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THE AROURA PROJECT

Discoveries in Central Greece, 2010–2014

ABSTRACT

Archaeological Reconnaissance of Uninvestigated Remains of Agriculture (AROURA) consisted of field and laboratory research in the landscape around the Mycenaean (13th-century b.c.) fortress and storehouses of Gla in the Kopaic Basin, Boiotia, Greece. Central to fieldwork was the application of a topographical model of palace estates, based on the interpretation of Mycenaean landholding records. It was then possible to use geophysical technologies to detect the realities represented by the constituents of this model. The present article describes the archaeological and linguistic context of palace agriculture in which this model was developed. It then details the methodologies used, presents results, and draws conclusions about the trajectory of local social complexity compared with other parts of the Aegean.

INTRODUCTION AND SYNOPSIS

The Archaeological Reconnaissance of Uninvestigated Remains of Agriculture (AROURA) project consisted of multiple-methodology research in the plain and hills around the Mycenaean fortress of Gla (Γλας) in the northeastern Kopaic Basin, Boiotia Prefecture, Greece.[1] The authors carried out fieldwork between 2010 and 2012, followed by laboratory studies in 2013 and 2014. Central to geophysical prospection and "ground-truthing" was the application of a topographical model of Mycenaean palatial

1. In addition to the archaeologists and support staff of the Ephorate of Antiquities of Boiotia, two prior Directors of the American School of Classical Studies at Athens (ASCSA), by which the official collaboration was vetted, Jack Davis and James Wright, deserve the greatest thanks. The Institute for Aegean Prehistory (INSTAP) sustained the project with generous financial and material support. Research would not have been completed on schedule without GIS Specialist Wes Bittner; Assistant Geophysical Specialist Allison Cuneo; and undergraduate trainees from the University of Maryland, Baltimore County (UMBC) and the National and Kapodistrian University of Athens, the latter supervised by Giorgos Vavouranakis. Jost Knauss of the Technische Universität München cannot be praised enough for providing, in the spirit of academic altruism, copies of his fieldnotes and original plans and drawings. Finally, the authors thank the anonymous reviewers who provided invaluable substantive, critical, and structural comments.

agricultural estates, based on analysis of relevant Linear B texts. We also conducted intensive and extensive collections of finds from the surface of certain sampling areas.

We begin the article by summarizing the consensus among archaeologists and Linear B epigraphers (linguists of Mycenaean Greek) about the nature, extent, and purpose of Mycenaean palace-administered agriculture. Identifying a set of problems in the current conception of the palaces' agricultural regime, we justify the design of a heuristic topographical model to address it. We provide a general argument in favor of heuristic models that draw from the linguistic and sublinguistic data of Linear B. The field and laboratory methods pertinent to the model are then detailed. We follow the methodology with a description and interpretation of the results of the various undertakings. The final part of the present article draws conclusions about both the emergence and devolution of social complexity in the Kopaic Basin during the Bronze Age compared with other areas of the Aegean area. We also assess the potential the application of the model realized for attaining the stated theoretical ends, as well as the success of our methodology in making archaeological discoveries. We intend to present a theoretical coda in a second article, further propounding our premises and calling for renewed development of middle-range theories of social complexity employing heuristic models of various practices.

THE STATE OF THE FIELD OF MYCENAEAN STATE AGRICULTURE

Since the decipherment of the Linear B texts in 1952,[2] their linguistic interpretation has been crucial to determining the inner functions of the palaces in which they were discovered and the part that palaces played in the "Mycenaean" states of mainland Greece in the last two and a half centuries of the Late Bronze Age, or the Late Helladic (LH) period, from about 1440 to 1190 B.C. (Table 1). Some interpretations have been largely internal, concentrating on linguistic nuances, paleographical details, and generally contextual and circumstantial interrelationships in order to reconstruct the activities, remit, and priorities of state functionaries. Others have been largely external—applying cross-cultural studies of modern or, by extension, ancient, presumably "first-generation" states—and look to the linguistic "content" of the Mycenaean Greek texts as a class of evidence. They fill gaps in the material cultural record and verify the social dynamics inferred from the residues of past human activity from linguistically interpreted "documents." Across the spectrum of permutations of these approaches, analogies must be drawn—whether ethnographic, epigraphic, or historic—to corroborate accurately the sociopolitical and economic reconstructions adduced. Where these two prevailing approaches meet, as they concern palace-administered agriculture, the authors have identified a set of problems for adequate understanding of the integrated evidence, as well as a possible solution.

Consensus has been achieved lately about certain facts available to or parameters around political-economic interpretations of the documents,

2. Ventris and Chadwick 1953; Chadwick 1990.

TABLE 1. AEGEAN BRONZE AGE CHRONOLOGY

Period/Subperiod	*Approximate Dates, High Chronology* (B.C.)	*Traditional Low Chronology* (B.C.)
Early Helladic (EH) I	3100–2700	
EH IIA	2700–2400	
EH IIB	2400– 2200	
EH III	2200–2000	
Middle Helladic (MH) I	2000–1900	
MH II	1900–1750	1900–1700
MH III	1750–1690	1700–1590
Late Helladic (LH) I	1690–1610	1590–1500
LH IIA	1610– 1500	1500–1430
LH IIB	1500–1440	1430–1390
LH IIIA1	1440–1400	1390–1360
LH IIIA2	1400–1300	1360–1300
LH IIIB1	1300–1230	
LH IIIB2	1230–1190	
LH IIIC Early	1190–1170	

Note: Cf. Shelmerdine 2008a.

particularly palace interest in agriculture. The palace is concerned with a small fraction of the total cultivable land within its territorial jurisdiction.[3] Whether this interest was limited just to lands in the vicinity of the palace is still a matter for resolution, discussion in large measure hanging on how one interprets certain commodity procurement records.[4] It is at least clear that the palace archived the landholding records pertaining to the *wanax* (cf. Homeric ἄναξ), "king," the *lāwāgetās* (cf. λᾱγέτᾱς), "leader of the *lāwos* ("armed") commoners," and Potnia (Πότνια), "the Mistress,"[5] the latter of whom is ceremonially connected with the *wanax,* perhaps through the cult of Poseidon.[6] Furthermore, the arable land that the palace's scribes record is described in terms compatible with an extensive strategy. This means cultivation of a few reliable, if modestly yielding staple crops, such as one or two varieties of grain, with the substitution of the labor of animals for that of humans, with whom they do not compete for subsistence, and fertilization with animal manure during seasonal grazing.[7] This strategy contrasts with an intensive tactical suite of human labor employed in growing, tending, weeding, and artificially manuring with crop by-products or household refuse.[8] The palace keeps tabs on arboriculture and viticulture too, both for subsistence supplements (figs) and luxury goods (oil and wine), which entail more intensive cultivation.[9] The scope of the cultivation of these

3. See Halstead 1992a, 1992b, 2007; Small 2007; Killen 2008b.
4. Deroy and Gérard 1965; Olivier 1974; de Fidio 1987; Small 2007; Killen 2008b, pp. 165–168; Lane 2009, 2012a.
5. See Carlier 1984; Pontani 1998; Younger 2005.
6. See de Fidio 1977; Leukart 1992.
7. See Forbes 1976a, 1982; Gallant 1991, pp. 46–56; Burford 1993, pp. 122–123, 156–157; Halstead 1995b; 2000; 2014, pp. 212–230; Halstead and Jones 1997, pp. 280–283. For modes of "intensification," see Morrison 1994; Kirch 2006, pp. 192–196; Scarborough 2006. The project's awkward acronym is the Mycenaean and later Homeric word for "plowland," ἄρουρα (Linear B *a-ro-u-ra:* tablet PY Eq 213.1).
8. See Halstead 1987, 1995b, 2000; Gallant 1991, pp. 46–56.
9. See Gallant 1991, pp. 74–75; Burford 1993, pp. 129–135; Foxhall 2007, pp. 97–129.

appears to be much more limited, however, with the clearest evidence for the cultivation of vines and figs being from lands closely associated with the palace.[10] Notwithstanding, their labor schedules do not conflict with those of plowing, sowing, and harvesting subsistence grains and pulses.[11]

People who might have dwelled in the areas selected for an extensive strategy in the LH palace period therefore could have become divorced from traditional usufruct rights, if they had not already been removed from the land. This would be due to the lowered ratio of persons to land worked, and because the traction animals needed would have belonged to those possessing enough land to sustain them and make their employment effective and efficient.[12] The only times in the agricultural year at which intensive collective labor would have been required was during harvests of extensively grown staples or for cultivating and harvesting much less extensive vine and tree crops. Then it would have been at a scale larger than a household, possibly pooling people from separate communities.[13] A corollary is that a larger pool of human labor, depending on some other body for subsistence, was available for non-agricultural purposes the rest of the time. It hardly seems coincidence, then, that Linear B records groups of scores (when not hundreds) of unnamed men working at various crafts and engaged in military deployments. While there seems to have been a system of leasing discrete lots of land within larger parcels, perhaps negotiated through sharecropping,[14] this arrangement probably obtained in the domain of named and often titled persons who made up the community of the *dāmos*. This community is distinct from that of the work groups of unnamed men (and related women and children) who would have belonged to a peasant lessee or landless class (perhaps the *lāwos*).[15]

The majority of the kinds of materials and commodities described in the Linear B texts is derived primarily or secondarily either from the crops recorded or from animals of the kind expected under an extensive agropastoral regime in the Aegean.[16] Among the latter are flocks of hundreds

10. Pylos text PY Er 880.5.6: lands belonging to the *wanax* or his surrogate *e-ka-ra$_2$-wo* often assumed to be physically close to the palace (Killen 2008b, p. 166). The Knossos KN Gm and Gv sets also refer to fig trees and vines, but they are few and fragmentary and are not identified with a paleographical hand. Thus, they are hard to associate with place. Text Gv 863.1 may refer to a place named *qa-ra.*

11. See Du Boulay 1974, pp. 274–277; Burford 1993, p. 132; Halstead 2014, pp. 71–89.

12. See Halstead 1995b; discussion in Lane 2009. Land distribution and contests over it in Greece, as well as its relation to subsistence, are dealt with by Burford on classical antiquity (1993, pp. 16–33) and Karakasidou on the Modern era (1997, pp. 164–169).

13. See Halstead and Jones 1997; Halstead 2014, pp. 67–126. Estimates of Mycenaean harvest requirements are found in Halstead 1992b, p. 67.

14. See Halstead 1999b; 2014, pp. 21–22. Cf. Gallant on Hellenistic kingdoms (1991, p. 188) and Karakasidou on modern Greece (1997, pp. 43–48, 57–61). The similarity of the Mycenaean Greek terminology and the possible tenancy relations in the Hellenistic period has been discussed by Debord (1982, pp. 79–84), among others.

15. We respectfully disagree with Halstead's inference (1999b) that the Linear B landholding texts describe peasant sharecropping relations. Rather, because the Pylian "nomenklatura" participate, we infer that the landholding texts reflect tenancy relations between nondependent persons and the palace, albeit sometimes with the loan of plow oxen (Lane 2004). *Da-mo (dāmos)* appears in KN C(4) 911.6, F(2) 845.B, and the PY Ea set and Eb–Ep series. The identity of the *dāmos* with the named *ktoinohokhoi* (allotment holders) is ensured by the equation of PY Eb 297.2 with Ep 704.5, two versions of the same record, where its collective entity is contrasted with a representative of the religious sector.

16. Unlike primary and secondary agro-pastoral products, there is, at least, no linkage between metal assessments and the size or productive capacity of any of the tributary places at Pylos. Rather, all the available bronze in the realm is assessed, and bronze for manufactures or bronze objects for finishing

of sheep and goats and smaller herds of swine, all grazing or foraging animals.[17] Among the former are the products of intensively cultivated tree and vine crops, which can be put to subsistence (for example, figs) or nonsubsistence ends (such as olives, olive oil, and wine).[18] It is noteworthy that these crops would have been cultivated on a schedule different from that of extensive cereals, not competing with them for planting or harvesting labor.[19] There are records of grain, fig, and olive rations and handouts,[20] and proportionately locally assessed and distributed textiles of wool or linen (flax being a row crop), animal hides, fatted hogs, wine, and perhaps horn, among other materials,[21] as well as embellished combinations of these, such as textiles suffused with perfumed oil or decorated with horn or bone.[22] The center's proportional assessment of some of these goods from certain places and its reciprocal distribution of others back to the same places,[23] together with occasional references to *g^{w}oukoloi* (ox tenders), possibly plowmen, and land plots *(ke-ke-me-no , e-to-ni-jo)* at these localities,[24] suggest that while the palace's interest in administering land for production might be partial, it may also be far-flung around the territory and restricted to discrete areas of high-quality arable fields.[25]

We might summarize as follows the unresolved questions implicit in the preceding discussion that concern disposition of land, mechanisms of the extensive combined agro-pastoral strategy, and logistics and mobilization of primary and secondary products and further-elaborated commodities:

1. Where were the landholdings of the palace's concern, and how were they spatially organized?
2. What was the periodic schedule of the human labor that depended on external sources of subsistence?
3. To what ends was such labor, alongside that of animals, turned, when it was not engaged in plowing, harvesting, or pruning and grafting trees and vines? Was any of it employed in building projects, including those that represent technological innovation for agriculture leading to intensified land use?

is sent to smiths in diverse places. This inference is reasonable, since metals are durable and recyclable, not a product of land cultivation and evidently not exchangeable for agro-pastoral equivalents. In short, the palace appears to maximize manufacture in bronze (if not also other metals), whereas it applies target production totals in agro-pastoral assessments (Smith 1992–1993; Killen 2008b, pp. 165–168 (esp. n. 26), 189–191; cf. Nakassis 2010, pp. 138–139, on bronze and smiths).

17. *Docs*^{2}, pp. 195–213, 432–438; Rougemont 2016. On manure from grazing, see Halstead 1995b; 2014, pp. 229–230.

18. *Docs*^{2}, pp. 272–274, 455–456; Duhoux 1976, pp. 12–15; Shelmerdine 1985; Gallant 1991, pp. 57–58; Burford 1993, p. 215; Bendall 1998–1999.

19. Du Boulay 1974, pp. 274–277; Forbes 1976b; Burford 1993, pp. 139–141.

20. See Chadwick 1988; Palmer 1989; Killen 2001a; Nakassis 2010, pp. 133–138.

21. *Docs*^{2}, pp. 205–207, 289–295, 435–436, 464–466; Killen 2008a; Perna 2016.

22. See, e.g., Killen 1984; Nosch 2001–2002, 2011, 2016.

23. See Melena 1983; Killen 1999, 2001b; Nosch 2006; Lane 2012a, pp. 95–100.

24. Texts PY An 830.10.11.12.13 *(qo-u-ko-ro),* PY An 830.26 *(ke-ke-me-no),* and PY An 724.12 *(e-to-ni-jo).* For alternative translations and contextual interpretations, which all relate to men tending oxen "working" on land, see Palaima 1989, 2015.

25. One hypothesis yet to be tested is that archives of these parcels may have been kept locally, just as those pertaining to the three major authorities of the realm were kept at the palaces. If confirmed, it could explain the appearance of palaces concerned only with their own vicinity (Killen 2008b, pp. 165–168). On possible procedures, see Bennet 2001; Del Freo 2016a; Marazzi 2016.

4. Can certain manufactured goods be linked to palace-administered agricultural land, through either their remains or proxies for the creative processes?
5. Within the constellation of identifiable administrative and settlement sites and agro-pastoral landscapes, how do permutations of *structured relationships* that reflect concrete practices and not just their objectified "end products" appear as material traces on the ground?

From Texts to Models and Back Again

It seemed to us from an early date that the most appropriate way to attempt to answer the questions summarized above was to construct a testable model that accounted for both the scribes' integrated archival procedures and the cognizant agencies underlying their own habitual and deliberate practices, and that accounted as well for the agencies of the practices they observed and recorded. In other words, rather than attempting to combine internal reconstruction with external interpretation, in the respective senses outlined above, we sought to develop a model that asserts human agency as socially causal in general while exploring the relations between diverse agencies in particular, each informed by different social contexts, structures of knowledge, and access to epistemic and instrumental resources. We recommend such models as an antidote to present aporias in the limited factual consensus or to competing theories (or conjectures) in chronic debates on Mycenaean political economies. Philologists and linguists make sense of newly presented texts by inferring structural relations based on contextual, paleographical, syntactical, morphological, phonological, and other cognitive or pragmatic understandings, rather than simply matching the presence, absence, or quantities of elements discovered when they compare them with texts already presumed to be fully understood. Archaeologists in the field likewise make interpretations about past human activity and events from the juxtaposition of various phenomena and specific causes attributable to them, rather than simply comparing these phenomena instance for instance, quantity for quantity, with material patterns defined and interpreted elsewhere. Thus, AROURA was a test case of a relational model in this sense.

It seems to us—since we regard texts as artifacts with practical histories and applications—that the scribes were colluding in an integrated theoretical practice, as habitual and routine as their recording of separate transactions may have become over several generations.[26] Put another way, the scribes' shared practices as a whole involved situational awareness of their role as "scribes" (in deed, if not name) at the intersection of relations among scribes and nonscribes alike, and their reflexive consciousness that perpetuated this contingent role ("scribe" being one of several), reproducing and transforming these relationships. They were endeavoring to construct representations of a system of separate, sometimes disparate practices, perhaps including the procedure of recordation itself,[27] and their representations were designed to guarantee certain future outcomes from these practices.[28] This much they have in common with many modern social and economic theorists.

26. Supporting evidence includes standard character sets and forms of execution, spelling and text layout rules with few exceptions, common metrology and vocabularies of contribution, distribution, land allocation, and kinds of commodities, and the names of "international collectors." See, e.g., *Docs*^{2}, pp. 42–60, 387–394; Palaima 2000–2001; Olivier 2001; Rougemont 2001; Killen 2007; Nosch 2012; Melena 2014; Del Freo 2016a, 2016b.

27. On possible scribal self-reference by personal name, see Bennet 2001. These same named persons may bear the title *e-re-u-te-r° (ereutēr)*, "inspector" (vel sim. = ἐρευνητής/ἐρευτής, "collector of state debts"), which plausibly describes a class of recordkeeper (texts KN As <4493>.1, PY Cn 3.2, Wa 917.2). The personal name or pertinentive *pi-ta-ke-u* on PY Jn 389.5 could be *pittakeus,* "he concerned with tablets, list, or labels" (cf. πιττάκιον and Πιττακός), rather than Pithākeus.

28. Killen 1963; Shelmerdine 1973; de Fidio 1977, pp. 13–129; 2017; Halstead 1996–1997; Nosch 2011; Lane 2012a.

In the case of Linear B, the procedures of integration comprised economic functions to the extent that they demonstrably entailed the quantitative assessment and meeting of quotas for production or the monitoring of the distribution of commodities from the palace to persons and places as payments or objects for elaboration.[29] The tablets were the space in which scribes realized a sui generis expert craft. The tablets are not just representatives of a type of artifact, namely, the written record that correlates with a type of institution, but rather they constituted a space in which a certain institution was promulgated.

We believe archaeologists can test the accuracy and limits of the scribes' theory of the palace economy. Rather than coopting or subordinating the role of linguists and epigraphers, we might start with the comparison of the structural details of a recorded practice to empirical features of some independently observed practice, bringing to bear what we know of the kinds of agencies and structures implicated in the latter, and arrive at one plausible analogy or more that could be applied to phenomena in fieldwork. Relevant, broadly "ethnographic" knowledge should include observation of interagent relations, social conventions and institutions, available technologies, and ecological conditions or dynamics,[30] not to mention ethnographies and histories of scribes. With these resources, we can proceed to create what has been termed an "iconic" model of the practice in question under certain conditions of realization or implementation.[31] We can identify the material features of the components of this model with suitable techniques, and we can provisionally attribute certain kinds of agency to the qualitative patterns of combinations of elements, not just static structures to the quantitative relations between numbers of each type. The dynamics of these patterns can then be adduced from suitable modern documentation. Alternative models starting from the same premises can be tested against each other, thus tightening the parameters on alternative working hypotheses of the agencies the models entail.[32]

One should note that we are speaking of practices presumed to constitute larger, perforce, open political-economic—if not also socially reproductive—interagent systems. We are not speaking of reified, totalizing institutional systems, even of limited scope. The heuristic value of the proposed models of practice, derived in the present instance from approaching texts as material culture (that is, creations of deliberate human agency), is both in the potential of confirmation or infirmation of one hypothesis or contingent set of hypotheses or another (models), and in the way the models allow us to test the actual explanatory adequacy (if not predictive capacity) of the scribes' theories of the world.[33] Simply put: Did the scribes know

29. Killen 1979, 1999, 2001b; Melena 1983; Palmer 1989; Nosch 2006, 2009; Nakassis 2010; Bennet and Halstead 2014.

30. On practice theory in anthropology and archaeology, Ortner's review article (1984, pp. 144–157) remains an excellent source on the issues and treatment, despite its age. In addition to the critical coverage of classics in practice theory there, see discussions by Dobres (2000, pp. 130–148), Pauketat (2001, pp. 71–81), Chapman (2003, pp. 64–68), and Knapp and van Dommelen (2008, pp. 21–22), and, not least, Ortner's update (2006, pp. 1–18).

31. Clarke 1978, pp. 30–34 (citing Ackoff, Gupta, and Minas 1962); Wylie 2002, p. 94 (citing Harré 1972).

32. Wylie 2002, p. 94.

33. See the discussion of "explication" and "prediction" by Quine (1953), and the discussion of "explanation" and "prediction" in archaeology by Gibbon (1989, pp. 149–159). See also Bhaskar (1975) 2008, pp. 53–132.

their business at least as well as we claim to do when we import definitive models of state bureaucracy and "leadership" to interpreting the products of their work? The common approach to the textual evidence—whereby the results of interpretation of the Linear B records are alternatively or partially fitted into a preconceived model qua system, dismissed as irrelevant or accepted as the evidence of the automatic bureaucratic functioning per se of states,[34] depending on what is convenient—is the opposite of our aim. Starting from our stance, we can begin to synthesize a broader systemic model from the inside out (more than from the "bottom up"). We do not suppose in advance that a model represents an effectively functional totality, as though the machinery of a single governing agency of some nature, opposed to an interagent network in which resources and practices of knowledge are unevenly distributed, and whose consequences sometimes defy its purposes.[35] In this respect, what we propose is not classic middle-range theory qua "bridging arguments" to a model whose structures of transformation are already broadly agreed. It is middle-range, however, inasmuch as it aims concretely to answer higher-order questions or test higher-order assumptions, especially about human agencies.[36]

The creation of iconic models is the first step toward developing grounded "relational analogies," in Wylie's terminology,[37] which identify the structural principles informing certain agencies and are not merely inductive algorithms of nested societal scopes. Greater generalities based on iconic models may be called "structural models" to the extent that they reflect the conditions of possibility and outcomes of interagent relations, each agency with its peculiar qualities. Structural models, however, should be distinguished from "descriptive," "logical," or "symbolic" models, which take the form of a set of propositions (for example, "if [and only if] [approximate] rank order of site sizes, then political hierarchy") purporting to be a total explanation, whose elements must all be true for the model to be valid.[38] Put another way, developing heuristics allows us to explore the possibility of structural conflicts inside constructed, *systematized* institutions, which is essential to understanding social, particularly political-economic change rather than identifying social and political-economic type.[39]

34. See Johnson and Earle 1987, pp. 21–22, 208, 246–270, 302; Galaty and Parkinson 2007a, pp. 25–27 (with references). Discussion in terms of political-economic strategies is found in Blanton 1998, pp. 141–148, 156–162.

35. When agency is personalized or granted a human body in neo-evolutionary or world-systems theories of social complexity in the Late Bronze Age, it is almost always in terms of the "leader" or "leadership" (see, e.g., Earle 1997; Kilian 1988; Voutsaki 2001; Wright 2004b; see also critique in Pauketat 2000; 2007, pp. 31, 84). Efforts toward balancing or correcting this tendency include Nakassis 2013; Olsen 2014; Brysbaert 2015; Farmer and Lane 2016.

36. Raab and Goodyear 1984; Merton 2007.

37. Wylie 2002, pp. 136–153.

38. See Clarke 1978, pp. 30–41; Wylie 2002, pp. 88–95, 136–153. We do not agree with Clarke about the probability of eventually distilling iconic models into parallel, structurally symmetric "symbolic" models. Rather, we concur with Wylie that the former can be developed into precise "relational analogies" through comparative testing and recursive improvement, and that these analogies in turn can explain structures at various scales and of various durations.

39. See Giddens 1979, pp. 96–164; Pauketat 2000, 2001.

METHODOLOGY, PROJECT AREA, AND SCOPE OF OPERATIONS

The Topographic Model

We gleaned linguistic and pragmatic, sublinguistic structural information for our topographical model of palace-administered agriculture principally from the landholding records of the palace at Ano Englianos, Mycenaean *pu-ro* (Pylos), adducing supporting and complementary evidence from the archives of other palaces.[40] It has long been recognized that the scribes measure parcels of land—represented by *ko-to-(i-)na (ktoinā), ka-ma* (*k^hamas),* and their fractional *o-na-ta* (*onāta,* sing. *onāton*)—in quantities of *pe-ma* (*sperma* "seed, sowing," also *pe-mo*) accompanied by the symbol GRA, indicating a certain variety of grain, conventionally wheat.[41] Records analogous in this respect are found in New Kingdom Egypt and Bronze Age Mesopotamia from the Ur III period onward.[42] With recourse to the same analogy, these measurements are presumed to be conventional, linked to expected yield in grain or its equivalent rather than periodic dispensations.[43] Not only does no linguistic evidence exist of the actual distribution of seed grain to contradict this inference, but also unsown vine and tree crops are sometimes given in areas measured in *pe-ma* GRA. Furthermore, the uniformity of measurements within and between archives is consistent with the inferred extensive regime, as opposed to intensive cultivators' shifting needs from one season or locality to the next.[44]

There is at least one text indicating that scribes inspected cultivated fields in person, estimating the amount cultivated "of the season" *(o-ro-jo = hōroio)* in whole units of GRA.[45] Again, parallel inspection procedures can be found in the records of Bronze Age palace and temple economies in western Eurasia.[46] The comparison of linguistic and arithmetic data between regions both reinforces these fiscal interpretations and contributes further plausible detail to the models of estimation and assessment in each, drawing out greater or lesser differences too. The imputed method of estimating agricultural production is consistent with a system of taxation in kind that provides incentives for optimizing production, since whatever portion of the yield not contributed to the fiscal agent resorts to the cultivating owner or lessee.[47] Coauthor Lane and others have argued on separate grounds

40. Lane 2009, 2012a.
41. *Docs*^{2}, p. 130. Further discussion is found in Palmer 1992, 2008; Halstead 1995a.
42. *Docs*^{2}, pp. 236–239; Lane 2009.
43. *Docs*^{2}, pp. 236–239. The system of measurement is consistent among all the archives (Palaima 2000–2001, 2003), and the Linear B formula is either *pe-ma* GRA, *pe-mo* GRA (Pylos), or GRA *PE* (Knossos, Thebes). See Burford on *kapbolaia (katabole)* and *kypros* measures in classical antiquity (1993, pp. 127, 252 [with references]).
44. See Gallant 1991, pp. 46–58; Halstead and Jones 1997, pp. 283–286. Pylos text PY Er 880.5.6 measures *we-je[-we,* "trellises" (vel sim.), and *su-ẓạ,* "fig trees," in area *pe-ma* GRA 42(+). Thebes text Ft 104 measures total GRA *PE* 88 alongside OLIV (for **176* "olive-trees"[?]) 194 at five places, however, suggesting the two quantities are independent. It is possible that the olives are grown on marginal land, while the figs and vines are grown together on better-irrigated, arable land.
45. Pylos PY Eq 213, whose heading reads *o-wi-de , a-ko-so-ta , to-ro-qe-jo-me-no , a-ro-u-ra , a_2-ri-sa* ("How Axōtās saw, making a tour, the plowland(s) of *A_2*,"), after which areas of land at five places are recorded in whole measures of GRA.
46. See Killen 2008b; Liverani 2014, pp. 102–106, 162–163.
47. Burford describes just such a system applied to the bonded class of *penestai* in classical Thessaly (1993, p. 199), and she quotes Archemachos (*FGrH* III, 424 fr. F1 [cf. Ath. *Deip.* 6.84 Kaibel]) stating that, as a result, "many *penestai* are better off than their own masters."

TABLE 2. HYPOTHETICAL AREAS OF LAND MEASURED IN SEED GRAIN

Unit	*Sowing Density*		
	40 liters/hectare	*50 liters/hectare*	*60 liters/hectare*
DOCS² (EQUIVALENT AREAS)			
Z	0.0125 ha	0.01 ha	0.0083 ha
V	0.05 ha	0.04 ha	0.03 ha
T	0.30 ha	0.24 ha	0.20 ha
GRA	3.00 ha	2.40 ha	2.00 ha
GRA 10	30.00 ha	24.00 ha	20.00 ha
CHADWICK/PALMER (EQUIVALENT AREAS)			
Z	0.01 ha	0.008 ha	0.007 ha
V	0.04 ha	0.032 ha	0.027 ha
T	0.24 ha	0.192 ha	0.160 ha
GRA	2.40 ha	1.920 ha	1.600 ha
GRA 10	24.00 ha	19.200 ha	16.000 ha

Note: Mycenaean dry measurement from *Docs*² vs. those put forward by Chadwick (1988) and Palmer (1989). After Lane 2009.

that exactly such a system existed for the agricultural lands recorded in the Linear B archives.[48] Furthermore, it is evident that the scribes have target totals of land area in view, implying that they have production quotas to meet.[49] That the land to which they turn time and again to meet these quotas is often specifically demarcated is suggested by such terms as *te-me-no (temenos)* and possibly *wo-ro-ki-jo-ni-jo (*wrogiōneion)*,[50] although target totals could also be met by adding part of or all separate tracts together, or by adding new plots to existing tracts.[51]

With these observations in mind, the next stage in constructing an iconic model of the relevant agricultural structures—that is, one in which there is an integrated one-to-one relationship between specific practices and combinations of observable phenomena—was determining the dimensions, shape, and arrangement of land plots of the kind recorded. We drew a relational analogy here from broadcast sowing densities combined with plowing rates with pairs of oxen, the latter of which are recorded in Linear B texts, during a typical planting season in mainland Greece.[52] Broadcasting and animal traction are used in tandem when a few reliable staples, such as cereals, are cultivated,[53] and human labor is concomitantly reduced, as mentioned above. The relevant data from both ancient and modern agronomic and ethnographic sources provided a usefully narrow range of both absolute areas and two dimensions for GRA and its aliquot fractions (T, V, and Z; Table 2).[54] Plowing with draft animals requires moving back and forth in nearly straight lines, so we surmised that the plots and their subdivisions should tend to be rectilinear, if not orthogonal, thereby increasing the likelihood of shared boundaries.[55]

At this point our model only described approximately what the scribes would have perceived on the ground, partly the result of their own directives, in the absence of cultivators and crop plants. The final stage comprised detailing this space with physical characteristics corresponding to the constitutive acts

48. De Fidio 1977, pp. 13–129; Lane 2009, p. 115; 2012a, p. 94; 2012b, p. 170. *Pace* Olsen (2014, p. 218), the present article's coauthor Lane has not argued that *o-na-to* is etymologically related to alphabetic Greek ὠνή; he has expressly argued that it is not (Lane 2012a, p. 65).

49. See Killen 1963; de Fidio 1977, pp. 130–188; Halstead 1996–1997; Nosch 2011; Lane 2012a.

50. Lane 2012a, pp. 73–74.

51. Lane 2012a, pp. 74–85.

52. Lane 2009; Halstead 2014, pp. 34–39.

53. See Halstead 1995b, pp. 15–18; Lane 2009.

54. Palmer 1963, pp. 12–15; *Docs*², pp. 58–60, 393–394; Palmer 1989; Lane 2009.

55. Lane 2009; Halstead 2014, pp. 12, 14, 21, 34.

of certain practices that, if verifiably observed, could eventually be traced back to systems of knowledge and their enactors.[56] Crucially, we could observe and validate these features by certain means. One should note that they do not constitute a list of best-fitting artifactual "correlates" to "cross-culturally" derived political-economic superstructures, representations that entail only parallel descriptions, not methods of independent validation of hypothetical social-structural types.[57] Such a typological approach to social complexity offers at most a rubric "hybrid" that diminishes the little explanatory power the typology has in the first instance.[58]

Hence we supposed, for purposes of investigation, that boundaries between land plots would be marked at least by adjacent but distinct sets of plowing scars in the subsoil, should they be preserved, if not more deliberately demarcated with alignments of cleared field stones, cairns or corner stones, rectilinear irrigation or drainage ditches, and paths for access to fields, given the palace's interest in equating land area with specific yield.[59] The smallest *o-na-ta* recorded are too small to represent effectively plowed plots (for example, a fraction described as GRA V 2). They may represent either intensively cultivated parcels or, more likely, claims to some part of the product of the larger plot, perhaps in return for investment of another form of capital, such as working animals.[60] While smaller parcels may not have been demarked, record of them contributes to the argument for demarcation and regular shape and arrangement of the larger that would facilitate their fiscal assessment. In addition to plowing scars, we expected pits dug into subsoil for vine and tree crops,[61] particularly on the margins of the most arable plots, perhaps where they fall along one border or more, as Classical *eskhatiā* land did.[62] There could also be evidence of outbuildings for storage and processing,[63] and, together with these especially, carbonized or waterlogged remains of plant parts, including ungerminated seeds identifiable with crop plants.[64]

56. We agree with Dobres that one "cannot excavate agency" (2000, p. 142), because agency is coming into being as a human in a social milieu. We also reemphasize her corollary, namely that agency and motivation can be adduced to traces of a past action (pp. 143–144), because reconstruction of a material context of social meaning is possible.

57. See critiques in Chapman 2003, pp. 41–59; Smith 2003, pp. 36–45; Pauketat 2007, pp. 43–45.

58. In our estimation, both sterile dichotomization and hybridization of socioeconomic types continues in Aegean archaeology despite earnest appeals against the former and in favor of the latter (see Kardulias 1999; Parkinson and Galaty 2007; Nakassis 2010; Parkinson 2010; Englehardt and Nagle 2011). The latter trend, in its "multiple levels" form, we deem fails to address what agency concretely is the object of study at each scale of analysis.

59. Observed in modern features (Halstead 2014, pp. 260–281) and ancient remains (Burford 1993, pp. 115–117). See also Kent 1948; Dufkova and Pečirka 1970; Saprykin 1994; Carter 2006, pp. 91–132.

60. Such great variation in lot size, based on amount of rent (read "investment") and respective use of land for staples, luxuries, or grazing, is seen in the Classical temple estates of Delos, Rheneia, and Mykonos (Kent 1948).

61. Burford 1993, pp. 117–118; Foxhall 2007, pp. 1–20, 97–120; Halstead 2014, pp. 271–277.

62. Lewis 1973; see also discussion in Lane 2012b, pp. 127–129.

63. See Forbes and Foxhall 1978; Foxhall 2007, pp. 131–218; Halstead 2014, pp. 149–151, 157–163.

64. See Livarda 2014.

Selecting the Project Area

The greatest hindrance to operationalizing the model was the way in which environmental factors in Greece since the end of the LH period seem to have conspired to erase any ancient agricultural landscape. Arable land has been at a premium, even when population densities have been low.[65] Hence most old fields have been plowed and plowed again, overwriting into obscurity the kinds of features that characterize the model. Long-term tectonic and erosional processes have exacerbated the problem in some places, dissecting and washing away fertile terrace land and depositing it in the sea or atop once-cultivated coastal plain.[66] Secular and periodic climate change and devegetation have sometimes accelerated these processes. Elsewhere, especially in central Greece, the physical landscape has remained relatively stable over millennia.[67] Recently, the emergence of sprawling conurbations around Athens, Thessaloniki, and Heraklion, and the development of private resorts, especially on the coast, have further erased ancient landscapes.[68]

Nevertheless, there are a few places in mainland Greece and even Crete that have not suffered severely from such forces because, for most of their history, they have been hydrically semiclosed and seasonally wet catchments, sparsely inhabited by humans. Chief among them are the karstic poljes that lie in a north–south band from central mainland Greece to the central Peloponnese.[69] Poljes are plains that have formed in downthrust graben in soluble carbonate (karstic) bedrock, into which water flows from rivers and falls in seasonal rains, draining more slowly through fissures and caverns in the substrate. Like other semiclosed hydric systems, they tend to accumulate deposits of alluvial sediment.[70]

Some of these systems, such as around Lake Karla in Thessaly, the Lasithi plain in Crete, and Lake Kopaïs in Boiotia, have been partly or completely drained for agriculture in modern times using powerful mechanical technologies.[71] The most successful of these modern undertakings was in the Kopaïs, or Kopaic Basin (Fig. 1).[72] During its drainage, between about 1889 and 1931, to the initial surprise of scholars and engineers, evidence of prehistoric drainage works came to light, preserved because of the net-depositional character of the polje.[73] Today their presence may not be such a surprise to archaeologists, since the works have been provisionally dated to the later "Mycenaean" part of the LH period (LH IIB–IIIB), in which we find increasing evidence of burgeoning population, as well as centralized political-economic authority investing material and deploying dependent labor in large-scale projects, including building dams, roads, and fortified citadels.[74] During the 20th century, LH hydraulic works were

65. See Isager and Skydsgaard 1992, pp. 108–114; Halstead 2000.

66. Van Andel, Zangger, and Demitrack 1990; van Andel, Runnels, and Pope 1997; Fuchs 2007; see also Imeson and Curfs 2008, pp. 3–6.

67. Greig and Turner 1974; Allen 1997; Rohling et al. 2009; Kaniewski, Guiot, and Van Campo 2015; Xoplaki et al. 2015; Finné et al. 2017. On landscape stability in Boiotia, see Bintliff 2000b, 2002.

68. Yassoglou and Kosmas 2000; Imeson and Curfs 2008, pp. 8–11, 15.

69. See Aronis 1963; Higgins and Higgins 1996, pp. 70–72, 207–208; Knauss 2001.

70. Higgins and Higgins 1996, pp. 12–14.

71. Watrous 1982, pp. 5–8, 31–35; Higgins and Higgins 1996, pp. 88–89, 207; Gialis and Laspidou 2014.

72. Durand-Claye 1888; Dean 1937; Papadopoulos 1997; Christou 2002; Idol 2018.

73. Kambanis 1892, 1893; Dean 1937; Lauffer 1973–1974; Knauss 1984, 1987.

74. See Balcer 1974; Zangger 1994; Dakouri-Hild 2001; Fitzsimons 2007; Bilis 2016.

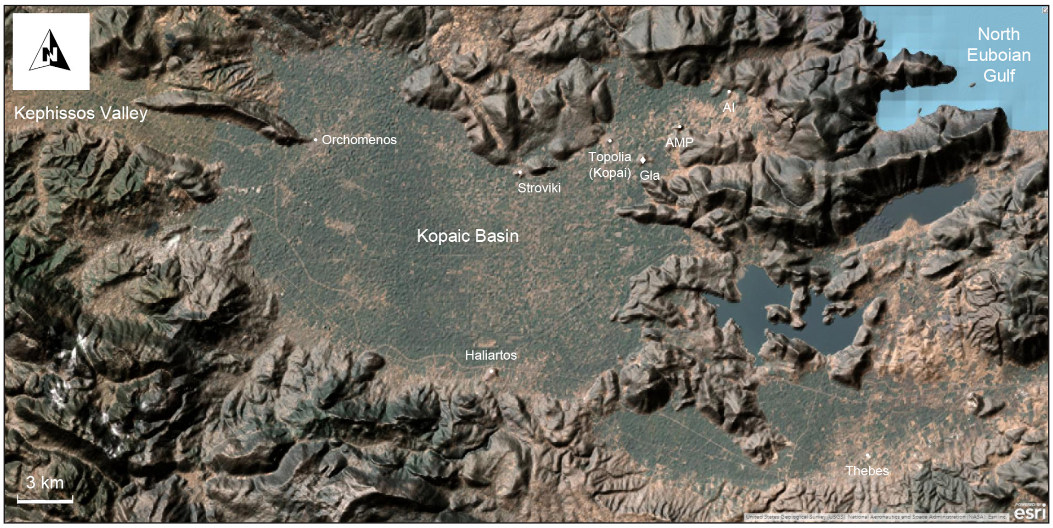


Figure 1. Landsat digital elevation model of the Kopaic Basin with sites mentioned in the text indicated. AMP = Ayia Marina Pyrghos; AI = Ayios Ioannis. Satellite base image ESRI; annotations M. F. Lane

identified in smaller semiclosed systems, such as the polje north of Mantinea, Arkadia, and in the valley of Thisbe, Boiotia.[75] Nonetheless, the evidence of Mycenaean hydraulic engineering remains on the fringes of discussion of the evolution and devolution of Mycenaean states, and it is sometimes misunderstood,[76] despite the fact it may hold answers to critical questions about the investment of palatial resources and (indeed) marginal returns.

If the LH populations drained these lands for cultivation—one of the conditions AROURA set out to investigate—then the topographic model may need to be adjusted accordingly. For instance, in a lakebed, in the absence of preexisting geological and settlement obstacles, and especially if the works were accomplished with a single intervention, one might expect greater regularity of layout and greater specific connection with drainage and irrigation systems. Nevertheless, one should expect the general characteristics of a palace-administered extensive regime, described above. Furthermore, it is parsimonious to assume that the common landholding metrology observed at all the palace archives would have been applied for land division and allocation here too.[77]

The Mycenaean drainage system in the Kopaïs is not only the largest recognized system of its kind,[78] but it is also embedded in a landscape that offers for exploration a dense constellation of political-economic relations in an area smaller than that of other hypothetical political-economic territories of the time. Two major tributaries to the Kopaic Basin, Melas and Kephissos, were channeled between Cyclopean walls at a point just east of Orchomenos, and from there they coursed over 20 km to three cavern mouths in the northeastern bay of the basin, which had apparently been improved in some fashion to increase outflow.[79] The prevailing hypothesis is that Orchomenos comprised the regional palace, because of the discovery there of massive stone architecture decorated with figural frescoes and two elite tombs within a few kilometers.[80]

The channeled rivers flowed eastward through at least two polders of the same era, situated on the northern and eastern shores and protected from the water in the center of the lake by Cyclopean dikes between 3 and 5 km long.[81] The polder preserved by the easternmost dike contains the fortress of Gla, constructed on a natural outcropping, whose buildings

75. See Knauss 1991, 2001; Salowey 1994; Salavoura 2015, pp. 96–99.

76. Extreme peripherality is evident in the absence of any mention of Gla or the Kopaic drainage system in two widely cited edited volumes on the palace economies published in approximately the last decade: Galaty and Parkinson 2007c; Pullen 2010. Shelmerdine seems to have been under the impression that the project was to drain the whole Kopaïs (2001, p. 340), while Krasilnikov (2010, p. 117) and Mithen (2012, pp. 88–90) get some crucial details wrong.

77. *Docs*[2], pp. 53–60, 232–239, 393–394; Palaima 2000–2001, 2003.

78. Knauss 1984, 1987, 1990; Iakovidis 2001.

79. See Knauss 1984, 1987; Mamassis, Moustakas, and Zarkadoulas 2015.

80. Schliemann 1881, pp. 13–46; Spyropoulos 1974; Kyriazi and Fappas 2015, pp. 22–24; Bennet 2017.

81. Kenny 1935; Lauffer 1973–1974; Knauss 1984.

also indicate palace-sector investment, including frescoes and Cyclopean terraces.[82] Gla sits approximately 18 km from ancient Orchomenos (see Fig. 1), a little more than the distance between Mycenae and Tiryns, and, although it possesses the largest perimeter wall of any fortress of its time in the Aegean, it is generally regarded as a special-purpose palace outpost (Fig. 2).[83] The main supporting evidence for this interpretation is that its circuit wall encompasses two complexes of storehouses, each about 145 m long and much narrower, in which were found ceramic containers for wine or olive oil, one of which may be marked with Linear B *wa* (as in *wanax*),[84] and the charred remains of a single variety of wheat (cf. *Triticum monococcum*) that could represent the amassment of several thousand metric tons.[85]

Several littoral sites, including Stroviki, Ayia Marina Pyrgos (AMP), and Ayios Ioannis (AI), as well as various upland landscapes, are found within a 6 km radius of Gla (see Fig. 1).[86] Thus, taking Gla to represent palatial interests, the potential to us seemed high for discovery of evidence of a variety of palatial, parapalatial, and nonpalatial political-economic practices in a relative microcosm, so far remarkably undisturbed by modern infrastructural development.[87]

Previous investigations by German hydraulic engineers from the 1970s through 1990s showed that Gla was connected with the channeled rivers to the north (Melas and Kephissos) by a linear feature, interpreted as a dam by the last investigator, Jost Knauss, descending from near AMP to the eastern tip of the outcropping on which it sits, and from there to the scarp of Mt. Ftelia to the south (see Fig. 2). This linear feature is presumed to have hugged the base of this rise and diverted water into one cavern or more, including the Vrystika sinkhole.[88] Moreover, a canal, also coming from the direction of AMP, followed the eastern edge of the polder's plain and eventually reconnected with the aforementioned feature.[89] Were this not enough to justify choosing the northeastern Kopaïs for a project area, historic vertical aerial photographs, which have mainly been ignored among archaeologists,[90] in addition to recent satellite data (for example, Google Earth, February 2014 and March 2017) show rectilinear patterns of crop and soil marks throughout the polder around Gla, as well as that around the settlement site of Stroviki to the west, indicating features preserved beneath the surface (Fig. 3).

Other than the modern complete drainage and the Mycenaean partial drainage, there were two other attested attempts to drain all or some of Lake Kopaïs in ancient times. The first began ca. 330 B.C. when Alexander the Great commissioned the engineer Krates of Chalkis to dig a trench across

82. De Ridder 1894; Threspiades 1955, 1956, 1957, 1958, 1959, 1960; Iakovidis 1989, 1998; Wright 2005.

83. Iakovidis 1995; Aravantinos 1999a; Shelmerdine 2001, p. 340; Shelmerdine and Bennet 2008, p. 299.

84. Iakovidis 1998, pp. 9–114, 135–163. On inscribed stirrup jars, see Raison 1968. Linear B plural *ka-ra-re-we: Docs*^{2}, pp. 328, 494.

85. Jones 1995; Iakovidis 1998, pp. 20–21, 174–175, 229.

86. Fossey 1988, pp. 277–290; Farinetti 2011, pp. 127–135.

87. I owe the term parapalatial, "beside-the-palace," as distinct from nonpalatial, to Bennet (2008). On the nonpalatial, see also Tartaron 2010.

88. Lauffer 1973–1974, pp. 452–453; Knauss 1984, pp. 213–227.

89. Threspiades 1960; Lauffer 1973–1974, pp. 452–453; Knauss 1987, pp. 207–218.

90. Knauss 1984, pp. 216–219; Kienast 1987. The only archaeologists recorded to have commented on Kienast's observation at the time he made it were the late Klaus Kilian and the late Antonios Zois.

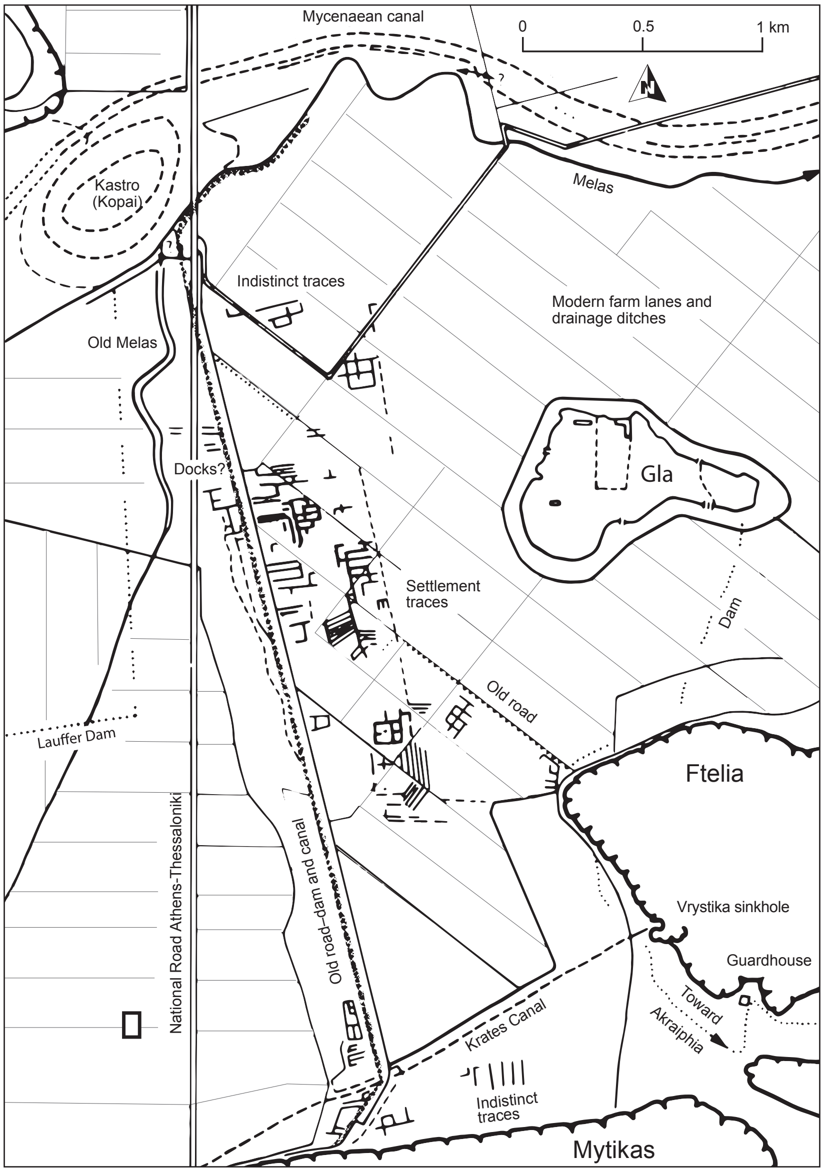


Figure 2. Gla and its vicinity with previously observed features indicated. After Knauss 1984, p. 217, fig. 6:16

the basin to drain the water into the Vrystika sinkhole south of Gla in order to increase the fortunes of northern Boiotian cities at the expense of Thebes, which he had leveled in 335. Traces of this canal are still visible. A series of shafts into the cavern system, from the northeastern bay of the Kopaïs and toward ancient Anchoe, are probably also of this period.[91] The geographer Strabo, however, informs us that this work was abandoned after the death of Alexander seven years later because of disputes among the factions that would benefit, the sinkholes then filling up with fallen rock.[92] During the reign of the emperor Caligula (A.D. 37–41), an ancient dike (χώρα χώματος), possibly Mycenaean, in the bay south of Akraiphia, located southeast of Gla, seems to have been repaired, presumably to claim land; but again, this project seems to have been abandoned by the reign of Nero (A.D. 54–68). The emperor Hadrian bestowed money on Koroneia and Orchomenos in the west of the basin for aqueducts and drainage ca. A.D. 125. After his death

91. Krasilnikov 2010; Mamassis, Moustakas, and Zarkadoulas 2015 (*pace* Knauss 1984).

92. Strabo 9.2.18 C407. See also Steph. Byz. 35.5–6, s.v. Ἀθῆναι.

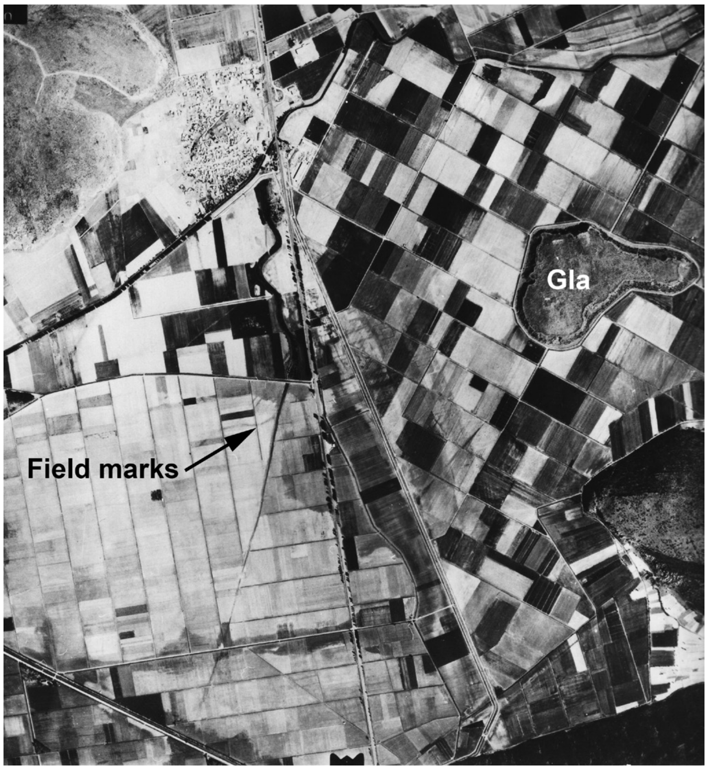


Figure 3. Vertical aerial photograph taken in 1974 showing field marks west of Gla (cf. Figure 2). U.S. Defense Intelligence Agency (declassified)

in 138, however, the works were abandoned, the cities falling out among themselves over how the new agricultural land was to be taxed.[93]

There is neither direct nor circumstantial evidence of Byzantine, Frankish, or Ottoman hydraulic engineering in the area.[94] Turkish authorities are reported to have invested in irrigated rice cultivation for subsistence in the vicinity of Livadia on the western edge of the Kopaïs, as they are known to have done in Bulgaria and central Anatolia.[95] The cadaster of the Ottoman governorate of Eğriboz includes the town nearest Gla, Topolia (ancient Kopai). Its taxable harvests consisted only of wheat and barley.[96] As discussed below, no archaeological trace in the northeastern basin corresponds to the distinctive character of Ottoman wet rice cultivation, while rice farming in the Early Modern period was sporadic and opportunistic.[97]

Methods Employed

The only feasible approach to the investigation of these evident subsurface features and their possible relation to the grain and other crops represented at Gla was through geophysical prospection. The modern land tracts are 180 m wide and generally many more hundreds of meters long, which meant they could be divided readily into units of 30 × 30 m that could be sampled efficiently and effectively with geophysical techniques. We therefore fitted a grid of these units to the 1:5,000-scale topographic diagram of the territory prepared by the Hellenic Military Geographical Service (HMGS), aligned parallel and perpendicular to the modern field boundaries, and we georeferenced the grid to the Greek Geodetic Reference System 1987 (GGRS-87). The grid was bounded to the north approximately by the

93. Oliver 1989, pp. 253–272; Boatwright 2000, pp. 112–117; *IG* VII 2712–2713; *SEG* XXXV 405.

94. Rubió y Lluch 1907; Svoronos 1959; Kiel 1997; Michas [1978] 2014, pp. 69–74. On Byzantine and Frankish agricultural intensification (or lack thereof), see Lock 1995, pp. 245–251; Laiou and Morrison 2007, pp. 96–115.

95. Kiel 1997, p. 325. On the broader policy and program, see Batakliev 1923; Venzke 1992.

96. Kiel 1997, pp. 338–339.

97. Palaiologos 1833, pp. 150–153.

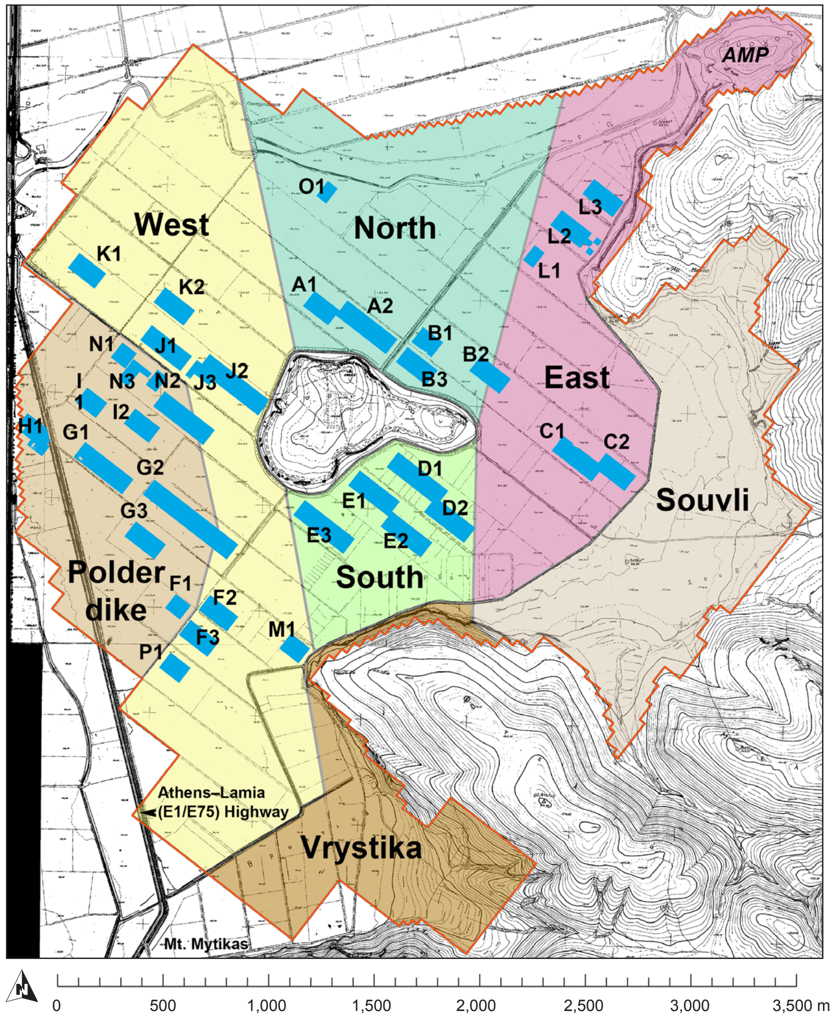


Figure 4. Plan of project area overlaid with sampling grid and areas geophysically sampled between 2010 and 2012. AMP = Ayia Marina Pyrgos. W. S. Bittner

traces of the LH channeled rivers, to the east by the alluvial fan of Souvli, descending to the erstwhile lakebed, to the south by the scarps of Mt. Ftelia and Mt. Mytikas (western extremities of Mt. Ptoön), and to the west by the modern E1/E75 highway (Fig. 4).

The geophysical sampling strategy was adaptive. In 2010, transects 90 m wide and up to 360 m long were demarcated in the aforementioned grid for sampling on all sides of Gla, where field marks or hydraulic works were known, as well as where approaches from AMP to Gla's northern gate were expected. The contiguous transects in this first year were offset from one another by 60 m, thereby spanning 150 m of the 180 m wide land tracts. Any geophysical features that happened to be aligned with the edges of a transect thus would not be lost in the data. Coauthor Horsley devised the transects to consist of continuous blocks of six sampling units (90 m wide × 60 m long) so that the instrument operator could move efficiently from one to the next in boustrophedon fashion. In subsequent years, either similar transects were sampled in modern tracts not yet explored, or new transects were laid out with the aim of pursuing leads from the previous year.

We chose magnetometry as the prospecting technology because it permitted rapid pedestrian traverse without contact of the instrument with the ground, which was often rough, and because it was capable of detecting in plan the kinds of features expected in the topographic model: plow scars, pits, stone and mudbrick foundations, compacted or built pathways, stone alignments, and areas of intense burning.[98] Within each 30 × 30 m sampling unit, traverses with the instrument, a Bartington 601-2 dual fluxgate gradiometer, were walked back and forth at a 1 m interval, taking measurements (sampling) every 0.125 m. The procedure was particularly efficient because the operator could move from one square unit to the next, such that assistants could pick up the staked-out guiding lines and begin to demark the next 90 × 60 m block without the operator having to pause. Thus, four or five blocks (2,160–2,700 m^2) could be sampled on average in an eight-hour period, stopping to calibrate the machine twice a day.[99]

A methodological advantage of extensive geophysical prospection over extensive collection of finds from the ground surface for determining the nature and character of archaeological features, as at the start of a classic settlement pattern survey, is that it allows quick, independent verification of the data, a step called "ground-truthing" in the technical jargon.[100] Ground-truthing, de rigueur among archaeological geophysicists,[101] was accomplished on AROURA in three ways. Firstly, a hand-driven auger was used to remove segmented cores of soil both from above "anomalies" in the magnetic data, as patterns of interest are called, and above background areas, so that profiles could be compared.[102] Extracted cores could be floated for macrobotanical remains as well. Similarly, where a modern ditch intersected an anomaly, flanked on each side by natural, undisturbed deposits, its section could be cleared of vegetation and recent erosional deposits and the profile studied. Secondly, volume-specific magnetic susceptibility (χ) was measured at intervals along each core using the Terraplus KT-10 magnetic susceptibility meter.[103] This method determined if any correlation existed between χ values and anomalies or background areas, further permitting causes to be inferred from the differential strength of the magnetic responses and future technologies to be calibrated accordingly. Finally, surface collection was employed in areas of magnetic sampling to ascertain if the distribution of finds corresponded to the presence of certain anomalies.

The first two methods of ground-truthing also allowed scientific chronometry of the constituent materials. Two dating methods were applied: accelerated mass spectrometry (AMS) radiocarbon analysis to material from cores through both anomalies and background areas;[104] and luminescence dating, both optically and thermally stimulated (OSL, TL),[105] of samples taken from ditch profiles.

98. See Gaffney and Gater 2003, pp. 36–39; Aspinall, Gaffney, and Schmidt 2008, pp. 91–113.

99. See Aspinall, Gaffney, and Schmidt 2008, pp. 103–107. The detailed annual reports of AROURA, which covers procedures, results, and tentative interpretations, can be found at http://www.umbc.edu/aroura.

100. Hence we seek correlations between discretely measured magnetometric data and the qualities underlying these phenomena (i.e., the portions of things and their interrelations), and not between quantified phenomena and commensurate values.

101. See Aspinall, Gaffney, and Schmidt 2008, pp. 94–98.

102. On ground-truthing, see Gaffney and Gater 2003, pp. 55–56; Aspinall, Gaffney, and Schmidt 2008, pp. 64–78.

103. On magnetic suspectibility, see Gaffney and Gater 2003, pp. 44–46.

104. On AMS radiocarbon dating, see Muller 1977.

105. On luminescence dating, see Bøtter-Jensen 1997; Aitken 1998, pp. 6–107.

Beginning in 2011, surface collection was employed in a different manner at the littoral settlement site of Ayia Marina Pyrgos. Here it was applied intensively in each of the 225 2 × 2 m subdivisions of each of three 30 m sampling units on the summit of the hill on which AMP sits. Our objective was to record the number and kinds of finds in each 2 m unit and determine whether any patterns of distribution of materials, functional forms, or chronological types could be discerned. These data could be quickly compared with both future geophysical data from one-meter-wide traverses and with future excavation consisting of combinations of the same 2 m units. The finds could also be compared immediately to extant features on the summit. Ground-truthing through excavation would test the predictive efficacy of this approach.[106]

RESULTS

Geophysics

Magnetometry

The major patterns of magnetic anomalies near the polder dike located to the west of Gla were divided into two classes, one nested within the other. We called these, respectively, "reticulate" at the smaller scale or "bounding" and "joining" at the larger scale. The former, as the name implies, consists of a regular network of anomalies. Two distinct orientations of reticulate patterns were detected within 300 m of the dike. The latter class is so named because the anomalies appear sometimes to bound the reticulate patterns on their east and at other times to join them to Gla, the polder dike, or the canalized Melas-Kephissos.

Reticulate pattern 1 was detected in sampling transects G1, G2, I1, and I2 (Fig. 5).[107] It consists of linear, magnetically negative anomalies (with respect to background), appearing 2–3 m wide in the data[108] and intersecting each other at right angles. The pattern is most easily seen in transects G1 and I1. In the former, the anomalies define nearly square quadrilaterals, each with a perimeter of 120 m. Their sides seem to vary less than 1 m from 29–30 m, given the resolution of the data. The pattern in transect I1 consists of anomalies appearing to delimit rectangles that have two opposite west–east edges ca. 30 m long and two south–north edges ca. 15 m long, creating a "herringbone" effect. The AROURA project's geographical information systems (GIS) data confirm that the pattern in transect I1 is on the same alignment as that in G1, and that one of the alternating intervals between linear anomalies that run approximately from west to east in transect I1 repeats the interval of ca. 30 m seen in G1. The pattern is less clear in transect I2, but it can be shown to share interval and orientation with reticulate pattern 1 in G1 and I1. Everywhere we detected reticulate pattern 1, it corresponded to field marks in satellite data and historic aerial photographs (see Fig. 3; cf. Fig. 5).

Reticulate pattern 2, detected in transect G3, also consists principally of linear, magnetically negative anomalies, again appearing 2–3 m wide (Fig. 6). However, the alignment of the constituent anomalies differs from that of reticulate pattern 1. The south–north anomalies are oriented as before, but

106. This approach is like that proposed for the surface collection at the famous Hatchery West site nearly 50 years ago (Binford et al. 1970, pp. 7–15, 70–78) and that made recently by Cavanagh and colleagues in the Laconia Rural Sites Project (Cavanagh et al. 2005). It is different from collection for the definition of site sizes and classes.

107. In Figures 5–7, the images at left display the grayscale magnetometry data projected onto HMGS 1:5,000-scale base maps. The images at right are line-drawing interpretations of the anomalies projected onto panchromatic satellite data (data from WorldView-2 [October 2010] for Figs. 5 and 7, and from Pléiades [February 2014] for Fig. 6).

108. Because the expanding field around a gradiometer's sensors fluctuates due to the presence of magnetically susceptible objects below it, the deeper the objects lie, the wider their corresponding anomalies appear.

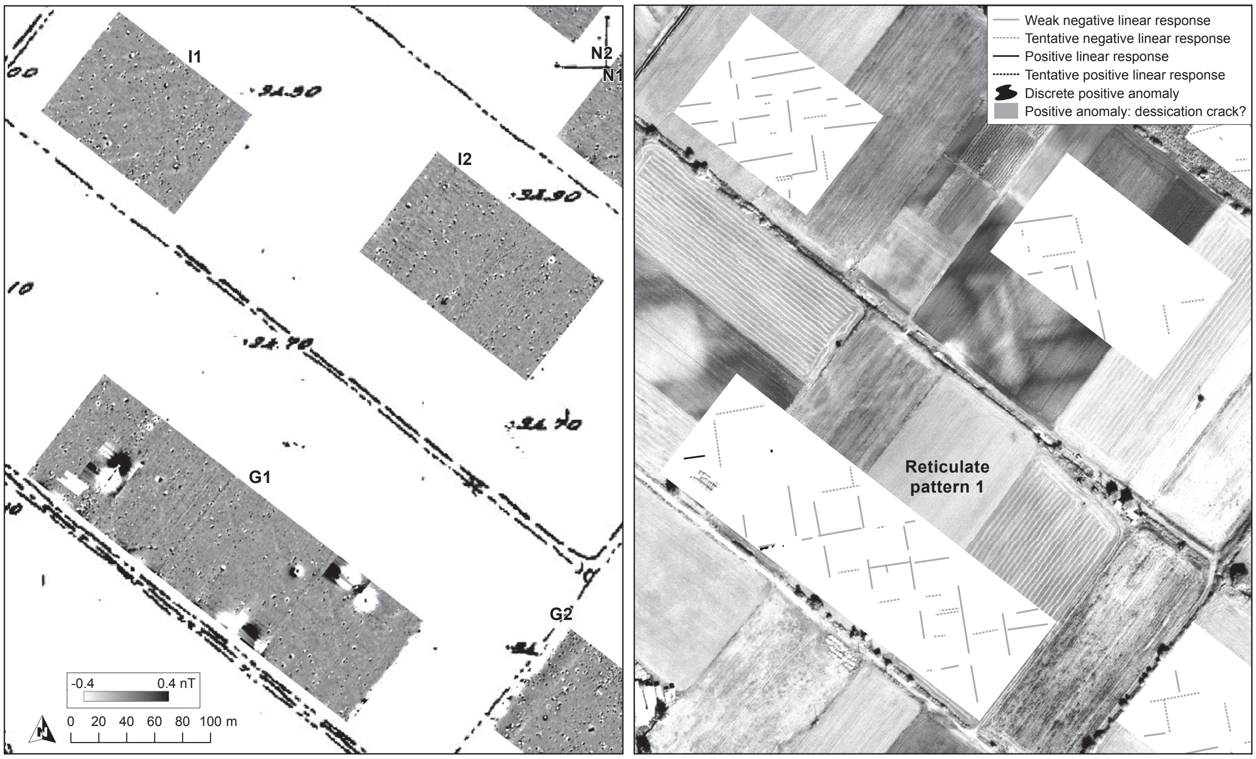


Figure 5. Reticulate pattern 1 (transects G1, G2, I1, I2). W. S. Bittner

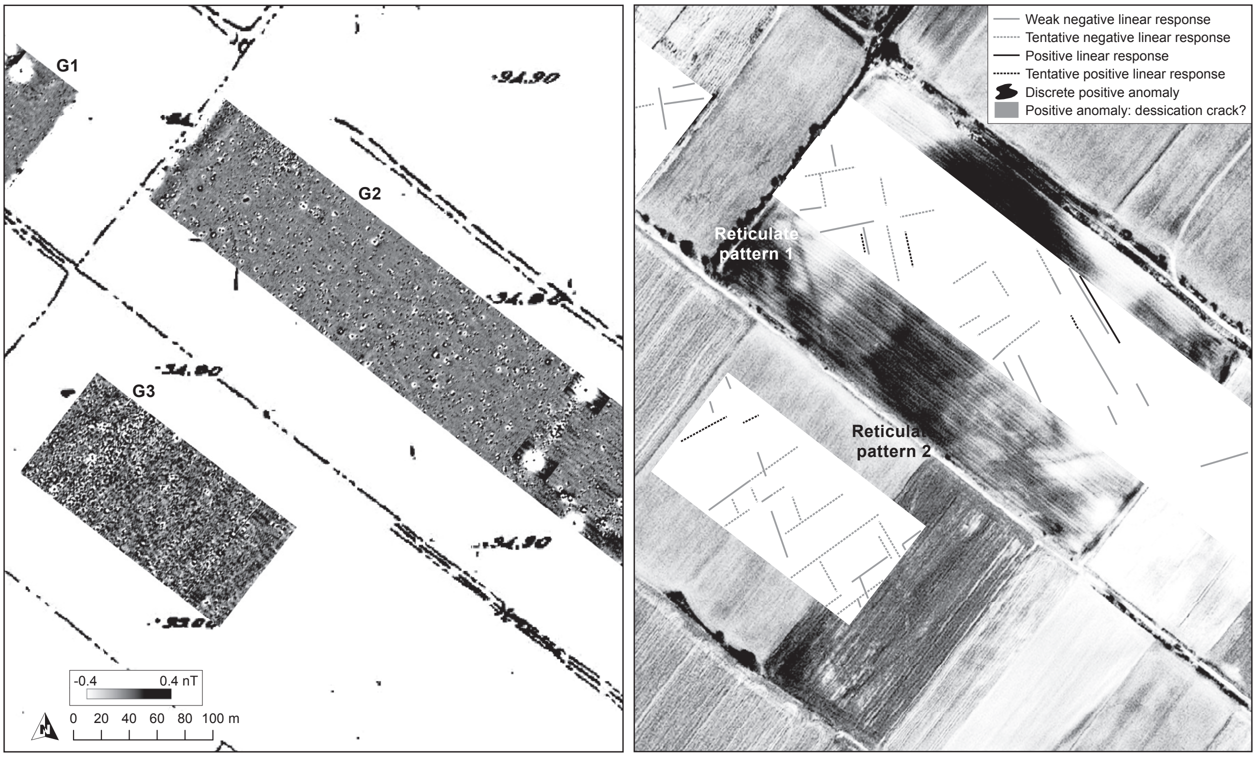
the crossing anomalies intersect at an angle of ca. 60° (or complementary 120°), forming rhomboids. The interval between the anomalies perpendicular to the dike is again nearly 30 m, but the distance between the intersecting anomalies is closer to 21 or 22 m. Hence the rhomboids vary in perimeter from about 104 to 106 m.

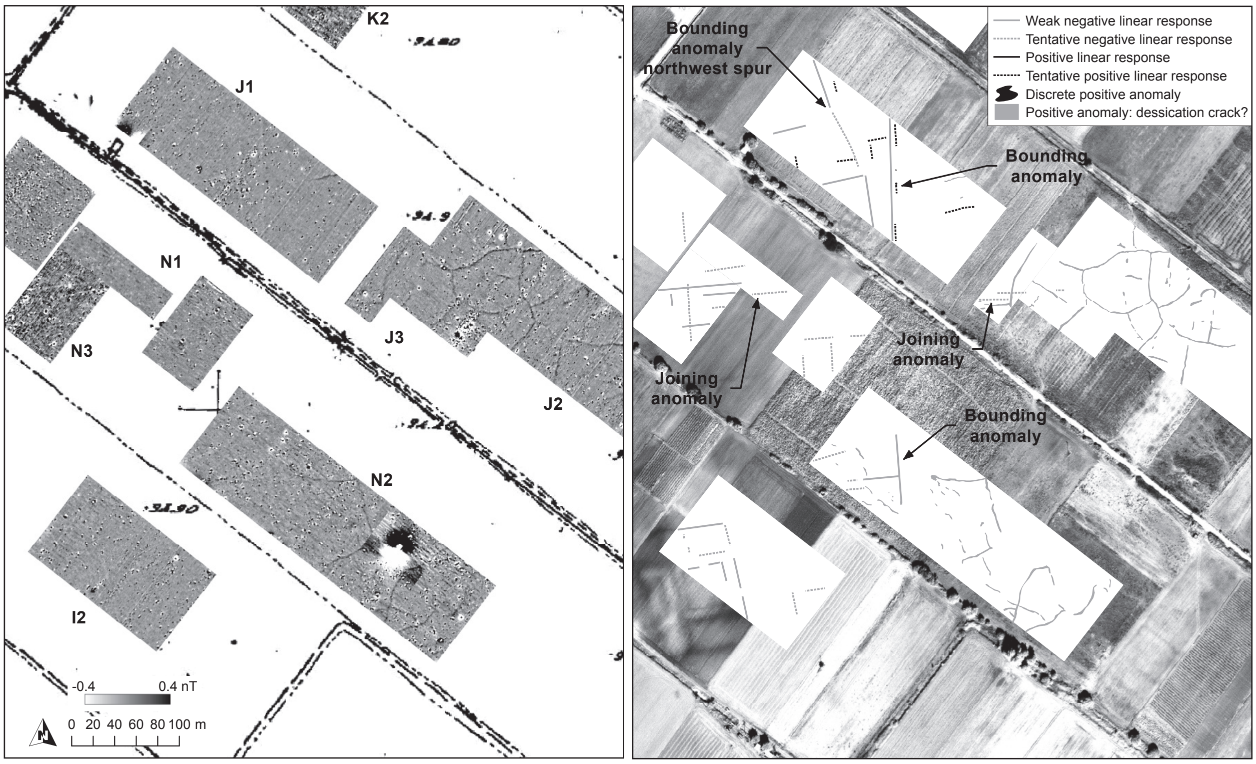
We detected bounding anomalies in transects G2, J1, K2, N1, and N2 (Figs. 6, 7). Faint traces of reticulate pattern 1 also continue in the northwest end of transect G2 and in N1, where they are oriented with and spaced like those in I2 and, by extension, G1. Several hundred meters to the southeast of these traces are several linear anomalies, approximately parallel to each other, some mainly negative, as the reticulate patterns' elements are, others mainly positive, and all evidently about 3 m wide (see Figs. 6, 7). The negative and positive anomalies seem to be adjacent to one another in a few places, suggesting that they represent components of the same feature, rather than components of the same magnetic anomaly (for example, a natural bipole).[109] They are almost exactly parallel to the south–north anomalies of reticulate pattern 2. In transects J1 and N2 farther to the north, one such negative anomaly runs approximately parallel to the south–north elements of reticulate pattern 1. It appears to be between 4 and 5 m wide, and it may be represented about halfway along transect G2, having turned slightly to the southeast in the intervening unsampled area (Figs. 6, 8). Farther north, this bounding anomaly appears again in transect K2. Just to the south, in transect J1, a branch seems to veer away to the northwest, in the direction of the northern end of the dike (see Fig. 7). No reticulate pattern was detected between these bounding anomalies and Gla, although other patterns were (see transect E3, below), suggesting the former delimit the latter.

Figure 6 ***(opposite, top)*****. Reticulate pattern 2 in transect G3. The bounding anomalies in the middle of transect G2 are indicated on right.** W. S. Bittner

Figure 7 ***(opposite, bottom)*****. Magnetometry results in transects I2, J1, J2–J3, K2, and N1–N3. The bifurcation of the bounding anomaly in transects J1 and K2 is indicated at top.** W. S. Bittner

109. Aspinall, Gaffney, and Schmidt 2008, pp. 57–68.


G1
G2
G3
-0.4
0.4 nT
0 20 40 60 80 100 m
Weak negative linear response
Tentative negative linear response
Positive linear response
Tentative positive linear response
Discrete positive anomaly
Positive anomaly: dessication crack?
Reticulate
pattern 1
pattern 2


K2
J1
N1
N3
J3
J2
N2
I2
-0.4
0.4 nT
0 20 40 60 80 100 m
Weak negative linear response
Tentative negative linear response
Positive linear response
Tentative positive linear response
Discrete positive anomaly
Positive anomaly: dessication crack?
Bounding
anomaly
northwest spur
Bounding
anomaly
Joining
anomaly
Joining
anomaly
Bounding
anomaly

We found joining anomalies in three areas of investigation: to the west of Gla, intersecting the bounding anomalies; to the north, linking Gla to the artificial river channel; and to the south, corresponding to the feature previously identified as the diverting dam running from the east end of Gla to Mt. Ftelia (see Fig. 2). On the southwestern edge of transect J3, a magnetically negative linear anomaly running from west to east seems to intersect the south–north bounding anomaly seen in J1, K2, and N2 (see Fig. 7). A long field mark seems to confirm the intersection of these two major anomalies; it is seen especially clearly in Google Earth satellite data from January 2008 and September 2017, passing from the area of reticulate pattern 1 in transect I1 toward a point ca. 70 m north of Gla's western gate (Fig. 9). Once more, the anomaly appears to be between 4 and 5 m wide. To the north of Gla, a linear negative anomaly, appearing ca. 5 m wide, passes through the eastern corner of transect A1 on an alignment of ca. 13° east of north. A parallel linear, positive anomaly traces the negative anomaly on its eastern edge, as best one can tell given the subtle magnetic response (discussed below). The anomaly thus resembles some of the bounding anomalies in transect G2. The field mark that precisely corresponds to it can be traced northward from transect A1 for ca. 800 m, almost without interruption, to the Late Helladic river channels (Fig. 10). If it continues southward ca. 200 m, then it connects with the north scarp of Gla, below which, it has been conjectured, a moat could have existed.[110] In transect O1, an area available to magnetometry in 2011, toward the anomaly's northern end, faint traces of west–east negative linear anomalies were detected, and possibly some intersecting south–north anomalies (Fig. 11). Hence a third reticulate pattern could exist in this zone near the conjoined rivers.

Other joining anomalies include that associated with the northern continuations of the feature between Gla and Mt. Ftelia, previously identified on the surface running from Gla to at least the hill of Nisi.[111] It appeared in transect D1, D2, and E2 as two parallel, negative anomalies a couple of meters wide, spaced almost exactly 10 m apart (Fig. 12). Inspection of piles of stone cleared from the modern land tract and intact courses in the irrigation ditches on its borders proved these anomalies to represent retaining walls, similar to but narrower than those of the double river canal. Insertion of a metal probe indicated that courses were intact at a depth of between 55 and 65 cm. We therefore named the feature the Revetted Canal. Like its evident source to the north, nothing about it suggested excavation between the walls (for example, a positive anomaly representing fill). This fact indicates that it was raised above the surrounding ground, and that modern plowing and deliberate clearance of stones have slowly reduced it.

In transect E3 (see Fig. 4), some 250 m south of Gla's southern gate and ca. 150 m from where the reconstructed ramp would have terminated, were a few faint, largely negative linear anomalies, in addition to irregular positive anomalies typical of filled-in desiccation cracks. Once again, these anomalies do not conform in orientation or dimensions to the known reticulate patterns. They may represent, however, compacted causeways (joining anomalies) connecting with the promontory of Ftelia to the southeast or the Revetted Canal to the southwest.

110. Knauss 1987, p. 216.

111. Lauffer 1973–1974, pp. 452–453; Knauss 1987, pp. 207–218. Despite its running parallel to the southeastern edge of modern field and consequent concentric plowing ridges and furrows, it can still be seen in Google Earth, esp. in the January 2009 and March 2017 images.

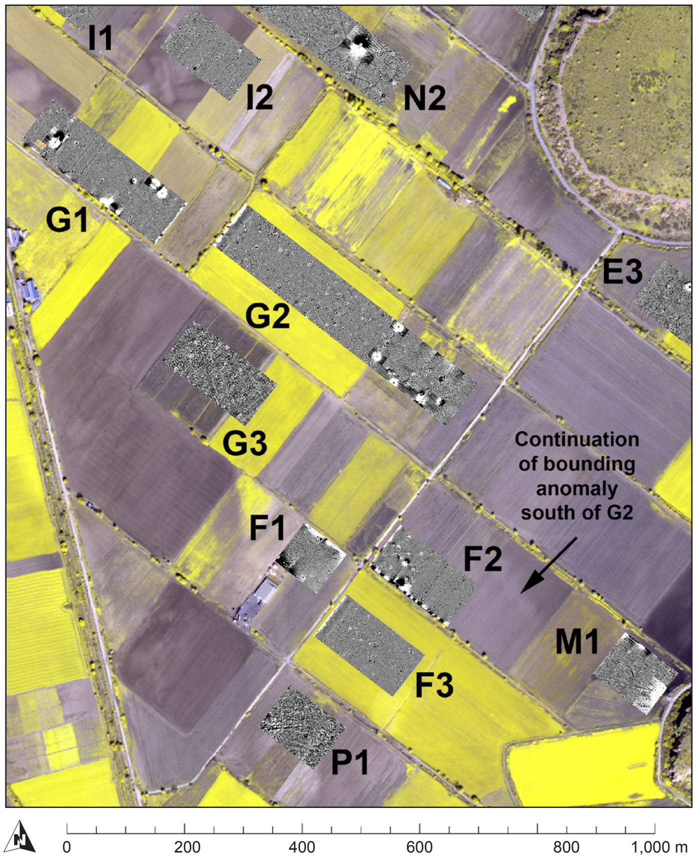
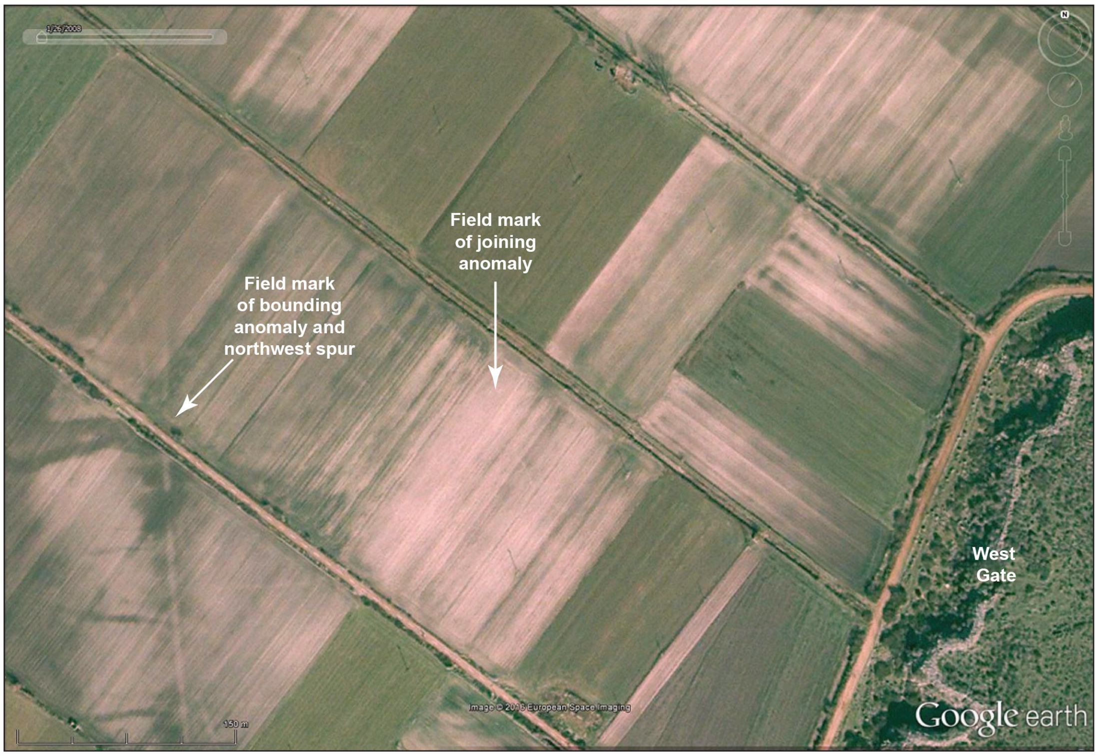


Figure 8 ***(right)*****. Overview of bounding and joining anomalies west of Gla (yellow near-infrared image).** W. S. Bittner

Figure 9 ***(below)*****. Joining anomaly in transects J1 and J2 (cf. Figure 10).** Satellite base image Google Earth 2008; annotations M. F. Lane



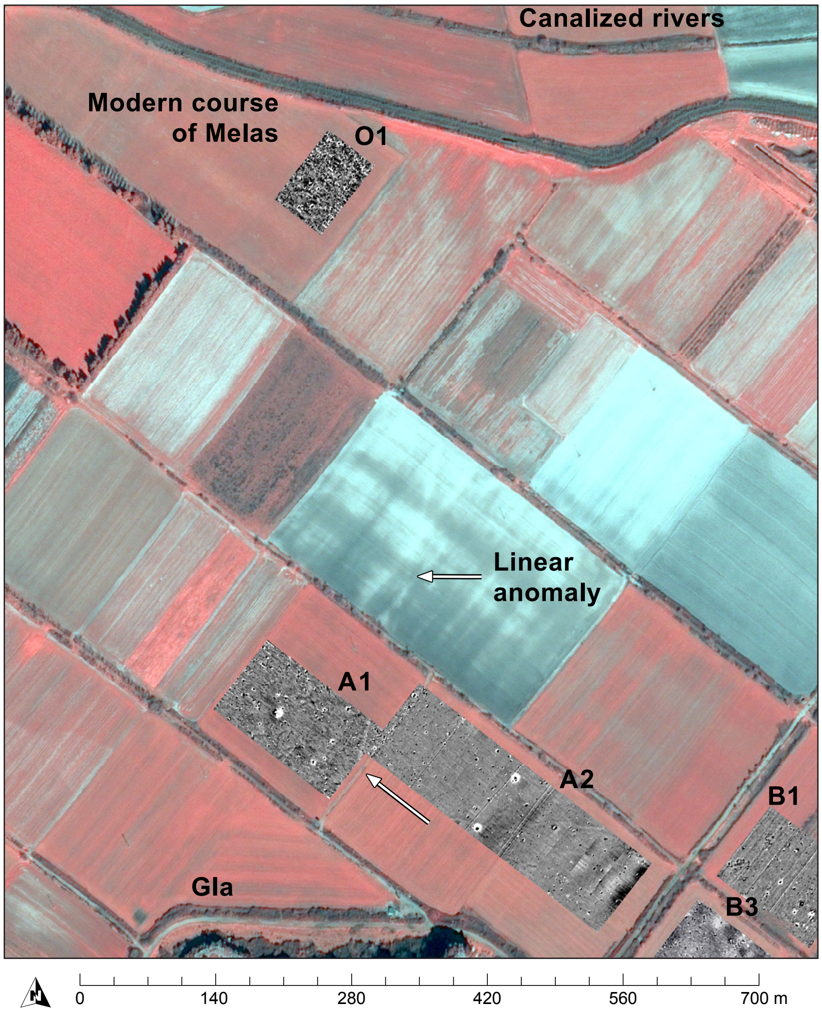


Figure 10. Joining anomaly running through transect A1 (blue-green near-infrared image). W. S. Bittner

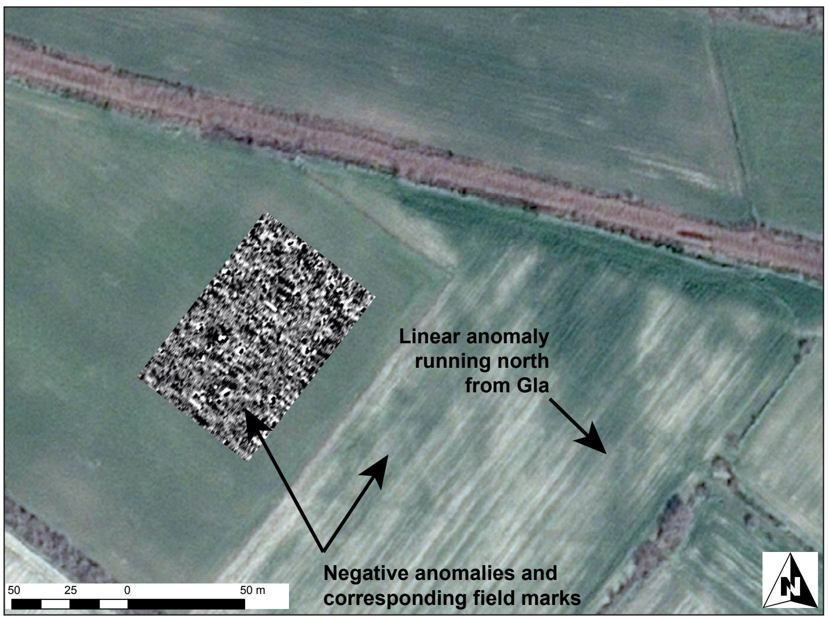


Figure 11. West–east anomaly in transect O1. M. F. Lane

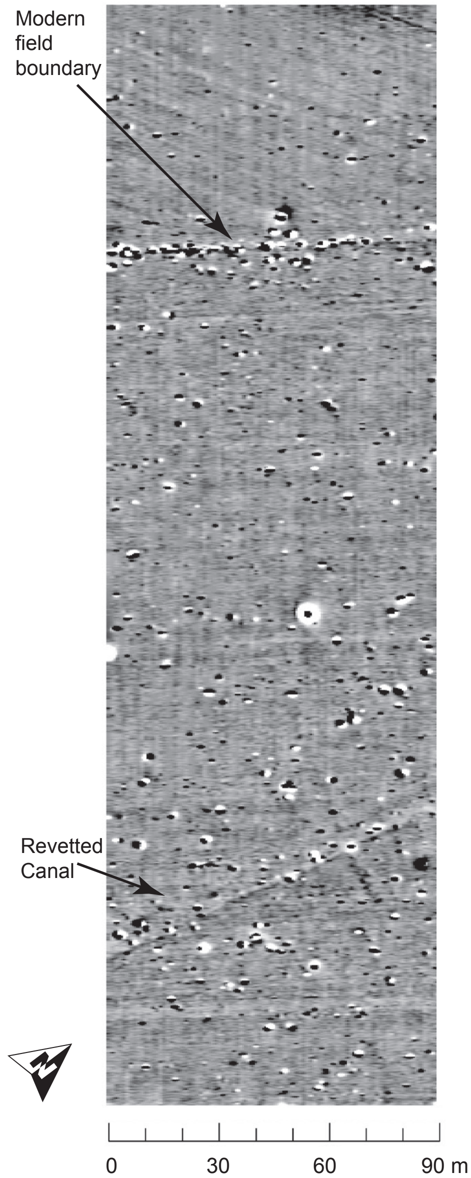


Figure 12. Revetted Canal anomaly running through transect D1.
W. S. Bittner

In transect C1 and C2, we detected the canal that previous investigators had identified ca. 600 m to the east of Gla, which appears to have started from the same point on the canalized rivers near Ayia Marina Pyrgos from which the Revetted Canal originated (Fig. 13).[112] This Peripheral Canal, as we called it, skirts the 97-meter elevation contour at the base of the alluvial fan of Souvli before joining the Revetted Canal again by Ftelia. The Peripheral Canal appears to have been hardly wider than 5 m, and to have been originally excavated or repaired as a series of pits that appear as overlapping strong, round, positive responses.[113] It does not betray walls either in magnetometric data or as displaced stones. Thus, it is unlike the raised Revetted Canal. However, magnetometry suggests the remains of a built, compacted, or eroded feature (embankment?) on the western edge of the canal, reflected in an adjoining, mainly negative anomaly ca. 4 m wide. This anomaly in turn may be delineated to the west with a narrow positive

112. Lauffer 1973–1974, pp. 452–453; Knauss 1984, pp. 213–227.

113. Aspinall, Gaffney, and Schmidt 2008, p. 27. One may conjecture work gangs assigned to successive pit excavations, much as they were assigned to successive sections of Cyclopean wall.

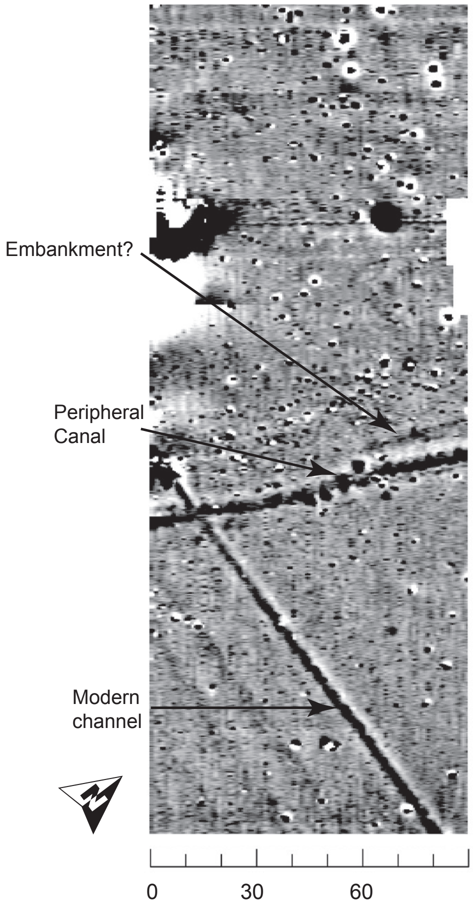


Figure 13. Peripheral Canal anomaly running through transect C1.
W. S. Bittner

anomaly, such as is typical of a ditch filled in with topsoil. The negative element of the feature shows up on the surface as a band of lighter-colored topsoil, especially visible at altitude. Cutting across the magnetic response from the Peripheral Canal is a clear linear, positive anomaly, corresponding to a modern irrigation ditch built at some point before 1954, when it first appears on the HMGS maps.

Our attempts to trace the Peripheral Canal and Revetted Canal back to their apparent common point of origin were inconclusive. What appear to be segments of a linear, positive anomaly were detected in transect L1. Their GGRS-87-perfect west–east alignment, however, like that of the west–east channel in transects C1–C2, looks modern. Transect L2 may contain three or four negative linear anomalies up to 6 m wide and spaced 20 to 21 m apart (Fig. 14; cf. reticulate pattern 2). They cannot be related to modern tilling, and they do not conform to the GGRS-87 geodetic grid. Similar anomalies may be evident in the subtler data from transect L3. Unfortunately for detection of the two canals' northern extent and any relation the negative anomalies in transects L2 and L3 could have with them, a zone about 15 m wide at the base of the scarp of Nisi is disturbed by a modern farm lane, adjacent drainage ditches, turning ruts from tractor plowing, and fire breaks dug on field edges.[114]

Miscellaneous other anomalies are germane to our interests. Transect B1 not only includes meandering, conjoined negative–positive anomalies of a type usually corresponding to paleochannels, but also clustered around the

114. The deepness of rutting, evident in the artificial dipole contrast in Fig. 14, explains why a checkerboard pattern of just three of six grid squares in the southeasternmost block was sampled.

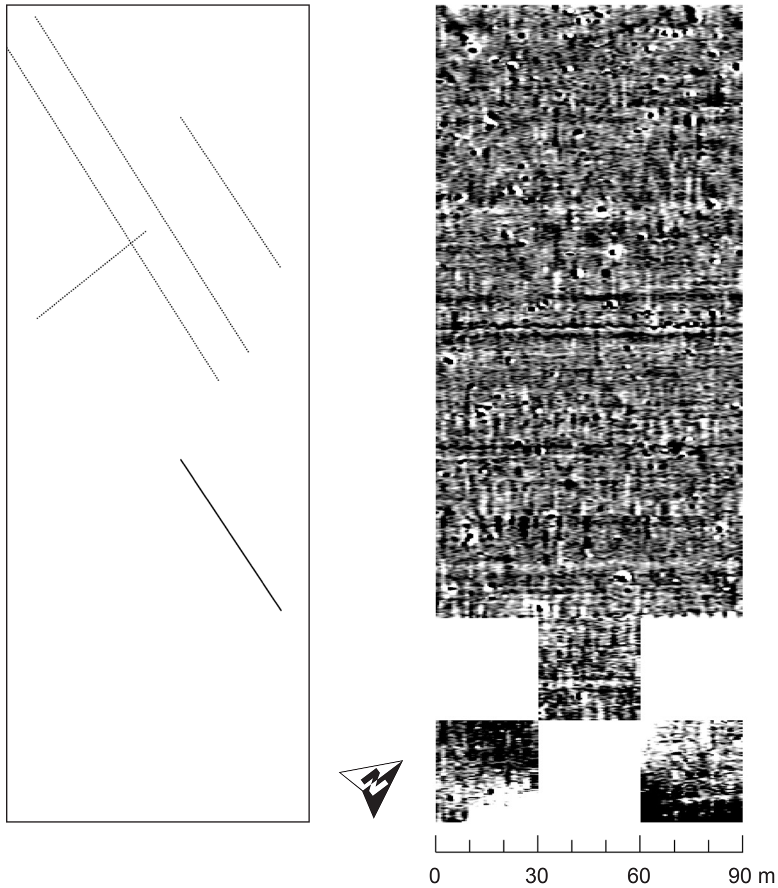


Figure 14. West–east anomalies in transect L2. M. F. Lane

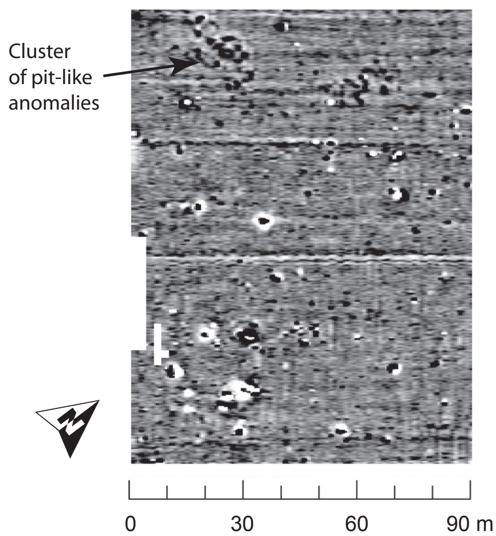


Figure 15. Pit-like anomalies in transect B1. W. S. Bittner

west end of this signature are up to 13 relatively strong positive anomalies, apparently 1–3 m in diameter, such as one expects of infilled pits (Fig. 15). Material recovered from the bottom of a core augered down into one of these anomalies provided a useful radiocarbon date (see Beta-301995, Table 3, below). Lastly, at the opposite end of the project area in transect P1, situated about 600 m south of G2 and 500 m west of Ftelia, we detected a very

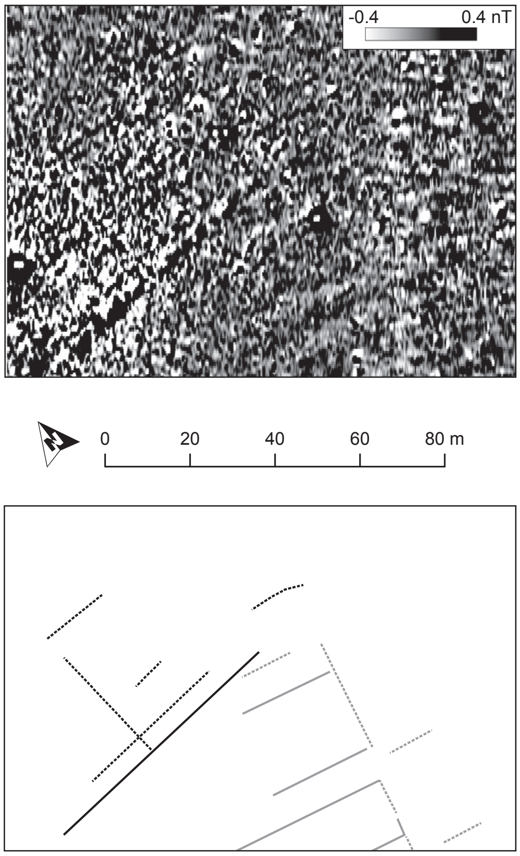


Figure 16. Linear anomalies in transect P1. W. S. Bittner

different pattern of anomalies, despite the signal interference of abundant modern ferrous refuse near the surface (Fig. 16). Other than the due west–east, largely positive anomaly that nearly bisects the west corner of transect P1 and suspiciously conforms to the GGRS-87 grid, there is a rectilinear pattern of weak negative anomalies about 4 or 5 m wide. It does not display, however, the same interval or orientation of the two reticulate patterns by the dike. The pattern does correspond in general location to a rectilinear but nonreticulate pattern of field marks shown in an aerial photograph of 1974 at the southern end of what could be one of the bounding anomalies (see Fig. 3). The pattern is located about 250 m southwest of a slight rise observed in the 1970s, on the margin of which a plowed-out fragment of a Classical boundary stone was found that read in the epichoric alphabet: A]ΚΡΑΙ[ΦΙΑ . . . | Κ]ΑΙ ΚΟ[ΠΑΙ . . . . (Akraiphia . . . and Kopai).[115]

Ground-Truthing

Using the auger, we removed cores from anomalies and background areas in or around reticulate pattern 1, the bounding anomaly running through transects J1, K2, and N1, the joining anomaly passing through A1, the Revetted and Peripheral Canals, the pit-like anomalies in B1, and the linear anomalies in P1 (the latter's cores are discussed on p. 451, below). We also exposed and examined modern ditch profiles between transects G1 and I2, between J1 and K2, and to the northeast of J2. In every case, a distinctive

115. Lauffer 1980; *SEG* XXX 440.

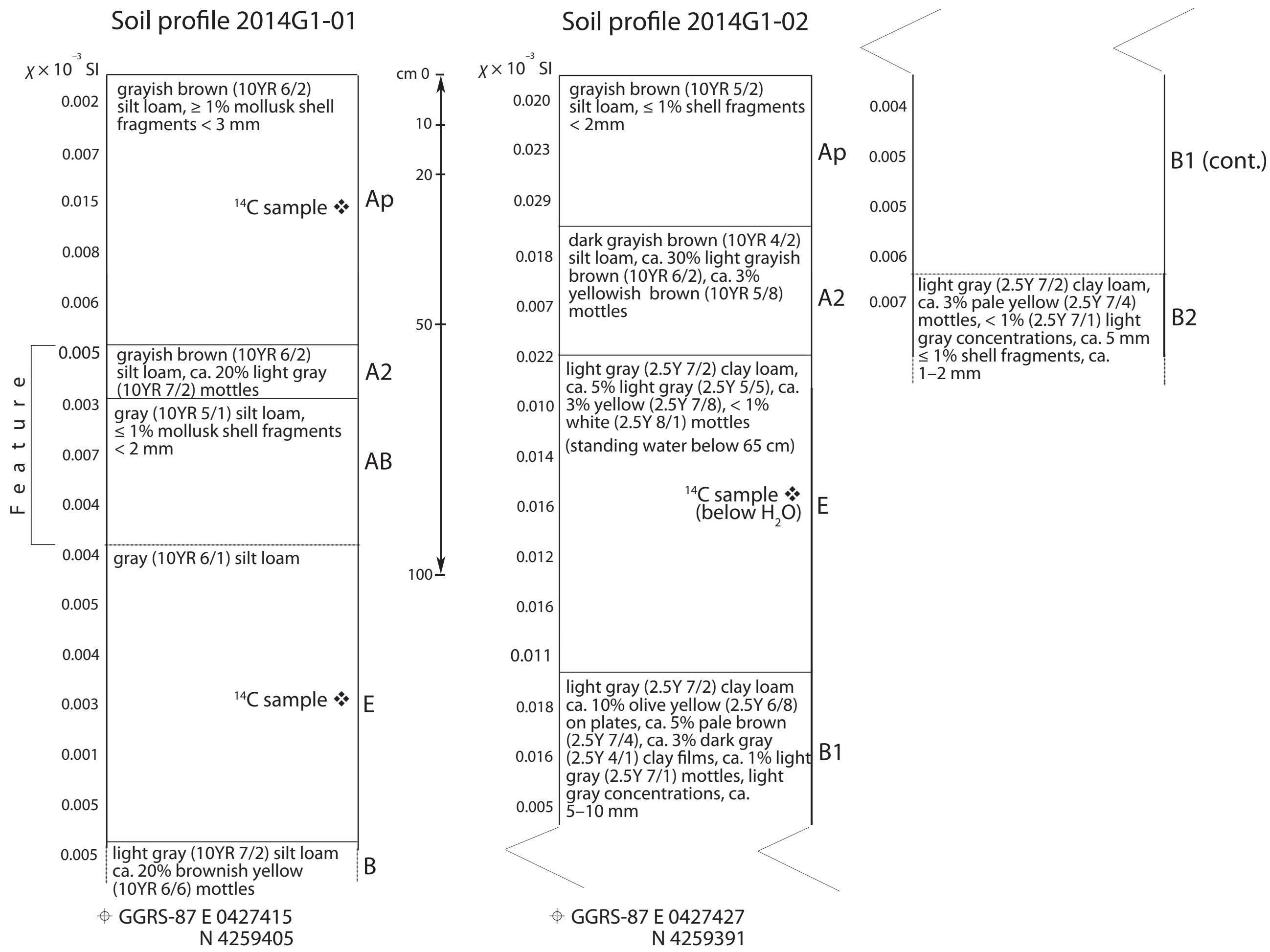


Figure 17. Soil core profiles 2014G1-01 and 2014G1-02.
Drawing M. F. Lane

layer of sediment was discovered in the core from above the anomaly that was not present in the core from the background. The profiles of reticulate pattern 1 and its background area are illustrated in soil profile 2014G1-01 (Fig. 17, left).[116] The profile displays a horizon of light gray or brownish gray silt loam about 40 to 80 cm beneath the modern field surface (as does profile 2011I2-01, not depicted). This stratum is not found in cores from adjacent areas, as illustrated by 2014G1-02 (Fig. 17, right). It resembles the more deeply lying B soil horizons in color and texture, which likewise contain a higher concentration of freshwater mollusk shell fragments than does the topsoil.[117] Ditch profiles 2011I2-P01 and 2011I2-P02 likewise revealed a lens of weakly mottled white or light gray silt loam, ca. 25 cm thick and 210–220 cm wide, ca. 40 to 60 cm below grade (Figs. 18, no. 2; 19, no. 2), whose location corresponded in plan exactly to the midpoint of a negative anomaly constituent of reticulate pattern 1 at the point where it intercepted the ditch. On the southwestern side of 2011I2-P01, at least, was a layer of grayish brown silt loam, darker than the surrounding soil and abutting the whitish feature, which could correspond to a thin, linear positive anomaly adjoining the aforementioned negative one, perhaps an in-filled cut (Fig. 18, no. 3). A similar whitish feature, ca. 30 cm thick and

116. For general information on horizon types and their standard abbreviations as shown in the soil profiles in Figures 7, 21, and 22, see Schoeneberger et al. 2012, pp. 2-3–2-5.

117. Flotation yielded nothing of archaeological value (E. Margariti, pers. comm., 2012). Most remains were freshwater gastropod shell (probably *Lymnaea* sp.). In all, there were three taxonomically unidentifiable pieces of charcoal and two seeds (probably *Adonis* sp.).

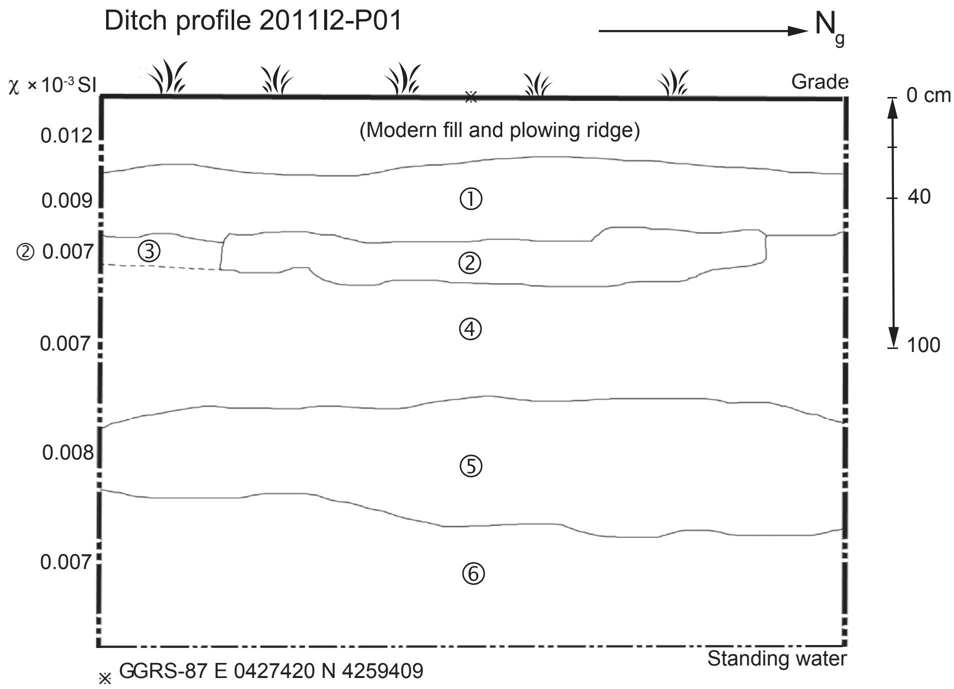


Figure 18. Ditch section profile 2011I2-P01. Numerals 1–6 mark distinct sediment beds or soil horizons. Drawing M. F. Lane

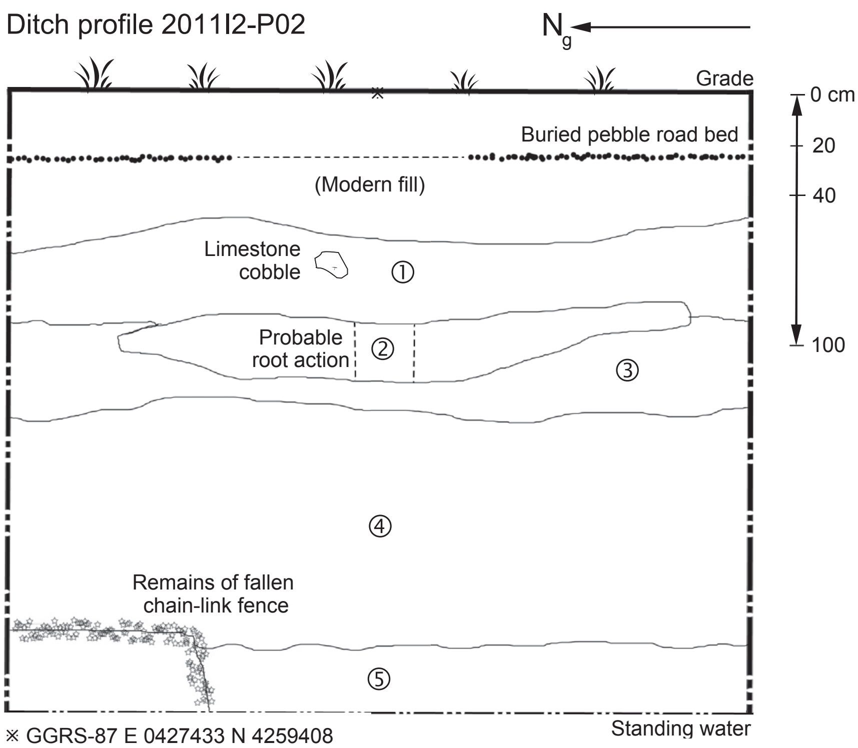


Figure 19. Ditch section profile 2011I2-P02. Numerals 1–5 mark distinct sediment beds or soil horizons. Drawing M. F. Lane

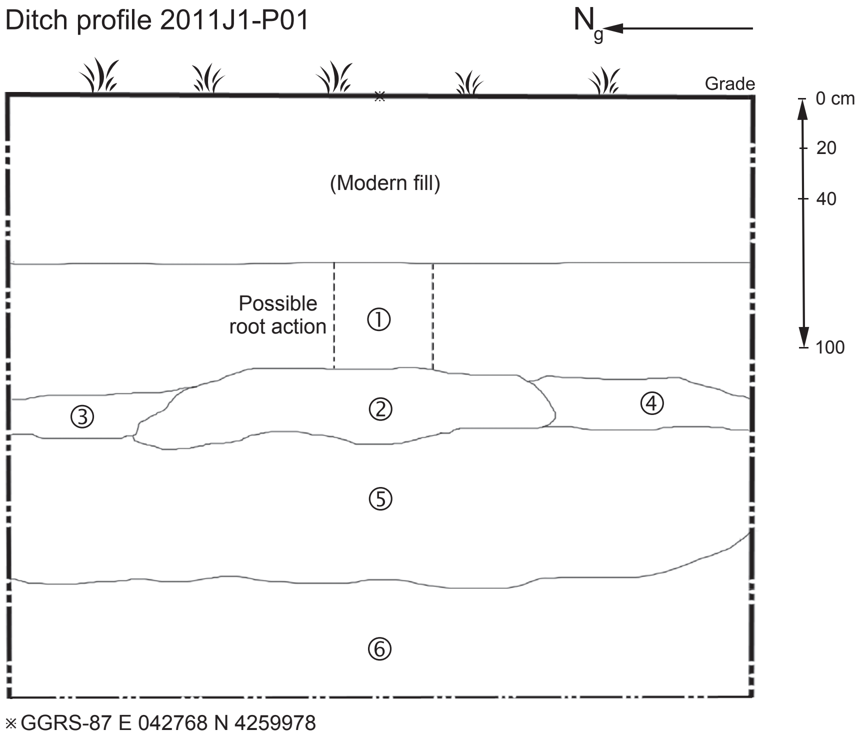


Figure 20. Ditch section profile 2011J1-P01. Numerals 1–6 mark distinct sediment beds or soil horizons. Drawing M. F. Lane

180 cm wide, was revealed at a depth of about 50 cm below the level of the fields in the ditch between J1 and K2 (Fig. 20, no. 2). It corresponds in location, if not precisely in width, to the bounding anomaly running through these transects. It is abutted on each side by a layer of grayish brown sediment that may contribute to the flanking positive component of the principally negative anomaly (Fig. 20, nos. 3, 4). A core into the bounding anomaly between J1 and K2 encountered groundwater before reaching subsoil, but it did provide a radiocarbon terminus post quem for the topsoil (see p. 446, below).

Similar white or gray lenses were found to the southeast in the same field-bounding ditch, beside transect J2, although they appear truncated in this profile because of the difficulty of precisely locating in the GIS data the point of intersection of the major west–east joining anomaly connected with Gla, to which they correspond. Elsewhere, a series of cores was augered across the joining anomaly that cuts through the corner of transect A1 (Fig. 21). It too revealed a distinctive layer, about 50 to 70 cm deep, corresponding to the anomaly, albeit attenuated in comparison with those found in reticulate pattern 1 and the ground-truthed bounding anomaly (Fig. 21, "feature" at far right).

In transect C1, we took one core from above the Peripheral Canal and two from the possible embankment immediately to the west. The profile of the first was different from that of the others, although the difference was not as clear as elsewhere. A considerable quantity of subangular gravel was in all three profiles, which inhibited coring deeply into the subsoil. The gravel may represent fill for the embankment taken from the cut. Bedrock is close to the surface in C1, and the stone inclusions appear to be of the same material as the channer in the local soil. The gravel is less likely, given its shape, to have been deposited by the seasonal stream to the east (see Fig. 4). Three cores in D1, one on each side of the Revetted Canal and another

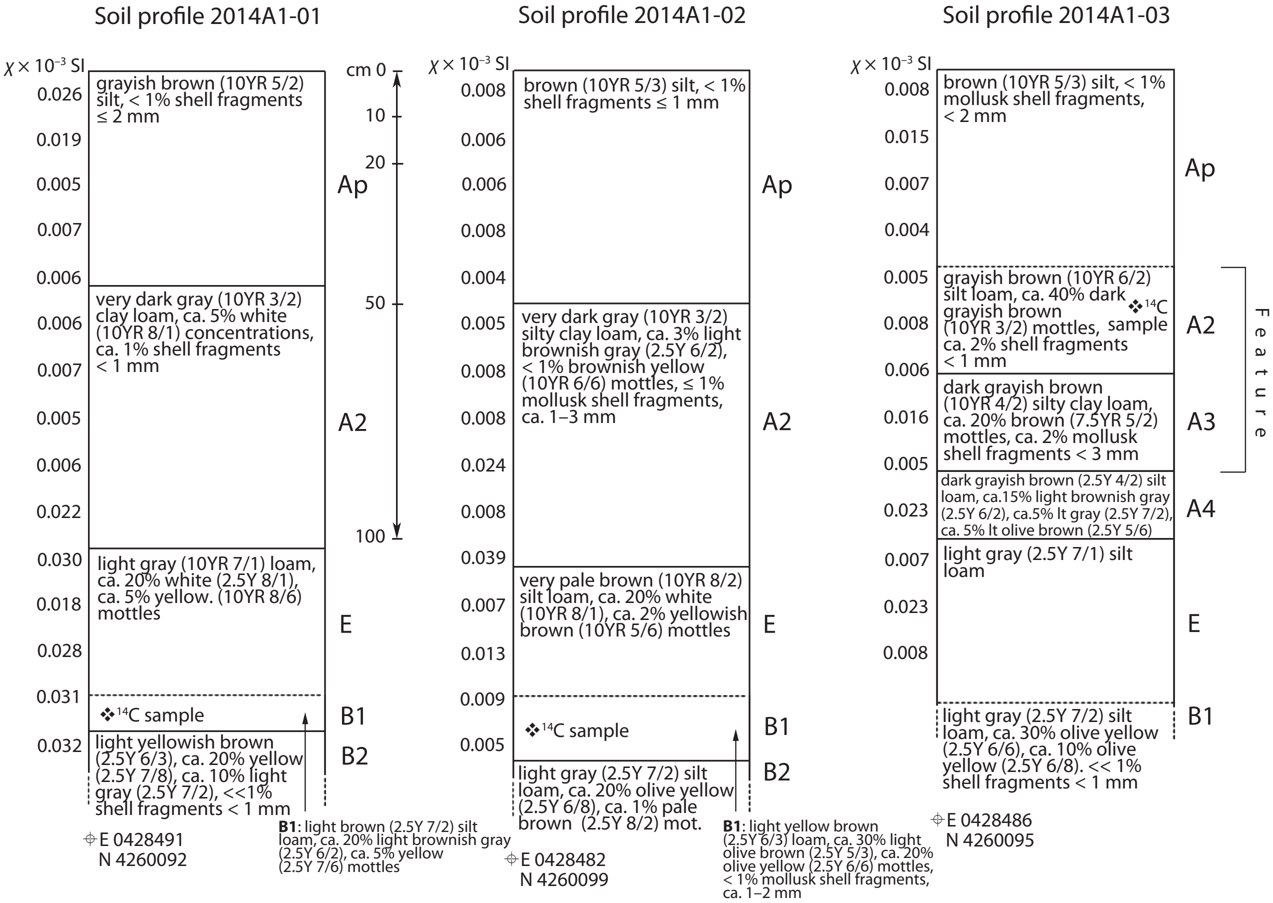


Figure 21. Soil core profiles 2014A1-01, 2014A1-02, and 2014A1-03. Drawing M. F. Lane

in the middle, provided profiles consisting of a sequence of soil horizons consistent with the canal having once stood at the elevation of the modern plow soil or higher (Fig. 22), rather than it being an excavated channel.

One of the pit-like anomalies in transect B1, in addition to providing a profile different from that of the adjacent background area, yielded what seemed to be ca. 15 cm of fill just below the plow soil (ca. 55 cm deep), much of which appeared to be disintegrated, yellowish red terracotta (Fig. 23). The AMS radiocarbon date of a sample of this fill is 5480–5370 cal B.C. (95% probability, sample Beta-301995), a date that corresponds to the Middle Neolithic period in the region (ca. 5800–5300 B.C.).[118] A Middle Neolithic–type greenstone adze head had been recovered from beside the road around Gla in 2010. It is attractive to think, though it cannot be proved, that these anomalies represent a Middle Neolithic temporary settlement or activity area, perhaps beside one of the seasonally fluctuating streams represented by the paleochannel-type anomalies (see p. 438, above).

Magnetic susceptibility results mainly corroborated those of magnetometry (see Figs. 17, 18, 20, 23). Susceptibility was generally very low in the plain in comparison with the outcropping of Gla, which is rich in ferrous laterite and limonite. The highest certain value for the topsoil in the plain is no greater than 0.04 × 10^{-3} International Units (SI), while

118. See Perlès 1992, p. 120. Cf. Coleman and colleagues, whose radiocarbon dates would place this in the Late Neolithic period (Coleman et al. 1999, pp. 296–297).

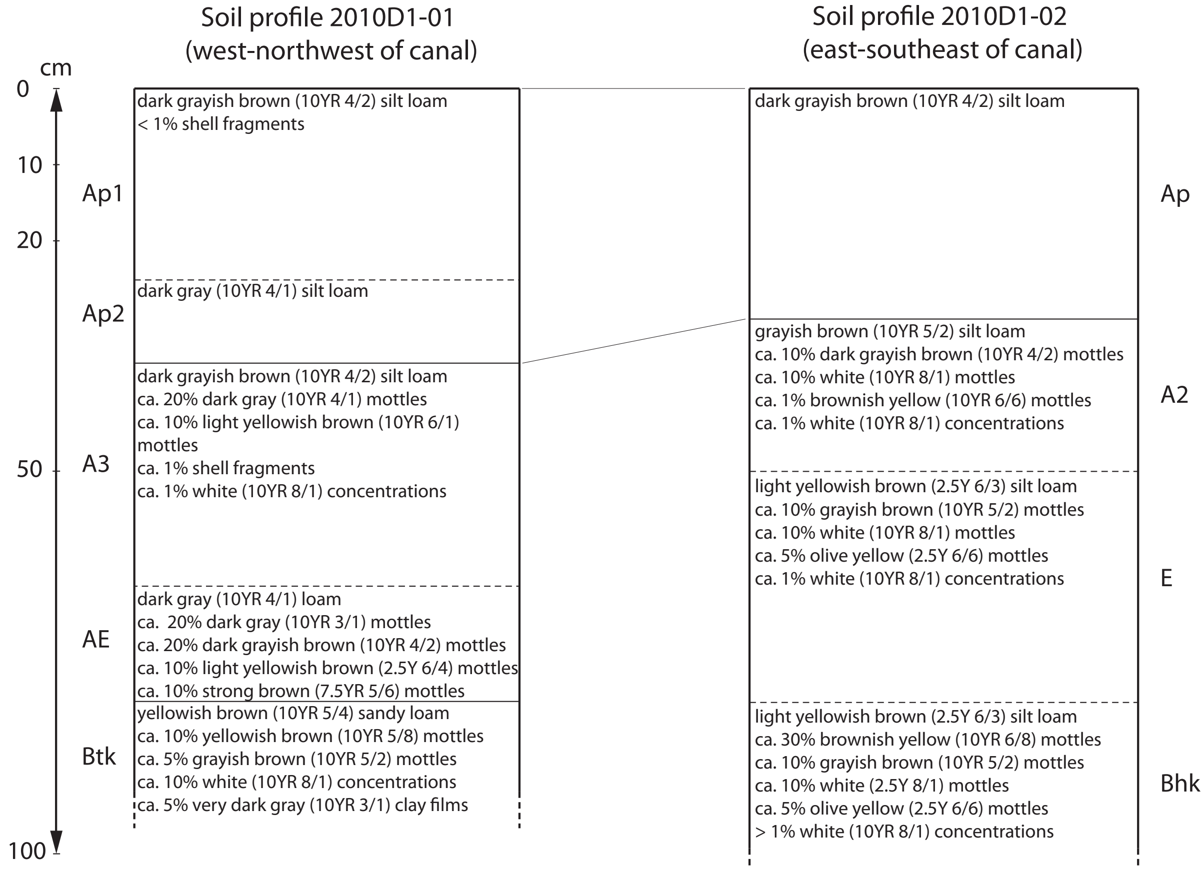


Figure 22. Soil core profiles 2010D1-01 and 2010D1-02.
Drawing M. F. Lane

Figure 23. Soil core 2010B1-01.
Photo M. F. Lane

the median of seven measurements of topsoil from Gla is 3.0×10^{-3} SI.[119] The KT-10 instrument is sometimes fallible, and some profiles exhibited irregular variation.[120] In general, however, where measurable, the deposits identified as corresponding to magnetically negative responses had lower values than the overlying topsoil and immediately underlying horizon, while horizons identified as correlating with positive responses exhibited the opposite tendency. As previously remarked, the archaeologically interesting magnetic anomalies we detected on AROURA were generally subtle with respect to background. In most transects, the contrast did not exceed ±0.4 nanoteslas (nT). Sometimes the responses were less than ±0.1 nT, within the range of background noise. They were only identifiable because of their long linear character and postcollection clipping of the data display range. Hence measurement of χ showed that subtlety of magnetic response did not correlate with poorly preserved or attenuated remains.

Scientific Dating of the Linear Anomalies

Samples of sediment were taken for AMS radiocarbon dating from horizons corresponding to anomalies and from control horizons, the latter either above or below the test horizon or from a subsoil horizon in a core from a background area, demonstrating correlation with depth. Results are presented in Table 3. The median value in reticulate pattern 1 (2011I2-01 and 2013I2-01) is 1786 and 1837 cal B.C. (68% probability) or 1708 and 1855 cal B.C. (95% probability). The core into the bounding anomaly between J1 and K2 that groundwater had stymied provided a terminus post quem of 1660 cal A.D. (68%) or 1650 cal A.D. (95%) for the lower, more compact part of the topsoil. The aforementioned date from the pit-like anomaly in transect B1 (5480–5370 cal B.C.) suggests a 6th-millennium B.C. terminus ante quem for the upper subsoil.

Nikolaos Zacharias of the University of the Peloponnese installed two OSL dosimeters in and took control samples from the features in each of three ditch profiles, 2011I2-P01, 2011I2-P02, and 2011J1-P02, the first two in reticulated pattern 1 and the last in the profiled bounding anomaly. We intended the resulting dates to check and complement radiocarbon results, particularly where ground conditions had thwarted relevant sampling. The mean dates of two samples from 2011I2-P01 are close to each other (Table 4). The quartz OSL dates are 3650 and 3700 B.P. (1637 and 1687 B.C.), respectively, whereas the calcite TL dates are 3290 and 3270 B.P. (1277 and 1257 B.C.). Calcite TL dates are typically 15%–35% lower than calendar age. Hence the mean ages could be in the range of 1724–1468 B.C. and 1697–1446 B.C. Furthermore, in the worst case of extreme fluctuation in the water table since modern drainage and reirrigation began, these dates should be lowered by 1%–3%, which means, to take the simplest example, that the OSL dates would fall in the range of ca. 1600–1528 and 1650–1578 B.C.[121] These luminescence dates, hypothetically corrected or not, are consistent with the radiocarbon dates when one supposes, in the prevailing hydrological circumstances, that the radiocarbon dates represent the terminus post quem of deposition of the constituent sediment on the ancient lakebed, whereas the luminescence dates represent the terminus ante quem of artificial redeposition (zeroing event) for the construction of the feature.

119. G. Tsokas, pers. comm., 2011.
120. Lee and Morris 2013.
121. N. Zacharias, University of the Peloponnese, pers. comm., 2013.

TABLE 3. ACCELERATOR MASS SPECTROMETRY RADIOCARBON DATES FROM SELECTED FEATURES

Sample Name (location)	*Beta Analytic Lab Code*	*Conventional Date ¹⁴C*	*Calibrated Date (1σ)*	*Calibrated Date (2σ)*
RETICULATE PATTERN				
2014G1-02 (E horizon, control above elevation of feature, H_2O-saturated)	Beta-416156	2310 ± 30 B.P.	395 B.C. intercept 395 B.C.	405–360 B.C. intercept 395 B.C.
2011I2-01	Beta-331307	3440 ± 40 B.P.	1860–1850 B.C. 1770–1720 B.C. 1720–1690 B.C. intercept 1740 B.C.	1880–1660 B.C. 1650–1640 B.C. intercept 1740 B.C.
2013I2-01	Beta-371126	3530 ± 30 B.P.	1900–1880 B.C. 1840–1820 B.C. 1800–1780 B.C. intercept 1880 B.C.	1940–1770 B.C. intercept 1880 B.C.
BOUNDING ANOMALY				
2013J1-01 (A2 horizon, control above feature)	Beta-371125	190 ± 30 B.P.	A.D. 1660–1680 A.D. 1740–1760 A.D. 1760–1800 A.D. 1940–1950+ intercept A.D. 1670 A.D. 1780 A.D. 1800 A.D. 1940 A.D. 1950	A.D. 1650–1690 A.D. 1730–1810 A.D. 1920–1950+ intercept A.D. 1670 A.D. 1780 A.D. 1800 A.D. 1940 A.D. 1950
JOINING ANOMALY				
2014A1-01 (profile 2014A1-01, B1 horizon, below elevation of feature)	Beta-416153		9275–9240 B.C. intercept 9255 B.C.	9290–9220 B.C. intercept 9255 B.C.
2014A1-02 (profile 2014A1-03, A2 horizon, above feature)	Beta-416154		A.D. 420–540 intercept A.D. 430 A.D. 490 A.D. 510 A.D. 515 A.D. 530	A.D. 405–550 intercept A.D. 430 A.D. 490 A.D. 510 A.D. 515 A.D. 530
PIT-LIKE ANOMALY, TRANSECT BI				
2010B1-01	Beta-301995	6470 ± 30 B.P.	5480–5460 B.C. 5400–5390 B.C. intercept 5470 B.C.	5480–5370 B.C. intercept 5470 B.C.
VRYSTIKA SINKHOLE, SOUTH SIDE OF MT. FTELIA				
2011VK-01 (A5 horizon, ca. 2.45 m deep, below ca. 5 cm boundary of probable sesquioxide accumulation)	Beta-331308	3340 ± 30 B.P.	1682–1610 B.C. intercept 1620 B.C.	1720–1720 B.C. 1690–1530 B.C. intercept 1620 B.C.

While the OSL dates of profile 2011I2-P02 are consistent with each other, their higher mean date compared with that of 2011I2-P01 opposite is curious. (No calcite TL comparanda are currently available.) The discrepant luminescence dates from the J1–K2 feature are also curious. However, the mean raised calcite date of 2011J1-P01, 1043–882 B.C., is reasonably close

TABLE 4. OPTICALLY STIMULATED LUMINESCENCE AND THERMOLUMINESCENCE DATES FROM SELECTED FEATURES

Sample Name	*University of the Peloponnese Lab Code*	*Geological Dose (Gy)*	*Dose Rate (mGy/a)*	*Age before Present (1σ)*
RETICULATE PATTERN I				
2011I2-P01	LUM 316/13	quartz (OSL) 3.47 ± 0.30 calcite (TL) 2.605 ± 0.13	0.95 ± 0.07 0.80 ± 0.07	3650 ± 330 B.P. (1637 ± B.C.) 3290 ± 200 B.P. (1277 ± B.C.)
2011I2-P01	LUM 317/13	quartz (OSL) 3.55 ± 0.30 calcite (TL) 2.65 ± 0.12	0.96 ± 0.07 0.81 ± 0.07	3700 ± 320 B.P. (1687 ± B.C.) 3270 ± 200 B.P. (1257 ± B.C.)
2011I2-P02	LUM 318/13	quartz (OSL) 4.12 ± 0.37	0.96 ± 0.07	4250 ± 380 B.P. (2237 ± B.C.)
2011I2-P02	LUM 319/13	quartz (OSL) 4.15 ± 0.45	0.96 ± 0.07	4333 ± 470 B.P. (2317 ± B.C.)
BOUNDING ANOMALY RUNNING FROM AREA J INTO AREA K				
2011J1-P01	LUM 320/13	quartz (OSL) 4.04 ± 0.17 calcite (TL) 2.50 ± 0.20	1.05 ± 0.08 0.90 ± 0.07	3850 ± 280 B.P. (1837 ± B.C.) 2780 ± 250 B.P. (767 ± B.C.)
2011J1-P01	LUM 321/13	quartz (OSL) 3.01 ± 0.25	0.96 ± 0.07	3140 ± 200 B.P. (1127 ± B.C.)

to the OSL date of the same, 1127 B.C. Evident root disturbance in profile 2011J1-P01 could account for the low date (see Fig. 20). Alternatively, the feature could exhibit several phases of construction, an observation that is relevant to interpreting the history of land use in the polder.

Both the radiocarbon dates and most of the luminescence dates are on average ca. 300 to 400 years older than the date of the construction of Gla, ca. 1300 B.C., as determined by material culture synchronism.[122] Hence, if the patterns of linear anomalies are elements of some artificial field system connected with Gla, as they seem, both the wider drainage system and the inhabitation of Gla too could be earlier than previously surmised (see further below).

Surface Survey

Field Walking in the Plain

We collected finds from the surface of the Mycenaean polder in 2 m wide pedestrian traverses within the 30 m geophysical sampling units whose corners were staked out. Any object small enough to be picked up with the fingers and placed in a 15 × 25 cm bag labeled by traverse number was collected. Anything else, such as field stone, was indicated on a pro forma plan of the sampling unit. Units for such field walking for surface collection were chosen so that the finds could be correlated spatially with magnetometric data in certain transects. To the extent possible, the pedestrian traverses were oriented parallel to major anomalies of archaeological interest, so that changes in quantity with distance could be assessed. Field walking was deliberately undertaken both in 30 m units that showed little on the surface, despite the presence of anomalies (which seemed to be the rule), and in units where surface finds were clearly abundant, regardless of the strength of the anomalies. The hypothesis was that there would be few, if any, finds on the surface, because extensive agricultural regimes do not entail the sort of artificial manuring with household rubbish that smallholding

122. Iakovidis 2001, pp. 142–145; Vitale 2006, p. 193. This date is corroborated by a recent AMS radiocarbon date (Beta-412470) whose 95% probability range is 1225 to 1045 cal B.C., and one of whose calibration curve intercepts is 1185 (G. Jones, pers. comm., 2016).

agriculture usually does.[123] We also supposed that the finds would be either Mycenaean or modern, reflecting the two known periods of sustained artificial drainage. Finally, we presumed that extraordinary concentrations of finds would represent either outbuildings or repairs to drainage or irrigation mechanisms of the sort described in the topographic model.

Surface collections were taken from units spanning the Revetted Canal in transects D2 and E2, comprising a total area of 16,200 m^2. A total of just 43 finds was gathered, equivalent to less than 0.003 find/m^2. What was collected consisted entirely of badly eroded ceramics of uncertain date, although some of the represented ceramic textures and pastes were consistent with Mycenaean fine wares. They await further analysis for final determination. Only one Mycenaean shape could be plausibly identified from a potsherd, part of the stem of a kylix.

Transect H2 fell on the western side of the Mycenaean polder dike, partly overlapping it. The major anomalies in the transect, other than noise from ferrous trash, could be associated with the construction of the modern highway about 100 m away. During magnetometry, an unusually large quantity of fragmentary finds, mostly ceramic, had been observed here. A total of 10 units (9,000 m^2) was traversed, from which we collected 839 finds, or 0.093 find/m^2 (ca. 1 per 10 m^2), although most were concentrated in the four units closest to the dike (Fig. 24). Again, the majority represented ceramic pottery, and, to the small degree that periods represented could be identified, they ran the gamut from possible Mycenaean through medieval (lead-glazed or tin-glazed) to obviously modern. Historic paintings of the northeastern Kopaïs, such as those by Carl Rottmann,[124] suggest that segments of the ruined polder dike stood above water at certain times until drainage commenced in the modern era. The English traveler William Leake described a "causeway" in disrepair that fits the description of this dike, which he attributed to "the ancients" and thought may have been maintained through Byzantine times.[125] Thus, it may have been possible to travel over the ruins much of the distance from Mt. Mytikas to the village of Topolia in the right season. We therefore provisionally concluded that the finds collected represented the accumulated trash of farmers, fishers, and herders passing along the dike through the millennia. Unfortunately, the sample of chronologically identifiable material is insufficient for determining whether certain periods are represented more than others, helpful proxies for changes in demography, climate, and resource use.

Transect L3, which encompassed some weak negative anomalies that could be associated with a field system close to the joint northern segments of the Peripheral and Revetted Canals, comprised a total of 16,200 m^2. We recovered a total of 60 finds from here. This is equivalent to 0.004 find/m^2, in the same order of magnitude as the collection ratio in transects D2–E2 covering the southern stretch of the Revetted Canal. All these finds were ceramic: 51 pieces of pottery and nine pieces identified as building tile. None could be precisely dated by decoration. Most was coarse ware, awaiting future fabric and paste analyses, while much of the tile resembled modern types and perhaps came from dumps or repairs on the nearby crushed-stone farm lane.

123. See Bintliff 2000a; Pettegrew 2001; Bintliff et al. 2002; Halstead 2014, pp. 212–230.

124. Carl Rottmann, watercolor, *Der See Kopais in Böotien mit dem Parnass im Hintergrund,* ca. 1839, Museum der bildenden Künste, Leipzig.

125. Leake 1835, pp. 308–309.

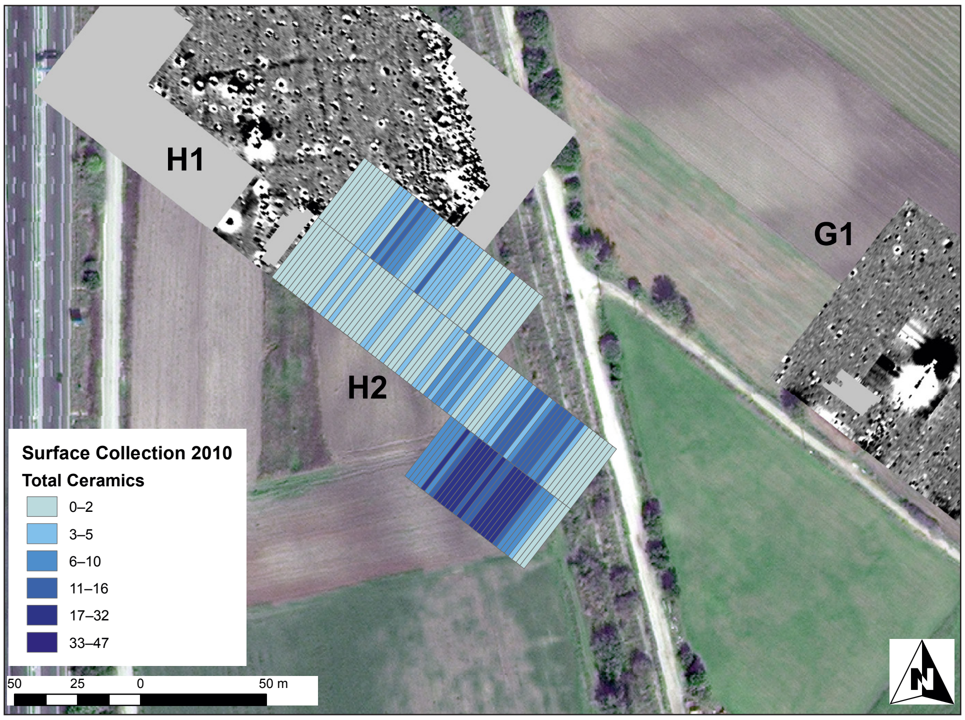


Figure 24. Magnetometry and field walking results in transect H2.
M. F. Lane

Figure 25. Magnetometry and field walking results in transect P1.
M. F. Lane

Transect P1, to the south of Gla, which comprised a rectilinear pattern of anomalies, showed the greatest density of finds: 752 objects in 900 m^2, or 0.836 find/m^2 (Fig. 25; cf. transect H2). While the finds were exclusively ceramic, the majority (481) was classified as building ceramic, based mainly on shape, while the remainder (331) was classified as pottery, unlike the proportions in other field-walked transects. While some of the building material appears to be modern, not least because of its well-preserved surface, some of the more eroded pieces have different fabrics, and they may be older. Furthermore, among the ceramics were potsherds that could be dated stylistically to the Protoboiotian and Archaic–Classical periods, including black-painted ware and a black-on-buff rim, with the partial silhouette of either the stylized feathers of a bird's wing or (less likely) an animal's antlers.[126] We therefore conjecture that the anomalies in transect P1 represent a construction dating to the Archaic and Classical periods. One should bear in mind that the surface of the fluctuating lake's bed was certainly more undulating than the currently heavily tilled plain is, as both the observation of a nearby rise as late as the 1970s and modern maps from before the drainage show. Therefore, the structure may have stood, at least periodically, on dry ground. The presence of the aforementioned Classical inscription near the rise, in addition to the Late Classical rupestral boundary marker at the west tip of Mt. Ftelia, suggests there may have been reason to mark territory close to this locale. Coring into the faint anomalies and background areas in transect P1 revealed nothing astonishing. Profiles from above the anomalies did contain a marly subsoil layer, which could be decomposed mudbrick and plaster, perhaps of a stable or outbuilding, accounting for the negative nature of the anomaly. No radiocarbon date was obtained.

Intensive Surface Collection at Ayia Marina Pyrgos

The purpose of collecting finds from the ground surface at Ayia Marina Pyrgos was heuristic, not ground-truthing. In the 2011 and 2012 seasons, each of three 30 m units of the AROURA sampling grid (AMP2a1, AMP2b1, and AMP2c2) on the summit of AMP was divided into 15 × 15 2-meter square units (a total of 225; Fig. 26), each of which was subjected to a hands-and-knees search, finds therein collected and bagged separately. Each 2-m square was also assessed, with the help of Munsell proportion diagrams, for the percentage of the surface that was visible to the investigators even after the removal of dead vegetation and organic overburden. Assuming the number of finds that could be recovered is estimable using a coefficient of visibility, $n_{possible} = n_{actual} + (n_{actual} \times 0.01[100 - \text{percentage visible}])$, any significant difference in numbers and distributions relevant to extant features could be noted and the accuracy of the method without the visibility coefficient could be assessed.

Ultimately, there was no significant difference between actual and hypothetical counts (Fig. 27), even where shrubs were dense, such as in the northern corner of square AMP2a1 and the center of AMP2c2. Finds were sparsest where bedrock was near the surface or protruded, or where wall courses were extant, as well as in units where the ground was close to

126. Cf. Ure 1913, pp. 4–13, plates; 1934, pp. 17–22, 47–50, pl. III (Rhitsona); Cook 1997, pp. 96–98 (Boiotia).

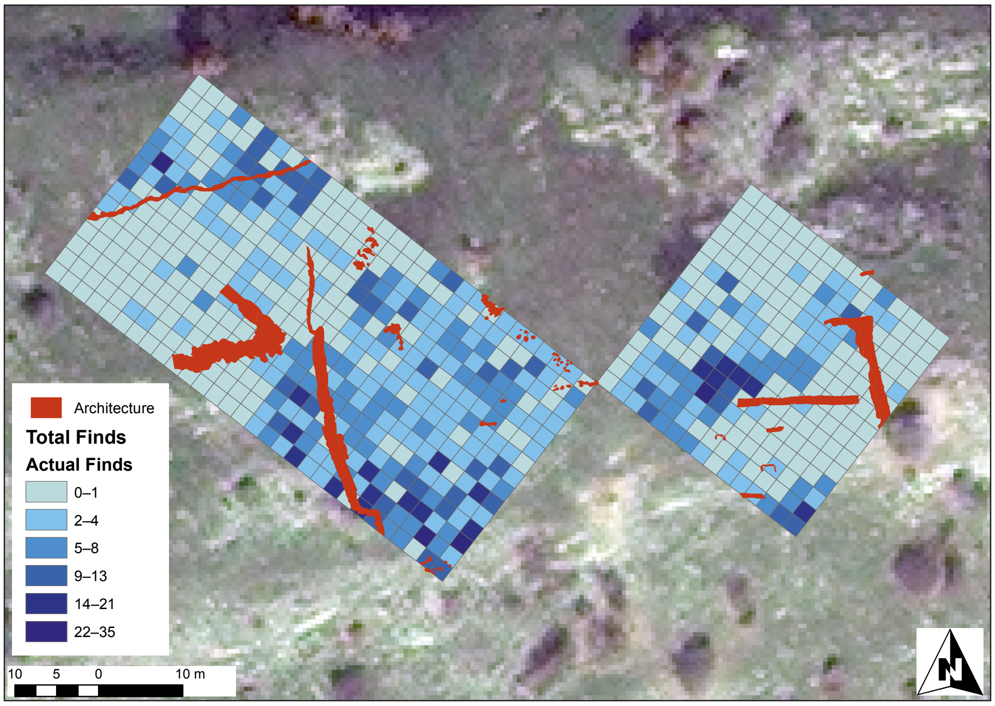


Figure 26. Actual surface collection results from Ayia Marina Pyrgos with extant architecture indicated in red. M. F. Lane

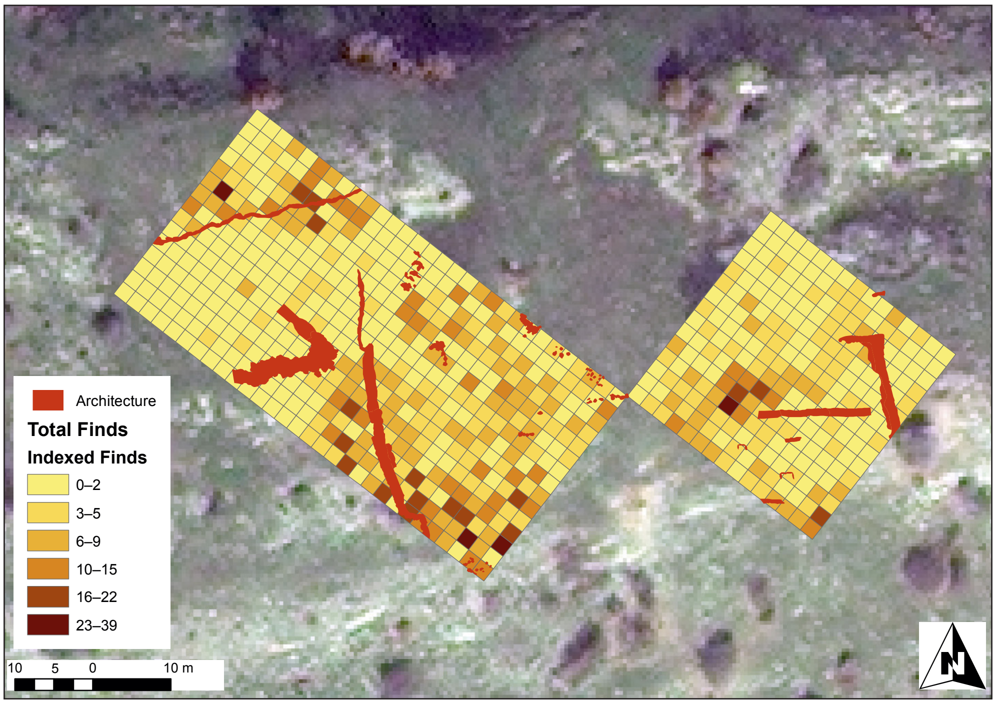


Figure 27. Visibility indexed surface collection results from Ayia Marina Pyrgos. M. F. Lane

Figure 28. Potsherds from collection unit AMP2a1-1210, within the north circuit wall: (left) fragment of a burned MH Fine Burnished ware ("Minyan") strap handle from a kalathos; (right) a MH Matt Polychrome body fragment. Scale (left) 2:3; (right) 1:3. Photos M. F. Lane

level and deposition deeper than 0.5 m, as later probing revealed. Finds were most abundant where slope increased, as concomitantly did the degree of erosion, and where root or animal disturbance had turned up artifacts. These were generally areas of low visibility, again mainly in the north of squares AMP2a1 and AMP2c2. Therefore, disturbance and lack of visibility seem to cancel each other's effects out.

Chronotypes represented consisted mostly of Middle Helladic (MH) through LH potsherds, with fewer representatives of Late Geometric or Protoboiotian, Archaic–Classical (black slipped), and likely Roman- and Medieval-period wares, the latter nearby the watchtower *(pyrgos)* that gives the site its name. These finds are consistent with prior investigators' lists of periods represented at AMP, derived from cursory surface explorations,[127] except that we found nothing convincingly dating earlier than the MH period. In addition to the general prevalence of MH–LH remains, the great majority of the MH material, which includes Fine Gray Burnished (Gray Minyan) ware and Matt Polychrome ware (ca. MH II–LH IIA in the region),[128] was found in or below the northernmost mapped wall (Fig. 28), which in fact is the inner face of a Cyclopean fortification/retaining wall some 2 m thick. The only other probable extant finds of the same period on the summit are traces of looted cist graves in square AMP2c2 to the east-southeast, as well as cist graves by the gate in the fortification wall to the west-southwest. The only certain piece of Protoboiotian pottery was found downslope, just outside the northern retaining wall in a unit also containing a foliate-banded body potsherd (Fig. 29), probably dating to the LH IIB period in the region, where they both had evidently eroded from the summit. The LH material appeared to be concentrated on the southern slopes and mainly to the west of the cist graves and medieval watchtower. It included Mycenaean decorated pottery fragments dating from LH IIIA2/B1, including a kylix rim with diagonal whorl shells (Fig. 30), to the LH IIIB2–C Early transition, including group B deep bowl rims and body potsherds (Fig. 31). The notable early exception is the foliate-banded piece mentioned above, which probably belongs to a cup of some form. There were coarse and semicoarse wares, including painted amphora fragments also typical of LH III.[129]

We conclude from the surface finds that a substantial permanent settlement already existed at Ayia Marina Pyrgos in the MH period. This settlement was succeeded by one in the LH period that was perhaps more

127. Fossey 1988, pp. 277–290; Farinetti 2011, pp. 127–135.

128. Sarri 2010a; 2010b, pp. 209–215; 2012.

129. See LH comparanda in Mountjoy 1983, pp. 12–16; 1986, pp. 44–46, 88–89, 138–140, 151–152; 1999, pp. 655–657, 684–686.

Figure 29. Potsherds from collection unit AMP2a1-1410: (left) Protoboiotian fragment from outside the north circuit wall; (right) LH fragment with foliate band. Scale 1:1. Photos M. F. Lane

Figure 30. Reconstruction of the LH IIIA2/B1 whorl-shell kylix from collection unit AMP2b1-0106, the south slope inside the circuit wall. Scale 1:3. M. F. Lane after drawing by M. T. Greenhouse

Figure 31. Late Helladic IIIB2–C Early group B deep bowl potsherds from collection units in grids AMP2b1 and AMP2c2, south slope inside circuit wall. Scale 1:1. Photos M. F. Lane

expansive and lasted until LH IIIC Early, at or shortly after the time the fortress of Gla burned down for the second and last time.[130] It brackets the period of the fortification of Gla and the latest phase of the drainage works, as well as evidently the earliest phases of the field system in the polder. It therefore promises to answer further research questions relevant to the various political-economic connections between Gla, the drainage works, the field system, AMP, and AMP's hinterland. Also noteworthy is the Early Archaic/Protoboiotian component, because it is now attested on the plain, not just at the nearby littoral sites of Stroviki, Topolia (ancient Kopai), and Ayios Ioannis. The evidence points to a resurgence of human population in the area from the 7th century b.c.[131] An Archaic–Classical period cemetery on the peninsula of Chantza just west of AI was previously recorded, too,[132] possibly associated with ancient Anchoe, situated ca. 5 km to the northeast.[133]

DISCUSSION

Systemic Reconstruction

From the outset of AROURA, there was the strong circumstantial argument that any features found in the ancient polder around Gla would be contemporary with or earlier than the building and main inhabitation of the fortress and the extant phase of the drainage works. The AROURA project has now proved this case to the exclusion of alternative hypotheses and has shown that the features in question most likely represent a system of irrigated agricultural fields.[134]

Reconstruction

The current reconstruction of LH IIIB drainage, irrigation, and field systems around Gla is shown in Figure 32. The linear features appear to be built up of the sedimentary matrix of the ancient lakebed that has become the present subsoil. It is unclear whether the material was sorted or mixed before artificial deposition—though no reason exists to suppose so—or whether the superficial differences with respect to the subsoil are due to difference in kind and duration of formation processes. In some of the magnetometry data, a linear negative anomaly is paralleled by a positive anomaly consistent with a levee (negative) and adjacent filled-in ditch (positive), and such a feature may be evident in at least one of the exposed profiles. Hence the simplest mode of construction could be cutting a linear trench and creating a parallel levee with the excavated material. The most convincing evidence of this hypothetical method of construction is in the Peripheral Canal, since it is large and obvious in the data; it is deep and wide, and it seems to have an embankment on its western edge.

At least two presumably interlaced networks of linear anomalies stretch through a zone about 500 to 600 m wide beside the polder dike. Tracing the visible and nonvisible field marks that correspond to the magnetic anomalies in correlating "reclassified" combinations of satellite data further supports

130. Iakovidis 1989, pp. 153, 154, 164; 1998, pp. 179, 188–191.
131. See Bintliff and Snodgrass 1985; Bintliff, Howard, and Snodgrass 2007, pp. 171–182.
132. Noack 1894; Farinetti 2011, pp. 127–135, 305–313.
133. Fossey 1990, pp. 27–32.
134. The present article excludes more recent data obtained with a separate archaeological permit with different Greek collaborators, which confirm and corroborate building and chronological observations made here (see http://myneko.umbc.edu).

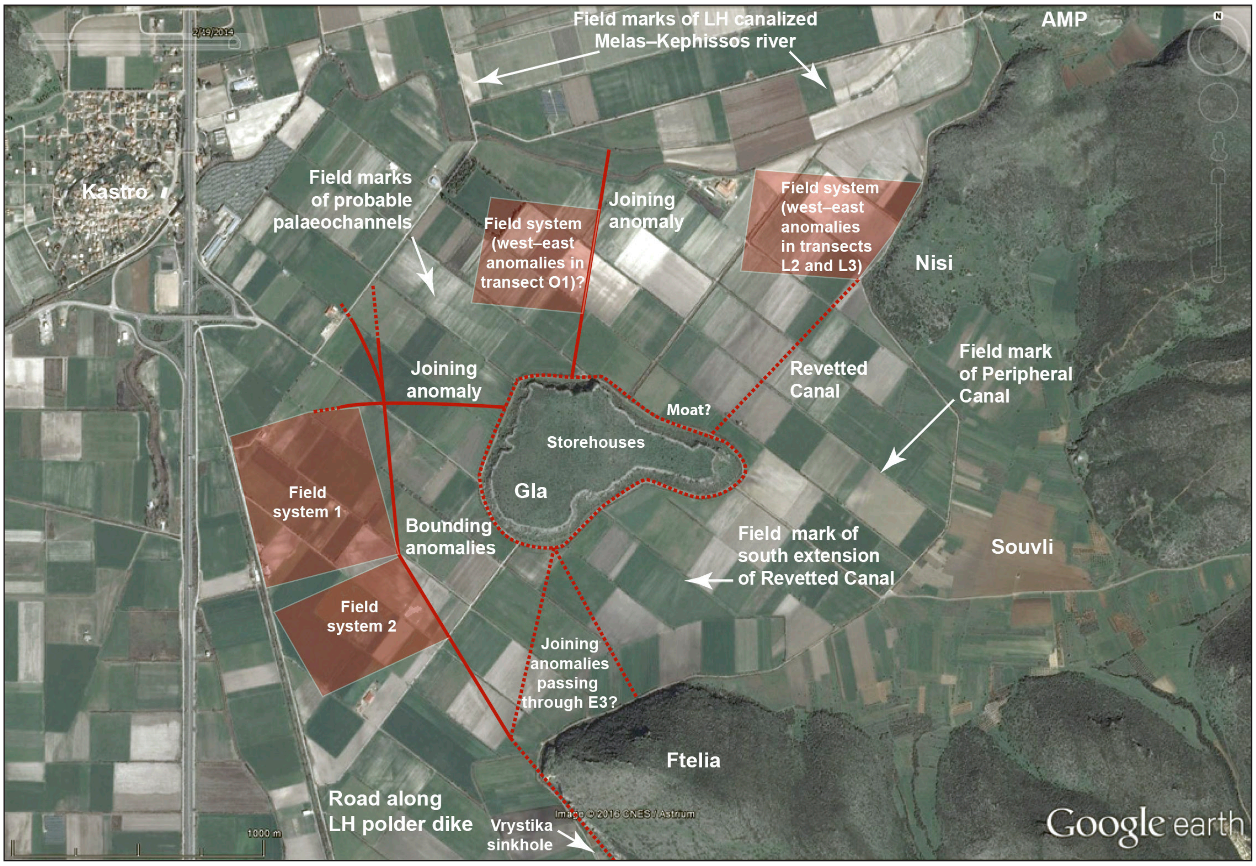


Figure 32. Current reconstruction of LH IIIB drainage, irrigation, and field systems around Gla. Satellite base image Google Earth 2014; annotations M. F. Lane

this conclusion (see Fig. 8). We may have detected other reticulate patterns elsewhere, for example, in transect L2, toward AMP to the northeast of Gla, and in O1 to the north. In any case, the reticulate patterns would be joined either to Gla or to the channeled rivers 900 m to its north by similarly constructed, albeit generally wider levees with adjacent ditches. The presence of calcareous stones and boulders in and around transects G1 and I2, as well as cobbles near O1, suggest that some of these levees were smaller, single-edge versions of the Revetted Canal.

The Revetted Canal, in addition to helping drain flood waters from the canalized Melas-Kephissos into the Vrystika sinkhole, could have brought fresh water to Gla, supplementing its cisterns. If it also contributed to the conjectured moat, then it would have been the major feeder canal for the network of ditches represented in the reticulate patterns both to the north and west, connected with them via the joining features and complemented particularly by water flowing along the linear feature between the rivers and Gla's northern scarp. The stone-revetted or paved segments of all these linear features could have doubled as causeways between Gla and the dike (and thence Kopai), Gla and the rivers (likewise), Gla and AMP, and possibly Gla and a route from the Vrystika sinkhole to Akraiphia and southern Boiotia (see Fig. 2).

The Peripheral Canal may have served as an overflow channel for the canalized rivers during extraordinary spates, supplementing the Revetted Canal. However, it is just as likely, in contrast with the latter, to have served to divert seasonal waters traveling down the canyon through Souvli, with the embankment on its western side preventing overtopping into the polder. Either way, the Peripheral Canal had to have been dredged periodically, and this activity could account for the overlapping pits apparent in the magnetometry. Of course, the conjectured hydraulic connections would require a series of gates to admit water into the polder, direct its movement therein, and possibly control its exit through the dike. The likely location and character of these gates can now be precisely explored, because of both magnetometry and satellite data analysis.

Chronology

The reconstruction above represents the system of drainage and irrigation as though perfectly complete, a phase that may never have been achieved. Nevertheless, the grain stores at Gla strongly suggest that the system came at least effectively close to completion by the end of the 13th century B.C.[135] The radiometric dates from both reticulate pattern 1 and the J1–K2 joining anomaly indicate that major components of the drainage system were already in place 300 to 400 years before the fortification was begun. Yet there is no solid evidence that Gla contained a large and permanent settlement before ca. 1300 B.C.[136] Hence it appears that Gla's establishment was a late intervention in an already well-developed agricultural landscape. The orientation of the south–north components of both reticulate pattern 1 and reticulate pattern 2 parallel to the Cyclopean polder dike might lead one to surmise that the dike had already been completed before these field systems were created. While surface exploration in the 1970s produced terminus-post-quem evidence of a MH phase of the system of polders,[137] excavation and geophysical prospection in the last decade along parts of the canalized rivers suggest that the latest phase of construction dates to LH IIIB, while parts of it have a terminus post quem no earlier than MH III.[138] Therefore, the construction of the dike to conform to the preexisting orientation of the field systems, perhaps to the contours of elevated and sometimes dry parts of the lakebed, is not out of the question. The proximity of the reticulate patterns to ancient Kopai—that is, Topolia or, since the early 20th century, "Kastro"—suggests that the field systems represented were not initially centered around Gla but instead were first undertaken to benefit this town's Bronze Age predecessor. The suggestion of a similar pattern in the northeast of the polder, below AMP, is again consistent with a field system particular to the settlement, before it was integrated into the later Gla-centered hydraulic works and administrative apparatus. Except for traces of connecting features, there is a zone around Gla largely devoid of any field mark and magnetic anomaly that cannot be interpreted as a desiccation crack or other substrate feature.

The other end of the chronological spectrum also deserves consideration. Although the earliest phase may date to the 17th century B.C., a century in which we have also found evidence of a substantial settlement at AMP at least, the herringbone pattern of anomalies in transect I1, as already noted, could be the palimpsest of repeated phases of replacement or repair. Hence the 11th- and 10th-century dates from the J1–K2 bounding feature may also be accurate. After the collapse of central administration, the maintenance

135. Iakovidis 1998, pp. 20–21, 178–179, 188–191.

136. Wace and Thompson 1912, p. 193; Iakovidis 1998, pp. 188–191.

137. Spyropoulos 1973a, 1973b; Lauffer 1973–1974; Knauss 1987, pp. 102–118.

138. Aravantinos, Kountouri, and Fappas 2006; Kountouri et al. 2013.

and repair, let alone expansion of the integrated drainage and irrigation systems would have been difficult, but they need not have gone out of use immediately. Kopai is the only littoral site in the northeast Kopaïs at which Protogeometric wares have been identified.[139] Thus, it could be that with the disintegration of the palatial economy, populations abandoned AMP, AI, and Stroviki and hunkered down at Kopai, the only place in the eastern basin recognized by Homer,[140] and continued to try to exploit claimed land in addition to Kopai's hinterland. As previously argued, Archaic–Classical populations' encroachment on the marshy margins was of different character, only later culminating and declining with the swiftly unsuccessful attempt to drain parts of the basin under Alexander.

The regularity of the land plots the reticulate patterns of features define demand comment too. The area within the vertices of reticulate pattern 1 is very nearly 900 m^2. This area is at the lower end of the size range of the Classical Greek *plethron,* as described in primary sources,[141] or of the modern *stremma,* which is between 30 and 40 m on a side.[142] Lane had expected, according to the terms of the topographic model, that Linear B value *pe-mo* GRA T 1 would be the Mycenaean equivalent to the *plethron,* insofar as it represented the area that on average could be plowed, sown, and turned over again by a person with a team of animals in one day. Given the means at the palace's disposal, however, including prime arable land and oxen, he expected it to represent a range nearer 1,600–2,400 m^2 (see Table 2).[143] Nonetheless, Linear B T is divisible into six even fractions V, each of which in turn is divisible into four fractions Z (meaning, T 1 = Z 24).[144] Hence the ca. 30 × 15 m areas delineated in transect I1, if not palimpsestic, could represent area V 3, while the ca. 30 × 20 m areas in G3 could represent V 4. These land allotment sizes are attested.[145]

THEORETICAL AND METHODOLOGICAL CONCLUSIONS

Ramifications for Regional Emerging Social Complexity

We think that the prevailing general model of emergence of social complexity in Late Helladic Greece, particularly the development of the Mycenaean state in central and southern mainland Greece (at least), may be fairly summed up as follows, the narrative trajectory being broadly neo-evolutionary, including varieties of systems theory. In the middle of the MH period, economic inequality had emerged in populations that were experiencing sudden regrowth after the rapid decline between the end of the Early Helladic (EH) period and the beginning of MH.[146] The inequality took the form of kin groups' differential access to large tracts of highly productive agricultural land and, partly contingently, to the capacity of some to buy into regional and interregional networks of exchanging wealth—that is, durable, elaborated, and/or easily bottlenecked materials or commodities.[147] Connections through Minoan Crete were crucial.[148] As communities entered the LH period, fewer of these kin groups were

139. Fossey 1988, pp. 277–281; Farinetti 2011, p. 129, 305–306.
140. Hom. *Il.* 2.502.
141. Burford 1993, pp. 113–115; Dem. 20.115; Hdt. 7.199; *IG* I[2] 376, 385; Pl. *Tht.* 174e; *Syll.* 306.13.
142. Palaiologos 1833, pp. 2–3; Psychogios 1995, pp. 24–25.
143. Lane 2009, pp. 112–114.
144. Bennett 1950; *Docs*[2], p. 55; Del Freo 2016b, pp. 160–161.
145. E.g., as discrete parcels in Pylos texts Eo 276.6.7 = En 74.7.8, Eo 224.2 = En 609.12, Eo 444.5, Eo 281.2 = En 659.6.16, Eb 874 = Ep 301.6, Eb 893.B = Ep 301.10, Eb 1176.B = Ep 539.8, Ep 613.18.19, Es 650.6.
146. See Davis et al. 1997; Cherry and Davis 2001; Wright 2004a; Bennet 2007.
147. See Voutsaki 2001, 2010; Sjöberg 2004; Wright 2004b; cf. discussion in Earle 1997, pp. 207–301.
148. See Galaty and Parkinson 2007b; Parkinson and Galaty 2007; Parkinson 2010.

supreme in any given area, generally taken to be centered on arable terrain (for example, the Argolid, Pylia, southern Boiotia), both because some outcompeted others in controlling access to long-distance exchange, and because of the military conquest and annexation of one by another.[149] By the LH III period, if not earlier, the dominant groups tried ideologically to legitimate their privileged positions with the exotica at their disposal, especially religious trappings derived from Crete.[150] Thus, at the time the palaces burned down, between ca. 1200–1190 B.C.,[151] central and southern mainland Greece comprised a patchwork of such separately evolved, more or less equally powerful "networked exclusionary" states (unlike the Minoan "corporate" states).[152] The homogeneity of elite culture among them is to be attributed to peer polity interaction, albeit somewhat ambiguously.[153]

The conditions and developments in the Kopaic Basin and more generally in Boiotia remain outliers that fit this model with difficulty. Bintliff and his colleagues have presented evidence that casts doubt on whether Boiotia ever underwent the precipitous EH–MH population decline and stasis evident in the Peloponnese and southern Aegean islands.[154] Therefore, should population pressure relative to environmental constraints in northern Boiotia have become an issue, it would have happened earlier and possibly more gradually than in southern Greece. Thus, the incentives to compete rather than to collaborate for scarce resources may not have been so exigent.[155] Furthermore, already by the middle of the MH period, Orchomenos appears to be the epicenter of production in Fine Gray Burnished (Gray Minyan) ware, which continues an EH pottery tradition.[156] It contributes a prestigious new regional style found around the northern Aegean, including parts of the Peloponnese and Anatolian coast,[157] and it persists into the LH period in central Greece.[158] This circumstance suggests the wherewithal to support long-distance communication and specialized manufactures, which could be difficult if land for mere subsistence was at a premium.

The results of AROURA make plausible other scenarios different from that of the prevailing model, namely, that gradual population pressure in the Kopaïs may have led to encroachment on wetland margins that could be

149. See Voutsaki 2001, 2010; Wright 2004b; Pullen and Tartaron 2007.

150. See Wright 2004c; Englehardt and Nagle 2011. Wright neatly sums up this process (2008, pp. 238–251). This exotica could also include Linear B, perhaps via a Cretan colony; see Hooker 1979; Palaima 1988.

151. Demakopoulou 1995; Iakovidis 1996; Mountjoy 1997; Aravantinos 1999b; Shelmerdine 2001, pp. 372–376; Vitale 2006.

152. See Blanton et al. 1996; Galaty and Parkinson 2007b; Parkinson and Galaty 2007; Englehardt and Nagle 2011.

153. See Wright 2006; Parkinson 2010; Parkinson and Galaty 2009; see also the counterpoint in Cherry and Davis 2007. We worry that "peer polity interaction" theory is easily applied in a way that assumes what it needs to prove. The peer polity model, as originally envisioned (Renfrew 1986), entailed both emulation *and* competition: in other words, one should always expect an element of the very distinction that drives the competition in the first instance, not just similitude. If one compares the classic illustration of the relations among Iron Age Greek city-states (Snodgrass 1986), one perceives that there is less variation in Linear B than between epichoric alphabets, and less variation in monumental architecture (including megara and dromos tombs) than between temples and sanctuary treasuries in the period before the Greco-Persian Wars (*Docs*^{2}, pp. 109–110; Cherry and Davis 2007, pp. 120–121; Killen 2007; Farmer and Lane 2016; see also the discussion in Petrakis 2009).

154. Bintliff and Snodgrass 1985; Bintliff, Howard, and Snodgrass 2007, pp. 171–182; Bintliff 2017.

155. Contrast the process theorized mainly for the Peloponnese by Wright (2004b, pp. 74–76; 2008, p. 244).

156. Sarri 2010b, 2012.

157. Pavúk 2010; Sarri 2010a.

158. Sarri 2010a; 2010b, pp. 209–215; 2012.

used opportunistically for crops or pasture in the proper season, as in early modern times and perhaps also as in the Archaic and Classical periods.[159] This encroachment then led to taking measures to ensure the productivity of these margins over the long term—for example, with irrigation during short-term droughts or dikes for protection against periodic floods.[160] In time, sites such as Kopai and AMP, perhaps at most periodically visited in the past, were targeted for settlement. Thus, within the basin, a mosaic of community-managed, river-fed irrigated polders grew up during the MH period. However, communal use of river water, labor coordination, and issues of usufruct boundaries of the land claimed from a previously unmarked lakebed, would have required some intercommunal process of negotiation based on traditional rights and obligations.[161] The exactness and systematization of the means of drainage and irrigation already in the MH period suggest institutions for supervision and maintenance of some nature. Curiously, all these things seem to have transpired in the absence of any of the classic trappings of a "state," "Mycenaean" or otherwise: for example, unique sumptuary rights of a ruling elite (including burial rites), third-tier or fourth-tier "capitals" with palaces or other administrative or political edifices, and written records.[162]

The settlement data are equivocal as they concern population growth in Boiotia from the later EH period through MH, except perhaps for nucleation around Orchomenos and possibly Haliartos;[163] they only indicate no steep decline in EH III, such as took place in the region to the south. Thus, socioeconomic or political-economic motivation for the "landesque" technological intensification of agriculture in the Kopaïs ought to be considered too.[164] The evident population decline in the south is correlated with the superregional late-3rd-millennium mega-drought,[165] whose effects are thought to have been exacerbated by human removal of vegetation from erosion-prone slopes. These slopes then gave way in massive episodes, contributing to the diminution of land available for subsistence agriculture, with all this circumstance entailed for population size.[166] However, the geomorphological-hydrological data from Boiotia, in addition to the settlement data, are different from those of southern Greece; there is no evidence of catastrophic erosion from the later EH period through LH, and moreover, conditions are suitable for rapid formation of fertile, arable soils on broad valley floors such as that of the Kephissos.[167]

It is thus possible that population found an equilibrium, despite punctuated climate change, because of reliance on the broad, ecologically

159. Idol 2018, pp. 82–86.

160. See Halstead on indigenous "microscale" and "mesoscale" drainage and irrigation in Greece and Spain in the absence of state authorities, where the environmental and social conditions are suitable (2014, pp. 277–281). Cf. discussion of decentralized drainage and irrigation projects in other parts of the world: Adams 1974, 2006; Gibson 1974; Lansing 1987, 1992; Erickson 2006, with review and critique of centralization premise; Scarborough 2006; McAnany and Gallareta Negró 2010, pp. 151–154.

161. Marcus and Stanish 2006b; Miller 2006; Halstead 2014, pp. 277–281.

162. See Johnson and Earle 1987, pp. 313–325; Earle 1997, pp. 8–10, 71–75; Marcus and Feinman 1998, pp. 7–10; Trigger 2003, pp. 46–48, 661–673; Yoffee 2010, pp. 34–40.

163. See Sarri 2010b, pp. 197–208; Bintliff 2017.

164. I.e., improvement of land as capital for increasing production (Sen 1959; Kirch 2006, pp. 192–196).

165. Weiss 2000.

166. See van Andel, Zangger, and Demitrack 1990; van Andel, Runnels, and Pope 1997.

167. See Shiel 2000; Bintliff 2002.

resilient valley soils, deliberate land conservation in marginal zones, or both. Under such conditions, the motive for agricultural intensification in the Kopaïs could have been Orchomenos's competition with agriculturally better-endowed settlements in the wider area, such as Thebes in southern Boiotia, for the production and political deployment of surpluses. If the interpretation of currently available evidence is correct—that is, that there was an arid trend in the regional climate from the later EH period through LH[168]—then locals might have seized the opportunity to cultivate increasing areas of at least seasonally available lake bottom. By the same climatic token, ensuring enough water for cultivation, as well as protecting this fertile land from extraordinary inundation, would have been indispensable to long-term success. A preexisting tradition of water management could have helped.

In any case, when the Mycenaean state appears as such in the Kopaic Basin, it does so relatively rapidly from the end of the LH IIIA1 period until LH IIIB1—within a century, rather than over two (see Table 1)—in the form of the fortification of Gla, the extensive improvement of the drainage system especially,[169] and the construction of a built tholos tomb and a rich, excavated chamber tomb, among lesser chamber tombs, situated around Orchomenos.[170] The tholos tomb, called the Treasury of Minyas, is a close second in size only to the so-called Treasury of Atreus at Mycenae, of which it is nearly a replica in design and embellishment.[171] To our mind, it remains an open question whether these manifestations are due to sudden peer polity competition with Mycenaean states to the south, which mobilized the resources of local communities, or to one of those states' direct intervention in this northern region. An objective of future research must be the determination of economic viability and ecological sustainability of this landesque system, in which state management is late and lasts for little more than a century before the palace economy's demise and that of the entire system thereafter.

It is worth remarking that while the Kopaïs may provide the clearest evidence of state intervention in a preexisting system of water management, it may not be the only place that does so in the LH period. A relatively primitive system of drainage has already been hypothesized for the vicinity of EH Petri in the Nemea valley,[172] an area that eventually came under the sway of Mycenae. To the extent that the landlocked poljes of Kaphyai, Pheneos, Stymphalos, and Tegea in Arkadia were already sustaining permanent settlements with the Peloponnesian population rebound of the MH period, it is plausible to think that the extant hydraulic works attributed there to the Mycenaean era are built upon earlier constructions.[173] While these constructions cannot be of the size and complexity of their contemporaries in the Kopaic Basin, the role of community water management, as much

168. See Knapp and Manning 2016; Finné et al. 2017.

169. Iakovidis 1998, 2001; Aravantinos, Kountouri, and Fappas 2006; Kountouri et al. 2013.

170. Spyropoulos 1974; Mountjoy 1983, p. 11; 1999, pp. 643–644; Kyriazi and Fappas 2015, pp. 22–24; Bennet 2017.

171. Schliemann 1881, pp. 13–46. For the revised chronology of the Treasury of Atreus, see Fitzsimons 2007, 2011.

172. Cherry and Davis 2001, pp. 154–156. Discoveries around Berbati/Prosymna and Limnes, other inland valleys above the Argive plain, led Johnson (1996) to conclude that the intensively cultivated Neolithic sites in the region favored wet meadows around artesian springs.

173. See Knauss 1991, 2001; Salowey 1994; Salavoura 2015, pp. 96–99.

as sponsored hydraulic engineering, in the emergence of social complexity in Greece seems increasingly worthy of consideration.[174] The place name *e-ko-me-no,* the Linear B spelling of Erchomenos, classical Boiotian for Orchomenos (found also in Arkadia), could signal such an undertaking.[175]

We foresee someone objecting that the radiometric dates indicate that we have discovered a prepalatial system of land division and allocation. Replying proleptically, we note that even if the entirety of the reticulate patterns dates to the 17th century B.C.—and it is uncertain that it does—the regularly demarcated areas could represent the forebears of the Mycenaean cadastral metrology, not an expression of it in developed form. The use of the formula *pe-mo* GRA, including permutations, already an abstraction of average sowing rates, is standard and widespread by the end of the Mycenaean era.[176] Furthermore, some of the basic terminology, including *ktoinā* and an alternative land division system consisting of *DA* and fractions *PA* (perhaps proportionate, rather than absolute measures), is already routine in the archives at Knossos by the Late Minoan IIIA1 period (after ca. 1430/1390 B.C.).[177] Shared metrologies around the region, especially for storable foodstuffs, is hardly surprising.[178] In any case, the evident land divisions are consistent with the fractions and multiples recorded in Linear B, and, more importantly, they seem to have served palatial purposes well, as the grain stores at Gla suggest.

Methodological Reflections

In our estimation, the most outstanding success of the AROURA project was the discovery of a Late Bronze Age agricultural landscape that could have remained undetected had we not approached it as we did. Many features have already been nearly erased since the previous investigations some 40 years ago.[179] We proved that magnetometry could be used to such an end under the right conditions in the Aegean. Together with crucial ground-truthing, it was able to test the heuristic validity of an iconic topographic model of extensive agricultural estates, producing positive results. Measurement of magnetic susceptibility provided parameters within which future technologies can be calibrated for more precise prospection under similar sedimentological conditions in the Kopaïs and beyond.[180]

The hypothesis that extensively cultivated land would contain negligible quantities of surface finds, in comparison with intensively cultivated areas or habitation sites, was not refuted. One might expect MH smallholders to

174. The Linear B corpus includes several Greek or Hellenized terms that may be related to water management, suggesting well-established practices by the palace period; see Lane 2016.

175. If this means "enclosed" or "improved [sc. land]." See Lauffer 1974; Knauss 1991; Lane 2016, pp. 112–113.

176. *Docs*², pp. 236–239; Palaima 2000–2001, 2003.

177. Driessen 2008, pp. 71–72.

178. Mycenaean metrology is consistent with classical Greek metrology (and quite different from that of Linear A), and both, particularly in their sexagesimal fractional systems (and Iron Age nomenclature), owe something to that which developed in Southwest Asia and Anatolia during the Bronze Age. See the discussion in Bennett 1950; see also *Docs*², pp. 53–56; Was 1971.

179. E.g., the extant courses of retaining walls, concentrations of boulders in fields, and subtle changes in relief above buried features around Gla and Stroviki. See Threspiades 1960; Lauffer 1973–1974, 1980; Knauss 1984; 1987, pp. 168–225.

180. In addition to classic magnetometric (magnetic gradient) survey, electromagnetic/conductivity and magnetic susceptibility survey (Gaffney and Gater 2003, pp. 42–46).

have cultivated the claimed land intensively.[181] While this may have been true to start, the uninterrupted expanses of arable, drained lakebed that also provided pasture would have lent themselves to extensive agriculture with animal inputs, with various arrangements for sharing of labor, resources, and products (perhaps ultimately to the advantage of the local rich).[182] Intensive surface collection at AMP was heuristically successful, demonstrating patterning of finds and providing some criteria for the location of future geophysical and subsurface exploration.[183]

The sublinguistic and agency-imbued approach to the texts not only can generate more iconic and structural models but can also provide material, through the discovery process, for constructing further models of contingent practices or practices independent of texts. One might consider, for example, the relevance of data from Claudia Chang's, Harold Koster's, and their colleagues' ethnoarchaeological investigations of herding sites and landscapes to new middle-range theories of the practices constituting the pastoral element of the palatial economy,[184] which was contingent on palace-administered agricultural estates and alluded through the Linear B records to interested parapalatial actors.[185] Volumetric and ergonomic studies of the human and animal labor requirements of the construction of settlements and monuments and the technological improvements of the palace agricultural regime would be apposite.[186] So too would be studies of extensive cultivation of staples and nonstaples, as well as more intensive undertakings outside the palace sector.[187] The scope of investigation can also be opened to nonpalace sectors. For example, nonpalace sites can be located and examined not for instantiation of what we think we already know in outline but rather for specific similarities and differences (the two keys to sound analogy), for instance, in administrative practices (perhaps previously unknown types and assemblages of Linear B records)[188] or in the differential consumption of palace sector or nonpalace sector goods and manufactures.[189] Through this branching out from the proxy of Linear B texts, the space of archaeological interpretation may become more tightly fitted to past inhabited human landscapes.

The AROURA project also met its goal of further researching the constitutive practices of Mycenaean economies through opening a broad

181. See n. 8, above.

182. See Erickson 2006; Kirch 2006; Miller 2006; Halstead 2014, pp. 191–324.

183. The basic sampling grid is already plotted in AROURA's GIS, the coordinate value of every corner point known. Therefore, it can be readily extended into adjacent areas and subdivided as a suitable degree of resolution required for future intensive collections of on-site and off-site areas (e.g., stratified sampling of different physiographic zones between the plain and mountaintops, comprising diverse sites).

184. Chang 1993; Chang and Tourtellotte 1993; Koster 1997.

185. Halstead 1992a, 1992b, 1996–1997, 1999a, 2007; Rougemont 2004, 2006; Bennet and Halstead 2014.

186. See, e.g., Fitzsimons 2011; Brysbaert 2015; Bilis 2016.

187. Examples of side-by-side intensive and extensive farming are discussed by Karakasidou (1997) and Zarinebaf, Bennet, and Davis (2005), and the study of proxies for such is given by Halstead (2004).

188. Discoveries continue at parapalatial sites, such as Midea and Iklaina (see Demakopoulou and Divari-Valakou 1994–1995; Cosmopoulos 2019). Professional opinion has been divided from nearly the time of discovery about the degree of literacy and consequent use of media other than unfired clay, ceramic vessels, and occasional objects of stone that may not have survived (*Docs*², pp. 109–110, 406). At the more open-minded end, one might find Palaima (1987) and Pluta (2011), and at the more conservative end Perna (2011), who thinks the extant Linear B documents are a self-contained system. Melchert (2006) argues that a Linear B fair copy of the Ahhiyawa Letters of Hattuša may have existed.

189. See, e.g., Knappett 2001; Whitelaw 2001; Parkinson 2007; Galaty 2010.

field of inquiry into and revision of the further details of the reconstructed drainage and irrigation systems. It has presented a case for its techniques being transferred and adapted effectively elsewhere, and for essentially the same practice-oriented methodology being applied to future resulting questions. Indeed, texts need not remain our starting point; the texts are convenient because of the pervasive habit of identifying agency with discrete, often named individuals and the resistance to treating linguistic texts as the result of discrete cultural practices.[190] The starting point could be anywhere in a landscape, and further well-framed ethnoarchaeology would inform appropriate middle-range theories.[191]

The identification of writing is central to archaeological discourse on the formation of first-generation states.[192] Writing thus occupies a precarious place on the Great Divide between archaeology as cross-cultural anthropology and archaeology as the handmaid of Classics, if not history more broadly.[193] On the one hand, it represents a typological degree of social complexity, while on the other—especially if writing can be rendered linguistically—it is often mined for details of the type or subtype of state that is represented. The focus on writing as a mirror of society can distract from attention to it as a concrete constitutive practice of a complex of social relations.[194] One can imagine a scenario in which Linear B was either not preserved or still undeciphered, yet Mycenaean civilization still possessed its characteristic monumental architecture, rich symbolism, and tokens of far-flung exchanges, indicative of some type of state. The hydraulic works of the Kopaïs might then also have been considered a defining feature rather than an awkward outlier, with respect to some standard model supplemented by linguistic content. Conversely, after the Great Divide, when second-generation states provide the political-economic context, archaeologists have been content to carry out cultural and economic landscape studies that supplement or test the limits of prevailing, historically defined social models.[195] Before the divide are also decidedly "pre-state" but nevertheless complex social formations, whose intricate landscapes archaeologists, in the absence of linguistic information, have investigated to understand better the disparate practices that create these formations.[196] Early states are no less deserving of or available for such agency-focused scrutiny.

190. Examples that have treated Linear B texts as transparently material culture, though sometimes only in a traditional paleographical framework, include Olivier 1967; Bennett 1979; Palaima 1988; Kyriakidis 1997–1998; Bennet 2001.

191. Besides the nonpalatial and parapalatial examples offered in the discussion, not to mention the long-ignored field marks, one could start with the palaces themselves as stages of ideological theater; see Farmer and Lane 2016.

192. Blanton 1998, pp. 161–162; Trigger 2003, pp. 585–603.

193. Renfrew 1980.

194. Smith 2003, pp. 112–115.

195. E.g., Carter 2006, pp. 9–51.

196. E.g., in Thessaly; see Orengo et al. 2015. Important exemplary exemptions to the tendency in question include Tartaron et al. 2006, 2011.

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