

J. Bintliff

*Sediments and settlement in southern Greece*

Six sample areas of southern Greece were selected for a study of settlement patterns from the earliest human occupation (Fig. 1). Two had been intensively surveyed for sites: the south-west Argolid Peninsular, the Agiofarango Gorge in south Crete; two had been extensively surveyed – the Sparta and Helos Plains; and two had a good number of sites discovered over a long period of investigation – the island of Melos and the Argos Plain. The location of suspected occupation sites was examined in the light of local geology, soils, geomorphology, water supplies and defensive possibilities, and where applicable, marine resources. The apparent relationship in space between sites of the same period was also studied.

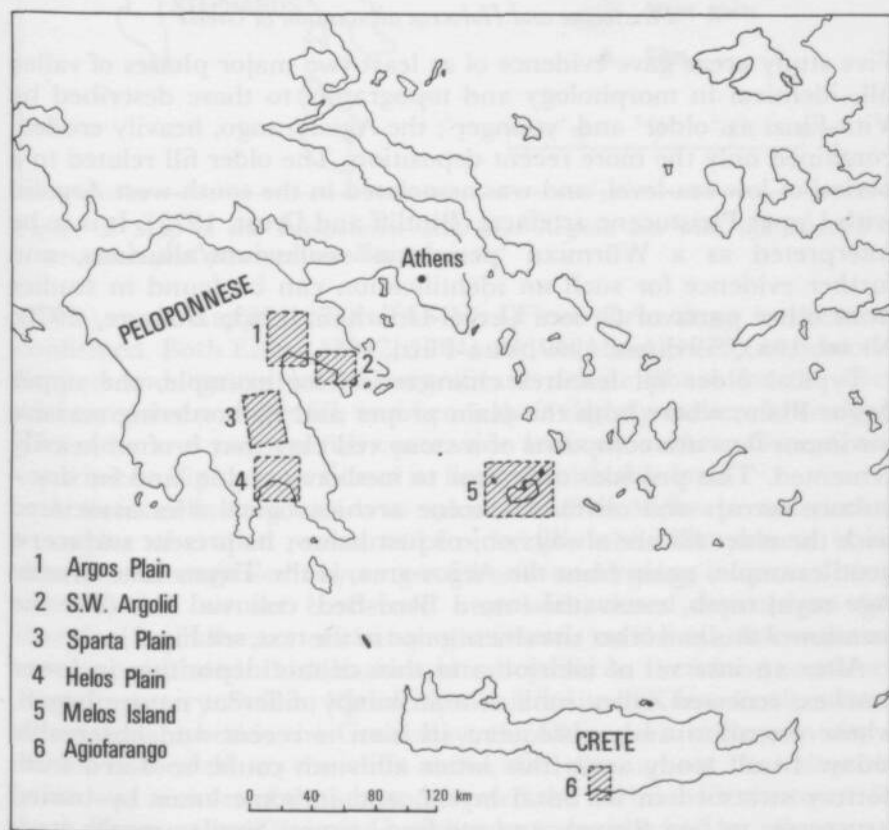


Figure 1. Map of southern Greece to illustrate the areas studied by the writer.

Hitherto the following views have prevailed amongst scholars in this field:

(i) The discontinuous development of the Mediterranean valleys proposed by the geomorphologist Vita-Finzi (1964, 1969), is neither widely applicable nor likely in its implications; Butzer (1971) and Loy (1967) criticised the scheme on grounds of general theory, but Eisma (1962, 1964) and Raphael (1973) produced studies where alluviation appeared to differ in chronology.

(ii) The most prized agricultural areas in the long-term occupancy of the Greek lowlands were alluvial valley-bottomlands.

(iii) Settlements are generally placed with priority given to water and defence.

(iv) The Mediterranean landscape has been progressively run down in its farming potential ever since, and directly due to, the activity of man in the area.

(v) Settlement network analysis, based on mutual distance, is of little value to the archaeologist with his incomplete data.

#### *1. Pleistocene and Holocene alluviation in Greece*

Five study areas gave evidence of at least two major phases of valley fill, identical in morphology and topography to those described by Vita-Finzi as 'older' and 'younger'; the Agiofarango, heavily eroded, contained only the more recent deposition. The older fill related to a period of low sea-level, and was associated in the south-west Argolid with Upper Pleistocene artefacts (Bintliff and Drost, 1972). It is to be interpreted as a Würmian 'periglacial' colluvium/alluvium, and further evidence for such an identification can be found in studies from other parts of Greece (Leroi-Gourhan, 1963; Dufaure, 1970; Nicod, 1963; Sordinas, 1969; Vita-Finzi, 1966).

Typical older fill features characterise, for example, the upper Argos Plain, where both the plain proper and its bordering massive piedmont fans are composed of a stony red clay that is often heavily cemented. This provides only poor to mediocre arable land for dry-culture cereals and olives. Holocene archaeological sites associated with the older fill are always on, or just below, its present surface; a good example, again from the Argos area, is the Tiryns Late Bronze Age royal tomb, excavated into a 'Red-Bed' colluvial fan. (For the location of this and other sites mentioned in the text, see Fig. 2).

After an interval of incision and thin deltaic deposition in lower reaches, renewed valley infill of a strikingly different nature began, whose cessation and subsequent incision is recent and observable today. In all study areas this latter alluvium could be dated from pottery stratified in its basal layers, and in some cases by buried structures, to late Roman and medieval times. Similar results have been obtained by Paepe (1969), Ward-Perkins (1962), Davidson

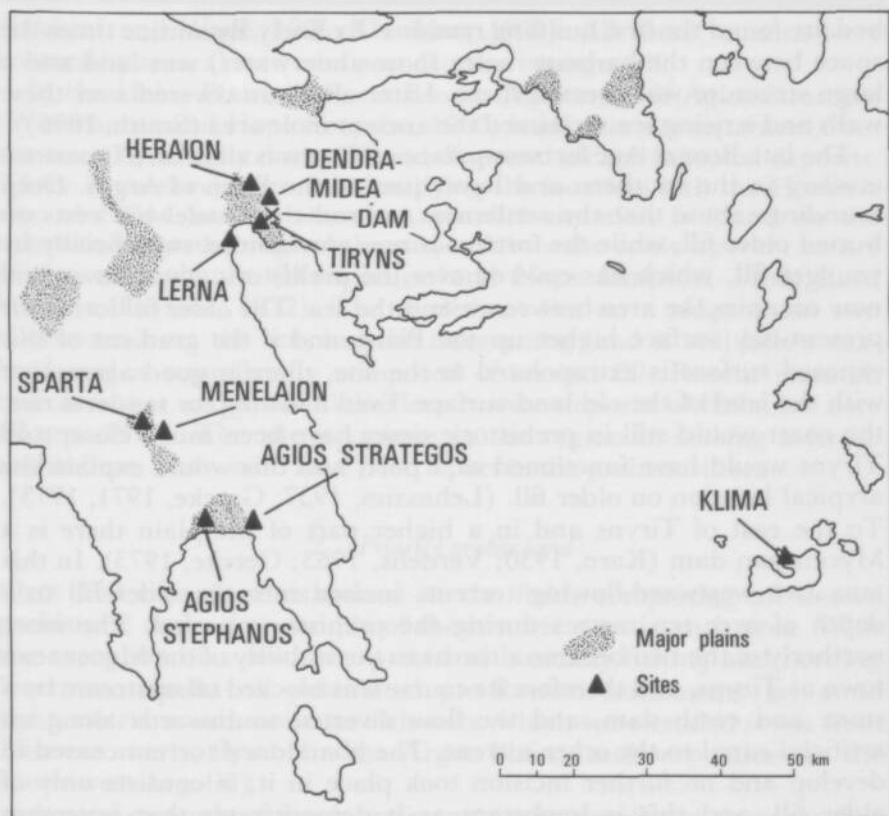


Figure 2. Map of the Peloponnese and west Aegean sea with the location of archaeological sites mentioned in the text.

(1971), and Rapp (1973). The Vita-Finzi chronology is therefore confirmed. Both Eisma (1962, 1964) and Raphael (1973) mistook the limited and agriculturally insignificant deltaic phase for the deep and extensive younger fill, and hence their slightly earlier chronology. The older and younger fills cover wide areas of southern Greece, and constitute a high proportion of its limited cultivable land.

A series of faulted basins in volcanic tuff on Melos provided clear examples of eroded remnants of older fill, while the present basin floors were composed of younger fill now undergoing incision. It is of interest that we are concerned here with closed depressions and therefore no influence of changing sea-levels on the alluvial sequence can be postulated. Both basin and valley fills on the island contained Roman pottery. Still on Melos, the ancient site of Klima lies in a small alluvial plain beside the Great Bay; the Classical and Roman city of Melos is located on the cliffs above, and throughout that time the plain was an inlet of the sea and formed the harbour for the town. By Late Roman times the port had begun to be blocked by alluvium of the second deposition, and above marine levels on a thin terrestrial

bed are found the first building remains. By Early Byzantine times the space between the harbour moles (now underwater) was land and a large structure was erected there. Later alluvium covered over these walls and a rising sea reclaimed the ancient mole area (Smith, 1896).

The late Bronze Age fortress-palace of Tiryns is sited on a limestone *inselberg* in the southern and lower part of the Plain of Argos. Deep soundings show that the settlement around the citadel hill rests on buried older fill, while the fortress is now surrounded superficially by younger fill, which has covered over the prehistoric lower town and now occupies the area between it and the sea. The older fill forms the present-day surface higher up the Plain, and if the gradient of this exposed surface is extrapolated to the site, there is good agreement with the level of the old land-surface. Even allowing for sea-level rise, the coast would still in prehistoric times have been much closer and Tiryns would have functioned as a port; and this would explain the atypical location on older fill. (Lehmann, 1937; Gercke, 1971, 1973). To the east of Tiryns and in a higher part of the plain there is a Mycenaean dam (Karo, 1930; Verdelis, 1963; Gercke, 1973). In this area two westward-flowing torrents incised into the older fill to a depth of over ten metres during the prehistoric period. The more northerly of the two became a threat to the stability of the Mycenaean town at Tiryns, and therefore its course was blocked off upstream by a stone and earth dam, and the flow diverted southwards along an artificial canal to the other torrent. The abandoned torrent ceased to develop and no further incision took place in it; it consists only of older fill, and this is important as it demonstrates that upstream sources control both incision and aggradation phases. The canal, on the other hand, which was most probably dug about 1250 B.C., experienced later incision followed by the second alluvial period and finally the present phase of renewed incision.

On the other side of the Argos Plain, at Lerna, a prehistoric town mound has its earliest foundations on a regular older fill land-surface, partly below present sea-level, and now cut off from the nearby coast by a narrow fringe of dark younger fill. As with Tiryns, extrapolation of the gradient plane despite necessary sea-level adjustments, would put the sea at the very edge of the mound. Again, as with Tiryns, the lower fertility of the older fill soil forming the hinterland to the site, compared with other soils available in the Plain, is amply compensated for by the potential of fishing and commerce.

A valuable local fixed point for the alluvial sequence in the Sparta Plain can be found in the riverside quarter of the ancient city. Immediately beside the present bed of the river Evrotas runs a modern and artificial levee, protecting behind it a low strip of recently reclaimed riverbed. Behind this in turn is a raised alluvial terrace, deposited against a higher plateau of Tertiary marls and sands. Beneath the alluvial terrace, and resting on a red clay older fill landsurface, were excavated ancient walls, roads, wells and altars

(Dickins and Wace, 1906; Dawkins, 1909). All these remains were covered by several metres of post-Roman younger fill.

In the Helos Plain, the Late Bronze Age centre of Agios Strategos (Waterhouse and Hope Simpson, 1960) is another site separated from the coast by a badly drained band of second fill and lagoonal deposits. There is good evidence for identifying the location with the Homeric city of Helos 'on the shore'. A parallel situation is found on the opposite (western) edge of the same plain – the contemporary centre of Agios Stephanos (Waterhouse and Hope Simpson, 1960; Lord William Taylour, 1972). The settlement lies on a ridge about two kilometres from the sea, but the intervening land is still below sea-level and is superficially composed of second fill. Recent research indicates that under this fill lie deep marine deposits of Holocene date (Rapp, 1973). The site is unique in the region in lacking a fertile arable base, and would have been a port in the prehistoric era.

## 2. *Priority arable land*

Over 150 sites were examined in the field, comprising all known prehistoric and a fair sample of the historic sites in each area. With the exception of a few, interpreted as basically fishing and herding locations, almost all postulated pre-Roman settlements lay amid light, nutrient and moisture rich soils, which were eroded *in situ* from Pliocene marls, flysch (in the Argos Plain), and serpentine (in the south-west Argolid).

A good example of flysch preference is the significant exposure that forms the basis of the palace centre at Dendra-Midea (Argos area). Flysch zones are also diagnostic for prehistoric settlements throughout Switzerland (Gates, 1972). Not far from Dendra the major early centre at the Heraion is placed neither on the limestone hills of the plain edge, nor the older fill of the plain proper, but locates on the fine soils of the bright yellow Neogen marls at an intermediate elevation between them. The rendzina soils found on the marls are often the key to early settlement elsewhere, for example the Italian Tavoliere (Jarman, 1972), northern France (Bender, 1971), and southern England (Evans, 1971). Research into early mining techniques suggests that prehistoric prospectors relied on simple characteristics such as colour and feel in differentiating between minerals. The striking soft sandiness and bright yellow and orange hues of the marls and flysch can often today single out an ancient site before its location is found from a map, and once early farmers became aware of the remarkably favourable properties of these soils, they would encounter no problems in searching out similar exposures. An interesting feature of the Helos Plain is a number of inconspicuous low Neogene hillocks that rise above the dark alluvium of the basin, several of which are prehistoric occupation sites. The alluvium is historic fill, and if this later deposit is discounted, the prehistoric

landscape around these settlements can be reconstructed as a low relief marl hillland.

On Melos, quite individual in geology, there was a locational preference partly on marls but chiefly in closed or inadequately drained depressions, where chemical breakdown, of little effectiveness normally in Greek soils, produced highly fertile basins of infill derived from the infertile glassy sand blanketing the isle. There is an obvious contrast between the normal Melian groundsurface of tuff sand and eruptive scree, with little or no soil, and the fine soils that have accumulated in the closed basins. It is the latter location that is usually favoured by the prehistoric communities of the island.

Close exploitation of the younger alluvial fill is predictably post-Roman in date, while settlement on the older fill begins generally with the recent introduction of irrigation from deep wells and mechanical ploughing, which vastly transform the dry, stony, heavy soil.

### 3. *The role of fresh water and defence*

Sources of water and defensive requirements appear only locally and temporarily to have significantly determined settlement situation, and in nearly all such examples there exists an adjacent zone of notably favourable arable land. A good example of this is the site, now under excavation, of what may be the Mycenaean palace centre for the whole of the Sparta Plain – the Menelaion. The immediate environs of the ancient site are dissected and rugged, appropriate for defence but inhospitable for farming. However the wider view from the site demonstrates how it dominates a very broad and fertile lowland of marls and sands, which were later occupied by the Classical and modern town of Sparta. To take another apparently 'defensive' location, consideration can be given to the imposing mountain of crystalline limestone that forms the Mycenaean palace-citadel of Midea (Argos Plain). It rises on the edge of the older fill of the main plain, and neither the latter nor the mountain itself are of particular arable fertility. However recent work by Hägg (1962) favours the suggestion that the main settlement was in fact at the mountain foot amid a localised pocket of flysch and marls, precisely where the modern village of Dendra-Manessi is found.

### 4. *The degeneration of the landscape*

The arrival of the historic fill may have considerably increased the agricultural and maritime depression of the early medieval Mediterranean, already suffering from invasions and pestilence, by creating swamps on a large scale along all stages of the rivercourses and especially in the plains, which were often malarial. The complexities of coastal change, involving probably absolute movement in both sea-level and bedrock, combined with sediment sinking and

the actual deposition, have yet to be unravelled and were inadequately tackled by Vita-Finzi (1969). However the vast bulk of recent *coastal plain* fill can be correlated with the early medieval *valley* fill, and together they constitute the most fertile and profitable soils of the Mediterranean. In contrast to the older fill they are loose, fine-textured, and at all times are very close to the watertable. Significantly, their exploitation was only on a small scale until the arrival of political stability, associated drainage and irrigation works, and citrus farming. The natural change in stream regime from aggradation to downcutting, which took place in the same late medieval period, aided the human efforts at reclamation and these soils became open to the farmer.

The nature and dating of the younger fill precludes direct human causation, and has ultimately in all the areas examined brought improved agricultural production in comparison to the potential of the prehistoric landscape. A similar conclusion was reached by Hutchinson in north-west Greece (Hutchinson, 1969). The most probable explanation for this deposition is climatic change. The studies of H.H. Lamb (1966) on recent climatic changes provides a sequence of striking reversals over the period during which clear discontinuities in river regimes have been noted. His postulated southward movement of depression tracks into the Mediterranean would be contemporaneous with the historic fill there. He cites evidence for unusually cold and wet conditions in south Europe at this time, while north Europe underwent a notably warm and dry period.

Human erosive activity paralleling alluviation is improbable considering the alternation of high and low population, intensive and extensive agriculture during this period (Russell, 1972), and the evidence of morphology and vegetation remains from the fill itself (Vita-Finzi, 1969, 1971). It should be noted that the last century has witnessed truly massive deforestation and human interference in Greece, perhaps more than ever before, but no aggradation has ensued.

##### 5. *Settlement network analysis*

Finally, though settlements were closely tied to priority arable resources, in at least three study areas during the Late Bronze Age, settlement hierarchies developed based on mutual distance within an isotropic surface. Sampling problems were obviated by selecting the higher order communities, which are very well represented in archaeological surveys, for the basis of the network, and a period when exact contemporaneity could be plausibly claimed from pottery studies.

*Acknowledgments*

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## DISCUSSION

Attention was focussed on the nature and origin of the younger fill. Mr. J. Wagstaff gave supplementary evidence to support a post-Roman and medieval date for the material. Professor A.C. Renfrew commented that a long period of relative stability is implied before the formation of the younger fill and he wondered if one possible explanation for the formation of the younger fill was an increase in deforestation during Classical times. He also noted that extensive deposition in certain areas must have been paralleled by erosion in others to infer a substantial change in relative land quality. The speaker replied that literary evidence for deforestation during Classical times was sparse and unreliable. Miss C. Delano Smith made the point that changes in sea level could also have initiated aggradation.