THE MANUFACTURE OF *SPONDYLUS* SHELL OBJECTS AT NEOLITHIC DIMINI, GREECE

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Introduction

The shell of *Spondylus gaederopus* Linné is a large and durable bivalve, and Neolithic people in Europe liked to use this species to make various shell objects, especially ornaments like bracelets, pendants and beads. *Spondylus gaederopus* was of south sea origin and the objects were transported far into inland Europe. It is one of the most spectacular indicators of large scale trade in Neolithic Europe, and has been discussed in various ways.

In earlier studies it was simply considered that *Spondylus* shell objects had been spread as a result of migration of Neolithic farmers from south-eastern Europe or by some sort of inter-tribal barter exchange.⁽¹⁾ From the end of the 1950's archaeologists began to study *Spondylus* shell objects more systematically and to try to clear the peculiarities in each region in order to follow up the mutual relationship among the various Neolithic cultures in Europe.⁽²⁾ *Spondylus* trade was often discussed as the indicator of the origins of some Neolithic cultures, especially Vincă-Tordos culture and Linear pottery culture.

In 1970, Shackleton and Renfrew threw new perspectives on the problem of *Spondylus* trade.⁽³⁾ They presented the scientific data on the source of the *Spondylus* shells and asserted that the *Spondylus* shells found in the Balkan originated not from the Black Sea but from the Aegean, especially the coasts near the Plain of Drama, Eastern Macedonia. They also tried to identify *Spondylus* trade mechanism and proposed a model of "prestige chain exchange" for Balkan *Spondylus* trade. The former point is widely accepted by many archaeologists,⁽⁴⁾ though there are some scholars who believe in the Black Sea origin.⁽⁵⁾ The latter point is not so frequently acknowledged as the former, because Shackleton and Renfrew did not propose sufficient data in their article to persuade other archaeologists of its validity.⁽⁶⁾ Setting aside whether or not the Balkan *Spondylus*

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Figure 1. Map to show the location of Dimini and the other main Neolithic sites in Thessaly (upper) and the location of Dimini and the coasts near Volos (lower; Shadow parts indicate rocky bottom coasts)

Figure 2. The settlement plan of Neolithic Dimini. The plan was redrawn from Plate 1 of "To Neolithiko Dimini" written by Hourmouziadis (Volos 1979). Numbers indicate his structure numbers, except House I-6 (after Tsountas in footnote 8). Lower case letters were added by the author to indicate find spots of shells and shell objects found in the spaces among structures.

trade was a kind of prestige chain exchange, considering the trade mechanism is very important for the study of prehistoric societies.

In order to discuss the mechanism of *Spondylus* trade, the study of *Spondylus* shells and shell objects in the Aegean region, which was assumed to be the resource area together with the Adriatic region, is indispensable. Recently the data on *Spondylus* shells and shell objects in Greece is increasing,⁽⁷⁾ and appropriate conditions for study are emerging. The purpose of this article is a proposal of one of these data for further discussions on the mechanism of *Spondylus* trade in future.

I. Dimini and the shell assemblage

Dimini is a Late Neolithic settlement near Volos, Greece (Fig. 1, 2). It was firstly excavated at the very beginning of this century by Stais, and then by Tsountas.⁽⁸⁾ From 1974 to 1976 new excavations were carried out by Hourmouziadis, and his work has opened up new perspectives for the interpretation of this site.⁽⁹⁾ The bulk of the settlement belongs to the last phase of the Late Neolithic period (Classical Dimini Phase or L. N. IV in Thessaly).

Hourmouziadis gave me a chance to study shells and shell objects found during his excavations, and I studied them in the summer of 1986.⁽¹⁰⁾

Over twenty species of marine shells were identified among almost 5800

Figure 3. The proportions of the different shell species making up the entire shell assemblage (left) and the entire shell object assemblage (right).

specimens. Figure 3 (left) shows the proportions of the different shell species making up the entire shell assemblage at Dimini. *Cerastoderma edule* is by far the most common species, followed by *Ostrea edulis* and *Spondylus gaederopus*. The numbers of the other species are very small compared with these three species.

500 shell objects were found in the new excavations at Dimini. The shell objects made of *Spondylus gaederopus* form almost half of the shell object assemblage, and those of *Cerastoderma edule* form 42.1 percent (Fig. 3 right). We must notice that *Spondylus* shell objects form a high percentage of the shell object assemblage, compared with a relative low percentage in the entire shell assemblage.

Twelve shell species were used as raw materials for shell objects (Fig. 4). They can be divided into two groups based on the percentage of shell objects in each species. The first group has high percentage of shell objects, and the second group has quite low percentage. It is very probable that the shell species belonging to the first group were gathered as raw materials for the production of shell objects and those belonging to the second group were gathered mainly for their edible value. *Spondylus gaederopus* is the most numerous among the species of the first group. The number of the shell objects made of *Cerastoderma edule* is also large, but the quite low percentage of the shell objects within this species indicates that this species belongs to the second group.

Figure 4. The percentage of shell objects in each shell species. *Columbella rustica* and *Nassa reticulata* were also made into shell objects, but their numbers are quite small. So, they are excluded in this figure.

Figure 5. The percentage of appearance of main three species in each find spot.

Figure 5 shows the percentage of appearance of the main three species in each find spot within the site. The proportions of the percentage of the first two species, *Cerastoderma edule* and *Ostrea edulis*, are similar, and the percentage difference among find spots was mostly due to the maldistribution of the excavations.⁽¹¹⁾ The find spots of shell objects from these two species were dispersed over the settlement and there was no significant accumulation. Working technique on these objects was also very simple. So, it is supposed that the production of shell objects from these two species was done on a personal and occasional level.

The proportion of *Spondylus gaederopus* is very different from those of the first two species and shows considerable accumulations in House N and Space g. In the proportion of shell objects such accumulations are more conspicuous. The production techniques for making *Spondylus* shell objects were also far more complicated than those used for the first two species. In any case, *Spondylus gaederopus* is certainly the most important marine shell species used for producing shell objects at Dimini. As it was supposed that these find spots would bear relation to the production of *Spondylus* shell objects, all of the shells and shell objects of *Spondylus* were carefully examined.

Plate 1. *Spondylus* shell objects of Dimini.
1. ring (actual size). 2. button (x 2), 3. cylinder bead (x 2).

II. Reconstruction of the manufacture of *Spondylus* shell objects

404 specimens of *Spondylus* shells and shell objects were found in the Hourmouziadis' excavations at Dimini. 243 out of the 404 specimens are complete or broken shell objects, made up of 87 rings (bracelets and annulets), 141 buttons, 8 cylinder beads and 5 miscellaneous objects. All of the rings except one example (Plate 1: 1) are broken and most of the buttons (Plate 1: 2) and cylinder beads (Plate 1: 3) are complete. The remaining 161 specimens are worked and natural shells. Table 1 shows the numbers of the types of *Spondylus* shell objects and worked and natural shells in each find spot.

To reconstruct the successive stages of *Spondylus* shell objects' manufacturing, worked shells and fragments were observed. There are 39 worked

Table 1. The numbers of *Spondylus* shell objects, worked shells and natural shells in each find spot based on their types.

find spots \ types		shell objects					worked shells and natural shells										grand total	
		rings	buttons	cylinder beads	miscellaneous	total	unfinished rings			worked shells & fragments for small objects	natural shells							
							stage 1	stages 2, 3	stages 4, 5		cores or primary flakes	secondary flakes	other worked shells & fragments	simple flakes	badly weathered shells	well conditioned shells		total
C.C.	Structure 9	1	1			2	2					4	4			1	12	14
	Between St.9 and St.6 (Space a)												1					1
	Structure 16 and its vicinity	2	1			3	1			1		4					8	11
DAA A	Other spaces in Central Court Area															2		
	Structure 18 (House N)	45	2	1		48	3	1	4	2	1	2	1	1	1	1	16	64
	Between St.18 and St.22 (Space b)	5	1	1		7				1	1	1					2	9
DAA B	Structure 22																	1
	Structure 23 and its vicinity												2				2	2
	Other spaces in DAA-A																1	1
DAA B	Outside of 4th peribolus (Space c)									1							1	1
	Eastern side of St.28 (Space d)				1	1											2	2
	Structure 28	2				2	1					1					1	1
DAA B	Structure 25																1	1
	Structure 30 and its vicinity											1					2	2
	Structure 32																1	1
DAA B	Structure 33		6			6	1										1	7
	Structure 39																	
	Unidentified in DAA-B										1						1	1
DAA B	Outside of 4th peribolus (Space e)						1			1	1	3	1	1	1		9	9
	Between 1st and 2nd periboli (Space f)				1	1		1				1	2			1	2	7
	Structure 40 and its western space	1	1			2		1				1	1			2	4	6
DAA B	Structure 43 (Megaron B)						2		1	1	1	2					7	7
	Between St.43 and St.50 (Space g)	8	122	6	1	137	1	1		3	2	2				2	11	148
	Structure 50 and its northern vicinity						2			1	1	1					4	4
DAA B	Structure 51 and its eastern vicinity	3				3	2			1		4				1	8	11
	Behind Space g (Space h)	4	9			13	2		1		1	7				4	16	29
	Behind Structure 50 (Space i)						1			2		2				1	7	7
DAA B	Between St.51 and House I-6 (Space j)											1					1	1
	House I-6 and its vicinity											2			2	1	6	6
	Unidentified in DAA-B											2					2	2
DAA B	Structure 53 and its vicinity	3			2	5		1	1	1		2	1				5	10
	Other spaces in DAA-B																	
	Unidentified in DAA-B and -B						1			1		1				1	3	3
DAA B	Surface collection and unidentified	13				13	1	2		2		11	1	1	1	1	19	32
	Total	87	143	8	5	243	25	7	7	17	15	57	6	13	14	16	191	404

Figure 6. Unfinished *Spondylus* shell rings in process of making (left) and the schematic processes of manufacturing *Spondylus* shell ring (right).

shells and fragments which are probably unfinished shell rings. Most of them are made of left valves of *Spondylus* shells. From these materials the successive stages in the manufacture of *Spondylus* shell rings were reconstructed. There are main five stages in the process.

Stage 1. The ventral margin of the shell is ground down to smooth the rugged natural margin (Fig. 6: I).

Stage 2. The outer surface of the shell is ground down to reduce the thickness of the shell. Usually a hole penetrates the thickness of the shell in this stage (Fig. 6: II).

Stage 3. The shell is pierced inside the pallial line (in case that a hole does not penetrate), and the hole is enlarged by tapping (Fig. 6: III).

Stage 4. The periphery of the hole is ground down until it is large enough to form a ring (Fig. 6: IV).

Stage 5. The hinge teeth, the ears and other projections are ground down and all the sides are smoothed (Fig. 6: V).

It seems that the order of these stages was sometimes partly inverted.

It is supposed that the tools used in ring manufacturing are a stone quern (stages 1, 2, 5), a drill and a small hammerstone (stage 3), a hand-held grinding stone (stages 4, 5), and so on. Sand with water were also probably used as abrasive materials.⁽¹²⁾ These tools are common implements used in everyday life during the Neolithic period in Greece. Such tools were found in the excavations at Dimini.⁽¹³⁾

Besides rings, many *Spondylus* buttons and some cylinder beads were found in the new excavations at Dimini. There are several worked shell fragments which were probably abandoned in the manufacturing process of these small objects, but their evidence is not so eloquent as that of rings. Anyhow the manufacturing process of these small objects is presumed.

Manufacturing is begun by breaking a *Spondylus* shell. This process is repeated until the size of the fragments become suitable for small objects (Fig. 7: I~III). Abrupt breakages are observed on some shells, from which the small fragments were cut (Fig. 7: I). These shells are called "cores" here. There are two right valves having blanks, from which the fragments for small objects were cut directly (Fig. 7: I'). They show another method to procure the fragments for small objects, but this method is very minor. Judging from the shapes of the blanks, the small fragments from this type cores were mainly used for making cylinder beads.

Figure 7. Worked *Spondylus* shells and fragments for small objects (right). and the schematic processes of manufacturing *Spondylus* shell button and Cylinder bead. (left)

The small fragment is ground in order to peel the periostracum of the shell and to make the rough shape of a button or cylinder bead (Fig. 7: IV, IV'). Then the piercing is done on the fragment with a small drill. Each button has two small holes which are pierced obliquely and connected internally (Fig. 7: V). Cylinder beads are pierced from both ends (Fig. 7: V'). In the final step the small fragment is ground again to smooth all the sides. On the surface of many buttons some different flats are observed (Fig. 7: VI). The tools used in the manufacturing of small objects are almost same as those for rings, except a very small sized drill which is used to pierce fine holes.

The products in the manufacture of *Spondylus* shell objects at Dimini are almost all made up rings, buttons and cylinder beads. The schematic processes of manufacturing are also shown in Figures 6 and 7.

Spondylus gaederopus is a bivalve shell, and the right and left valves are considerably different in shape. The left valve is brownish-red in color with spines and small ears, and much flatter than right valve. The right valve is paler and convex, and its porcelaneous body is thicker than that of the left valve. This difference was considered in the manufacture of *Spondylus* shell objects at Dimini. Most of the unfinished rings were from left valves and most of the worked shells and fragments for the small objects were from right valve

Figure 8. The proportions of the left and right valves of *Spondylus* in each type of shell objects and worked shells and fragments.

valves (Fig. 8). It is not so easy to determine which valve was used by looking at the finished objects, because they have been completely ground. But in the case of rings, traces of hinge teeth and / or the location of the adductor muscle impression sometimes indicate the original valve. 27 out of 87 rings were identified in this way, and most of them were from left valves (ibid.). The left valve is easier material for producing shell rings because it is thinner, and the right valve is more suitable for producing small shell objects because its porcelaneous body is thicker and small objects were made of only porcelaneous parts.

It is quite certain that the people of Neolithic Dimini recognized the difference between left and right valves of *Spondylus gaederopus* and that they knew how to utilize the raw materials effectively. They used mainly left valves for making rings and right valves for making buttons and cylinder beads.

Now we return to table 1 and review the find spots where *Spondylus* shells and shell objects were found.

There are considerable accumulations of *Spondylus* shell objects in House N and Space g. The former produced over half of the *Spondylus* rings, and the latter produced 85 percent of the *Spondylus* buttons and most of the cylinder beads. In the worked shells and fragments the accumulations were not so remarkable as those of objects. But House N produced 8 worked fragments which were presumed as unfinished rings, and Space g produced 5 worked fragments which had been probably discarded in the manufacture of small objects. Each number is larger than those of the other find spots. Concerning the tools used for the manufacture of shell objects, querns and grinding stones which were very suitable for making shell rings were found in House N,⁽¹⁴⁾ and stone drills which could have been used as piercing implements for small objects were found in Space g and its vicinity.

It is very probable that *Spondylus* rings were made chiefly in House N and *Spondylus* buttons and cylinder beads principally in and around Space g.

III. Dimini and its significant geographical position for the manufacture of *Spondylus* shell objects

Now it is quite certain that the manufacture of *Spondylus* shell objects existed in the settlement of Neolithic Dimini. Its scale was considerably large compared with those of the other Neolithic settlements which have been reported

to date.

The manufacture of *Spondylus* shell objects is a mere productive sphere in the system of material circulation, and we must investigate the other spheres in the system, e. g. the procurement of raw materials, the transportation of raw materials and products, and the consumption of products, for understanding the *Spondylus* trade.

Spondylus gaederopus lives in the littoral zone below a few meters down, and quite firmly attached to a hard substratum. Therefore they must have been gathered in a rocky bottom area. In the specimens of *Spondylus* shells of Dimini, there are many right valves with traces of rock adherings and very few specimens with polychaetes inside the shell, telling us that they were not collected as beach dead but gathered while still alive.

The settlement of Dimini is situated about 3.5km west of the modern beach near Volos (Fig. 1). The study of the ancient coastlines of Greece reveals that the sea level has been rising continuously from the last glacial maximum of the Late Paleolithic. Around 9000 b. p. there were still coastal plains which today are submerged in the sea, but the essential shape of coastlines was not so different from that of today.⁽¹⁵⁾ It is supposed that the Late Neolithic coastlines were more similar to those of today.⁽¹⁶⁾ The details of the Late Neolithic coastlines near Volos remain unclear in spite of some geological studies in this area,⁽¹⁷⁾ but north-western coast of Volos Bay (the northern projection of Pagasitikos Bay) has been produced by the alluvial formation for the Holocene.⁽¹⁸⁾ So, it is supposed that the Late Neolithic coastline there extended somewhat further inland than that of today, as Hourmouziadis has already pointed out.⁽¹⁹⁾

I investigated the coasts near Volos to gather marine shells in January of 1987. The coast lines of Volos city and the western part of the inlet of north-western Volos Bay were artificially transformed, but almost all coasts inside the inlet had been sandy beaches. This is one of the reasons why *Cerastoderma edule* shells were so numerous at Neolithic Dimini. People of Dimini used to gather this species on the sandy beaches which existed very near from their settlement. Therefore *Spondylus* shells must have been gathered outside the inlet. The nearest rocky bottom coast suitable for gathering *Spondylus* shells is situated along the western coasts of Volos Bay outside the inlet, about 5km from the settlement of Dimini (Fig. 1: lower). I could collect some specimens of *Spondylus* shells on the cast near Pagasai.

At Dimini, the number of the shells of rock dwellers is considerably small compared with that of sand burrowers, especially *Cerastoderma edule*. This may be reflected in the fact that the rocky bottom coast was situated rather far from the settlement.

Procurement of *Spondylus* shells must have been systematic to maintain the manufacture of *Spondylus* shell objects, and there are two hypothetical sources of *Spondylus* shells for Dimini. The first presumed source is the rocky bottom coasts near Pagasai. In this case the people of Dimini themselves used to go there to gather *Spondylus* shells. As the rocky bottom littoral there is not so large, it is not certain that they could gather enough *Spondylus* shells to maintain the manufacture in their settlement. The second hypothesis is that some specimens of *Spondylus* shells were imported from more coastal settlements, situated especially in the Aegean islands where *Spondylus* shells lived more densely.⁽²⁰⁾ *Spondylus* shells were discovered in the excavations of some Neolithic sites in the islands near Volos,⁽²¹⁾ and it is possible that some of these *Spondylus* shells were brought into Dimini.

As I have already mentioned, 87 *Spondylus* shell rings were discovered in the excavation seasons of 1974 to 1976 at Dimini. In the old excavations of Tsountas some *Spondylus* shell rings were reported.⁽²²⁾ After the excavations of Hourmouziadis, small scale excavations were carried out at Dimini for site preservation and some more *Spondylus* shell rings were found. Then the total number of *Spondylus* shell rings found at Dimini to date amounts to almost one hundred. With one exception all of these rings are broken specimens. It is not definite whether they were broken due to the usage or in the very final stage of production. But as most of them were found in the manufacturing context, almost one hundred specimens would have been too numerous for consumption within the settlement of Dimini, and most of the broken rings show traces of having been burned, the latter explanation seems to be the case. If so, Neolithic Dimini produced *Spondylus* shell rings on a quite large scale.

Buttons made of *Spondylus* shells are more numerous than rings at Dimini, but their economic value was not so large as their number, because a lot of buttons could be produced from only one valve and the distribution of *Spondylus* buttons is quite limited.⁽²³⁾ But quite similar type *Spondylus* buttons were found from Grave no. 3 of Varna II Necropolis,⁽²⁴⁾ and we have to pursue the distribution of this type objects more widely.

Anyhow it seems very probable that the settlement of Dimini produced

Spondylus shell objects for exportation and actually exported them with perhaps raw materials (unworked *Spondylus* shells), especially towards Central Thessaly.⁽²⁵⁾

Fig. 1 is the map showing the location of Dimini, which was situated at a strategic point in the corridor connecting Central Thessaly with Pagasitikos Bay. It stood near the confluence of the Kserias and the Seskouliotis rivers, and along the latter people could obtain easy access to Volos Bay (a projection of Pagasitikos Bay) and towards Central Thessaly. We can not ignore this strategic position of Dimini in the corridor which was almost the sole route for collection and transportation of materials from the Aegean Sea into Central Thessaly. *Spondylus* shell was one of the most important Aegean Sea materials in the Neolithic period, and this strategic position would have made Dimini a suitable place for the management of *Spondylus* shell object manufacture. This could have been one of the reasons for the establishment of a Neolithic settlement at Dimini.

Conclusion

Up until now, *Spondylus* shell objects have been reported from about twenty Neolithic sites in Greece (Fig. 9).⁽²⁶⁾ It has been supposed that Eastern Macedonia was the most suitable region for a transporting center of Aegean *Spondylus* shells because it is adjacent to the Balkan, where *Spondylus* shells were required in large numbers. In fact, Neolithic sites like Sitagroi, Dikili Tash and Dimitra produced many *Spondylus* shell objects and even some unfinished objects, showing that they were not only transporting but manufacturing sites.⁽²⁷⁾ Recent excavations at Vasilika in Halkidiki revealed that some *Spondylus* shell objects were also found in Central Macedonia.⁽²⁸⁾ In Western Macedonia, *Spondylus* shell objects were discovered among the excavated materials from Servia and Rodohori Cave.⁽²⁹⁾ These sites were situated inland and the source of these objects was not established.

In Central Thessaly, Agia Sofia Magoula and Tsangli produced *Spondylus* shell objects. As conjectured in the former pages, their source was probably the Volos area where Dimini, Sesklo and Phithiotis Thiba produced *Spondylus* shell objects.⁽³⁰⁾ The evidence of the manufacture of *Spondylus* shell objects in Volos area raises a new perspective on the source of *Spondylus* shell objects in Western Macedonia, and farther north towards Balkan.

Fig. 9. Main Greek neolithic sites which produced *Spondylus* shell objects (Crete excluded).

The *Spondylus* shell objects in the sites of north and Central Greece consist mainly of rings and cylinder beads, and their assemblages are comparatively large in scale. In south Greece, the *Spondylus* shell objects were produced on a small scale.⁽³¹⁾ There are no remarkable object types in the assemblages. *Spondylus* shells are merely one of the marine shells which were used as raw materials for shell objects, and they were gathered primarily as diet in south Greece. As south Greece is far from the Balkan and Thessaly and Macedonia are situated between south Greece and the Balkan, a large scale manufacture

producing *Spondylus* shell objects had not been developed there, though *Spondylus* shells live more densely.

The evidence of the large scale manufacture of *Spondylus* shell objects at Dimini suggests that there were various trade routes from the Aegean coasts to the Balkan. Up until now, most of the *Spondylus* shell objects in the Aegean region have been found in the settlements. It is partly due to the poverty of excavations on the Neolithic burials in this region, but it is a striking contrast to the Balkan and its northern regions where many *Spondylus* shell objects were discovered in the burials.⁽³²⁾ It is presumed that the *Spondylus* shell objects found in the Aegean region during Neolithic periods, especially in Thessaly and Macedonia, were manufactured as trade items for the further regions rather than for consumption within the region. The Aegean region may have exported also *Spondylus* shells themselves together with shell objects, because the various types of *Spondylus* shell objects were produced in the Balkan.⁽³³⁾ A secondary manufacturing site of *Spondylus* shell objects like Hirşova indicates this situation.⁽³⁴⁾

At Dimini left and right valves of *Spondylus* shells were made properly into different type objects. Left valves are more suitable for mass production of shell rings because of their thinner bodies, and the fact throws new material for the discussion of craft specialization.

The proper usages of left and right valves for shell objects were considerably different among regions and phases. For example, not a few *Spondylus* shell rings from right valves were observed in the excavated materials of Sitagroi, and the technique of production there was somewhat different from that of Thessaly.⁽³⁵⁾ The typological and technical studies on the *Spondylus* shell objects will make it possible to reconstruct the chronology, regional differences and trade routes of *Spondylus* shells and shell objects.

As I mentioned in the introduction, the purpose of this article is a proposal of the data of *Spondylus* shells and shell objects in the resource area. In order to follow up the mechanism of *Spondylus* trade, detailed analyses on the objects must be conducted at various sites at first. I hope that many archaeologists in various countries will join the discussion on this problem.

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Notes

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Besides the Aegean and the Adriatic origins, *Spondylus* shells of fossil origin may have been used for making shell objects, but it seems that the case was very rare.

(6) S. Milisauskas, *European Prehistory* (Academic Press: New York 1978) 86–87.

(7) D. S. Reese, "Marine and Fresh-water Molluscs" in P. Hellstrom ed. *Paradeisos: A Late Neolithic Settlement in Aegean Thrace* (Medelhavsmuseet: Stockholm 1987) 119–134; C. Renfrew, "Trade and Craft Specialisation" in D. R. Theodoridis ed. *Neolithic Greece* (National Bank of Greece: Athens 1973) 186–187, fig. 243; D. V. Grammenos, "Neolithikes Ereunes stin Kentriki kai Anatoliki Makedonia," Ph. D. dissertation, University of Thessaloniki (Thessaloniki 1984) 148–156, pl. 57–60, 62, 63; G. E. Mylonas, *Excavations at Olynthus, Part 1, The Neolithic Settlement, The Johns Hopkins University Studies in Archaeology* 6 (The Johns Hopkins Press: Baltimore 1929) 81, fig. 93; M. Ps. Petsas, "Rodohorion" *Arhaiologikon Deltion* 19 (1964) 356, fig. 9; R. J. Rodden, "Recent Discoveries from Prehistoric Macedonia: An Interim Report" *Balkan Studies* 5 (1964) 117, pl. 8A; C. Ridley and K. A. Wardle, "Rescue Excavations at Servia 1971–1973: A Preliminary Report" *BSA* 74 (1979) 212, 217, Pl. 26: c; V. Milošević et al., *Die Deutschen Ausgrabungen auf Magulen um Larisa in Thessalien 1966*, (Rudolf Habelt Verlag GmbH: Bonn 1976) 12–13, Tafel 21; A. J. B. Wace and M. S. Thompson, *Prehistoric Thessaly* (The University Press: Cambridge 1912) 84, 125, fig. 78; D. Vialou, "La parure," in N. Lambert ed. *La grotte préhistorique de Kítsos (Attique), Recherche sur les grandes civilisations* 7 (École Française d'Athènes: Paris 1981) 409–410 fig. 282; G. Touchais, "Le matériel néolithique," in *L'Antre Corycien I, BCH supplément VII* (École Française d'Athènes: Athens 1981) 159–160, pl. XV; L. W. Kosmopoulos, *The Prehistoric*

Inhabitation of Corinth, vol. 1 (München Verlag Bisher F. Bruckmann: Munich 1948) 66, fig. 49; T. W. Jacobsen, "Excavations in the Franchthi Cave, 1969–1971, Part II," *Hesperia* 42 (1973) 258, pl. 48–d; J. C. Evans and C. Renfrew, *Excavations at Saliagos near Antiparos, BSA Supplementary Volume 5* (Thames and Hudson: Oxford 1968) 65, fig. 78, pl. XLVI. All of the *Spondylus* shell objects mentioned in these articles belong to Greek Neolithic. Cretan and Bronze Age specimens are excluded. In addition to these specimens, there are much more Neolithic *Spondylus* shell objects which has not been published.

(8) C. Tsountas, *Ai Proistorikai Akropoleis Diminiou kai Sesklou* (Archaeological Society at Athens 1908).

(9) G. C. Hourmouziadis, *To Neolithiko Dimini* (Society for Thessalian Studies, Volos 1979).

(10) A. Tsuneki, "Shells and Shell Objects from Neolithic Dimini", *M. S. for Anthropologika* (Volos-Thessaloniki n. d.).

(11) Hourmouziadis had to excavate the site after partly intensive excavations by Stais and Tsountas. This situation affected the statistical studies for all kind of materials of Dimini.

(12) G. F. Dales and J. M. Kenoyer, "Shell Working at Ancient Balakot, Pakistan" *Expedition* 19–2 (1977) 13–19, J. M. Kenoyer, "Shell Working at Moenjo-daro, Pakistan" *South Asian Archaeology 1983* (Naples 1985) 297–344. These studies on shell working by Kenoyer serve as a good reference.

(13) The stone industry of Dimini has been studied by Moundrea, and some results were discussed in her doctoral dissertation. H. –A. Moundrea-Agrafioti, "La Thessalie du sud-est au néolithique: outillage lithique et osseux" unpublished Ph. D. dissertation, University of Paris X (Paris 1981).

(14) Prof. Hourmouziadis also gave me a chance to observe the stone implements of Dimini. I confirmed that there were at least two hand-held grinding stones and some stone urns in the materials of House N.

(15) T. H. van Andel and J. C. Schackleton, "Late Paleolithic and Mesolithic Coastlines of Greece and the Aegean" *JFA* 9–4 (1982) 445–454.

(16) Theoharis suggested that the neolithic coastline of Agios Petros had been at least five meters below the present coastline. D. R. Theoharis, "Agios Petros" *Arhaiologikon Deltion* 26 (1975) 293–296.

(17) J. Ferrière, "Étude préliminaire d'un secteur des massifs cristallins internes (zone pélagonienne): la région de Volos, Grèce continentale-orientale" *Bull. Soc. géol. France* 18–2 (1976) 256–272; H. Schneider, *Zur Quartärgeologischen Entwicklungsgeschichte Thessaliens (Griechenland)* (Rudolf Habelt Verlag: Bonn 1968); "L'histoire géologique du bassin néogène et quaternaire de la Thessalie" *La Thessalie: actes de la table ronde 21–24 Juillet 1975, Lyon* (Lyon 1979) 43–50.

(18) *ibid.*

(19) Hourmouziadis, *op. cit.* (in footnote 9) 51.

(20) Some fishermen whom I met in the fish-market of Volos told me that we could find *Spondylus* shells easily in such islands like Skyros and Euboea.

(21) A. Sampson, *I Neolithiki kai Proto-Elladiki I stin Euboea* (Society for Euboian studies, Athens 1981) 47–49, 85, 141.

(22) Three broken shell rings, which were supposed made of *Ostrea edulis* by the excavator, were reported, *op. cit.* (in footnote 8) 355, Plate 46: 5–7. All of them are now in the National Archaeological Museum at Athens, and I observed them in June, 1986. Two of them are made of *Spondylus gaderopus* and the other one is made of boar's tusk.

(23) Stone buttons which are similar to *Spondylus* buttons of Dimini have often been discovered from many Greek Neolithic sites including Dimini itself, but no *Spondylus* button of Dimini type has been reported from the other sites in Greece.

(24) *Das Erste Gold der Menschheit — Die Älteste Zivilisation in Europa* (Freiburg 1985) 56.

(25) V. Milojević et al., A. J. B. Wace and M. S. Thompson, *op. cit.* (in footnote 7); A. Tsuneki, "A Reconsideration of *Spondylus* Shell Rings from Agia Sofia Magoula, Greece" *Bul-*

letin of the Ancient Orient Museum, Tokyo, Vol. IX (1987) 1–15, Some of these rings were discovered in earlier context than the Classical Dimini phase.

(26) *op. cit.*, (in footnote 7).

(27) The exhibited materials of Sitagroi at Philippi Museum include the unfinished *Spondylus* shell rings besides finished rings.

(28) D. V. Grammenos, *op. cit.*, (in footnote 7).

(29) C. Ridley and K. A. Wardle, M. Ps. Petsas, R. J. Rodden, *op. cit.*, (in footnote 7).

(30) Some *Spondylus* shell objects were discovered in the new excavations at Sesklo (personal communication, K. Kotsakis). The materials of old excavations at Phithiotic Thiba, now stored in Volos Museum, include a *Spondylus* shell ring. It was reported as a digging tool by Theoharis. D. R. Theocharis ed. *Neolithic Greece* (National Bank of Greece: Athens 1973), illustration 118 left.

(31) D. Vialou, G. Touchais, L. W. Kosmopoulou, T. W. Jacobsen, J. D. Evans and C. Renfrew, *op. cit.*, (in footnote 7).

(32) R. J. Rodden, (in footnote 2).

(33) E. Comşa, *op. cit.*, (in footnote 5).

(34) D. Galbenu, Așezarea neolitică de la Hirşova. *Studii și Cercetări de Istorie Veche* 13–2 (1962) 285–306; Neoliticheskaja Masterskaja dlja Obrasenij v Hirşova. *Dacia* 7 (1963) 501–509.

(35) This point was merely based on my glance on the exhibited materials of Sitagroi at Pili-ppi Museum. Mollusca of Sitagroi will be published in the second volume of the final report of Sitagroi.