found in the vicinity of the tank. An olive press was probably located nearby, and the tank was most likely used for the separation of oil and water produced in the course of pressing. Yet another large stone tank may have been robbed from an area in the northwest corner of Building X, where a similar pebble floor was found (SOUTH 1996, 42-43). Additional press beds that might have been used for making either olive oil or wine in lesser volume have been found in the east and central areas of *Ayios Dhimitrios* (SOUTH 1980, 40-42, pls.7:2, 8:1; 1983, 103, pl.15:5), and probable press weights have been found in various locations.

We cannot be certain that all of the Building X *pithoi* contained oil, as some samples did not show traces of the relevant organic compounds. This could either mean that those compounds were never there or that they were not sufficiently well preserved to be detected. Nevertheless, we have good reason to believe that many of the Building X *pithoi* was used to store olive oil, and minimal evidence for the storage of any other commodities. Although a few grape pits were found, virtually no remains of cereal crops were identified in palaeoethnobotanical analyses of flotation samples from the *pithos* hall (HANSEN 1989, 87-89, tab.24). If Building X had been used for the storage of cereals, we might expect to find a considerable quantity of burned grain in the aftermath of the conflagration attested in the west *pithos* hall (HANSEN 1989, 92).

In the course of the following discussion of olive oil production and consumption, I work with two sets of calculations: the more conservative set of calculations assumes only half of the Building X storage capacity, or 25000 litres, was devoted to olive oil storage; the other set of calculations assumes that the entire 50000 litres was devoted to olive oil.

Calculating the Number of Olive Trees Required

In order to answer the question of how many olive trees and how much land would have been required to produce 25000 to 50000 litres of olive oil, we first need to know how many kilos of olives it takes to produce one litre of olive oil.³

³ In the sources quoted below, ratios are usually expressed as kilos of olives to kilos (rather than litres) of oil. One litre of oil weighs 0.9kg (HELTZER 1987, 108). For the sake of simplicity, I will transpose kilos of oil to litres, but the reader should be aware that the units of weight and volume are not precisely equivalent.

The flesh of the olive is 60-75% water, and only 6-25% oil. The quality of the olives and their maturity will affect the output of oil, as will technologies of crushing and pressing. If wild or feral olives are used, up to 20kg may be required to produce a single litre of oil. Young, cultivated green olives produce less oil than mature, cultivated green or black olives, of which 4-7kg of fruit may be required to produce one litre of oil (AMOURETTI & BRUN 1993, 553; FORBES & FOXHALL 1978, 38-39; FOXHALL 2007, 213-215; HELTZER 1987, 108; MATTINGLY 1988a, 182). Assuming that the very sizable oil-making industry at Kalavassos (represented by the storage capacity of Building X and the size of the separation tank) was based on mature, cultivated olives rather than young or wild olives, it may be reasonable to employ a ratio of 5kg of olives to 1 litre of oil for the present calculations.⁴

The next question to be asked is how many kilos of olives can be harvested from a single tree. The answer depends on a number of factors, including the age of the tree. A young tree may produce no more than 10kg of olives in a good year, while a tree over 40 years old may produce 50kg or more (BOARDMAN 1976, 189). Therefore, the overall maturity profile of the trees is a major consideration. An equally important question is whether the year of production is a good year or a bad year for olives in general. Because the olive fruits on two-year-old wood, productivity varies from good to bad in alternating years, and the output may differ by a factor of two to 10 times (BOARDMAN 1976, 188; CHRISTODOULOU 1959, 171; FOXHALL 2007, 7-9). Moreover, one bad year may sometimes be followed by several more, and under adverse environmental conditions such as a severe drought, a good harvest may occur in only one year out of 10. Interannual fluctuations in Cyprus are clearly illustrated in **Figure 3**, which charts olive production in Cyprus between 1890 and 1950.

One important implication of this variation is that, under traditional systems of agricultural production, olive farmers try to store enough oil to supply their families for more than one year. Most sources claim that oil stored in pottery vessels or barrels can only be kept for two years, although some communities in Crete reportedly stored it for up to five years (CHRISTAKIS 1999, 7; FORBES & FOXHALL 1978, 46; MATTINGLY 1993, 493). For Late Bronze Age Kalavassos, we will assume a two-year storage plan.

⁴ This translates to a ratio of 1kg of oil to 5.5kg of olives, or 18%. This is a slightly more conservative figure than the 4:1 or 5:1 (*i.e.*, 20-25%) fruit to oil ratios proposed for ancient Greek and Roman presses (FOXHALL 2007, 215). Regarding the use of cultivated versus wild olives at *Ayios Dhimitrios*, HANSEN (1989, 92-93) mentions the difficulty of distinguishing wild from cultivated olives on the basis of size, but she also notes that the *Ayios Dhimitrios* pits are similar in their dimensions to remains of reportedly domesticated olives from 6th-5th century BC Salamis in Cyprus.

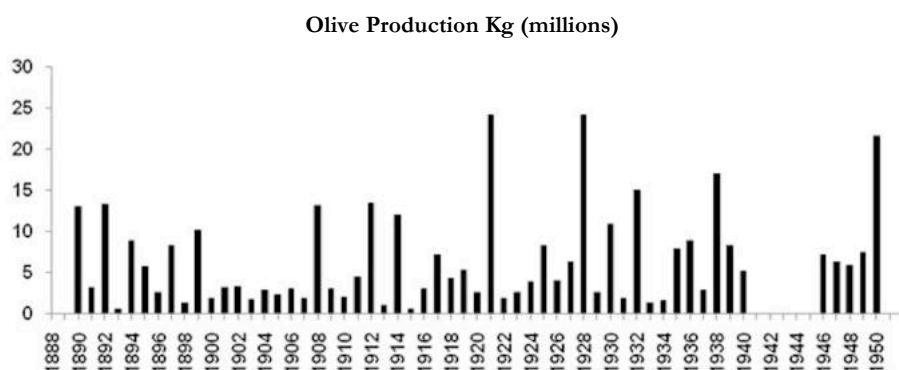


Figure 3: Interannual fluctuations of olive production in Cyprus between 1890 and 1950. Data from CHRISTODOULOU 1959, 170, fig.95; units converted from okes (Graph by KESWANI)

Statistics for average tree output in bad years and good are relatively similar throughout the Mediterranean. The averages from the Provence region of France range from 10 to 20kg per tree (AMOURETTI & BRUN 1993, 553-555). For Israel, a range of 12 to 25kg per tree has been quoted (HELTZER 1987, 108; ZERTAL 1987, 198). For Cyprus in 1994 and 1995 (bad and good years, respectively), average output varied from 11 to 34kg per tree.⁵ In the calculations undertaken here, I will assume that oil production and storage facilities at Kalavassos were geared to handle the output from a relatively good year, and that in a relatively good year, the average output was 20kg of olives per tree.

Now we can address the question of how many trees would have been needed to produce 25000 or 50000 litres of olive oil. At 5kg of olives per litre of oil, and 20kg of olives per tree, the estimated yield from one tree is four litres of oil. Therefore, 25000 litres would have required 6250 trees, and 50000 litres would have required 12500 trees—in a good year.

Calculating the Hectares of Land under Olive Cultivation

The next question to be addressed is how many hectares of land would have been needed to grow 6250 or 12500 trees. The density of trees per hectare depends on the mode and intensity of cultivation. Olive trees may be grown in dedicated plantations, where the density of trees is high. Alternatively, they may be interplanted with cereals and other crops, and under this regime, lower tree

⁵ These figures are calculated on the basis of data kindly provided to me by the Cyprus Agricultural Research Institute.

densities will be found. Variable statistics for ancient and modern densities are shown in **Table 1**.

Table 1: Densities of olive trees per hectare under plantation and mixed modes of cultivation

Region	Mode of cultivation	Trees/Ha	Sources
Israel, recent	Plantation	75-112	ZERTAL 1987: 198
Mesara, Crete, Greece, 1980s	Plantation	100-150	Calc. from BLITZER 1993, 171
Methana, Greece, recent	Plantation	100	FOXHALL 2007, 79, 116
Provence, France, recent	Plantation	110-120	AMOURETTI & BRUN 1993, 553
Cyprus, mid-1980s	Plantation	120	Calc. from PAPAYIANNIS 1985, 1
Cyprus, mid-1990s	Plantation	150-180	Data courtesy Cyprus Agricultural Research Institute
Roman Italy	Plantation	121-170	AMOURETTI & BRUN 1993, 554, tab.1 (based on Cato and Columella)
Roman Italy	Mixed	40	AMOURETTI & BRUN 1993, 554, tab.1 (based on Columella)
Kalavassos, Cyprus, 1996	Mixed (olive and carob trees together)	max. c.34	Author's personal observations

My own informal survey of a number of mixed plots and old olive groves in the Kalavassos area in 1996 showed a relatively low density of trees; the highest density I observed for olives and carobs combined was 34 trees per hectare. Granted, Kalavassos is not presently noted as an important olive production zone, and land use patterns have no doubt changed considerably over the last 3300 years. The contemporary prevalence of intercropping may be significant, however. A substantial number of the extant olive trees occur in zones of mixed cultivation. Denser stands of olive trees are most commonly found near the riverbed, where underground moisture levels are higher and irrigation from wells is feasible.

Using the Roman agriculturalist Columella's round number of 40 trees/ha for mixed cultivation zones (AMOURETTI & BRUN 1993, 554, tab.1) and a conservative figure of 100 trees/ha for Late Bronze Age plantations,⁶ we can make some rough calculations for olive hectareage requirements at varying tree densities. As indicated in **Table 2**, in a regime of intensive, plantation-style olive cultivation,

⁶ FOXHALL (2007, 79, tab.3.1) estimates 60 trees per hectare for ancient Greek mixed cultivation, but I have opted to use the lower figure of 40 in view of the lower estimate for Roman Italy offered by AMOURETTI & BRUN (1993, 554, tab.1) and my own observations of the current very low densities in Kalavassos agricultural lands.

62.5ha would be needed to produce 25000 litres of oil; 125ha would be needed for 50000 litres. At the other extreme, assuming that all the olive trees were interplanted with grain and other crops, 156.25ha of land would be needed for 25000 litres of oil; 312.5ha would be needed for 50000 litres. It may be more realistic to assume that both intensive and extensive modes of cultivation were employed simultaneously; assuming a 50-50 mix, the requirement of 109.375 and 218.75 hectares may be calculated for 25000 and 50000 litres of oil, respectively.

Table 2: Hectares of land required to produce 25000 or 50000 litres of olive oil at varying tree densities (assuming average output of 4 litres of oil per tree)

Tree density	Hectares for 25000 liters	Hectares for 50000 liters
100/ha (plantation)	62.5	125
40/ha (mixed cultivation)	156.25	312.5
50-50 mixed cultivation and plantation	109.375	218.75

Labour Requirements of Olive Production

In order to understand the role of olive production within the political economy of Kalavassos, it is important to consider not only the amount of land it would have taken to produce 25000 or 50000 litres of olive oil, but also the human labour requirements associated with growing and harvesting the 125000kg or 250000kg of olives needed to produce those amounts of oil. Olive cultivation requires a protracted commitment of time and effort to establish and nurture new trees. Trees are typically transplanted from the wild and are grafted with domesticated strains. The establishment of plantations requires land clearance in marginal areas, ploughing, fertilization, and regular watering of young trees (BLITZER 1993, 170-171; FOXHALL 2007, 97-129). The initial returns from young trees are very low, and it may take up to 25 years before measurable productivity is achieved (BLITZER 1993, 171; CALLOT 1984, 7; FOXHALL 2007, 76). In the Greek and Roman world, much of the labour associated with olive cultivation on large farms was undertaken by slaves, tenants, or other dependent labourers (FOXHALL 2007, 72-75; MATTINGLY 1988b, 37).

On top of the effort required to establish and maintain young trees, a tremendous input of labour is required at harvest time. Although hydraulic rakes are used to bring down the olives on some modern farms, the technology of olive picking has not changed much since antiquity (WARNOCK 2007, 19-21). One needs a ladder, a drop cloth to catch the fallen olives, and some sort of stick, along with one's hands, to bring them down. In the region of Achaia in modern Greece, where traditional methods of picking are still practiced, it has been reported that it may

take two people two hours to half a day to pick one tree; a skilled harvester can pick up to 80kg of olives per day.⁷ Assuming that not everyone in any given community of pickers is necessarily a “good” picker, and that the lack of motorized transportation in Late Bronze Age Kalavassos would have lessened the total feasible harvest of each individual per day, I would propose that a figure of 55kg per picker per day may be a reasonable one to use in calculating ancient labour requirements.⁸

Table 3: Approximate number of workers required to harvest 125000 or 250000kg of olives (yielding 25000 or 50000 litres of olive oil)

Days of work devoted to the olive harvest by a single individual^a	125000kg harvested^b	250000kg harvested^c
15 (assuming olive pickers have other full-time farming and craft pursuits)	152 people	303 people
45 (assuming a mix of occasional and dedicated pickers)	51 people	101 people
75 (assuming a dedicated work force and allowing for rainy days)	30 people	61 people

^a Duration of olive harvest: 60-90 days between November and February

^b 125000kg/55kg per person per day = 2273 person days needed

^c 250000kg/55kg per person per day = 4545 person days needed

In **Table 3** I present calculations for the number of people whose efforts would be required to harvest 125000kg of olives (25000 litres of oil) or 250000kg (50000 litres of oil) depending on the number of days devoted to harvesting by each individual. Assuming a workforce of dedicated olive-pickers working 75 days during the season, the total of 30 to 61 people required (see last row of table) does not seem all that large, but it is worth considering that a dedicated workforce of any size would probably have been dependent on the ruling authority for rations over an extended period of time. The olive harvest, after all, coincides with the time for planting cereal crops in the Mediterranean world (DU BOULAY 1974, 274-277, tab.4). Most farming families would have many other chores to do while the olive harvest was taking place and might be unable to devote more than 15 days to harvesting (see discussion in n.7). If there were no dedicated pickers, 152 to 303

⁷ As reported on the website: <http://www.elikioliveoil.com/oltrecul.html>.

⁸ According to a BBC report on the 2008 olive harvest in the West Bank region of Israel, it was expected that one family would work 15 days (12 hours per day) to harvest 100 trees (see http://bbc.co.uk/2/hi/in_pictures/7687357.stm, page 2 of 10). Assuming an average of 20kg per tree and a total yield of 2000kg of olives for 100 trees, this means that one family would pick approximately 133kg per day over the 15-day period. The size of the family was not specified in the report, but assuming that two adults did most of the work and young children picked lesser amounts and helped with other tasks, then a picking rate of 55kg per adult per day may be proposed. In view of this calculation and the figure of 80kg per day for a good picker in Achaia, Greece (see n. 6 above), MATTINGLY's (1993, 491) figure of 150kg per person per day in southern Tunisia seems too high.

people would have been needed to participate in the olive harvest; assuming that small children and elderly people did not take part, these figures might have encompassed a significant proportion of the adults in the community (see discussion of population size below).

Once the olives were picked, they would have had to have been processed almost immediately to prevent spoilage. Traditional olive production involves several steps: crushing the olives to break down the flesh and separate it from the stones; pressing to release the oil (with hot water being poured on the stacked bags or baskets to facilitate the extraction); collection of the liquid runoff, and separation of the oil from the water (BRUN 2004; FORBES & FOXHALL 1978; FOXHALL 2007, 131-217; FRANKEL 1999, 46-48; HADJISAVVAS 1992; WARNOCK 2007, 22-47).

The methods and equipment used to crush the Kalavasos olives are largely unknown, although some relatively small crushing or grinding stones were found in the vicinity of the stone tank (SOUTH 1992, 137-138, fig.3). It is possible that pestles and cylindrical rollers were the principal tools used for this task in the Bronze Age (CALLOT 1993, 56-57; FORBES & FOXHALL 1978, 40-41; HADJISAVVAS 1992, 7). Large rotary motion crushers that might have been worked with animal power such as the *trapeta* and *mola olearia* described by Cato and Columella have not yet been found in contexts preceding the Hellenistic and Roman periods (FORBES & FOXHALL 1978, 41; HADJISAVVAS 1992, 7-19). Whether the equipment used at Kalavasos was large or small, however, we can assume that the efforts of many people would have been required to crush 125000 to 250000kg of olives.

The occurrence of perforated stone weights suggests that the lever-and-weights press known from Classical Greek times was already in use in the eastern Mediterranean Late Bronze Age (HADJISAVVAS 1992, 21; 33, fig.59; see also CALLOT 1987, 206, fig.12 for a reconstruction of a press at Ugarit). The sizes and load capacities of these early presses are unknown, but it appears that they may have varied considerably within the site of *Ayios Dhimitrios* itself. The 2000 litre volume of the settling tank found in the northeast area suggests the use of a much larger press or presses than those identified tentatively in the east and central areas of the site. The oil or other liquid produced in Area 217 of Building III in the central area, for example, would have drained into a relatively small Group I *pitbos* with a volume of less than 100 litres that was set into a pit beneath the floor (K-AD 498; SOUTH 1983, pl.XVI:4; for *pitbos* typology: KESWANI 1989, 14-15). The volume of the northeast area tank, moreover, attests to a press that was relatively large by ancient standards; it was more than three times greater in volume than the

settling tank or trough found at Hellenistic Praisos in Crete, estimated to hold 630 litres (BOSANQUET 1901-1902, 264; FORBES & FOXHALL 1978, 46).

Unfortunately, we can only speculate about the size of the presses associated with the northeast area storage magazines at Kalavassos. HADJISAVVAS (1996, 131) suggests they were comparable in size to relatively small Roman oil-making installations discussed by BRUN, who calculates maximum outputs of 1500 litres per press per year (BRUN 1986, 279, n.25). According to BRUN, who extrapolates from the accounts by Cato, two such presses would have been needed to press the oil from 30ha of land with a total of 3000 trees. BRUN postulates very low fruit yields (7-10kg per tree) and very low oil yields (10-15% oil per kg of fruit). From these numbers it may be inferred that he assumes a maximum yield of 15000kg of olives from 1500 trees to be handled by one press. Assuming a maximum of 90 days in the harvesting and processing season, a load capacity of c.165kg per press may be calculated accordingly. MATTINGLY (1993, 492, tab.3) has estimated much greater load capacities for olive presses in Roman *Tripolitania*, with small, medium, and large presses capable of processing 250kg, 600kg, and 1000kg per load, respectively. If each press could handle only a single load per day, as ethnographic observations would seem to indicate (*e.g.*, MATTINGLY 1993, 494-495; WARNOCK 2007, 21), and the harvesting and processing season lasted a maximum of 90 days, it is likely that several presses were in use at Kalavassos, no matter what the press sizes were (**Table 4**).

Table 4: Estimates of the number of presses and laborers required based on varying press load capacities

Load size:	165kg	250kg	600kg	1000kg	165 and 250kg
Number of loads to process 125,000kg olives (25000 liters oil)	758	500	208	125	
Number of presses to process 125000kg in 90 days	8-9	5-6	2-3	1-2	5 presses @ 165 + 2 presses @ 250
Number of laborers to process 125000kg^a	64-90	40-60	16-30	8-20	56-70
Number of loads to process 250000kg olives (50000 liters oil)	1516	1000	417	250	
Number of presses to process 250000kg in 90 days	16-17	11-12	4-5	2-3	14 presses @ 165 + 2 presses @ 250
Number of laborers to process 250000kg	128-170	88-120	40-50	16-30	128-160

^a Assuming 8-10 laborers per press for all activities: olive crushing; press load preparation; pressing; carrying, heating, and pouring water; separation of oil from water; emptying water from tank or other collection containers; removal of waste and clean-up in preparation for next load

A sizable work force would have been required to operate multiple presses. CALLOT (1984, 99) has estimated that it would have taken 8-10 workers to operate an average press in antiquity: two to four people to operate the press itself, two others at the opposite end to adjust the height of the lever, two more to prepare the baskets of olives (after crushing) for the press load, and another two people to transport water and do other odd jobs. Members of the same crew might also have been responsible for the crushing operations. The high end of CALLOT's labour estimate may be justified when the effort required to empty a 2000 litre settling tank is considered. For every litre of oil produced, there would have been a liquid run-off of approximately five times as much olive oil, juice, and the hot water used in the pressing process (FORBES & FOXHALL 1978, 46). The production of 25000 litres of oil would have yielded 125000 litres of liquid, representing over 60 fills of a single 2000 litre tank or about 30 fills of two such tanks; 50000 litres of oil would have yielded 250000 litres of liquid, representing 125 fills of a single 2000 litre tank or over 60 fills of two such tanks. As there is no drain in the preserved tank from the northeast area at Kalavassos, the water would have to have been bailed out after the oil was skimmed from the top. This would certainly have been a time-consuming and labour-intensive operation.

In view of the tank size in the northeast area, it might be hypothesized that two of MATTINGLY's "small" 250kg load presses were used there, while the other presses used outside the ashlar administrative complex fell into the 165kg size category or were even smaller. Approximately five 165kg presses would be needed, in addition to the two 250kg presses, in order to produce 25000 litres of olive oil, necessitating a work force of 56-70 people for 90 days. Approximately fourteen 165kg presses would be needed, in addition to the same two 250kg presses, in order to produce 50000 litres of oil, and the size of the work force would have increased to 128-160 people for 90 days. This labour requirement would have been in addition to the labour required for the harvesting of olives that was taking place simultaneously (see **Table 3** above).

Uses and Consumption of Olive Oil in Antiquity

The discussion so far has been concerned with the scale of olive production at Kalavassos-*Ayios Dhimitrios*: the number of trees, the amount of land, and the extent of the labour that would have been required to fill the Building X *pitthoi* with olive oil. The next problem to be confronted pertains to how olive oil was used and how much was consumed on a *per capita* basis in antiquity.

One of the principal uses, of course, was food; olive oil would have been an important source of fat and calories in a diet otherwise dominated by grains and pulses. We know that oil was issued as rations to palace dependents in ancient Near Eastern societies; HELTZER (1993, 49) estimates that up to 11 metric tons per year of oil were distributed to the royal dependents of Ugarit in Syria. Another important use of oil in antiquity was for lighting. Flat-backed ceramic lamps that could be hung against the wall were common at Kalavassos-*Ayios Dhimitrios* and other Late Cypriot sites (*SCE* IV:1D, 518; SOUTH *ET AL.* 1989, fig.27), and trefoil, dish-type lamps have been found in a number of Late Cypriot tombs (*SCE* IV:1D, 517-518, fig.65:2).

Oil was also valued for its use in bodily anointment. Perfumed or scented oils were highly prized as luxury products. They were an important export of Mycenaean societies, and some have suggested that olive oil was more important within the Aegean palace economies for this luxury use than as a food source (BUNIMOVITZ 1987, 12-13; HAMILAKIS 1999, 43; 47; 49; MELENA 1983, 123). Elaborate containers filled with exotic oils may have served as “greeting gifts” between rulers in the eastern Mediterranean (KELDER 2009). Oils were also used for religious ceremonies and offerings in the Aegean, Syria, and other parts of the eastern Mediterranean world (BENDALL 2007; BLITZER 1993, 169-170; CALLOT 1993, 61; CHADWICK 1976, 96-98; 2014; LUPACK 2014).

Although we do not know exactly how much oil people would have consumed on an annual, *per capita* basis in Bronze Age Cyprus, we can make some rough estimates based on information from other ancient civilizations and more recent historical data. Some scholars have estimated consumption in the Greek and Roman world at 20-25 litres per person per year (AMOURETTI 1986, 183; HITCHNER 1993, 500; MATTINGLY 1988c, 22), and similar figures have been proposed for ancient Israel (SAFRAI 1987, 178; ZERTAL 1987, 198).⁹ Other scholars working in Crete favour a lower figure of 15 litres per person per year (DEWOLF *ET AL.* 1963, 51; VAN EFFENTERRE 1980, 456). We might therefore use 15 and 25 litres as our low and high estimates for annual *per capita* consumption at Kalavassos. With these numbers, it is possible to address the question of how many people's needs could be met from the Kalavassos stores.

⁹ FOXHALL (2007, 86, 89) suggests that wealthy Athenian households may have consumed as much as 25-35kg of oil per person per year in the Classical period; presumably the mean consumption *per capita* was lower for the majority of the population.

Oil Provisions and the Population of Kalavassos

Assuming, for the moment, exclusively local consumption, with two years' supply of oil stored because of biennial variations in productivity (*i.e.*, negligible productivity in alternate years), a range of approximately 500 to 1666 people could be supported, depending on the total amount of storage devoted to olive oil and the annual rate of consumption (**Table 5**).

Table 5: Number of people who could be supported by Kalavassos-*Ayios Dhimitrios* oil stores

Consumption rate per person for 2 years	Number of people supported with 25000 litres total oil storage	Number of people supported with 50000 litres total oil storage
30 litres	833	1666
50 litres	500	1000

In order to understand how these numbers relate to political and economic organisation, it is necessary to compare them with the total population size of *Ayios Dhimitrios* and its overall domain. Without historical census records for the area, the estimation of population is problematic. On the basis of architectural evidence, however, SOUTH once estimated that the population of *Ayios Dhimitrios* might have been as high as 1500 people, with a few hundred more living at outlying, contemporaneous occupation sites identified in the survey of the valley (SOUTH 1996, 40-41).¹⁰ An overall population of 2000 people would be consistent with the population of the Vasilikos Valley in the 1960s. These calculations are also consistent with estimates of the agricultural carrying capacity of the environs of *Ayios Dhimitrios*.

A site catchment analysis undertaken by WAGSTAFF and colleagues for the Neolithic settlement at Kalavassos-*Tenta*, which is located only 150-200 meters from *Ayios Dhimitrios*, allowed WAGSTAFF to estimate the total population that could be supported from the cultivation of land within 15 minutes' walking distance, or a radius of approximately 1km, from the site. The 1km distance is significant because studies of peasant agriculture have shown a decline of benefits versus costs for farmers exploiting lands more than 1km from home on a regular basis. WAGSTAFF estimated that the total ploughable land within a 1km radius of the archaeological sites totalled approximately 260ha (WAGSTAFF 2005, tab.116). Assuming a regime

¹⁰ In a very recent analysis employing several different modes of estimation, SOUTH suggests that the population total for *Ayios Dhimitrios* may need to be lowered to 850-1150, with an additional 725 people residing at other sites in the valley, for a total population of 1575-1875 valley-wide, although if greater residential densities (deemed less likely) are assumed, the total could have been as high as 3000 (SOUTH 2014, 76). If the lower population range is accepted, the argument made below for broad-scale redistribution of surplus olive oil by the elite becomes even stronger.

of mixed cultivation including cereals, vegetables, and grapes, and using the total estimated cereal yields divided by the standard ration of wheat per man per day in ancient Greece, WAGSTAFF estimated the carrying capacity of the 260ha within the 1km radius at 800 to 1200 people (WAGSTAFF 2005, tab.122). Of course, more land outside the 1km radius could also have been exploited, either directly and with greater associated travel times, or perhaps through the collection of tribute from outlying areas.

Given the preceding estimate of 500 to 1666 people having been provisioned from the Building X olive oil stores and an estimated regional population of 2000 people, it appears that anywhere from 25% to more than 75% of the total regional population could have been provided with olive oil, or 33-100% of the population of the site of *Ayios Dhimitrios* alone.

Olive Oil Production and Models of Political Economy

At the outset of this paper I proposed three possible explanations for the extensive production and storage of olive oil at Kalavassos: long-distance trade, staple finance, or large-scale redistribution. The estimates of total storage capacity, land requirements, labour inputs, and oil consumption discussed above may now be used, in conjunction with other archaeological considerations, to evaluate these possibilities.

With oil stores adequate for the support of 500 people or many more, it seems obvious that the Building X magazines were designed to fulfil the needs of more than a small elite minority of the population. Might the Kalavassos elite, therefore, have specialized in olive oil production for the purpose of external trade? According to one of the Amarna letters (EA 34:51) and Papyrus Anastasi IV, oil was exported to Egypt from *Alashiya*, which is generally equated with Cyprus. According to another text from Ras Shamra (RS.20.168), however, *Alashiya* was also on at least one occasion the recipient of a large consignment of oil from Ugarit (CALLOT 1993, 62; HOLMES 1975, 92; 102, n.23-25). If the main purpose of the oil production enterprise was trade, we might expect to find significant numbers of Cypriot-made transport vessels, possibly of standardized size—which have not been recognized to date. While Kalavassos has produced a sizable number of fragments of Canaanite-style jars (SOUTH, *pers. comm.*), we do not know how many of these were local and how many were imported, or whether they were used or reused for exporting local olive oil.

Of the 10 large *pithoi* (all reportedly of Cypriot type) found in the Ulu Burun shipwreck, at least one contained pomegranates and three contained various types of Cypriot pottery (PULAK 1998, 204; WARD 2003, 537). Whether any of the other *pithoi* contained olive oil is unknown, although several Canaanite jars contained olive pits (HALDANE 1993, 353; PULAK 2008, 295), attesting to the transport of whole fruits from the Levant. The shipwreck *pithoi* are smaller than the giant vessels from Kalavassos Building X (PILIDES 2000, 48-50). Assuming that the Ulu Burun cargo was typical, with a maximum capacity of 500 litres per *pithos* and perhaps three *pithoi* of oil per ship load, that would amount to a total of 1500 litres exported. Even if the total amount exported was double (3000 litres), the amount left over for local consumption at Kalavassos would have been minimally depleted, unless, of course, multiple ships visited every year. If the seafaring merchants of the Late Bronze Age maintained trading alliances with specific communities, however, as MANNING & DE MITA (1997) have suggested, then the likelihood of any single community entertaining numerous ships in a single year seems small.

We certainly cannot rule out the possibility that some oil was exported from Kalavassos, but the hypothesis of a bulk trade in olive oil as the primary rationale for the Kalavassos stores is not well supported at present. This leaves us with the models of staple finance and redistribution.

In order to evaluate the applicability of either of these models, it is important to consider the mode of accumulation of the olive oil stored in Building X. Was it collected from the population at large, was it produced on private elite estates, or was it accumulated from both of these sources?

If all or most of the oil stored in Kalavassos Building X came from tribute or taxes paid to the ruling authority by its subjects, then presumably it constituted only a fraction of the total oil production in the region —perhaps a traditional tithe or 10%. If so, then the land under olive cultivation would have had to have been 10 times as extensive as previously estimated to fill the Building X stores. The hectares of land and the amount of labour required would have vastly exceeded the local agricultural catchment and the estimated population of Late Bronze Age Kalavassos (**Table 6**).

If, alternatively, all of the oil stored in Building X was directly produced on elite-controlled estates, in dense plantations or groves of olive trees, and if those plantations were located within a 1km radius of the site, then approximately 25-50% of the local ploughable land must have been under elite control and devoted to olive cultivation. The population that could be supported by cereal production within a 1km radius would correspondingly have been reduced by 25-50%, meaning there would have been a much smaller labour force available to work the

estates. Alternatively, the plantations could have been located outside the 1km zone, but then the travel and transport costs would have been greatly increased, especially at harvest time.

It may be more reasonable to assume a regime that involved a combination of mixed cultivation and plantation production, with the plantations belonging exclusively to the elite and with much of the mixed farmland being cultivated by general population. Many different ratios of the two cultivation categories are possible, but, in the interest of brevity, I will explore just one of these combinations here.

Table 6: Calculation of the total land and labour requirements if the Building X storage facilities represented only 10% of olive production in the Kalavassos region. The scaled-up requirements clearly exceed the estimated totals for farm land within the catchment area of *Ayios Dhimitrios* and the labour requirements would also have been excessive in view of the estimated Late Bronze Age population of the Vasilikos Valley overall

Total oil production (litres)	25000	50000	$\times 10$	250000	500000
Olives (kg) required	125000	250000		1250000	2500000
Number of trees required	6250	12500		62500	125000
Total hectares required	62.5-156.25	125-312.5		625-1563	1250-3125
Number of workers for harvest	30-152	61-303		300-1520	610-3030
Number of presses^a	7	16		83	167
Number of workers for processing	56-70	128-160		664-830	1336-1670
Number of people supported	500-833	1000-1666		5000-8330	10000-16660

^a Assuming two 250kg load presses (even with production scaled up $\times 10$) and the remainder with 165kg load capacities or smaller

If we assume that the elite controlled 109 hectares in plantations and mixed fields in the 1km radius of *Ayios Dhimitrios*, it could have produced 25000 litres of oil. HELTZER (1993, 49) notes that while private households and villages in the realm of Ugarit were required to pay a fraction of their olive oil production in taxes, the main oil production centres were in fact part of the royal agricultural domain; it is not unreasonable, therefore to reconstruct a similar emphasis on royal or elite-controlled production for Kalavassos. If, in addition, the general public controlled 156 hectares of land under mixed cultivation, another 25000 litres could have been produced. The numbers 109 plus 156 make a sum of 265, a figure that is almost identical to the proposed Kalavassos catchment area of 260ha. Now it becomes possible to consider how this distribution of cultivation would (or would not) have

fulfilled the needs of the population, based on the unequal distribution of land between elite and commoners, or rich and poor (**Table 7**).

I make the following additional assumptions:

- that there was a minimum oil requirement of 30 litres per person for two years,
- that there was a total population of 2000 people in the valley, with a major concentration at *Ayios Dhimitrios*, and
- that the elite regularly supported a total of 500 people —its own members and direct dependents

Table 7: A redistributive model for Late Bronze Age Kalavassos

Assumptions:
Elite controls 109 hectares; produces 25000 liters of oil
General population controls 156 hectares; produces 25000 liters of oil
Minimum olive oil requirement is 30 liters per person for 2 years
Total population of the domain is 2000
Elite requirement is to supply 500 people (its own membership and dependent laborers)

Implications:
Elite olive production can support 833 people = surplus for 333 people
Remaining population (1500 people) has equal production: enough to supply 833 people = deficit for 667 people
Elite surplus can alleviate one half of the deficit
Cultivation of an additional 25-62 hectares can make up the balance required

The 25000 litres of oil produced from elite lands would thus have supported 833 people, or 333 above the requirement. With a general population numbering 1500 people, the 25000 litres from commoner lands would have supported only 833 people, leaving a shortfall of oil for 667 people. The elite surplus could have alleviated half of this shortfall. Moreover, if the elite brought another 25 hectares of plantations or 62 hectares of mixed cropland under cultivation, the oil needed to support the other 333 people could have been produced.

Material and Ideological Origins of a Redistributive Economy

The preceding calculations illustrate the plausibility of a large-scale redistributive economy at Kalavassos. The questions of how such a system might have arisen and how it would have benefited an otherwise self-interested elite remain to be addressed.

One important consideration is the length of time it takes to practice successful olive cultivation. As noted earlier, it can take as long as 25 years for an olive tree to reach a measurable level of productivity. This means that the families established in a particular area (such as the vicinity of *Ayios Dhimitrios*) for the longest time would have had more generations to bring trees under cultivation, and they would have had a considerable economic advantage over newcomers to the area. Whether the population of *Ayios Dhimitrios* aggregated suddenly or gradually, there would have been a significant potential for economic stratification, favouring older inhabitants of the region.

Such inequalities seem to be common in societies with an agricultural complex based on cereal and olive cultivation. Tax records and other ethnohistoric data from late medieval Italy and early modern Greece show pronounced social differences in holdings of olive trees and probable consumption of olive oil in olive-producing communities. Large olive plantations were the property of wealthy landowners, and landless labourers or poor peasants worked their estates. In some areas, up to half the population owned no olive trees or very few of them, and they stored far less olive oil than their biennial consumption needs (GRIECO 1993, 301; FORBES 1993, 214). Even when poorer families owned some olive trees, their lands and tree holdings would presumably have been subdivided through inheritance, so that the households of the next generation would have begun at a disadvantage. BLITZER notes that in the Mesara region of Crete in the early 20th century, a man might begin married life with two or three trees and hope to end up with eight or nine to leave to his children (BLITZER 1993, 171). Assuming those first two trees would yield a total of eight litres of oil, and nine trees would yield 36, even at the peak of his wealth a poor farmer could at best fulfil the needs of two people for one year, not of an entire family for two years.

Large plantation owners, by contrast, would have produced a considerable surplus. Assuming this was true of the Kalavassos elite in the Late Bronze Age, it is possible to imagine how they might have used those surpluses to their advantage. In order to be a leader, one must attract followers. In order to accomplish large-scale building and industrial projects —quarrying and working ashlar blocks, constructing monumental buildings, mining and smelting copper, cutting trees for fuel— the elite also needed to attract a labour force. The judicious deployment of surplus olive oil might have been one way both to attract and retain new settlers — followers and labourers— over time. This does not mean that everyone became entirely dependent on olive oil rations disbursed by the elite, but it does seem possible that we are looking not merely at a staple finance economy, but at an even larger redistributive system that helped to make up for household shortfalls in

production and alleviated subsistence stress in periods of crisis —*i.e.*, years of low productivity.

Olive oil would have been an important source of calories, an enhancement to the flavour of food, a substance for bodily anointment and balm, and an important source of light in a world without electricity. Accordingly, it was probably imbued with a high degree of ideological value that made it more than just a *quid pro quo* when it was distributed from the central storehouse. The provision of oil—with its nutritional, cosmetic, and practical uses— would have enhanced the status of its elite providers among those who received disbursements.

When we try to understand the origins and operations of Late Bronze Age society in Cyprus, it is easy to become preoccupied with themes of copper production and the long distance trade in elite luxury goods. What we need to keep in mind, however, is that both the copper industry and long distance trade enterprises were sustained first and foremost by an agricultural economy. The scale of olive oil storage at Kalavassos and the considerable labour requirements associated with cultivating, harvesting, and processing the olives would seem to indicate that agricultural strategies were key to the rise and success of this particular Late Bronze Age polity.

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