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The innovation of the potter's wheel: a comparative perspective between Mesopotamia and the southern Levant

Johnny Baldi[1] and Valentine Roux[2]

The southern Levant and northern Mesopotamia are two areas in which the potter's wheel seems to have appeared independently. New data enable us to undertake a comparison between both regions. As a result, it appears that in both regions the context of production of the first wheel-made vessels was very similar. Wheel-coiled bowls were made by craft specialists attached to some kind of elite and responding to the demand of this same elite for fine vessels. Thus the potter's wheel was not adopted to improve productivity, but to produce to strong vessels with status value. As a consequence, this technology was not transferred to more utilitarian categories of vessels, and in both regions its development followed the same distinctive saw-tooth evolutionary trajectory.

Keywords potter's wheel, Late Chalcolithic, north Mesopotamia, southern Levant, innovation, diffusion, ceramics

Introduction

When we try to compare historical events — like the innovation of the potter's wheel — the issue is the terms upon which the comparison can be made. The dynamic approach taken here argues that while technological innovations emerge within particular historical contexts, there may be elements within these that indicate the existence of more general conditions relevant to a particular innovation, and which can form the basis for comparison, across different chrono-cultural areas (Roux 2003b). In brief, the dynamic approach argues that the comparison should focus on the context within which technical innovations took place, in order to draw-out potential regularities between historical settings which are in many ways particular and non-reproducible (Gallay 2011). We here apply this approach to compare the situation in two regions within which the potter's wheel appeared independently — the southern Levant and northern Mesopotamia.

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Briefly, let us recall that in the southern Levant the potter's wheel appeared during the 2nd half of the 5th millennium BC on so-called Late Chalcolithic sites. This device was dedicated to the manufacture of small bowls interpreted as lamps used for ceremonial events (Roux and Courty 1997). The forming technique employed was wheel-coiling, the innovation of which has been viewed as emerging from a dynamic interaction between an invention, on an individual scale, and the demand for ceremonial vessels. That this innovation took place in a context of craft specialists attached to an elite is suggested by the two attributes related to the manufacture of wheel-coiled bowls: specialized skills and ceremonial value of the bowls. This view takes support from the disappearance of both wheel-coiled bowls and the wheel-coiling technique itself, with the collapse of the Late Chalcolithic elites and polities (Roux 2003b; Roux *et al.* 2013b).

In Mesopotamia it is usually stated that the potter's wheel was used across the Uruk cultural area during the second half of the 4th millennium BC. Indeed, some authors uncritically postulate the existence of a link between southern Mesopotamian urbanization and the emergence of wheel fashioning techniques (Rothman 2001; 2002; van der Leeuw 1994; Laneri

1997; 2009); others simply accept this point of view (Frangipane 1993; 1996; 2000; 2002; Helwing 1999; 2002). The rationale is that south Mesopotamian urbanization and the subsequent development of an Uruk colonial network were catalysts of technological progress. Following an old axiom of Near Eastern archaeology (Lloyd 1948; Mallowan 1933; 1970), the development of the potter's wheel was thus held to be a techno-economic response, designed to increase productivity in an urban context characterized by a growing demand for ceramic vessels (Nissen 1993).[1] However, recent archaeological investigations and technological studies in northern Mesopotamia have drastically changed the perspective. On the one hand, the process of urbanization in northern Mesopotamia appears to be completely independent from that in the south (Frangipane 2009; 2010; Oates *et al.* 2007; Stein 2012), on the other the emergence of the potter's wheel appears to be a process typical of the proto-urban phase, i.e. Late Chalcolithic (LC) 2, rather than a corollary of the main period of urbanization (Baldi 2012d; 2013a).

These new data now make possible a comparison between both regions — the southern Levant and northern Mesopotamia (Fig. 1). In this paper, we will examine the historical settings for the innovation of the potter's wheel in northern Mesopotamia, and the context of production of the wheel-made vessels. New data from the central and northern Levant (southern Syria and Lebanon) will then be presented in order to test whether these conditions apply more generally to the emergence of the wheel forming technique; the evolutionary trajectories of the potter's wheel in both regions are then discussed.

The potter's wheel in northern Mesopotamia: a view from Tell Feres al-Sharqi

In northern Mesopotamia, innovation of the potter's wheel has been observed at the site of Tell Feres al-Sharqi, a 4 ha rural village near the major centre of Tell Brak in the Khabur basin (Hassake province, north-eastern Syria). Extensively investigated by a French-Syrian archaeological mission between 2006 and 2010, Tell Feres has revealed a series of different contexts (ceramic workshops, public buildings, dwellings, granaries) dating back to the late Ubaid and post-Ubaid phases (Forest *et al.* 2012). While its uninterrupted sequence documents the evolution of an important village in the sustaining area of Tell Brak (Wright *et al.* 2006) during the 5th and 4th millennia BC, the site also offers a wide cultural and ceramic panorama of the Khabur basin, and northern Mesopotamia generally, during the proto-urban phase (Baldi and Abu Jayyab 2012).

One of the most interesting results, and certainly the most unexpected, is the early emergence of the potter's wheel during the first centuries of the 4th millennium BC, i.e. at the end of the LC2 (around 3900–3800 BC) (Fig. 2). No clear evidence of rotary instruments has been found within the late Ubaid phase (about 4700 BC), except for one clay disc with a slight socket on its underside, that was found in a potter's workshop. This clay disc could have rotated on a pivot, as a *tournette* or even as a fly wheel, but, because of its small size (approximately 26 cm in diameter) it is unlikely that it produced the rotary kinetic energy (abbreviated RKE) required for wheel fashioning techniques. Moreover, the ceramic evidence indicates that the first use of RKE dates to a later phase (about 3900 BC).

Rather, this clay disc suggests that in northern Mesopotamia the formative phase in the development of the technology for the potter's wheel fell in the late Ubaid and LC1 phases.[2] The only evidence in the region for a rotary device dating back to the LC2 comes from Hamoukar, where a fragment of a little flat basalt slab was uncovered (Al-Quntar and Abu Jayyab pers. comm.; Al-Quntar and Abu Jayyab 2014: 107).

The use of RKE and the associated fashioning technique has been identified through a systematic technological analysis of the ceramic assemblage of Tell-Feres al-Sharqi, the purpose of which was to reconstruct the traditional *chaînes opératoires*. Shaping methods and techniques, surface treatments, petrographic composition of the pastes, firing procedures and morphological variants of the assemblage have been examined in order to identify traditional ceramic production. Different forming techniques

[1]According to this evolutionary framework, the phases that preceded the Uruk urbanization — in particular the Ubaid (5900–4600) and Late Chalcolithic periods 1–2 (4600–3800) — would have known some forms of 'experimentation' with the use of rotating tools (Nissen 1989; Berman 1994; Thuesen 1989; 2000; Henrickson and Thuesen 1989). Indeed, during the Ubaid phase, some ceramics were probably decorated on a turntable: the sharpness and regularity of some designs, painted all around the vessel-body, could only have been achieved if the hand of the decorator was stationary, and the vessel was rotating on a pivot. However, this kind of technical gesture cannot be considered 'experimental' use of the potter's wheel because the rotational kinetic energy plays no role in vessel-forming (Baldi 2012e; Ther 2016: 222). Moreover, from the beginning of the Late Chalcolithic, all evidence for the use of turntables disappears. At Tell Feres, radiometric evidence dates the transition between Ubaid and LC1 to 4600 BC or even earlier, see also evidence from Tell Zeidan, Tell Helawa or Surezha (Vallet and Baldi 2016; Peyronel and Vacca 2015: 100; Stein 2009: 135; Stein and Alizadeh 2014: 149–50).

[2]During the first half of the 5th millennium BC, there are no traces of rotational instruments, even in the Levant. The two most ancient specimens identified in that region seem to date to the second half of the 5th millennium (although one of them, from Tel Halif, is unpublished and the other comes from a disturbed context at Nahal Besor Site E — Fiaccavento 2013: note 28; Roux and de Miroschedji 2009: 162).

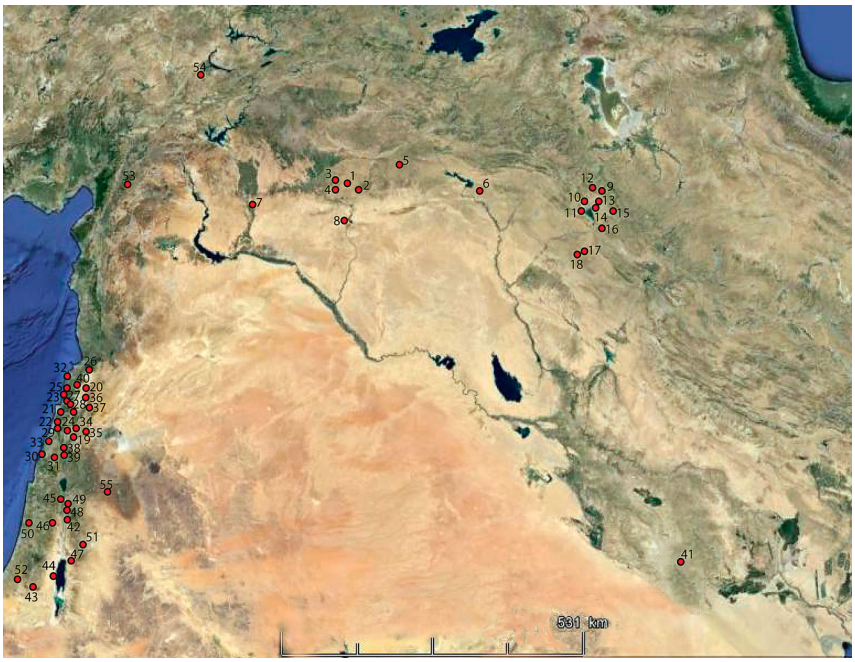

Figure 1. **Map showing the location of sites mentioned in the text (1 - Tell Feres, 2 - Brak, 3 - Tell Nahar Khalinj, 4 - Tell Umm el-Kahfeh, 5 - Hamoukar, 6 - Tepe Gawra, 7 - Hammam et-Turkman, 8 - Tell Boueid II, 9 - Qalaat Saïd Ahmadan, 10 - Bosken, 11 - Waranga Saru, 12 - Gulak, 13 - Salkis, 14 - Alyawa, 15 - Qaladiza, 16 - Dinka, 17 - Gird-i Qalaa, 18 - Logardan, 19 - Jisr, 20 - Ard Tlaili, 21 - Arslan, 22 - Khalde, 23 - Naccache, 24 - Rouaisset al Khalle, 25 - Dbaye, 26 - Qalaa 'Aïcha, 27 - Jeita, 28 - Ras al-Kelb, 29 - Yerate, 30 - Naqura, 31 - Birket Rama, 32 - el-Heloue, 33 - Nahr Damour, 34 - Dommale, 35 - Ta'nayil, 36 - el-Qlaiaat, 37 - Baabdat, 38 - Bchamoun, 39 - Aaramoun, 40 - Bikfaya, 41 - Uruk, 42 - Abu Hamid, 43 - Abu Matar, 44 - En Gedi, 45 - Neveh Ur, 46 - Tell el-Far'ah, 47 - Teleilat Ghassul, 48 - Pella, 49 - Tel Fendi, 50 - Azor, 51 - Sahab, 52 - Gilat, 53 - Oylum Höyük, 54 - Arslantepe, 55 - Tell Qarassa).**

have been identified, among which is the wheel-coiling technique, and that uses RKE for thinning, shaping and finishing a rough-out previously assembled by coiling. It has been identified on the basis of diagnostic surface features including horizontal concentric parallel striations combined with fissures, cracks, ridges, wrinkles and bulges matching with coils, and spiral features on the interior surface of the base, as well as

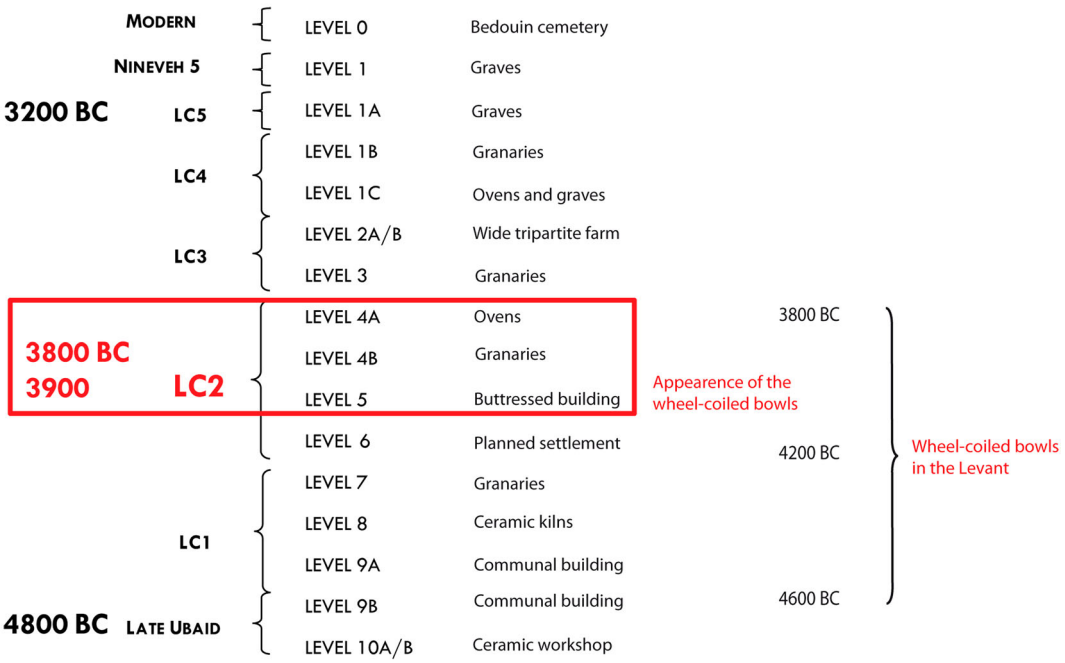

Figure 2. **The stratigraphic sequence of Tell Feres and its chronological framework.**

by microscopic features revealing junctions of coils and diagnostic deformation of the poral system and the clay mass due to the use of RKE (Courty and Roux 1995; Roux and Courty 1998) (Fig. 3).

The wheel-coiled vessels

The containers shaped by the wheel-coiling technique belong to a single specific morpho-functional type of hemispherical bowl, rare, but diagnostic of the late LC2 phase in the whole of northern Mesopotamia (Abu Jayyab 2012: fig. 8.10, 11.3; Rothman 2002: 17) (Fig. 4). They are characterized by their high quality, as shown by highly symmetrical profiles, regular thin walls (about 4 mm in thickness) and the use of very fine pastes, the petrography of which indicates a *terra rossa*-like clay, with microscopic natural serpentine inclusions.

These wheel-coiled bowls make-up around 0.7% of the late LC2 ceramic assemblage from Levels 5–4B and 4A at Tell Feres.[3] This indicates that they were a rare product, and were not mass produced. Thus the use of the potter's wheel was not intended to increase the rate of production by reducing the working time, a point demonstrated by previous experimental studies (Roux and Courty 1998; Laneri 2009; Baldi 2012a; 2012d; Courty and Roux 1995; Roux 2003a). A further argument supporting this view is the fact that other (and faster) techniques used for shaping serially-produced bowls had existed since the middle of the 5th millennium BC (at first, by hollowing out and stretching a lump of clay and then, from the second quarter of the 4th millennium, by moulding large open vessels). The spread of 'mass' produced bowls intended for redistribution of individual food rations during feasts or collective meals, is a well-known phenomenon of the post-Ubaid phase in northern Mesopotamia (Baldi 2012b; 2012c; Kennedy 2012). But these coarse containers used for redistributive practices — the so-called Coba bowls, which are extremely abundant around the middle of the 5th millennium BC — are produced (at Tell Feres and elsewhere) by hollowing out a lump of clay, pinching and then stretching the wall of the bowls by discontinuous pressures (Baldi 2012b; 2012c). As many experimental tests have confirmed, this rough and effective technique is not only much easier, but also much faster than the wheel-coiling technique. Moreover, in the first half of the 4thmillennium BC (shortly after the appearance of wheel-coiling), consistent improvement in productivity was obtained through another technical innovation: the moulding technique. The latter was adopted for certain large bowl forms, ubiquitous in the whole of northern and central Mesopotamia, the so-called 'hammerhead' bowls intended for collective consumption of food (Forest *et al.* 2012: fig. 3; Stein 2012: 139–41, fig. 7a–f), thus providing a very simple and quick response to a need for serially produced and relatively standardized large bowls in the growing proto-urban polities. The fact that the wheel-coiled bowls were of high quality, occurred only in small numbers (between 0.6%and 0.8% in Levels 5 and 4b–a), demonstrated high levels of skill (Roux and Corbetta 1989), were made according to a technique which was by no means aimed at improving productivity, which was exclusively employed to produce to a specific type of bowl, and was never transferred to any other vessel category, suggests that the wheel-coiled bowls were of exceptional value. Their spatial distribution also argues in favour of this hypothesis. Among the range of contexts revealed by the excavations at Tell Feres (ceramic workshops, public buildings, private dwellings, and granaries), the majority of the wheel-coiled bowls were collected in the partially-exposed, niched-buttressed building of Level 5 (second half of the LC2, beginning of the 4th millennium BC), which contrasts with the other domestic and working spaces.

Its architectural form, with a bi-partite plan and buttresses on the façade (Fig. 5), is well known during the post-Ubaid period as a layout associated with elite houses or public and communal buildings (Nissen 1993; Butterlin 2006; Frangipane 2002; 2009). Moreover, this edifice occupies a prime location in the centre of the village; placed on the top of the LC2 tell so as to dominate the entire settlement.[4] It comprises collateral areas dedicated to storage and a wide plastered central hall with special facilities, such as a bench on the southern side. It is in this central space that all the wheel-coiled bowls were found *in situ*. The floor yielded 14 specimens of relatively well-preserved bowls. This constitutes a concentration much higher (and with a much lower fragmentation rate) than the specimens collected in the fill layers of the Levels 4b and 4a (at the end of the LC2). Both the distribution and concentration suggest that the wheel-coiled bowls were used during special occasions,

[3]Bowls of this kind are completely absent in the early LC2 Level 6 and first appear in Level 5, where 14 samples have been collected (out of a total of 2019 sherds). They are attested in later Levels 4B and 4A (respectively 9 and 11 fragmentary specimens out of 1511 and 1375 sherds), but the examples from Level 5 are the only ones that were found *in-situ* and are characterized by a lower rate of fragmentation.

[4]R. Vallet, *Mission archéologique franco-syrienne de Tell Feres. Les sociétés proto-urbaines de Haute Mésopotamie (5ème–4ème millénaires)*, Rapport pour la demande d'allocation de recherche pour l'année 2012, Commission Consultative des Recherches Archéologiques à l'Etranger, Ministère des Affaires Etrangères et Européennes, p. 26.

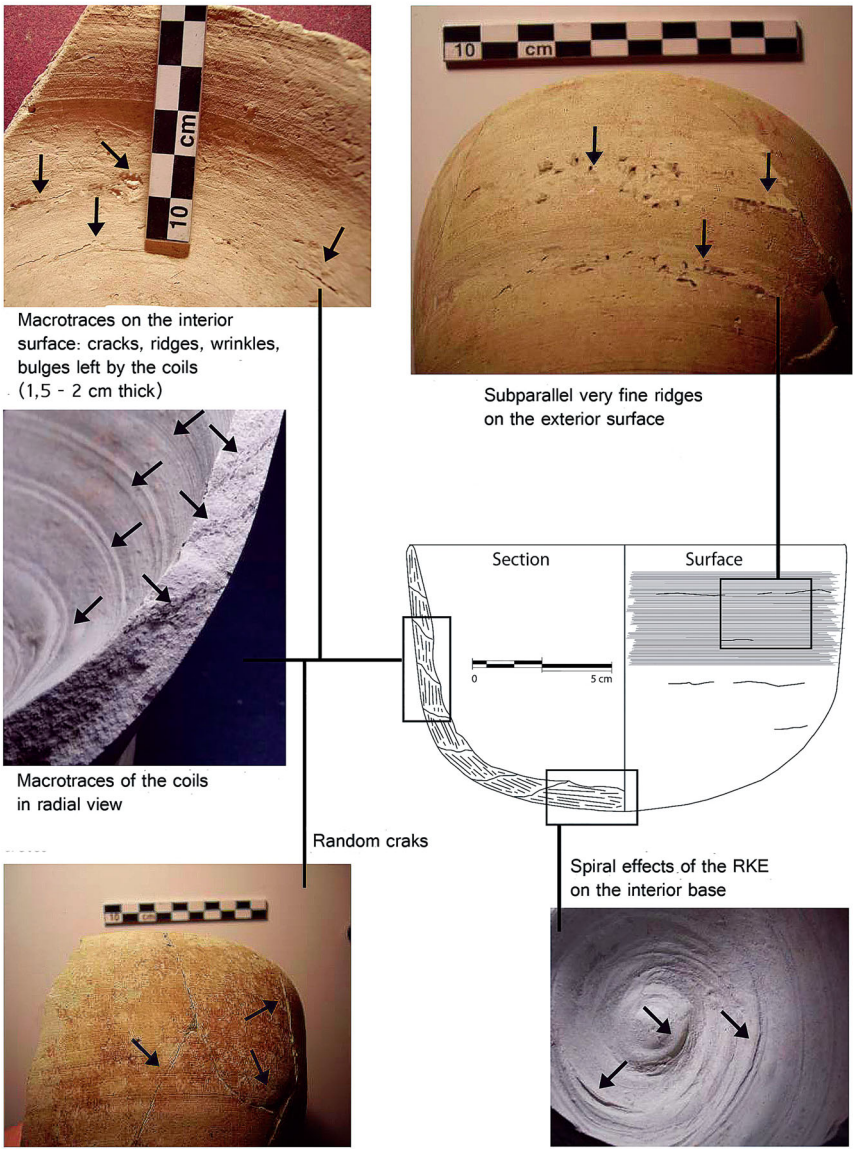

Figure 3. Diagnostic attributes of the wheel-coiling technique observed on material from Tell-Feres.

and in the central space of the Level 5 elite building. In short, they had a specific social meaning.

As the invention of wheel-coiling was specifically connected to these bowls, and it appears to have emerged around 3900 BC, we might ask whether this took place in a manner similar to its emergence in the southern Levant. In both regions, wheel-coiling developed from an invention rooted in the internal evolutionary potential of rotary devices (which already existed and were used in Ubaid times) and, in response to a demand by an elite for specific vessels.

Context of production of the wheel-coiled vessels

The context of production of the wheel-coiled bowls can be inferred from the level of skill involved in their manufacture, which, given the lengthy apprenticeship necessary to master the use of RKE, indicates that the artisans were surely specialists (Roux and Corbetta 1989). Another piece of evidence is the degree of standardization of the ceramic containers as established by measuring the coefficient of variation (CV) of the rim diameters, one of the most robust indices for assessing standardization (Eerkens and Bettinger 2001; Kvamme *et al.* 1996). According to the so-called 'standardization hypothesis', low CVs indicate a high level of control of motor skills, something that can be attained only with a high rate of production (Benco 1988; Blackman *et al.* 1993; Costin 1991; 2000; Costin and Hagstrum 1995; Longacre *et al.* 1988; Sinopoli 1988; Stark 1995; Roux 2003a).

In other words, when CVs are low, they express intense production at the individual scale and therefore specialization. The number of artisans can be assessed against both the CVs and the estimated annual production: low CVs combined with a low level of production suggests a limited number of artisans since regular practice would have been necessary to develop the motor habits required. Low CVs combined with a high annual level of production suggests the involvement of a large number of artisans (Costin and Hagstrum 1995: 622; Roux 2003a: 769).

The wheel-coiled bowls are amongst the more standardized containers, with a very low CV (between 2.1 and 1.8%, Fig. 6). By reference to ethnographic cases (*ibid*), a low coefficient of variation such as this, is reachable only in contexts of high production rates since it requires highly developed motor skills, that are attainable only through intense repetition of gestures. However, given that the low number of wheel-coiled bowls indicates a very low rate of production, such low CVs suggests manufacture by a small number of specialist artisans, perhaps one or two for the whole village community (Baldi 2012e).

When considering the spatial distribution (in high-status buildings) and function (related to special occasions) of the wheel-coiled bowls, it seems reasonable to argue that production of wheel-coiled bowls was in the hands of a restricted number of highly specialized potters, probably attached to the emerging socio-economic elite of the proto-urban north Mesopotamian polities[5]. An additional argument in favour of this hypothesis is that both the wheel-coiling technique and the wheel-coiled bowls disappear in LC3 (around 3800–3600 BC), at a time when proto-urban elites were undergoing major reorganization[6].

Placing Tell Feres in a broader northern Mesopotamian perspective

Tell Feres, as a case study, is representative of a wide northern Mesopotamian technical evolution. Indeed, the same situation has been recently observed at other sites in north Syria (in particular Tell Umm el-Khahfeh and Tell Nahar Khalinj — Baldi 2013a) and Iraqi Kurdistan sites (Baldi *et al* forthcoming)[7]. Moreover, other excavations have yielded wheel-coiled bowls of the same type dating

Figure 4. Wheel-coiled hemispherical bowls from Tell Feres.

[5]The nature of LC north Mesopotamian elites and the ways in which they mobilize labour (Stein 1996) has been recently studied, by focusing the attention not only on prestige goods and architecture (Butterlin 2006; 2013), but also on redistributive practices and growing inequalities (Baldi 2012b; 2012c; Frangipane 2010), as well as on iconography and administrative systems (McMahon 2009: 2013).

[6]Evidence for a deep and sometimes violent socio-political reorganization between late LC2 and early LC3 in northern Mesopotamia comes from the destruction of Tell Hamoukar (Al-Quntar and Reichel 2008: 20), the abandonment of some previously important centres (as Tepe Gawra VIII or Grei Resh — Kepinski 2011; Rothman 2002), the mass-graves of Tell Majnuna (McMahon 2007: 8–11), and a growing centralization of redistributive practices in specific monumental buildings within the main centres (Oates *et al.* 2007).

[7]In particular, surface pottery showing traces of the adoption of the potter's wheel at the beginning of the 4th millennium come from Qalaat Saïd Ahmadan, Bosken, Waranga Saru, Gulak, Salkis, Alyawa, Qaladiza and Dinka, surveyed by the MAFSG (*Mission Archéologique Française au Gouvernorat de Sulaymaniyah*, directed by Dr. Jessica Giraud). Moreover, some surface specimens also come from Logardan (surface collection) and Gird-i Qalaa (three late LC2 stratified fragments), where a French archaeological mission is currently directed by Dr Régis Vallet, CNRS.

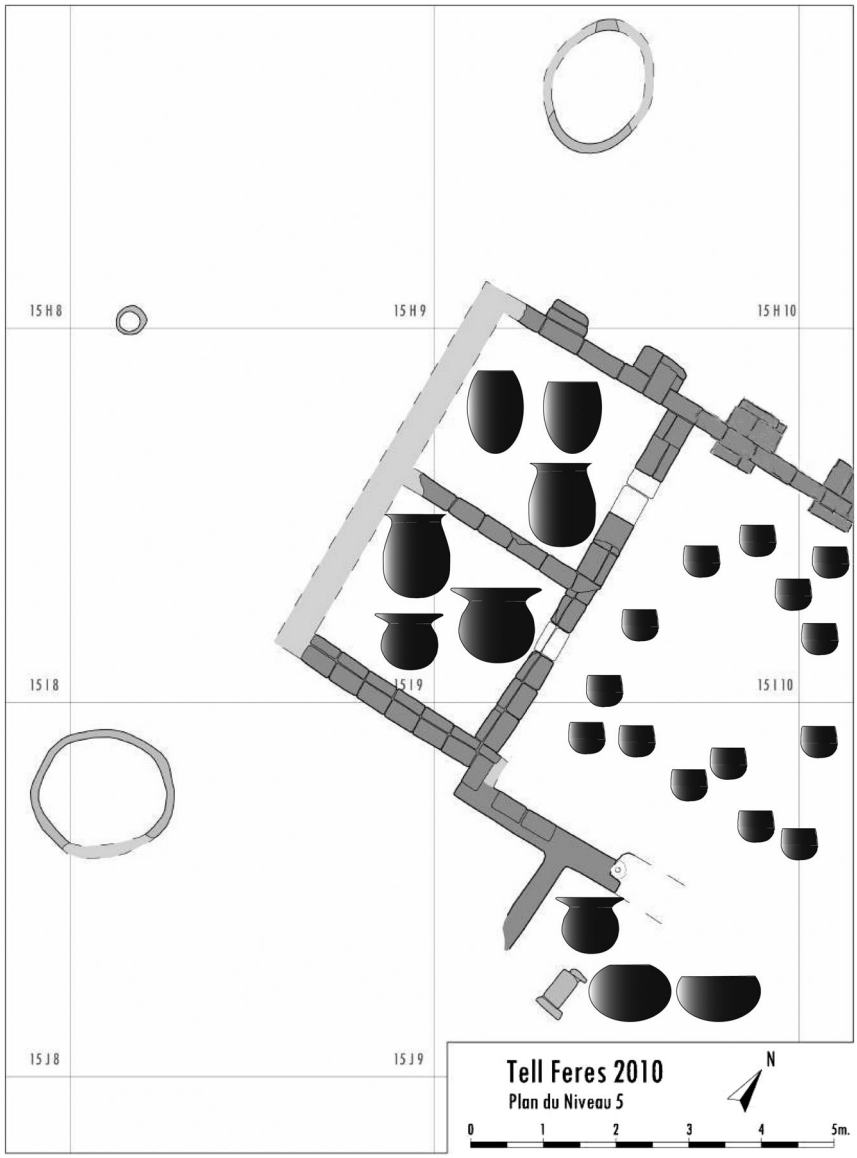

Figure 5. Tell Feres Level 5. Plan of part of buttressed building showing the distribution of ceramic containers. All the wheel-coiled bowls were concentrated in the main hall.

back to the second half of the LC2 period. This phase is quite poorly known (and is often documented only through limited exposures in deep soundings) because it coincided with a period of reorganization at many settlements, at which point several major centres attained a genuine proto-urban status (Oates 2006; Oates *et al.* 2007; Stein 2012).

That said, some sites do offer clear archaeological evidence. Wheel-coiled bowls demonstrating the same quantitative and technical features as are documented between Levels 5 and 4b–a at Tell Feres, are attested at Tepe Gawra Level X, Levels 2–1 of the Hamoukar 'southern extension', Hammam et-Turkman VB and Tell Boueid II (Abu Jayyab 2012: fig. 8.10, 11.3; Akkermans 1988: fig. 107.97, 108.107; Al-Quntar and Abu Jayyab 2014: table 6.1; Rothman 2002: 17.1950; Suleiman and Nieuwenhuyse 2002: fig. 8.1.17). The wheel-coiled bowls occurring at these sites at the beginning of the 4th millennium BC, were rare, fine, medium-sized, standardized, globular containers that, when found *in situ*, were mainly present in high-status buildings.

This last aspect is the most difficult to prove irrefutably, as some archaeological contexts do not offer unequivocal evidence. For instance, in Levels 2–1 of the Hamoukar 'southern extension' the excavated area was occupied by pits and scattered sherds no architectural remains were evident (Al-Quntar *et al.* 2011: 156). However, a context very similar to the high status building of Tell Feres Level 5 is represented

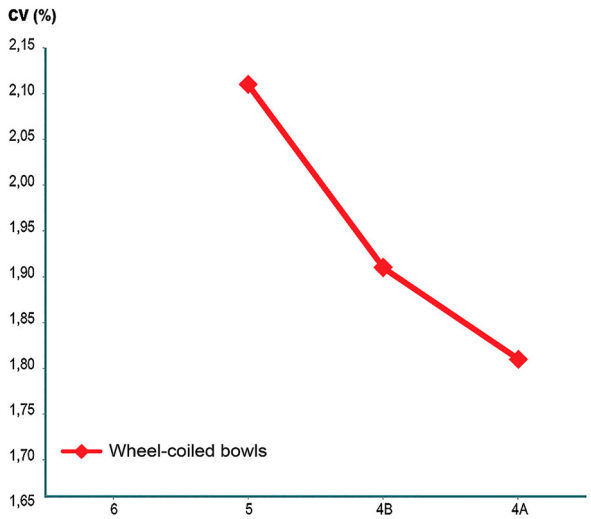

Figure 6. Coefficient of variation (CV) of the rim diameters of the wheel coiled bowls during LC2 (presented by stratigraphic phase).

by the 'monumental niched architecture' (Akkermans 1988: 287) of Tell Hammam et-Turkman VB Level 7. This structure has been interpreted as an elite building, the main reception hall of which contained some globular, wheel-coiled bowls, and had side-rooms containing storage vessels (as at Tell Feres Level 5). The presence of wheel-coiled bowls in high-status structures is also attested at Tepe Gawra X where, for the first time since the beginning of the Chalcolithic sequence, the top of the Tell was organized as an acropolis and was occupied exclusively by major buildings (Rothman 2002: fig. 3.11). At Tepe Gawra the architectural evolution was studied over a large area and the ceramic material has been examined using a fine-grained spatial analysis (Rothman 2002). The results obtained show parallels with Tell Feres Level 5 and confirm that wheel-coiled bowls were used during special occasions in the central hall of elite buildings.

Remarkably — and despite the widespread assumption that the appearance of the potter's wheel was a corollary of southern Mesopotamian influence — all these contexts precede the arrival of the first 'Uruk' settlers during the LC3 phase (around 3800–3600 BC) (Butterlin 2003; Frangipane 2009; Stein 2012). Indeed, the appearance of the wheel-coiling technique in northern Mesopotamia occurred before the emergence of any cultural contact with the south Mesopotamian (Uruk) urbanization. So, even if the appearance of wheel-coiling is not related to the Uruk expansion, and may not have originated in southern Mesopotamia, there is, at present, no definitive confirmation for a north Mesopotamian origin. In particular, the pattern of relations with the Levant in the early 4th millennium BC remains largely unknown.

In the middle: new data from central-northern Levant

Northern Mesopotamia and the Levant do not constitute two poles separated by a complete absence of information, although the Late Chalcolithic period in the central and northern parts of the Levant remains poorly known. We now present a brief overview of the first wheel-coiled bowls in these two regions to help set the previous discussion in a wider perspective (Fig. 7).

The southern Syrian Leja plateau

Valuable information on the emergence of the potter's wheel comes from the northern mound of Tell Qarassa, located in the southern Syrian Leja basaltic plateau, and excavated by a French mission in 2009 and 2010. Compared to the environmental milieu of Tell Feres (the wide plains of the Khabur basin, very suitable for large-scale dry farming agriculture), the region of Tell Qarassa was characterized by well-established pastoralist activity, which during the Late Chalcolithic was at least as important as agriculture to the area (Braemer 2011). The stratigraphy of the northern mound includes a PPNB occupation and a, possibly, continuous sequence spanning the 7th–4th millennia BC (Godon *et al.* 2015: 161–62). During the period here considered (Middle and Late Chalcolithic — around 4800–3800 BC), architectural remains are represented by several ovens, as well as by the reconstruction of an important building, the entrance of which is marked by two stone pillars. The ceramic assemblages are characterized by a clear morphological continuity, with a typology broadly within to the so-called Ghassulian *koiné* as defined by Bourke (2007). The morphological repertory from Qarassa Tell North represents a local variant of this tradition, and has close similarities with Byblos *Néolithique Récent* and *Enéolithique Ancien* (Dunand 1973) and, above all, with other south Syrian sites as Tell al-Khazzami (Contenson 1968). The assemblage from Tell Qarassa North is closely related to well-known south and central Levantine ceramic repertories, and has no particular similarity to the Ubaid-LC1–2 assemblage from Tell Feres.

As in the whole Levantine area (Gilead and Goren 1995: note 1; Roux 2003b), wheel-coiled straight-sided (or 'V'-shaped) bowls are well attested, and appear during the second half of the 5th millennium

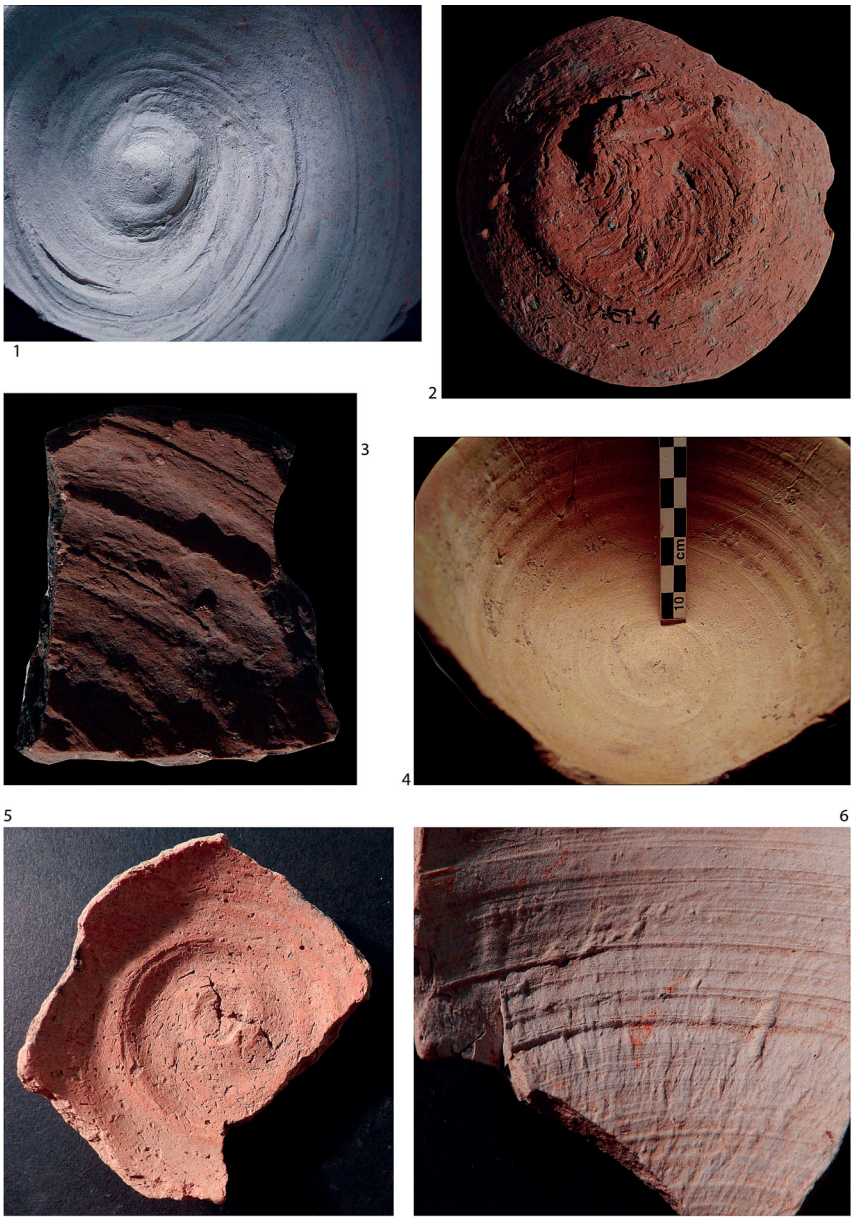

Figure 7. Wheel coiled bowls from central-northern Levant (1–2 - Tell Qarassa North, southern Syria; 3 - Nahr Damour, coastal area, central Lebanon; 4 - Qlaiaat, interior, central Lebanon; 5 - Tell 'Ain el-Ghassil, central Beqaa Valley, Lebanon; 6 - 'Ain el-Metn, northern Beqaa Valley, Lebanon).

BC. Moreover, as in the southern Levant, the wheel-coiling technique does not extend to any other morpho-fuctional ceramic category, but remains exclusively associated with 'V'-shaped bowls. Moreover, the fabrics associated with these vessels are not consistent with the local petrographic range (Baldi 2013b). Despite the increasing trend towards a homogenization of the local basaltic-ferruginous pastes at Late Chalcolithic Tell Qarassa North, 'V'-shaped bowls never demonstrate metamorphic or basaltic compositions. In itself, this feature does not automatically point to a non-local mineralogical origin as it could simply reflect a decision to use radically purified raw materials. However, the presence of carbonatic minerals and sedimentary rocks such as dolomite and phosphorite (clearly distinguishable at a magnification of x 35) suggests the use of allogenic and quite distant sources. The available data on petrography and sedimentation could be taken to indicate a location in Transjordan or even in northern Negev (Gilead and Goren 1989; Soudry *et al.* 2013)[8]. Thus,

[8]In fact, a connection with Transjordan is also confirmed by the ceramic typology (Godon *et al* 2015), but such a southern origin of the pastes is mainly suggested by the absence of data on all the other areas surrounding Tell Qarassa. The key element here is not to determine the mineralogical origin of the fabrics, but to highlight the fact that they come from distant locations.

the straight-sided bowls of Tell Qarassa clearly belong to a ubiquitous Levantine category of vessels, which can be contrasted with the globular morphology of the first wheel-coiled bowls from Tell Feres.

Evidence for the context of use of wheel-coiled bowls at Tell Qarassa North, takes the form of four specimens that were collected from below the basal level of the walls of an important building, the entrance of which was flanked by two massive stone pillars (Godon *et al* 2015: 161) (Fig. 8). The first phase of the house dates back to the Early Chalcolithic; however its last phase of use, that with which the wheel-coiled bowls were associated, can be attributed to the end of the Middle Chalcolithic/beginning of the Late Chalcolithic (mid-5th millennium BC. Two additional small instances of wheel-coiled vessels were identified (Fig. 8), in a slightly later context, under a wall of a Late Chalcolithic structure, of a possibly domestic nature. All the bowls were virtually intact. While the evidence is admittedly sparse, the deposition of intact bowls under the walls could be read as evidence that the bowls had a 'ceremonial' or other 'non-routine' value, as previously documented for the 'V'-shaped bowls in the southern Levant (Roux and Courty 1997)[9].

Lebanon

Lebanon remains poorly known because of the paucity of fieldwork. Some recent analyses have suggested an early adoption of the potter's wheel in the Beqaa Valley (Badreshany 2013: 253), but the regional and supra-regional context of this innovation is still uncertain. A research programme started in 2015 by the Ifpo-Beirut with the Museum of Lebanese Prehistory (*Université Saint Joseph*) involves technological analysis of ceramic assemblages originating from ancient surface collections and excavations (namely the Chalcolithic collections of the Museum of Lebanese Prehistory), and those from current surveys in central Lebanon.[10]

The 32 assemblages analysed so far testify to the appearance of wheel-coiled 'V'-shaped bowls towards the end of the 5th millennium BC. This is not a tendency specific to a particular area as the same pattern is evident on both large sites (Jisr, Ard Tlaili, Arslan, Khalde, Naccache, Rouaisset al Khalle) and smaller ones (Dbaye, Qalaa 'Aïcha, Jeita, Ras al-Kelb), on the coast (Yerate, Naqura, Birket Rama, el-Heloue, Nahr Damour,) and in the interior (Dommale, Ta'nayil, Baabdat, el-Qlaiaat, Bchamoun, Aaramoun, Bikfaya). Thus the wheel-coiled bowls are typically a trait of the Late Chalcolithic assemblages (Fig. 7). Since the assemblages studied here come from a combination of older and more recent surveys, the percentage of these bowls in each assemblage is not representative in itself, but the average across the surveys — between 0.4 and 0.8% of all late chalcolithic sherds — indicates that these were rare items. Moreover, as in the southern Levant and at Tell Feres, their petrographic features point to the non-local nature of some components. In particular, the wheel-coiled bowls show a very fine dark sandy clay matrix with marble inclusions. This is not consistent with the minerals available locally, which are characterized by different qualities of *terra rossa*-like red clays (Gasse *et al.* 2011; Sayegh and Salib 1969: 168). Furthermore, the homogeneity of the petrographic components of the wheel-coiled bowls is quite remarkable throughout the entire Lebanon area. Within every single assemblage, the wheel-coiled bowls differ from the rest of the contemporary ceramic material, while simultaneously demonstrating a fairly standardized and uniform composition across an area encompassing the northern Beqaaa Valley, the coastal plain and the central upland regions. Even allowing for our limited knowledge of the pedology of Lebanon (Badreshany 2013: 60–61), the marble inclusions do not seem to be local to this area. The petrographic distinction between the wheel-coiled bowls from Lebanon, both from the rest of the assemblages and from the local mineralogical possibilities, recalls the non-local character of the fabrics used to manufacture the 'V'-shaped wheel-coiled bowls known in the southern Levant during the second half of the 5th millennium BC (Roux 2003b).

In Lebanon, the only ceramic material sharing the petrographic components of the 'V'-shaped wheel-coiled bowls is another kind of wheel-shaped bowl: these are globular as in northern Mesopotamia and even less common than the 'V'-shaped variety (between 0.1 and 0.3% of the chalcolithic sherd assemblage) (Fig. 7). Their technological similarity to the wheel-coiled bowls of north Mesopotamia does not consist exclusively in their use of RKE, but also in the dimensions of the coils used to pre-form

[9]The ceremonial function of the Chalcolithic 'V'-shaped bowls, supposedly lamps used during ceremonial events, was suggested by considering, at the scale of the southern Levant, their context of use (settlement versus tombs versus shrines), the strong association between this type of bowl and the use of the wheel-coiling technique, and their clay paste which revealed a mix of local and non-local clay materials (Roux and Courty 2005).

[10]J. S. Baldi is heading this research programme in cooperation with Maya B. Haidar (Museum of Lebanese Prehistory — *Université Saint Joseph*): these observations have to be understood as the very preliminary results of an on-going study. In the longer term, the research programme will focus upon well-stratified material coming from new excavations. All of the assemblages referred to here consist of at least 600 sherds.

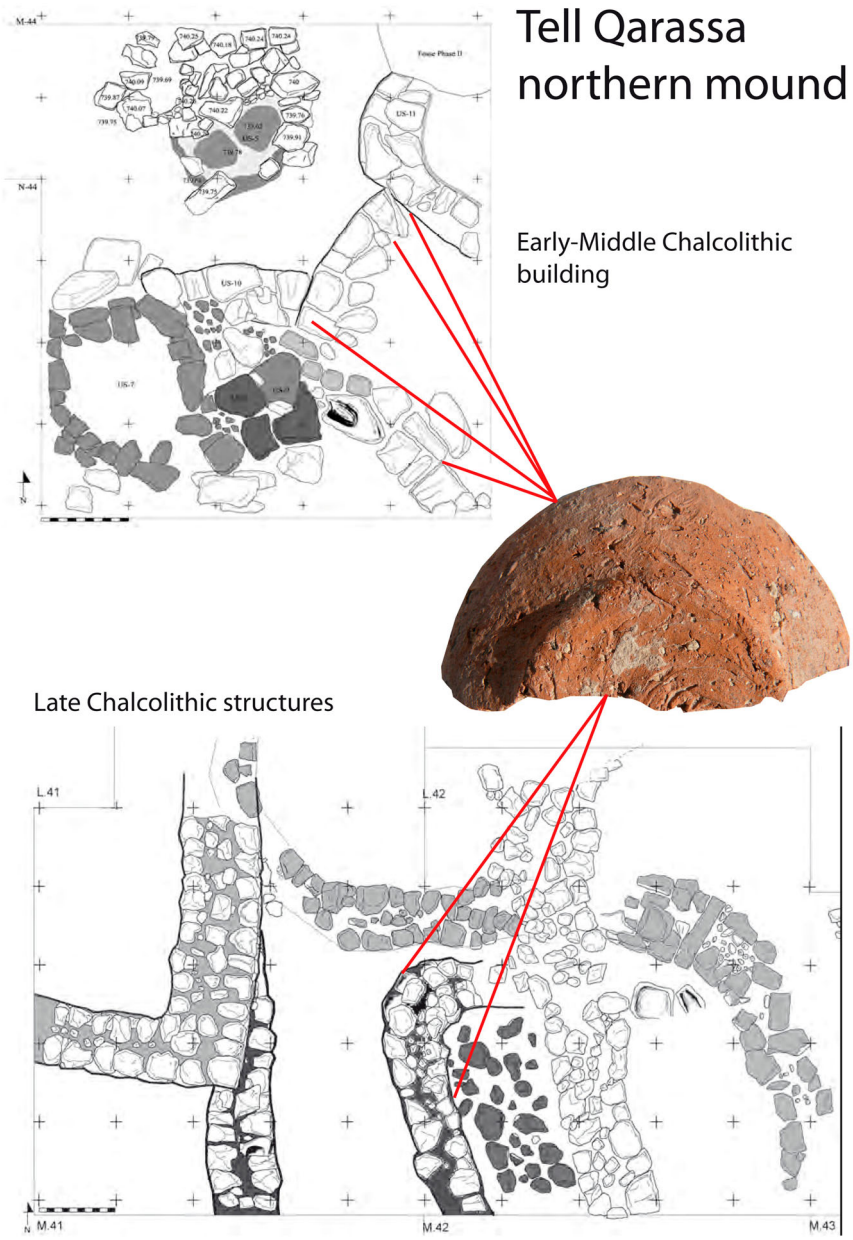

Figure 8. Tell Qarassa North: location of the wheel-coiled specimens. The samples associated with the Early Chalcolithic dwelling come from the last renovation of the structure (final Middle Chalcolithic). Plans drawn by Dr Martin Godon.

the rough-out (coils of thickness 2–2.5 cm in contrast to the 1 cm coil documented in the southern Levant).

These data leave us with two questions:

a) the use of the wheel shaped bowls. The absence of data coming from large excavated areas limits the possibility of understanding the contexts of use of these vessels.
b) the context of their production. Either, they were produced locally, with exogenous material, by potters from the southern Levant and Mesopotamia, or, they were brought to the area by people from the southern Levant and Mesopotamia who moved to the Lebanon with their paraphernalia. In any case, the small quantities in which they occur, and their morphological and technological similarities with southern Levantine and Mesopotamian bowls respectively, argue in favour of Lebanon being a region of contacts, rather than a separate centre of invention.

The question of a possible connection between the southern Levant and Mesopotamia via the Lebanon region is a difficult one; globular and 'V'-shaped bowls (the north Mesopotamian and Levantine

wheel-coiled traditions) have not yet been observed in association in well-stratified contexts dating to the second half of the 5th millennium, and of course, the borrowing of the wheel-coiling technique implies encounters between knowledgeable practitioners — potters. Suffice it to say that the currently available data do not allow us to argue that potters practising the wheel-coiling technique came to the Lebanon region.

Discussion

Comparing the southern Levant, northern Mesopotamia and central-northern Levant

When comparing the conditions for the emergence of the potter's wheel in the southern Levant, northern Mesopotamia and central-northern Levant, two main results emerge.

Firstly, the wheel-coiling technique is the first method of wheel fashioning used with the potter's wheel (also called *tournette*, depending on the quantity of RKE provided by the rotary instrument; Roux and Miroschedji de 2009). The same situation has been observed for the first emergence of the potter's wheel in other regions, at different times, in the Mediterranean — Bronze Age Cyprus and Crete (Jeffra 2011) — or Central Asia during the Middle Bronze and Iron Ages at Ulug Depe (Dupont-Delaleuf 2011). That technology evolved in a similar manner in areas without any geographical or cultural connection, demonstrates that this developmental pattern is not random. On the contrary, it enables us to argue that, from an evolutionary and cognitive perspective, the wheel-coiling technique is the first developmental stage in the use of RKE and, therefore, in the evolutionary tree of the wheel forming techniques (Roux 2010).

Secondly, the conditions for the emergence of the potter's wheel are very comparable in both the southern Levant and north Mesopotamia, regions where the presence of large excavated areas means that we have a reasonable understanding of the contexts in which wheel-coiled bowls were used. In both regions, potters were craft specialists as shown by the specialist skills involved (Roux and Corbetta 1989). They were few in number and attached to elites as shown by the ceremonial or elite-related function of the wheel-coiled vessels and their use contexts. The nature of 'elites' in the Late Chalcolithic of the Levant is controversial, a matter which goes beyond the scope of this study (Bourke 2001: 151; Rowan and Golden 2009: 67–68; Rowan and Ilan 2007: 249; Joffe 2003). The notion of 'elite' is, however, mostly associated with the chiefdom concept and with the existence of ranked societies with various degrees of internal complexity (Forest 2001; Kerner 2010). However, the term 'elite' is not used here to refer to a specific chiefdom organization. Even in quite hierarchical organizations, where socio-economic systems are based on horizontal complementarities between large household units, emerging 'elites' play important regional and supra-regional roles, which deal less with 'power' than with 'co-ordination' (Verhoeven 2010). We apply the term 'elite' here to people who promoted a new technique through the demand for ceremonial bowls that were, apparently, used throughout the southern Levant.

In the same way, the notion of 'attached specialists' does not mean that the social systems in northern Mesopotamia and the southern Levant were similar. It is likely that in early 4th millennium northern Mesopotamia, the nature of the 'attachment' between potters and elites implied that, at least during certain times of the year, artisans were dependent upon quite centralized political institutions (Baldi 2012d; 2012e; McMahon 2013; Oates *et al.* 2007) and produced exclusively for them. On the other hand, in the Late Chalcolithic southern Levant, craft-specialists probably produced specific vessels during particular occasions for the leaders of their own kinship group, or according to supra-local kinship and exchange relations (Baldi 2013b; Commenge-Pellerin 2006; Goren 2006). Moreover, it seems that in both cases these potters were itinerant, and undertook the production of wheel-coiled vessels at a macro-regional scale. In the southern Levant this has been suggested by the clay pastes of the wheel-coiled bowls, which are a mix of local clays with clay from the Negev, as observed at Abu Hamid, Abu Matar, 'En Gedi, Neveh Ur, Tell el-Far'ah, Teleilat Ghassul, Pella, Tel Fendi, Azor and Sahab (Roux and Courty 2005)[11]. In Mesopotamia, at Tell Feres, this is suggested by the composition of the paste which is not local, and the origin of which could be the south-eastern Taurus. This hypothesis is consistent with the presence on many sites of a small number of well-made and standardized wheel-coiled bowls; such high standardization implies intense production.

[11]Indeed, the wheel-coiled bowls are not the only ceramic material suggesting the existence of attached specialists working under particular circumstances (Goren 2006). This is also the case with other very peculiar ceramic shapes, such as the so-called torpedo jars from Gilat, which were manufactured using clays from different regions, or the big ritual churns that were produced in standardized sizes (Commenge-Pellerin 1990; 2006).

Evolutionary trajectories of the wheel-coiling technique

In the southern Levant during the Late Chalcolithic period the potter's wheel did not spread. Rather, it disappeared with the collapse of the local Late Chalcolithic societies (Braun and Roux 2013; Roux *et al.* 2013a; 2013b). When it reappeared during the 3rd millennium BC, the potter's wheel was in the hands of potters attached to the palaces (Roux and Miroschedji 2009). It disappeared again when these entities collapsed at the end of Early Bronze Age III, and reappeared only in the 2nd millennium through the demic expansion of northern populations, and the associated spread of a new socio-economic system in which craft specialist were in charge of all pottery production (Roux 2013).

In a very similar way, at Tell Feres and across northern Mesopotamia generally, the wheel-coiling technique did not spread during the 4th millennium BC (end of the LC2). Rather, it remained in exclusive use for the manufacture of the few fine globular wheel-coiled bowls, without transfer to any other functional types. It briefly disappeared at the beginning of the LC3 period (around 3800 BC) with the beginning of the southern Mesopotamian (Uruk) colonial presence in the North and with a reorganization of the economic networks of the northern proto-urban elites. Some settlements (such as Sheikh Hassan or Hirbemerdon Tepe) appeared, while others (such as Tepe Gawra or Hamoukar) were abandoned (Rothman 2002; Stein 2012). When wheel-coiling reappears, it is during late LC3 and the LC4–LC5 periods (between 3600 and 3100 BC), along with new organizational dynamics between the local northern and southern Uruk elites.

In late LC3 and LC4, at some major north Mesopotamian proto-urban centres, such as Arslantepe and Oylum Höyük, wheel-coiling was used to produce bowls intended for the redistribution of food rations by indigenous elites (Balossi Restelli 2012: 244; Balossi Restelli and Helwing 2012: 294; D'Anna and Guarino 2012: 61–62, fig. 5a; Helwing 2012: 219). Then, during the LC5, in the context of close contact with south Mesopotamian Uruk traditions, the wheel-coiling technique was used for producing specific, and relatively rare, vessel types, in this case a medium-sized and very fine type of hammerhead plate (Helwing 1999; 2002; Stein 2012)[12]. Surprisingly, at Tell Feres, the paste of these wheel-coiled vessels is the same as that used in LC2, namely a terra rossa-like clay matrix containing serpentine (i.e. non-local) inclusions, suggesting comparable craft organization. The wheel-coiling technique disappeared again at the beginning of the Early Bronze Age (the so-called Early Jazeera 0–I–II periods in the Syrian Jazira) with the collapse of the southern Mesopotamian colonial networks and the resulting radical changes in the power systems of the local elites (Wilkinson *et al.* 2014). Later, in the 3rd millennium BC, the same technique reappeared once again, but was limited to quite specific, fine products, such as certain late versions of Nineveh V vessels and some instances of the so-called Akkadian 'metallic wares' (Boileau 2005).

It is striking to observe the non-diffusion of the wheel-coiling technique in both the southern Levant and northern Mesopotamia, and that in both cases this entailed discontinuous evolutionary trajectories (Fig. 9). In neither area was the wheel-coiling technique transferred to utilitarian vessels, remaining, rather, in the hands of a few artisans, and disappearing whenever the demand for wheel-coiled bowls ceased. This phenomenon can be understood in light of the process of affiliation and differentiation which occurs regularly in heterogeneous communities, for example communities of potters made up of social groups making different ranges of vessels with different techniques. In these communities, each group learns to produce a particular range (or multiple ranges) of vessels using specific techniques, that are learned in the course of apprenticeship, particular techniques then becoming associated with specific types of vessels. The outcome of this process is a strong correlation between techniques and specific products, as well as between products and social groups. It follows a general tendency towards mechanisms of affiliation (within each social group) and differentiation (between distinct groups) fostering persisting technological boundaries between the groups (Gelbert 2003; Gosselain 2000; 2010; Henrich and Boyd 1998; Roux 2008; 2013; Stark 1998). These boundaries can be transgressed only in presence of very particular social conditions and circumstances (Gosselain 2008; Roux 2015).

This explains the fact that when pottery production is divided into wheel-coiled symbolically-charged vessels made by potters attached to elites, and non-

[12]During LC3–4, large hammerhead bowls in chaff-faced fabrics were a hallmark of the indigenous north Mesopotamian assemblages (Baldi 2013a; Frangipane 2009; Oates 2006; Oates *et al.* 2007; Stein 2012) and they were produced by a fast moulding technique. LC5 wheel-coiled hammerhead bowls are a radically different matter: the 'hammerhead'-shaped rims reflected a local morphological tradition, but these vessels were rare, mineral-tempered and finely made (by wheel-coiling) according to a southern Mesopotamian tradition. From all points of view, they represent a case of technical hybridization between the north and south Mesopotamian technical traditions (Baldi forthcoming).

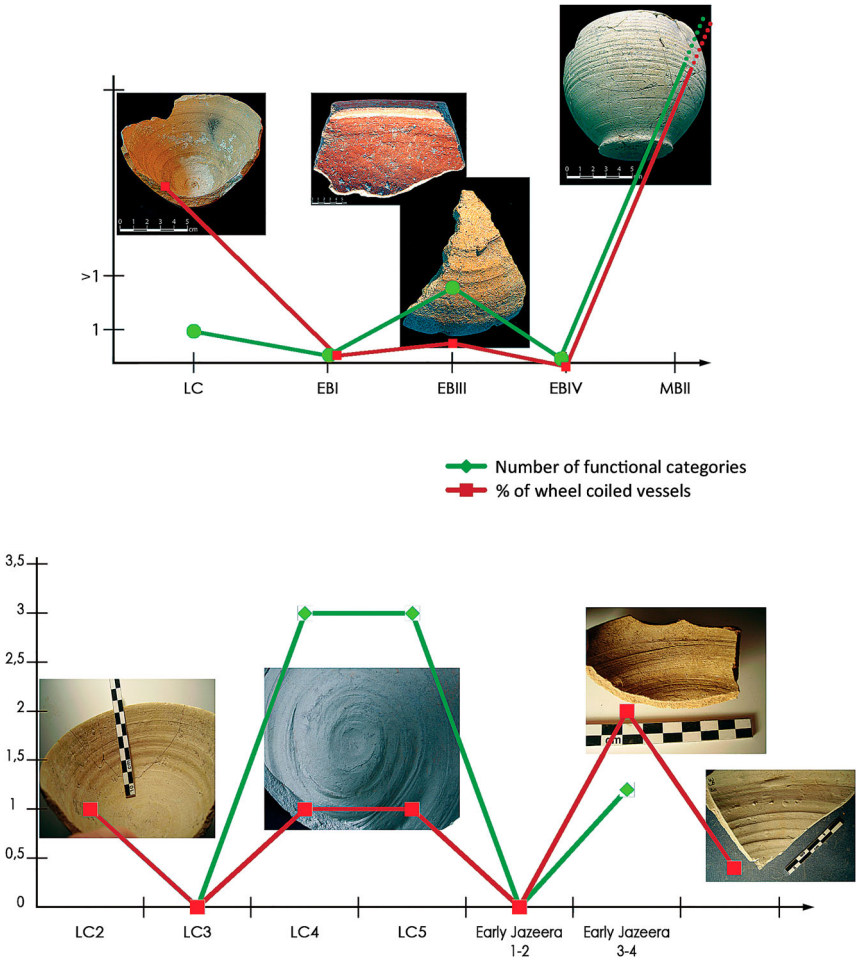

Figure 9. Comparison of the evolutionary trajectories of the wheel-coiling technique in the southern Levant and in northern Mesopotamia.

wheel-coiled utilitarian vessels made by other categories of artisans, there is no transfer of the former technique to the utilitarian vessels. In our case studies the wheel-coiling technique and the associated wheel-coiled vessels represented technological norms different from those associated with utilitarian vessels. As a result, these technological norms acted as socio-cultural as well as cognitive boundaries, thus preventing the transfer of the wheel-coiling technique to the utilitarian vessels.

Conclusion

As far as the history of the potter's wheel goes, it is now possible to compare the chronology, trajectories and modalities of introduction of this fundamental innovation across large areas of the Near East. Recent evidence from northern Mesopotamia demonstrates that the potter's wheel was not a consequence of southern Uruk urban and colonial expansion, rather it was a technology that was already in use in a local northern proto-urban context. However, despite new data from the central and northern Levant (Tell Qarassa North and Lebanon), we cannot yet say whether this innovation was genuine and independent, or whether it spread from the southern Levant to northern Mesopotamia.

From the point of view of the anthropology of techniques, several regularities appear. When comparing the innovation processes of the potter's wheel in northern Mesopotamia and the southern Levant, it appears, that despite obvious cultural differences between societies in the two areas — the former characterized by heterarchical co-operation between different types of 'elites' (Golden 2014; Rowan and Golden 2009; Kerner 2010), the latter by hierarchical proto-urban elites (McMahon 2013; Frangipane 2010) — there are regularities that underlie the diversity of the historical scenarios describing the emergence of the potter's wheel. These regularities include the context within which the potter's wheel emerged; one of attached craft specialists responding to a demand for specific vessels to be used in ceremonial contexts in

ever more hierarchical societies. In both cases the first use of the wheel was, therefore, not intended to improve productivity, but was associated with symbolically charged vessels. This also explains why, in both cases, the wheel-forming technique was used for the manufacture of small-sized open vessels, as this shape is particularly associated within ceremonial contexts (used as lamps in the southern Levant). Given such a context of production, it follows that the evolution of the wheel-coiling technique followed a very similar path in both regions, while the particular context served to restrict the transfer of the wheel-coiling technique to other functional categories of vessels, thus aiding its disappearance whenever the demand for these special vessels ceased.

These conditions for the emergence of the potter's wheel have been observed with other technical innovations representing thresholds in the history of techniques, such as lost wax casting in the field of metallurgy, or lever pressure in the lithic sphere (Roux *et al.* 2013a). They could also explain why major technical innovations appeared during the Chalcolithic, a period characterized in multiple regions by the emergence of elites who provided a demand for prestige or special objects.

Going one step further, our results indicate that social change (as far as the case studies presented here are concerned — the emergence of different kinds of Late Chalcolithic elites) acts as a primary mechanism for innovation (Roux 2010), as previously suggested by anthropologists (Creswell 1996). This empirical result contrasts with Darwinian hypotheses, which insist on the importance of population size in the innovation process (Bentley and O'Brien 2011; Powell *et al.* 2010). One may wonder here about a correlation hiding another important issue, that of the relationship between population size and social structures.

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