THE URARTIAN BRONZES OF AYANIS (TURKEY). FIRST METAL ANALYSES

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The archaeological investigations at Ayanis have provided us with a great deal of new data useful for reconstructing the civilisation of the kingdom of Urartu, the most important results having recently been published in the report on the first ten years of activity[1]. Urartu was a city-fortress founded by king Rusa II with the name "City of Rusa, in front of Mount Eiduru". An approximate date is provided by the Urartian chronology, which is largely based on synchronisms with Assyria, the city most probably being founded between 675 and 660 BC. This is an important factor as it also enables us to date the numerous objects found during the excavations and, in particular, the bronzes. The most significant bronze objects, furthermore, bear an inscription declaring them to be the property of the king, Rusa Argištiḫi. To date there has been only one exception, a bronze helmet which bear an inscription along the lower edge by the father and predecessor of Rusa II. This is Argišti Rusaḫi, that is to say Argišti II (713 – ca 685) son of Rusa I[2]. The object, unlike the other bronze finds, was clearly not made to decorate the new city, but was borne there, probably as a sacred family relic, from some other, previous centre.

This phenomenon had already been noticed by Russian archaeologists during the excavation of Karmir-blur, another city founded by Rusa II, and given the name of "City of Teišeba", where numerous bronze pieces were discovered bearing inscriptions by kings of the VIII century such as Argišti I and Sarduri II[3]. Here can be seen dedications to the city of Erebuni (Arin-berd), founded a century earlier by Argišti I. From this it has been possible to deduce that, at the start of the VIII century, the administrative capital was transferred from the Urartian province in what is today Armenia, from Erebuni to the "City of Teišeba". From Karmir-blur we also have a cup dedicated to the "Little City of Rusa"[4], which studies have identified with Bastam, excavated by the mission of the German Archaeological Institute under the direction of W. Kleiss[5]. These examples clearly demonstrate that the objects travelled from one place to another and that there were various production centres operating in the same period.

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[1] Altan Çilingiroğlu and Mirjo Salvini (Eds), *Ayanis I. Ten years' Excavations in Rusaḫinili Eiduru-kai* ("Documenta Asiana" VI), Roma 2001.

[2] M. Salvini, SMEA 43, 2001, 279 and Tab. I p. 287.

[3] B. Piotrovsky, *The Ancient Civilization of Urartu*, Nagel, Geneva 1969, 160.

[4] G.A. Melikišvili, *Urartskie Klinoobraznye Nadpisi*, Moscow 1960, text N° 285.

[5] W. Kleiss (Ed.), *Bastam I. Ausgrabungen in den Urartäischen Anlagen 1972-1975* (Teheraner Forschungen, Band IV), Berlin 1979; W. Kleiss (Ed.), *Bastam II. Ausgrabungen in den urartäischen Anlagen 1977-1978* (Teheraner Forschungen, Band V), Berlin 1988.

SMEA 45/2 (2003) p. 203-207.

Today we have Urartian bronzes which, thanks to the inscriptions they bear, can be dated from the reign of Išpuini (ca 820-810 BC.) up until the reign of Rusa III, son of Erimena and Sarduri III (second half of the VII century), most of which were discovered by chance and sold into the antiquarian market. This lengthy chronological span in itself necessitates an investigation into the evolution of techniques and materials employed by the bronze craftsmen of Urartu. Given the pieces on the antiquarian market and the presence of numerous Urartian bronze objects (both with and without inscriptions) in museums and collections, we naturally have the problem of identifying the numerous forgeries.

To date there are at least four Urartian sites, excavated at different times, which have revealed important pieces in bronze belonging to the same period. These are the three cities founded by Rusa II (Toprakkale, Karmir-blur and Ayanis), and Altintepe, which probably dates to the times of Argišti II. The finds from these sites are conservated in following Museums: British Museum, Vorderasiatisches Museum, Hermitage as regards finds from Toprakkale; in the Armenian Historical Museum of Erevan for the material from Karmir-blur; in the Van Regional Museum for material from Ayanis; and the Museum of Ancient Anatolian Civilizations of Ankara for the cauldrons discovered at Altintepe. Comparative analysis is both desirable and, in theory, feasible. The bronzes from Toprakkale conserved in the British Museum have, moreover, already been analysed, the results indicating that the bronze contains a high percentage of tin and only traces of lead[6]. The samples analysed come, moreover, from bronze sections of pieces of furniture and vases, rather than parade weapons. The values of the alloy are, anyhow, very close to those observed at Ayanis (see table below).

We here, therefore, present the first results of analysis carried out on the Ayanis material. The enormous amount of material from these excavations, the variety of forms and typology of the objects furnish a large sample which is lacking in other Urartian sites, with the exception of Karmir-blur and the material from Toprakkale. As is well known, the excavations at Bastam, dating to the same period as Ayanis insofar as it too was founded by Rusa II, have not led to the discovery of any bronze artefacts.

The exceptional nature of Ayanis lies precisely in this wealth of material, which enables us to carry out wide scale analyses and thus create a data bank that can serve as a firm future point of reference for the analysis of archaeological finds from other Urartian sites. It will also be important to compare the results of analyses of the same kind carried out on bronzes from other sources, like those, for example, from contemporary Assyrian centres. Another important aim is that of finally creating a firm basis for comparisons of the numerous objects of uncertain provenance on the antiquarian market, claimed to be Urartian or Assyrian[7].

In agreement with the director of the Ayanis excavations, Prof. Altan Çilingiroğlu of the University of the Aegean (Ege Üniversitesi, İzmir), and in collaboration with the direction of Van Museum, ten samples were taken, in the summer of 2002, from

[6] M.J. Hugues, J.E. Curtis, E.T. Hall, Analyses of some Urartian Bronzes, AnSt 31, 1981, 141-145.

[7] Cf. the Exibition Catalogue *Urartu. A Metalworking Center in the First Millennium B.C.E.* (Ed. by R. Merhav), The Israel Museum, Jerusalem, 1991.

9 shields and a protome in the shape of a lion's head[8]. Small samples were also taken from the edges of the shields, in the form of both fragments and powder.

The analysis of the metal from the bronze shields was carried out at the Rathgen-Forschungslabor in Berlin. 10 samples of the bronze shields were analysed by atomic absorption spectroscopy to determine the main components and trace elements of the metal. For atomic absorption spectroscopy a tiny sample of 5 mg is needed. From this sample all the main elements can be determined quantitatively except copper, which is calculated as the difference of the sum of the concentrations of all other elements from 100%. In the following table the concentrations of the elements bismuth, cobalt, gold and cadmium are not listed, since their concentrations are below the detection limit of atomic absorption spectroscopy (Bi: 0.025%, Co: 0.01%, Au: 0.002%, Cd: 0.002%)

The following compositions of the 10 samples were obtained:

	Cu	Sn	Pb	Zn	Fe	Ni	Ag	Sb	As
GVI Ay 01.74	93,29	5,94	0,16	0,016	0,15	0,03	0,12	0,09	0,22
GYR Ay 01.73	93,16	5,97	0,21	0,069	0,18	0,03	0,07	0,09	0,22
FCJ Ay 99.38.1242	93,27	5,98	<0,04	0,025	0,49	0,01	0,06	<0,05	0,17
GUR Ay 01.71 2001	92,92	6,67	<0,04	0,014	0,17	<0,01	0,04	<0,05	0,19
GVY Ay 120.01 1745	92,68	6,69	0,07	0,015	0,20	<0,01	0,05	<0,05	0,30
GCD Ay 97.00 1389	92,78	6,70	<0,04	0,010	0,15	<0,01	0,04	<0,05	0,32
GMM	91,11	8,41	<0,04	0,006	0,07	<0,01	0,10	0,11	0,19
DKP Ay 80.97	89,76	9,34	<0,04	0,193	0,26	0,01	0,09	<0,05	0,35
1.81.97 shield	89,54	9,90	<0,04	0,016	0,05	0,01	0,07	<0,05	0,41
1.81.97 lion head	86,73	9,83	0,40	2,13	0,19	0,02	0,07	0,16	0,48

9 of the 10 samples consist of a pure tin bronze with concentrations of tin between 6 – 10%, which is quite a narrow range. The head protome 1.81.97 was made of a tin bronze similar to those of the shields, but with a very small amount of zinc (2%).

The first two samples, GVI Ay 01.74 and GYR Ay 01.73 are very similar in their compositions: the concentration of tin is low and the concentrations of lead, 0.16 and 0.20, are the highest of this series. Among the trace elements the concentrations of nickel are higher than in all the other samples. The concentrations of antimony and arsenic are the same, proving again their close relation.

[8] *Ayanis I*, 186.

The following four samples, FCJ Ay 99.38.1242, GUR Ay 01.71 2001, GVY Ay 120.01 1745, GCD Ay 97.00 1389 again are quite similar in composition. The concentration of tin is in the middle range of the whole series. Lead is close to or below the detection limit of the analytical system. The trace elements are all in the same range. Judging purely on the concentrations of arsenic it appears probable that the metal comes from two different batches, one with lower, the other with higher amounts of arsenic.

The following three samples, GMM, DKP Ay 80.97 and 1.81.97 shield, are distinguished from the rest of the group by slightly higher concentrations of tin in a range between 8 and 10%. The trace element concentrations are in the same range as those from the samples with the lower amounts of tin.

The composition of the head corresponds perfectly with that of the samples from the shield, apart from the higher amount of zinc. If we examine the concentrations of the different elements, we find tin in a very homogeneous range between 6 and 10%. By that, for the manufacture of the head a very common type of a tin bronze has been used. Tin bronzes of this type have favourable properties, especially as they render the object malleable; from the earliest periods of the use of tin bronzes this type was and was to remain the favourite material for various types of metal work. The concentration of lead is very low, which is not common, since this metal is rapidly introduced in a copper alloy, when scrap metal is used. In this case, obviously fresh copper ores were alloyed with pure tin ores to prepare a bronze of a particular quality.

Apart from the head, the concentrations of zinc are in a very low range, which is to be expected, since zinc ores normally do not occur together with ores of copper and tin so that zinc in bronzes of this period remains a trace element. Iron varies between 0.05 and 0.49% which has no real significance for the characterization of the bronze, since iron is a normal but insignificant impurity of the base metals and those materials which come into contact with the molten metals during the metallurgical process.

Nickel was detected in a remarkably low range, close to the detection limit of atomic absorption analysis. This characterizes the copper ores which are not from the common fahlerz-type, which is rich in trace elements. This observation is supported by the fact that also bismuth and cobalt occur in a concentration which cannot be detected any longer by the relatively sensitive atomic absorption technique.

Silver covers a relatively broad range between 0.04% and 0.12%, which is relatively high for early bronze objects, since the concentrations of silver are relatively low in copper ores. Antimony is present in a very low concentration. This confirms the observation of the low amounts of nickel, which define a peculiar type of copper ore poor in trace elements.

Arsenic is a very common element in bronzes, since it frequently accompanies copper in its deposits. The concentrations are in the medium range, since even the highest value of 0.48 does not reach the concentrations of arsenic-rich bronze, where the concentrations of this element are over 1%; on the other hand, they are not as low as they can be in bronzes.

As a result, the bronze of the shields can be defined as a pure tin bronze with tin in a range between 6 and 10%, representing a type of tin bronze very common in this period. The bronze can also be characterized by the concentrations of trace elements, with very low concentrations of nickel, antimony, bismuth and cobalt, a medium amount of arsenic and a comparatively high concentration of silver.

The above analyses carried out at the Rathgen-Forschungslabor of Berlin, give us an initial and partial idea of the type of information that may be obtained by systematic future research in this area. It would be more than opportune to extend similar metal analysis on a wider scale, including not only analysis of the elements present but also (by electronic microscope study of microscopic sections) so as to understand how the individual pieces were made and the metal worked, the tools used, the presence of tin-plating[9], mechanical joins, types of decorations, early forms of restoration, etc.

These limited analyses already show how the craftsmen of Urartu, in the VII century BC, used pure minerals in their alloys, and the extremely limited presence of impurities could provide useful indications as to which mines were in use during this period[10].

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[9] I. Reindell, Observations on the bronze shield GPM 1628, inv. Ay. 39.01, found during the 2001 archaeological campaign in Ayanis, SMEA 43, 2001, 280-283, Pl. V-VIII (p. 291-294).

[10] O. Belli, The Greatest Metalworking Kingdom of the Ancient World: Urartu, in: O. Belli (Ed.), *Istanbul University's Contributions to Archaeology in Turkey (1932-2000)*, Istanbul 2001, 338-345.