A SOCCER BALL IN THE KUNSTHISTORISCHES MUSEUM?

In the Antique Glass collection of the Kunsthistorisches Museum in Vienna a Late-Roman sprinkler flask with a remarkable geometric decoration can be found. The flask, inv.nr. XI 1597 (probably from the Eastern Mediterranean area, consists of a spherical body and a neck; between body and neck there is a restriction in order to regulate the outflow.

The body is mold-blown, in a two-piece mold; the seam is clearly visible. The neck must have been added separately.

Flasks of this type are very common, but the decoration of the spherical body needs a closer inspection. It consists of regular hexagons and pentagons, and resembles a modern soccer ball. Such a ball consists of 12 pentagons and 20 hexagons, each pentagon surrounded by five hexagons, and each hexagon surrounded by alternating pentagons and hexagons. This pattern can be considered as a (inflated) truncated icosahedron, one of the 13 Archimedean solids. Although Archimedes (c 287-212 B.C.) probably was the first to describe the solids, the oldest surviving text is from the 4th century, and the oldest drawing of a truncated icosahedron is from the 15th century [1], by Piero della Francesca. As far as I know, no objects from Antiquity (or depictions thereof) with a soccer ball pattern are known [2]. So the resemblance is intriguing. and closer investigation might shed light on the early history of Archimedean bodies.

Unfortunable it is impossible to count the exact number of hexagons and pentagons on “our” flask: due to the seam, the addition of the neck (and the influence of "time") the pattern is distorted. But apart from the optical resemblance there is a more important argument in favor of the soccer ball pattern: in order to get a ball-shape out of a limited number of regular hexagons and pentagons the truncated icosahedron is the **only possibility**. A closed form out of hexagons and pentagons **always needs exactly 12 pentagons** [3], the number of hexagons may vary. Without hexagons you get the ball-symmetrical [4] dodecahedron (one of the five Platonic bodies, objects with a dodecahedral pattern were common [5] in antiquity); adding hexagons leads to

less-symmetrical shapes; the truncated icosahedron with 20 hexagons is the next ball-symmetrical form.

Were the makers of “our” flask familiar with the Archimedean bodies, or was the creation of the soccer ball pattern just a happy chance? Let’s imagine a Late Roman craftsman without knowledge of the Archimedean bodies, who wants to construct a ball-shaped body out of a limited number of regular hexagons and pentagons (or wants to decorate a spherical body with them). Starting with a hexagon, and continuing with a ring of six pentagons (six hexagons would yield a flat plane) leads to a pattern found on bowls [6]. Adding a ring of six hexagons [7] and closing with the bottom as “cap” leads to a pattern such as found on a Late Greek inkwell in the Allard Pierson museum in Amsterdam [8]. At first sight it resembles a soccer ball pattern, but on closer inspection it is a flattened ball without connection to the Archimedean bodies.

So let’s start again, now with a regular pentagon, followed by a ring of five hexagons (taking five pentagons instead ultimately leads to a dodecahedron). To get a ball-symmetrical body, the next ring should consist of alternating pentagons (five) and hexagons (five too), to be continued by the same procedure in reversed order. Very complicated! It seems unlikely that the craftsman who made the mold for the Vienna flask worked this way. Knowledge of (or mimicking) the truncated icosahedron, at least known by the intellectual elite, seems more likely.

If craftsmen or their commissioners had knowledge of Archimedean bodies, it is thinkable that other objects from Antiquity with a soccer ball pattern exist. Searching for more of such objects, or depictions thereof, is desirable. Maybe even flasks from the same mold as our flask might be found!

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[1] For Archimedean bodies and the history thereof see for instance: Field J., Rediscovering the Archimedean Polyhedra: Piero della Francesca, Luca Pacioli, Leonardo da Vinci, Albrecht Dürer, Daniele Barbaro, and Johannes Kepler, Archive for History of Exact Sciences, 50, 1997, 227.

[2] The ball in the so called athletes-mosaic in the Terme di Porta Marina in Ostia is often wrongfully interpreted as a “soccer ball”; see, e.g., M. Fittà, “Spiele und Spielzeug in der Antike”, Stuttgart, 1998, p.102 (original edition: Milan, 1997), and, for a scientific approach: A. Rassat and J.-P. Thuillier, “A fullerene like ball in a second century Roman mosaic?”, Fullerene Science and Technology, 4, 1087-1090 (1996).

[3] The 12 pentagons necessary to make a closed form out of hexagons follow from Eulers theorem on polyhedra: F - E + V = 2, in which F is the number of faces, E is the number of edges and V is the number of vertices; see for instance: http://en.wikipedia.org/wiki/Euler_characteristic.
[4] Both the dodecahedron and the truncated icosahedrons pocess full icosahedral symmetry (I_h).
[5] For spherical objects with a dodecahedral decoration, see, for instance, a spherical Roman weight with a dodecahedron-pattern (from the 2nd part of the 1st century, found in the river Rhine, in the collection of the Rijksmuseum van Oudheden in Leiden, inv. nr. e 1895/10.19), and, maybe more relevant, the Gallo-Roman bronze aryballos, also from the 2nd part of the 1st century, in the Getty Museum in Malibu (inv. nr. 96.AC.190), and a mold-blown flask in the Corning Museum of Glass, inv. nr. 68.1.45 http://www.cmog.org/artwork/bottle-shaped-ball.
[6] For the bowl (Allard Pierson Museum, APM 15.039) also see R. Lunsingh Scheurleer, Nieuwe aanwinsten voor een jarig museum, Mededelingenblad Allard Pierson Museum Amsterdam 87, 2004, pp 1-3.
[7] A silver bowl from the “Morgantina Treasure” (formerly Metropolitan Museum New York, now in the Museo Archeologico Regionale in Aidone, Sicily) actually has an upper ring with six bisected hexagons.
[8] For the inkwell (Allard Pierson Museum, APM 1862) also see M. Kleijwegt, De socialisatie van het antieke kind: opvoeding in Griekenland en Rome, Mededelingenblad Allard Pierson Museum Amsterdam nrs. 81-82, 2001, pp 25-28.

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