In Search of the Origins of Lower Egyptian Pottery:
A New Approach to Old Data
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Chapter 6
Comparative analyses of the pottery of Lower Egypt, the southern Levant and the eastern Sahara

The purpose of the comparative analyses covering ceramics from Lower Egypt, the southern Levant and the eastern Sahara presented below is to identify the most important similarities and differences between pottery production in the 6th and 5th millenniums BC of these three regions. The results of the analyses will allow verification of two hypotheses concerning the origin of Neolithic Lower Egyptian pottery, linking it with the southern Levant or with the Western Desert.

The scope of the analysis covered pottery from all currently known sites in Lower Egypt dated to the middle of 6th and the 5th millenniums BC (Map 2), namely: Fayumian pottery from the sites on the northern shore of Lake Qarun (Caton-Thompson & Gardner, 1934; Ginter *et al.*, 1980; Ginter & Kozłowski, 1983; Kozłowski & Ginter, 1989); Merimde pottery (Eiwanger, 1984; 1988; 1992); as well as el-Omari pottery (Debono & Mortensen, 1990). The data from the Fayum was supplemented by the results of J. Emmitt's recent analyses of the Fayumian ceramics excavated by G. Caton-Thompson and E. Gardner (2011; 2017; Emmitt *et al.*, 2018). Moreover, the author takes into account the results of her own research on the Neolithic pottery presented in the Appendix (Tables 7abc-9abc).

Lower Egyptian pottery was juxtaposed with undecorated thin-walled pottery that emerged in the Western Desert during the Middle Holocene period (Map 3). The latter is characteristic for the Bifacial technocomplex distinguished in the central and northern parts of the Western Desert in the final part of the Holocene humid phase (Riemer *et al.*, 2013). Pottery from Sodmein Cave in the Eastern Desert, associated with this northern pottery tradition, is also addressed here (Vermeersch *et al.*, 2015).

This analysis also takes into account the Pottery Neolithic ceramic assemblages from the southern Levant, belonging mostly to three main cultures, namely the Yarmukian, the Lodian and the Wadi Rabah, despite the fact that these go beyond the timeframe discussed in this monograph (Map 4). The ceramic assemblages of the Nizzanim and the Qatifian cultures have also been taken into account, although their size and unclear chronological position and cultural identity affect their scientific value in comparative analyses.

Pottery collections from the three regions could not be analysed comparatively on the basis of statistical data. Although the ceramic assemblages studied here are mostly available in the form of scientific publications, there are significant differences in approaches to ceramic assemblages and in the way they are described, not only between regions but also between sites located in the same region. As a result, the available data, including statistics, is not homogeneous. Harmonising such data for the purposes of this research was impossible due to a lack of, or limited access to source materials.

The comparison was made difficult by the nature of ceramic assemblages from Lower Egypt, including, in particular, those from the Fayum, found in the first half of the 20th century. Desert assemblages were challenging too, both for their small size and a limited amount of detailed publications. Southern Levantine pottery seems to be the best understood, as it has been researched in accordance with the latest standards and numerous publication are available. However, comparative and parallel analyses are made difficult by a great diversity among sites, including large differences in the percentages of both vessel forms and surface treatments, existing even between sites of similar chronology in the southern Levant (Gopher & Eyal, 2012a: tables 11.5-6).

The pottery from these three regions is presented in detail in Chapter 5 and the Appendix. However, in order to facilitate the analysis, the basic pottery data has been arranged and presented in a similar way in this chapter. Given the nature of the available data, comparative analyses are carried out taking into account the principal stages in pottery production, as proposed by C. Orton *et al.*, namely procurement and preparation of raw materials (clay, tempers), forming vessels and pre-firing treatments, and firing (Orton *et al.*, 2010: table 10.1; see also Rice, 2005). Moreover, in the analyses two morphological features of pottery, namely forms and decoration, are also addressed.

Additionally, the analyses took into account the factors influencing pottery production defined by D.E. Arnold (1989) as part of ceramic theory. Thus, five of the seven factors outlined have been analysed in detail, namely: raw material resources; weather and climate; possible scheduling conflicts; the degree of sedentariness; and demand. Their analysis will help determine the organisation of pottery production in the regions in question.

6.1. Neolithic pottery production in Lower Egypt

6.1.1. The stages of pottery production

Procurement and preparation of raw materials (clay, tempers)

Locally available clay was used for pottery production during the Lower Egyptian Neolithic. The pottery of the Fayumian culture was mostly made of Nile clay. Thanks to analyses of pottery from sites at Qasr el-Sagha, it was confirmed that Nile silts originating from the Hawara Depression were used to make vessels. Moreover, lake sediments and lake silts were also used for pottery production. On the basis of analyses involving a portable X-ray fluorescence spectrometer, Emmitt identified four different raw materials used in the Fayum, originating from different sources (Emmitt, 2017: 149-150; Emmitt *et al.*, 2018). Although the identification of their exact location was impossible, in Emmit's opinion, the presence of multiple raw material sources indicates movements from outside the Fayum. Although Nile silts were also used for pottery production at Merimde, a number of different clay sources is suggested as well (Emmitt, 2017: 155; Emmitt *et al.*, 2018). The el-Omari pottery was made of two kinds of local calcareous clays present in the region of Wadi Hof.

Among tempers added to the Neolithic pottery sand and straw were recorded, although their relative proportions may differ from site to site. The oldest Merimde pottery was made also of untempered clay. At Sais I, untempered and tempered pottery coexists. In the pottery of Merimde phase II, straw-tempered pottery is well represented, while in phase III it accounts for a half of the entire assemblage.

In the younger ceramic assemblage of this site, Emmitt identified a number of tempers, including gravel, sand, quartz, limestone, and shells (Emmitt, 2017: 219-220). He also suggests that the frequency of using sand and gravel tempers decreased over time. As for el-Omari tempers, sand dominates over straw, which may be associated with the use of other clays, the quality of which differed from that of Nile silts. Moreover, crushed papyrus fibres and ochre were also confirmed inside sherds collected at Wadi Hof as intentional fillers (Debono & Mortensen, 1990: 25; Hamroush & Abu Zied, 1990: 117-127; Holmen, 1990).

The frequent use of chaff temper by Neolithic potters was likely related to the requirements of pottery technology in humid conditions. Chaff added to clay could improve drying and prevent shrinkage of wet vessels before firing.

While conducting analyses of Lower Egyptian Neolithic pottery, the author made some fresh observations. Voids of burnt straw found on the surfaces of vessel from all Neolithic sites are sometimes large and can be up to 2 cm in length. Moreover, impressions of other plant remains (including grains) are also visible. A very coarse organic temper is present even in the paste used for the production of thin-walled vessels, and covered with slip before firing. As a result, this kind of temper causes the slip to crack, peel and damage the vessel surface. The large

amount of plant remains added to clay indicates that pottery was produced in households, where the remains of crops or other plants were probably available in large quantities, as they were commonly used (see Appendix).

Forming vessels and pre-firing treatments

Pottery was made by hand of coils joined together and using the pinching and hollowing method. The slab method emerged during phase III at Merimde and is also seen in el-Omari pottery. The inventories from the northern shore of Lake Qarun show both fine vessels with thin walls and pots with thick and uneven walls (Emmitt, 2011: 110). In the group of complete vessels studied by Emmitt, vessel thicknesses ranged from 5 to 12 mm, while their diameters varied from 5 to 50 cm. At Merimde, the wall thickness of Urschicht vessels was between 4 and 18 mm, while the rim diameter, depending on the form, varied from 3 cm to as much as 45 cm. In phase II, the minimum thickness of vessel walls increased slightly to about 5 mm, not exceeding 15 mm (Eiwanger, 1984: 25-26; 1988: 19-20). At el-Omari, wall thicknesses ranged between 5 and 15 mm while the rim diameter of most vessels ranged from 5 to 30 cm, although large vessels with diameters of between 30 and 42 mm were also present (Debono & Mortensen, 1990: tab. 3). Smoothing the inner vessel surfaces by means of a bunch of grass or straw was also used at the stage of vessel formation (Fig. 23). In the opinion of author, the pottery skills of all Neolithic cultures in Lower Egypt were comparable as they used the same methods during forming and shaping. Differences between sites (i.e. tempers, shapes) probably reflect differences in factors affecting pottery production (i.e. resources, subsistence strategies, demand).

The colours of pottery surfaces at all Neolithic sites range from black to various shades of grey, brown and red. It was only in the case of the sherds from Kom W and the Upper K Pits that Emmitt recorded 28 colours, of which red as the dominant colour occurred only on 8.1% of all sherds (Emmitt, 2011: 104-105). At Wadi Hof, ochre was added to the paste to ensure vessels had a red colour. The increase in human skills in controlling the firing atmosphere and obtaining high temperatures had an impact on more uniformly coloured surfaces of vessels during the Neolithic.

Surface treatments recorded on the Neolithic pottery of Lower Egypt included slip, burnishing and smoothing, although vessels with rough surfaces were also present. In the sample from Kom W and the Upper K Pits studied by Emmitt, 68.9% of all sherds were too worn to identify the surface treatment method used (Emmitt, 2011: 100-102). Among sherds with preserved surface treatment, he identified ceramics with slip and burnish (11.5%), as well as ceramics that were only covered with slip (7.4%) or only burnished (2.7%) (Table 2) (see also Em-

mitt, 2017: 200-201). Apart from red and black slip, orange slip was recorded too. Burnished surfaces prevail over smoothed surfaces at Merimde (62.5%) and Sais (67.25%), although the percentage of burnished ware decreased during phase II (to 53%) and that of smoothed ware grew from 33.7% to 46.7%. In phase III, these proportions remained almost unchanged (Table 2) (Eiwanger, 1992: 19, Abb. 4). Moreover, in the latter part of the Neolithic, the burnishing direction and the quality of this surface treatment changed as well. Although in the el-Omari assemblage the dominance of burnished vessels covered by slip is clearly visible (62%), the burnishing was not done carefully and consistently (Table 2). F. Debono and B. Mortensen point out sherds blackened with fire or soot, found in el-Omari pottery (Debono & Mortensen, 1990: 26). These may have been imitations of black-topped vessels. Alternatively, the surface colour may simply be the result of placing them upside down in ashes during the cooling process in order to prevent them from cracking.

Firing

The uneven surface colouration of most Fayumian vessels suggests a simple open firing process and its incomplete control, with interrupted access to oxygen. The likely firing temperature was approximately 600°C. According to Emmitt, fire-clouds identified on part of the ceramics concerned indicate that vessels were surrounded by fuel during the firing process (Emmitt, 2011: 107-108). He also suggests the use of dung as fuel. Pottery analyses on materials from Qasr el-Sagha also suggest firing at a temperature of approximately 600°C, both in oxidizing and reducing conditions. At the beginning of the Merimde culture, the arrangement of the firing process was similar to that known from the Fayum. The emergence of grey-coloured vessel surfaces in phase II, and additionally black surfaces in phase III, could be interpreted as progress in pottery-firing technology, attributable to improved control of firing conditions and oxygen availability during the process. In case of el-Omari pottery, one's attention is drawn to a relatively high temperature of approximately 800°C, in an oxidizing environment. Although such high temperatures could be reached in open firing, it called for skills and know-how. The suggested presence of vessels with black tops in the el-Omari culture could have also been linked to a thorough understanding of the firing process and an ability to control oxygen access (Hamroush & Abu Zied, 1990: 122).

Forms

The most plentiful shapes of the Fayumian culture are open vessels, namely hemispherical, spherical or conical bowls. Deep jars with a restricted mouth (hole-mouth jars) also occur. Fairly numerous are rectangular bowls, vessels on a raised

base and vessels on 'knobbed feet' (Figs. 1:1-4; 2:1-2; 3:1-5; 4:1-3; 11-15). Emmitt suggests a preference for unrestricted vessels with flaring and straight rims among the Fayumian assemblages. However, in the Upper K Pits, restricted vessels represent 60%, which may be attributable to the site's function as a storage place (Table 3) (Emmitt, 2011: 99-100).

Vessel forms in the oldest phase of Merimde seem to be very similar to those of the Fayumian culture. They include hemispherical, spherical and conical bowls, vessels with vertical walls or deep vessels with a restricted mouth (Figs. 1:5-7; 2:3-4; 3:6-8, 11; 16-20). Open forms prevail in both burnished and smoothed ware (Table 3). However, in Sais I, closed forms prevail over open forms. Additionally, some fragments of broad jars, known from the younger phases of Merimde, are also known from Sais I (Wilson *et al.*, 2014: 118–121, figs. 113–114). During phases II and III of the Merimde settlement, an increase in the number of closed forms could be observed. In the last phases of Merimde, the domination of closed forms over open forms is clearly visible in the group of burnished wares, although open and closed forms were recorded in similar numbers in smoothed ware. Moreover, in the younger phases of the Merimde site, new forms of closed vessels appeared, namely jars with a S-shaped profile or burnished jars with a globular body and a long neck (Figs. 5:7-8; 6:1-2, 4, 7; 16:15-16; 20:1, 3, 6).

At the site of el-Omari, open forms prevail over closed forms. The percentage of vertically walled vessels is also high (Table 3). Among the most numerous shapes, there are fairly deep restricted spherical vessels (some with a S-shaped profiles) and vessels with vertical walls. Conical bowls with flat bases are plentiful as well. Vessels with long necks and rims everted outwards, similar to Merimde III bottles, are also present. Some fragments of pottery with a knobbed base, known from the Fayumian culture, were also recorded (Figs. 1:13-15; 2:9-11; 3:17; 4:9-10, 12; 5:10-14; 6: 3, 5-6, 19; 21).

Decoration

Neolithic pottery is rarely decorated. In the Fayumian culture, knobs constitute the only form of decoration but are also found on pottery at Merimde and el-Omari. The oldest pottery of Merimde and Sais was decorated with an incised herringbone pattern (Fig. 22). This kind of decoration is present on burnished vessels, either under the rim or on the upper part of the vessel. The decorated area is not burnished. The pottery of Merimde II was not decorated, except for knobs identified on a few vessels. In phase III, decorated pottery became more numerous, with a greater variety of techniques (incised, impressed, plastic, painted) and motifs. A range of horizontal, vertical and diagonal lines and oval, or even crescent-shaped indentations, were identified.

6.1.2. The organisation and development of pottery production in Neolithic Lower Egypt

Resources

Determining the exact location of sources of raw materials used for pottery production in Lower Egypt is not always possible. At each known Neolithic site, clays from deposits located at some distance from the site were probably used. Extracting clay from such deposits may have accompanied movements across the area concerned, thus being part of exploiting the abundant resources of the region.

Ethnographic studies investigating the distance between resources and the place of pottery production concentrate primarily on sedentary or semi-sedentary populations. Among these communities, the maximum distance to clay deposits was 50 km, although in most cases the sources of raw materials were located 7 km or less from the production site (Arnold, 1989: 50). However, the logistics of raw materials procurement may have been different in the case of mobile groups, while distances may have been greater than those observed in the case of sedentary or semi-sedentary communities. A 20-30 km round trip is suggested by L.H. Kelley as the upper limit of the distance that mobile hunter-gatherers could walk in a day (Kelley, 1995: 133). Assuming that the Neolithic groups from Lower Egypt were partly mobile and their existence was based on movement and using resources (materials and food) located within an area they occupied and probably knew well, they may have used multiple clay deposits located at distances ensuring their return home before sunset. N. Shirai suggests that the people of the Fayumian culture obtained lithic raw materials from different locations within the area between the lake and the Nile Valley at Gebel el-Rus and Gebel Lahun (between 10 to 30 km to the Neolithic sites) and at Ilwet Hialla and Umm es-Sawan (ca. 14 km north of Kom K) (Shirai, 2010: 278-292). A parallel situation may have taken place in the case of clay. Tempers were probably also sourced from similar locations.

Other materials necessary for pottery making, i.e. water and fuel, were also easily available in the vicinity, as the sites were located in rich ecological niches (Barakat, 1990; Wilson *et al.*, 2014: 149). The presence of water had a positive effect on vegetation including, in particular, trees. Indeed, most charcoal samples from the sites in the Fayum were identified as originating from tamarisk or other typical waterside trees (Marston *et al.*, 2017; Wendrich & Holdaway, 2017). Tamarisk and acacia were also identified among el-Omari charcoals (Barakat, 1990). Emmitt additionally suggests the use of animal dung as firing fuel in the Fayum (Emmitt, 2011: 107-108).

Vessels were made and fired in places used for an extended stay, next to other activities (production of food, production of lithics and baskets). Pottery was made at Kom W as indicated by an unfired clay vessel found on the site, large vessels not suitable for transport and hearths which could have been used for pottery

firing (Emmitt, 2017: 243-244). Emmitt suggests that pottery production at Kom W was not routinised and that vessels were made only when necessary (Emmitt, 2011: 131-132). At present, there is no evidence that would clearly indicate the local production of pottery at the Merimde and Sais sites or in Wadi Hof. However, given the presence of a large number of vessels and their widespread use, such production would have had to take place at or near the sites, while the structures recorded at the sites could also have been used for vessel firing.

Weather and climate

Although, according to R. Phillipps *et al.* (2012), the Fayum was located beyond the reach of the ITCZ in the Early and Middle Holocene periods, it was influenced by the southward movement of Mediterranean winter rains (see also Welc, 2016: 276-277). Winter rainfalls and cooler conditions, both being of key importance for crop farming in this region, may have had a negative effect on pottery production in general, and vessel drying and firing in particular. As a result, pottery production may have been confined only to periods when temperature and humidity levels were favourable for pottery making, including first of all warm summers (see also Köhler, 1997 for the Predynastic period). Higher temperatures during summer periods could have limited the migration of people across the area, while the high-water level in the lake associated with the Nile floods, guaranteeing access to water and diverse wildlife (fish, birds, animals) allowed for longer stays in one place, thus favouring pottery production (Table 4).

In the second part of the Neolithic, the negative impact of climate and weather on the pottery production could have also been reduced by stable settlement structures. There was also a great popularity of using chaff as temper, which makes it easier to dry vessels before firing.

Seasonal pottery production may have taken place at sites close to branches of the Nile, namely at Merimde and Sais, and even at Wadi Hof. In addition, H.A. Hamroush and H. Abu Zied suggest that the el-Omari people used the Nile flood plain for crop cultivation after the floods (Hamroush & Abu Zied, 1990: 92). The presence of a small number of vessels made from Nile silt in the el-Omari assemblage may be linked to the presence of the inhabitants of Wadi Hof on the floodplain in connection with the cultivation or use of other river resources available there, including, in particular, fish. A small amount of pottery could have been made during the harvesting and processing of crops, or intensive fishing in the late summer (Table 4).

Degree of sedentariness

For many years, the Neolithic societies of Lower Egypt were considered as fully sedentary. Currently, however, a certain degree of mobility connected with the

use of many different resources available in the environment has been implied. Some degree of such mobility has been suggested for the Fayumian culture on the basis of flint and pottery analyses (Holdaway *et al.*, 2010; 2016; 2017; Phillipps *et al.*, 2016ab; Holdaway & Wendrich, 2017; Emmitt, 2011; 2017; Emmitt *et al.*, 2018; contra Shirai, 2017). Moreover, the results of recent wood charcoal analyses from the Fayum show the use of a few ecological zones for wood gathering. This particular observation could also be treated also as an indicator of mobility in this area in the period in question (Marston *et al.*, 2017).

In the estimation of Emmitt, places where pottery was produced had to be occupied long enough for the whole production process to be completed (Emmitt, 2011: 132). Vessels may have been produced at extended stay sites, where lithic items were made, food was cooked and other activities were carried out. However, they could not have been possibly made in transit. When leaving a given location, people would take those vessels that were useful on the way. Other vessels were probably left behind in the form of 'site furniture'. Subsequently, when returning to a given location, people would use both the vessels they carried with them and those constituting the site's 'equipment'. Particularly remarkable among the latter are large vessels, whose dimensions and weight made them perfect 'site furniture'. As they were used for storage, it was their contents that may have made people come back. Storage facilities (including large vessels) located in various locations within the area used by the Fayumians became permanent points in their settlement pattern (Emmitt, 2017: 242-243).

In the light of the most recent research, the Merimdians also travelled across Wadi Gamal and exploited available resources for hunting, food processing and working tools (Rowland, 2015; Rowland & Bertini, 2016). Round structures recorded in phase I of the site, probably constituting part of a camp, have been interpreted in the context of seasonal occupation (Wetterström, 1993). Pottery may have been made within the camp, while the hearths recorded there may have been used for vessel firing. Movement across Wadi Gamal did not necessarily influence pottery production, since if it was practiced in places used for a longer stay (e.g. seasonal camps), it could have been pursued independently of, and simultaneously with other activities, not unlike in the Fayum. In the younger phases of Merimde, when settlement structures became more stable, dense and complex (thus denoting permanent human presence), pottery production could have been practiced within the settlement, inside households or in their vicinity.

A similar situation may have taken place at Wadi Hof, a rich ecological niche exploited by the el-Omari community. With its numerous structures in the younger occupation phases (including a semi-subterranean circular hut), the settlement may have served as a permanently inhabited central place, from where expeditions to other parts of the region were organised. Pottery production may have

been located in the vicinity of clay outcrops in one of the places of activity located around the main settlement sites. A small amount of pottery made of Nile silt may indicate that pottery production was also located on the Nile floodplain, a place visited in search of fish and in connection with crop farming (Hamroush & Abu Zied, 1990: 92).

Scheduling conflicts

In the early studies on the Neolithic in Lower Egypt, domesticated plants and animals from the Fayum were treated as an important source of food for humans. However, recent studies have largely changed this view. According to R. Phillips *et al.*, domesticated grains were not extensively used in the Fayum (Phillips *et al.*, 2016b: 12). Moreover, they were adopted rather late, probably in the 5th millennium BC. Although Shirai (2017) has suggested that cereals could have been introduced earlier, in the early or middle 6th millennium BC, due to its experimental character, early cultivation is not well recognised. In both cases, the initially minor role of domesticated crops in the human diet may have helped avoid scheduling conflicts with pottery production. In the Fayum area, crops were sown after summer inundations, probably in lake basins. The growing season coincided with the cold and humid winter (November – April). As this part of the year was unfavourable for pottery production, scheduling conflicts were minimised. Pottery production may have begun after harvesting – not only because of favourable climate conditions but also due to demand for storing grain in ceramic vessels (Table 4).

A similar situation is clearly visible in the case of domesticated animals. Although their bones in the Fayum are dated to the middle of the 6th millennium BC, V. Linseele *et al.* (2014) stress their unclear context. Studies conducted in the Fayum indicate that domesticates were only an addition to wild food (Phillipps *et al.*, 2016b: 12). Faunal analyses indicate the major importance of fish among groups that occupied the northern shores of Lake Qarun (99% of all identified faunal remains). On the basis of the predominance of adult/spawning fish, Linseele *et al.* have suggested that fishing was probably practised in the late summer months, namely August/September or slightly later (Linseele *et al.*, 2014; Phillips *et al.*, 2016b). Compared with fish, other wild animals did not constitute an important source of food for the Fayumians, while the quantity of their bones in the assemblages makes it reasonable to suggest that hunting was an opportunistic activity, practiced all year round (Linseele *et al.*, 2014).

Fishing, hunting and pottery production may have been practiced in the Fayum at the same time, namely in summer (Table 4). Currently, the available evidence is insufficient to determine the existence of a scheduling conflict between them. Since pottery was produced as and when necessary in places of extended stay during dry and warm periods, its simple technology and firing conditions

did not necessarily interfere with other activities, including, in particular, those related to food supply (fishing or hunting). A lack of scheduling conflicts between pottery production and other activities (including subsistence strategies) seems also likely in the case of the early occupation at Merimde and Sais. Mobility coupled with rich environmental resources available all year round, as well as the seasonality of various activities, allowed for the flexible organisation of pottery production during the Early Neolithic.

Domesticated plants and animals were also known to the inhabitants of Wadi Hof. However, the diet of the inhabitants of Wadi Hof was primarily based on fish, along with products supplied by domesticated animals. The richness of natural resources in Wadi Hof and in its vicinity, as well as the probably permanent human presence, made it possible to organise pottery production in a manner preventing possible scheduling conflicts with important subsistence strategies. Assuming that crop farming was linked to the Nile floods, it was of a seasonal nature (took place mostly after floods and during winter). In addition, it was at a rather early stage of development. As such, it probably did not create any conflicts with pottery production.

Probably in the 5th millennium BC, the Nile Delta saw a reduction in the mobility of human groups, accompanied by a more stabilised settlement activity. Both processes may have been linked to the growing importance of domesticated plants and animals as food resources. Remains from Merimde show that, during the 5th millennium BC, farming and breeding became important subsistence strategies. Although fish are still present in faunal assemblages, their relative proportions are far lower than those recorded earlier. Pigs begin to appear among domesticated animals, which, according to Linseele *et al.* (2014), is a discernible marker of reduced mobility among Neolithic communities. Such a reduction in mobility may have had a positive effect on the development of pottery production. Pots may have been formed and fired as and when needed in a given household, rather than only in periods of extended stay in one location. Scheduling conflicts with farming, herding, or other activities followed by sedentary groups, may have been resolved by a division of labour. Arnold suggests pottery production could have been easily introduced as an additional activity for women, as they were closely attached to households because of pregnancy, infant care, and other tasks (Arnold, 1989: 100-102).

Demand

In the Fayumian culture, pottery may have served a number of functions, from storage to processing, to cooking and serving, and through to transport. Before the introduction of domesticated grains, ceramic vessels may have been used for processing 'wild' foods. P. Jordan and M. Zvelebil, as well as P. Rice suggest that

in non-farming communities pottery introduction and adoption was best suited to aquatic zones owing to the abundance of foods, including both aquatic fauna (fish, water mammals, birds), as well as wild plants (Jordan & Zvelebil, 2010: 58; Rice, 1999: 21). Ceramic vessels made it possible to use these resources efficiently for both storage and processing. The introduction of domesticated plants and the growing importance of domesticated animals surely extended the range of uses and functions of ceramic vessels.

The prevalence of open forms and simple shapes in the early Neolithic promoted using the same vessels for multiple purposes (Table 3) (Mączyńska, 2017). Owing to their reduced permeability, vessels with slip and burnishing may have been additionally used for the storage of liquids. Ceramic containers were in common use and people relied on them, both in transit and during longer stays in a given location. Both portable pots and 'site furniture' were also in use. In places of extended stay, potters manufactured vessels that were immediately necessary, but also due to their breakage. When it comes to large storage vessels, the situation may have been different, as such vessels were not carried from one place to another. Instead, they were used for the storage of grain. The demand for these vessels appeared probably after the harvest when grain had to be properly stored.

The variety of vessel forms known from Merimde and el-Omari settlements, coupled with the lack of detailed data concerning their function, renders it impossible to precisely analyse the effect of demand on pottery production. As in the Fayumian culture, they may have been used for a number of activities (food storage, preparation, serving or transport). Particularly remarkable are the cord marks recorded by Emmitt on Merimde pottery, formed during vessel transport (Emmitt, 2017: 221). Other interesting observations have been provided by the Sais site. While its chronology is similar to that of Merimde, unlike in Merimde I, most burnished ware items recorded in Sais are closed forms. The difference may be linked to the key function of the site, namely a fish-catching station.

The production of clay vessels during the Neolithic period in Lower Egypt changed from a seasonal activity pursued between transits to a permanent activity. In both cases, production was not routinised and output was regulated by demand. People probably made vessels to cater for their own needs. Changes in the organisation of pottery making resulted from the reduction of human mobility and the emergence of permanent settlements, as well as from an increase in the importance of farming and herding. The technological and typological development of pottery also took place at this time. Next to simple shapes known from the Fayum or Merimde, new forms emerged. The number of closed forms used to store a variety of products increased. The dominance of vessels with flat bases, ensuring greater stability on flat surfaces, such as household floors could be observed. A greater variety can also be seen among surface treatments,

although their quality in some cases decreases, perhaps due to a declining importance of decorative functions. The ceramic assemblages also indicate an increase in potters' skills during firing. The ability to control oxygen made it possible to obtain a range of different surface colours. In the last phase of the Merimde settlement, pottery decorated with various motifs and techniques appeared. Although it is impossible to understand meaning of decoration in this context, the presence of this new feature of the Neolithic pottery may also indicate its additional non-utilitarian function, which may have emerged during the development of the Neolithic communities (Rice, 2005: 266-272).

6.2. Middle Holocene pottery production of the central and northern part of the Western Desert

6.2.1. The stages of pottery production

Procurement and preparation of raw materials (clay, tempers)

In the Western Desert, pottery was produced using both clay and tempers available locally, although precise data on the location of clay deposits is not available. Only in the case of the Dakhleh or Farafra oases, has detailed research indicated sources located within the given oasis, although the use of other deposits is not excluded either (Eccleston, 2002; Muntoni & Gatto, 2014: 456; Warfe, 2018: 61-73). Local or oasis origin is also suggested for Djara pottery (Riemer & Schönfeld, 2010)

Tempers added intentionally to clay include mostly quartz, shale and organic temper in the form of straw or other plant remains, as well as seeds of different sizes. At the Dakhleh Oasis, gypsum (anhydrite) was recorded and in the Late Djara B sherds, limestone grit. In addition, some vessels were also made of naturally tempered or untempered clay (e.g. Abu Tartur and Farafra Oasis). The surprising lack of shale temper in the pottery from the Farafra Oasis is explained by the absence of shale deposits in the oasis (Muntoni & Gatto, 2014).

Forming vessels and pre-firing treatments

Undecorated thin-walled vessels were made by hand of coils. Vessel walls are narrow, ranging from 3 to 7 mm. Surface colours are dominated by different tones of brown, although vessels with red or gray surfaces have also been found. Vessel surfaces are smoothed, although rough surface vessels are known in this context. Slip and burnishing have been recorded on some sherds too. Differences in surface treatments are visible among various sites. On the Abu Muhariq Plateau, most sherds have burnished surfaces (18 out of 38 sherds). Rough sherds are less numerous (8 out of 28 sherds). Although a red coating has also been recorded, this sherd group is the least numerous (2 out of 38 sherds) and is linked to the Late Djara B and the Bashendi B cultural units (Riemer & Schönfeld, 2010: 731-734; 750; fig. 7c). For the Dakhleh Oasis, A. Warfe suggests that most sherds have

plain, compacted surfaces (Warfe, 2018: 54-57). While coating appeared during the Bashendi B period, it was rarely used for vessel surface finishing. Warfe also noted a considerable investment of labour in finishing the Bashendi pottery, visible in the symmetry of vessel forms, straight rims, smooth and even surfaces and uniform wall thickness (Warfe, 2018: 52).

When it comes to Farafra pottery, surface treatment is difficult to identify because sherds are either completely or partially abraded. Only in the case of a single potsherd from the Hidden Valley were traces of smoothing on the external and internal surfaces recognised (Muntoni & Gatto, 2014). It is worth mentioning the presence of blackened rims in a few locations on the Abu Muharque Plateau and in the Dakhleh Oasis.

Firing

Vessels were probably fired in an open fire, as implied by their non-uniform colouration and numerous dark grey or black fire stains on the surface (e.g. the Abu Muhariq Plateau) (Riemer & Schönfeld, 2010: 740). Moreover, the low hardness of some sherds of the Late Djara B culture may indicate low-temperature firing (Riemer & Schönfeld, 2010: 730-731). Some Bashendi B vessels were fired at low temperatures, which made them fragile. Detailed studies on the pottery from the Farafra show that vessels were fired in a semi-controlled oxidizing atmosphere at a maximum temperature of 700°C (Muntoni & Gatto, 2014).

Forms

Given the small number of sherds recorded at the desert sites, vessel reconstruction was possible only in a few cases. Undecorated thin-walled pottery is dominated by simple forms, namely open bowls, open bowls with straight walls, hemispherical bowls, and deep restricted vessels (Fig. 7). Although most vessels have rounded rims, some pointed and flat rims have also been found. Pots have rounded or pointed bases, are rather small, with their rim diameters ranging from 10 to 20 cm. One's attention is drawn to the thin walls of vessels requiring specialised skills from potters during forming and shaping.

Decoration

The pottery of the Bifacial technocomplex is not decorated. However, at some sites dated to the Middle Holocene period, decorated imported pottery was found next to undecorated local vessels (e.g. Mudpans, Eastpans, Dakhleh Oasis). Sherds with a characteristic elaborate decoration are typical for the southern part of the Western Desert for the Khartoum-style technocomplex. In the northern part of the Western Desert, Khartoum-style vessels or sherds are treated as imports which appeared in the region due to the mobile way of life of hunter-

gatherers and herders and the mingling of ideas (Warfe, 2018: 75). In the opinion of K. Kindermann and H. Riemer, the undecorated pottery of the northern tradition derives from Khartoum-style pottery (Kindermann & Riemer, in press).

The only exception of probably local decoration is known from the Eastern Desert. An incised herringbone pattern was recorded on one sherd from Sodmein Cave. The decorated fragment belonged to a hole-mouth jar, probably with a diameter of approximately 18 cm. Its inner and outer surfaces are red and burnished (Fig. 7:8).

6.2.2. The organisation and development of pottery production in the central and northern part of the Western Desert

Resources

The exact location of deposits from which clay or tempers for pottery making were sourced cannot be possibly determined. Herders who made and used ceramic vessels probably had a fairly thorough knowledge of the environment within which they operated seasonally. The knowledge of places offering essential raw materials (including those for making tools, such as lithics and pottery) helped them survive in the challenging conditions of a savannah environment. Clay and temper deposits were probably located in the vicinity of vessel-making sites. However, in the eastern Sahara where mobile groups travelled, the distance to raw material sources may have been greater, extending beyond the confines delineated for sedentary groups (Arnold, 1989: 50). In the opinion of Kelley, the maximum distance that hunter-gatherers could walk per day was 20-30 km (Kelley, 1995: 133). Raw material sources were probably located within such distances. Only in the case of the Dakhleh or Farafra oases, have sources located within the oasis been pointed out.

The undecorated thin-walled pottery from the eastern Sahara is not homogeneous in terms of fabric. Although Riemer and Schönfeld (2010) identified three different fabrics for the Late Djara B culture, they noted that most recorded sherds do not fit well into these categories and exhibit a mixture of a few of them. A parallel situation can be observed in the Dakhleh Oasis (Warfe, 2018: 52-54). The variety of recorded fabrics of which the vessels were made may be the result of different pottery production sites and different raw material sources.

Apart from clay and tempers, two other important raw materials were necessary for pottery production, namely water and firing fuel (Arnold, 1989: 53-54). Although the climate in the eastern Sahara in the Middle Holocene was milder than today, access to water sources was not equally simple in all locations. The presence of artesian springs in oases encouraged people to set up production sites in their vicinity. A lack or limited availability of water could render pottery production difficult or simply impossible. In the northern part of the Abu Muhariq Plateau, long

distances between water sources (more than a day's walk) were the reason for the scarcity of pottery in the area (Riemer & Schönfeld, 2010: 752-753).

Vessel firing was an important stage in pottery production. The fuel necessary to sustain a high firing temperature was most plentiful in places with a permanent water presence. In the Farafra Oasis in the Hidden Valley, a large palaeobotanical sample with 30 different taxa has been identified. Acacia and tamarisk trees, found there in large quantities, may have been used during firing (Lucarini, 2014).

Weather and climate

In the Middle Holocene period, the southern part of Egypt was under the influence of monsoonal summer rains, while its northern part was dominated by a winter rain regime. It has been commonly accepted that the annual rainfall for the eastern Sahara during the Middle Holocene ranged between 50 and 100 mm (Kuper & Kröplin, 2006). Rainy seasons were separated by dry periods during which people may have faced difficulties in accessing water. Furthermore, average temperatures in the eastern Sahara grew in the Middle Holocene. Although the evaporation rate did not exceed 3 mm annually in winter, in summer it even tripled due to high temperatures (Neumann, 1989; Riemer, 2006).

Although summer monsoons and (to some extent) winter rains were of key importance for a human presence in the desert, rainy weather may have had a negative influence on pottery production. The way production was organised (including, in particular, the timing of vessel shaping, drying, and firing) had to take precipitation and related humidity into account. In dry periods, herders moved to places ensuring permanent access to water. Given the favourable conditions for pottery making offered by oases (including access to the necessary raw materials), it seems that they were the best place for potters in the summer period. Since they were regularly visited by mobile groups, it was in the oases that herders could seasonally make vessels in periods when high temperatures and limited access to water made it difficult to stay elsewhere (Table 4).The negative influences of the summer monsoons could be minimised by high temperatures, which allowed vessels to dry more rapidly (Kindermann & Bubenzer, 2007: 29).

However, it should be emphasised that a lack of water, or difficult access to it, could have been factors to the limiting, or even abandonment of pottery making in areas without access to other resources or favourable climatic conditions.

Degree of sedentariness and scheduling conflicts

Desert groups who made and used pottery were highly mobile, which was a form of adaptation to unstable conditions prevailing in this area in the Holocene humid phase. Mobility made their presence in the savannah possible by offering access to a variety of resources, such as water, wild animals, and plants availa-

ble in various locations. Movements in search of food, water and various plant and animal resources took place in the winter season when transient reservoirs formed after rainfalls. Lower temperatures also favoured mobility during winter seasons, as people and animals were able to walk greater distances with little or no need for replenishing water. In dry seasons, water sources outside oases and large reservoirs became limited, and vegetation and pasture for herds shrank rapidly. Oases and other places with access to water attracted human groups from various directions (Riemer 2009; Riemer *et al.*, 2013). Dry seasons were the right time for pottery making, as the production technology (e.g. drying before firing) required a prolonged stay in one location (Eerkens, 2001: 7-8; 2008: 309-310). Pottery production organised in this way could be successfully adapted to the mobile way of life and to subsistence strategies followed by desert groups, without causing any scheduling conflicts. The limited scale of pottery making also allowed one to avoid scheduling conflicts (Table 4) (Arnold, 1989).

The emergence of undecorated thin-walled pottery in the area of the central oases in the late 6th and 5th millenniums BC may be linked to the increase in sedentism observed at sites as suggested by M. McDonald for the Late Bashendi A groups who started to use and probably produce ceramic vessels (McDonald, 2009: 26). Conducive conditions and extended stays in one location favoured pottery adaptation (see also Warfe, 2018: 75). Despite the fact that the Bashendi B people had returned to a mobile lifestyle, they continued to make and use undecorated thin-walled pottery. This situation fits well with the observations J. Eerkens made during a study on the relationship between mobility and pottery production (Eerkens, 2008: 319). In his opinion, once pottery had begun to be used by mobile groups, pottery production would have been continued and would no longer have been affected by the mobile way of life.

The presence of low-fired pottery among the Bashendi B assemblages could be also treated as an attempt at minimising the mismatch between pottery production and mobility (Gibbs, 2012). Local potters made vessels that either had a short use-life or were simply disposable, paying far less attention to their durability or longevity. Vessels could be made even during short stays, in cold and humid periods while the production process itself could be short, with little preparation of raw materials and no special tools. Likewise, the drying and firing processes could be reduced to the bare minimum. The outcome would be 'ugly' low-fired pots, discarded after use rather than transported to the next stopover.

Demand

Limited size of assemblages is a particular feature of pottery from the Western Desert. On the basis of research on the ceramic assemblages from the Dakhleh Oasis, taking into account the number of recorded sherds and temporal spans

of Dakhleh cultural units, Warfe suggested that, on average, the Bashedni A people made one vessel every 35 years and their descendents – the Bashedni B people – a vessel every 11 years (Warfe, 2018: 52). The quantity of sherds recorded at sites is low, which may result from production limitations or from the fact that vessels were cumbersome to transport. Although the fragility of pottery and the ensuing high breakage rates during movement did not favour vessel transport during seasonal movements, it did not preclude it altogether either. The problem of vessel transport may have been solved by caching pots in regular stopover locations along seasonal movement routes (Eerkens, 2008: 313). Clay vessels may have remained in places where people stayed for longer periods of time or to those which they frequently returned. Unfortunately, no evidence from the Western Desert linked to the Bifacial technocomplex has been found so far in support of the above assumption. The production of short use-life vessels as observed in the Dakhleh Oasis could also have helped avoid problems with pottery transport (Gibbs, 2012; Warfe, 2018: 76).

The number of clay vessels used by desert groups may have also reflected the demand for, and the functions of such vessels. In this part of the eastern Sahara, undecorated thin-walled pottery emerged simultaneously with the introduction of domesticated animals. Its function may have been linked to new food resources. Despite the greater presence of domesticated animals at sites, wild animals continued to be one of the major components of Middle Holocene faunal assemblages in this region. In the opinion of Riemer, herding could have been incorporated in the traditional hunting subsistence strategy, while domesticated animals played a minor role in the 6th millennium BC (Riemer, 2009: 132). Ceramic vessels seem to be well suited for dairy processing, which allowed herders with lactose intolerance to consume milk products. The earliest traces of dairying were recorded in clay vessels used by fully pastoral groups in the Libyan Sahara in ca. 5,200 BC (Dunne *et al.*, 2018). Ceramic containers could also have been used to process dairy products on a small scale at the end of Holocene humid phase in the Western Desert. The limited number of vessels could reflect a minor role played by dairy products in the local diet and subsistence practices. With a limited demand and high production requirements, people may have preferred to use containers made of other materials, as they were simpler to produce and could even be made in transit.

Last but not least, it cannot be precluded that pottery had some sort of symbolic meaning, as suggested by B. Hayden (1995) or Rice (1999). Pottery could have been a prestige technology available to a limited number of users, thus denoting their special social status (Warfe, 2018: 76). Moreover, Warfe has suggested that efforts invested in pottery production in the Bashendi cultural units extended beyond requirements for water containers (Warfe, 2018: 52).

6.3. Pottery Neolithic pottery production in the southern Levant

6.3.1. The stages of pottery production

Procurement and preparation of raw materials (clay, tempers)

All Pottery Neolithic cultures of the southern Levant used locally available raw materials. Clays and tempers were sourced from locations distributed around the sites at various distances, not exceeding 10 km. Differences in the location of clay deposits can be seen, both among the cultures of this period and among sites belonging to the same cultural unit. Most pastes used by the Yarmukians were made of calcareous clays (Vieugué *et al.*, 2016: 99). During the Lodian period, new local raw materials were introduced, probably because of their superior quality and the increase in potters' skills. At Nahal Zehora II, a terra rosa clay was used for the production of vessels, although its deposits were further (about 10 km) from the site than alluvial clays used there during the Yarmukian period. Terra rosa was mixed with locally available rendzina. In addition, Wadi Rabah pottery production was based only on the use of locally occurring rendzina clay, easily accessible and easy to form even without tempers.

During the Pottery Neolithic, a wide range of tempers such as chalk, sand, crushed calcite, straw, basalt, grog and flint chalk, as well as organic temper, were added to the clay. Their choice depended both on the location of their sources and on the preferences of manufacturers and users, which may have changed over time.

Forming vessels and pre-firing treatments

Vessel forming techniques used by the Yarmukian and Lodian cultures do not differ from each other. Vessels were made by hand of coils or slabs, although the former technique was used less frequently than the latter during the Lodian period. At some sites of the Wadi Rabah, coiling was the only technique used to form vessels. In the Yarmukian, Lodian and Wadi Rabah assemblages, traces of using moulds have also been reported. Numerous mat imprints on Yarmukian and Wadi Rabah pottery indicate that mats were also used for vessel forming. Traces of the pinching and drawing method have been recorded so far only on Wadi Rabah pottery. In the context of this culture, the use of a tournette, in the form of a stone mould or a reed mat, has also been suggested. The internal walls of some vessels show traces of wiping and smoothing using grass or straw.

Potters possessed the appropriate knowledge and skills to make vessels of various sizes with different wall thicknesses. Pottery Neolithic assemblages include small diameter thin-walled vessels (both bowls and jars), as well as large storage vessels, ten to twenty times larger than the smallest pots (Garfinkel, 1999: 37). Vessel wall thickness depended on vessel size. Although vessel surface colouration depended on the type of clay used, throughout the entire Pottery Neolithic a preference for light brown/ beige, orange or pink or yellowish white is clearly visible.

On Pottery Neolithic pottery, different surface treatments have been identified, such as smoothing, slip covering, burnishing, plain burnishing and roughening (including honeycomb roughening). Pottery without any surface treatment has also been found. Differences in the relative proportions of the different surface treatments are visible both among cultures and among sites representing the same culture. The first vessels with slip-covered surfaces (red and pale) emerged at the beginning of the Pottery Neolithic. Burnishing is present on slip-covered vessels, as well as on plain or self-slipped vessels. Plain burnishing is considered to be a purely Yarmukian phenomenon. Surface treatments typical for the Lodian culture include burnishing over painted elements. Nizzanim and Qatifian pottery assemblages are of low quality and are coarse, heavy, crumbly, and crudely fashioned. Among all Pottery Neolithic cultures, only the Wadi Rabah stands out for its high burnishing quality. Slip (red, orange, brown, dark brown, grey and black) and burnishing occur over large parts of the vessel surface, or even cover the entire vessel. Vessels with slip and burnishing account for most of the assemblages from a number of sites (Ein el-Jarba – 71%; Nahal Zehora II – 56%; Munhata 2A – 86.4%). Moreover, plain burnishing and honeycomb roughening are absent from Wadi Rabah assemblages.

Firing

Yarmukian and the Lodian vessels were fired in an oxidising atmosphere, with potters probably having been capable of controlling it. However, pottery suggesting a relatively high level of firing atmosphere control is accompanied by fragments displaying a low level of such control. In the Wadi Rabah period, firing was well controlled, probably in kilns that could create both an oxidising and reducing atmosphere.

Forms

The Yarmukian and Lodian ceramic assemblages are characteristic for a large quantity of similar open and closed forms. Open vessels include small and medium-sized truncated bowls, small and large chalices, pots, basins, and pithoi (Figs. 8:2-4, 6; 9:4, 6, 8). Closed vessels feature jars of various sizes with a globular body, a long vertical neck and a simple rim with two lug handles (Sha'ar Hagolan jars), jars with a globular body, a short vertical neck and a simple rim (Jericho IX jars), hole-mouth jars and large jars with an ovoid body, a wide flat base and an S-shaped profile. Despite the typological similarity of these two cultures, some differences can also be discerned in their respective assemblages. The Yarmukian culture is characterised by the so-called Sha'ar Hagolan jar (Fig. 8:5, 7-8). Although their number clearly declines in Lodian assemblages, instead, inclined-neck jars with a globular or oval body and an indentation or ridge between the

neck and the shoulder, known as Lodian jars, become more plentiful (Fig. 9:3, 5). Another vessel type, known as the Jericho IX jar, is referred to as a characteristic feature of the Lodian ceramic assemblage. It is a medium-sized vessel with handles and a low neck, either straight or slightly everted outwards. However, according to some researchers, this vessel type should be linked to the Yarmukian culture, as it has a number of archaic features (Gopher & Blockman, 2004: 15). Other characteristic Lodian elements include cylindrical handles.

The relative proportions of particular vessel forms vary from site to site. Vessels used for serving and consuming food, including, in particular, bowls of different sizes and shapes, are the largest group of early Pottery Neolithic assemblages. However, as regards the other vessel forms, differences exist between sites and cultures. At the Yarmukian sites of Sha'ar Hagolan, Munhata and Nahal Zippori 3, the second largest group are large pithoi used for long-term storage. On the other hand, at Nahal Zehora II, in layers dated to the Yarmukian, bowls are followed by kraters and hole-mouth jars. In the Lodian assemblages, open forms, including bowls, continued to dominate, while the second most numerous group consisted of jars used for short-term storage (Nahal Zehora II, Yesdot). Hole-mouth jars constituted about 10% of all forms. In the younger part of the Pottery Neolithic, vessel forms underwent considerable changes. The Wadi Rabah culture is characterised by a sharp carination between the neck and the body and/or between the shoulder and the lower part of vessel, near the base, and a carefully formed rim. Typical vessels include carinated, S-shaped or V-shaped bowls, pedestaled bowls, mini bowls, jars with bow-rims, flaring rims, or collard jars, tabular stands, pithoi with thumb-impressed ledge handles and hole-mouth jars. Churns, spouted bowls, and spouted kraters appeared for the first time. Bowls of various shapes and sizes and hole-mouth jars are the most numerous group of Wadi Rabah ceramic assemblages from most known sites, while jars, including bow-rim jars, do not account for more than 10%. The Pottery Neolithic sites of the Nizzanim variant and the Qatifian culture exhibit little variety of shapes while their ceramic assemblages are dominated by hole-mouth jars and bowls of various shapes and sizes.

Decoration

Richly incised and painted decoration makes the Pottery Neolithic pottery distinguishable. It is present on 10 to 25% of all Yarmukian vessels, both on bowls (conical shapes and deep bowls with a slightly restricted orifice) and on tall handled jars. Incised motifs include, first of all, horizontal lines located below the rim or on the neck, zigzag lines and herringbone patterns on the body in a variety of arrangements (Fig. 8:2-3, 8). They are sometimes accompanied by painted decoration. The paint was applied all over the non-incised surface or only on a part

thereof. Sometimes, only a small space adjacent to, or around incisions is painted. Moreover, painted decoration in the form of triangles, zigzags, and lines in various arrangements have also been identified (Fig. 8:7). Rich decoration also covers Lodian pottery. Lodian painted motifs include triangles, lozenges, and zigzags (Fig. 9:1, 4). Some of them are made of thin or wide parallel lines. Painted and burnished narrow or wide red/brown lines were applied on a creamy/whitish slip on cups, deep bowls, hemispherical bowls, as well as necked jars. Another unique design feature of the Lodian culture is well-burnished and lustrous paint. Incised motifs are rarely identified at Lodian sites (herringbone patterns inside a frame or frames of parallel lines) (Fig. 9:6).

Compared with Yarmukian and Lodian pottery decoration, the assemblages of the Wadi Rabah show an increase in the range of decorative motifs and techniques and a shift towards simpler decorative motifs. Burnished slip, generally considered to be a form of decoration on Wadi Rabah pottery, is accompanied by painted, incised and combed patterns. Painted horizontal lines are present on the inside or the outside of the rim or (less frequently) on the body, in the form of horizontal lines, parallel lines, semi-circles, triangles or net patterns. Incised motifs include net and herringbone bands. Although combed decoration takes the form of wavy line motifs, this technique could also be used to form herringbone patterns and zigzags (Fig. 10:1-3). Wadi Rabah pottery also features impressed decoration made using a comb or a round/triangular stylus. They take a variety of forms, including dense puncturing, round or triangular impressions, lunar-shaped impressions or roulette impressions. Equally remarkable is plastic decoration in the form of pendants or figural representations. Moreover, knobs may be considered as a decorative form present on Pottery Neolithic ceramic materials.

6.3.2. The organisation and development of pottery production in the Pottery Neolithic southern Levant

Resources

All Pottery Neolithic cultural units used local resources. Deposits of clays and temper sources were located near the sites, within a radius of approximately 10 km from the production site. The distance to raw material sources may have been one of the important factors taken into account when choosing clay (e.g. at Yesdot). Clay quality may have been another criterion also used in the selection process (e.g. at Nahal Zehora II).

Other raw materials, such as water and fuel, were probably easily available in the vicinity of the sites of the Pottery Neolithic. As they were located in the Mediterranean zone, along the Rift Valley, in the coastal plain, as well as on the edges of major alluvial valleys, all these sites enjoyed convenient access to water, farmland, and pasture.

Weather and climate

The Holocene epoch brought warmer and more humid conditions to the southern Levant. These conditions were treated as factors exerting a major influence on the economic and socio-cultural transformations during the Neolithic period in the southern Levant, namely an increase in sedentism, as well as the emergence and spread of new subsistence strategies that relied on domesticated plants and animals (Borrell *et al.*, 2015; Rosen & Rosen, 2017). The 8.2 kiloyear BP cold event, which apparently caused drier and cooler conditions in the southern Levant, has often been linked to the changes that took place between the Pre-Pottery Neolithic and the Pottery Neolithic. However, warmer and wetter conditions returned to the southern Levant, where Pottery Neolithic communities of a unique nature were formed throughout the 7th and 6th millenniums BC. Favourable climatic conditions prevailing in the Middle Holocene period, in combination with the occupation of the rich Mediterranean zone, caused it to stabilise settlement activity. Permanent settlements with access to water, farmland, and pasture together with numerous raw materials in the vicinity allowed Pottery Neolithic societies to develop.

Although pottery production first appeared in the PPNB, it flourished during the Pottery Neolithic, when clay pots became common utensils typically used in many activities during the period in question. Relatively warm conditions were conducive to pottery production all year round (Table 4). Possible negative impacts of rain and humidity could be minimised by stable settlement patterns and the possibilities offered by it.

Degree of sedentariness

The Pottery Neolithic societies of the southern Levant were sedentary. Settlements may have been inhabited permanently or seasonally, with the differences in their size denoting a kind of hierarchy in the settlement system with small farmsteads, larger villages, and mega sites. Most of the Pottery Neolithic sites are small and transitory. However, some sites ('Ain Ghazal, Sha'ar Hagolan, Jericho) revealed a much more sophisticated spatial organisation of the settlement. The stable settlement pattern of the Pottery Neolithic communities surely allowed for organising pottery production in a manner addressing all its constituent stages, from raw material procurement over to vessel firing. Unlike farming communities, mobile pastoral groups who occupied the southern desert areas in the Pottery Neolithic did not make ceramic containers.

Scheduling conflicts

Pottery Neolithic groups relied on domesticated grains and pulses, as well as on secondary products of domesticated or tamed sheep, goats, pigs, and cattle.

The importance of hunting decreased during this period, which is clearly visible in the typology and frequencies of projectile points in the Pottery Neolithic assemblages. Moreover, in the later part of the Pottery Neolithic, Wadi Rabah groups reached beyond the basic food products offered by domesticated plants and animals. The production of dairy products and the intensive use of olives are suggested for the second part of the Pottery Neolithic. Since clay pots could be produced all year round, their production could interfere with other activities, particularly those relating to the procurement and production of food, such as farming and breeding (Arnold, 1989: 99-108). Scheduling conflicts between pottery production and subsistence strategies in the Pottery Neolithic could have been avoided due to appropriate social organisation. The mega sites like Sha'ar Hagolan or 'Ain Ghazal are characterised by a sophisticated spatial organisation and are notable for their building complexes incorporating numerous rooms arranged around courtyards. Such compounds may have been inhabited by extended families consisting of several nuclear families (Garfinkel & Ben-Shlomo, 2009: 67-84; Banning, 2010: 73-74; Gibbs & Banning, 2013: 365-357). Moreover, the courtyards connecting households could have been a place of various activities for those living in the compound, including pottery making (Garfinkel & Ben-Shlomo, 2009: 76-77). Extended families inhabiting the compounds had access to large labour forces, allowing for the distribution of various activities among its members (see also Kadowaki, 2012: 19-21). Arnold suggests a gender-based division of labour, consisting of allocating pottery making to one gender (mostly to women) as one of the ways to avoid scheduling conflicts (Arnold, 1989: 100-101). In his opinion, female potters were able to combine pottery production alongside other household activities and with the demands of pregnancy and infant/child care. However, according to J. Peterson, the archaeological evidence does not indicate that Neolithic societies in the southern Levant were organised in terms of gender (Peterson, 2010: 260). Her analyses show that both males and females were engaged in different activities. However, the same researcher admitted that one of the reasons for the emergence of large households in the Pottery Neolithic could be the challenges of the timing and pace of farming activities (Peterson, 2010: 260).

The emergence of specialisation of pottery production could also have reduced scheduling conflicts between subsistence activities and pottery production (Arnold, 1989: 107). According to S. Kerner, the Pottery Neolithic was characterised by household production (Kerner, 2010: 187-189). Vessels were made in households from locally available raw materials, in a simple way, as and when needed. A low level of specialisation in pottery production first appeared during the Wadi Rabah culture (local and non-local raw materials, a more expansive repertoire of vessels, use of tournettes/mats, high burnishing quality). At the same time, the first traces of specialisation appeared in agriculture (dairy production,

intensive use of olives), and lithic production. Exchange processes also became intensified. All these changes were part of more complex social and economic processes that took place in the Pottery Neolithic community. Thus, the emergence of specialists in different fields, including pottery production allowed one to avoid scheduling conflicts.

Demand

The pottery of the Pottery Neolithic had a utilitarian character and was used mostly for storing, transporting, cooking and consuming foods. Clay vessels used at sites formed a typical set of kitchen utensils, although its composition differed between sites and cultures. Detailed analyses sometimes show large differences in the relative amounts of particular vessel types in different assemblages. Such sets of kitchen utensils may indicate different dietary habits and practices and may be the reflect differences in demand. At the Yarmukian sites of Sha'ar Hagolan, Munhata and Nahal Zippori 3, large pithoi used for long-term storage are the second largest group of vessels, outnumbered only by bowls. A different situation was recorded at Nahal Zehora II, where vessels of this type represent only 1.4% of all vessels in the Yarmukian layers, indicating a lower importance of long-term storage and thus little demand for such vessels or perhaps other, alternative ways of storage that were not identified among the remains. In addition, differences in the quantities of hole-mouth jars, small and medium jars or kraters at Yarmukian and Lodian sites may be related to other ways of food cooking and storage.

Significant changes in relation to Yarmukian and Lodian pottery are visible in the Wadi Rabah assemblages (technology, surface treatment, shapes, and decoration). In the opinion of Gopher, it was during the Wadi Rabah period that the final stage of the second Neolithic revolution took place, involving adaptation of the full agricultural package (Gopher, 2012c: 1577). New forms could be a response to new demand. Thus, the emergence of churns has been linked to the beginning of dairy production in the period in question (Gopher & Gophna, 1993: 334).

Particularly remarkable among the Pottery Neolithic ceramics is decorated pottery, which constitutes up to 25% of the whole assemblage. For Kerner, decorated Pottery Neolithic ceramics forms a group of special vessels occurring in small quantities and requiring considerable time and effort for production (Kerner, 2010: 188). According to Kerner, the interpretation of decorative vessels goes beyond their utilitarian meaning. The lack of use marks on decorated pottery does not make its interpretation any easier. Gopher and Goren consider decorated pottery to be a continuation of the production of symbolic objects (figurines, beads) using plaster technology (Gopher & Goren, 1998: 224). In addition, E. Orrelle and A. Gopher (2000) suggest non-utilitarian functions for decoration on Yarmukian pottery and link it to gender roles. The elaborate decoration on

Yarmukian and Lodian vessels may be a response to the demand for symbolic behaviours. However, J. Vieugué *et al.* (2016) position decorated pottery among differentiated functional groups and see it also as utilitarian.

Pottery decoration evolved in the Wadi Rabah period. Compared with those of the Yarmukian and Lodian cultures, the assemblages of the Wadi Rabah show an increase in the range of decorative motifs and techniques, and a shift towards simpler decorative motifs is noticeable. According to Gibbs (2013), changes in pottery decoration were a response to changes in the symbolic system of the Wadi Rabah culture. The emergence of new forms of decoration may have been associated with a demand for a more flexible symbolic system, which may have facilitated contacts and positively influenced social relationships.

6.4. A comparative analysis: Lower Egyptian Neolithic pottery vs. Pottery Neolithic pottery of the southern Levant

The similarities between the Lower Egyptian Neolithic pottery assemblages, on the one hand, and the Pottery Neolithic southern Levantine assemblages, on the other, used to be quite generally referred to as arguments in favour of the Levantine origin of Lower Egyptian ceramics. However, more detailed analyses show that, despite some similarities, the inventories of the two regions differ significantly (Table 5).

Although in both cases pottery production was at an early stage, the social and economic context in which vessels were produced and used was different in either region. In Lower Egypt, pottery production was an innovation introduced from outside and adapted to local conditions. In the case of the southern Levant, its emergence was connected with the development of human skills in pyrotechnology.

At first glance, both regions are linked by the use of local raw materials, simple forming methods and a simple firing process. However, these features are characteristic for the early pottery production of each (Rice, 1999). In Lower Egyptian pottery, one can notice a large variability in clays and tempers, probably related to the use of many different deposits of raw materials located in areas explored by partly mobile groups (e.g. the Fayumian and Merimde I cultures) (Emmitt, 2017). Meanwhile, the number and quality of clays used in the Pottery Neolithic is limited, which involved the use of deposits located near permanent settlements or production sites. In Lower Egypt, a similar situation is only visible during the later part of the Neolithic in the area of Wadi Hof, probably because of the stable settlement pattern enabled by the local rich ecological niche, reminiscent of the Pottery Neolithic occupation in the southern Levant.

The organisation of pottery production in both regions was influenced by various social, economic and environmental factors, of which lifestyle, subsistence strategies, and probably weather and climate, deserve special attention. Due to

the partly mobile way of life in Lower Egypt, pottery production was possible at extended stay sites ensuring access to water and other resources needed in the production process. Additionally, winter rains and cold and humid conditions occurring in the Middle Holocene period could have limited pottery production and caused it to have a seasonal character (Table 4).

The Pottery Neolithic groups of the southern Levant were sedentary, while pottery production probably took place throughout the year at or near their settlements. The stabilisation of settlement activity in places with access to water and various resources had a positive effect on how pottery production was organised. Vessel production was made easier by the warm climate of the Middle Holocene, while the possible negative impacts of wetter conditions could be minimised by locating pottery production inside extended households, more stable settlement structures, and technological adjustments.

Subsistence strategies also had a significant impact on the organisation of pottery production in the two regions concerned. Although domesticated plants and animals were known in both of them, their role differed. In Lower Egypt, domesticated animals and plants were initially only an addition to 'wild' food available in rich environmental niches. It seems that the flexible organisation of the Neolithic communities, apart from the richness, seasonality, and renewability of wild resources, allowed one to avoid scheduling conflicts between pottery production and subsistence strategies. During the later part of the Neolithic, after the stabilisation of the settlement pattern in Lower Egypt (large permanent settlements at Merimde and Wadi Hof), scheduling conflicts could have been reduced through the division of labour.

From the very beginning of the Pottery Neolithic, the Levantine communities relied on products supplied by agriculture and animal husbandry. Moreover, these subsistence strategies were continuously developing, which lead to the emergence of dairy production and the intensive use of olives at the end of the Pottery Neolithic. From the beginning of this period, the division of labour in large households may have helped avoid scheduling conflicts between pottery production, on the one hand, and farming and breeding, on the other. In some way, the initiation of a process of specialisation towards the end of the Pottery Neolithic could also be attributable to the need to minimise such conflicts.

To conclude, the organisation of pottery production in Lower Egypt and the southern Levant shows more differences than similarities. The differences are more visible at the beginning of the Neolithic period, while the similarities begin to emerge in the later part of the period. During the 6th millennium BC, communities in both regions were at different stages of socio-economic development. Although in Lower Egypt, pottery had been adapted to local conditions, it kept developing during the Neolithic period, which probably accompanied a reduc-

tion in mobility, stabilised settlement activity, the introduction of domesticated plant and animal species and their gradually increasing role. During the 5th millennium BC, ceramic vessels became common utensils used for many different activities. Although pottery was still produced in households, progress in forming techniques, surface treatments, vessel shapes, decoration, and firing is noticeable. It is during this period that parallels between Lower Egyptian and southern Levantine pottery production become more visible.

The southern Levantine communities underwent social, economic and symbolic transformation between the Pre-Pottery Neolithic and the Pottery Neolithic. However, their cultural development did not end with the beginning of the Pottery Neolithic. Throughout the period, Pottery Neolithic communities continued to evolve. The technology was being developed, also in the area of pottery production, which had first appeared already at the end of the Pre-Pottery Neolithic. Although the Yarmukian and Lodian cultures are mainly characterised by generalised, unspecialised production, their inventories are notable for the presence of vessels with elaborate decoration, requiring time and skills. Vessels of this type are present alongside simple, rough pottery. Such a dichotomy may indicate a faster technological advancement in the production of certain kinds of pottery, perhaps related to symbolic behaviours (Kerner, 2010: 188-189). The progress in pottery production visible in the Wadi Rabah assemblages (new forms, improvement in surface treatment techniques, the appearance of kilns, changes in decoration patterns, first traces of specialisation) results from the development of Pottery Neolithic communities affecting social, economic and symbolic systems alike.

The comparative analysis also included morphological features of pottery from both regions. Taking into account vessels forms and the set of shapes used on the northern shore of Lake Qarun or at Merimde, phase I is rather modest when compared with the assemblages of the Pottery Neolithic units from the southern Levant. Initially, Lower Egyptian sites (the Fayum, Merimde, phase I) featured a limited number of mostly open, simple forms serving multiple functions. However, younger assemblages show an increase in the variety of shapes and a growing number of closed forms (Merimde, phase II-III, el-Omari). These changes should be seen as a result of the development of pottery production technology, changes in demand and the increased importance of clay vessels as utensils for Neolithic society.

The variety of forms is clearly visible from the beginning of the Pottery Neolithic period. Although open forms continue to prevail (including, in particular, bowls of different sizes), jars already account for a significant percentage of the entire collection (approx. 15% in the Yarmukian culture). Clay vessels were important utensils used in many everyday activities of southern Levantine farmers.

Particular attention is required in the case of hole-mouth jars, an important part of Lower Egyptian and southern Levantine inventories. This type of vessel

can be found at all Neolithic sites in Lower Egypt. In phase I of Merimde, they represent 42.3% of all burnished forms and 21.1% of all smoothed forms. However, in the younger phases of the Merimde site, their number gradually decreases. Hole-mouth jars are also present at the sites of all cultures of the Pottery Neolithic in the southern Levant. Their percentages vary and range from 5 to over 33% in the first part of the Pottery Neolithic and from 10 to 40% during the Wadi Rabah culture (Gopher & Eyal, 2012a: table 11.5-6). Although they have been interpreted as cooking pots, traces of fire on these vessels are not always recorded. In both regions, this type includes vessels with smoothed or rough surfaces, used for preparing food, as well as burnished vessels covered with slip, which are likely to have been used for short-term storage. Their simple production method and use for various purposes probably contributed to their popularity, high demand and, consequently, their large quantities in the assemblages from both regions.

Another noteworthy form of clay vessels is seen in large storage jars. Large vessels used for storing grain have been found both in Lower Egypt and in the southern Levant. In Lower Egypt, these vessels are known from Kom W, Kom K and the Upper K Pits in the Fayum, where they had been placed in pits. A few large vessels of unknown shape, probably in pits, have also been recorded at the site of the el-Omari culture (Debono & Mortensen, 1990: 20) In the southern Levant, large pithoi, known from Yarmukian, Lodian and Wadi Rabah sites, were used to store cereals. At sites at Sha'ar Hagolan, Munhata and Nahal Zippori 3, they represent 27% of all vessels in the Yarmukian layers, although at other sites pithoi are less numerous (e.g. 1.4% at the Yarmukian site of Nahal Zehora II). These differences may indicate a different way of storage, or no need for it. It seems that alternative cereal storage techniques were also used in Lower Egypt. In the Fayum, Merimde and Wadi Hof, particularly remarkable are storage pits lined with basketry or with Nile silt (Debono & Mortensen, 1990; Wetterström, 1993: 212-214; Wendrich & Holdaway, 2017).

Parallels between inventories from both regions are also visible in surface treatment techniques. Slipping and burnishing is the dominant surface treatment in the early Lower Egyptian Neolithic. Although the amount of burnished pottery decreases over time, it still accounts for more than a half of the total assemblage. Slipped and burnished surfaces account for a significant proportion of the Yarmukian and Lodian assemblages, and for over a half of the Wadi Rabah assemblage. In both regions, changes in this surface treatment technique can be observed. At Merimde, throughout phases II and III, and at Wadi Hof, a decrease in the quality of burnishing was observed, while during the Wadi Rabah period, burnished surfaces are of very high quality and sometimes cover the entire vessel surface. The decrease in burnishing quality in Lower Egypt during the Neolithic may have been linked to the decrease in its importance as a decorative element. During the Wadi Rabah pe-

riod, the decorative character of slip and burnishing may have gained importance, especially during the 'birth' of household specialisation.

One of the most frequently mentioned similarities between Neolithic Lower Egyptian pottery and Pottery Neolithic pottery of the southern Levant is the herringbone pattern incised on the earliest Merimde pottery (Fig. 22). This has been linked to Yarmukian, Lodian and Wadi Rabah decoration patterns (Eiwanger, 1984:62; Shirai, 2010: 314; Streit, 2017). At Merimde, decorated pottery represents only a small part of the entire assemblage (2.3%) and stands out for its quality (untempered clay, red slip, and burnishing). The herringbone pattern is incised on the outer surface of closed vessels (hole-mouth jars), in the upper part of the vessel under a straight edge. In the Yarmukian culture, however, the herringbone pattern is part of a more elaborate decoration composed of other elements (Garfinkel, 1999: figs. 25, 41). Most often it is located in a narrow frame of two lines, which could be placed horizontally in the upper part of the vessel or formed a zigzag pattern around the vessel on its body (Fig. 8:2-3, 8). A similar type of decoration is also characteristic for Lodian pottery (Fig. 9:6) (Garfinkel, 1999: figs. 46; 61). A fragment with incised herringbone was also found at Nizzanim (Garfinkel, 1999: fig. 64:12). The herringbone pattern is also a characteristic element of Wadi Rabah decoration. However, the designs in which it appears are already simpler, while the herringbone itself is not placed in a frame and is twice as wide as in the Yarmukian or Lodian cultures (Fig. 10: 1-3; Garfinkel, 1999: fig. 90). The author agrees with the suggestion of Streit (2017) that, in terms of form, the herringbone pattern of Merimde I phase is more similar to Wadi Rabah decoration than to the Yarmoukian or Lodian herringbone pattern.

6.5. A comparative analysis: Lower Egyptian Neolithic pottery vs. undecorated thin-walled pottery

A careful look at pottery production in the Western Desert typical for the final part of the Holocene humid phase and Neolithic pottery production in Lower Egypt reveals a few similarities, attributable, first of all, to the parallel lifestyles and (to some extent) subsistence strategies particularly visible in the second half of the 6th millennium BC (Table 6).

Both in the desert and in Lower Egypt, pottery was made at extended stay sites, in response to the requirements of the production technology, such as access to raw materials and a sufficient amount of time required by the process (from raw material sourcing through to vessel firing). Although in both cases vessels were made of local materials, their diversity suggests reliance on multiple deposits within the group's movement area. Likewise, the diversity of tempers (both in the eastern Sahara and in Lower Egypt) may suggest that they came from different locations. In both cases, such a situation was probably linked to the groups' mobility within a well-known environment and to the use of various resources offered by it.

In the eastern Sahara, oases were the most likely production sites. Nevertheless, it is possible that pottery was also made in other locations ensuring easy access to water. The lack of water could have been a limiting factor in the production of vessels (e.g. in the northern part of the Abu Muhariq Plateau). Difficult access to water could also be the reason for the lack of ceramics in the areas north of the Farafra Oasis, despite the presence of mobile groups in this area during the Middle Holocene period. Given the importance of firing fuel for the production process, oases or locations with permanent water availability and the resulting vegetation provided convenient access to it.

Although the mobility of people in Lower Egypt in the second part of the 6th millennium was probably limited when compared with that of desert groups, Lower Egyptians nevertheless moved around exploring various environmental resources. Unlike desert groups, Neolithic people inhabited rich ecological niches with permanent access to water and its resources. Although pottery production inevitably involved extended presence in the same location, it could nevertheless take place in a few different places, as long as each of them ensured a rich environment and easy access to the necessary raw materials.

Pottery production both in the eastern Sahara and Lower Egypt depended heavily on weather and climate (Table 4). A human presence in the desert was made possible by the northward shift of the ITCZ and summer monsoonal rains. In the Middle Holocene period, the northern part of Egypt was within reach of Mediterranean rainfalls that supplied water to wadis and to areas located at greater distances from water reservoirs. While precipitation had a positive effect on the presence of vegetation and wild animals (thus enabling or facilitating human existence in both areas), it was rather unfavourable for pottery production, as it interfered with every single stage of the process. It seems that both in the desert and Lower Egypt, pottery production was a seasonal activity, practised not only in specific places but also at specific times of the year. In the desert, high temperatures and limited access to water in the summertime forced people to gather in the vicinity of reservoirs or springs (playas, ponds, wadis, oases) with easy access to a wide range of plants and animals. Such locations were favourable for pottery production, which was additionally facilitated by warm and dry weather and reduced mobility due to droughts and high temperatures. However, the production of low-fired vessels was also possible in less favourable weather conditions (e.g. the Dakhleh Oasis). Likewise, the summer (April – September) seems to have been the most convenient time for pottery making in Lower Egypt, allowing potters to avoid the negative impact of winter rains.

The mobility of human groups in the eastern Sahara and Lower Egypt resulted from their adaptation to the local environment. Hunting was the fundamental subsistence strategy of desert groups, supplemented by gathering wild plants and

herding domesticated animals. Longer stays in oases or other locations ensuring permanent access to water in hot and dry summers, when humans' and animals' mobility was reduced by the harsh climate, probably made it possible to combine a few different activities, involving both subsistence and tool-making. A similar situation may have been observed in Lower Egypt, where wild resources constituted a very important source of food despite the presence of domesticated animals already in the second part of the 6th millennium BC. Seasonal pottery production in places of extended stay did not necessarily cause any scheduling conflicts with other activities (including subsistence), as the surrounding area offered plentiful, predictable and renewable resources. Even the introduction of domesticated plants in this region at the beginning of the 5th millennium BC or even earlier did not cause a scheduling conflict since farming activities were confined to the cold season of winter rainfalls and the importance of grains of domesticated plants in the Neolithic diet was rather small in this initial period (Table 4).

In the course of the Neolithic, Lower Egypt saw the growing role of domesticated plants and animals, accompanied by the declining mobility of human groups who switched to more permanent settlements. Possible scheduling conflicts between pottery production and subsistence strategies may have been resolved by a division of labour, with some individuals being in charge of pottery making in households (as and when necessary), while others procured and produced food.

The similarities between undecorated thin-walled pottery and Lower Egyptian Neolithic pottery are visible not only in how pottery production was organised but also in the production technology itself (Table 6). A simple technology, involving open firing and vessels that were made by hand of coils could have been applied even when potters' skills and know-how were rather low, as long as access to raw materials and adequate conditions (time, temperature and humidity) were ensured. One's attention is drawn to the striking degree of similarity between vessel forms used by desert herders, on the one hand, and those of the Fayumians and early Merimdians, on the other. While in either case it is not possible to compare relative amounts, assemblage analyses indicate that open vessels prevailed in both regions. The most common forms in both regions were hemispherical, spherical and conical bowls, vessels with vertical walls or deep vessels with a restricted mouth (hole-mouth jars). Most vessels have round rims and bases. The only exceptions are large storage jars from Lower Egypt, linked to growing domesticated plants and used for the storage of grain.

Some common features are also visible in surface treatments, although the poor condition of artefacts makes proper recognition difficult. The presence of slip on vessel surfaces, as well as vessels with burnished or smoothed surfaces, has been confirmed both in the eastern Sahara and at Neolithic sites in Lower Egypt. Burnishing is the dominant form of surface treatment on the Abu Muhariq Plateau

(Riemer & Schönfeld, 2010:731-734). A similar situation is visible in pottery from phase I of Merimde, although in the younger phases of the settlement the quantity of vessels with burnished surfaces decreases gradually, while smoothed surfaces become increasingly common (Mączyńska, 2017: table 2). Moreover, vessels with rough surfaces are also present in both regions. The fact that black-topped vessels have been found in el-Omari assemblages is rather puzzling, as vessels of this kind are known from a few locations in the Western Desert, and from the Eastern Desert. Unfortunately, the available data is too scant to verify whether any relationship exists between black-topped pottery from these two regions (Debono & Mortensen, 1990: 26; Riemer & Schönfeld, 2010: 754-758; Vermeersch *et al.*, 2015: Sodmein Online Resource 3).

The presence of the herringbone pattern on materials from Merimde and Sodmein Cave deserves special attention. In both cases, this form of decoration was found on hole-mouth jars with a surface covered by slip and then burnished. However, the herringbone pattern found in the Eastern Desert is rougher compared with the finely incised decoration from Lower Egypt (Figs. 7:8; 22). The decorated sherd from Sodmein Cave is dated to approximately 5,600 cal. BC, while the Merimde settlement was established just before the 5th millennium BC. Since the current state of research does not provide information that would help link the two decoration patterns, the issue requires further research.

Apart from the above similarities in pottery production in the eastern Sahara and in Lower Egypt, a number of differences have also been identified. Considerable disproportion in the size of ceramic assemblages from both regions is fairly evident and may result either from the state of research, or from a multitude of cultural and environmental factors affecting the presence and use of ceramic vessels. For desert groups, such vessels may have been a tool used for a limited scope of activities. Since they were introduced simultaneously with domesticated animals, their function has often been linked to these new food resources. Given that domesticated animals were merely an addition to food obtained by hunting, the scarcity of vessels may be a reflection of the scarcity of products of animal origin (such as milk or blood) used by these groups. Thus, the limited demand for animal secondary products resulted in a limited demand for ceramic containers.

The number of vessels used may have also resulted from the degrees of difficulty related to pottery production faced by mobile groups. Seasonality, the necessary resources, a lengthy production process and challenging external conditions affected the quantity of vessels produced. Moreover, mobility and transport problems may have limited the number of vessels used. Moreover, desert groups may have also more frequently used containers made of organic materials, such as straw or leather, as they were much simpler to make. Since the production of short use-life vessels found in the Dakhleh Oasis did not require longer stays

or elaborate techniques, they could have been a way of overcoming difficulties typically caused by pottery production.

Finally, it is possible that undecorated thin-walled vessels had a certain non-utilitarian function, as suggested by Hayden (1995), Rice (1999) or, recently, Warfe (2018). The limited quantity of vessels may reflect their special, symbolic function, as well as a limited group of users.

Ceramic assemblages from Neolithic sites in Lower Egypt are far more numerous and indicate the common use of vessels in many activities related to food processing, cooking, serving, storage, and transport. Although Lower Egyptian assemblages (the Fayum, Merimde I and II) are initially dominated by simple open forms suitable for many different activities, younger layers show an increase in form diversity and a growing proportion of closed forms. These changes may have resulted from the development of the pottery tradition. They suggest not only an improvement in potters' skills but also the growing role of clay vessels among Neolithic communities. Such vessels gradually became utilitarian utensils used in many activities, while the diversity of forms and surface treatments reflects their various possible functions. The development of the pottery tradition visible in the Neolithic communities of Lower Egypt was probably linked to reduced mobility, a more stable settlement pattern and the growing importance of domesticated animals and plants during the 5th millennium BC.

At the beginning of the Neolithic period, the size of early Lower Egyptian pottery inventories was also influenced by the practice of caching pots, which solved problems caused by transporting vessel faced by mobile groups. The possibility of leaving vessels in frequently visited places in order to use them during the next stay had an effect on the size of the inventory used by a given group. Such a practice may have also contributed to greater production volume and a greater diversity of vessel forms, including vessels too large and too heavy for transport.

6.6. Summary and conclusions

The results of comparative analyses of pottery dated to the Neolithic period from Lower Egypt and the Pottery Neolithic pottery of the southern Levant, as well as Lower Egyptian pottery and undecorated thin-walled pottery from the eastern Sahara, do not allow one to confirm or disprove either the hypothesis promoting the Levantine origins of Lower Egyptian Neolithic pottery or that claiming its desert origins. Parallels with Lower Egyptian pottery production can be seen both in the assemblages from the southern Levant and those from the eastern Sahara (Tables 4-5).

In the Levantine hypothesis, pottery is an element of the Neolithic package, introduced to Lower Egypt together with domesticated plants and animals. While the archaeological evidence found so far does not indicate directly that migrants

from the east were present in Lower Egypt, breeding of domesticated animals and farming of domesticated crops of Levantine origin began there in the 6th and 5th millenniums BC, alongside the production of previously unknown clay vessels. The production process was simple and vessels were made using local raw materials. Similarities indicated in the ceramic assemblages by many researchers, in terms of shape, surface treatments and decoration, were apparently supposed to confirm the eastern origin of pottery. Thus, a foreign idea was adapted to local conditions, with clay vessels becoming popular utensils over time and widely used in many activities.

There are many vague aspects of the Levantine hypothesis. It is still rather puzzling how the Neolithic package appeared and was adopted in these regions. So far, migration from the southern Levant to Lower Egypt has been suggested, while some researchers have also proposed a long-term infiltration of the region by drifters and refugees from the East, continuing for approximately 500 years or more (Eiwanger, 1984: 61-63; Hassan, 1984b: 222-223). In addition, the existence of a socio-cultural network linking Egypt with the Levant and enabling a steady flow of ideas has been proposed (Shirai, 2010; 2013a; 2015; 2017). Various Pottery Neolithic cultures have been considered as a source of Egyptian pottery. Undoubtedly, domesticated animals and plants introduced to Egypt originated from the Near East. Domesticates may have reached Lower Egypt with the Levantines, although, currently, no archaeological evidence exists to confirm the presence of such eastern visitors (see Garcea, 2016; Garcea *et al.*, 2016). Despite the fact that some clues are provided by DNA studies, indicating a genetic influx from the Near East into north-eastern Africa dated to the Neolithic, this issue needs further research (Arredi *et al.*, 2004; Kujanová *et al.*, 2009; Smith, 2013b).

Comparative analyses of pottery from Lower Egypt and the southern Levant has allowed the author to identify some similarities and differences both in how pottery production was organised and in pottery technology and typology. In the middle of the 6th millennium BC, pottery production in both regions was organised in significantly different ways, which resulted from different lifestyles and subsistence strategies. In addition, pottery production is likely to have been affected by weather and climate differently in both regions. In the 5th millennium BC in Lower Egypt, declining mobility, a stabilised settlement pattern, and the growing role of domesticated plants and animals all had a significant impact on pottery production, thereby fostering its development. As a result, the organisation of pottery production in the later part of the Egyptian Neolithic period was similar to that known from the Pottery Neolithic in the southern Levant (the use of a limited number of local raw materials, a wide range of open and closed forms, a controlled firing atmosphere, the introduction of decoration).

Comparative analyses have also shown some technological and typological convergences and differences between the pottery of both regions. However, the parallels pointed to in such analyses are sometimes of a rather general nature. Similarities in production methods may, in both cases, result from the fact that pottery production was at an early stage of development. The dominance of open forms is characteristic for all settlement sites due to the widespread use of this type of vessels during food preparation, serving and eating and the short life span of such. The presence of hole-mouth jars may be attributable to their simple method of production and their multiple functions. The high proportion of slip-covered pottery with burnished surfaces in both regions could have been caused by a high demand for short-term storage containers.

The herringbone pattern present on the oldest ceramics at Merimde and Sais may be an important link between the two regions (Fig. 22). The presence of untempered pottery in the same phase of Merimde, reminiscent of Wadi Rabah pottery made of untempered rendzina should also be mentioned. The technique of smoothing the inner walls of the vessels using a bunch of grass, characteristic during the Pottery Neolithic in the southern Levant, and also recorded on some vessels from the Merimde culture, may also be of eastern origin (Fig. 23).

The other hypothesis addressed in this monograph assumes the desert origins of Lower Egyptian Neolithic pottery production. Clay vessels, being part of the desert heritage, supposedly appeared in Lower Egypt together with communities of herders and hunter-gatherers, forced to leave the eastern Sahara when the desert began to desiccate in ca. 5,300 BC. The northern shore of Lake Qarun, or Wadi Gamal at the boundary of the Nile Delta and the desert, may have been places where desert groups settled. These groups probably belonged to the Bifacial technocomplex occupying the central and northern part of the Western Desert. One of their features was the ability to produce and use clay vessels. If the groups who came to, and settled in Lower Egypt possessed pottery making skills, pottery production could have flourished in an environment with an abundance of water, food resources, and raw materials.

Comparative analyses of pottery production in both regions has allowed the author to identify a number of similarities and differences in its organisation. The mobile way of life, the important role of wild resources accompanied by the relative insignificance of domesticated animals and plants, and a dependency on weather and climate all influenced pottery production in both regions, limiting it to periods of longer stays in places ensuring access to water and other necessary resources during dry and warm periods (Table 4). However, the similarities between Lower Egyptian Neolithic groups, on the one hand, and desert groups, on the other, are outnumbered by the differences which appeared during the development of Neolithic communities in Lower Egypt. Declining mobility, a stabi-

lised settlement pattern and the growing role of domesticated plants and animals significantly influenced the organisation of pottery production. Although it still took the form of generalised household production, the progress in potters' skills (new forms of pottery, decoration, firing control) and stabilisation of production is notable.

Parallels and differences between the Lower Egyptian and eastern Saharan assemblages are also visible in terms of technology and typology. In both regions, the raw materials came from the area explored by the local community, although their deposits may have been located far from production sites. Both assemblages are linked by the variability of fabrics, a great similarity of forms, and similar surface treatment. However, the simple way of producing vessels in both regions can also be explained by the fact that pottery production was at an early stage in both cases, not unlike in the Levantine hypothesis. Particularly remarkable is the herringbone pattern known from Lower Egypt and the Eastern Desert, although their relationships need further research.

One of the most important differences is visible in the size of assemblages from both regions. Desert assemblages are small, and their size probably reflects a low demand for pottery and the requirements of the production process, as well as the difficulties commonly encountered by mobile herders and hunter-gatherers. In Lower Egypt, the Neolithic assemblages are much more abundant, as in this region vessels became common utensils, used for many different activities.

The current state of research does not allow one to confirm the presence of desert herders' groups in Lower Egypt. Research on the Western Desert has shown that the activity of Middle Holocene herders and hunter-gatherers also included the northern part of the area, namely the Siwa and Qattara Depressions, or even parts of north-eastern Africa further to the west (Hassan, 1976; 1978; Cziesla, 1989; 1993; Tassie *et al.*, 2008; Lucarini, 2013; Garcea, 2016; Garcea *et al.*, 2016; Barich, 2016). Furthermore, Wendorf and Schild (1984) suggest that the area around Lake Qarun was known to hunter-gatherers and herders as a fishing ground already before the 6th millennium BC. Recent studies in this area have shown a high level of activity on the northern shore of Lake Qarun from the Early Holocene period until 6,000 BP (Wendrich *et al.*, 2010; Holdaway *et al.*, 2016; Holdaway & Wendrich, 2017). Lower Egypt, including the Fayum and the Nile Delta, may have been known to desert groups that moved over long distances across the eastern Sahara in search of water, plants, and animals. These locations could have been part of their annual cycle of migrations. One's attention is drawn to the similarity of Middle Holocene lithic assemblages from sites in the Western Desert, on the one hand, and from the Fayum and Merimde Beni Salame, on the other. Mobile herders may have visited the area in question and settled there at the beginning of the desert desiccation process (see Kindermann & Bubenzer, 2007).

In the author's opinion, both hypotheses addressed here are based on similar assumptions. In both hypotheses, stylistic and technological similarities are an important issue. The state of research on the Lower Egyptian Neolithic does not provide any grounds for disproving either of these hypotheses nor does it allow us to consider one of them more accurate or better than the other. The prevalence of the Levantine hypothesis stems from the long history of research and from the fact that this hypothesis is deeply rooted in Near Eastern archaeology. The hypothesis claiming eastern Saharan origins of the Lower Egyptian Neolithic emerged only after intensive research on the Western Desert and has gained popularity among researchers dealing with the prehistory of north-eastern Africa.

Egypt enjoys a special geographical and cultural position. It is both part of the Near East and the African continent. The lack of any significant geographical barriers between Lower Egypt and the eastern Sahara, or between Lower Egypt and the southern Levant, enabled the movement of people and ideas between these regions. Lower Egyptian pottery was, therefore, not invented in this area but introduced from outside. It seems that the desert groups who settled on the northern shore of Lake Qarun or in Wadi Gamal may have possessed pottery making skills. Once introduced to Lower Egypt, the pottery tradition developed dynamically, and also because of social and economic changes within Neolithic societies. Reduced mobility, stabilised settlement patterns, as well as the greater role of farming and animal breeding, all had an effect on pottery production. Furthermore, its development may have been influenced from another direction. Domesticated plants and partly domesticated animals were introduced to Lower Egypt from the southern Levant in the 6th and 5th millenniums BC. It was then that local pottery production may have been influenced by Levantine newcomers, who knew and used clay vessels (Garcea, 2016; Garcea *et al.*, 2016; Shirai, 2017; Streit, 2017). However, the very process of pottery adaptation is unclear and requires further research

Finally, taking into account the results presented in this monograph, the author is of the opinion that, in the first place, searching for the origin of Lower Egyptian pottery is not actually necessary. What seems more important is conducting intensified studies on the occupation of Egypt in the Early and Middle Holocene periods. Such studies will make it possible to reach beyond the concepts of prehistoric communities developed in the early 20th century and repeated ever since, as well as beyond the boundaries of regions, or even archaeological units. Probably during the Early and Middle Holocene periods, the Western Desert and Lower Egypt were traversed by many groups of people, namely hunter-gatherers and herders. Their destinations depended on a multitude of factors, primarily environmental and economic. They probably knew the local territory and its resources very well. Rich ecological niches such as oases, valleys, wadis or playas

could have been visited for centuries. From our present perspective, the end of the Holocene humid phase was a dramatic event influencing human life and forcing human groups to migrate. However, movement from the dry and hot desert to more hospitable areas was part of their annual cycle. Although increased aridity must have influenced migration patterns, people could have come back to places known from previous journeys, where all they need to survive was available. It is us, archaeologists, who systematise all remains and data region by region, affixing archaeological labels to them. In doing so, we tend to forget that, in this way, we build artificial frameworks. Is it really so that the Qarunians, Fayumians and herders of the Bifacial technocomplex were distinct groups with different cultural backgrounds? Perhaps all of them were hunter-gatherers and herders with a very similar cultural background, well adapted to local conditions and skilfully using different resources available in different parts of the north-eastern Africa. In this context, solving the problem of the origin of Lower Egyptian pottery is closely related to studies on the socio-economic development of communities occupying this part of north-eastern Africa.