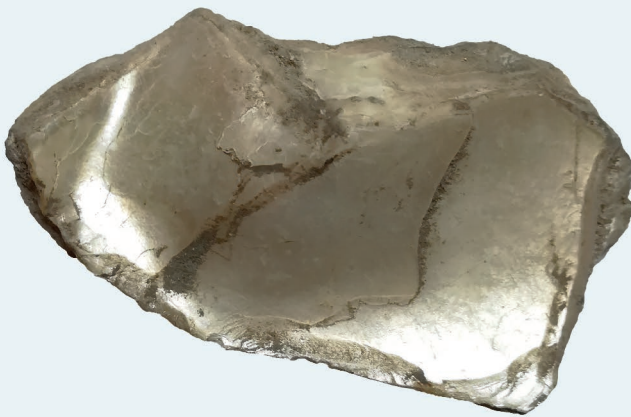




The exploitation of molluscs and other invertebrates in Alexandria (Egypt) from the Hellenistic period to Late Antiquity: food, usage, and trade



Nicolas MORAND



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Fragments of pearl oyster from 5th-6th century AD levels on the Diana Theatre site and from Late Roman levels on the Billiardo Palace; half-finished mother-of-pearl objects found on the Diana Theatre site.

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The exploitation of molluscs and other invertebrates in Alexandria (Egypt) from the Hellenistic period to Late Antiquity: food, usage, and trade

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ABSTRACT

A number of archaeological salvage excavations conducted in Alexandria (Lower Egypt) by the Centre d'Études alexandrines have provided a corpus of around 2000 fragments of marine, freshwater and terrestrial invertebrates. These archeomalacological remains come from several occupation layers of the same district within the town, the *Brucheion*, dating from the end of the 4th century BC until the 6th century AD. After macroscopic observations and through a binocular microscope, the analysis of the malacofauna vestiges has provided previously unknown information regarding the exploitation of the aquatic environment by Alexandrians during antiquity. In addition, some residues of mineral material preserved on the shells have been analysed under a scanning electron microscope (SEM). This study sheds light on both consumption choices and on the variety of uses for shells (container, decoration, raw material) within the Alexandrian domestic context. Certain species from the Red Sea and the Western Mediterranean Sea provide new data on the movement of products of marine origin within Ptolemaic and Roman Egypt.

KEY WORDS

Alexandria,
Lower Egypt,
archaeomalacology,
mollusc,
Red Sea,
Mediterranean Sea,
food supply,
trade,
red coral,
mother-of-pearl.

RÉSUMÉ

L'exploitation des mollusques et autres invertébrés à Alexandrie (Égypte) de l'époque hellénistique à la fin de l'Antiquité: alimentation, utilisation et commerce.

Plusieurs fouilles archéologiques de sauvetage menées à Alexandrie (Basse-Égypte) par le Centre d'Études alexandrines ont livré un corpus d'environ 2000 fragments d'invertébrés marins, d'eau douce et terrestres. Ces restes malacofauniques proviennent de plusieurs niveaux d'occupations d'un même quartier de la ville, le *Brucheion*, entre la fin du IV^e siècle avant notre ère jusqu'au VI^e siècle de notre ère. Grâce aux observations macroscopiques et à la loupe binoculaire, cette analyse des vestiges malacofauniques fournit des informations inédites sur l'exploitation du milieu aquatique par les Alexandrins au cours de l'Antiquité. De plus, quelques résidus de matière minérale conservés sur les coquilles ont été analysés au microscope électronique à balayage. Cette étude met en lumière à la fois des choix de consommation et une pluralité d'usages des coquilles (récipient, décoration, matière première) dans la sphère domestique alexandrine. Certaines espèces provenant de la mer Rouge et de la Méditerranée occidentale apportent de nouvelles données sur la circulation des produits d'origine marine dans l'Égypte ptolémaïque et romaine.

MOTS CLÉS

Alexandrie,
Basse-Égypte,
archéomalacologie,
mollusque,
mer Rouge,
mer Méditerranée,
alimentation,
commerce,
corail rouge,
nacre.

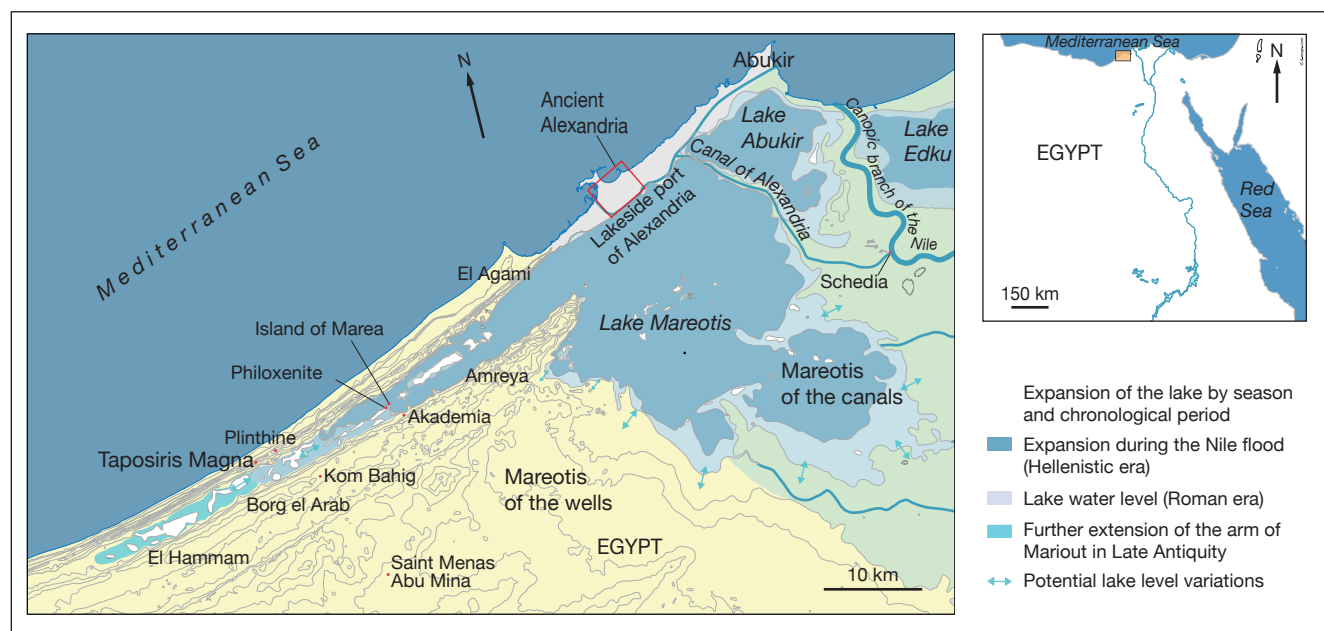


FIG. 1. — Location map of Alexandria in Lower Egypt, surrounded by the Mediterranean Sea and Lake Mareotis. Computer aided design: V. Pichot, CEALex.

INTRODUCTION

Marine molluscs occupy an important place in Mediterranean societies. As a result of studies of archaeological malacofauna remains that have been conducted over several decades, it is currently well known that the molluscs of the Mediterranean Sea were widely exploited by the populations of the littoral for food, for adornment and decoration, and also as a raw material (Becker 1996; Trubitt 2003; Bar-Yosef Mayer 2007b; Theodoropoulou 2007a; Girod 2015). Nevertheless, we know nothing, or at least very little, about Alexandrian tastes for invertebrates of the Egyptian shores. Some ancient authors tell of the famous products of the Alexandrian region. Athenaeus of Naucratis (c. 170-223 AD) mentions the reputation of the lobsters of the city, which were exported throughout the rest of the province during the Roman era (Ballet 1999: 191). Xenocrates (c. 400-314 BC) and Oribasius (c. 320-c. 400 AD), two writers of antiquity separated by eight centuries, recall the reputation of the mouth of the Nile for its high quality oysters (*Ostrea edulis* Linnaeus, 1758) (Oribasius, *Med. coll.* II, 58.95; Voultsiadou *et al.* 2009). Thanks to the papyrus, we know that they were appreciated in Egypt during antiquity (Reekmans 1996: 23). Furthermore, Galen (c. 131-c. 201 AD) says that Alexandrians eat molluscs, and also salted products and lentils (Fournet 2009: 23). That is all the information at our disposal.

Archaeozoology can provide new answers to questions regarding the exploitation of molluscs, whether marine, freshwater or terrestrial, by the inhabitants of the city. As Strabo wrote in the 1st century BC, Alexandria has the particularity of being a city “between two seas” (Strabo, *Geo.* 17.7). The ancient port city was set upon a sandstone ridge (Ridge II) (Flaux *et al.* 2011: 116; 2017: 670), overlooking

the Mediterranean to the north and bordered to the south by Lake Mareotis (Fig. 1). This stretch of brackish water, closed to the sea by the creation of a canal in the 3rd century BC, was a veritable inland sea and a navigable waterway linking the lakeside harbour of Alexandria to the Canopic branch of the Nile throughout antiquity (Hairy & Sennoune 2011: 144, 145; Pichot 2017: 20; Flaux *et al.* 2017: 669). This geographic configuration made the Greek city a major centre of trade for the Mediterranean basin to which it exported products coming from the Red Sea and India (Sidebotham 2011: 208). The inhabitants of this harbour capital, surrounded by water, enjoyed the mollusc resources provided by this luxuriant region on the margins of the Nile Delta. In addition, they benefitted from the trade routes to bring in shells from more distant regions. The contents of the refuse ditches of the Greek and Roman town are evidence of this. The aim of this article is to determine the consumption choices and supply strategies, as well as the uses of mollusc shells in the domestic sphere of this great city.

THE ARCHAEOLOGICAL CONTEXT: AN ALEXANDRIAN DISTRICT BETWEEN THE 4TH CENTURY BC AND THE 6TH CENTURY AD

THE HELLENISTIC PERIOD (4TH-1ST CENTURIES BC)

The city was divided into several large districts, one of which was the *Brucheion*, situated to the north-east of the town, close to the Ptolemaic royal palaces. This district is well known, thanks to the archaeological excavations conducted by the Centre d'Études alexandrines (CEALex) during the last decade of the 20th century (Fig. 2). These



FIG. 2. — Location of the archaeological excavations of the Centre d'Études alexandrines in the *Brucheion* district (archaeological map of M. El-Falaki, 1866). Computer aided design, C. Shaalan, CEALex, March 2018. **Red stars:** 1, former British Consulate; 2, Cricket Ground; 3, Fouad; 4, Diana Theatre; 5, Billiardo Palace.

interventions revealed remains of the ancient city occupied by a Greek and Roman intellectual elite (Empereur 1998: 61; Martin 1998: 11).

The excavation sites of the former British Consulate garden (site 1) and the Cricket Ground (site 2) are located on a natural elevation just a few dozen metres from one another. These two sites provided the largest quantity of malacofauna remains from this era. Housing on the Cricket Ground was built upon artificial terracing (Dubourg 2015: 107). Shops ran along one street (Silhouette 2011: 366). In the vicinity of the *Plateia*, the main east-west thoroughfare of the town, the so-called Fouad Street excavations on the site of the former Greek Orthodox Patriarchate (site 3) revealed vestiges of domestic area from the same period. To the north-west of the *Brucheion*, a fourth occupation from the end of the Greek period (2nd-1st centuries BC) was uncovered on the site of the Diana Theatre (site 4; Rifa-Abou el Nil 2011: 379). However, only three deep trenches reached this housing with beaten dirt floors.

THE ROMAN PERIOD (1ST-6TH CENTURIES AD)

On the site of Diana Theatre (site 4), at the beginning of the Early Roman Empire (1st-3rd centuries AD), several richly decorated *domus* with mosaics and painted stucco replaced the older dwellings (Rifa-Abou el Nil 2011: 379). Archaeozoological material was plentiful, especially in the levels corresponding to the housing of the 1st century AD. During the Late Roman

period (4th-6th centuries AD), a part of the district seems to have been abandoned by the upper class population that had occupied it a few centuries previously. Several societal upheavals, including certain revolts (Martin 1998: 11) and a tsunami in 365, which is said to have devastated a third of the city (Taher 1998: 52), hit the district. On the Diana Theatre (site 4), a workshop district settles in at the end of the 4th-5th centuries and lasts until the Arab conquest at the beginning of the 7th century (Empereur 1998: 32). Lastly, on the Billiardo Palace site (site 5), a few archaeological levels dated to the 4th century AD (Picard *et al.* 2012) complete our sampling. This excavation was located within the grounds of the Caesareum, built originally by Cleopatra VII in honour of Mark Antony and later transformed by Augustus into a sanctuary of the imperial cult (Empereur 2018). The archaeological material comes from the large refuse pits and the abandonment levels of the temple in the Late Roman era.

MATERIAL AND METHODS

From the five Alexandrian archaeological sites 2197 pieces at a total weight of 7.7 kg have been collected: that is, a minimum number of individuals (MNI) of 960, spread across refuse pits, construction landfill, and well backfill. Mollusc shells and invertebrate remains were systematically collected during these salvage excavations. All the same, the study is limited by the lack of sediment sieving. Fragments, fragile shells and the

TABLE 1. — Mediterranean malacofauna remains for the Hellenistic and Roman periods. Abbreviations: **MNI**, minimum number of individuals; **NISP**, number of identified specimens.

Taxa	Hellenistic period		Roman period	
	NISP	MNI	NISP	MNI
Bivalves				
Noah's ark shell (<i>Arca noae</i> Linnaeus, 1758)	7	5	—	—
ark clams (<i>Barbatia barbata</i> Linnaeus, 1758)	—	—	1	1
antique cardita (<i>Cardites antiquatus</i> Linnaeus, 1758)	2	2	—	—
lagoon cockle (<i>Cerastoderma glaucum</i> Bruguière, 1789)	29	17	11	7
wedge clams (<i>Donax</i> sp. Linnaeus, 1758)	103	57	8	9
bald scallop (<i>Flexopecten glaber</i> Linnaeus, 1758)	9	7	1	1
bittersweet clams (<i>Glycymeris</i> sp. (da Costa, 1778))	46	28	1	3
<i>Gari</i> sp. Schumacher, 1817	1	1	—	—
date mussel (<i>Lithophaga lithophaga</i> Linnaeus, 1758)	2	1	—	—
black scallop (<i>Mimachlamys varia</i> Linnaeus, 1758)	20	7	—	—
Mediterranean mussel (<i>Mytilus galloprovincialis</i> Lamarck, 1819)	1	1	2	2
flat oyster (<i>Ostrea edulis</i> Linnaeus, 1758)	446	234	199	121
Mediterranean scallop (<i>Pecten jacobaeus</i> Linnaeus, 1758)	—	—	1	1
Pectinidae	8	8	—	—
fan mussel (<i>Pinna nobilis</i> Linnaeus, 1758)	14	7	—	—
carpet shell (<i>Politapes aureus</i> Gmelin, 1791)	8	5	1	1
carpet shell (<i>Ruditapes decussatus</i> Linnaeus, 1758)	46	24	2	2
thorny oyster (<i>Spondylus gaederopus</i> Linnaeus, 1758)	6	6	4	7
warty venus clams (<i>Venus verrucosa</i> Linnaeus, 1758)	56	43	2	3
Gastropods				
spiny murex (<i>Bolinus brandaris</i> Linnaeus, 1758)	87	69	46	46
cerith (<i>Cerithium</i> sp. Bruguière, 1789)	5	5	1	1
Atlantic triton (<i>Charonia variegata</i> Lamarck, 1816)	2	2	3	2
dove snail (<i>Columbella rustica</i> Linnaeus, 1758)	24	24	4	4
Mediterranean cone snail (<i>Conus ventriconus</i> Linnaeus, 1758)	4	4	2	2
banded murex (<i>Hexaplex trunculus</i> Linnaeus, 1758)	26	11	15	12
fallow cowry (<i>Luria lurida</i> Linnaeus, 1758)	1	1	1	1
Muricidae	3	3	1	1
<i>Neverita josephina</i> Risso, 1826	—	—	—	—
limpet (<i>Patella</i> sp. Linnaeus, 1758)	6	6	1	1
turbinat monodont (<i>Phorcus turbinatus</i> Born, 1778)	4	4	—	—
grooved helmet (<i>Semicassis granulata</i> Born, 1778)	—	—	1	1
giant tun (<i>Tonna galea</i> Linnaeus, 1758)	—	—	2	1
dog whelk (<i>Tritia gibbosula</i> Linnaeus, 1758)	1	1	—	—
dog whelk (<i>Tritia cuvierii</i> Payraudeau, 1826)	1	1	—	—
Turbinidae	2	2	—	—
Other invertebrates				
crabs	2	2	1	1
purple sea urchin (<i>Paracentrotus lividus</i> Lamarck, 1816)	21	3	—	—
cuttlefish (<i>Sepia officinalis</i> Linnaeus, 1758)	2	2	1	1
red coral (<i>Corallium rubrum</i> Linnaeus, 1758)	—	—	602	—
TOTAL	995	593	915	233
Shell fragment undetermined	54	—	21	—

smallest specimens are underrepresented (Dupont 2017: 30). Nonetheless, the corpus shows a wide variety of invertebrates. Marine species of Mediterranean Sea are largely the most exploited, considering the quantity and diversity shell assemblage. In total, 39 species of molluscs and invertebrates have been identified, that is, 611 individuals for bivalves and 206 for the gastropods (Table 1). Six hundred fragments of Mediterranean red coral (*Corallium rubrum* Linnaeus, 1758) have been collected in the Late Roman levels. A few species, six in total, come from the Red Sea, with 14 individuals counted (Table 2). The molluscs from the Nile are also present in the archaeological layers, but their number and diversity is less than the marine molluscs, with only two taxa for some 65 individuals (Table 3). A few terrestrial mollusc shells of two types of gastropods in similar proportions complete this malacofauna corpus (Table 4).

The registering and quantification methods of this study are based upon several archaeomalacology projects (Claassen 1998; Dupont 2006; Theodoropoulou 2007b; Bardot-Cambot 2010; Mougne 2015). Reference works on the marine species of the Mediterranean (Quéro & Vayne 1998; Delamotte & Vardala-Theodorou 2001; Cossignani & Ardevini 2011) and the Red Sea (Rusmore-Villaume 2008) helped in identifying the taxa. The World Register of Marine Species website¹ was used as a source for the exact attribution of Latin nomenclature. The freshwater mussel (*Chambardia rubens* Lamarck, 1819 and *Unionidae* Fleming, 1828) shells were identified through the University of Wisconsin database².

1. <https://marinespecies.org/>, last consultation 06/12/2019.

2. <http://www.mussel-project.net/>, last consultation 06/12/2019.

TABLE 2. — Red Sea malacofauna remains for the Hellenistic and Roman periods. Abbreviations: **MNI**, minimum number of individuals; **NISP**, number of identified specimens.

Taxa	Hellenistic period		Roman period	
	NISP	MNI	NISP	MNI
Bivalves				
pearl oyster (<i>Pinctada margaritifera</i> Linnaeus, 1758)	3	3	15	2
hooded oyster (<i>Saccostrea cucullata</i> Born, 1778)	4	3	–	–
small giant clam (<i>Tridacna maxima</i> Röding, 1798)	2	2	–	–
Gastropods				
spider conch (<i>Lambis</i> sp. Röding, 1798)	1	1	1	1
ramose murex (<i>Chicoreus ramosus</i> Linnaeus, 1758)	1	1	–	–
toothed top shell (<i>Tectus dentatus</i> Forsskål in Niebuhr, 1775)	–	–	1	1
TOTAL	11	10	17	4

The few terrestrial gastropods were recognised from studies of the current populations in Lower Egypt (Ali 2017).

During the study of the malacofauna remains traces of mineral residues were observed using a binocular stereomicroscope (Olympus SZX7) by Valérie Pinchot, and some of these were analysed using the desktop scanning electron microscope (Phenom pro X – EDS) of the CEALex material characterisation laboratory, and provided an initial idea of the chemical composition of the samples taken. The preliminary results are presented in this article.

SEAFOOD

A LARGE DIVERSITY OF SPECIES CONSUMED

The initial results of the archaeozoological studies of the five sites show that invertebrates were part of the Alexandrians' meat diet, along with pig (*Sus scrofa domesticus* Erxleben, 1777), cattle (*Bos taurus* Linnaeus, 1758), sheep (*Ovis aries* Linnaeus, 1758) and goat (*Capra hircus* Linnaeus, 1758), as well as poultry and fish (Morand *et al.* in press). Many invertebrate remains have been collected in food dumps. The taphonomical analysis of shells has distinguished the consumed species from those that were already dead when collected and were used for other purposes, as we shall see below. The shells of food refuse are often whole and very well preserved. They are not eroded by the sea, perforated by predators or broken. Mediterranean species were the most commonly eaten although molluscs from the Nile and terrestrial taxa are present in food refuse. They were consumed but seem rather marginal in comparison with Mediterranean species. The same can be said for the few molluscs from the Red Sea. The pearl oyster (*Pinctada margaritifera* Linnaeus, 1758), the hooded oyster (*Saccostrea cucullata* Born, 1778) and even the small giant clam (*Tridacna maxima* Röding, 1798) may have been eaten, but only occasionally.

TABLE 3. — Nile malacofauna remains for the Hellenistic and Roman periods. Abbreviations: **MNI**, minimum number of individuals; **NISP**, number of identified specimens.

Taxa	Hellenistic period		Roman period	
	NISP	MNI	NISP	MNI
Bivalves				
freshwater mussel (<i>Unionidae</i> Fleming, 1828)	23	11	24	15
freshwater mussel (<i>Chambardia rubens</i> Lamarck, 1819)	1	1	1	1
Gastropod				
apple snail (<i>Pila</i> sp. Röding, 1798)	66	35	3	2
TOTAL	90	47	28	18

TABLE 4. — Terrestrial malacofauna remains for the Hellenistic and Roman periods. Abbreviations: **MNI**, minimum number of individuals; **NISP**, number of identified specimens.

Taxa	Hellenistic period		Roman period	
	NISP	MNI	NISP	MNI
Gastropods				
land snail (<i>Helix</i> sp. Linnaeus, 1758)	26	17	19	17
<i>Eremina desertorum</i> (Forsskål, 1775)	13	13	8	8
TOTAL	39	30	27	25

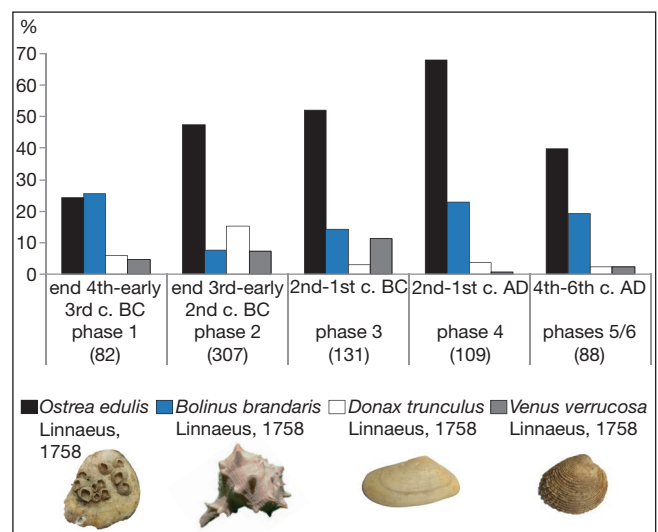


FIG. 3. — MNI (minimum number of individuals) proportions expressed as percentages of the four main marine mollusc species between the 4th century BC and the 4th century AD (raw data between brackets). Abbreviation: c., century.

The flat oyster (*Ostrea edulis* Linnaeus, 1758) was the most commonly consumed bivalve by the Alexandrians if we consider the number of shells found in the ancient refuse pits. At the end of the 4th century and the beginning of the 3rd century BC, they represent 24% of MNI. In the following phase, they reach 45% of MNI and then 68% in the Roman era (Fig. 3). They are found on all the archaeological sites.

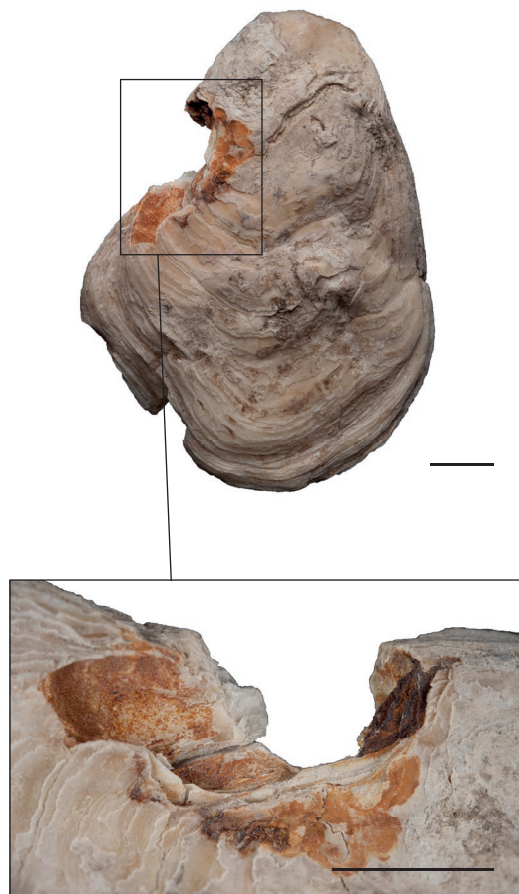


FIG. 4. — Fragment of a broken blade (?) in an oyster shell. Scale bars: 10 mm.

Signs of human opening of the oyster shells confirm consumption. This is most often in the forma of slight U-shaped, or larger, damage to the ventral edge. The insertion of a knife blade between the two valves leaves this type of mark during forced opening (Gruet 1993; Dupont 2010). In an early imperial layer on the Diana Theatre site, a fragment of probably a knife blade remained stuck in the rear edge of a shell (Fig. 4). Nevertheless, one should remember that it is not necessary to break the shell when opening an oyster: the few clear traces simply allow us to formally attest human agency. On the other hand, the methods of preparation and consumption of these oysters remain unknown: no anthropogenic traces noted on the shells give us any clue.

Measuring the oyster shells has revealed the small size of these bivalves. On average, the left valves measure 44.3 mm in length and the right valves 40.8 mm in the Hellenistic period. They can be classified as shells of very small size (Bardot-Cambot 2010: 123), their total length being less than 49 mm. In the Roman period, the valves are slightly bigger by about 5 mm (Fig. 5)³. At the same time, the difference is perhaps only a question of the number of shells examined. This size is perhaps a characteristic of the Eastern Mediterranean oysters. On the Hellenistic site of Halos in Thessaly they are also small (Prummel 2005: 118).

3. A non-parametric statistical test (Mann-Whitney) comparing the median values of the batches from the Hellenistic and Roman eras would consider them as different (p. value = 0.0001).

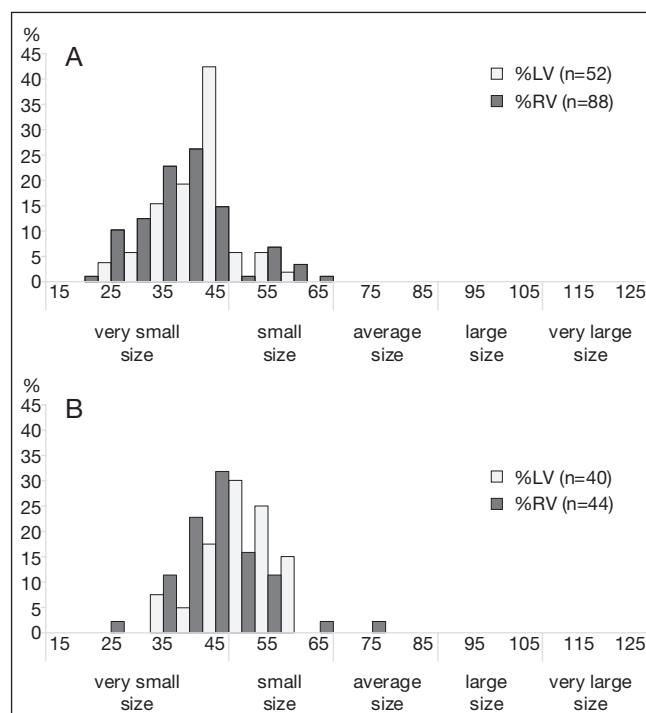


FIG. 5. — Distribution of total lengths of oysters in the Ptolemaic and Roman periods in Alexandria expressed as percentages (measurements in millimetres, raw values are given between brackets). Abbreviations: **LV**, left valves; **RV**, right valves.

Moreover, one might imagine that there was so much pressure on the beds that the oysters were not left to grow to a greater size. The presence of spat and of bouquet on archaeological shells would seem to show that dense natural oyster beds were exploited.

The other main bivalves consumed are wedge clams (*Donax* sp. Linnaeus, 1758) and warty venus clams (*Venus verrucosa* Linnaeus, 1758; Fig. 3). Among the gastropods, the main species are spiny murex (*Bolinus brandaris* Linnaeus, 1758) and banded murex (*Hexaplex trunculus* Linnaeus, 1758). Other molluscs such as scallops, fan mussel (*Pinna nobilis* Linnaeus, 1758), Mediterranean mussel (*Mytilus galloprovincialis* Lamarck, 1819), Atlantic triton (*Charonia variegata* Lamarck, 1816) and limpet (*Patella* sp. Linnaeus, 1758) are part of the diet with only less than 10 MNI for each one. Lastly, other invertebrates, such as cuttlefish (*Sepia officinalis* Linnaeus, 1758), purple sea urchin (*Paracentrotus lividus* Lamarck, 1816) and crabs, complete the range of edible species.

THE EXPLOITATION OF THE ENVIRONMENT FOR A FOOD SUPPLY
These invertebrates of Mediterranean origin live in the marine zone, but several species can also live in the brackish water of lagoons and estuaries, such as cockles (*Cerastoderma glaucum* Bruguière, 1789), carpet shells (*Polittapes aureus* Gmelin, 1791 and *Ruditapes decussatus* Linnaeus, 1758), Mediterranean mussel, black scallops (*Mimachlamys varia* Linnaeus, 1758), oysters and cuttlefish (Table 5; Quérou & Vayne 1998; Theodoropoulou 2007b). Thus, the molluscs consumed could be collected from the marine shore, the

TABLE 5. — Environment data of the Mediterranean molluscs consumed.

Species	Environment	Substrate	Shoreline stages		
			mesolittoral	infralittoral	circolittoral
date mussel (<i>Lithophaga lithophaga</i> Linnaeus, 1758)	marine	rocky	x	x	—
limpet (<i>Patella</i> sp. Linnaeus, 1758)	marine	rocky	x	x	—
Mediterranean mussel (<i>Mytilus galloprovincialis</i> Lamarck, 1819)	marine/brackish	rocky	x	x	—
turbinate monodont (<i>Phorcus turbinatus</i> Born, 1778)	marine	rocky	x	x	—
thorny oyster (<i>Spondylus gaederopus</i> Linnaeus, 1758)	marine	rocky	—	x	—
Noah's Ark shell (<i>Arca noae</i> Linnaeus, 1758)	marine	rocky	—	x	x
Atlantic triton (<i>Charonia variegata</i> Lamarck, 1816)	marine	rocky, sandy, marine meadow	—	x	x
flat oyster (<i>Ostrea edulis</i> Linnaeus, 1758)	marine/brackish	rocky, silted rocky	x	x	—
banded murex (<i>Hexaplex trunculus</i> Linnaeus, 1758)	marine	rocky, silted rocky	—	x	x
black scallop (<i>Mimachlamys varia</i> Linnaeus, 1758)	marine/brackish	rocky, sandy, marine meadow	—	x	x
bald scallop (<i>Flexopecten glaber</i> Linnaeus, 1758)	marine/brackish	rocky, sandy	—	x	x
antique cardita (<i>Cardites antiquatus</i> Linnaeus, 1758)	marine	rocky, sandy, silty	—	x	x
wedge clam (<i>Donax</i> sp. Linnaeus, 1758)	marine	sandy	x	x	—
warty venus clams (<i>Venus verrucosa</i> Linnaeus, 1758)	marine	sandy, gravel, marine meadow	—	x	—
carpet shell (<i>Ruditapes decussatus</i> Linnaeus, 1758)	marine/brackish	sandy, silty	x	x	—
lagoon cockle (<i>Cerastoderma glaucum</i> Bruguière, 1789)	marine/brackish	sandy, silty	—	x	—
spiny murex (<i>Bolinus brandaris</i> Linnaeus, 1758)	marine	sandy, silty	—	x	x
Mediterranean scallop (<i>Pecten jacobaeus</i> Linnaeus, 1758)	marine	sandy, silty	—	x	x
Gari sp. Schumacher, 1817	marine	sandy, silty	—	x	x
giant tun (<i>Tonna galea</i> Linnaeus, 1758)	marine	sandy, silty	—	x	x
fan mussel (<i>Pinna nobilis</i> Linnaeus, 1758)	marine	sandy, silty, marine meadow	—	x	x
purple sea urchin (<i>Paracentrotus lividus</i> Lamarck, 1816)	marine	sandy, rocky, silty, marine meadow	—	x	—
cuttlefish (<i>Sepia officinalis</i> Linnaeus, 1758)	marine/brackish	sandy, silty, marine meadow	x	x	x

nearby lakes of Alexandria (Abukir and Edku) or from Lake Mareotis (Fig. 1). During antiquity, this huge lake was mostly supplied by water from the Nile but it was connected to the sea by canals (Flaux *et al.* 2017: 678; Pichot 2017: 28). Cockles were numerous in this lagoon (Flaux *et al.* 2011: 123; Ikram & Bertini 2016). At last, the Bay of Canopus (present-day Abukir) was perhaps a good spot for the exploitation of large oyster shell beds. It is at this point in antiquity that the Canopic branch of the Nile used to flow into the Mediterranean (Hairy & Sennoune 2011: 155). Flat oysters can live close to the estuaries where desalination is constant and moderate (Bardot-Cambot 2010: 312). According to ancient textual sources, the tastiest oysters in Egypt were to be found at the mouth of the Nile. The supply of fresh water plumped up the flesh and gave it a slightly sweet taste (Oribasius, *Med. coll.* II, 58.95).

Furthermore, the Mediterranean species that were consumed live in different substrates (Table 5). It also shows that several supply locations have been exploited. One notes particularly flat oysters, limpets, Mediterranean mussels, date mussels (*Lithophaga lithophaga* Linnaeus, 1758) and also thorny oyster (*Spondylus gaederopus* Linnaeus, 1758) which attach themselves to rocky areas of the mesolittoral and infralittoral zones. The soft substrate of the shorelines was also exploited as is demonstrated by the presence of wedge clams, which live exclusively in fine sand and silty substrates with cockles and carpet shells. The fan mussel lives in the soft bottom, most often amidst *Posidonia* meadows. Other species who lived on the deeper seabed were also gathered. The Noah's Ark shell (*Arca noae* Linnaeus, 1758), attached to the rocky substrate, and the banded murex, at

home on silted rocky substrate, are present. A paleogeographic reconstruction of the seabed around Alexandria (Papatheodorou *et al.* 2016) and geoarchaeological studies (Stanley & Bernasconi 2006) have provided a wider and more precise view of the substrates in this zone. It reveals an essentially sandy and silty sand sediment in the Eastern Harbour of Alexandria. Further out the marine substrate becomes rocky, interspersed with sandy and muddy zones. Geomorphological studies in the Lake Mareotis area have revealed a sedimentary hiatus during antiquity (Flaux *et al.* 2011: 125). However, the preserved more ancient levels are soft bottom of muddy, silty and sandy layers.

The presence of taxa from a variety of biotopes underlines the opportunist exploitation of the aquatic environment. All of the species identified in the archaeological layers could have lived in proximity to the city. Thus, the Alexandrians enjoyed a local supply of invertebrates for food.

The archaeozoological remains collected on the sites are largely from food refuse. For all that, Alexandrians also used mollusc shells and corals in other everyday activities. Manmade marks are evidence of their use as an object or a raw material. In addition, preserved mineral residues are also proof of their use in the domestic sphere.

ITEMS OF ORNAMENT?

PERFORATED SHELLS

The shells of mollusc species that were ordinarily eaten could be used for ornament. Such a case has been documented on the Diana Theatre site from the Roman period. Within a layer of silty soil, seven shells of lagoon cockle (*Cerastoderma*

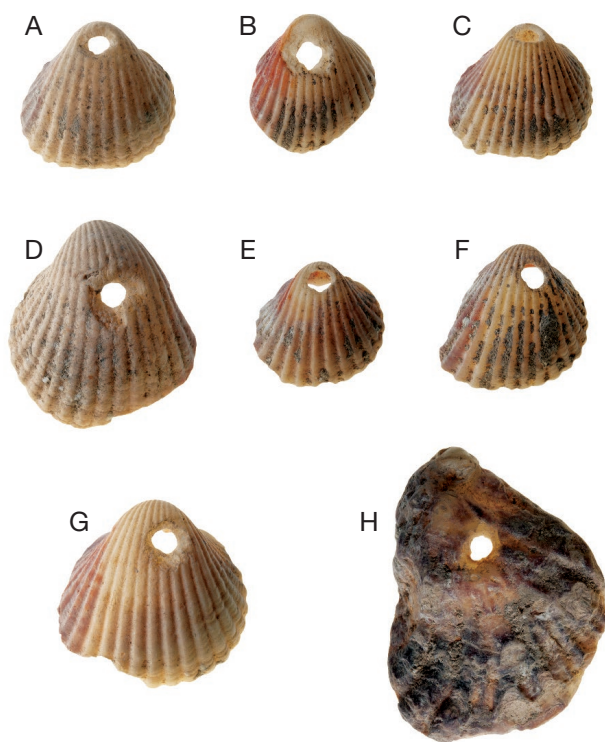


FIG. 6. — Perforated marine mollusc shells found in the same archaeological layer: **A-G**, Lagoon cockles (*Cerastoderma glaucum* Bruguière, 1789); **H**, flat oyster (*Ostrea edulis* Linnaeus, 1758). Scale bar: 10 mm.

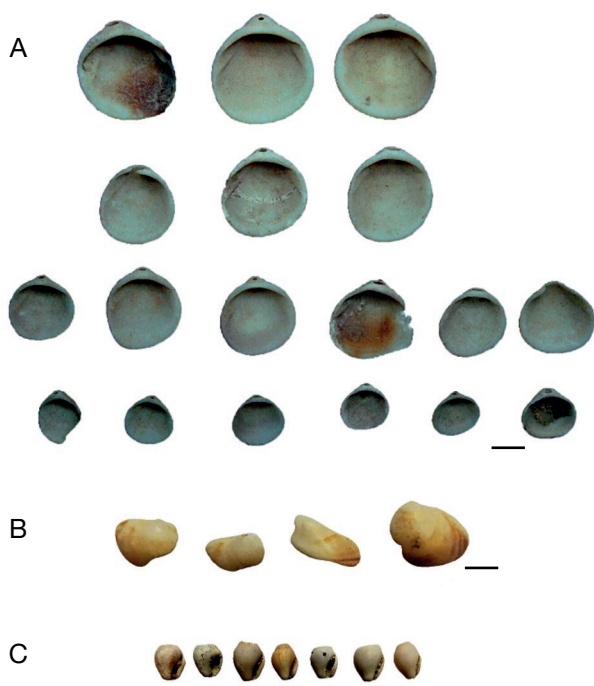


FIG. 7. — Some examples of shells from a 2nd century BC occupation level on the Diana Theatre site. **A, B**, bittersweet clam (*Glycymeris* sp. da Costa, 1778); **C**, rustic dove snail (*Columbella rustica* Linnaeus, 1758). Scale bars: 10 mm.

glaucum Bruguière, 1789) and an oyster were found with a deliberate perforation (Fig. 6). The hole was made from the outside of the shell. The surface had been scraped prior to

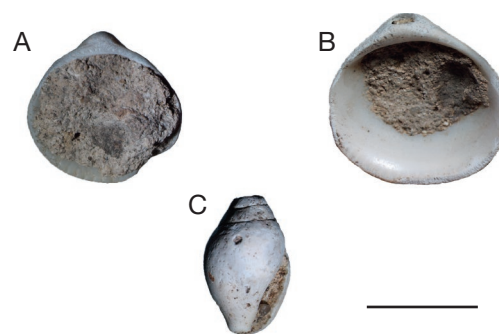


FIG. 8. — Traces of earthen mortar on: **A, B**, washed-up bittersweet clams (*Glycymeris* sp. da Costa, 1778); **C**, washed-up dove snail (*Columbella rustica* Linnaeus, 1758). Scale bar: 10 mm.

perforation. Similar cases have been observed on Roman-era sites, notably at Mons Porphyrites (Hamilton-Dyer 2007: 348). The shell of the oyster and of one cockle had been polished by the natural action of the sea.

These bivalves were found in the Late roman phase of the site where activities related to the working of semi-precious stones, red coral and bone were attested (Empereur 1998: 32; Rifa-Abou el Nil & Calligaro 2020). The shells are not particularly original or rare species but they could of course have been used as beads or elements of ornament, perhaps pendants. However, other activities were happening on this site alongside people working expensive materials: there were numerous remains of fish. One might imagine that the shells were more likely connected to fishing activities and not to jewellery. They could have been attached to lines as lures or on nets as weights. Examples of mollusc shells being used in fishing are still visible in several parts of the world (Lavondès 1971: 344; Goto 1997: 13).

“WASHED-UP” SHELLS

Some of the mollusc shells in the archaeological batches display systematic erosion. It would appear that these species were not gathered as food. The impact of marine erosion and also the presence of marine organisms on the inside of the shell demonstrate that these are “washed-up” shells. The state of preservation confirms that these individuals were already dead before collection. They are not numerous within the ensemble of the corpus and are concentrated in specific archaeological levels.

A layer dated to the 2nd century BC on the Diana Theatre site has provided an ensemble of shells (n=79) among other archaeological remains including amphora shards, pottery, and badly preserved metallic elements. The malacofauna batch is largely composed of bittersweet clams (*Glycymeris* sp. da Costa, 1778) with 44 valves and 24 rustic dove snails (*Columbella rustica* Linnaeus, 1758). One cockle shell (*Cerastoderma glaucum*), a cerith (*Cerithium* sp. Bruguière, 1789), a Mediterranean cone snail (*Conus ventriconus* Linnaeus, 1758) a fallow cowry (*Luria lurida* Linnaeus, 1758), dog whelks (*Tritia gibbosula* Linnaeus, 1758 and *Tritia cuvierii* Payraudeau, 1826) complete the assemblage. This layer does not correspond to food

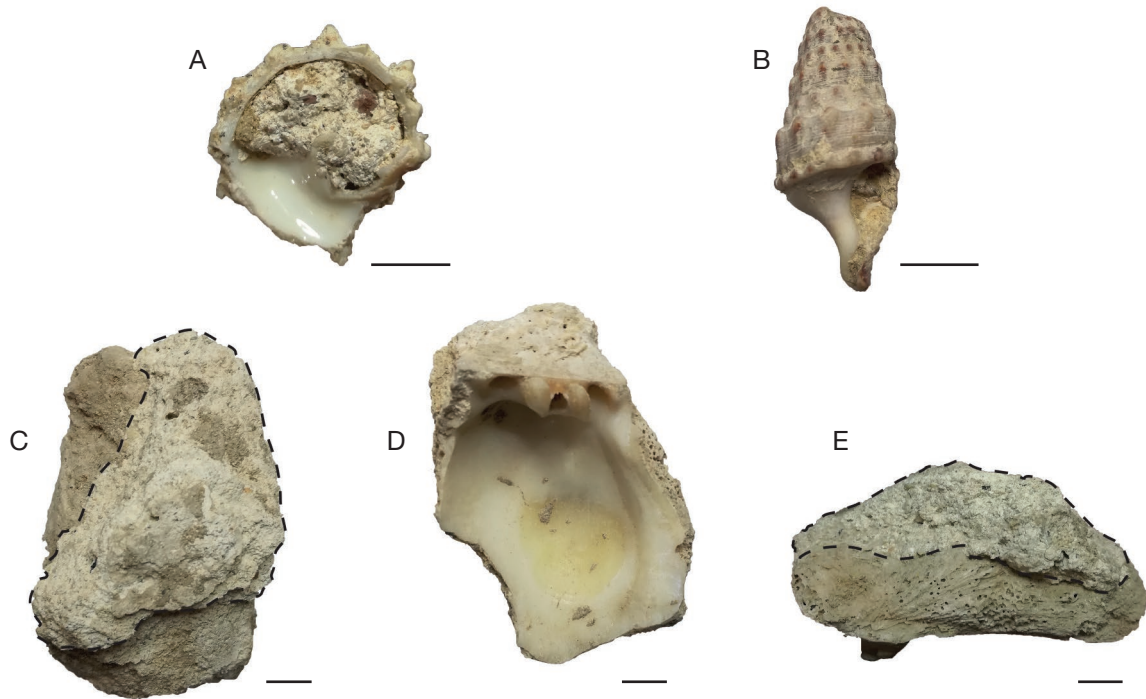


FIG. 9. — Traces of mortar on: **A**, spiny murex (*Bolinus brandaris* Linnaeus, 1758); **B**, cerith (*Cerithium* sp. Bruguière, 1789) from Cricket Ground site; **C-E**, thorny oyster (*Spondylus gaederopus* Linnaeus, 1758) from Billiardo Palace. Scale bars: 10 mm.

refuse. All of the shells were gathered from the seashore where they had been washed up: they are all eroded by the sea waves. 54.5% of the bittersweet clams show a hole in the umbo. No deliberate abrasion has been observed of the shells. They are of varying sizes but 82% measure between 10 mm and 25 mm in height, with an average diameter between 50 to 60 mm. There is some type of selection of small individuals. Some fragments of this species, of quite similar shape are also very eroded and two are perforated (Fig. 7). They seem to have been deliberately gathered for their particular shape. Of the gastropods, 91.6% of the dove snail shells have no apex. The *Tritia cuvierii* shell has been perforated by a predatory mollusc. The *Tritia gibbosula* has two irregular holes, one close to the peristome and the other on the opposite side.

An initial interpretation of these pieces would see them as elements of ornament. The natural holes could be used for threading and creating a necklace or for attaching to clothing. The species that were identified in this layer, especially the dove snails, the bittersweet clams and the dog whelks are currently used for ornamentation in the Eastern Mediterranean basin (Leguilloux 2003: 564; Theodoropoulou 2007b: 437). Observations through a binocular microscope will be useful in any use-wear analysis and examination the openings that might confirm the above hypothesis.

ARCHITECTURAL DECORATION

In the same layer of the Diana Theatre several bittersweet clams and a gastropod dove snail had traces of very dense sediment on their concave surface or around the aperture

(Fig. 8). This sediment is like an earthen plaster and the shells may have been pressed into bricks or adobe for decorative reasons, with the convex surface being visible. All of these shells could have been used but only three of them have preserved the earthen plaster. In these houses with beaten earth flooring, the walls may also have been plastered with clay and decorated here and there with small seashells chosen for their size or particular shape.

Other more obvious examples of shells being used as decorative elements have been found elsewhere in Alexandria. Several fragments of spiny murex were collected in a room belonging to a wealthy residence on the Cricket Ground site. These shell fragments came from levels dated to between the end of the 3rd and the beginning of the 2nd century BC. A residue of wall plaster has remained stuck to the inside surface of the apex of one of these gastropods (Fig. 9A). The extremity of the shell had been chosen for some eventual decoration. Within a layer from the same sector the inner and outer surfaces of a cerith were covered with traces of a rather fine mortar with gravel and terracotta inclusions. It had perhaps been set into the final layers of plaster applied to the wall.

On the site of the former British Consulate, right next to the Cricket Ground, two wedge clams were found in a layer dated to the 2nd century BC bearing traces of red pigment and a white coating on the internal surfaces (Fig. 10A). The initial results of a chemical analysis on a sample confirmed the ferrous base (chemical element: Fe) of the pigment, which could be hematite. This pigment was used as a cosmetic but also for painting on plaster. The presence of lead (Pb) in the analysis (Table 6) could be in the form of tetroxide and in this case associated with the ferrous pigment in the com-

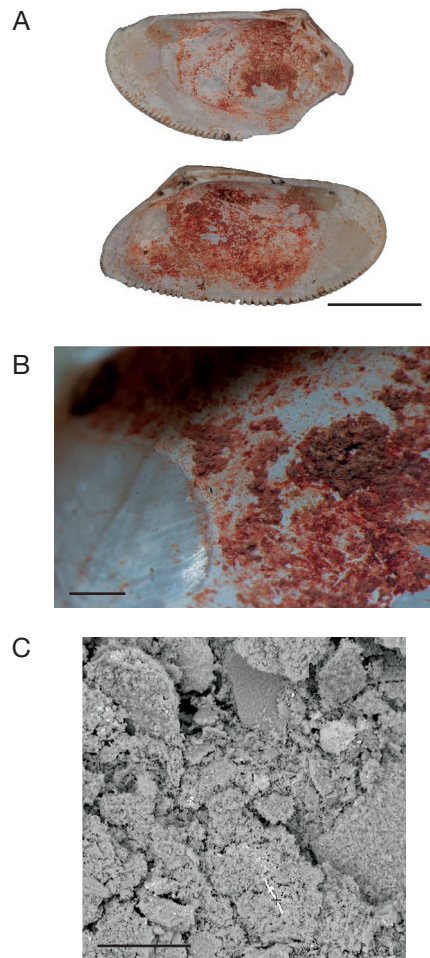


FIG. 10. — Traces of red pigment and white lead (?) on a wedge clam (*Donax* sp. Linnaeus, 1758) shell: **A**, traces of red pigment and white lead (?) on the inside surface of a wedge clam (*Donax* sp. Linnaeus, 1758) shell; **B**, observation through binocular microscope; **C**, observation through scanning electron microscope: FOV, 173 µm; mode, 15kV – Point; detector, BSD full. Scale bars: A, 10 mm; B, 1 mm; C, 50 µm.

position of the colour red, or else as a carbonate (cerrusite) and thus would identify the fine white layer, which strongly resembles a preparatory wall coating. With the red pigment, these two residues would then be the preserved remains of a painted plaster.

Similar examples have been observed in Italy and in Gaul where the shells are inlaid onto plaster (Eristov 1995: 20; Boislève *et al.* 2014). The use of seashells as decoration is attested in the Hellenistic world, for example in the nymphaeums of Rhodes (Rice 1995: 391; Michaelides & Guimier-Sorbets 2016: 320; Dupont 2019). Further analyses are required to support these initial hypotheses regarding the Alexandrian material. A detailed observation of painted plaster discovered on the sites would allow one to note any eventual imprints of shells and would provide supplementary proof.

On the Billiardo Palace site, two thorny oysters of the Roman era were discovered in the destruction layers of a hypostyle hall (Petitpa 2011: 340, 341): the external surfaces were covered with a layer of rough mortar about 10 mm thick (Fig. 9C-E). The internal white surfaces of both shells were visible. It is

TABLE 6. — Chemical composition of a pigment and white lead sample taken from the wedge clam (*Donax* sp. Linnaeus, 1758) shell and analysed with the scanning electron microscope (Fig. 10C). The grey cells highlight the iron (Fe) and the lead (Pb).

Element	Atomic concentration	Weight concentration
C	34.14	14.46
O	28.71	16.20
Si	12.39	12.27
Ca	10.43	14.74
Fe	6.68	13.15
Pb	2.54	18.52
Br	1.79	5.05
K	1.41	1.94
Mg	1.02	0.87
Sr	0.91	2.81

currently difficult to know whether these shells featured in the decoration of the rooms of this Roman building or whether they were used as construction material. On this same site, a grooved helmet (*Semicassis granulata* Born, 1778) and a toothed top shell (*Tectus dentatus* Forsskal in Niebuhr, 1775) were also found. This latter comes from the Red Sea. Perhaps these gastropods were part of an architectural decoration in the rocaille style (Ginouvé 1998: 99, 100).

An oyster shell found in a refuse pit on the Cricket Ground dating to the Early Empire has a preserved residue of gilding on its internal surface. The initial analysis of the chemical composition of a sample using a scanning electron microscope has confirmed the presence of gold (chemical element: Au; Fig. 11C; Table 7). One can imagine that this is a gold leaf applied upon a coating: the oyster was part of a mural decorative motif and the fine layer of gold adhered to the shell. It is also possible that this oyster was part of a rocaille-style decor and that it was deliberately covered with gold leaf to give it a shiny effect like that of mother-of-pearl. The presence of gold in the decoration recalls the terracotta and stucco fish that were unearthed on the same site and which were remarkable for having been gilded with gold leaf (Guimier-Sorbets 2009: 343). These are unique naturalistic motifs in the Mediterranean basin. Their specific use remains uncertain: they may have decorated walls or perhaps furniture. This oyster and the gilded fish may have been part of the same ornamental composition or of the same decorative theme. The damage caused by recent construction works on this archaeological site is such that it is difficult to advance any more expansive interpretations.

SHELLS AS OBJECTS AND CONTAINERS

BETWEEN THE MEDITERRANEAN SEA AND...

The usage of shells as objects, tools and utensils is sometimes difficult to identify through simple macroscopic observation of malacofauna remains. Ancient texts can be useful in describing the use of certain shells and can reveal practices that are unsuspected in the archaeological record, thus explaining their presence in domestic contexts. On the other hand, several archaeological cases have led to new interpretations of usage being proposed where the ancient sources remain silent.

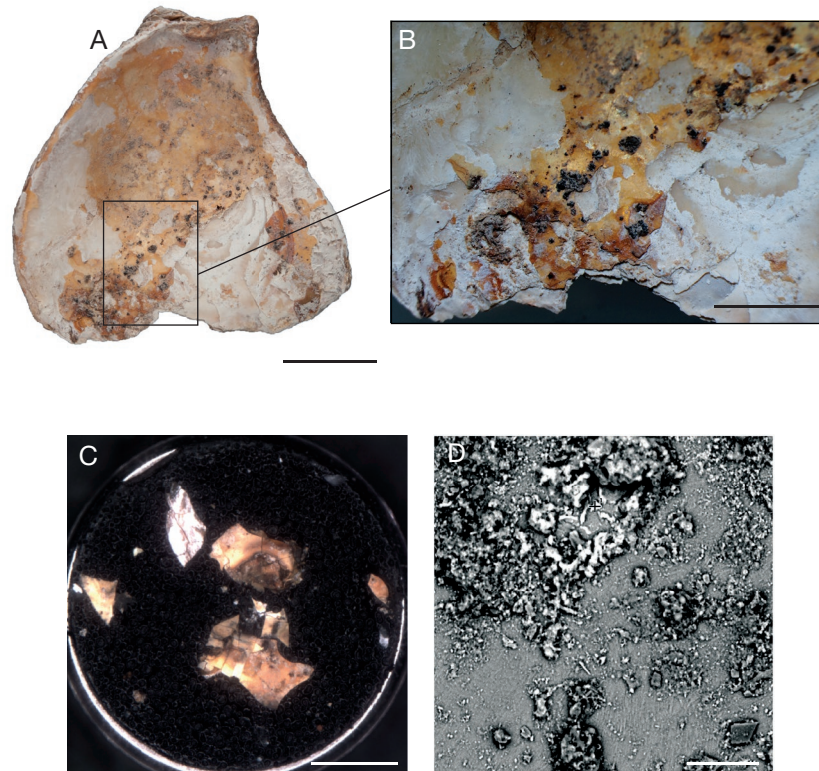


FIG. 11. — Gold leaf on an flat oyster (*Ostrea edulis*, Linnaeus, 1758) shell: **A**, gold leaf on a flat oyster (*Ostrea edulis* Linnaeus, 1758) shell; **B**, photograph of the gold leaf taken with binocular microscope; **C**, **D**, photographs of the gold leaf taken with scanning electron microscope (D: FOV, 233 µm; mode, 15kV – Point; detector, BSD full). Scale bars: A, 10 mm; B, 5 mm; C, 3 mm; D, 50 µm.

The occasional presence of the Atlantic triton, in its Mediterranean species and not Indo-Pacific, within the Hellenistic levels raises certain questions. This gastropod is known in the Mediterranean for having been used as a trumpet (Sáez Romero & Gutiérrez-Lopez 2018: 72). The apex is usually cut off or the last whorl is perforated so that one can blow into the shell and emit a powerful sound. The few remains identified in Alexandria are in general the peristomes of the shell. It is thus very difficult to confirm the practice of transformation with only this fragment of the shell. They might quite simply have been eaten.

In a similar fashion, fragments of the giant tun (*Tonna galea* Linnaeus, 1758) have been identified in two archaeological levels of the Diana Theatre site dated to the Late Roman period. This Mediterranean species, which lives buried in the sand, is particularly rare on ancient archaeological sites of the Mediterranean. The shell of this large gastropod was used to contain liquids. Artisanal activity involving hard mineral material has been revealed in this district of Alexandria in Late Antiquity. This big gastropod might have been eaten by the workers and its shell then reused. However, the rarity of the species in the corpus means that one should not imagine frequent usage.

Mollusc shells could also be used as containers. For example, the valve of a flat oyster was found to hold a green residue some 1 mm thick on two points of its inner surface (Fig. 12A). A sample was taken and the initial analysis of the chemical composition confirmed that it was copper (chemical element: Cu; Fig. 12C; Table 8). Further analyses will allow us to deter-

TABLE 7. — Chemical composition of a gold leaf sample taken from the flat oyster (*Ostrea edulis*, Linnaeus, 1758) and analysed with the scanning electron microscope (Fig. 11C; D). The grey cells highlight the gold (Au).

Element	Atomic concentration	Weight concentration
O	33.33	7.74
Au	24.12	68.97
C	13.61	2.37
Ca	10.22	5.94
Mn	7.08	5.65
Si	2.68	1.09
P	2.11	0.95
Fe	2.04	1.65
Sb	1.10	1.94
K	0.78	0.44
Al	0.77	0.30
Cl	0.59	0.30
Pb	0.40	1.21
Sn	0.34	0.59
s	0.34	0.16
Ag	0.29	0.45
As	0.21	0.23
Cu	0.00	0.00
Zn	0.00	0.00
Co	0.00	0.00
Cr	0.00	0.00
Ni	0.00	0.00

mine whether it is malachite or atacamite, two copper oxides used in antiquity as cosmetics and for painting mural decorations (El Salam 2001: 25). This practice is attested from the

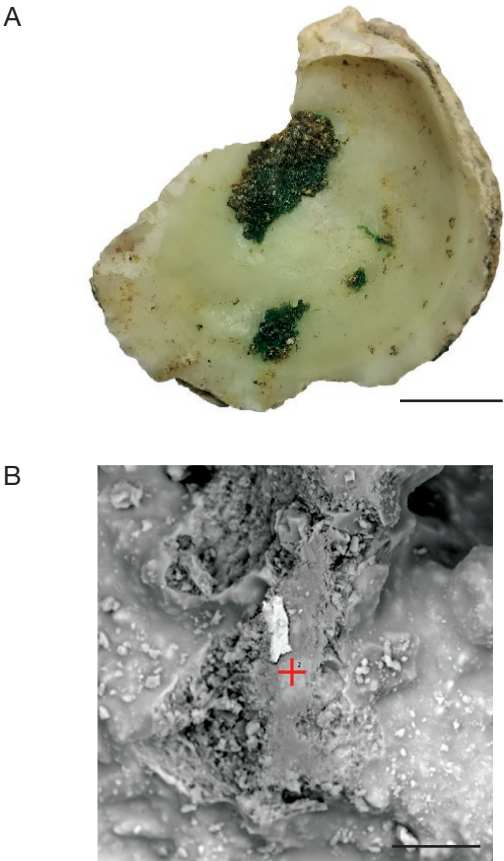


FIG. 12. — Copper residue (atachamite/malachite?) on the inside surface of a flat oyster (*Ostrea edulis* Linnaeus, 1758) shell: **A**, observations through binocular microscope; **B**, scanning electron microscope: FOV, 89.6 μm ; mode, 15 kV – Point; detector, BSD full. Scale bar: 10 mm.

TABLE 8. — Chemical composition of a copper residue sample taken from the flat oyster (*Ostrea edulis* Linnaeus, 1758) and analysed with the scanning electron microscope (Fig. 12B). The grey cells highlight the copper (Cu).

Element	Atomic concentration	Weight concentration
C	36.44	12.40
Cu	28.88	52.02
O	14.57	6.60
Si	11.55	9.20
Ca	4.85	5.51
Ta	2.12	10.89
Sr	0.97	2.41
Fe	0.61	0.96

Predynastic period in Egypt. Elsewhere in the Mediterranean basin the association of a shell and malachite is already known. These little bivalves could have been used to store or transport malachite used as a cosmetic (Hardy & Rollinson 2009: 2).

The Diana Theatre site also revealed the shell of a thorny oyster whose concave surface was covered with a powder that might be red ochre (Fig. 13). Analyses of the chemical composition are planned. Unfortunately, this shell came from a disturbed context dating to between the end of the Roman period and the beginning of the Islamic era. Thus, it is impossible to know whether this shell was used as a sort of mortar or as a container by the craftsmen of the Late Roman district.



FIG. 13. — Thorny oyster (*Spondylus gaederopus* Linnaeus, 1758) shell from the Diana Theatre site, with traces of red pigment on its inner surface. Scale bar: 10 mm.

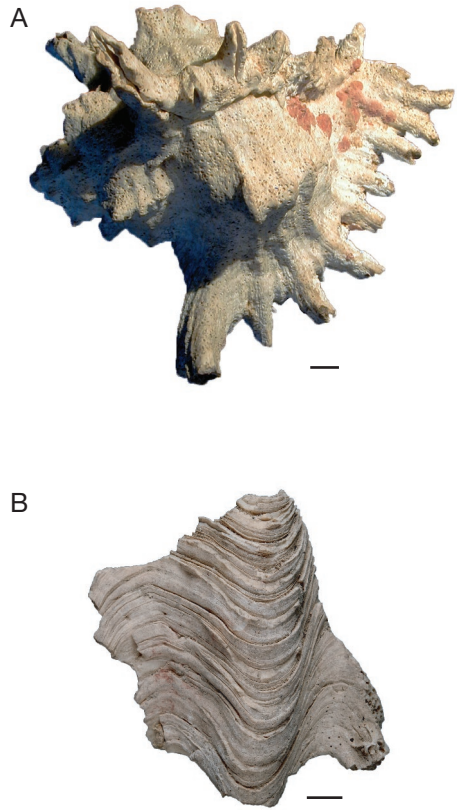


FIG. 14. — Indo-Pacific mollusc shells: **A**, *Chicoreus ramosus* Linnaeus, 1758; **B**, *Tridacna maxima* (Röding, 1798). Scale bars: 10 mm.

... THE RED SEA

The shells from the Indian Ocean within our archaeomalacological assemblage give us food for thought. From the beginning of the 3rd century BC, the Hellenistic kingdom stretched to the shores of the Red Sea, which connects to the Indian Ocean. Ptolemy

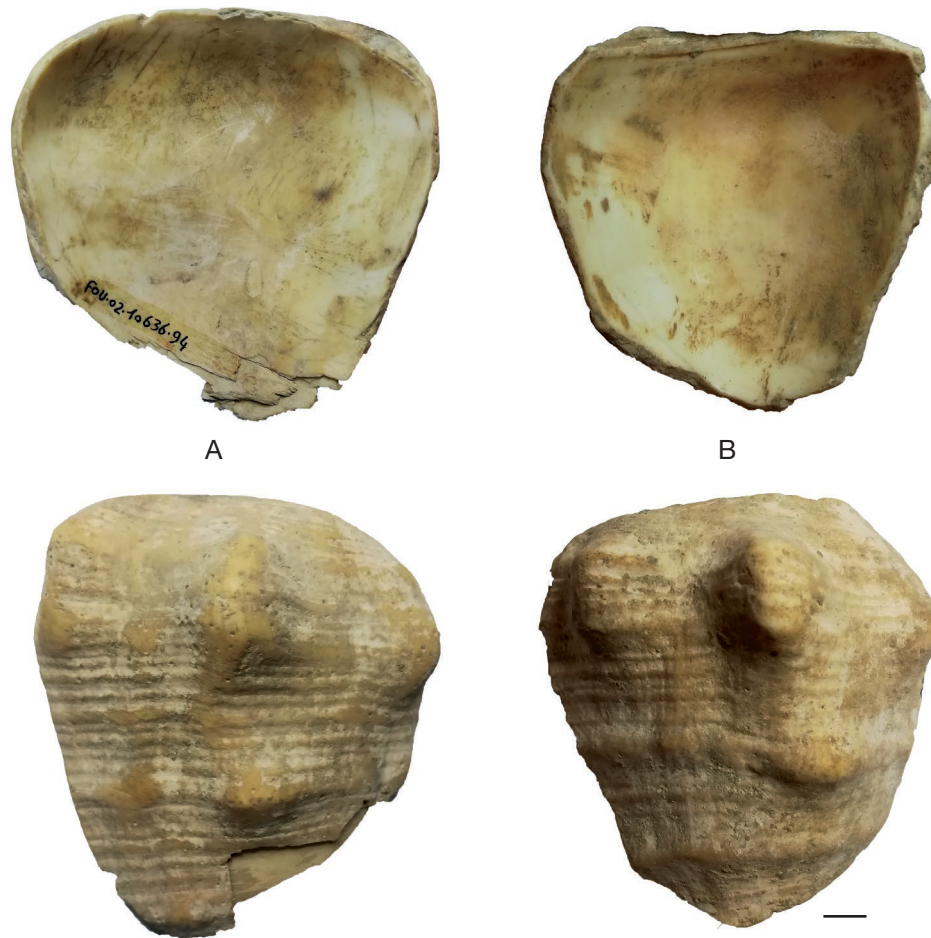


FIG. 15. — Spider conch (*Lambis* sp. Röding, 1798) shell from: **A**, Fouad site; and **B**, Theater Diana, probably used as a container. Inner side at the top and outer side at the bottom. Scale bar: 10 mm.

Philadelphus commissioned the foundation of several ports along the Red Sea coast, including that of Berenike, in order to import precious materials such as ivory from the Horn of Africa (Rodziewicz 2016: 35), as well as spices and incense from the Arabian Peninsula (Ballet 1999: 100). All of these goods were carried across the Eastern Desert by caravans and then by boat along the Nile. Alexandria was at the head of this important trade route. Shells from the Red Sea were also transported and are evidence of the trade relations between Alexandria and this part of the world.

The presence of these shells, sometimes only a single example, in the Alexandrian corpus requires an explanation (Fig. 14). This is the case of the ramose murex (*Chicoreus ramosus* Linnaeus, 1758). A shell of this species was found in a level dated to the 3rd-2nd centuries BC on the Fouad site: this site is remarkable for holding a large number of mammal bones connected to artisanal activity in the Hellenistic era (Rodziewicz 2016: 179). This large gastropod with its peculiar shell was perhaps transported to Alexandria for a specific reason linked to the working of animal material, but this reason still escapes us. It was perhaps sold as a simple decorative object in one of the urban markets.

The small giant clam is present in Hellenistic levels of both the former British Consulate and Fouad sites. One might initially think that this shell, often of large size, was sold in

the capital for its beauty. The attraction of these huge bivalves in the Mediterranean basin has been known for thousands of years (Reese 1991). Examples from archaeological contexts have revealed their use at Naukratis in Egypt of the Saite period as lamps and censers. However, these remains were identified in sanctuary and funerary contexts (Thomas & Bertini 2018: 7). The small giant clam valves used as pigment container, vessel and incense burner are attested also in Hellenistic and Roman Berenike (Carannante, pers. comm.). In Alexandria, several have been found in burials of both the eastern and western necropoleis (Empereur & Nenna 2003: 523) where, considering the associated material, they were used as cosmetics containers. They may have had the same use in Alexandrian domestic settings, but we only have a few fragments of these large shells and without any traces of particular use (Fig. 14).

The majority of the Indo-Pacific shells have not been worked. However, one species from this part of the world seems to have undergone modifications: the spider conch (*Lambis* sp. Röding, 1798). The average size of this shell when complete is between 200 and 300 mm. Two shell fragments have been found in two domestic levels of the Hellenistic period. In both cases it is the final whorl of the gastropod (Fig. 15). They measure about 90 mm in diameter. The example from

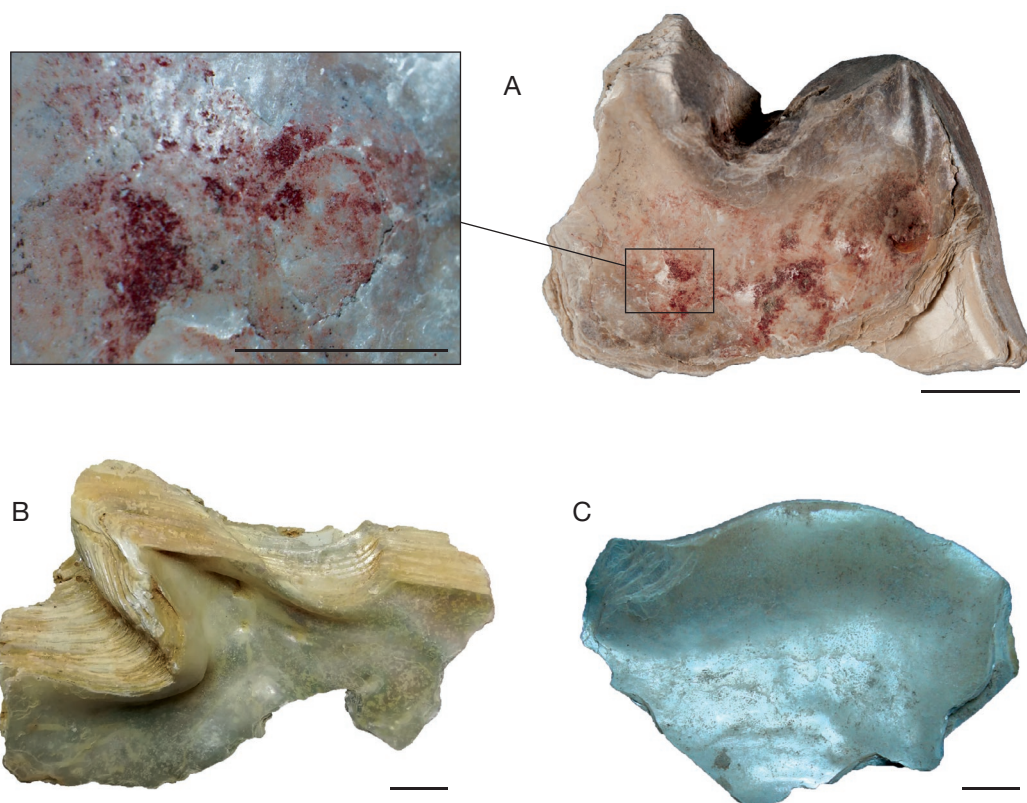


FIG. 16. — Fragments of pearl oyster (*Pinctada margaritifera* Linnaeus, 1758) from the Hellenistic period: **A**, one of the shells displays traces of red/violet pigment (with an observation through binocular microscope); **B**, the second is unworked; **C**, the third is polished. Scale bars: 10 mm.



FIG. 17. — Perforated mother-of-pearl plaque dated to the 2nd century BC. Scale bar: 10 mm.

the Fouad site is polished on one side. Observation through a binocular microscope is necessary for a better reading of these traces. Similar cases have been noted elsewhere in Egypt, in particular in the Sinai (Bar-Yosef Mayer 2007a: 273) and at Mersa Wadi Gawasis on the Red Sea coast (Carannante *et al.* 2014a: 130). However, the quantities of spider conch on these sites are much greater and in more ancient contexts. Any comparison between these sites and Alexandria is tricky, but the theory that they were used as containers or as raw

material can be entertained. We still do not know, however, if these shells were intact when they arrived in the city or whether that last whorl was previously removed to be sold.

Amongst all the examples, the most common Indo-Pacific shell in the corpus is the black-lip pearl oyster (*Pinctada margaritifera* Linnaeus, 1758; n=15). It is well known in Egypt and in many regions of the Indian Ocean particularly for the nacre and pearls that it produces. At the time of the first Ptolemies in Egypt the shells were preferred over the pearls (Schneider 2013: 318). Then, from the 2nd century BC they were imported from India and the Persian Gulf (Schneider 2013: 158) via the Red Sea and Alexandria to make jewellery throughout the Mediterranean. They enjoyed great popularity in the Roman world, both for the shells and the pearls (Bar-Yosef Mayer 2007b: 200). Nonetheless, archaeological discoveries if these bivalves are very rare. A few fragments have been found in Eastern Europe (ancient Aquincum and Viminacium), in Italy (Pompeii, Voghenza), in Greece (Athens, Thessaloniki) on Cyprus (Amathus, Nea Paphos), in the Middle East (Amman, Jerusalem, Nuzi) and in Egypt on sites of the Eastern Desert (Mons Porphyrites, Mons Claudianus and Quseir el-Qadim [Myos Hormos]), at Aswan and in the Fayoum (Láng 2006; Ifantidis 2014). The majority of these archaeological remains come from funerary or sanctuary contexts except for Athens and the Egyptian sites.

In Alexandria the pearl oyster is found on domestic housing sites of the Ptolemaic and Roman periods. The oldest archaeological discovery is dated to the beginning of the 3rd century

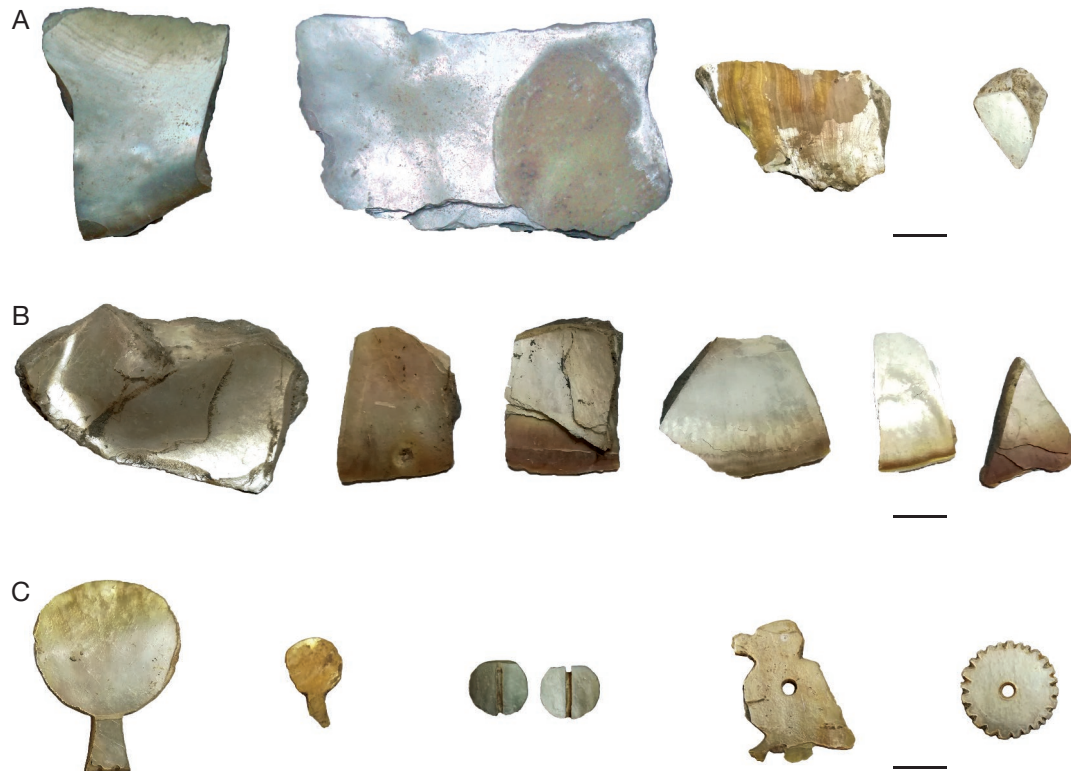


FIG. 18. — Fragments of pearl oyster from: **A**, 5th-6th century AD levels on Diana Theatre site; **B**, Late Roman levels on the Billiardo Palace site; **C**, half-finished mother-of-pearl objects found on the Diana Theatre site. Scale bars: 10 mm.

BC on the Cricket Ground, that is, the first decades after the foundation of the city. Two examples are fragments of the hinge. A fragment from the former British Consulate site in a context dated to the 2nd century BC bears traces of a red-dish pigment (Fig. 16). Samples have been taken for future chemical analysis. In another refuse pit of the 1st century BC, a shell fragment has been polished to give it a shiny look (Fig. 16). The pearly, iridescent surface is smooth and flawless. This large bivalve, which can measure up to 25 or even 30 cm in diameter (Carpenter *et al.* 1997: 42; Poutiers 1998: 185), could have been used as a container for carrying or preparing cosmetic powders (Sigl 2017: 251). Such shells were used as decorated containers (Ifantidis 2014), boxes (Spazic-Duric 2017), and as symbolic decorative objects like the shell unearthed at Mons Porphyrites onto which an image of Aphrodite had been drawn (Hamilton-Dyer 2007: 353). These archaeological discoveries in domestic Ptolemaic-era contexts at Alexandria clearly show that the better-off inhabitants of the capital were also entranced by this “mother of pearls” from the Erythraean Sea. On the other hand, no pearls have been found on these sites.

THE SHELL AND CORAL AS A RAW MATERIAL

The mollusc shell is also a raw material for the manufacture of objects. The pearl oyster is especially sought after for its thick nacreous shell. Its use as a raw material is attested in

Egypt on the Eastern Desert sites of Mons Claudianus and Mons Porphyrites from the Roman period (Hamilton-Dyer 2001: 290). This bivalve was already used to create objects at Alexandria in the Ptolemaic era. A rectangular plaque with six perforations on its short edges was found on the Cricket Ground (Fig. 17). This plaque is 40 mm long, with a maximum width of 16 mm and minimum of 12 mm, and is 1.5 mm thick. One surface is not completely polished and the growth lines of the bivalve are still visible. Two holes are not closed. It is almost certainly an unfinished decorative element that was flawed and thrown into a refuse pit.

The pearl oyster remains from the Roman period are different from those of the Ptolemaic era. They are often fragments of a few centimetres, rectangular or triangular and barely worked (Fig. 18A). They come from levels dated to the 5th-6th centuries, mostly concentrated in the north of the Diana Theatre site. Similar fragments were found in the refuse pit of the Billiardo Palace site (Fig. 18B). They may have been decorative elements designed to be inlaid into caskets or furniture (Láng 2006: 151). Pearl oyster shell was also used to make round perforated beads. Decorative elements like small, notched wheels and circular plaques with a handle resembling a mirror are also part of our ensemble (Fig. 18C). The pearl oyster is the most commonly used bivalve at Mons Porphyrites for the manufacture of elements to be inlaid (Hamilton-Dyer 2007: 349).

Furthermore, red coral was also used as a raw material during the Late Roman period. The red colour and the dense longitudinal striations on the coral surface are typical

(Carannante *et al.* 2015: 285; Fürst *et al.* 2016: 8). On the Diana Theatre site, the assemblage is composed of 602 essentially raw fragments, but also slightly worked beads and finished objects (Fig. 19). Some layers are composed of two hundred fragments. This may be a stock of raw material for craftsmen. Red coral lives in the western Mediterranean Sea (Harmelin 2000: 16), so it was imported into Egypt. During antiquity, it was used as a resource for exchange with India (Meeks 2000: 102). Alexandria was a stopover on this trade route (De Romanis 2000: 211; Sidebotham 2011: 238). Discoveries of red coral on sites along the Red Sea coast, such as Berenike (Sidebotham 2011: 238) and Adulis (Carannante *et al.* 2015: 285) attest to this trade, also mentioned in the *Periplus Maris Erythrae* (*Peripl. M. Rubr.* 28). One can also imagine that red coral of Alexandria was exploited for local jewellery requirements in the city.

In Alexandria, along with semi-precious stones and animal bones cut on site for the manufacture of refined objects, marine resources like pearl oyster, cowries and red corals were used as raw material. The tools and techniques used to work stones were most probably similar to those needed to produce ornamental elements in nacre and red coral.

DISCUSSION

The mollusc shells unearthed in occupation and abandonment levels are just the meagre traces of their consumption during antiquity. One should bear in mind that these seafood remains were most certainly dumped far from wealthy housing in order to avoid smells and pollution. Moreover, a certain unevenness in collection is undeniable within the framework of a salvage excavation. Without having sifted the earth, the malacofauna spectrum is reduced to the largest specimens and to those best recognised by the excavator. One can easily imagine that the number of molluscs that were eaten is even greater.

The malacofauna range highlights the importance of marine molluscs in the food supply of the inhabitants of this district, whereas shells from a lacustrine environment are only occasional. The mollusc supply was local and predominantly from the Mediterranean Sea. One might ask whether their presence in the refuse dumps of affluent populations is a marker of the social level of the inhabitants. The marine malacofauna spectrum of the Hellenistic period includes 21 eaten species of the 23 identified throughout the entire chronology. Alexandria lies close to the sea and it is possible that all social categories were able to gather molluscs at least along the shoreline as a source of food. Nonetheless, certain species are less accessible than others since they live in infralittoral and circalittoral zones: boats and dredging equipment are required to collect them. This is perhaps an issue that should be considered, but it is difficult to gauge given the present state of our understanding of the exploitation of marine invertebrates in Alexandria. One can reasonably assert that the consumption of Mediterranean seafood is proven for the wealthier social classes, without knowing whether this practice was common to the entire population. In the archives of Zenon, private secretary to the *dioecetes* Apollonios in the

3rd century BC, one of his correspondents sends a large selection of fish, crustaceans and oysters (38 in total) to some guests. This example does not concern Alexandria directly but it shows that seafood featured on the tables of the richest and that it was considered suitable as a gift (Reekmans 1996: 24). In the Roman era, the diversity is greatly reduced to just 11 edible species in the domestic refuse dumps. It is difficult to know whether this change is significant or if it is linked to a reduction in the number of studied samples. Oysters take on the largest role, to the detriment of the diversity of the previous period. They are often described as a delicacy in Roman banquets because they are rare and expensive (Hitchner 1999: 376; Carannante *et al.* 2014b: 181).

At Schedia, the large river port at the junction of the canal of Alexandria and the Canopic branch of the Nile, oysters are the main marine molluscs identified in the levels of the Roman era (MacKinnon 2013). On the other hand, they hardly appear to have been eaten elsewhere in Egypt. On the site of the island of “Marea/Philoxenite”, in the close hinterland of Alexandria, it is mostly freshwater shellfish (freshwater mussels and apple snail [*Pila* sp. Röding, 1798]) and marine species that can survive in brackish water (lagoon cockle) that predominate (Ikram & Bertini 2016). At Buto, some 100 kilometres east of Alexandria, freshwater molluscs are once again in the majority for the Ptolemaic and Roman eras. But, several flat oyster and wedge clams have been collected (<10 NISP; Driesch 1997: 36). Excavations on sites of the Eastern Desert – often military, strategic (mines) or ports of the Roman period – have revealed numerous marine mollusc shells mostly from the Red Sea (Van Neer & Lentacker 1996; Van Neer & Ervynck 1998, 1999; Van der Veen & Hamilton-Dyer 1998; Leguilloux 2003). The inhabitants of the city of Syene (present-day Aswan), situated in the extreme south of the country, also consumed molluscs from the Red Sea and from the Mediterranean (Sigl 2017: 247–269). On the other hand, flat oysters are few or absent from these sites. They were perhaps only eaten very rarely in these regions or were replaced by the hooded oyster (*Saccostrea cucullata*), as at Mons Claudianus (Hamilton-Dyer 2001: 290). The location of these sites, several hundred kilometres distant from the Mediterranean coast, would more than likely have limited the importation of oysters. All the same, these bivalves were sometimes eaten in regions of Europe very far from the coast. This does not appear to have been the case in Egypt. Transport conditions were perhaps not adapted to transporting fresh seafood into desert zones. One can also imagine that they were shelled and salted in a similar fashion to the meat and fish eaten by soldiers in the Eastern Desert.

In the present state of our knowledge regarding Egyptian marine malacofauna of the Ptolemaic and Roman period, only the wealthiest (?) inhabitants of Alexandria and Schedia (and Bouto?) ate flat oysters in large quantities. This situation might suggest a trade that was restricted to the elite of these towns, but the still limited number of archaeozoological studies in Egypt might perhaps skew this idea. Moreover, the flat oyster may have held a special place in Alexandria. It was both eaten and its shell was used as an element of decoration. Beyond

its position as a dietary delicacy, the shell of this bivalve was perhaps also a sign of ostentation in the domestic circles of the elite of the city.

More generally, marine molluscs were an integral part of the everyday life of the most affluent social classes. Oysters and other species from the Mediterranean and Red Seas were used for decoration and dress, and were associated with ancient beauty products. On the Diana Theatre site they were worked alongside semi-precious stones, some of which were exported to Europe to be made into jewellery. Whether local or exotic, the shells and red corals were used in the manufacture of refined objects at least until the end of the Roman period. A market must have existed to supply the workshops. The Diana Theatre site cannot have been unique within the city. Moreover, the shells of the Red Sea and red corals of the western Mediterranean Sea are direct evidence of long-distance trade and confirm the status of Alexandria as a major Mediterranean port during antiquity. Moreover, these luxury items were probably bought, sold and worked to satisfy the tastes of a social elite in Alexandria that did not escape the fashion for wall decorations featuring seashells and for mother-of-pearl containers brought from the warmer seas.

CONCLUSION

This study of mollusc shell remains reveals their important place within the domestic sphere in Alexandria. They were eaten, and local marine species were preferred over freshwater or terrestrial species. One can clearly observe the consumption choices among the available food resources in the close environment of Alexandria. These choices were perhaps governed by dietary tastes or by market supply. It is currently difficult to know the real place of molluscs in the overall diet since a large part of the consumption waste was certainly removed. Moreover, through lack of on-site sieving, some of the remains were not collected during the excavation. Just how much is impossible to calculate but if one considers the presence of shells in the archaeological layers, they are everywhere. Consumption was regular throughout antiquity.

This study also throws light on the hitherto unsuspected plurality of uses of molluscs and their shells within the Alexandria domestic sphere. They were used as decorative elements, containers and as a raw material. Although there are still some grey areas as regards the exploitation of molluscs within the city, analyses of chemical composition and observations using a binocular microscope will most probably provide additional information. A look at funerary offerings (Empereur & Nenna 2003) in the different necropoleis of the town would also be enlightening as to exactly what place molluscs had in Alexandrian culture.

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FIG. 19. — Red coral from 5th-6th century AD levels on the Diana Theatre site: **A**, raw fragments; **B**, beads. Scale bar: 10 mm.

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