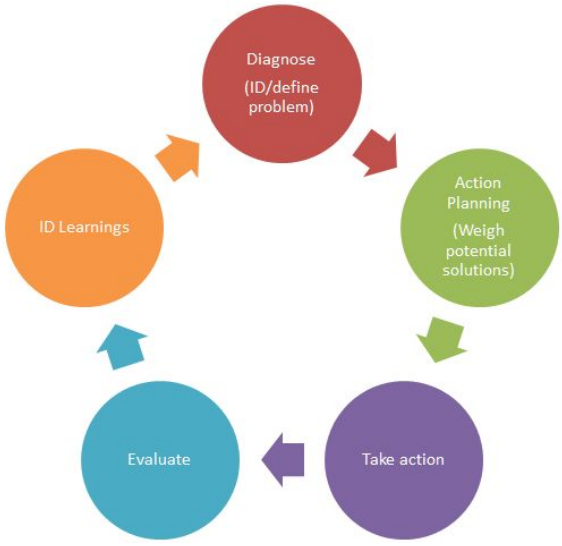
What is Design Action Research with Government

Modern cities are experiencing a unique historic moment. There is no shortage of tools available to the civic hackers among us, with more available each day. It's possible for cities to understand and plan for shifting transit patterns, to communicate to citizens in the moment, and to serve up the exact right piece of information to the specific constituent at the exact right moment. What's often lacking, however, is a suitable framework within which we can examine data, understand impacts and outcomes, and tailor future actions.

When the Boston Mayor's Office of New Urban Mechanics (MONUM) first collaborated with Emerson University's Engagement Lab, the shared goal was to foster research-based innovation in cities across the country. In part, their motivation was the explosion in the number of tools available to urban planners and city administrators around the country.

It also was clear that the combination of open data and the continued democratization of technology - in which seemingly anyone with an idea and the ability to copypasta code snippets can roll out an app - would only further the proliferation of tools, approaches, and data. At some point - whether we're already there, long since passed that point, or so short of it that it barely is visible on the horizon - the unfathomable ocean of data becomes just noise.

What is needed, then, is a framework within which civic innovators and researchers can create, analyze, and iterate. Such an approach to the delivery of public services, which is heavily influenced by Lean Startup principles, aims to create a virtuous feedback cycle.



This feedback cycle helps ensure that the efforts of civic hacker brigades are focused where they can have the greatest impact. It serves as a check, a way to confirm that the impact they are having is in line with the end goal of the project or organization. It allows for the quick recognition of unforeseen interdependencies in a way that simply is not possible in more

restrictive development environments. Perhaps most important, contained within the approach itself is the implicit acknowledgment that local, practical knowledge is as important as formal, epistemic knowledge.

The ingredients of a successful collaboration

Clear goals

Questions are a reflection of priorities. If you were to ask, “How many houses in my neighborhood are owner-occupied?”, we would assume that your goal is to effect the percent of owner-occupied households in your neighborhood. And that may be true, in some sense. What if you were to then say, “Why, no, in fact my goal is to fight neighborhood displacement that occurs as a result of gentrification”? In that case, you might ask several additional research questions about housing choices, the network effects of current and planned transportation infrastructure, or even about recreation activities and nightlife options.

Your goal wouldn’t be simply to identify the percent of households living in subsidized or some other below-market-rate rental arrangement. You would want to achieve a deeper engagement with a neighborhood, its current and former residents, and those people who might move there for their own individual motivations.

Effective, fully-invested partners

When New Urban Mechanics and The Engagement Lab first laid out design-action research as a framework for creating a more engaged civic life, a key tenet was the idea of collaboration. And not what many see as the traditional public-private, “Lets both grit our teeth and hold our nose” form of cooperation. Rather, it’s paramount that both sides be true partners.

Finding effective partners means breaking out of silos. And just to be clear, silos are not unique to government agencies. They are a common complaint among data analysts and generalist knowledge workers the world over.

There are a lot of ways to approach the search for partner organizations. The key is to find community organizations, non-profits, traditional businesses, and/or universities and academic researchers who want to research, develop, and iterate, together. Finding appropriate partners early on will allow your project to benefit from everyone’s expertise - meaning better, more relevant iterations; more reliable findings; and, more clearly articulated goals.

Are you part of an organization that would like to partner with Code for Boston? Contact us here. Just loving what you read and want to support us in building a better city? Did you know you can support us here?

How to Find a Startup: The Startup Ecosystem, The Innovation Community, and Network Effects

When the TechScene map first launched, its goal was to highlight the incredible growth, economic potential, and positive impact to the city of Boston's startup ecosystem. From modest beginnings, the app has grown to now list over 1,600 startups, representing over $38.5 billion in funds raised and over 74,000 jobs created - numbers of which any city would be eager to boast! (Are you associated with a startup and not on the map? Drop us a line, we'll add you!)

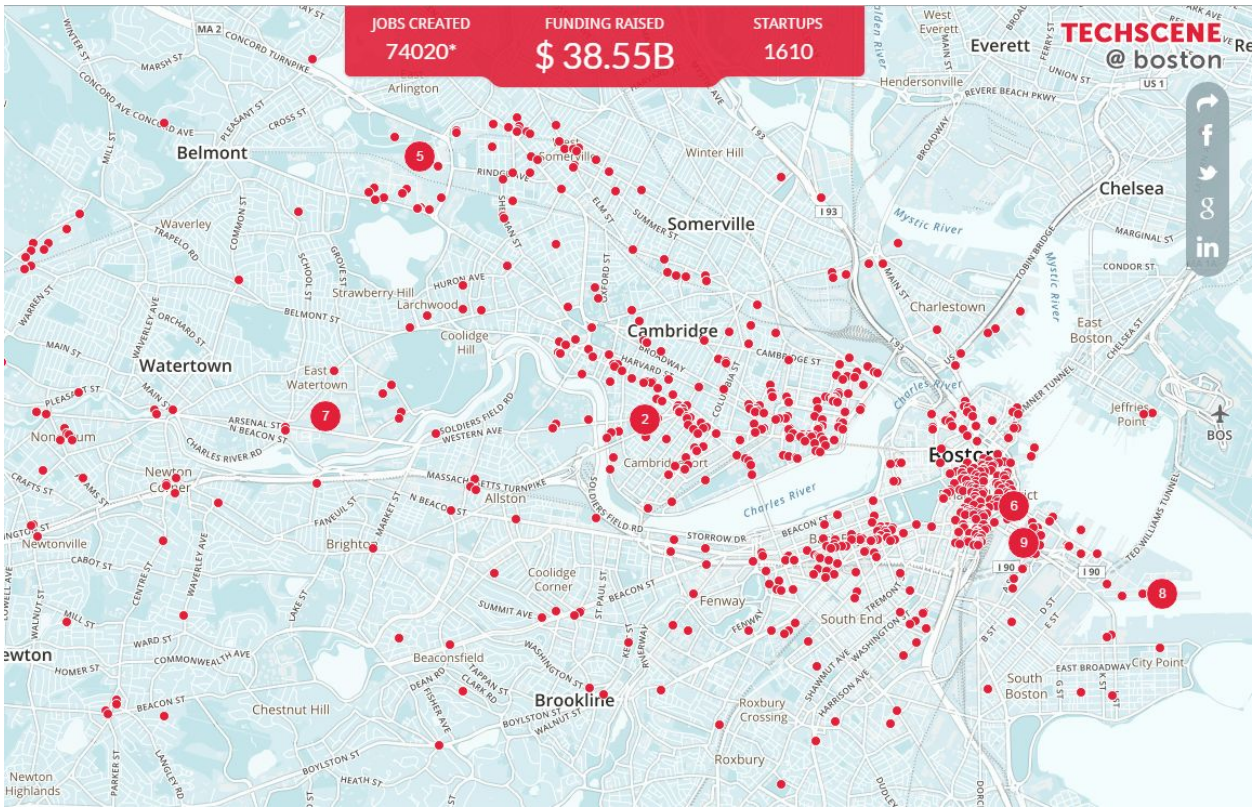
As is often the case, having created a resource and put it out into the world for consumption, we've been thrilled and amazed at the life the technology has taken on. Now, it's possible to get a view into the startup ecosystems of some of the most technologically advanced, entrepreneur-friendly cities in the country. What's more, we've started to hear from companies about deals and partnerships forged thanks to this simplest of discovery mechanisms.

All of this raises one question.

How do we get from points on a map to a thriving innovation community?

Early on, it was enough simply to quantify the scope of growth in Boston's startup scene. But from those early days, follow-on questions were quick to come to mind. What is the economic impact of Boston's plethora of new tech startups? Are they creating jobs? Are they helping the city attract outside investment? Is Boston's startup ecosystem presenting or obscuring lessons that might benefit other cities?

For years, there's been a theory that Boston suffers a brain drain. Despite the metro area's density of world-class universities and colleges, many founders and talent moved to the supposedly more robust ecosystems of Silicon Valley and New York City. Even if once true, the state of the map today would hardly support such reasoning. It's hard to look at this and not see a thriving innovation community.



There are two sides to this coin - the venture capitalists and angel investors, who might be more attracted to companies founded in a particular city as they become more familiar with the available supply of talent; and, startups themselves, especially as they pivot, increase their headcount, or expand their service and technology offerings.

How venture capitalists benefit from a healthy startup ecosystem

Technological growth has decreased the distance between potential business partners. It's easier than ever to arrange virtual meetings, and effective communication doesn't *really* require being in the same room - not in a world with Skype, Google Hangouts, and a host of advanced video tele-conferencing providers.

Telepresence technologies are so popular for the very same reason that VCs are among the biggest beneficiaries of the healthy startup ecosystems that now dot the map. As both a discovery mechanism and research tool, the Techscene startup map makes it easier than ever to find and communicate with young companies primed for growth.

The idea of traveling from San Francisco to Austin for a single meeting might be difficult to justify. Being able to identify handfuls of intriguing startups with which to meet, however, means that VCs the world over will be that much more likely to schedule in-person meetings with multiple companies in the same city, on a single trip.

Not only that, but for many venture capital arms, it's increasingly likely that they will assume a role that shares many traits more traditionally associated with business incubators and startup accelerators. This is particularly the case when it is necessary to pair founders with a technology team, and when asked to assist portfolio companies as they grow and increase headcount. In fostering the growth of and engaging with a city's startup community, VCs are better able to quickly connect with relevant expertise as needed.

How your startup benefits from the network effect of an innovation community

Growing companies have needs across the spectrum. Incorporation into existing founder networks is a powerful solution to many such hurdles, but still leaves the question of how to gain access to those networks in the first place. Tools that aid the investment community in their discovery of promising ventures, such as the TechScene map, can help startups gain initial traction. As Matt Hurley, co-founder of the business accelerator Dat Venture, notes:

> "Boston's extensive startup network helps our international entrepreneurs find mentors to chat over coffee with, identify investors to pitch their companies to, and discover new customers and partners. Gaining exposure to this ecosystem is a critical task for growth-stage companies that have good traction overseas but need to expand into the US market in order to secure their next round of funding and internationalize their companies."

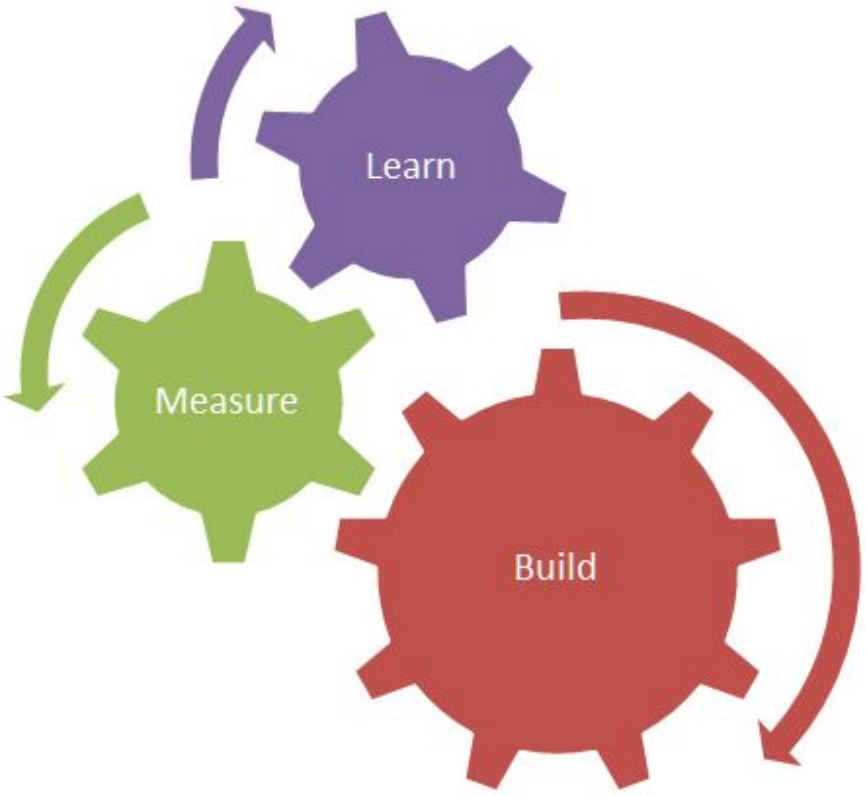
There’s good news and there’s bad news to go along with that fact. It’s always better to end on a high note, so we’ll tackle the bad news first.

The bad news is, there now are so many tools available to accomplish any single goal that it can require expert advice just to decide on a CMS for your website, or a CRM for your sales team. And that says nothing about the plethora of languages and frameworks with which web developers might have to engage on a given project. Diversity of choice may be a social good, but it’s a headache from a business operations perspective.

The good news is that, with the explosion in the number of tools there has been a proportionate increase in experts available. Being part of a thriving innovation community means easy access to the expertise of companies, like yours, that just want to build cool things and help their clients realize their business goals.

Whether it’s finding a well-regarded Elasticsearch developer to better integrate search functionality in your application, identifying a full-service ember.js development team to serve as your technological partners on a new venture, or recruiting a new hire that addresses real issues in your current organization, the broader and deeper startup communities being fostered across the country are making it easier than ever before for businesses at all stages of growth to identify and address their needs.

To learn more about how Greenfield can help you build a stunning web app from your data, contact us today. And make sure you know about our new content as we post it by subscribing to our blog here.



Agile Research: Mindset or Method?

According to Eric Ries, author of *The Lean Startup*, lean thinking answers the following question: “What is the least amount of resources I can devote to this question in order to validate my core hypothesis?”

Lean startup principles originally centered on the concept of a minimum viable product – a proof of concept. Applying market research validated learning with an eye toward marketing automation, however, represents a new and novel application of lean business practices. The core tenet is as simple as it is powerful – build-measure-learn. For marketing, insight, and innovations departments, these principles can be used to arrive at minimum viable insights.

Testing is not a four letter word

One all-too-common approach in insights departments is to go through the development process and test only a handful of preferred versions before launch, or not even to test because traditional research tools are too slow. Meanwhile, you may have turned your back on a truly resonant idea, like Apple nearly did with their iconic iPod silhouette campaign.

It's not surprising that when we visit with Fortune 500 companies the mere mention of the word 'test' is taboo, like wearing Puma sneakers to a meeting at adidas. We, the market research industry, have ourselves to blame. Testing historically has been done as a blind pass or fail. Good students know exactly what they will get on the test as soon as they hand it in because they have done the work. In reality, over 70% of new CPG products fail within the first year and a majority of the advertisements on TV fail to break through the noise because we have not been studying. If we bring the consumer to our board tables and into our marketing and creative departments early and often we will know with statistical confidence that we will pass the test because we have done our homework.

In the case of creative, especially, it makes economic sense to move testing up-funnel. Products like Millward Brown's LinkNow let you pay for validated learning regarding your core assumptions around creative so you make informed decisions as to which ideas to bet on:

- Does it make economic sense to earmark the same or greater spend only for the final cut stage of your creative development process?
- What if all of the iterations you're considering fail to resonate with audiences?
- What if a discarded, outside-of-the-box idea held unrealized potential?

Evaluating multiple ideas early and often will give you a better chance of identifying the execution that truly resonates with your target consumer.

Minimum Viable Insight

The true value of constant, iterative analysis is the improved executions you will generate. At each iteration, you derive the minimum viable insight that allows you to move the creative, innovation, or new product through to its next iteration, until you arrive at the ideal execution.

This is why the agile mindset is so key. You need to know when to be lean, when to say that an insight is good enough, and also when to dive deep to get at the core of understanding the impact your execution will have on your business. Cost savings in research, media, and development spend are ancillary The true value in your business adopting the agile research mindset comes from inviting the consumer into the process throughout, and knowing that what you do will not just move the needle with them, but blow it up!

What should a good ad look like?

We've all seen groupthink. Maybe it's too many notes from the studio in the runup to a big budget movie. Maybe it's an overly polished line in a politician's stump speech. Or maybe it's a new product launch that debuts to crickets on the market, a Crystal Pepsi for the digital age.

In each scenario, the shared misstep occurred long before the market spoke. Not testing early and often hamstrings your business, leaving it without certain ideas that might have better resonated with your core audience. Had you tested from the start, along the way you would have focused your spend on the creative that had passed some hurdle of quality, rather than trying to reshape irrelevant creative through focus group feedback.

In other words, **you would already have proved the business case in support of each proposed piece of creative, or new product**. Your market research spend therefore would be more efficient, and your subsequent learning would allow you to **iterate on and improve already-relevant creative**.

Would you rather spend $27,000 for the in-depth testing of just a handful of final cuts, and some number of man hours pulling together your findings into a polished, digestible presentation only to find out that you don't have a single good option in the bunch? Or would you rather spend some significantly smaller sum to gauge many ideas at an earlier stage of development, so that you identify those ideas that most strongly resonate with your customers' expectations? We might as well ask if you'd rather start on third base.

The Power of Iteration

The steps you take are clearly defined in any validated learning process.

You start with the exploration phase, centered on customer interviews and surveys. Exploration generates broad insight into the market's expectations for and reactions to your various creative.

From exploration you progress to the pitch – asking a potential customer for something in exchange for you solving a specific problem they have.

The final step in your evaluation is the concierge service – you deliver your pitch with as little overhead as possible, to as few customers as possible, until they're giddy with your product.

Each element – exploration, pitch, and concierge – is integral to true validated learning. Each step must be undertaken in order. Each step increases the total cost of your market research and creative development. **And each step is best suited to a particular stage of your creative development process.**

Analyzing your creative throughout the development process will protect you against catastrophic failure on the scale of New Coke, M. Night Shyamalan movies, and Homer Simpson-designed luxury automobiles. That's how agile research breaks down barriers to doing market research.

You'll have proved, ahead of the investment of scaling up to deliver your idea to a broad audience, that your idea is a winner. It will be like taking an open-book final exam – meanwhile, your competition doesn't even know there's a test today.

At its core, any business decision is about achieving the greatest possible return for the least amount of risk and with the smallest possible investment. Think back to your days at university – sure, there were classes where you were able to roll in and ace a test. But how much more confident did you feel in those other instances, when you'd diligently reviewed your notes, read the textbook, and gone to the study sessions?

The goal for a modern creative department or agile marketing team, then, must be to collect information on how their output is perceived from as many potential customers as possible, as quickly and for as little money as possible.

What would such "holy grail" look like? It would be a standardized survey that can be implemented quickly, with results available in hours, not weeks. If you would like to find out if such a holy grail exists, or if you just want to continue the debate and discussion further, feel free to email me at ryan.barry@zappistore.com

HESPERIA 78 (2009)
Pages 165–194

WARFARE IN NEOLITHIC THESSALY

A Case Study

ABSTRACT

Cross-cultural archaeological and ethnographic evidence for warfare in farming societies invites us to reconsider the traditional picture of the Greek Neolithic (ca. 7000–3400 B.C.) as a period of peaceful coexistence among subsistence farmers. Archaeological correlates of intercommunal conflict in the prehistoric American Southwest and the widespread evidence for warfare in Neolithic Europe suggest that warfare is also likely to have taken place in Neolithic Greece. The well-known Neolithic record for Thessaly reveals evidence for warfare in defensive structures, weapons, and settlement patterns. Competition for resources such as arable land, grazing rights, and water may have contributed to the causes of Greek Neolithic warfare.

Did warfare exist in Neolithic Greece?[1] The question is difficult to answer because early warfare, apart from Bronze Age warfare, has received relatively little attention from Aegean prehistorians.[2] It is unlikely, however, that warfare began abruptly with the Bronze Age, and we believe that it is reasonable to trace the roots of warfare back to the Neolithic period. Until recently, it was thought that warfare was negligible in prehistoric times, but new research on prehistoric warfare, along with warfare among contemporary foragers and farmers around the world, challenges this view.[3] An ever-increasing number of case studies have created a consensus that prehistoric warfare was widespread in the Old World in general, and specifically in Neolithic Europe.[4] Indeed, if warfare could be shown *not* to be present in Greek Neolithic society, in light of current research on Neolithic warfare in Europe, Greece would represent an anomalous exception. On the basis

1. We would like to thank Priscilla Murray and Eliza McClennen for their drawings and maps, and also the anonymous *Hesperia* reviewers who helped us to refine our arguments.

2. See, e.g., Renfrew 1972; Drews 1993.

3. There is a large and growing literature on prehistoric warfare: e.g., Keeley 1996; Carman and Harding 1999; LeBlanc 1999, 2006; Kelly 2000; LeBlanc and Register 2003; Christensen 2004.

4. For case studies, see, e.g., Roper 1975; Villa et al. 1986; Keeley and Cahen 1989; Christensen 2004. For the Old World, see Vencl 1984; Gat 1999, 2006; Young 2005; Guilaine and Zammit 2005; Golitko and Keeley 2007; and Parkinson and Duffy 2007, pp. 114–115, where the growing consensus among European prehistorians for Neolithic warfare is summarized.

of the emerging understanding of prehistoric warfare, and in agreement with Parkinson and Duffy, who argue for a continental-scale, cross-cultural study of this topic, we believe an evaluation of the existence of warfare in the Greek Neolithic is both desirable and timely.[5]

To begin, what do we mean by prehistoric warfare? A number of definitions of warfare have been formulated that apply to societies at levels of socioeconomic organization below that of states, which in the Aegean emerge only after the Neolithic. In keeping with our objective of dealing with the less complex, village-based Neolithic agriculturalists, we follow Christensen in defining warfare as "the use of organized lethal force by one group against another independent group."[6] This definition is more succinct than others, and, at least when it is applied to early agriculturalists, avoids the usual, but not useful, anthropological distinction between "primitive" and "civilized" warfare.[7] This definition of warfare recognizes that force is sanctioned by society and that it is this sanctioning of force that distinguishes warfare from other categories of human conflict such as intragroup conflict, vendetta, and murder. This definition does not confine warfare to the use of physical force in conflict, but embraces the patterned and recurring events connected with the preparation for war in personnel training, the manufacture of weapons, and the building of fortifications. It also addresses the hierarchical social structure that permits the specialization of individuals as warriors, and the consequences of conflict, such as the destruction of settlements or the displacement of populations. We believe that the perceived threat of warfare is as important as actual combat for interpreting the archaeological record, because a perceived threat may result in the same material correlates—such as fortification walls or weapons—as those resulting from warfare.

Research on prehistoric warfare is hindered by the inherent difficulties involved in identifying the specific characteristics of the prehistoric archaeological record that can be connected with conflict. Our approach was inspired by LeBlanc's case study of prehistoric warfare in the American Southwest,[8] where environmental and cultural conditions are similar to those in Neolithic Greece. LeBlanc identified a number of specific archaeological features that serve as material correlates or proxy evidence for the existence of warfare. These include, but are not limited to, particular classes of artifacts, skeletal pathologies, sex ratios in mortuary data, specific site locations, internal site structures, fortifications, differential histories of sites within clusters, and regional settlement patterns, particularly those exhibiting clusters of sites separated by open territories, or "no-man's-lands." Many of these features can be identified in other regions of the United States, such as the northwest coast and the eastern United States,[9] but it is the quality of the preservation of archaeological sites in the American Southwest that makes this region ideal for this sort of study.

5. Parkinson and Duffy 2007. Our study is a regional contribution toward an understanding of what seems to be a general social phenomenon in Europe.

6. Christensen 2004, pp. 129–130.

7. See, e.g., Otterbein 2004, pp. 9–10: "armed combat between political communities"; other definitions are discussed by LeBlanc and Register (2003).

8. LeBlanc 1999.

9. Maschner and Reedy-Maschner 1997; Milner 1999.

PREVIOUS RESEARCH ON NEOLITHIC WARFARE IN THESSALY

For this study we applied the archaeological correlates for warfare derived from the study of the American Southwest to the Neolithic in eastern Thessaly (Fig. 1). The comparison is relevant because of the many similarities between Neolithic Thessaly and the American Southwest: levels of social complexity based on small villages, typically smaller than 4 hectares (ha), with populations probably under 500 individuals; villages with architectural forms consisting of rectangular domestic structures of adobe brick or stone; economies based on agricultural production using digging sticks; a technology based on flaked- and ground-stone implements; and the production and use of handmade pottery. The environmental settings are also similar. Thessaly and the American Southwest are arid regions where human settlement is dependent on perennial rivers or other hydrographically favored localities to supply water for agricultural production.

Another reason for looking at Thessaly is the long history of archaeological research there.[10] After more than a century of research, there are many known sites, more than 400 in eastern Thessaly alone.[11] These sites are low flat mounds or high tells (locally called *magoules*) widely interpreted as the remains of permanently settled villages of 1–4 ha in size (Fig. 2).[12]

The history of research reveals that the archaeological consensus on the existence of Neolithic warfare has swung back and forth, largely in concert with the popularity of theoretical models of cultural processes. A review of this research will help place our study in its sociological context.

At the beginning of the 20th century, the consensus was that Neolithic Thessaly was a peaceful place. As the result of their surveys and test excavations, Wace and Thompson concluded that early in the Neolithic "as far as can yet be known, the first inhabitants of North-Eastern Greece lived an uneventful life free from foreign invasion and more or less at peace among themselves."[13] Wace and Thompson acknowledged that during the transition from, in their terminology, Neolithic A to Neolithic B, the early period of peaceful coexistence ended. They write:

> [the period] ends in a great upheaval, many sites are abandoned, new styles of pottery suddenly make their appearance, and Northern Greece no longer possesses a uniform culture extending from end to end. . . . The question at once arises is Dhimini ware a rapid indigenous growth or the result of an inroad [?] . . . [a] general resemblance to other painted wares in Thrace points to invasion [and the walls of Dhimini are] the mark of an invading race, who came and meant to stay.[14]

It is evident that for Wace and Thompson Neolithic culture was essentially static and that change was induced by exogenous forces in the form of migrations or invasions of new peoples. This view of cultural change was widespread among European prehistorians, but in Thessaly it can be traced in part to the use by Wace and Thompson of the chronology developed by Tsountas.[15] Tsountas divided the Thessalian Neolithic into

10. See, e.g., Wace and Thompson 1912.

11. See, e.g., Theocharis 1973, pp. 33–110; 1974; Papathanassopoulos 1996, pp. 49–68; Halstead 1999b; Perlès 2001, pp. 121–151.

12. Gallis 1992.

13. Wace and Thompson 1912, p. 242.

14. Wace and Thompson 1912, pp. 242–243.

15. Tsountas 1908.

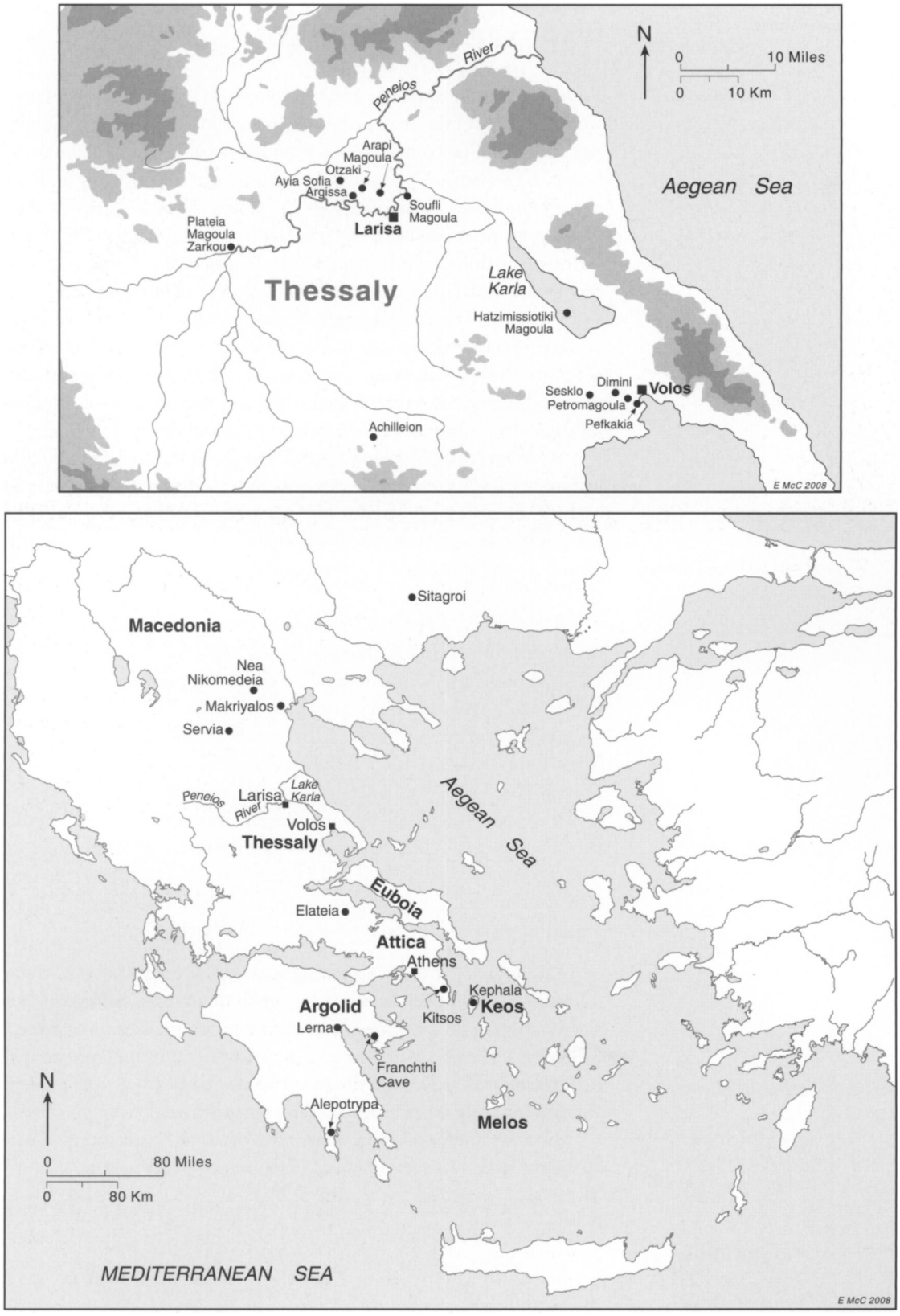


Figure 1. Maps showing the principal Greek sites and locations mentioned in the text. E. McClennen

Figure 2. View of the eastern Thessalian plain. Photo C. N. Runnels

two undated phases, Neolithic A (now Middle Neolithic) and Neolithic B (now Late Neolithic), a scenario that was later amended to include a Pre-Sesklo culture corresponding to the Early Neolithic and a Post-Dimini culture corresponding to the Final Neolithic.[16] This initial two-part scheme contributed to the widespread assumption that invasion and migration were necessary to explain cultural change. This broad chronology with only two very different cultural phases seemed to Wace and Thompson to result from a complete cultural break from Neolithic A to Neolithic B, an abrupt transition that suggested the succession of unrelated archaeological cultures.

Our review of the literature suggests that archaeologists in the 20th century continued to regard Neolithic Thessaly as uncomplicated and peaceful, at least as far as internal affairs were concerned. Thus, any evidence for warfare such as weapons, fortifications, or burned settlements that turned up in the course of excavation could be attributed to invaders or immigrants. The tendency to explain cultural change through invasions and migrations—which was certainly justified by historical events such as the folk migrations of the Huns or Visigoths in antiquity, and by apparently abrupt changes in the archaeological record—persisted throughout the 20th century, and was especially popular in southeast Europe.[17]

Although invasions and migrations are indeed sources of cultural change at times, the abrupt changes in material culture evident to Tsountas, Wace, and Thompson in Neolithic Thessaly reflect the incomplete nature of the archaeological record and the paucity of research. Gaps in the archaeological record were taken to indicate abrupt and rapid cultural change because new forms of decorated ceramics or domestic architecture appeared suddenly, without antecedent forms. Later generations of archaeologists found the limited scope of early excavations inadequate for identifying the numerous small and discontinuous stratigraphic layers that often characterize deeply stratified tells. The problem of interpreting cultural change

16. Weinberg 1970, pp. 572–575.

17. Parkinson and Duffy (2007, pp. 114–115) remind us that models of invasion and migration remained popular among central and eastern European prehistorians for much of the 20th century, even when they fell out of favor elsewhere.

was complicated by the lack of a reliable chronology. It was not possible to challenge the invasion/migration model until the 1950s; with the end of World War II and the Greek civil war, which had prevented research in Thessaly, a number of new excavations began, bringing finer stratigraphic control and more detailed chronologies.[18]

Invasion and migration, however, continued to be the preferred explanations for Neolithic cultural change in Thessaly for some time. As Tomkins puts it, "the Childean view of Neolithic societies, as isolated, self-sufficient entities, lacking social stratification and craft specialization and preoccupied with the production of their own subsistence . . . hugely influenced the standard view."[19] Weinberg was voicing this standard view when he noted that "the existence of fortifications in a few places in Thessaly probably indicates some apprehension, possibly on the part of newcomers who felt it necessary to consolidate their position,"[20] and argued that "the varieties of cultures present in different parts of Greece in the latter half of the fourth millennium B.C. . . . are indications both of the arrival of new peoples from east and north and of the beginning of a new way of life."[21]

As late as the 1960s, Vermeule continued to subscribe to the invasion/migration model, and in her influential textbook on Bronze Age Greece she explained changes coinciding with the transition from Neolithic A to Neolithic B thus:

> Dimeni [*sic*] mound, neighbor of Sesklo, represents a disruptive event in Neolithic history. . . . After the long promising developments seen at Sesklo, new people invaded the eastern valleys of Thessaly; some of the established villages, which had never fortified themselves, were burned, and many were overlaid by a characteristically alien though connected culture.[22]

It was only after the 1960s that the two-stage model of a peaceful Sesklo culture being supplanted by the invasive Dimini culture changed as the result of methodological, theoretical, and chronological developments. In methodological terms, as noted above, the expansion of archaeological research in Greece after World War II and the Greek civil war contributed new evidence.[23] Site surveys and excavations throughout Greece, from Argissa, Otzaki, and Pefkakia in Thessaly to Lerna and Franchthi Cave in the Argolid, were used in the 1970s to construct a new system based on four phases of Neolithic culture: the Early Neolithic (EN), Middle Neolithic (MN), Late Neolithic (LN), and Final Neolithic (FN).[24] Although further refinements have been suggested, this four-part scheme is now widely used.[25]

In theoretical terms, scholars in the United States and United Kingdom were influenced to abandon invasion/migration models by the rise of the New Archaeology, a movement that combined evolutionary models, positivism, and Marxian thought, and that favored the interpretation of cultural change as the result of the often gradual action of indigenous cultural processes.[26] The embrace of this new theoretical orientation was in some ways unfortunate, because the invasion/migration model was abandoned without due consideration; it remains a plausible explanation for cultural change, and one that requires further examination.[27]

18. See Gallis 1979.
19. Tomkins 2004, p. 39.
20. Weinberg 1970, p. 600.
21. Weinberg 1970, p. 608.
22. Vermeule 1964, p. 14.
23. Theocharis 1973, 1974; Gallis 1979.
24. Weinberg 1970.
25. Demoule and Perlès 1993.
26. Trigger (1989, pp. 289–328) summarizes the goals of the New Archaeology; see Watson, LeBlanc, and Redman (1971) for a contemporary expression of this movement.
27. See also Andreou, Fotiadis, and Kotsakis 2001, pp. 263–266, 297.

Finally, the division of the Neolithic into four cultural phases was supported by the expansion of Neolithic chronology by radiocarbon dating. While Tsountas had difficulty pushing the beginning of the Neolithic as far back as 3000 B.C., radiocarbon dating has now shown that the Neolithic in Thessaly began close to 7000 B.C.[28] This expanded chronology made it possible to distinguish long-term patterns of development in architecture, pottery, fictile art, and mortuary customs, in line with the concept favored by the New Archaeology that there was no need to invoke abrupt cultural breaks between phases. Now there was adequate time in the course of the long Neolithic period for the working out of local cultural processes to produce the changes we observe in the material record. As a consequence of these developments, Theocharis was able to stress cultural continuity in the Thessalian Neolithic, although he continued to acknowledge evidence for conflict:

> A certain amount of cultural differentiation during the second half of the period indicates an atmosphere of disquiet and disturbance, which was eventually to erupt into more violent manifestations [with site destructions and abandonments].[29]

The new model of endogenous cultural processes did not require intercommunal violence as an explanation, and after the 1970s the Neolithic landscape was widely understood to be characterized by cultural continuity and the peaceful coexistence of politically egalitarian societies.[30] One example of the effect of the new model on the interpretation of Neolithic society can be seen in the treatment of the walls and ditches, often in concentric bands, that encircle Neolithic sites like Argissa, Sesklo, and Dimini. These features had been interpreted as fortifications for half a century, but were reinterpreted as symbolic features intended to serve ritual purposes, and as markers of space and animal enclosures.[31] Archaeologists continued to elaborate a model of peaceful local change by assuming that social conditions predominant in Neolithic Thessaly, a region where fluctuations in agricultural success due to microclimatic variation make conflict dangerous and unnecessary, enabled cooperation among communities through sharing, delayed-return obligations, negotiation, social reciprocity, and alliances.[32] It can be argued that peaceful relations were in fact required by the instability of a climate that created unequal agricultural yields in Thessaly, with its variations in topography, elevation, and microclimates. Such conditions may have rewarded societies that pursued the sharing of resources and the mitigation of conflict, and this in turn may have led to communal interaction and bad-year economic strategies of subsistence and recovery performed through peaceful contacts such as intermarriage, trade, and social partnership.[33]

This model of communal interaction is useful for explaining some aspects of the archaeological record and leads to interesting conclusions, but it of course does not rule out the possibility of violence in Neolithic society. In eastern Thessaly, for instance, Halstead notes the tendency of Neolithic social structure to become segmented and isolated over time in terms of physical space.[34] The structuring of domestic spaces suggests that familial areas were partitioned to separate them from communal spaces,

28. Perlès 2001, pp. 98–120.
29. Theocharis 1974, p. 73.
30. Theocharis 1973; Demoule and Perlès 1993; Halstead 1999a, pp. 89–90.
31. Gallis 1996, p. 65; Kotsakis 1999, p. 71; Andreou, Fotiadis, and Kotsakis 2001, pp. 265–266, 268, 294–295.
32. See, e.g., Halstead 1999a.
33. Halstead 1999a, p. 90.
34. Halstead 1999a, p. 79.

with the result that village areas were subdivided by ditches or walls, a move he associates with the contemporary segmentation of decorative motifs on pottery. These symbolic moves were calculated to signal the "less inclusive nature of Late Neolithic hospitality."[35] In short, the assessment of Neolithic cultural change due to violence in the form of invasions and migrations was ultimately abandoned and was replaced with a model that stressed cultural change as the result of endogenous social processes, largely peaceful in nature.

NEOLITHIC WARFARE IN THESSALY

We believe that the time has come to revisit the question of violence in Greek Neolithic culture. As noted in the introduction, we are guided by previous research into warfare in the prehistoric American Southwest. Strong material correlates in the archaeological record for the presence of warfare include walls and ditches, particularly those with gates suitable for controlling passage into and within a site; skeletal remains with indications of violence; the presence of weapons; and the separation of groups of sites by unoccupied territories, or no-man's-lands.[36]

Walls, Ditches, and Gates

Features interpreted as having a military function have been identified at many European Neolithic sites.[37] These features include perimeter walls of stone or mud brick, palisades, ditches, baffle gates, flanking buttresses, wall projections, and towers. Such features are often described as defensive in nature, although this explanation is not universally accepted. We acknowledge that there are many alternative social and symbolic explanations for some of these features, and can only agree with Parkinson and Duffy that "the main interpretive conclusion to be drawn from the last 20 years of archaeological research on enclosures and fortifications is that there is none."[38] Although a single explanation for any of these features is not possible, or indeed necessary, warfare as an explanation is still a strong possibility, and indeed is now widely accepted by European prehistorians.[39]

We argue here that walls and ditches in Thessaly are indeed fortifications, but we cannot exclude entirely the possibility of symbolic roles for these same features. Nevertheless, we are persuaded by Parkinson and Duffy, who argue that there are reasons for connecting the appearance of communally constructed features like walls and ditches in Neolithic Europe with the emergence of segmentary social units such as descent groups, and their attendant institutions in Neolithic societies—a pattern that they extend from Greece across the entire continent of Europe.[40] Although Neolithic walls and ditches may have served many functions, from mundane domestic tasks such as controlling the movement of animals to symbolic uses as representations of boundaries, many archaeologists, anthropologists, and military historians strongly associate them with military defense.[41]

It is hard to imagine that some villages were building defensive ditches and walls while their contemporaries were using these same constructions for completely different purposes, and we must ask how we know that

35. Halstead 1999a, p. 80.

36. LeBlanc 1999, pp. 43–91.

37. Keeley and Cahen 1989; Keeley, Fontana, and Quick 2007; Parkinson and Duffy 2007.

38. Parkinson and Duffy 2007, pp. 112–113.

39. Parkinson and Duffy 2007, pp. 114–116.

40. Parkinson and Duffy 2007, pp. 100–105.

41. Keeley and Cahen 1989; Saville 2002; Tinevez 2002; Keeley, Fontana, and Quick 2007.

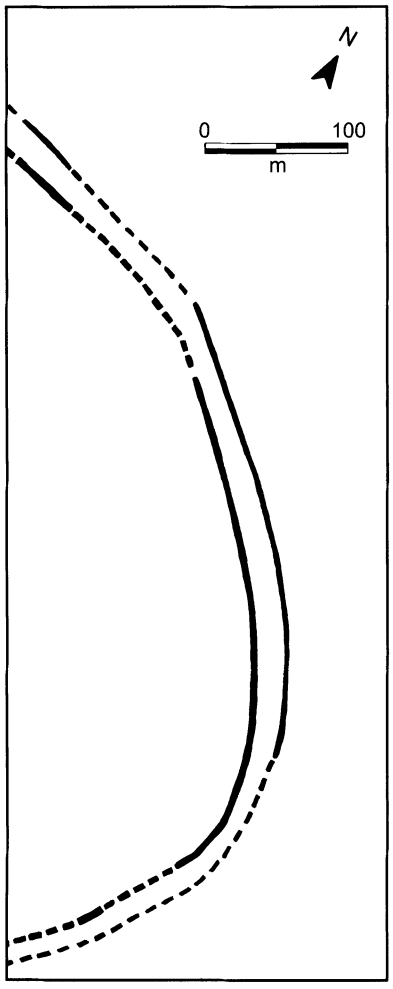


Figure 3. Neolithic ditches at Makriyalos. Drawing P. M. Murray, after Pappa and Besios 1999, p. 115, fig. 7.6 (inset)

ditches and walls were in fact intended for defense. For broad swaths of Neolithic Europe, the military functions of ditches and walls have been argued convincingly. At least 70% of the Early Neolithic Linearbandkeramik (LBK) sites in central Europe, for instance, are enclosed with ditches averaging 2.8 m in width and 1.6 m in depth, and 54% of these enclosures have baffle gates, that is, openings with defensive arrangements such as dogleg shapes designed to prevent easy access.[42] In addition, Golitko and Keeley note that the LBK ditches typically have V- or Y-shaped sections that "are impractical for any domestic purpose, as they erode more quickly than any other form and are more difficult to dig, but . . . represent an ideal form for purposes of defence against human attack."[43] Enclosures, whether ditches, palisades, walls, or some combination of these, are certain to be of military significance when they have complex gate or opening arrangements such as offsets, doglegs, or screens, all of which are identified by military historians and archaeologists alike as "classic defensive features at numerous sites stretching across thousands of years of history."[44]

In Thessaly, walls, ditches, or a combination of the two encircle many sites, at least partially. Argissa, on the northern bank of the Peneios River, and Soufli Magoula, Arapi Magoula, and Otzaki, in the same general area, have concentric ditches on the outer edges of the settlements similar to those found elsewhere in Greece, for example, at Servia, Nea Nikomedeia, and Makriyalos in Macedonia.[45] Two concentric ditches encircle the EN site of Nea Nikomedeia, but the limited excavated area prevents detailed analysis of their function.[46] The LN site of Makriyalos on the northern edge of our study area has two ditches that appear to be defensive in nature.[47] The inner ditch (Alpha) averages 4.5 m in width and is 3.5–4.5 m deep, and the outer ditch (Beta) is somewhat narrower but is equally deep (Fig. 3). Both ditches have V-shaped sections. The published plan shows a number of openings in the two ditches offset in a way that can be interpreted as serving defensive purposes.[48] In addition, ditch Alpha was strengthened by adobe and stone walls. Alpha was created over a number of years as a series of deep pits that were eventually connected, and it was also used for the disposal of the dead.[49] Corpses were thrown "carelessly into the ditch and . . . left there without any special treatment."[50] The fragmentary human skeletons in the ditch are represented by scattered disarticulated bones from at least 50–60 individuals—males and females—of all ages.[51] Although the causes of death of the Makriyalos dead have not been ascertained, similar accumulations of human bone in ditches are widely attested in LBK Europe, where they are interpreted as particularly convincing evidence for warfare.[52]

42. Golitko and Keeley 2007, p. 338; Keeley, Fontana, and Quick 2007.

43. Golitko and Keeley 2007, p. 337.

44. Golitko and Keeley 2007, p. 337.

45. Pyke and Yiouni 1996; Kokkinidou and Nikolaidou 1999; Andreou, Fotiadis, and Kotsakis 2001.

46. Pyke and Yiouni 1996, pp. 39–53, fig. 3.3.

47. Pappa and Besios 1999, pp. 113–115.

48. Pappa and Besios 1999, p. 113, fig. 7.4.

49. Andreou, Fotiadis, and Kotsakis (2001, pp. 294–295) discuss the episodic nature of the digging at the site, and, following Hodder (1992, pp. 232–233), they speculate on the symbolic and social functions of such activities, which may have involved competition between social units in the community; they emphasize that the process of creating these ditches could have been as significant as the finished product.

50. Pappa and Besios 1999, p. 116.

51. Triantaphyllou 1999, pp. 129–130.

52. Golitko and Keeley 2007, pp. 334–335.

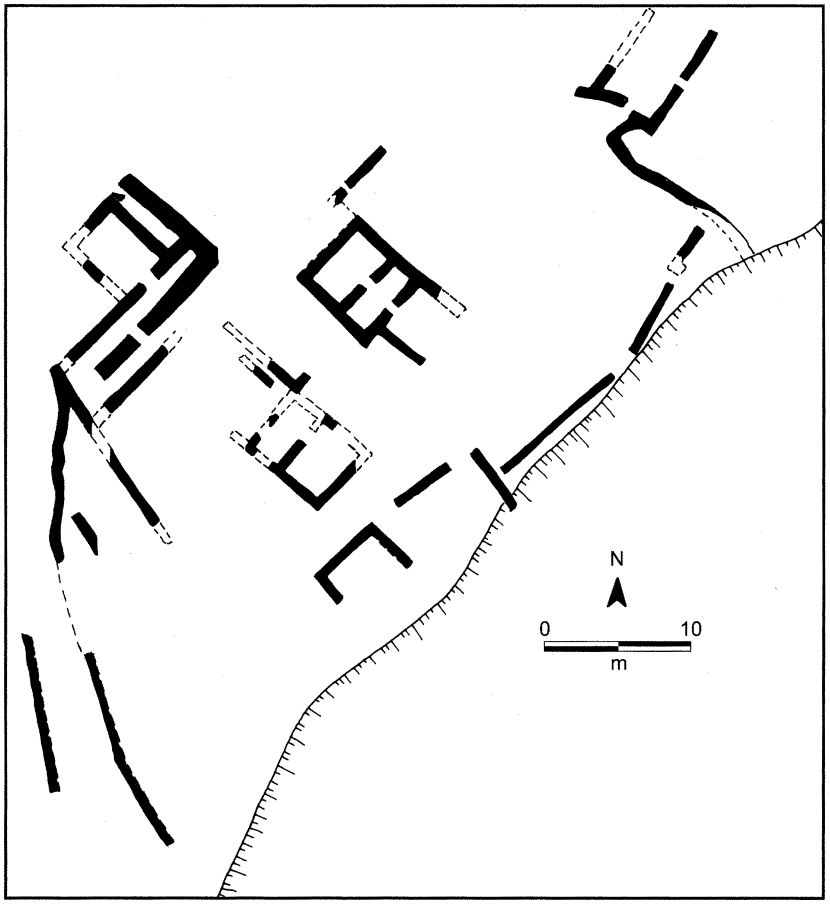


Figure 4. Plan of the Neolithic defensive walls at Sesklo in the Middle Neolithic. Drawing P. M. Murray, after Theocharis 1973, fig. 177

The best-known and most controversial fortifications in Thessaly may be the stone walls at Sesklo and Dimini. At MN Sesklo the acropolis appears to be enclosed by walls, although the site is much disturbed by later Neolithic construction (Fig. 4). Notable is a baffle gate on the side of the site not protected by the deep, steep-sided ravine to the east. The walls were augmented in the Late Neolithic when the acropolis was remodeled and a large central megaron was constructed (Fig. 5). The walls are up to 1.5 m thick and equally high. Tsountas, who excavated the Sesklo acropolis more than a century ago, provides few details about the construction of these walls or whether he found any evidence for substantial superstructures in the form of adobe or pisé, but he was nevertheless convinced that the walls served a defensive purpose.[53] Based on the available plans, the most noteworthy features of these walls are the baffle gate in the earlier phase and the heavier wall on the landward slope (i.e., the part of the acropolis that faced the lower town to the south, rather than the steep-sided ravine to the east), which served to separate the structures on the highest part of the site from the lower town. It is perhaps also significant that the site shows signs of extensive burning.[54]

At LN Dimini, the acropolis is ringed with walls that encircle a small domestic compound (Fig. 6). These concentric ring walls are pierced by narrow entrances or gateways, which were negotiated by means of narrow stone-lined walkways leading to small openings that gave access into a

53. Theocharis 1973, pp. 65–68, fig. 177, and passim; and Andreou, Fotiadis, and Kotsakis 2001, p. 263.

54. Theocharis 1973, figs. 5–7.

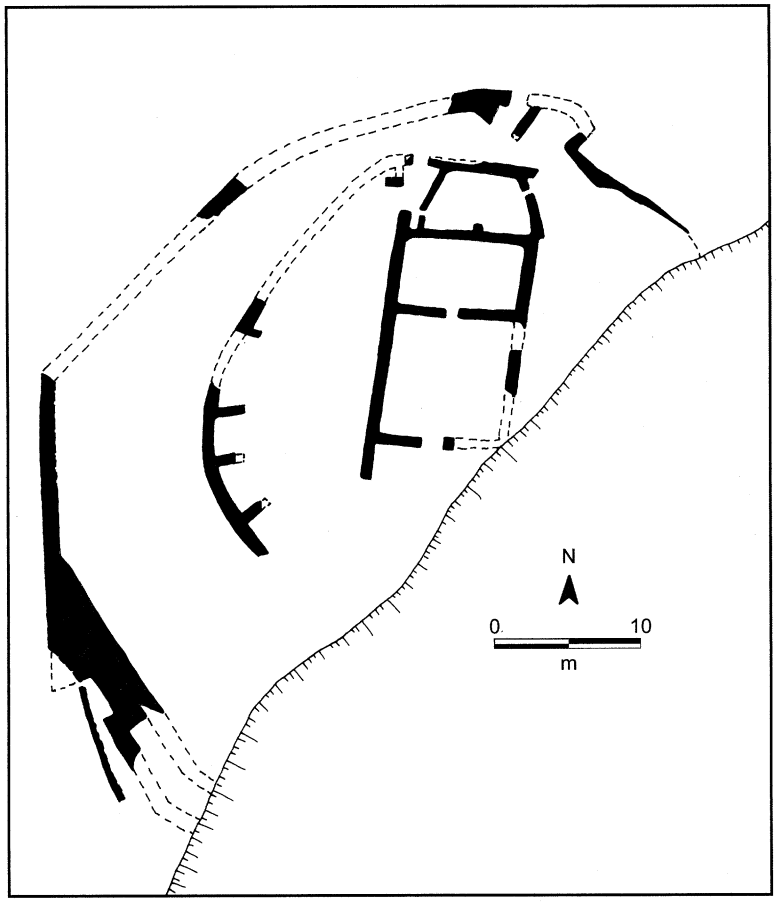


Figure 5. Plan of the Neolithic defensive walls at Sesklo in the Late Neolithic. Drawing P. M. Murray, after Theocharis 1973, fig. 186

maze of domestic compounds and intramural spaces.[55] These openings could have been intended for defense.[56] Particularly notable are the baffle gates that protect the openings in the walls at the northern and southern ends, and two on the west (perhaps with remains of a fifth in the southeast quadrant). If attacked, these small entrances could have been easily defended; in addition, they would have confused outsiders and provided inhabitants with multiple exits.

Tsountas proposed a defensive function for the walls at Dimini, but this view was seriously challenged by the work of Hourmouziadis, who reexcavated the site in the 1970s. Hourmouziadis rejected the defensive explanation partly on the basis of his archaeological findings: he could find no evidence that the walls had been capped by superstructures of any kind, although he could not rule out the removal of such evidence by erosion and Tsountas's excavations. He also placed his findings in the context of Marxian theory, arguing that fortifications would imply a stratified society in the Neolithic, a finding he rejected because he believed that social stratification was not part of the "Neolithic mode of production," as he called it.[57] In the years since Hourmouziadis published the results of his reinvestigation of Dimini, the debate about the function of the walls has continued, with scholars either embracing a defensive military function for them, or following Hourmouziadis in seeing them as partitions used to organize space within the community.[58] We have no hope of settling

55. For plans, see Theocharis 1973, figs. 176–188.

56. See especially Theocharis 1973, fig. 185.

57. Hourmouziadis 1979; see also the English summary in Andreou, Fotiadis, and Kotsakis 2001, p. 265, n. 34.

58. For further discussion and details, see also Andreou, Fotiadis, and Kotsakis 2001, p. 266, n. 37.

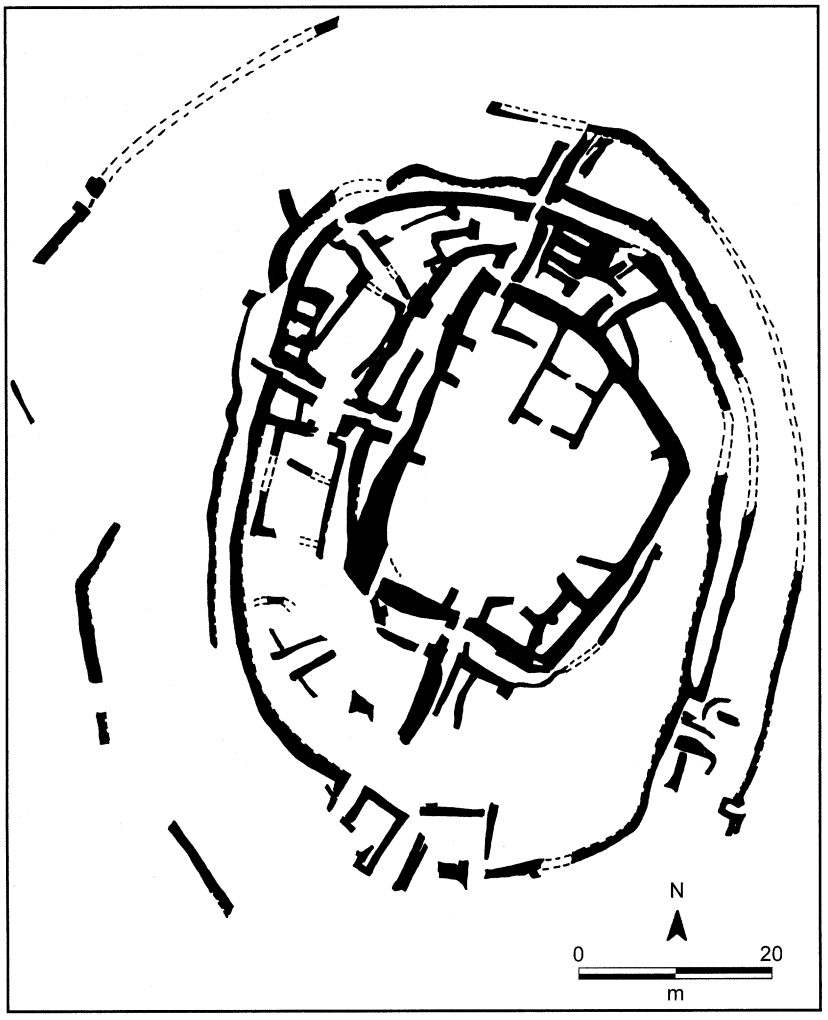


Figure 6. Plan of the Neolithic defensive walls at Dimini. Drawing P. M. Murray, after Theocharis 1973, fig. 185, and Papathanassopoulos 1996, p. 56, fig. 11

this issue here, which is at heart one of theoretical perspective, almost a matter of faith, but only urge the necessity of viewing Dimini and its walls within the wider European context of fortifications and enclosures, monumental constructions with both military and symbolic functions that have been linked to the emergence of complex segmentary societies and their emergent institutions.[59]

Other Thessalian sites have walls with stone foundations and adobe or pisé superstructures arranged in complex concentric patterns. Petromagoula, for example, has houses surrounded by circuit walls, and the low mound of Ayia Sophia has mudbrick walls forming a gateway east of a large central building and a ditch surrounding the *magoula.*[60] In addition to features noted in publications, we have observed unpublished walls or ditches at other Thessalian sites, such as an undated stone wall surrounding Plateia Magoula Zarkou. Even where there are no known fortifications, a still-unstudied aspect of site location in Thessaly is the choice of strategic defensible settings for sites such as Pefkakia, which is situated on the rocky slope of a promontory overlooking the Gulf of Volos.

Bearing in mind that walls and ditches undoubtedly had many uses that changed through time, some of them symbolic, we conclude that the preponderance of evidence for their sizes, arrangements, and baffle gates

59. See n. 4, above. It is worth noting that Parkinson and Duffy (2007, p. 101, fig. 6) include Dimini in their discussion of fortifications and enclosures in European prehistory.

60. See Andreou, Fotiadis, and Kotsakis 2001, pp. 265–266, 271, 274–275, for summary and references.

indicates that the Neolithic walls and ditches in Thessaly served at least in part for military defense. Perhaps it is safest to conclude, in the absence of further research, that to build a wall or to dig a ditch is at the very least a statement about the abilities and level of preparedness of the community to defend itself, and is also an expression of the level of trust they had in their neighbors. The walls and ditches were perhaps intended by their very existence to discourage attacks from happening in the first place, as much as they were used to ward off actual physical confrontation.

Skeletal Remains with Indications of Violence

Mortuary data would be very useful for assessing Neolithic warfare, particularly in cases where there are high rates of trauma evident among the dead, since cross-cultural studies have shown that is not uncommon in many traditional societies for a quarter of adult males to die in war.[61] Unfortunately, violent deaths leave traces in the skeletal remains in only a minority of cases. For example, a careful study of deaths in battles between Native Americans and U.S. soldiers in the American West showed that fewer than a third of deaths from arrow wounds left recognizable skeletal evidence.[62] Milner argues that this is probably typical for battle deaths in general, and that the number of warfare deaths from all causes was much greater than the proportion that produces skeletal evidence. This may have been the case in the Neolithic, where in the LBK culture of central Europe the percentage of individuals who suffered traumatic injuries or show signs of violent death (e.g., unhealed head wounds from blunt trauma) reaches staggeringly high proportions of 20%, and even more than 30% when the traumas were not confined to young men of fighting age but included adults and children who had suffered violent deaths.[63]

Our efforts to apply these findings to the assessment of mortality in the Thessalian Neolithic were unsuccessful because the burial practices, which included cremations, secondary burials, and hard-to-detect extramural cemeteries, did not produce enough data for analysis.[64] Primary interments are too scarce to permit the study of the causes of mortality. There is circumstantial evidence, however, to suggest that a larger skeletal sample would yield interesting evidence for violence, and we include the following discussion only as an illustration of the line that future research might take to test the hypothesis of Neolithic warfare.

Two male crania from the FN site of Kephala on Keos have wounds, one with a shallow depression in the rear area of the skull vault, and the other with a penetration wound. The second skull had healed cuts around the wound "as if to remove a projectile point."[65] Angel explained the wounds as the result of "hostile action" rather than accidental injury. In a later study of this site, Fowler describes the unique burial circumstances of two other adult males, both of whom appear to have been dropped into grave pits soon after death.[66] One of the individuals was positioned with his legs bent beneath his body, and the other was laid on his chest with one leg flexed toward his head. Although no pathologies are visible on these remains, the haphazard burial of the individuals, which Fowler estimates occurred within 12 hours of death,[67] is consistent with the hypothesis that they were victims of violence.

61. LeBlanc and Register 2003, p. 8.
62. Milner 2005.
63. Golitko and Keeley 2007, pp. 335–336.
64. Gallis 1979, 1982; Jacobsen and Cullen 1981, pp. 88–96.
65. Angel 1977, p. 136.
66. Fowler 2004, p. 94.
67. Fowler 2004, p. 94.

The skeletal material from LN–FN Alepotrypa Cave in southern Greece also exhibits levels of trauma that might be related to warfare.[68] The examination of 69 individuals from burial deposits, mostly containing cranial bones, revealed that 13% of the individuals exhibited healed depressed cranial fractures, a percentage not out of line with what is known for the rest of Europe in this period. For one ossuary in the cave, Papathanasiou, Larsen, and Norr note that "all fractures are small, circular, and well-healed at the time of death, and are found in adult males and females and sub-adults."[69] Some individuals show multiple fractures, mostly nonlethal. The appearance of the wounds suggests that blows had been dealt in much the same way regardless of the victim's sex or age, though the evidence for trauma is more prevalent among males. The size and shape of sling bullets seem to us to match the fractures, and so could have been responsible for this pattern of trauma.[70] Also from Alepotrypa is a burial where the victim appears to have suffered from a large, unhealed head wound, possibly the cause of death.[71]

Overall, the astonishing range of variability in even the small available mortuary sample from Greece makes any interpretation very difficult.[72] The cases cited here are not dissimilar to prehistoric assemblages from comparable times and places where levels of violence are correlated with competition for resources and population stress that suggest warfare—for example, in the American Southwest, where evidence for skeletal trauma, though low, is present.[73]

Weapons

If warfare existed in Neolithic times, one would expect to find weapons in the archaeological record. Unfortunately, the forms and raw materials of quotidian implements and military weapons can and do overlap in size, form, and function, further complicating the identification of military equipment. An edged blade of copper with evidence of hafting could be a dagger or the head for a thrusting spear used in warfare, but could equally have been used for display, hunting, or butchery. It is easy to imagine the same implement serving both military and nonmilitary functions during its active use life. As a consequence, archaeologists tend to avoid interpreting Neolithic artifacts as weapons when alternative explanations such as hunting, butchery, and agricultural functions are ready to hand. For our evaluation of the hypothesis of prehistoric warfare, we felt it was useful to ask a simple question: if Neolithic Thessalians engaged in warfare, what weapons would they have used? There are numerous possible Neolithic military weapons, including flaked-stone projectile points, sling bullets of clay and stone, stone mace heads, polished stone axes, and copper axes and knives, all of which are considered below.[74]

68. Papathanasiou 2001, pp. 35–36, 43, 90, fig. 12; also pp. 58–59, table 7.

69. Papathanasiou, Larsen, and Norr 2000, p. 218.

70. Papathanasiou, Larsen, and Norr 2000, p. 220, fig. 6; Papathanasiou 2001, p. 90, fig. 12.

71. Fowler 2004, p. 75. Unfortunately, this skull is now missing and this observation cannot be verified (A. Papathanasiou, pers. comm.).

72. See, e.g., Jacobsen and Cullen 1981; Cullen 1995.

73. LeBlanc 1999, pp. 83–91; see also Allen, Merbs, and Birkby 1985 and Turner and Turner 1999.

74. Many examples are illustrated and described in the catalogues in Theocharis 1973 and Papathanassopoulos 1996.

Figure 7. Neolithic stone projectile points from Franchthi Cave.
Drawing P. M. Murray, after Perlès 2004, pp. 94, 111, 125, 126, figs. 8.4, 10.3, 11.5, 11.6

Projectile Points

To judge from the large number of small stone projectile points with notches and tangs for hafting known from Greek Neolithic sites, we assume that the bow and arrow was known. The large size of some projectile points, similarly fitted for hafting, suggests that spears or javelins were also used. Neolithic projectile points of flint, obsidian, quartz, and other materials are found in a wide variety of types (Fig. 7).[75] There is some chronological patterning to these types, from tranchets in the earlier phases to tanged, shouldered, and triangular forms in later phases. Although the smaller types would have been used as points for arrows, larger examples such as the triangular points illustrated here could well have served, when hafted, as spearheads or knife blades.

Were any of these points used for warfare in Neolithic Thessaly? Context is a poor guide here, as the distribution and association of projectile points have only rarely been published, and in any case the sample sizes are small because of the small soundings made in most Thessalian sites. The archaeological record of all regions of Greece suggests that Neolithic arrowheads were less common in the earliest Neolithic, but became more common in the Middle Neolithic and later.[76] It is interesting that the production of stone arrowheads in Greece continued, with some modifications in form, to the end of the Bronze Age. The apparent continuity in the use of arrowheads at Bronze Age Lerna in the Argolid prompted Runnels to ask why this would be so if hunting was of limited economic importance, as indicated by the low representation of wild species among the faunal remains at that site.[77] In Thessaly, during the Neolithic, hunting was certainly of less importance than in the Palaeolithic or Mesolithic, with bones from wild animals typically forming less than 8% of the total faunal assemblage, while at Pefkakia, the size of the largest available prey, red deer, decreased at the end of the Neolithic, suggesting a less favorable habitat for wild game.[78] At the same time, the size and variability of projectile points increased across Greece,[79] and we conclude that these artifacts were not specialized for hunting.

In a similar fashion, large projectile points are associated with LBK assemblages in western Europe, where hunting also shows a steady decline and the frequency of burial trauma and fortification is highest.[80] Likewise, in Neolithic France, projectile points are found embedded in human bones, with unhealed traumas as a result, and they appear in patterns and frequencies that make it likely that the wounds were the result of warfare.[81]

75. See, e.g., Diamant 1977; Torrence 1991, pp. 182, 183, figs. 7.5, 7.6; Demoule and Perlès 1993, p. 374, fig. 6; see also pp. 382–383.

76. Demoule and Perlès 1993, pp. 393–394.

77. Runnels 1985, p. 381, n. 29.

78. Halstead 1999a, pp. 84–85, table 5.1.

79. See examples cited in n. 75, above.

80. Golitko and Keeley 2007, p. 340.

81. Guilaine and Zammit 2005, pp. 124–157.

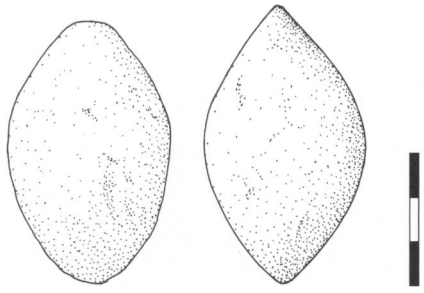


Figure 8. Neolithic sling bullets from Sesklo. Drawing P. M. Murray, after Theocharis 1973, fig. 274

Sling Bullets

Another possible Neolithic weapon was the sling. Biconical sling bullets of both stone and clay are common on Greek Neolithic sites (Fig. 8).[82] Neolithic sling bullets resemble Classical examples in size, weight, and shape, and we know that Classical sling bullets were used in warfare.[83] The mass of a typical Greek Neolithic sling bullet falls within a range of ca. 20–45 g.[84] This range is similar to that observed by Zangemeister in his survey of Classical sling bullets found at sites in Sicily and Italy, where the mass of a bullet varies from 24 to 47 g.[85] The finding of caches of sling bullets on Neolithic sites (e.g., 158 at Rakhmani, 110 at Sesklo, and 130 at Tsangli) further supports the likelihood that slings were used as weapons.[86]

Also significant is the shape of the typical Neolithic sling bullet. Neolithic bullets are biconical or ovoid, and like the biconical bullets of Classical times are designed for precision throwing.[87] The preferred raw material for Classical sling bullets was lead, while their Neolithic forerunners were typically made of sun-dried clay, terracotta, or stone.[88] Despite the similarity of the Neolithic sling bullets to Classical weapons, it has been suggested that the Neolithic versions were used for peaceful, utilitarian purposes rather than for warfare. Perlès argues that clay sling bullets were used as missiles by shepherds to control their flock, basing her argument chiefly on the fragility of sun-baked clay, which she believes is impractical for use as a weapon in warfare.[89] This argument can be countered by Korfmann's suggestion that the accuracy of sling bullets in combat was

82. See, e.g., Childe 1951; Foss 1974. For illustrations of sling bullets at Sesklo, see Theocharis 1973, fig. 274.

83. This function is evident from inscribed specimens that say "Your heart for Cerberus!" or "Take this!" or even "Ouch!"; see Korfmann 1973, p. 39.

84. We estimated the mass of Neolithic sling bullets on the basis of their dimensions, typically length and width (i.e., diameter), as given in publications such as Tsountas 1908, Wace and Thompson 1912, Papathanassopoulos 1996, and Perlès 2001. The relative densities of the raw materials used for their manufacture, i.e., clay and stone, were based on data available from www.simetric.co.uk/si_materials.htm (accessed 2008). The estimation of mass assumed that mass = density × volume/1,000. Volume [V] was calculated for biconical bullets with one of two formulas, depending on the number of dimensions that were given. When three dimensions (length [l], width [w], and thickness [th]) were provided, the formula used was

$$V = \Pi \left(\frac{l \times w \times th}{6} \right)$$

When only two dimensions (length and width) were provided, 0.6 of the width was substituted for "thickness" in the formula. This substitution is supported by the data for Classical sling bullets collected by Foss (1974): the thickness of the bullets was found to be typically 60% of the width.

85. Zangemeister 1885, p. 141.

86. Tsountas 1908, pp. 327–329, and passim; Wace and Thompson 1912, pp. 43, 70–73, 125; Pritchett 1975, pp. 39–42.

87. Pritchett 1975, p. 43.

88. Pritchett 1975, p. 43.

89. Perlès 2001, pp. 228–232.

in fact improved by the choice of sun-baked clay, rather than terracotta or stone, as a raw material.[90] Korfmann argued that the use of sun-baked clay aided in the standardization of the bullets' weight and shape, allowing the slinger to keep his throw consistent. He proposed that Neolithic clay bullets were sun-baked without temper or chaff in order to maximize their density and hardness, as fired clay would crack upon impact with hard objects; Korfmann also held that the preference for a biconical shape was intended to improve accuracy, distance, and velocity.[91]

In the Neolithic Near East, sling bullet assemblages are sufficiently common in contexts of destruction and sieges that archaeologists point to these assemblages as evidence for the military use of slings.[92] Sling bullets are often found in large caches, such as those at Umm Dabaghiyah[93] and at Tel Sabi Abyad, where "along the court wall opposite the entrance over a thousand sling missiles of unbaked clay were found, all stored in narrow, rounded containers sunk into the floor,"[94] suggesting their storage near defensive walls in preparation for their use against military attack. While the numbers of sling bullets in Near Eastern caches are greater than those found in Neolithic Thessaly, the function of the caches seems similar. Chapman also argues for the defensive function of stockpiles of sling bullets on Neolithic Balkan sites.[95]

In the subsequent Early Bronze Age, sling bullet assemblages are associated with destruction horizons at some Greek sites, including Korphi t'Aroniou and Panermos on Naxos, suggesting that slings continued to be used into post-Neolithic times.[96] We assume, following Vutiropulos, that the form of the Neolithic sling bullet endured because it was the ideal form to deliver a destructive effect.[97] In sum, when we compare the size and shape of Greek Neolithic clay sling bullets with later examples, and consider the relatively large caches in which they occur, it seems likely that they were in fact used primarily, if not exclusively, as weapons of war.

Axes and Mace Heads

Other potential Neolithic weapons that await detailed analysis are ground and polished stone axes (celts) and perforated mace heads. It is undeniable that celts, if hafted, would have been effective as battle-axes (Fig. 9:a). It is hard to demonstrate the use of celts as weapons in the absence of detailed studies of context, hafting, and use wear, but there is circumstantial evidence for the use of stone axes as weapons in Neolithic Europe, deduced from the large numbers of unhealed traumas, particularly blows to the skull, in the LBK.[98]

The other potential ground and polished stone weapon is the perforated stone sphere sometimes identified as a mace head (Fig. 10). One cannot easily suggest an alternative use for these objects (although a digging-stick weight is one possibility), because there are numerous examples made from exotic and colorful stones (e.g., at Neolithic Knossos) that suggest a special value and purpose.[99] It is difficult to know how many mace heads occur in Neolithic deposits because of the incomplete publication of excavations, but they occur widely, from Alepotrypa Cave in the Mani to Thessaly, where more than a dozen of them have been reported from Dimini, Sesklo,

90. Korfmann 1973, pp. 38–39.
91. Korfmann 1973, p. 39.
92. Pritchett 1975, p. 43; Korfmann 1986.
93. Kirkbride 1982.
94. Akkermans 1993, p. 63.
95. Chapman 1999.
96. Vutiropulos 1991, p. 282.
97. Vutiropulos 1991, p. 282.
98. Golitko and Keeley 2007, p. 339.
99. Evans 1964, pp. 229–231, fig. 52.

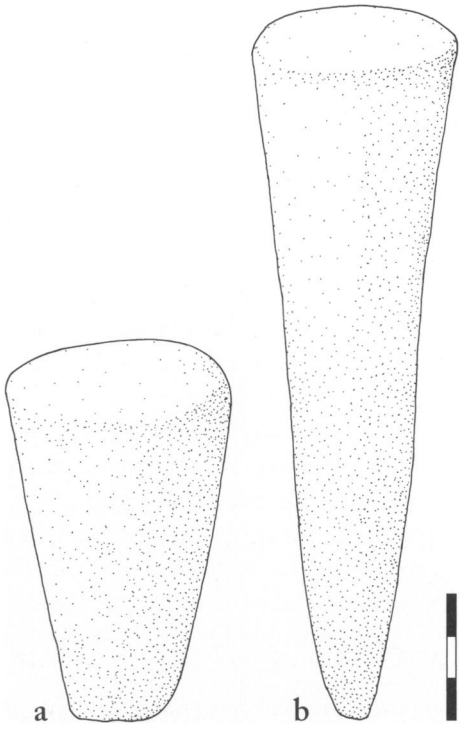


Figure 9. Neolithic (a) ground stone ax, and (b) copper ax (weight 714 g), both from Sesklo. Drawings P. M. Murray, after (a) Theocharis 1973, fig. 267, and (b) Papathanassopoulos 1996, p. 290, fig. 184

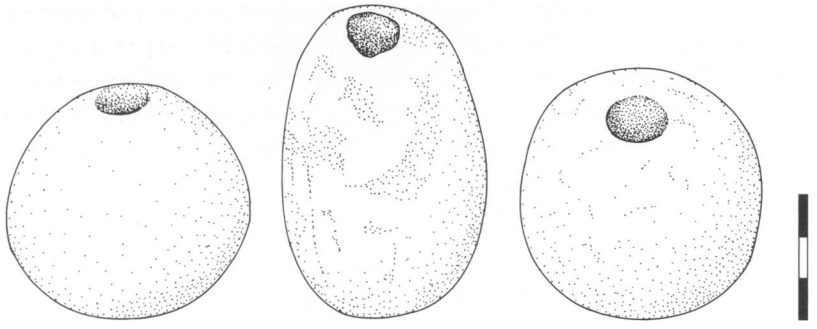


Figure 10. Neolithic ground stone mace heads from (left to right) Sesklo, Dimini, and Alepotrypa Cave. Drawing P. M. Murray, after Papathanassopoulos 1996, pp. 226, 240, figs. 40, 65:a, b

and Marmariani.[100] The known maces average about 6–7 cm in diameter, and the use of attractive stones for their manufacture does not rule out their use as symbols of power or rank. The vast numbers of stone objects that have been found by chance in recent years on the Neolithic mounds in Thessaly and turned into the Archaeological Museum have yet to be examined, and we predict that many more mace heads will be identified once these collections are studied.

Copper Knives or Daggers

Finally, we also note the occurrence on Thessalian sites of axes and daggers of cast copper with forms similar to typical Bronze Age weapons from throughout the world (Figs. 9:b, 11).[101] Neolithic copper axes and daggers are not numerous, but Zachos lists 17 examples, including specimens from

100. See Tsountas 1908, pp. 322–323; and catalogue entries in Papathanassopoulos 1996, pp. 226–227, no. 40 (G. Papathanassopoulos), and p. 240, no. 65:a–c (A. Moundrea-Agrafioti and Z. Malakassioti).

101. See Renfrew 1972, pp. 308–332, for Bronze Age examples.

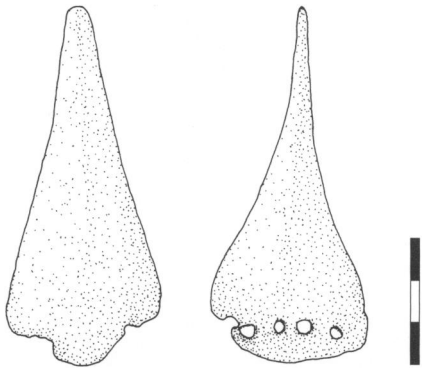


Figure 11. Neolithic blades of copper from Alepotrypa Cave. Drawing P. M. Murray, after Papathanassopoulos 1996, p. 228, fig. 44

Pefkakia and Sesklo in our study area.[102] It is probable that many others were melted down. Zachos suggests that the Aegean Bronze Age daggers developed from a Neolithic predecessor in an unbroken sequence, an argument based on the difference in shape between the Greek specimens and those known from neighboring regions.[103]

Settlement Patterns and No-Man's-Lands

In the study of prehistoric warfare in the American Southwest, one of the most persuasive indicators of sustained violence was the separation of groups of sites by empty territory, or no-man's-lands.[104] No-man's-lands were necessary buffer zones separating groups of settlements that were experiencing high levels of more or less continuous raiding and warfare. The buffer zones provided some protection because they exposed anyone crossing them without authorization to detection and provided the defenders an opportunity to prepare for attack. They also provided places outside the community for combat to take place. Other examples of prehistoric no-man's-lands, voids, empty zones, or buffer zones, are known from the Maori, the New Guinea highlands, Mesoamerica, and the eastern United States.[105] This pattern, particularly well attested in the American Southwest, has been found to correlate with endemic warfare in all cases where it has been investigated.

We expected, therefore, that groups of sites in Neolithic Thessaly would be separated by no-man's-lands if the threat of warfare was a factor influencing settlement patterns. An inspection of previously published maps of the distribution of Neolithic sites in Thessaly shows that voids—areas of landscape that are empty due to unexplained causes—are present in the settlement pattern.[106] If warfare is not the explanation for these voids, why are they there? We must begin with a number of assumptions. For instance, we assume that each individual Neolithic *magoula* represents a single village of closely related individuals. We also assume that the social relations that may have existed between individual Neolithic villages, especially relations based on kinship, while they encouraged cooperation among villages that were physically close together, would become weaker as the distances between sites increased. We further assume that competition for land, water, and grazing rights would not be as strong among villages *within* a group of settlements that are in close proximity, where kinship ties were likely to

102. Zachos 1996, p. 141, fig. 40; see also catalogue entries in Papathanassopoulos 1996, p. 290, nos. 182–184 (K. L. Zachos), with illustrations.

103. Zachos 1996.

104. LeBlanc 1999, pp. 69–73; 2006, pp. 441–449; Adams and Duff 2004.

105. For these different examples, see, e.g., Allen 2006; Heider 1979; Marcus and Flannery 1996; Milner 1999; Dye 2006.

106. See van Andel and Runnels 1995, pp. 492–493, figs. 9, 10; and Perlès 1999, p. 49, fig. 2.5.

be direct and reasonably strong, but that conflict over resources would be more likely to occur *between* groups of sites separated by open land.

These assumptions permit us to conclude that the Thessalian empty areas were in reality buffer zones, or no-man's-lands, designed to separate groups of settlements where the ties of kinship were weakest, and social cooperation gave way to conflict. This interpretation of the landscape voids, derived from the study of the American Southwest, is not universally accepted. In Thessaly, for instance, Halstead makes a good case that the voids in the landscape between groups or clusters of Neolithic villages were filled with signs of habitation—such as cultivation and evidence of deforestation and herding—that anyone entering these open areas would encounter.[107] These signs, he argues, could have served to reinforce kinship bonds and reciprocal social relationships among villages having direct kinship connections. In Halstead's view, the unoccupied land between site clusters also served to reinforce territorial limits, but he explicitly rejects warfare as an explanation for these open areas.[108] It is certainly possible, though, that cultivated fields and hunting and grazing areas could also have served as effective buffer zones.

To evaluate the different possible explanations for the open areas of landscape in Neolithic Thessaly (see Figs. 12–14, below), we must consider previous work on the area's settlement patterns, which have been the subject of study since the time of Tsountas.[109] The EN settlement pattern, for example, has recently been studied in detail in connection with the question of whether the earliest Neolithic farmers in Thessaly were indigenous foragers who developed into farmers, or were immigrants from outside Greece.[110] Van Andel and Runnels concluded that the first farmers who settled in Thessaly found the region largely uninhabited, a conclusion supported by the results of a survey of the region that targeted sites of pre-Neolithic age and found numerous Palaeolithic sites but no trace of major Mesolithic habitation.[111] They argued further that the earliest farmers were free to establish their settlements on the most productive lands for agriculture, and exhibited a preference for access to water in the form of springs, lakes, and rivers because their technology depended on the digging stick for cultivation of relatively small fields with mixed crops. With few competitors—at least initially—for access to the best soils near water, the earliest settlers selected locations close to perennial water sources for their settlements. In Thessaly, springs or other point sources of water were few, and the best lands were the lowlands around the Peneios River, which could be relied upon to receive floodwaters from late winter into the summer. Secondarily, the shorelines of Lake Karla, with its fluctuating water level, exposed fertile land on a more or less annual basis and attracted settlers. The hypothesis of river floodplain use was tested by augering below EN sites to determine the nature of the underlying sediments, and the results appeared to confirm that there was a preference for floodplain settings.[112]

In her analysis of EN settlement data from eastern Thessaly, Perlès arrived at a somewhat different conclusion. She carried out a nearest-neighbor analysis of the distribution of *magoules* from one phase within the EN (Proto-Sesklo, or EN 2).[113] While she found that the *magoules* are closely spaced, "what is most characteristic is that often not one but *several* nearest neighbours are located at roughly the same distance from a site,

107. Halstead 1999a, p. 87.

108. Halstead 1999a, p. 89.

109. See, e.g., Gallis 1979, 1992; van Andel and Runnels 1995; Halstead 1999a; Perlès 1999, 2001.

110. The indigenous model: Kyparissi-Apostolika 2006; the diffusionist model: van Andel and Runnels 1995; Perlès 2001, pp. 38–63.

111. This survey is reported in Runnels 1988; van Andel and Runnels 1995.

112. See van Andel, Gallis, and Toufexis 1994.

113. Perlès 1999; 2001, pp. 121–151.

in a reticulated, multidirectional pattern."[114] While noting that the small distances between sites indicate a pattern of dense settlement, her statistical tests suggest that EN 2 sites, at least, are neither randomly distributed nor strongly clustered.[115] It is important to note, however, that she did not include the "voids," or open areas, between groups of settlements in her analysis (which was in any case intended to test the association of *magoules* with certain types of soil or other geographic features such as floodplains). She concluded from her analysis that there was a regularity in the distributional pattern *within* the settled areas, but despite widespread archaeological survey it seems that "fundamentally, Early Neolithic 2 settlements avoided some areas, for reasons as yet unexplained, but spread according to a regular grid of c. 2.3 km in all directions around and between these areas."[116] Perlès's distribution maps for the EN 2 show clearly the tendency for groups of the *magoules* to be separated by large empty areas, a pattern that can be seen also on the maps provided by van Andel and Runnels in their earlier study.[117] Empty spaces were settled only gradually in later phases of the Neolithic, if at all, as site numbers, and presumably population, increased through time. As we shall see, some of the voids remained unsettled throughout the Neolithic for "reasons as yet unexplained."

Previous studies of Thessalian Neolithic settlement patterns have not considered the effects of warfare on the distribution of sites. To do so, it is useful to begin with a reconsideration of Sahlins's pithy dictum that "maximum dispersion is the settlement pattern of the state of nature."[118] This suggests that, in theory, a large, relatively uniform, plain like the eastern Thessalian basin should have a more or less evenly distributed pattern of settlements, as long as there were no physiographic, cultural, social, or economic barriers to "maximum dispersion." Indeed, within the areas of EN 2 settlement, this is exactly what Perlès appears to have found through her nearest-neighbor analysis, with the average area of separation between *magoules* being ca. 2.3 km. In the Sahlins model, kinship and social cooperation are attractants that bind settlements together in mutually supportive groups. In theory, warfare could reinforce this tendency. Archaeological site distributions in the American Southwest on the Colorado plateau, for example, show many local distributions of sites along the river valleys that drain the plateau, and these groups of sites are interpreted as resulting from the effect of kinship and cooperation. But here, too, the groups of sites, even where the internal distribution is rather uniform, are separated by empty areas or unoccupied no-man's-lands that served both as territorial markers (in the sense used by Halstead) and as defensive buffer zones between clusters of sites that were in a state of hostility.[119]

Turning to Thessaly, a comparison of the distribution of sites plotted in Figures 12–14 shows that open areas between zones of dense settlement are evident from the beginning of settlement in the Early Neolithic, and some remain unoccupied throughout the Neolithic period.[120] How large are these empty areas or voids? If the average spacing of *magoules* is ca. 2.3 km, we can assume that an open space between settlements greater than this would constitute an unoccupied area. Based on the available data (e.g., the spacing visible in our Figure 12 or in Perlès's maps, cited above), we propose that spaces of 4 km or more without settlements represent areas that were unoccupied or void.

114. Perlès 1999, p. 46; the emphasis is in the original.

115. Perlès 1999, p. 46.

116. Perlès 1999, p. 51.

117. Perlès 1999, pp. 49–50, figs. 2.5, 2.6; 2001, pp. 121–151; van Andel and Runnels 1995, pp. 492–493, figs. 9, 10.

118. Sahlins 1974, p. 97.

119. LeBlanc 1999, pp. 200–218.

120. In our attempts to create a GIS model of site distribution through time in the Neolithic, we used site coordinates provided by Gallis in his *Atlas* (1992). However, the lack of precision in the coordinates (they are not expressed to the minute and second) led to sites in close proximity being sorted into short linear strings by the software program, exaggerating the linear alignment. It is still possible, however, to see that considerable areas were devoid of sites and remained empty throughout the period.

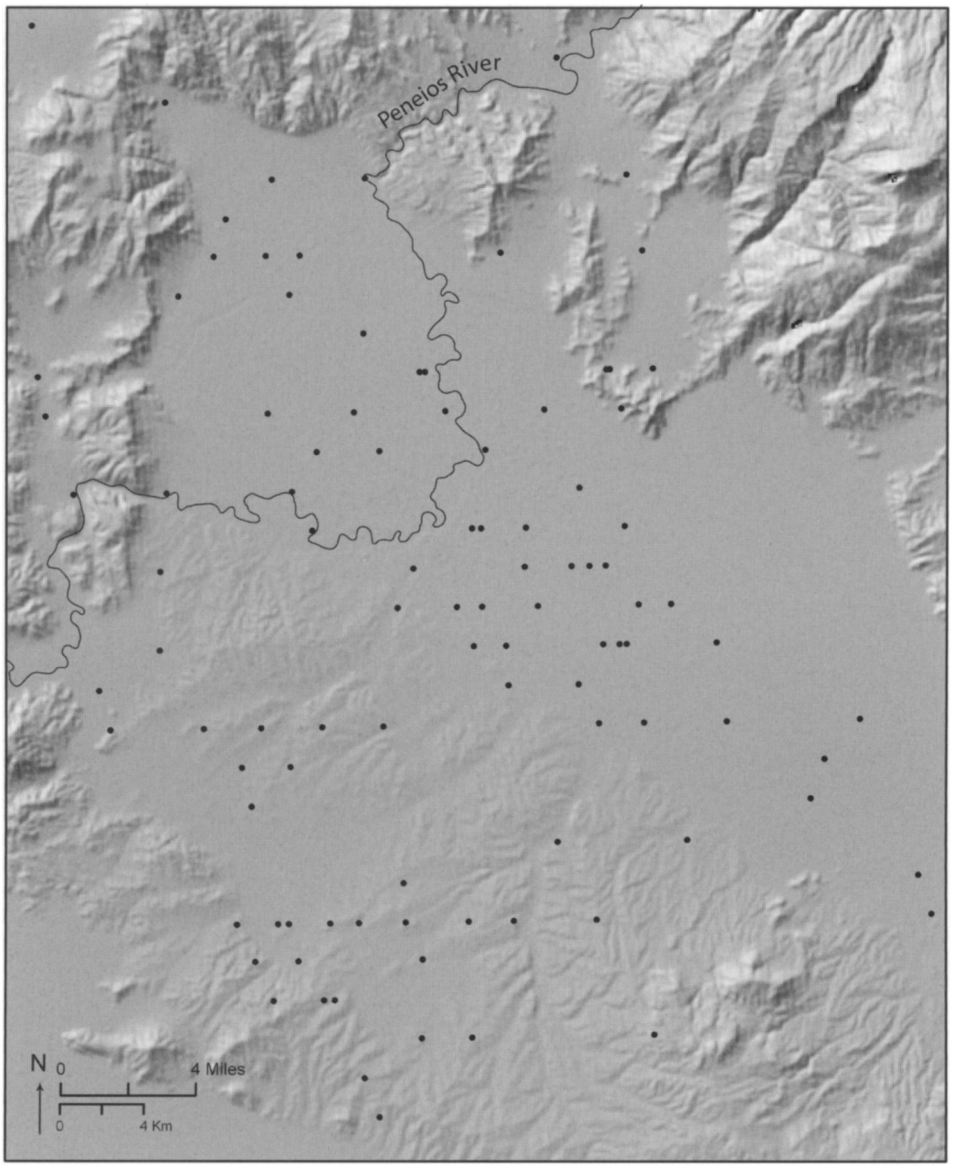


Figure 12. Approximate distribution of Early Neolithic sites in eastern Thessaly. Based on coordinates given in Gallis 1992

Before we can attribute these empty areas to warfare, we must consider alternative explanations for the existence of unoccupied areas. Is the absence of sites the result of a lack of research in these areas, or are sites not detectable in these places by pedestrian survey? These are possibilities, but Gallis's review of the history of exploration and his detailed catalogue of finds by survey and chance suggest that these empty areas are not due to a lack of research, but are real.[121] Is the explanation environmental? The relief shown in Figures 12–14 makes it clear that some of the empty areas do coincide with low hills, particularly in the southwestern portion of the plain, but it is equally clear that other voids are located in the level plain. The environmental factor is difficult to evaluate in the absence of detailed palaeoenvironmental reconstructions, and while there is documented evidence for soil erosion during and after Neolithic times that might have served to remove or mask sites, these episodes were not large in extent and are unconvincing as explanations for the empty areas.[122] Wetlands on the

121. Gallis 1979; 1992, pp. 13–22.

122. See van Andel, Zangger, and Demitrack 1990.

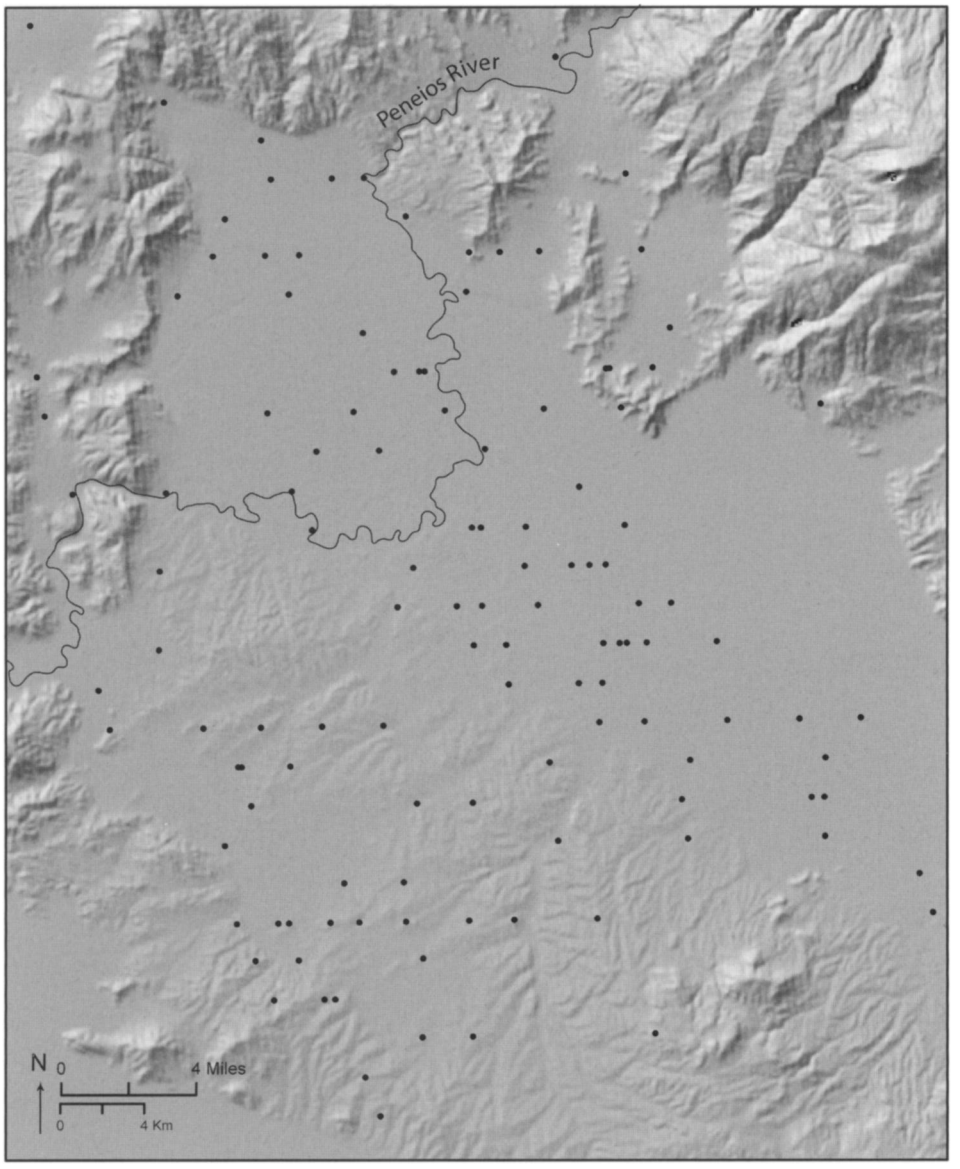


Figure 13. Approximate distribution of Middle Neolithic sites in eastern Thessaly. Based on coordinates given in Gallis 1992

southeastern edge of the plain such as Lake Karla (see Fig. 1) have been drained systematically in recent years, but their past locations are known, and again they are unlikely to be the only explanation for the empty zones.[123] Of course, some zones could have been unattractive to Neolithic farmers who relied upon a relatively simple agricultural technology of digging sticks and hoes, or they may have lacked water, or perhaps had poor soil.

Environmental factors certainly must have played a role in the creation or maintenance of empty zones, but this argument can also be used to support the hypothesis that they were buffer zones. Poor soil, scrubby grazing land, or wetlands exploited for fish and game could have caused a particular area to be chosen as a buffer zone between communities when conflict was a factor. The Peneios River, for instance, might have served as both a resource of water and food, as well as being a useful buffer zone. The Peneios bisects the plain from the southwest to the northeast, and sites on either bank would be about 2.5 km apart. The river would

123. Gallis 1992, pp. 23–32.

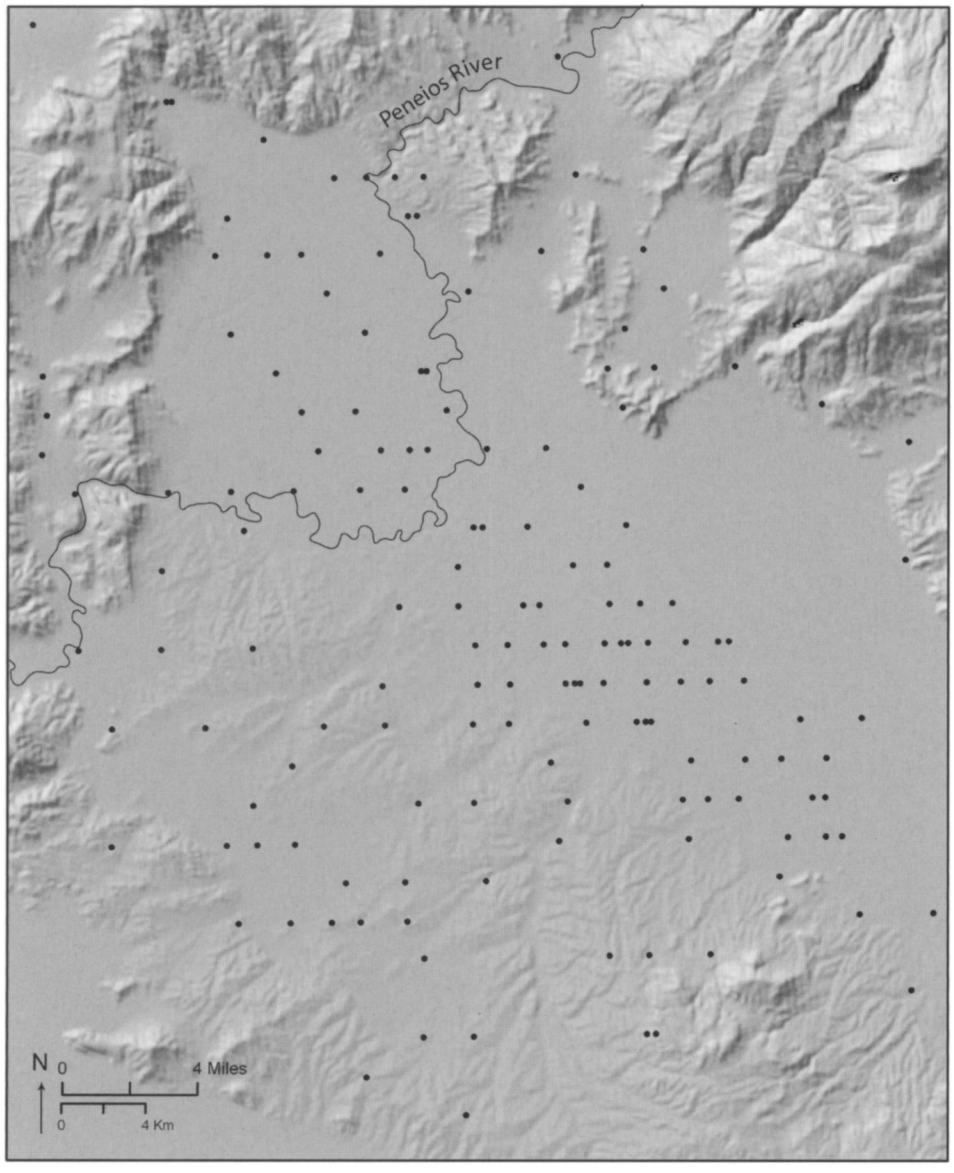


Figure 14. Approximate distribution of Late and Final Neolithic sites in eastern Thessaly. Based on coordinates given in Gallis 1992

nevertheless have served as an effective environmental barrier. By its nature, a river cannot be "occupied" by settlement, and is an easily defined feature, allowing the inhabitants of different settlements to be specific about the limits of their territories, ensuring that anyone encountered on the "wrong" side of the river would be considered as making a hostile act and therefore subject to attack.

If the voids, or no-man's-lands, were barriers separating different groups of settlements in circumstances of chronic conflict, it would be reasonable to expect other indicators of warfare to emerge once more information from extensive stratified excavations of mounds within the individual site clusters becomes available. LeBlanc's American Southwest model predicts that smaller, fortified sites are likely to be located near the edges of no-man's-lands, and that larger, more densely occupied villages would be located closer to the centers of clusters.[124] At present, we do not have enough data to test this hypothesis in Thessaly.

124. LeBlanc 1999, pp. 69–73.

If correctly identified, the voids can be seen to fall between four or five areas of settlement in the Early Neolithic (Fig. 12). In the Middle Neolithic, the patterns are somewhat different (Fig. 13). The number of sites has increased, and at least one of the voids appears to have been partially filled. Is it possible that competition for territory increased along with population growth, leading to the merging of two of the groups in the region, and thus allowing the no-man's-land to be filled in? Finally, in the Late and Final Neolithic (Fig. 14), the number of sites decreases, and some of the no-man's-lands appear to have grown larger. This trend may have continued after the Neolithic period. Although we have not produced a map to show the Bronze Age distribution, maps published earlier by van Andel and Runnels show that these no-man's-lands are also a salient feature of the Early Bronze Age settlement pattern in Thessaly.[125]

CONCLUSIONS

We have based our assessment of Neolithic warfare on a combination of features seen in the archaeological record, including the no-man's-lands separating groups of settlements, the common occurrence of stone walls with baffle gates, ditches with V-shaped sections, evidence for fortifications, and the occurrence on many sites of potential weapons such as copper knives, stone axes, arrowheads, sling bullets, and mace heads. While no one class of artifact or feature can be used individually to determine the existence of prehistoric warfare, the combined evidence from these different classes of data points to violent conflict. We readily acknowledge, however, that each class of data is also subject to alternative explanations: the empty spaces could have resulted from the avoidance of poor-quality farmland, or simply been common grazing lands; the ditches and walls could have served many peaceful purposes, if not purely symbolic ones; and the knives, axes, arrowheads, sling bullets, and mace heads could have been tools used in craft work, items of status and display, or hunting weapons. Scholarly opinion on these matters will remain divided for some time to come, and we cannot dismiss lightly the possibility of alternative, peaceful explanations for these features of the Neolithic in Thessaly. But when viewed as a whole, the sum of evidence provides a strong circumstantial case for the presence of warfare, and at the very least the possibility of warfare cannot be dismissed without further investigations.

It is perhaps too early to speculate about causes of Neolithic warfare in Greece. One area for further research would be to investigate the individual site clusters. LeBlanc has argued that under conditions of chronic warfare one would expect that outlying sites nearest to the no-man's-land would be abandoned and the remaining populations would move away from the borders of enemy territory to settle in larger, more readily defensible villages protected by extensive no-man's-lands.[126] This may be what we see in the Early Bronze Age in Thessaly, where smaller sites were seemingly abandoned and the remaining sites were grouped more tightly.[127] In the Neolithic, Halstead documents the building up of tells to make them taller, which he thinks was done to achieve monumentality as the result of the competition among households within the settlement.[128] We believe that

125. See van Andel and Runnels 1995, pp. 492–493, figs. 9, 10.
126. LeBlanc 1999, pp. 54–74.
127. See van Andel and Runnels 1995, p. 493, fig. 10.
128. Halstead 1999a, pp. 87–88.

this interesting hypothesis could be explored further, as the possibility of such social competition could have been a catalyst for warfare, with the higher, more visible tells serving as "footprints" on occupied land to symbolize corporate rights to defined territories. This building up of higher tells would certainly lend itself to the creation of intervisibility among sites within a site cluster, a feature associated with warfare in the American Southwest.[129] Although Halstead thinks that the use of these tells as grand communal expressions meant to evoke awe, fear, or grudging respect among one's neighbors is an unlikely motivation for their construction,[130] we are not ready to rule out that possibility. Halstead also argues for the tendency for Neolithic social structure over time to become segmented and isolated in terms of physical space within villages; domestic structures in Thessaly suggest that familial spaces were partitioned off from communal spaces.[131] He interprets the subdivision of the village area by ditches or walls as symbolic moves calculated to signal the "less inclusive nature of LN hospitality."[132] The culmination of this trend was the emergence of the more socially stratified and territorially divisive cultures of the Early Bronze Age. Clearly, the evaluation of the role of warfare in this process is essential.

Another promising area for research is the study of human remains. LeBlanc and Register note in their world survey of early warfare that one could expect high mortality rates among young men where warfare is present, with the figure approaching 20%–25% where warfare was endemic.[133] The data needed to test such a hypothesis for Neolithic Greece are simply nonexistent today.

If warfare existed in Neolithic Greece, what were its causes? Archaeologists once assumed that early foragers and village-based agriculturalists were able to control social conflict and prevent outbreaks of inter- and intracommunal violence, although Keeley's and LeBlanc and Register's global surveys of ethnographic and archaeological evidence have thrown doubt on this comfortable assumption.[134] It is evident that competition for territory, water, and grazing rights often led to warfare among prehistoric foragers and farmers, and that warfare or the threat of intercommunal violence may have characterized much if not all of human prehistory. A significant problem connected with the understanding of the causes of warfare in the past is that ethnographic research points to the social control of violence in many contexts where social and cultural norms dictate what resources are considered worth fighting over.[135] If it is agreed that subsistence and economic values are at least partly culturally construed, we can avoid determinism as an explanation for warfare or its absence.

Equally significant to the recognition of Neolithic war in Thessaly is the likelihood that warfare appears to have been present from the very beginning of the period. We can speculate that warfare was perhaps the result of competition for arable land and water triggered by the 8200 cal B.P. climatic event that caused rapid emigration from Anatolia.[136] This event, a period of much colder and arid conditions lasting for about 200 years, is thought by Weninger and his colleagues to have forced farmers to move westward from southeastern and central Turkey to seek favorable conditions for agriculture. An episode of mass emigration from Anatolia could

129. LeBlanc 1999, pp. 72–73.
130. Halstead 1999a, p. 88.
131. Halstead 1999a, p. 79.
132. Halstead 1999a, p. 80.
133. LeBlanc and Register 2003, p. 8.
134. Keeley 1996; LeBlanc and Register 2003.
135. LeBlanc and Register 2003, pp. 55–76.
136. Weninger et al. 2006.

have had a major impact by accelerating the pace of demic diffusion of Neolithic farmers from Anatolia to the Aegean, as migrants searched for reliable water sources and arable land.[137]

While we await the results of future research, can we prove the existence of prehistoric warfare in Thessaly? We do not assert that it has been proven, but believe that it is highly likely. It is in this spirit that we offer our study: not as a final judgment on the existence of Neolithic warfare, but as a call for further research to understand the Greek Neolithic in its European context.

137. See Ammerman and Cavalli-Sforza 1984, pp. 50–62; Weninger et al. 2006.

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