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Two Bronze Equal-Arm Balances (*Librae*) from Perge: Their Archaeological Context and Function

Perge'den İki Bronz Eşit Kollu Terazi (Librae): Arkeolojik Bağlamları ve İşlevleri

Aytaç DÖNMEZ [*] Sedef ÇOKAY KEPÇE [**]

Abstract: Excavations carried out at the Stadium of Perge between 2020 and 2025 have demonstrated that the northern sphendone of the structure was transformed during Late Antiquity through a series of architectural modifications into a venue for amphitheatrical spectacles. As part of this transformation, the spectator entrances (*vomitoria*) within the sphendone, together with most of the vaulted chambers that probably originally functioned as shops, were converted into animal and gladiatorial holding cells. Excavations conducted within these cells and the surrounding vaulted chambers further revealed that, from the late 4th or early 5th century CE onwards, the vaults other than the animal cells were then repurposed as workshops and production spaces accommodating a range of craft activities. Among the archaeological finds recovered from these vaulted chambers are two bronze equal-arm balances, which are noteworthy both because they represent some of the few Roman-period examples from Anatolia recovered from well-documented stratigraphic contexts and because they provide valuable evidence for the economic and commercial activities carried out in the Stadium of Perge during Late Antiquity.

Keywords: Perge, *Librae*, Bronze Equal-Arm Balances, Roman Period, Late Antiquity

Öz: 2020–2025 yılları arasında Perge Stadiumu'nda gerçekleştirilen kazılar, yapının kuzeydeki sphendone bölümünün Geç Antik Dönem'de bir dizi mimari düzenlemeyle amfitiyatral gösteriler için bir gösteri alanına dönüştürüldüğünü ortaya koymuştur. Bu dönüşüm sürecinde, stadiumun sphendonesindeki seyirci girişleri (*vomitoria*) ile olasılıkla başlangıçta dükkân olarak işlev gören tonozlu mekânların çoğu, hayvan ve gladyatör bekletme hücrelerine dönüştürülmüştür. Bununla birlikte, bu hücrelerde ve arenayı çevreleyen diğer tonozlu mekânlarda gerçekleştirilen kazılar, MS 4. yüzyılın sonlarından veya 5. yüzyılın başlarından itibaren hayvan hücreleri dışındaki tonozlu mekânların çeşitli zanaat faaliyetlerinin yürütüldüğü atölye ve işliklere dönüştürüldüğünü göstermiştir. Söz konusu tonozlu mekânlarda gerçekleştirilen kazılar sırasında ele geçen arkeolojik buluntular arasında yer alan iki bronz eşit kollu terazi, hem Anadolu'da stratigrafik bağlamı iyi belgelenmiş Roma Dönemi'ne ait sınırlı sayıdaki örnekler arasında yer almaları hem de Perge Stadiumu'nun Geç Antik Dönem'deki ekonomik ve ticari faaliyetleri hakkında değerli kanıtlar sunmaları bakımından dikkat çekicidir.

Anahtar Kelimeler: Perge, *Librae*, Eşit Kollu Teraziler, Roma Dönemi, Geç Antik Dönem

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Introduction

From the Roman Imperial period through to the end of Late Antiquity, two principal weighing systems serving different commercial and craft-related purposes were widely employed across the Eastern Mediterranean. While steelyards[1] (*staterae*), operating on the principle of leverage, were preferred for weighing bulky and heavy commodities, bronze equal-arm balances (*librae*) constituted the standard instruments for weighing lighter, higher-value goods[2]. Throughout the Roman Imperial and Byzantine periods, bronze equal-arm balances played a fundamental role in ensuring the reliable conduct of commercial transactions, maintaining standardized systems of weight, and supporting the orderly functioning of the market economy[3].

Bronze equal-arm balances generally consist of a long, circular-section beam, a centrally positioned pointer and suspension assembly, and ring-shaped terminals at either end to which the pans were attached by means of chains. During use, the commodity to be weighed was placed in one pan, while standardized weights were placed in the other. Equilibrium was achieved when the beam assumed a horizontal position, with the central pointer indicating that the two loads were balanced[4]. Well-preserved bronze equal-arm balances recovered from the House of Menander at Pompeii clearly illustrate the operation of this mechanical system, preserving the circular-section beam, the central suspension assembly, the circular bronze pans suspended by chains, and the four-hole suspension arrangement of the pans[5]. Examples recovered from numerous sites across the Roman world demonstrate a remarkable degree of standardization in both their overall form and their mechanical operating principles throughout the Mediterranean basin[6].

In contrast, bronze equal-arm balances recovered from secure stratigraphic contexts in Anatolia remain exceedingly rare. Consequently, the examination of their typological characteristics in conjunction with their archaeological contexts provides valuable insights into the economic life, as well as commercial and craft activities, of the Roman period. The two bronze equal-arm balances (*librae*) recovered during the excavations of the Stadium of Perge constitute particularly significant examples in this respect, owing to both their secure archaeological contexts and their well-preserved typological features. Although both examples were recovered without their pans and suspension chains, the surviving balance beams, suspension assemblies, and terminal fittings clearly identify them as examples of the *libra* type. This study first presents these finds within their archaeological contexts, then compares their typological characteristics with parallel examples from across the Mediterranean, and finally discusses their possible uses.

Context

Both fragmentary bronze equal-arm balances were recovered during the 2024 excavations in the western vaulted chambers of the Stadium of Perge[7]. One specimen (Pg.lib. 1) was found in front of Vault 40, while the other (Pg.lib. 2) was recovered from within Vault 45 (Figs. 1-3). Vault

1 Franken 1993, 70. 120.

2 Acara-Eser 2003, 34; Oransay 2006, 121; Demirer 2013, 62; Şahin 2017, 58.

3 Morrisson 2012, 379–381.

4 Waldbaum 1983, 82-3; Allison 2006, 34.

5 Allison 2006, 34, 173, 341, Cat. Nos. 1173–1174, Pl. 78.3–4. For the exceptionally well-preserved bronze equal-arm balance recovered from Kaiseraugst (Switzerland) and published as "Waage 1", see also Mutz, A. 1983, 28–31, Figs. 15–16.

6 Waldbaum 1983, 83; Oransay 2006, 121–122.

7 Çokay-Kepçe et. al. 2025, 207–208; 2026, 175–176.

40 is thought to have originally functioned as a shop during the stadium's primary phase of use[8]. During its subsequent conversion into an amphitheatre, the wall facing the arena was breached by the width of a doorway, creating a new entrance, and the space was reconfigured as one of the holding cells for gladiators and for condemned criminals (*noxii, damnati*)[9]. During this phase, the floor of the chamber remained at the level of the original stadium surface. In Late Antiquity, however, the floor level was raised by means of a fill approximately 0.70 m thick, creating a new occupation surface about 0.90 m above the original stadium floor[10]. A workshop, probably associated with glass production, was subsequently established on this new surface, and the workshop phase is stratigraphically distinct from the earlier phase during which the chamber functioned as a holding cell[11]. The first balance discussed in this study (Pg.lib. 1) was recovered approximately 1 m west of this workshop, embedded within the fill deposit belonging to the same Late Antique occupation phase.

Fig. 1 Perge Stadium-Amphitheatre. Vaults no.40 and 45 (Photos: ABAUAM Archive)

Figs. 2-3 Perge Stadium-Amphitheatre. Vaults no.40 and 45 (Photos: ABAUAM Archive)

8 The vault numbering system adopted in the excavation reports of the Stadium of Perge published up to 2025 has been revised following a re-assessment of the stadium plan. Accordingly, the numbering used in earlier publications has been advanced by one. Thus, the chamber previously identified as Vault 39 is designated as Vault 40 in the present study and in subsequent publications.

9 Dönmez 2025, 212, 223.

10 Dönmez 2025, 223.

11 Çokay-Kepçe et al. 2026, 176. A comprehensive study of the Late Antique glass-production workshops identified in five vaulted chambers of the Stadium of Perge is currently in preparation by Sedef Çokay-Kepçe and Özgü Çömezoğlu Uzbek.

A stratigraphic sequence comparable to that documented in Vault 40 was also identified in Vault 45, where the Late Antique occupation level was found to lie approximately 1.70 m above the original stadium floor. Glass furnaces uncovered along the western entrance of the chamber, together with associated production debris, demonstrate that the space was used as a workshop during Late Antiquity. Like the first specimen, the second balance was recovered from the fill deposit associated with this workshop phase.

As noted above, both finds belong to the same Late Antique phase of production and occupation. The chronology of this phase is securely established by the bronze coins recovered from Vault 40, which date to the reigns of Valens I (364–378 CE), Theodosius I (379–395 CE), Arcadius (383–408 CE), and Honorius (393–423 CE)[12].

Fig. 4. Pg.lib. 1 (Photo: ABAUAM Archive)

Fig. 5 Pg.lib. 1. Other side (Photo: ABAUAM Archive)

Pg.lib. 1 (Inv. No. B.24.470)

Pg.lib. 1 is made of bronze (Fig. 4-5). The object is partially preserved, with the surviving balance beam measuring 13.8 cm in length. The suspension arm is 3.8 cm high, while the pointer measures 2.3 cm in length. Although the surface exhibits localized corrosion, the overall form and mechanical arrangement of the balance remain clearly discernible. The circular-section balance beam is largely preserved, together with the centrally positioned pointer and the suspension arm attached to it by means of a rivet. The rectangular-section pointer moves within a framed axis associated with the suspension arm. Both ends of the beam terminate directly in ring-shaped attachments for the suspension of the pans, without any profiled transition between the beam and the rings. The suspension arm likewise displays no profiling or decorative treatment. The pans and suspension chains are not preserved.

[12] See fn. 10.

Fig. 6 Pg.lib. 2. (Photo: ABAUAM Archive)

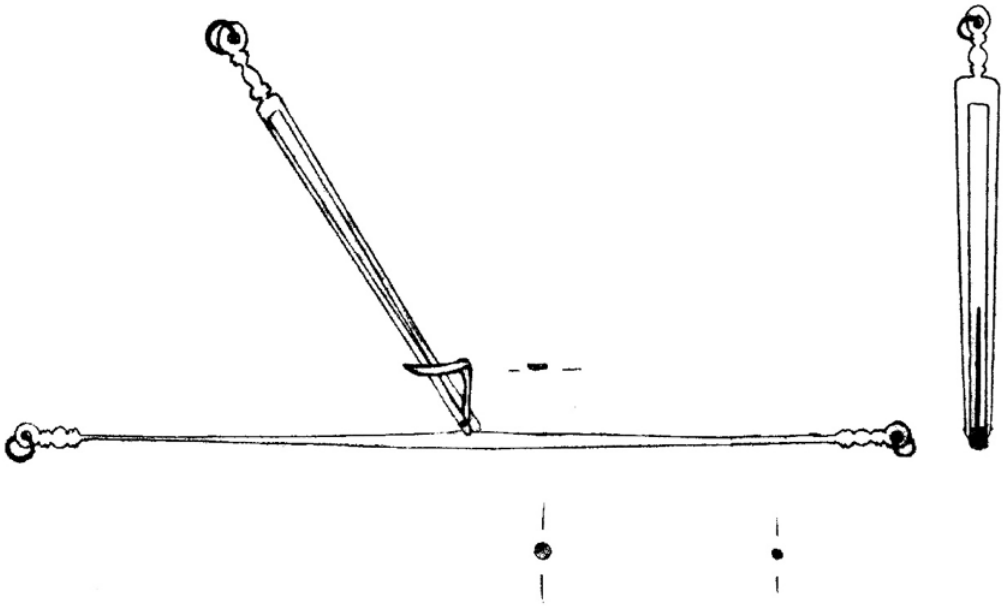

Fig. 7 Pg.lib. 2. Drawing of the present state and sectional view of the proposed original form of the suspension handle (A. KILINÇ-DÖNMEZ)

Pg.lib. 2 (Inv. No. B.24.611)

Pg.lib. 2, like the first specimen, is made of bronze (Fig. 6). The balance beam measures 15.4 cm in length, the suspension arm is 8.8 cm high, and the pointer measures 2.3 cm in length. The object is better preserved than Pg.lib. 1. The circular-section balance beam, the centrally positioned pointer, and the suspension arm attached to it by means of a rivet are largely intact. Although the pointer is slightly deformed, the overall form and mechanical arrangement of the balance remain clearly discernible. As in Pg.lib. 1, the pointer moves within a framed axis associated with the suspension arm; in Pg.lib. 2, however, this framed arrangement is more clearly articulated. The suspension arm and the central suspension assembly are also more elongated than those of the first specimen (Fig. 7). Unlike Pg.lib. 1, the circular-section pointer gradually tapers towards the top. Ring-shaped attachments for the suspension of the pans are preserved at both ends of the beam, immediately behind which is a series of bead-and-reel mouldings. A comparable profiled treatment is also present on the suspension arm. The pans and their suspension chains are not preserved (Fig. 8).

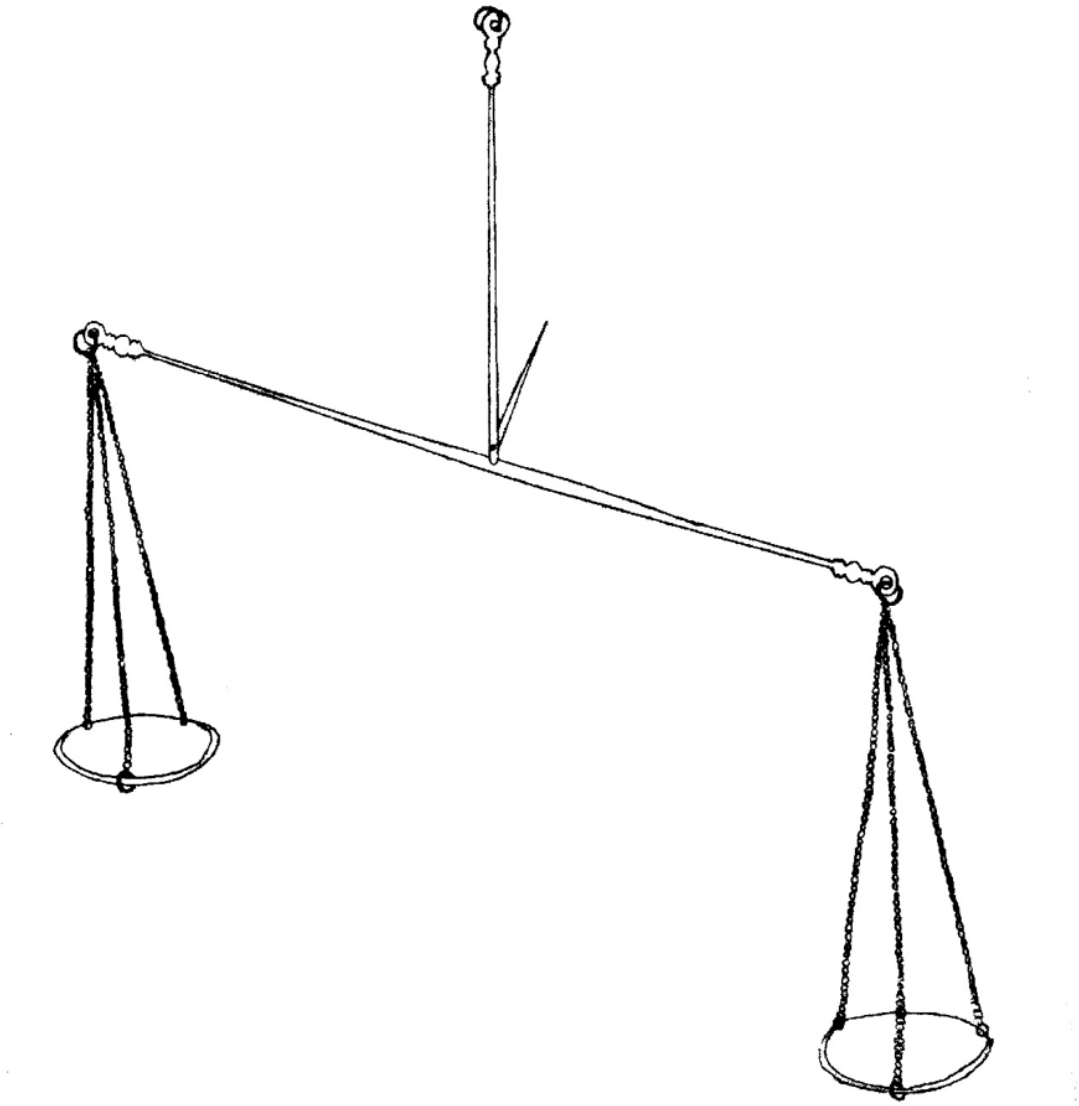

Fig. 8 Pg.lib. 2. Proposed reconstruction with the missing chains and pans (A. KILINÇ-DÖNMEZ)

Evaluation

The Perge examples are consistent with Roman bronze equal-arm balances in terms of their overall form and operating principle. In both specimens, the centrally positioned pointer moves within a framed axis associated with the suspension arm, thus reflecting the same basic mechanical principle. The differences between the two examples lie not in the mechanical system itself, but rather in the proportions and configuration of the central suspension arrangement and in the use of profiled decorative elements. Pg.lib. 1 is characterized by a shorter and simpler central arrangement and undecorated beam terminals, whereas Pg.lib. 2 is distinguished by a longer and more pronounced suspension arm and framed central arrangement, together with bead-and-reel profiles on both the suspension arm and the ends of the beam. On the basis of these formal differences, the two examples are discussed below under the headings “Plain Arrangement” and “Profiled Arrangement”.

Plain Arrangement

Pg.lib. 1, examined in the present study, exhibits the characteristic features of the examples discussed under this heading, with its simple terminal arrangement and plain, undecorated

form. In this arrangement, the circular-section balance beam terminates directly in ring-shaped attachments for the suspension of the pans, without any profiled transition or decorative element at either end. Within the central suspension system, the pointer moves within a framed axis associated with the suspension arm. Although this arrangement operates according to the same basic mechanical principle as Pg.lib. 2, it is distinguished by its shorter and less pronounced framed central arrangement and by the absence of profiled decoration on both the suspension arm and the ends of the balance beam.

Close parallels for this formal arrangement are known from Sardeis[13], Arykanda[14], Tralleis[15], and the Köprülü Mahallesi chamber tomb at Tralleis[16]. These examples share several common features, including a plain and undecorated balance beam, ring-shaped attachments for the suspension of the pans at either end, and a centrally positioned pointer fixed to the beam. Although their states of preservation vary, they are comparable with Pg.lib. 1 particularly in the absence of profiled transition elements at the ends of the beam and in their generally plain formal arrangement. The example from the chamber tomb at Köprülü Mahallesi in Tralleis (dated to sixth century CE), together with the glass coin weight recovered from the same context, indicates that this plain arrangement continued in use through Late Antiquity. Within this framework, Pg.lib. 1 may be regarded as an Anatolian representative of a tradition of simply constructed bronze equal-arm balances that was in use from the Roman Imperial period and continued into Late Antiquity.

Close parallels for this formal arrangement are known from Sardeis[17], Arykanda[18], Tralleis[19], and the Köprülü Mahallesi chamber tomb at Tralleis[20]. These examples share several common features, including a plain and undecorated balance beam, ring-shaped attachments for the suspension of the pans at either end, and a centrally positioned pointer fixed to the beam. Although their states of preservation vary, they are comparable with Pg.lib. 1 particularly in the absence of profiled transition elements at the ends of the beam and in their generally plain formal arrangement. The example from the chamber tomb at Köprülü Mahallesi in Tralleis (dated to sixth century CE), together with the glass coin weight recovered from the same context, indicates that this plain arrangement continued in use through Late Antiquity.

Within this framework, Pg.lib. 1 may be regarded as an Anatolian representative of a tradition of simply constructed bronze equal-arm balances that was in use from the Roman Imperial period and continued into Late Antiquity.

Profiled Arrangement

Although Pg.lib. 2 operates according to the same basic mechanical principle as Pg.lib. 1, it differs from the first specimen in the more pronounced configuration of its central suspension system and in the use of profiled decorative elements. It therefore belongs among the examples discussed here under the second formal arrangement. In this arrangement, the pointer is positioned between the two arms of the frame formed by the suspension arm and moves along

13 Waldbaum 1983, 84, Kat. No. 459, Lev. 29.
14 Oransay 2006, 121–123, Kat. No. H1, Şek. 18, Lev. 22.
15 Özcihan 2025, 129–131, Kat. No.30.
16 Coşkun 2022, 336 Kat. No. 167.
17 Waldbaum 1983, 84, Kat. No. 459, Lev. 29.
18 Oransay 2006, 121–123, Kat. No. H1, Şek. 18, Lev. 22.
19 Özcihan 2025, 129–131, Kat. No.30.
20 Coşkun 2022, 336 Kat. No. 167.

the central axis of the suspension system. This mechanical solution, also observed in Pg.lib. 1, is executed in Pg.lib. 2 within a longer and more clearly defined frame. The visual coherence of the design is further enhanced by profiled transition elements composed of bead-and-reel mouldings applied to both ends of the balance beam and to the upper part of the suspension arm.

The closest parallels for this formal arrangement are provided by examples recovered from Sardeis[21], Tralleis[22], and Korinthos[23]. In these examples, the balance beam, suspension system, and pointer are preserved together, allowing the arrangement in which the pointer is positioned between the two arms of the suspension frame to be clearly observed. In terms of the profiled transition elements at the ends of the beam, the ring-shaped attachments for the suspension of the pans, and their overall proportions, these specimens are directly comparable with Pg.lib. 2.

Further representatives of the same formal arrangement are known from Korinthos[24], Ephesos[25], Patara[26], Metropolis[27], Stratonikeia[28], and Kaiseraugst[29]. Although the suspension system and pointer are not preserved in some of these specimens, they share several characteristic features, including a circular-section balance beam, ring-shaped attachments for the suspension of the pans at either end, a central suspension point, and profiled transition elements composed of bead-and-reel mouldings. The finds from Ephesos, Patara, Metropolis, and Stratonikeia indicate that this formal arrangement was widely employed in Anatolia, particularly during Late Antiquity, while the examples from Korinthos and Kaiseraugst attest to its broad geographical distribution across the Roman Empire.

Taken together, the available evidence indicates that the two bronze equal-arm balances from the Stadium of Perge represent two different formal applications of the libra system based upon the same fundamental operating principle. The principal differences between the two specimens lie in the proportions of the central arrangement, the prominence of the suspension frame, and the use of profiled decorative elements. Whereas Pg.lib. 1 displays a plain and undecorated arrangement, Pg.lib. 2 represents a more elaborate execution, both in the more pronounced configuration of its central suspension system and in the bead-and-reel mouldings applied to the suspension arm and the ends of the beam. The chronology of the comparative material likewise supports the use of both formal arrangements during Late Antiquity. Waldbaum dates most of the Sardeis examples to the Late Roman–Early Byzantine period, while Davidson assigns the Korinthos finds to the Byzantine period or later. The Patara example, dated to the fifth–seventh centuries CE, the Metropolis example to the sixth century CE, and the Stratonikeia finds to the fifth–seventh centuries CE are likewise closely comparable with Pg.lib. 2 in both formal and chronological terms.

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21 Waldbaum 1983, 83, Kat. No. 448, Lev. 29.

22 Özcihan 2025, no.29. For an example of a balance fragment from Tralleis preserving only the beam, see Özcihan 2025, no. 31.

23 Davidson 1952, 204–205, Kat. No. 1674, lev. 98.

24 Davidson 1952, 204–205, Kat. No. 1672-3, lev. 98–99.

25 Gassner 1997, 221, Kat. Nr. 920, Taf. 70.

26 Şahin 2017, 58–60, Lev. 14, 31, E1.

27 Arslan et. al. 2026, 410–411, Fig. 10

28 Yıldırım 2023, 157–158, Kat. No. L1; 444, Kat. No. L2.

29 Mutz, A. 1983, 28–31, Abb. 14–16.

Function of the Balances

The functions of bronze equal-arm balances can be reconstructed, at least in part, through their archaeological contexts. A bronze equal-arm balance recovered together with a set of medical instruments at Colophon indicates that such balances were employed for the precise weighing required in the preparation of medicines[30]. Likewise, the example from Anemurium has been interpreted by Russell as being associated with jewellery production[31]. These finds suggest that bronze equal-arm balances were primarily used in craft and manufacturing activities requiring a high degree of precision. The finds from the Stadium of Perge provide a new archaeological context for evaluating this interpretation.

As discussed above, the two bronze equal-arm balances recovered from the Stadium of Perge derive from secure stratigraphic contexts directly associated with vaulted chambers that were converted into workshops during Late Antiquity. The fact that both specimens were recovered from production areas belonging to the same phase of reuse suggests that they may have been connected with the craft and commercial activities carried out within these workshops. In particular, their close association with a glass-production workshop allows some observations to be made regarding their possible function.

Archaeometric studies of Roman glass production have demonstrated that the colour, transparency, and durability of glass were controlled through the addition of various additives during manufacture. Manganese was employed both as a colourant and as a decolourising agent, antimony as a refining and opacifying agent, while copper and cobalt were among the principal additives used to produce different colours[32]. Given that these substances had to be prepared and added to the glass batch in carefully controlled proportions according to specific production recipes, it is plausible that bronze equal-arm balances were employed for the precise measurements required during this process. Nevertheless, the available archaeological evidence does not demonstrate conclusively that the Perge balances were used directly in glass production. Their secure stratigraphic contexts, however, together with the associated production remains and the large number of coins recovered from the same deposits, provide important indirect evidence in support of this interpretation.

The balances recovered from the Stadium of Perge are among the most significant examples from Anatolia, not only because of their typological characteristics but also because of their archaeological contexts. The examples from Patara and Parion[33] demonstrate the association of such balances with production and commercial activities carried out in public buildings that were reused during Late Antiquity, whereas the example from Tralleis shows that bronze equal-arm balances could also serve as grave goods. Owing to their secure stratigraphic contexts, the Perge balances provide some of the strongest archaeological evidence currently available for associating these instruments with craft production and manufacturing activities.

Conclusion

The comparative analysis demonstrates that the Perge examples share the same basic mechanical operating principle as Late Antique bronze equal-arm balances, while displaying two different formal applications in terms of the proportions and configuration of the central

30 Buckler & Caton 1914, 235–236, Fig. I, No. 2.

31 Russell 1982, 136, Fig. 1. 7–8.

32 Möncke et. al. 2014, 24, 31–32.

33 Çelikbaş 2016, 37.

suspension arrangement and the use of profiled decorative elements. The comparative material further shows that this formal variation was not unique to Perge, but can be traced through examples from a wide geographical area of the Roman Empire.

The archaeological contexts of the Perge finds, however, lend them particular significance. Recovered in association with glass-production workshops, production debris, and large numbers of coins, the balances can be linked to the production and economic activities carried out within the vaulted chambers of the stadium during Late Antiquity. Although this association cannot be demonstrated conclusively, the archaeological context supports the possibility that bronze equal-arm balances were employed in craft activities requiring precise weighing.

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* Abbreviations of epigraphical editions and reference works follow the "Liste des abréviations des éditions et ouvrages de référence pour l'épigraphie grecque alphabétique (GrEpiAbbr – Version 03, Septembre 2024)" developed by the *Association Internationale d'Épigraphie Grecque et Latine*.