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Project Gallery

Deconstructing the 'Gandhāra still': a new challenge to the accepted trajectory of early distillation technology

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The 'Gandhāra still' has been an influential element in the archaeology of south-central Asia for decades. This project combines archival research, material synthesis and experimental evaluation to reappraise this eminent and pervasive reconstruction, and to systematically dismiss an assumed component in the history of distillation.

Background

The ancient region of Gandhāra (encompassing parts of Pakistan, Afghanistan and northern India) is often cast as a point of origin for early distillation technology. Ceramics interpreted as distillation apparatus from excavations in this region reportedly chart innovations in distillation through morphological changes. Yet such conceptualisations rely on recreating and reassembling complete articulated stills from fragmentary material, on assumed functions and on preconceived developmental stages. Therefore, 'early' apparatus configurations, seen to pre-date recognisable forms of distillation by modern standards, derive from comparisons drawn with modern equipment and chemical understanding (McHugh 2020: 45). Thus, the arrangement of hypothetical reconstructions into evolutionary models (e.g. Needham *et al.* 1980: 81) and global diffusions of distillation traditions (e.g. Park 2021: 27) cannot be achieved without first scrutinising individual reconstructions of apparatus forms and origins.

Between 2018 and 2022, as part of a body of research examining the impact of Hellenism on technological change in Gandhāra, a ceramic typology connected with early distillation, and seen to exemplify the emergence of a significant technical innovation, was interrogated. The 'receiver-condenser', a unique vessel with a large body and angled spout, was first identified as a 'water condenser' during excavations at Sirkap, Taxila (Marshall 1951: 420–21) (Figures 1 & 2). As a central component of the later-termed 'Gandhāra still', the vessel's earliest iteration has been labelled as a Greek, Indo-Greek and Saka typological form as chronologies are revised, suggesting morphological variability in its characterisation. While a significant number of these vessels were recovered during excavations at Shaikhān Dherī, Charsada (Figure 2) (Allchin 1979: 59–60), different receiver-condenser forms have been reported across greater Gandhāra, expanding the vessel's chronological range to include finds from as early as the fourth century BC (e.g. Mahdihassan 1972: 165). As a complete apparatus, the still comprises three specialist components—a still head or cowl, a condensing

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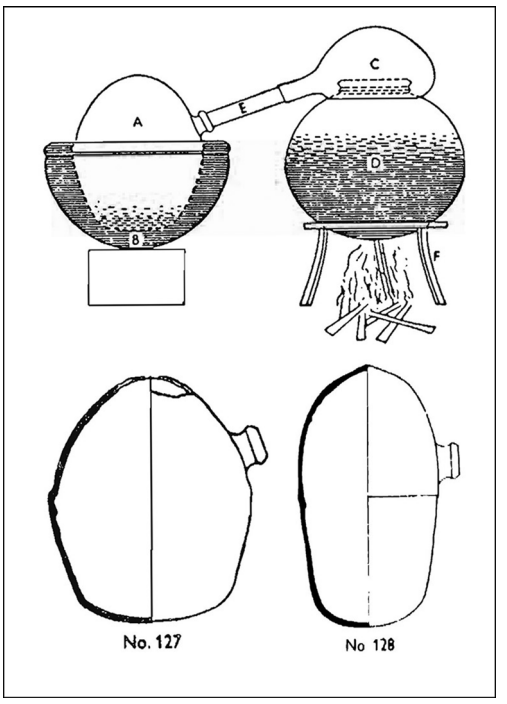

Figure 1. Reconstruction of the 'Gandhāra still' from Sirkap and its morphologically different 'condensers' (not to scale) by Marshall (1951: pl. 125).

tube and a receiver-condenser—along with a still body and cooling basin fashioned from cooking vessels (*handi*) (Marshall 1951: 420). Although continually cited since its first publication, the original reconstruction of the receiver-condenser has only recently been criticised, owing to issues with artefact distribution and frequency and chronological inconsistencies (see McHugh 2020). No comprehensive survey has fully evaluated reported evidence for the Gandhāra still, particularly the receiver-condenser. Under these circumstances, the functional capacity of the reconstruction, its constituent parts and contribution to regional narratives require further critical assessment.

Methodological approach

Interpretation of the still was evaluated through two lines of analysis: assessment of its representation and typological range and a practical test to determine whether the individual vessels would function together as distillation equipment.

Material survey

Primary information on excavations was revisited to understand reconstructions in individual contexts. Archives, collections, catalogues and site diaries, primarily from the Ancient India and Iran Trust, were consulted to establish reported numbers and distributions of apparatus components from the earliest phase of the still's interpretation. In total, 76 components were recorded across 16 sites: 65 receiver-condensers, seven still heads and four condensing tubes. Items were distributed across five chronological groups, but previously ascribed to a multitude of cultures. As the characteristic feature of the Gandhāra still, the projected receiver-condenser shape had been broadly applied to other vessels that shared few features (Figure 2). Despite its distinctive form in comparison to other components, undiagnostic spouts, fragmented body sherds and generalised shape descriptions have been used to mark the presence of receiver-condensers ('misclassified/mistyped' on Figure 2), unintentionally creating an artificial overestimation of the spread of the Gandhāra still. The Shaikhān Dherī finds, seen to demonstrate a typological evolution (e.g. Allchin 1979; Husain 1993), equally display morphological divergence and inconsistencies within chronological groups. This indicates that the receiver-condenser is unlikely to be as widespread or standardised as previously

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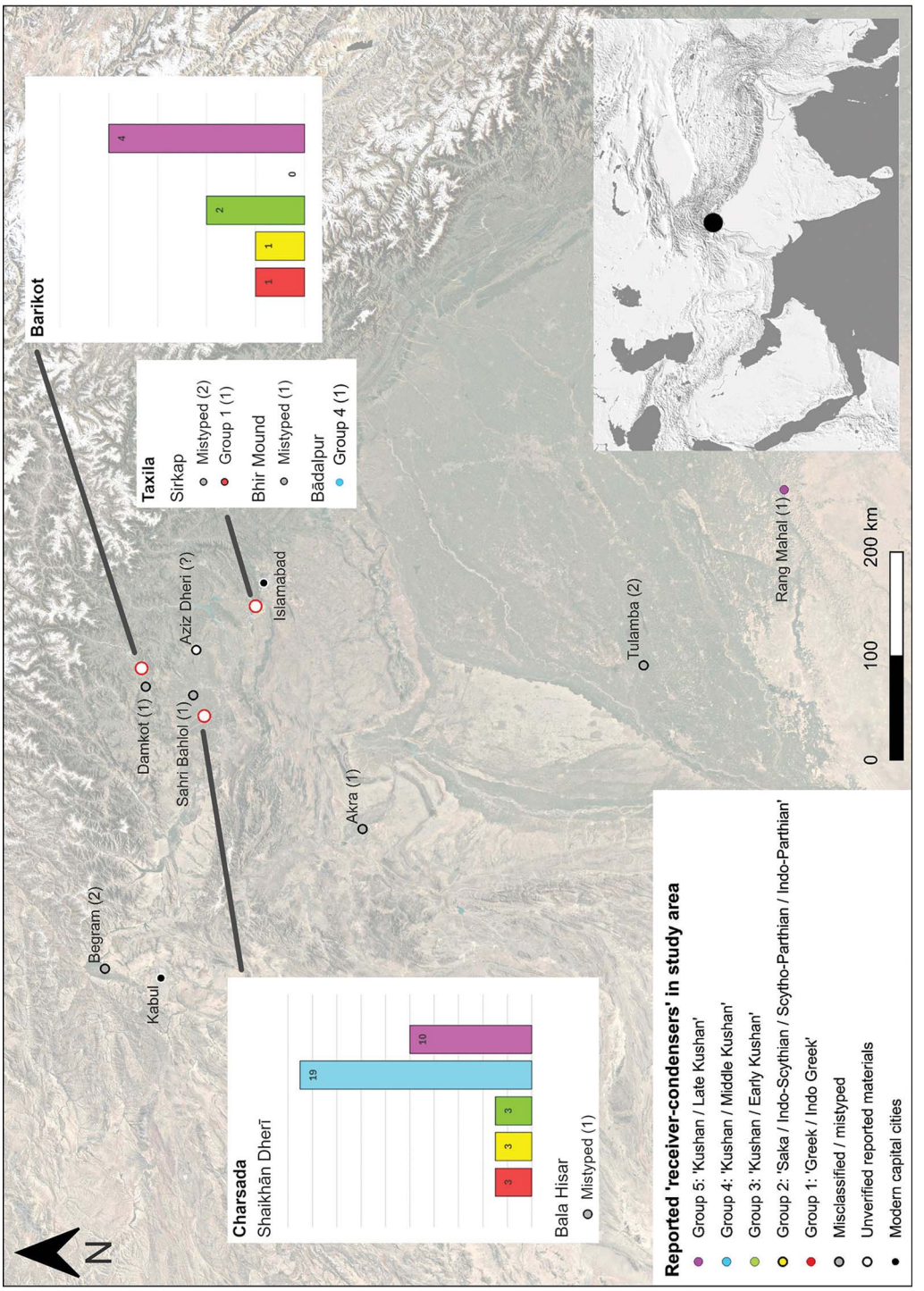

Figure 2. Distribution of reported 'receiver-condensers' by chronological groups and morphological similarities (figure by author).

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suggested. Hence, the prevalence of receiver-condensers raises questions about the comparative absence of complete articulated stills and other specialist components, irrespective of archaeological preservation conditions.

Experimental campaign

Experimental water distillations, modelled on Marshall's original reconstruction and using a replica Gandhāra still made by an experienced potter, identified issues overlooked in previous work appraising the still's distilling capabilities (Table 1). Following suggested modifications to the apparatus on heating (use of hearths), sealant materials (wet clay) and condensing techniques (see Allchin 1979), experiments demonstrated that the still routinely failed to accommodate conditions conducive to distillation.

The combination of individual vessel morphologies struggled to facilitate distillation without modifications that are neither observed in the archaeological record nor accounted for in reconstructions. By trialling different volumes of starting liquids, heating methods and run times across the campaign, specific issues with the apparatus could be isolated. In tandem with detailed temperature mapping of apparatus components, multiple experiments identified how leaks caused by internal reflux processes, vapour build-up and insufficient areas for condensation regularly impeded distillation. These issues were exacerbated by a channel formed between the still head and body that gathered distillate (Figure 3). As such, the reconstructed still fundamentally could not condense the volume of water vapour produced (see Groat 2023 for detail). This observation underlines issues identified in material representation (see McHugh 2020) by connecting functional parameters of the apparatus with operational problems revealed through practice. Accordingly, the unification of material synthesis and experimental evaluation exemplifies the consistent failure of the apparatus, further refuting the plausibility of the Gandhāra still.

Table 1. Summary of distillation experiments (see Groat 2023).

Set	Heat source; location	Heat source mean (°C)	Cooling/ condensing techniques	Run time (mins)	Start/end water (ml)	Collected distillate (ml)
Comparative (lab-based)	Hotplate; base	261.5	Regulated condensing tube cooling	240	2000/563	0
		234.1		240	4000/2477	9
		274.1		240	6000/4490	3
Exploratory (outside)	Clay hearth fire; base/lower-body	510.4	Condensing tube cooling	120	4000/2750	0
		561.4	Condensing tube/ basin cooling	60	4000/2850	146
		509.2		60	4000/2910	0
	Rock hearth fire; base/lower-body	365.7		120	4000/2010	0
		320.1		60	4000/2950	3
		502.9		180	4000/1010	16

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Figure 3. Complete experimental apparatus (left) and distillate leaking through a channel created at a contact point between the still body and head (right) (after Groat 2023: fig. 59).

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Rethinking the distillation hypothesis

Through revisiting an established idea in the historiography of distillation, supplementary experimental evaluation provides a critical perspective on a reconstruction that is not apparent when reviewing archaeological evidence alone. This insight provides further justification for questioning the validity of the reconstruction of the Gandhāra still and the 'receiver-condenser' label, and re-opens debate surrounding evolutionary models and maps of distillation innovation diffusion by dismissing key elements integral to their logic. Ultimately, such models carry more concerning issues than we may be comfortable acknowledging, and so need challenging. While not unique to distillation, accepted interpretations of technological histories often unconsciously contribute to national, global and colonial narratives (Rocha 2016: 14–18), onto which political ambitions have been projected. Consequentially, this association highlights the influence of technological reconstructions like the Gandhāra still that have largely been taken at face-value.

More positively, this evaluation encourages review of material away from distillation interpretations, instead opening it up to emerging dialogues on local agency and cultural interaction. Equally, the potential for applying new analytical methods to existing archives and materials is exemplified, offering renewed perspectives on distinctive pottery forms. The material survey, experimental campaign and re-evaluation of receiver-condenser groups are in preparation for publication; revising recent contextualised reports of the receiver-condenser (e.g. Callieri 2020: 548–50) and localised concentrations of this vessel (e.g. Husain 1993) can lead to meaningful reconsiderations of technology in a region and period dense with sociocultural interactions.

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