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NEW DATA ON AGRICULTURE OF APARAN-III EARLY BRONZE AGE SETTLEMENT (ARMENIA)

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The grain hoard from vessel at Early Bronze Age (end of IV millennium calibrated B.C.) Aparan III mountainous settlement has been studied. It mostly consists of cultivated barley and wheat charred grains mixture with very few seeds of weeds. The barley was represented with hulled two-rowed and six-rowed varieties. The wheat grains almost certainly belong to bread wheat, particularly common bread wheat and club wheats. In general the recorded archaeobotanical situation is common for the EBA mountainous sites of Armenia. The only essential difference from higher situated sites is the larger amount of wheat (44%) in cereals ratio at Aparan III, which supposedly is due to altitudinal and climatic differences.

Archaeobotany − prehistoric agriculture −cereals − Bronze Age

Հետազոտվել է Ապարան III վաղ բրոնզեդարյան (մ.թ.ա. IV հազարամյակի վերջ, ճշգրտված) լեռնային բնակատեղի կավանոթներից մեկում հայտնաբերված հացահատիկային պաշարը: Այն կազմված է հիմնականում մշակովի գարու և ցորենի ածխացած հատիկներից և մոլախոտերի մի քանի սերմերից: Գարին այստեղ ներկայացված է թեփուկավոր երկշարք և բազմաշարք վարիացիաներով: Ցորենի հատիկները ամենայն հավանականությամբ պատկանում են փափուկ ցորենին, մասնավորապես՝ սովորական փափուկ և կունդիկ ցորեններին: Ընդհանուր առմամբ նկարագրված իրավիճակը բնութագրական է Հայաստանի լեռնային վաղ բրոնզեդարյան հնավայրերի համար: Ավելի բարձրադիր հնավայրերի համեմատությամբ միակ էական տարբերությունը ցորենի համեմատաբար մեծ քանակությունն է (44%) հացաբույսերի հարաբերակցությունում Ապարան III-ում, որը ենթադրում ենք, որ կապված է տեղանքի բարձրության և կլիմայական տարբերությունների հետ:

Հնաբուսաբանություն – մինչպատմական բուսաբուծություն –հացազգի մշակաբույսեր – բրոնզի դար

Исследовался зерновой запас в одном из керамических сосудов из раннебронзового (конец IV тысячелетия до нашей эры, калиброванный) высокогорного поселения Апаран III. Он состоит в основном из обугленных зерен ячменя и пшеницы и нескольких семян сорняков. Ячмень представлен пленчатой двурядной и многорядной вариациями. Зерна пшеницы, по всей вероятности, принадлежат к мягкому сорту, в частности к обыкновенной мягкой и карликовой пшенице, что характерно для раннебронзовых горных памятников Армении. Единственным отличием от прежних находок является сравнительно высокое количество пшеницы (44%) в соотношении зерновых в Апаране III, что, возможно, связано с высотными и климатическими различиями.

Археоботаника −предысторическое растениеводство −культурные злаки ─ бронзовый век

The territory of Armenia contains archaeobotanical evidences from several Early Bronze Age settlements (Gegharot, Aparan III, Tsaghkasar, Voskevaz, Aragatsi-berd, Mokhrablur, Lorut, Aygevan, Elar (P_3), Shengavit), but not all of those sites provide enough material to recover agriculture of the past (e.g. Mokhrablur, Elar (P_3)). The plant assemblages recovered from above mentioned EBA sites are known and repeat each other [4]. The territory of Armenia has also expressed by vertical zonality, which in all probability caused some differrences also in past agricultures. But there was no evidence for agricultural differences in different vertical zones for prehistoric territory of Armenia. In general only Gegharot and Aparan III sites provide several hundred and more grains and good for quantitative analysis, which could be useful medium for uncovering some differences in EBA agricultures at different altitudes. The aim of the current work is to study archaeobotanical situation in Aparan III site and find out differences in agricultures of that site from Gegharot settlement - another higher situated mountainous site of the same period and close distance.

Early Bronze Age settlement Aparan III is situated in the plain of Aparan (Aragatsotn marz), on the right bank of Qasakh river, at the altitude of 1860 m above sea level. Several clay vessels are found at the site and some of those pots contained charred grains (excavations of 2000). Ground stones were also found. The site belongs to the end of IV millennium B.C. This fact has been confirmed with radiocarbon dating of charred grains mass (AA-40153, BP: 4455±75, cal BC (1σ): 3340-3210, cal BC (2σ): 3350-2920; LY-10623, BP: 4321±33, cal BC (2σ): 3015-2884; Bln-5528, BP:4428±39, cal BC (1σ): 3270-2920, cal BC (2σ): 3330-2910). The culture of the site belongs to the first phase of Kura-Araxian culture [6,1].

The part of grain mass recovered from large jars (karas) had been studied by P.A. Ghandilyan [6, 1]. The following species had been identified by him (the first Latin names are given as those were published (in [6]), and in {} brackets and in following text Latin names are given according to recent taxonomical system): two-rowed barley (*Hordeum distichum* {=*Hordeum vulgare* subsp. *distichon*}), multi-rowed barley (*H. vulgare* {=*Hordeum vulgare* ssp. *vulgare*}), bread wheat (*Triticum aestivum* {=*T.aestivum* subsp. *vulgare*}), club wheat (*T.compactum* {=*T. aestivum* ssp. *compactum*}) and mouse barley (*Hordeum murinum*). Ghandilyan noticed that the barley is prevailing in sample and the majority of it is hulled variety but there is naked variety as well. We believe that P. Ghandilyan have identified as naked grains the hulled ones, which lost their flower glumes during charring and following thousands years of corrosion; reexamination of that material did not reveal any naked barley grains. Gandilyan noticed also the purity of the grain mass: by him the weeds practically are absent, only *Hordeum murinum* was noted as weed [6, 1].

Materials and methods. Archaeobotanical material was recovered from an Early Bronze Age vessel excavated from Aparan III settlement. Carpological material was mixed with burnt organic mass remained as charred dust. The sample was divided into tree parts; first third passed to P. Ghandilyan, second third to us and the rest used for radiometric dating analyzes. Our subsample of charred grains containing mass with approximately 1 liter volume was processed to separate carpological macroremains. It is known that contact of charred material with water is supporting destruction process. To shrink that negative effect of water processing, the sample was firstly dry sieved with two level sieves (0.25 mm and 1 mm mesh sizes) and all visible plant macroremains were picked up. After that procedure the rest with some plant macroremains left was wet-sieved to uncover unrecognized remains. After drying this part also was picked up for macroremains.

Total 4 482 units of carpological material have been recovered. There were no charcoal fragments in the sample.

Results and Discussion. 21 taxa of Higher Plant are identified in the studied material. The most of carpological material are charred cereals grains, in comparably pure state - 96.6% and the weeds seeds and fruits consist only 3.4% of total carpological material (Fig. 1).

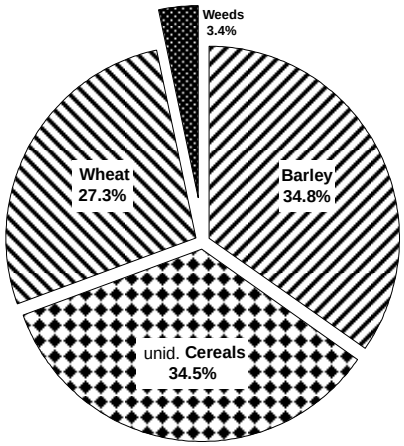

Fig. 1. Ratio of unidentified cereals, wheat, barley and weeds in Aparan III sample.

The cereals grains are comparably well preserved; it was possible to identify at least genera of practically all complete grains. In addition, there are also cultivated cereals grain fragments. The 56.1% of genus identifiable cultivated cereals grains are barley grains, 43.9% - wheat grains (Table 1).

As recovered wheat grains are morphologically very similar with naked bread wheat and as there are not any features which could reject the belonging of those grains to it we identified those as *Triticum* cf. *aestivum*. It is possible to distinguish two main groups of wheat grains, which we conventionally called T. cf. *aestivum* subsp. *vulgare* and *T.* cf. *aestivum* ssp. *compactum* (Table 1, Fig. 2:1-6).

All recovered barley grains belong to hulled varieties of cultivated barley (*Hordeum vulgare*). The presence of asymmetric, slightly bent and smaller triplet lateral grains (Fig. 2:9-11) is evidence of multi-rowed hulled barley presence (*H. vulgare* ssp. *vulgare* convar. *vulgare*). The portion of triplet lateral grains is less than 2/3 of total, which means that hulled two-rowed barley (*H. vulgare* ssp. *distichon* convar. *distichon*) also present in the sample (Fig. 2:7-11).

The taxonomical composition of recovered weeds is not large: *Lolium sp.* (Fig. 3:1-3), poaceous plant (possibly bad preserved *Lolium* sp. kernels), *Rumex* sp. (very bad preserved nutlets; Fig. 3:4), *Polygonum* sp., *Neslia* sp. (Fig. 3:5), Fabaceae gen. sp., Viceae gen. sp., *Buglossoides arvensis*, *Rochelia* sp., *Lycopsis/Anchusa/Nonea* sp., *Galium* cf. *spurium*, *Convolvulus* cf. *arvensis* and one unidentified plant. Erems of some species of *Lycopsis*, *Anchusa* and *Nonea* genera are morphologically very similar and the only find from Aparan-III is very bad preserved. All fabaceous plants seeds, single finds of *Polygonum* nutlet and *Neslia* capsule are uncharred, erems of Boraginaceae and Convolvulaceae families species are biomineralized (as those are usually being in the most of recovered archaeobotanical materials), while other taxa seed material is charred. We are doubtful concerning the age of fresh look fabaceous seeds and *Polygonum* nutlet; presence of those in carbonized grain hoard could be result of contamination with recent seeds. Excluding those non-charred seeds from our calculations will reduce ratio of weeds down to 2.7% (instead of 3.4%) and will increase the crop ratio up to 97.3% (instead of 96.6%). All above-mentioned weeds are common for the studied region.

Table 1. Archaeocarpological material from Aparan III Early Bronze Age settlement

Plant Taxa	**Total**	**4,482**	
CULTIVATED CEREALS (Gramineae), carbonized grains; Total		**4,329**	***96.59%***
Triticeae gen. spp. /grains unidentifiable fragments/		1,547	***34.52%***
Barleys (*Hordeum vulgare* L.), Total		**1,560**	***34.81%***
Hordeum vulgare (hulled)	triplet position unidentifiable hulled grains	898	***20.04%***
	triplet middle hulled grains	312	***6.96%***
Hordeum vulgare subsp. *vulgare* convar. *vulgare*	triplet left hulled grains	200	***4.46%***
	triplet right hulled grains	150	***3.35%***
H. vulgare ssp. *distichon* (L.) Koern. convar. *distichon*	triplet middle hulled grains	+	+
Wheats (*Triticum* spp.), Total		**1,222**	***27.26%***
T. aestivum L. /*turgidum* L.		397	***8.86%***
T. cf. *aestivum* L. ssp. *vulgare* (Vill) MacKey		767	***17.11%***
T. cf. *aestivum* ssp. *compactum* (Host) MacKey		22	***0.49%***
T. cf. *aestivum* ssp. *spelta* (L.) Thell.		4	***0.09%***
T. cf. *aestivum* ssp. (small grained)		22	***0.49%***
T. cf. *turgidum* L. conv. *durum* (Desf.) MacKey		4	***0.09%***
T. cf. *turgidum* ssp. *dicoccum* (Schrank) Schuebl.		6	***0.13%***
WEEDS, Total		**153**	***3.41%***
Poaceae, carbonized grains			
Lolium sp.		15	***0.33%***
Poaceae gen. sp.		53	***1.18%***
Fabaceae, uncharred seeds			
Viceae gen. sp.		4	***0.09%***
Fabaceae gen. sp. (*Medicago*/*Melilotus sp.*?)		20	***0.45%***
Trifolium sp.		10	***0.22%***
Boraginaceae, biomineralized erems			
Buglossoides arvensis (L.) Johnst.		1	***0.02%***
Rochelia sp.		1	***0.02%***
Lycopsis orientalis/Anchusa ovata/Nonea pulla		4	***0.09%***
Polygonaceae, nutlets			
cf. *Rumex sp.*, charred		31	***0.69%***
Polygonum sp., uncharred		1	***0.02%***
Rubiaceae			
Galium cf. *spurium*, charred mericarps		8	***0.18%***
Convolvulaceae			
Convolvulus cf. *arvensis* L. , biomineralized erems		3	***0.07%***
Brassicaceae			
Neslia sp. , uncharred capsule		1	***0.02%***
Unidentified, charred nutlet (Lamiaceae gen. sp.?)		1	***0.02%***

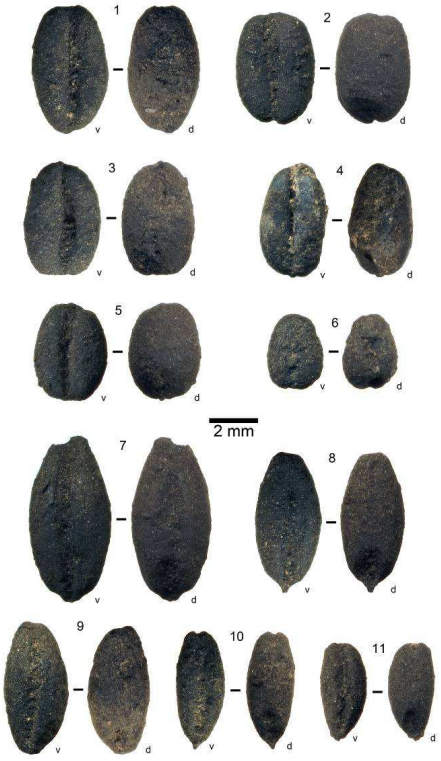

Fig. 2. Charred grains from Aparan III Early Bronze Age settlement
1-6 - *Triticum aestivum/turgidum*, 7-11 - hulled *Hordeum vulgare*:
7-8 - triplet middle grains, 9-11 - triplet left grains.
Notes: v - ventral side, d - dorsal side.

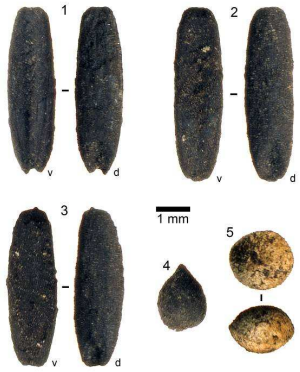

Fig. 3. Some weeds carpological material from Aparan III Early Bronze Age settlement.
1-3 - *Lolium sp.*, charred kernels, 4 - *Rumex sp.*, charred nutlet,
5 - *Neslia sp.*, mineralized capsule. ***Notes***: v - ventral side, d - dorsal side.

There is strongly expressed vertical zonality in the territory of Armenia and supposedly the agriculture varied in different altitudes also in the past. It is possible to find out some qualitative and quantitative differences in the agricultures of the past with use of archaeobotanical methods. We had aim to compare agricultures of the same period populations lived in different altitudinal zones. Particularly differences between assemblages of cultivated plants and weeds, cultigens - weeds ratios and ratio of cultigens are the main characteristics, which we are going to recover. There is more or less detailed study on high mountainous Early Bronze Age agriculture of Tsaghkahovit plain (by archaeobotanical evidence from Gegharot EBA settlement; [4,2]). For this case we studied archaeobotanical situation in Aparan III site and compared the agriculture of it with that one of Gegharot site. Tsaghkahovit and Aparan plains are practically in the same geographical region, middle mountainous zone and only altitudes are different: Aparan III is on 1860 m a.s.l. and plain part of Gegharot site is on 2100 m a.s.l. (difference is ~240 m).

Some notes on modern environmental conditions of the studied areas. Each type of soils has been formed under specific bio-climatic conditions during comparably long time - centuries and millennia. Reformation of soil under change of climate and vegetation again takes long time. The soils around of studied sites are de-carbonated mountain-chernozems (blackearth) with carbonates in deep slices, which is evidence that soils of those areas were formed under common bio-climatic conditions. Several characteristics of those soils, especially the fact that carbonates moved into deeper layers and high concentration of humus (5-12%) is evidence that those soils are formed under comparably humid and cool conditions [5]. The vegetation cover in both studied areas is presented with meadow-steppe vegetation [3]. Both sites are in Aparan floristic region [7]. Unlike of soil and vegetation cover the agro-climatic characteristics of Tsaghkahovit (Gegharot) and Aparan regions are differ (Table 2).

Table 2. Some geographic and resent climatic differences between Aparan III and Gegharot sites environs [1].

Region	***Aparan***	***Gegharot***
Altitude of sites, above sea level	1860 m	2100 m
Middle air temperature (°C)		
January	-6/-8	-8/-10
April	(+2)+4/+6	0/+2(+4)
July	(+16)+18/+20	(+12)+14/+16
October	+8/+10	+6/+8
Sum of annual average temperatures higher than 10°C	2000-2400°	1500-2000°
Days with temperature higher than 10°C	135-150	115-135
Annual rainfalls	600-700 mm	

These two sites are situated in neighboring agro-climatic zones. At present the maturity time of cultivated cereals in Gegharot delayed with ~10 days in comparison with Aparan III site surroundings [3].

Conclusions. In general, the palaeocarpological material found in vessel from Aparan III site is common for the Early Bronze Age mountainous sites of the territory of Armenia. The cereals, particularly - two and multi-rowed hulled barleys and bread wheat with its common and club subspecies, are the only recorded cultigens in this site.

The recovered weeds are common elements of prehistoric agrophytocenoses (particularly cultivated cereals fields) of the territory of Armenia until recent times. The only essential difference from higher situated Gegharot site of the same period is larger amount of wheat (43.9%) in the cereals ratio at Aparan III, which supposedly is related with altitude of the site (1860 m above sea level) and climate (in higher territories with more severe climate the ratio of wheat is lesser, usually not more than 10%).

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