4

The COMPASS method for the estimation of the capacity of pottery vessels

Eugen S. Teodor
National History Museum, Bucharest

4.1 Introduction

The 24th Annual Meeting of Computer Applications in Archaeology, held in 1996 in Iaşi (România), gave me the opportunity to understand the concern of English archaeologists for the volumetric capacity of vessels (see, for example, Hawthorne, this volume). The discussions that developed persuaded me that this parameter could not only bring a new dimension to demographic matters but could also be interesting as a theme of cultural comparison.

It took only a step to note that a recently published study (Teodor 1996) offers a useful starting point for the estimation of volume. The COMPASS SYSTEM works with complete morphological data, so it can re-build the shape from published figures. It is also the theoretical support for a database of the post-Roman and Slavic migration period pottery for Eastern and Central Europe. The COMPASS SYSTEM deals with both complete pots or sherds, the latter being the main aim and the challenge. The principal idea is to enable us to compare the entire object with the part of it. This is why this system does not employ Bezier functions or other mathematical methods (as described in Orton *et al.* 1993, pp. 155–162) which can only deal with entire shapes. The fact is that recovered shapes are a very low percentage of recovered sherds. The number of complete posts does not allow us to compare the majority of Romanian sites from the morphological point of view. The very poor decoration for 5th to the 7th centuries AD must also be taken into account. Concluding, the COMPASS SYSTEM cannot use volume functions.

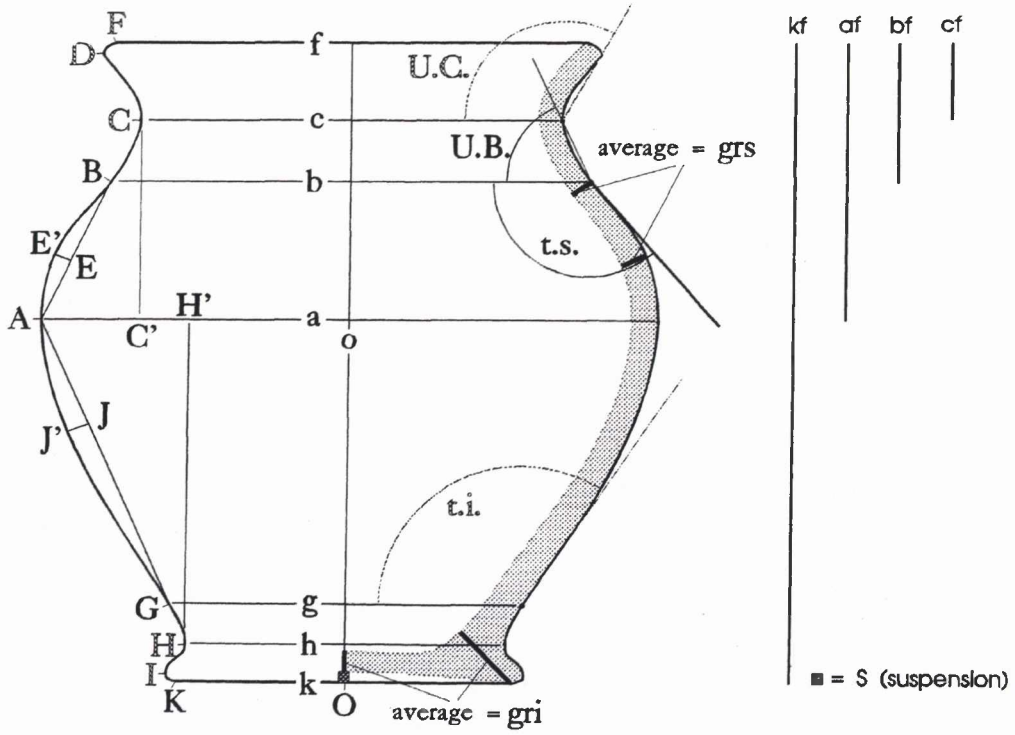
4.2 The COMPASS system

As published (Teodor 1996), this system does not work with absolute dimensions (except the mouth width), but with proportions, such as the neck diameter relative to the maximum body width, the upper height (see Fig. 4.1) relative to the total height, and so on. However, in actual research, the whole calculation has been transferred to computer, using for primary data the measured dimensions (in millimetres). This is how the data taken for morphological purposes could be used also for the volume estimation.

The estimation takes as a starting point the comparison of a closed vessel with two truncated cones, which have for their base the plane of the maximum body width. The volume of each 'half' of the pot is calculated from the truncated cone formula. The results are corrected by taking account of the profile thickness (morphological measurements being taken on the exterior of the pot), the curve (arch) of the body (positive correction), and the curve (arch) of the neck (negative correction). The height cf (between neck diameter and the rim diameter, see Fig. 4.1) is not considered to make a significant contribution to the volume.

The separate estimation of the upper and lower volumes offers the ability to compare complete vessels and half-preserved vessels (which are more numerous) when the morphological data are similar. Volumetric data could improve functional criteria, especially for cultures with a very low diversity on morphological and decorative characteristics such as those from the left bank of the Lower Danube at the beginning of Early Middle Ages. It is quite probable that two pots from the same morphological group, with dimensions in the same size class ('middle size pots'), have different functions if one has a capacity of 0.5 litres and another of 2.5 litres.

One can see in Figure 4.1, the correction calculation for the upper and lower volume are not identical. This is because the compass system has been designed, from the very beginning, as an interrogative tool for Early Middle Age pottery. This kind of pot often has, on the lower part, a 'foot', not very well executed and not very marked. This is why I no longer take measurements for angles from G and H (Fig. 4.1), as I do for B and C. This argument is even more valid looking at the inside-shape, where the 'inflection point' (Shepard 1974, pp. 1, 26) is hard to see. For cultures with more complex shapes, one must consider the angles from points G and H for morphological criteria, and the differences between the angle at G point and t.i. (inferior tangent) for volumetric correction.



Truncated cone formula:
$\frac{\pi I}{3}(R^2 + r^2 + rR)$

Superior volume:

`=(((1.0467×`	$\pi/3$
`((((([af]-[bf])×[scale])×`	I *ab* (height *ab*)
`(([EE']/[AB])+1))+`	correction of the body arch
`(([bc]×[scale])×`	I *bc* (height *bc*)
`(((1−((([ts]−90)−(90−[UB]))/100))+1)/2))))×`	correction of the neck arch
`((((((([a]/2)−[grs])×[scale])×((([a]/2)-[grs])×` `[scale]))+`	R^2 (without the thickness of the body)
`((((([2C'o]/2)-[grs])×[scale])×((([2C'o]/2)−[grs])×` `[scale])))+`	r^2 (ditto)
`((((([2C'o]/2)-[grs])×[scale])×((([a]/2)−[grs])×` `[scale]))))×`	rR (ditto)
`0.000001)`	$\mathrm{mm}^3 \rightarrow \mathrm{dm}^3$ (= litres)

Inferior volume:

`=((1.0467×`	$\pi/3$
`((((([kf]−[af])−((([gri]+[grs])/2)+[S]))×[scale])×`	I (without inferior thickness)
`(([JJ']/[AG])+1)))×`	correction of the body arch
`((((((([a]/2)−[grs])×[scale])×((([a]/2)−[grs])×` `[scale]))+`	R^2 (without the thickness of the body)
`((((([2H'o]/2)−((([grs]+[gri])/2))×[scale])×`	r^2 (ditto)
`((([2H'o]/2)−((([grs]+[gri])/2))×[scale]))))+`	
`((((([2H'o]/2)−((([grs]+[gri])/2))×[scale])×` `((([a]/2)−[grs])×[scale]))))×`	rR (ditto)
`0.000001)`	$\mathrm{mm}^3 \rightarrow \mathrm{dm}^3$ (= litres)

Figure 4.1: Schematic of the COMPASS measurements. In black (top) can be seen those measurements that are involved in calculating the capacity. The meaning of af, bf *etc.* in the formulæ can be deduced from the diagram.

Admittedly, the COMPASS method for calculating the volume of a pot needs to be calibrated on some examples calculated in AUTOCAD. In the short time at my disposal, this program was not available. Also, the cost of AUTOCAD is too high for a research program which involves thousands of pieces. If this method could work with an error less than 2%, it would be preferable, because it does not take extra effort, using data that most morphologists usually take from pots.

References

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Eugen S. Teodor
Muzeul Naţional de Istorie a României
Calea Victoriei 12
704122 Bucureşti
România