THE SETTLEMENT OF AKNASHEN-KHATUNARKH, A NEOLITHIC SITE IN THE ARARAT PLAIN (ARMENIA): EXCAVATION RESULTS 2004-2009

AĞRI OVASI, ERMENİSTAN KESİMİNDE NEOLİTİK BİR YERLEŞİM AKNASHEN KHATUNARKH: 2004-2009 KAZILARININ SONUÇLARI

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ABSTRACT

This paper presents the preliminary results of the excavations (2004-2009) of Aknashen-Khatunarkh, a Neolithic site in the plain of Ararat. More than 300 m^2 has been excavated of this tell, which is about 100 m in diameter and 3,5 m in height. The cultural layer, more than 4 m thick, was subdivided preliminarily into five horizons, the upper one (I) belonging to the Early Chalcolithic and the others (II-V) to the Late Neolithic. A series of ^{14}C dates enables dating the Neolithic horizons to the first half of the 6^{th} millennium.

On the basis of a multidisciplinary study of artefacts (obsidian chipped stone-more than 22.000 pieces, antler and bone industry, ground stone, pottery, etc) and of floral and faunal remains, the main features of the material culture and economic life of this Late Neolithic settlement are brought to light. The culture represented at Aknashen-Khatunarkh has many common characteristics with contemporary cultures in the southern Caucasus (Shulaveri-Shomutepe culture, and Kültepe of the Nakhchevan).

ÖZET

Ermenistan'ın Neolitik ve Kalkolitik dönem kültürleri yakın zamanlara kadar yalnızca farklı höyüklerde yapılan küçük çaplı kazı çalışmalarından biliniyordu. 1999-2004 yılları arasında Ermeni-Fransız ortak projesi olarak Arastashen yerleşiminde yürütülen kazı çalışmaları, tabakalanmış Neolitik ve Kalkolitik dönem dolgularıyla, MÖ 6. ve 5. binyılda görülen kültürel ve ekonomik gelişmeleri değerlendirmemize olanak sağlayan anahtar bir yerleşim durumuna gelmiştir. Ağrı (Ararat) Ovası'nda, Sev Jur vadisinde, deniz seviyesinden 838 m yükseklikte bulunan Aknashen-Khaturnarkh/Aknashen, 100 m çapı ve 3,5 m yüksekliği olan bir höyük yerleşimidir. Geniş çaplı yürütülen çalışmalarda 313 m^2'lik bir alan kazılmıştır.

Çanak çömlek üzerinde yapılan değerlendirmelere göre en üst tabaka (I) Kalkolitik, bunun altında bulunan tabakalar ise (II-V) Neolitik döneme ait olmak üzere höyükte beş ana evre belirlenmiştir. Bunlardan en alt evreyi temsil eden tabaka V, sadece A açmasında ayrıntılı olarak kazılmıştır. Yapılan toprak analizleri, höyükte hem insan etkili, hem de doğal etkenlerle oluşmuş dolguların incelenmesine olanak sağlamıştır.

7 no'lu açmada hocker pozisyonunda gömülmüş olan bir çocuk iskeleti üzerinde yapılan değerlendirmelerin, gömütün olasılıkla Neolitik döneme ait olduğunu ortaya koyması, bunun şimdiye kadar Ermenistan'dan bilinen en eski gömüt olması açısından önem taşımaktadır.

Radyokarbon ölçümleri için höyükten alınan 24 örneğin 18 tanesi Neolitik dolgulardandır (Tablo 1). Höyükte bulunan 7000'den fazla çanak çömlek parçası içinde yalnızca 9 tanesinin ithal mal olduğu belirlenmiştir. Höyükte bulunan 22485 tane yontmataş bulgunun % 96'sı obsidyenden oluşur; çakmaktaşı ve kuvartz gibi hammaddelerden yapılmış alet ve yonga sayısı ise oldukça düşüktür. Kaynak analizine göre yerleşimde bulunan obsidyenler 10 ayrı kimyasalın bileşimini içermekte ve obsidyenlerin büyük bir kısmının 3 ana kaynaktan temin edildiği anlaşılmaktadır. Yontmataş aletlerin büyük bir kısmını dilgi üzerine yapılan aletler oluştururken, yongaların sayısı özellikle Kalkolitik dönemde oldukça azalmıştır. Özellikle alt tabakalarda çok sayıda öğütmetaşı ve bunlar ile ilişkili olarak sıkıştırılmış toprak kenarları, çakıl döşeli tabanları olan ocak yerleri bulunmaktadır. Öğütmetaşları genelde bazalt ve tüf gibi püskürük kayaçlar, ayrıca az sayıda granit ve kireçtaşından da yapılmıştır. Öğütmetaşlarının yanı sıra çok sayıda vurgu taşı da bulunmaktadır. Bakır ve taştan küçük boncuklar, gerdançeler, delinmiş hayvan dişleri, deniz kabukları süs eşyaları arasında sayılabilir. Bakır, Neolitik tabakalarda da kullanılmıştır. Kazıda çıkan çok sayıdaki kemik ve boynuz aletlerin arasında bız ve deliciler çoğunluktadır.

Hayvan kemiklerinin analizinde balıklar, sürüngenler, kuşlar ve memeli hayvanlardan oluşan 30 farklı hayvan türü belirlenmiştir. Evcilleştirilmiş hayvanlar arasında başta keçi ve koyun olmak üzere, sığır, domuz ve köpek yer almaktadır; ancak yabani hayvanlardan da yararlanıldığı kuşkusuzdur. Tablo 8'de de görüleceği gibi bitki analizleri de zengin bir çeşitlilik göstermektedir. Karbonlaşmış ağaç kalıntıları arasında genelde dere yataklarında yetişen ağaç türleri yoğunluktadır.

Sonuç olarak, Aknashen-Khatunarkh yerleşimi, MÖ 6. ve 5. binyıllarda sadece Ermenistan değil, tüm Güney Kafkaslar için kesintisiz tabakalanmasıyla önemli bir yerleşim yeridir. Alt tabakalarda (V-IV) sıkıştırılmış çamurdan yapılmış yuvarlak planlı yapılar, zengin bir kemik ve yontmataş buluntu topluluğu olan ve çanak çömlek üretiminin ilk evrelerini tanımlamamızı sağlayan önemli katmanlar kazılmıştır. Alt tabakalardan itibaren evcilleştirilmiş bitki ve hayvan türleri bulunmaktadır. Neolitiğin son evrelerinde (III-II) çanak çömlek kullanımı artmakta, taş ve kemik aletler ise azalmaktadır. Bu dönemde göçebe yaşama geçiş olabileceğini gösteren bazı izlere rastlanılmıştır. Kalkolitik dönemde (I) çanak çömlekte saman katkıda büyük bir artış izlenmekte, Sioni kültürünü andıran ağız, tutamak ve bezemeli parçalar bulunmaktadır. Bu sayede Aknashen-Khatunarkh çanak çömleği, Son Neolitik ve İlk Kalkolitik arasındaki geçiş evresi hakkında önemli verilere ulaşmamızı sağlamaktadır. Vurgulanması gereken iki önemli unsur ise: a) evreler arası geçişin yavaş ve uzun sürdüğü, b) bir devamlılık olsa da genel olarak bakıldığında dönemler arasındaki farklılıkların da belirgin olduğudur.

INTRODUCTION

In the succession of cultures that were present in Armenia, the least known periods are without any doubt the Neolithic and the Chalcolithic. In general, the level of study of these periods is far behind in comparison to other cultural phases in the archaeological sequence of Armenia, but also in relation to the same periods in the southern Caucasus. Until recently, these periods were known in Armenia only through a series of complexes that are isolated both chronologically and culturally, most of which had been discovered and studied in the 1960s to the 1980s on the Ararat plain, in the lower basin of the Kasakh River, a left tributary of the Araxes (Tsaghkunk, Aratashen, Verin Khatunarkh/Aknashen, Teghut, Ada-Blur), and towards the southeast (Masisi-Blur and Artashat).

With the exception of Artashat, established on a

rocky hill, these sites are small artificial tells (*blur* in Armenian) from 1 to 3 ha in surface area and as high as 4 m. The fragmentary character of the information available has not permitted the construction of a chronological sequence for the material culture within the 7th/6th to the middle of the 4th millennium BC, nor to characterize the main stages in the development of the production economy.

A new stage in the study of the Neolithic and Chalcolithic cultures of Armenia was reached with the excavations of the settlement of Aratashen, carried out by the Armenian-French mission between 1999 and 2004. This work has enabled the systematic study of an early farming settlement, a sedentary and stratified village with quite well-defined architectural features; the site, a new archaeological complex for Armenia, has enabled the establishment of a stratigraphic sequence covering several phases of the Neolithic and the Chalcolithic. The preliminary publications of Aratashen (Badalyan and Lombard et al. 2004; Badalyan et al. 2007; Palumbi 2007) are today practically the only source for the culture and economy of the 6th-5th millennia in Armenia.

This situation has made it necessary to verify and complement the data from Aratashen by systematic excavation of other similar sites, in order to constitute a representative base that enables extending research on the Neolithic and Chalcolithic cultures of Armenia. With this goal in mind, the settlement discovered at Aknashen (previously Verin Khatunarkh), 6 km southeast of Aratashen, was chosen (Fig. 1:1).

THE SITE AND THE FIELDWORK

The site of Aknashen-Khatunarkh is located in the Ararat Plain, in the basin of the Sev Jur (Metsamor), at an altitude of 838 m, in the province (*marz*) of Armavir (6 km south of Echmiadzine, on the northeast periphery of the village of Aknashen). The site is an artificial hill (*blur*), circular in plan, 100 m in diameter (a surface area of about 0,8 hectares), with a flat top rising about 3.5 m above the plain (Figs 1:2.2). In 1969-1972, 1974-1977, and 1980-1982, R. M. Torosyan carried out excavations in the west sector of the tell on a surface area of about 400 m^2. The results of this work were not published[1].

A new stage in the excavations of Aknashen-Khatunarkh was realized in 2004-2009[2] within the Armenian-French program of study on the Neolithic and Chalcolithic cultures in Armenia, in a logical continuation of the excavations of the neighboring site of Aratashen. Between 2004 and 2009, excavations were carried out in the eastern sector at Aknashen-Khatunarkh, with test Trench A on the north side and test Trench B on the south side (both 6 x 4 m in surface area). On the top of the mound 10 squares were excavated (Trenches 1 to 10), 4,5 x 4,5 m each, lying in two parallel series, the whole reaching 26,5 m in length (on a west-east axis) and 10 m in width (on a north-south axis) (Fig. 2:2). The total excavated zone thus covers 313 m^2.

Test Trench A was excavated to a depth of 475 cm in relation to absolute 0; in this trench, the cultural layer was 415 cm thick (compared to the hill's relative height of 3,5 m). The cultural layer continues beyond this depth, but the high level of the water table does not allow further excavation. In Trench A, the occupation layer is partly disturbed by an intrusive tomb of the Late Bronze Age.

Stratigraphy and Architecture

The cultural layer once excavated, being relatively thick and on the whole well stratified, was subdivided preliminarily into five horizons (I to V). The lower horizon (V) has so far been studied only in test Trench A. In test Trench B, Tr. 9 and Tr. 10, only Horizon I has been excavated thus far. The preliminary typological analysis of the material, mainly pottery, has enabled attribution of the upper horizon (I) to the Chalcolithic and the underlying horizons (II-V) to the Neolithic.

Horizon I, with an average thickness of 0,7 m, is represented in test Trench A by an undisturbed Chalcolithic layer, whereas in Trenches 1 to 8 and in test Trench B this level was covered by a medieval occupation[3], later destroyed by a sub-contemporary cemetery. In Trenches 1 to 8 and in Trench B, 117 individual sub-rectangular graves without funerary objects were discovered, as well as two tombs of the Late Bronze. The tombs intrude into the cultural layer to a depth of 120 to 205 cm. In this level, no Chalcolithic architectural vestiges have been found. However, this level does contain a large quantity of Chalcolithic objects, mainly lithic industry in obsidian and pottery. Some of these objects were recovered *in situ*, as 'islands' in their original positions; this

is the case for an assemblage consisting of three shaft-hole axes/adzes and an obsidian blade (Trench 3) (Fig. 3:1) and the large vessel found in test Trench B. Horizon I is characterized by a high percentage of chaff-tempered pottery (68 per cent).

Lower down, between 130/145 cm and 180/190 cm, lies *Horizon II*, with an average thickness of 0,6 m. This horizon, which is disturbed by intrusive tombs, is represented by surfaces of beaten earth-partly preserved floors, by *pisé* walls with fragments of bricks, and by structures that are oval or circular in plan. The pottery material of Horizon II is characterized by an abrupt decrease in the production of chaff-tempered pottery (which changes from 68 per cent in Horizon I to 30 per cent here) and by the predominance of grit-tempered pottery (the group Grit I reaches 60 per cent and the group Grit II 10 per cent).

Horizon III, ranging from 0,3 to 0,4 m thick (between 180/190 and 220 cm in depth), also destroyed in places by late intrusions (medieval and contemporary) in the form of rubbish pits, is represented by *pisé* walls and by cellular structures, containing grit-tempered pottery *in situ*. The proportions of the different groups of pottery in Horizon III are on the whole similar to those of Horizon II (Chaff - 24%, Grit I - 57%, Grit II - 19%). This horizon is also scattered with structures made with pebbles, hearth remains, and piles of material *in situ*. In particular, there is a group of three nuclei in obsidian (Fig. 3:2), clearly associated with a structure in pebbles, which contains fragments of querns.

In *Horizon IV*, unlike the overlying horizons, the architectural remains present relatively clear contours (Fig. 4:1-2). In Trenches 1-2 and 4-5, the main elements in the plan are two circular structures built from *pisé*, one 5 m in diameter on the interior and the other about 4,5 m in diameter. The walls, 25 to 50 m thick, are preserved to a height of 35 to 40 cm, in places to 55 cm. The constructions are contiguous and probably correspond to different phases of this horizon.

Against the external face of the first construction, on the west side, lie two semi-circular 'buttresses'-65 x 55 cm and 125 x 65 cm-symmetrically placed on each side of the entrance. Within the building, in a north-south direction, a low rectilinear wall rises ('pylon' ?), resting against the internal face of the south wall; this low wall, 2,2 m long and 30-35 cm wide in the part visible, divides the southern half of the building into two parts. In this construction, two floor levels were revealed. The upper floor lies at a depth of between 220 and 230 cm; a considerable quantity of material was found on its surface-obsidian artefacts, compact heaps of bones, three flat bone objects with a perforation in the upper part (pendants or tools), a tool made of deer antler, two awls/punches, discoid beads, a small celt, and ground stone artefacts.

On the lower floor (between 235 and 253 cm in depth) there are linked two structures, which are situated approximately at the centre of the building: a cylindrical *pisé* structure between 57-60 cm in diameter, containing several pebbles and a stone tool, and a shallow pit, 80 x 85 cm in diameter, filled with burned earth, pebbles, tools made from pebbles, obsidian artefacts and faunal remains. A nucleus in obsidian and a bone tool lay on the floor.

At a depth of 250-259 cm, the south part of the interior space of the house is coated with a layer of beaten earth, which covers a pile of clay blocks in the southeast corner and in the central part of the dwelling. A pit 80 cm in diameter was dug north of this pile in the layer of beaten earth, and was filled with black and orangey burned earth, which contained a few scattered pebbles, a bone palette and a large flint object (nucleus?). In the construction situated in Trench 5, at a depth of 245-260 cm, a floor was revealed on which much material was found *in situ*: a cluster of faunal remains, three nuclei of obsidian, a bone palette, a bone tool made on a palette with a toothed edge, four bone awls, an oval handstone and a cluster of obsidian blades.

Further down, 274-280 cm below the datum, there was another layer of beaten earth that extended around the building and inside it. In the middle of this layer a figure-eight shaped pit was dug (measuring 2,10 x 1,5 m), composed of two sections and filled with black and orangey burned earth, as well as fragments of whitish clay blocks. The space around these constructions was filled with features that conformed to no clear plan, mainly sections of platforms of beaten earth, certain of which continue in the baulks.

In Horizon IV, the quantity of pottery decreased by half in comparison with the overlying horizon (III).

The majority of ceramics (85 per cent) comprised grit-tempered fragments.

Horizon V, based on the evidence from Trench A, comprised five 'sub-horizons': V-1, between 290 and 348 cm deep; V-2, between 348 and 370 cm; V-3, between 370 and 400/410 cm; V-4, between 400/410 and 420 cm; and V-5, between 420 and 475 cm.

Sub-horizon V-1 was destroyed by an intrusive tomb of the Late Bronze Age. Of the original arrangement only part of a building in *pisé*, circular in plan, survived, continuing in the north baulk of the trench. The building measured 230 x 160 cm with a wall between 35 and 40 cm thick. The wall is preserved to a maximum height of 25 cm, and lies above a layer containing many blocks of charred clay. In the south part of the trench a hearth stain was found, scattered with organic material, fragments of burned bone and obsidian artefacts (25 pieces); the central part of this hearth-a circle 1 m in diameter-was 30 cm deep. The flotation of the fill produced a large quantity of archaeobotanical material.

Sub-horizon V-2 produced several structures, including a pit 90 cm in diameter, filled with charred earth, of which the bottom is lined with blocks of black and orange clay, as well as a cluster of pebble and bone fragments. A nucleus and a series of large blades were also discovered here *in situ*; to the south lay a saddle-shaped basalt quern (34 x 13-17 cm) surrounded by five to six pebbles. Flotation recovered a rich sample of plant remains. Near the south wall of the trench a cluster of charred sheep/goat bones-almost exclusively fragments of mandibles-were found in a small pit measuring 40 x 30 cm, together with obsidian artefacts. To this same level corresponds the upper limit of an oval structure (1 x 0,66 m) built from pebbles, which are arranged in four to five courses, measuring 45 cm in thickness, and surrounded by a clay border 10 to 15 cm wide; in all, this structure contains 42 complete ground stone tools and pebbles, and 57 fragments. One of the ground stone tools is a saddle-shaped quern (43 x 16-19 x 5,5 cm). All the stones had been heated red-hot right through, and have a smoke blackened layer.

Below 370 cm (*sub-horizon V-3*), the entire surface of the trench was covered with ashy stains, saturated with organic material, small fragments of charcoal and burned bones.

In *sub-horizon V-4*, in the northwest part of the trench, part of a construction was brought to light: a curved *pisé* wall, 25 to 30 cm thick. Inside this building are oval structures also in *pisé* measuring 35 x 43 cm and 25 x 50 cm, as well as a structure made of pebbles on a clay platform. In the building were found, most notably, the scapula of a large mammal, a spoke-shave and a sherd of painted pottery. In the northwest corner, a *pisé* feature (50 x 75 cm) with rounded corners was filled with burned earth, organic matter, and fragments of charred bone. Inside and outside the dwelling, close to the east wall, were hearth remains, measuring 50 to 120 cm in diameter.

Perpendicular to this wall, on the east side, was a rectilinear wall built in the same manner. The space that extends to its north is strewn with burned earth and bones. In particular, a skull, mandible and other bones of a sheep/goat were found *in situ*.

The central and southern parts of the trench produced oval structures (48 x 52, 32 x 68, 54 x 90 cm) with walls 2 to 3 cm thick in a burned orangey clay (Fig. 4:3). The flotation of this material also produced a large quantity of archaeobotanical remains.

Below a depth of 420 cm (*sub-horizon V-5*), excavations were carried out in a limited sector of 0,8 x 0,8 m at the foot of the south wall of the trench. The water table appeared at 453 cm, which made the continuation of the excavations practically impossible. However, in this deep trench, it was possible to reveal part of a *pisé* construction, circular in plan.

On the whole, Neolithic architecture at Aknashen-Khatunarkh consists of circular buildings 4 to 5 m in diameter built in *pisé*. In terms of technique of construction and plan, this architecture is similar to that of Level II at Aratashen. However, at Aratashen, some structures used 'mud bricks' and a lighter mortar, as at Arukhlo in Georgia (Hansen et al. 2007) and the sites of the Shulaveri-Shomutepe culture. At Aknashen-Khatunarkh, mudbrick fragments were found at various points on the site, but no brick wall has yet been discovered.

GEOARCHAEOLOGY: ANTHROPOGENIC DUST ANALYSIS AND NEOLITHIC ACTIVITIES

The first geoarchaeological observations and sampling occurred during the 2009 excavation season. They

concerned sedimentary units of Horizon IV (UF 6b to 8) in the central part of the tell (Trenches 1, 4-5).

The sampling method used is a twofold one: (1) many micro-samples which enable determination of the different types of anthropogenic particles[4], and (2) blocks of undisturbed sediments which allow observation of the relations between the different constituents of the soil. The sampling at Aknashen-Khatunarkh, although the quantities necessary for the analysis are very small, is particularly difficult because of the high level of bioturbation that has occurred. On a large scale the sedimentary units are clearly perceptible (Fig. 5:1), but at the centimetric scale of sampling, the undisturbed sedimentary layers are rare. Our samples were thus not taken from clearly defined sectors, but from different points, which appeared to be the most favourable in the sections available. In this preliminary report on anthropogenic sedimentation, only the more general features will be presented.

The most striking characteristics that emerge from the study of the 15 samples analysed are the very good preservation of anthropogenic dust; the abundance of siliceous phytoliths; the scarcity (often absence) of wood ashes (or POCC, Brochier and Thinon 2003); the unusual abundance of siliceous freshwater algae (diatom frustules and chrysophyte stomatocysts); and the variable, but often high, proportion of faecal spherolithic carbonated particles (Brochier 1983; Brochier et al. 1992) from domestic livestock dung (mainly sheep and goats).

Despite the small number of samples observed, the rareness of POCC is somewhat surprising considering the usual high production rate and easy dispersion of these silt-sized particles in and around inhabited zones. No taphonomic phenomenon may be invoked in this case, since much more alterable particles (such as faecal spherulites) are perfectly preserved. Only a few examples of POCC, attributable to angiosperms (wood, leaves or bark) without any possible specific assignment, were observed. This unexpected observation, *if confirmed by the analysis of more numerous samples*, argues against a long and year-round presence of a large agropastoral community at the time of the Horizon IV deposition.

Numerous siliceous phytoliths occurred as isolated particles (a usual phenomenon in accumulations of decayed dung); floral epidermis (chaff) phytoliths of cereals are extremely rare and, up to now, do not support cereal grains processing on or near the tell. The lack of other types of siliceous epidermis (from grass leaf or culm for instance) raises questions about the nature of roofs.

Associated with siliceous phytoliths and widespread discontinuous phosphatic crusts, the abundance of faecal spherolithic carbonated particles gives a strong pastoral character to these deposits. The thickness of the spherulite-rich layers, observed outside the circular walls of buildings, shows that the dung accumulations were important, and that rearing was an important activity at the site. As a consequence, the existence of dung accumulations, slowly or quickly mineralized by biochemical processes or burning (Fig. 5:2) respectively, points to the inhabitants' lack of interest in this kind of crop fertilizer.

These first geoarchaeological examinations of the sediments from Aknashen-Khatunarkh emphasize the high quantity of the sub-products of herding in the sedimentary record, a phenomenon which, in itself, is not really unexpected in a Neolithic site. From a geoarchaeological point of view, in Horizon IV the domestic signal remains surprisingly weak, as if this settlement had a strictly pastoral vocation.

Discovery of a Child Burial

During the 2008 campaign at Aknashen-Khatunarkh, a child burial[5] was found in the northeastern part of Trench 7 (UF 5, F2) (Fig. 2:2), north of a curvilinear wall.

At the time of discovery[6], the limits of the burial pit could not be recognized; it might thus be assumed that the pit was refilled with the earth taken off while it was dug. The individual was in a clay matrix; some of the bones were therefore taken out in blocks of soil, waiting for further excavation in the laboratory. The biggest block included the skull, the mandible, and the upper part of the vertebral column, as well as a few bones from the upper limbs.

In 2009, all the blocks of soil were carefully excavated in the laboratory. While excavating the human remains, the exact position of each bone element or fragment of an element, its anatomical orientation as well as relation to other bone elements, were recorded according to the methods of archaeothana-

tology (Duday 2006). The data collected in the field were then combined with those recorded in the laboratory so as to describe the body position.

The age at death of the child was estimated at between 5.25 and 7 years, based on the degree of dental maturity. The method of Moorrees and his colleagues (Moorrees et al. 1963), which enables evaluation of the stages of dental formation and resorption, was used.

The body was lying on its left side, in a flexed position, presenting three-quarters of the back. The skull was crushed. The position of the upper limbs could not be identified, except for the right arm, which laid on the trunk. The thighs were flexed at a right angle to the trunk and the legs were flexed at the thighs. The axis joining the pelvis to the top of the skull followed an east-northeast - west-southwest orientation, the head facing the north-northwest (Fig. 6).

A broken copper or bronze ring (Fig. 6) was uncovered under the left temporal bone. Two pieces of obsidian were found in the pelvis area but it is not clear if they were associated with the body or just included in the filling of the burial pit, since the matrix contained inclusions among which were other pieces of obsidian, a few sherds and fragments of animal bones.

CHRONOLOGY

The absolute chronology of the site of Aknashen-Khatunarkh is based on a series of 24 radiocarbon dates (Tab. 1). Eighteen of these (all those of Horizons V and IV and three dates from Horizon III) belong to the first half of the 6th millennium cal. BC, which enables dating of the Neolithic horizons of the settlement. Moreover, the diversity of the dates from Horizon III within the limits of the 6th millennium suggest either the possibility of a chronological subdivision of this horizon, and thus the necessity to refine the internal stratigraphy, or that samples LY-13664 and Poz-22746 belong to intrusions (Tab. 1). The late (medieval and modern) dates UGAMS-4083,-4084 and-4085 are also evidence that Horizon III in Trenches 7 and 8 was highly disturbed by intrusions from different periods (for example, the 'rubbish heap' containing modern grape seeds). Owing to the lack of samples, the dating of the Chalcolithic Horizon (I), and thus the complexes containing chaff-tempered pottery, remains a problem.

POTTERY

Excavations at Aknashen-Khatunarkh have produced 7196 pottery sherds, of which 6340 belong to Neolithic and Chalcolithic levels (88 per cent of the whole), nine of them being probably imported.

To classify the Neolithic and Chalcolithic pottery of Aknashen-Khatunarkh, we have used the traditional technological method, based on visual examination of the characteristics of the paste, and comparisons with contemporary material from the site of Aratashen (Arutyunyan 2008; Palumbi 2007); in addition, a petrographic analysis was carried out[7] on 125 samples (Arutyunyan and Mnatsakanyan 2010). The results of the study of the Aknashen-Khatunarkh pottery enable a division into three groups:

1. Pottery with organic temper-chaff-tempered-2918 sherds (46 per cent of all the Neolithic and Chalcolithic pottery)
2. Pottery with mineral temper-grit-tempered I-2643 sherds (42 per cent)
3. Pottery with organic and mineral temper-grit-tempered II-770 sherds (12 per cent)

The distribution by horizons of Neolithic and Chalcolithic pottery is represented in Fig. 7. The chaff-tempered production, which makes up the absolute majority in Horizon I, has not been found in association with any structures or buildings, because of disturbance by the intrusion of late tombs. Only in Trench B was there found *in situ* a large conical vessel (a 'basin' 50 cm in diameter), with a decoration on the edge of the rim consisting of four groups of three almond-shaped protuberances (Fig. 9:2/23).

In the underlying horizons, the proportion of chaff-tempered pottery clearly decreases. At the same time, in Horizons II and III, the quantity of grit-tempered I and grit-tempered II pottery increases. Moreover, in Horizon III, grit-tempered I pottery was found *in situ* inside buildings made of *pisé*. In Horizon IV, the total quantity of pottery is reduced by half; most of the sherds (largely grit-tempered I and grit-tempered II productions) are concentrated in the ruins of *pisé* buildings. Horizon V, brought to light only in Trench

A, had been disturbed by an intrusive tomb of the Late Bronze Age, which probably accounts for the presence of pottery in this horizon.

Chaff-tempered ware

The clay is tempered by organic inclusions, probably chopped straw, cereal residue, animal excrement. For the thin-walled vessels (between 0,3 and 1,2 cm thick), the temper is fine or coarse, for the medium-sized or large vessels (between 1,3 and 2 cm thick), a sandy temper is added to the organic temper. The density of organic temper varies between 10-12 per cent and 30-37 per cent (rarely as much as 45-48 per cent). In the mineral fraction, dolerites, dacites, and andesites predominate, with a low representation of ancient rocks (granite, quartzite, epidozite, quartzitic porphyry) (Fig. 8:4-6). The use of grog (chamotte) is of limited importance and is combined with the use of particles of ancient rocks (Arutyunyan and Mnatsakanyan 2010).

Most of the sherds presented evidence that the vessels had been carefully made. The surface often preserved marks of burnishing or traces of combing, the latter being characteristic of the Chalcolithic pottery of the region. The colour of the internal face is distinguished from the exterior surface only by a lighter tone-these are different nuances of reddish-pink, brown, and gray. Patchy areas on the sherds and contrast between the gray-black core and the surface colours are evidence of low and irregular firing, between 450 and 600° C (Arutyunyan and Mnatsakanyan 2010).

The shapes of the chaff-tempered pottery are varied: a) bowls with vertical or flared sides, sometimes with slightly rounded shoulders and a rim cut at a right angle, or sharp or turned inward (Fig. 9:2/21); b) closed globular vessels (Fig. 9:2/20); c) pots with a relatively small or medium neck (Fig. 9:2/22, 24); d) large vessels in the shape of basins (Fig. 9:2/23). As for the bases of the vessels, only a few fragments provide evidence that they were rounded, or sometimes flat (in particular the large basin).

The plant-tempered pottery is decorated with protuberances of conical form, almond-shaped or pinecone-shaped (Fig. 9:2/1-4), with perforations beneath the rim (Fig. 9:2/1-4), notches on the rim (Fig. 9:2/17-18), or geometric motifs incised on the shoulder (Fig. 9:2/17-18). The applied knobs, which appear in Level VI of Shulaverisgora (Dzhavakhishvili and Dzhaparidze 1975: figs. 11:1, 17:3), in the first phase of the Shulaveri-Shomutepe culture, are a widespread form of decoration at the sites of this culture, as well as in the plain of Ararat (Sardaryan 1967: pl. XL:1-2, 4-5, 3), and have a long existence, up to the Late Chalcolithic of Tsiteli Gorebi (Varazashvili 1992: pl. VIII:1-7; X: 7-8; XI:1-10, 11) and in the Early Bronze Age.

The pottery decorated with perforations is known at sites of the Late Chalcolithic, attributed to the first half of the 4th millennium: Teghut (Torosyan 1976: pl. V:4-5), Tsopi (Kiguradze and Sagona 2003: 91) and Ginchi (Gadzhiev 1991: Fig. 24). However, these are mainly "frying pan" types, whereas at Aknashen-Khatunarkh and Aratashen (Palumbi 2007: figs 2:3-5; 3:1-2; pl. 2:7) perforations decorate cups and bowls.

Decoration of straight or oblique notches on rims, widespread during the Chalcolithic at sites of the Sioni culture (Menabde and Kiguradze 1981: figs 2-3), appears on the pottery of Level II at Shulaverisgora (second phase of the Shulaveri-Shomutepe culture-first half of the 6th millennium BC) at the same time as incised decoration, the chevron motif and applied protuberances (Dzhavakhishvili and Dzhaparidze 1975: figs 17:2, 4; 54:20-21), elements which are all present on the Neolithic pottery of western Georgia (Dzhaparidze 1989: figs 68-69).

Grit-tempered I ware

The paste of this pottery group contains coarse mineral temper (from 14-20 per cent to 35 per cent), sometimes with very large inclusions (up to 0,5-0,9 cm), resulting in a surface covered with star-shaped cracks. The mineral inclusions consist of palaeovolcanic andesites, acid effusive rocks and their tuffs, old granites, quartzites, and also neovolcanic olivine basalts, andesites, ryodacites, and vitroclastic tuffs (Arutyunyan and Mnatsakanyan 2010: Fig. 8:1,3). Grog (chamotte) was also used as temper (Fig. 8:2).

The vessels were formed using coils 2 to 10 cm wide and wider (depending upon the dimensions of the vessel). The pottery is very compact, with a bumpy surface where the coils of clay join. The thickness of

the sides is more or less standard, 0,5-1/0,9-1,2 cm, independent of the dimensions of the vessel. The colour of the surface varies from pink through reddish-brown to gray and black with spots. The sherds in cross-section have only one colour, rarely two or three colours. The firing temperature was also around 450-600° C (except for some sherds that were fired at a temperature up to 700-750° C).

The mineral-tempered pottery consists of cylindrical or barrel-shaped vessels with a wide flat bottom and a bulge at the base, shoulders that are sometimes rounded, a simple rim-cut at a right angle, rounded or sharp (Fig. 9:3/1, 4, 6, 8-14). The large and the small vessels belong to the same types. The impressions of spiral basketry on the base, so characteristic of the Shulaveri-Shomutepe culture (Dzhavakhishvili and Dzhaparidze 1975: fig. 48:6-7) are represented by only two examples (Fig. 9:3/7). Sometimes on the bases and the lower parts of the walls, on the external face, are impressions of straw, grains, or fine sand. The pottery is not decorated. However, there are some large applied lugs, conical or cylindrical in shape (Fig. 9:3/2, 3, 5, 14), which have analogies in the southern Caucasus, in particular to the plant-tempered pottery of Kültepe I of Nakhichevan (Abibullaev 1982: pl. X:1; XI:12), of Chalagantepe (Narimanov 1987: fig. 46), of Alikemektepesi (Munchaev 1982: pl. XLV:2), and on the mineral-tempered pottery of Arukhlo (Chelidze and Gogelia 2004: pl. XXXVI:2 ; XXXVIII:6-7; Hansen et al. 2006: abb. 39; Hansen et al. 2007: abb. 26).

Grit-tempered II ware

In this group, the main temper is grog (chamotte), unfired clay and sand, in proportions ranging from 5-11 per cent to 18-24 per cent, to which a small quantity of organic matter is added. The surface of the sherds is carefully smoothed, slipped, and burnished. As for Grit-tempered I production, the thickness of the walls of the Grit-tempered II pottery varies from 0,5-1 to 0,9-1,2 cm. Generally the external and internal surfaces are the same colour-nuances of brown to gray-black; in section, most of the sherds bear the same colour.

In terms of typology and the surface treatment, this pottery is similar to both chaff-tempered and the grit-tempered I: hole-mouth pots and bowls, flat-bottomed with a rounded junction from base to body and often straight walls (Fig. 9:3/16-19) (a fragment of a vase of this type was found *in situ* within a *pisé* structure at a depth of 268 cm in Trench A, Horizon IV, Fig. 9:3/18); low-collared jars with a smooth transition from body to neck (Fig. 9:3/15), more developed shapes than those in the chaff-tempered group. The pottery of this group is not common in the plain of Ararat, but it has very precise parallels in the pottery of Arukhlo (Hansen et al. 2006: abb. 33; Hansen et. al. 2007: abb.18) and on other sites of the Shulaveri group.

The pottery of Aknashen-Khatunarkh, whether plant-tempered or mineral-tempered, because of its morphological and techno-typological characteristics is typical of contemporary sites of the plain of Ararat, and especially of the nearby village of Aratashen:

1. Ceramics from Aknashen-Khaturnarkh with organic temper is similar to that of Level 0 of Aratashen; in general, the chaff-tempered pottery of the two sites is identical; however, the firing of the pottery at Aratashen was carried out at a higher temperature and the surfaces worked more carefully.
2. Pottery of the grit-tempered I group of Aknashen-Khatunarkh corresponds above all to its counterpart of Level I at Aratashen; but at the latter site no in situ grit-tempered I vessels were found, as is the case for Horizon III at Aknashen-Khatunarkh; in its technological characteristics, the pottery of Aknashen-Khatunarkh is distinguished from that of Aratashen by a more standardized composition of the paste and by a lesser proportion of mineral temper; at Aratashen, the pottery is characterized by great variability in its content.
3. Grit-tempered II pottery, also found in situ at Aknashen-Aratashen in Horizons III and IV, is represented at Aknashen only by a few very fragmented sherds (Levels 0 and I).

Painted pottery

Besides the common pottery production, nine sherds of high quality were found in Horizons III-V, made of pure homogenous clay, finely mixed. They belong to painted vessels of two types (Fig. 9:1/1-9): 1) with a geometric decoration, painted in black, or blackish with an olive green tint, or olive green, on a

gray-beige background; 2) with a geometric decoration painted in red on a reddish-yellow background. These sherds are best compared in fabric, decoration (and shape, for the carinated pieces, Fig. 9:1/7-8) with the Samarran pottery, traits of which spread over a large part of the northern Fertile Crescent in the first quarter of the 6th millennium BC (Shimshara in northern Iraq, Hakemi Use in southeastern Turkey, Sabi Abyad Levels 6-4 in northern Syria) (Le Mière and Nieuwenhuyse 1996; Mortensen 1970; Tekin 2005).

PRELIMINARY ANALYSIS OF THE OBSIDIAN ARTEFACTS

The six excavation campaigns up to now at Aknashen-Khatunarkh (2004-2009) recovered 22,485 lithic artefacts (whole, complete and fragmentary). Almost all these objects were obsidian (99.6 per cent), apart from 96 that were fashioned from flint, dacite, quartz, or jasper. This is an analysis-in-progress on the lithics, especially those found in the 2009 campaign. A complete and detailed publication of this material will be produced at the end of the excavations.

Obsidian procurement

In order to determine the sources of the raw material, neutron activation analysis was carried out on 50 obsidian samples (J. Blackman, NIST-10 samples, E.Pernicka, Kh.Meliksetyan, Curt-Engelhorn-Zentrum Archäometrie, Mannheim - 40 samples). According to the analysis, ten different chemical compositions are present in the obsidian used. However, the quantity exploited at the respective deposits differed: three sources provided 86 per cent of the raw material (Fig. 10). The main volume of obsidian (48 per cent) comes from Arteni deposits (Mets Arteni and Pokr Arteni), located about 55 km northwest of the settlement (on the southwestern periphery of the Aragats massif); the second most used source (32 per cent) is the complex at Gutansar (Gutansar, Jraber, Fontan, Nurnus, Alapars) about 50 km to the northeast (on the western foothills of the Gegham Highland); the third source (6 per cent) is the volcano Hatis, south of Gutansar, about 45 km from Aknashen-Khatunarkh. The last seven chemical compositions are mainly represented by single specimens-one from the Geghasar volcano (in the southern Gegham Highland); one sample had a very approximate localisation in the Kars-Akhuryan deposit; two samples belong to unidentified deposit TCUNK 3; and three samples are not clustered. Thus, the inhabitants of Aknashen-Khatunarkh practiced the poly-sources model of raw obsidian procurement (Badalyan, Chataigner and Kohl 2004: 459-460), which is attested at many other Neolithic-Early Bronze Age sites in the Ararat valley, particularly in the neighbouring and contemporary settlement of Aratashen. Moreover, both sites exploited the same key deposits (Arteni, Gutansar, Hatis), the only difference being their respective percentages: Arteni obsidian was more favoured at Aratashen (62 per cent) than at Aknashen-Khatunarkh, whereas the quantity of Gutansar (and Hatis) obsidian is lower (19 per cent) (Badalyan et al. 2007: 43).

Typology and technology

Tables 2-5 present the inventories for each horizon of the lithic material from Aknashen-Khatunarkh studied up to now (*debitage*, cores, flake tools and blades, and raw blades). These inventories will continue to evolve as we carry out analysis on the whole of the collection, but this sampling is reliable for revealing certain tendencies, because it is based on the examination of several thousands of artefacts (37 per cent of the total collection up to now).

The Horizon I inventory is the only one which is not dated from the Neolithic period; it belongs to the Chalcolithic. Broadly, it comprises fewer products than the Neolithic horizons. As far as flake tools are concerned (Tab. 3), a total of 24 were inventoried and the result does not indicate a really notable difference between the Neolithic and Chalcolithic horizons. Even if this sampling is modest, there are more flake tools in Horizon I than in the Neolithic Horizons III and IV.

With regard to raw laminar elements (Tab. 4), which are often used (in an early agricultural context) or intended to be used without retouch, even though the Chalcolithic phase is the one with the lowest number of these artefacts, they are nevertheless well represented, despite the absence of whole blades.

The same phenomenon is apparent for blades (Tab. 5), though there are fewer specimens. There

is no innovation here either, and there is a notable absence of the blades in the Chalcolithic horizon. In addition, if one takes into account that the majority of the blades are initially intended to be used without retouch, the total number of potential blade tools (excluding the distal sections) is to be read as follows for the different horizons: 758 (V), 561 (IV), 652 (III), 1382 (II), 503 (1). Bearing in mind they have been identified in very limited quantity, at the moment the end-scrapers on blades are present only in the two most recent horizons of the site, the only exception being an end-scraper on flakes discovered in Horizon IV.

With regard to the evolution of lithics, it is interesting to note certain preliminary observations: *debitage* (Tab. 2) is clearly less common in the Chalcolithic level, which may indicate a fall in lithic production during this period (which is also shown by a reduction in the number of lithic categories).

Horizon IV does not contain any whole blade cores, but there are nevertheless four fragmentary examples. This same level contains fewer tools in general than the other horizons. Furthermore, if one integrates the raw segments of blades that were often used, it hardly exceeds Horizon I. On the other hand, Horizon II dominates in every category. But before concluding a decline or an increase in the importance of lithics for a given level, it will be necessary to augment our current inventories.

The major part of Aknashen-Khatunarkh tools were manufactured from sections of long blades possibly for a specialized function: 95 per cent of the potential tools of Horizon I are blades, 96 per cent for Horizon II, 97 per cent for Horizons III and IV, and 93 per cent for Horizon V. We described in detail the method of manufacture of this material in two of our preceding publications on the Armenian Neolithic (Badalyan et al. 2007; Chabot et al. 2009), and on Northern Mesopotamia, where this knapping method is systematized from the 4th millennium (Anderson et al. 2004; Chabot 2002; Chabot and Eid 2007).

Table 6 draws up the inventory of the knapping techniques recognized on some specimens of long blades and well-preserved cores. It can seem surprising initially that a limited number of diagnoses can be made, but it is important to keep in mind the fact that most of these objects were found in a context of use, and that the raw or retouched tools are in most cases used sections of blades. Thus they are rather short and their proximal ends, which had a certain convexity because of the presence of the bulb, are often damaged. However, it is precisely this part of the object, which contains the majority of the marks, which makes it possible to diagnose a knapping technique.

Certain specimens of nucleus and long blades are illustrated here (Fig. 11). It is normal to find blades manufactured by indirect percussion (Fig. 11:2/1-2) on a site where pressure with lever (Fig. 11:3) is attested. Indeed this technique is part of the knapping method which ultimately makes it possible to manufacture blades by pressure with a lever (see Anderson et al. 2004; and as revealed by experimental work of J. Pelegrin: Chabot 2002). We are certain that other specimens will appear in the remainder of the inventory. The unforeseen events of conservation result in the fact that we have few of these blades analysed up to now. Several specimens exist with characteristics that might be observed as much on segments manufactured by indirect percussion as by pressure, and therefore we cannot decide which manufacturing technique was used. Thus the goal of this analysis is not to diagnose each specimen, but to reconstruct the activities present at the village and the technological level of this population.

Table 6 makes it possible to observe that pressure with lever (Fig. 11:3) is attested for now in the three most recent horizons of the site. This testifies to very elaborate technical knowledge dating back as early as the Neolithic of Aknashen-Khatunarkh, as is also the case in the nearby village of Aratashen.

However, the presence of blades manufactured by indirect percussion in the oldest horizons of the site cannot automatically mean that pressure flaking was also known there (blades made by indirect percussion can also be obtained independently). For the moment, this technique is seen only from Horizon III. On the other hand, pressure flaking at Aratashen is attested at the beginning of the 6th millennium for several specimens (Chabot et al. 2009), which means it is one of the oldest sites where a certain systematization of this technique is attested. In the Near East, the production of Canaanean blades is sys-

tematized only at the end of the Uruk period (Anderson et al. 2004). So considering these two Armenian sites are so close, culturally speaking it would not be surprising to identify such tools in the oldest levels of Aknashen. These knapping methods and techniques will be described and analyzed in detail in the final publications of Aratashen and Aknashen-Khatunarkh.

The presence of pressure flaking using a crutch (small pressure) (Fig. 11:2/3-4) is not surprising either. Some cores attested this technique. It is possible that these are old lever pressure cores, which would have been recycled at the end of their course, when they became too small to continue knapping with the lever. The same phenomenon is well known at Aratashen; as yet, however, no workshop has been found so far. Even if several types of waste and *debitage* products are present, no significant concentration was identified. It is also possible that knapping activities were carried out in another sector of the site. So far, since the blades found show intensive use, they seem to have been mostly discovered where they were used well after they were first crafted in a workshop. Given the types of lithic products found, it is nevertheless mysterious not yet to have found an area where knapping activities occurred; they must, at least in part, have taken place in the vicinity.

Functional analysis

As we have just stressed, the preliminary examination of this material reveals that it is found especially in a context of use, since both raw segments of blades and retouched ones show traces of use. We recently undertook functional analysis at high magnification of some samples of blades discovered in the fall of 2009. We selected tools from every level, representative of the great majority of the material of Aknashen; that is, sections of long blades obtained by means of the three knapping techniques we just discussed.

So far all ten samples examined show traces related to agricultural work, which is hardly surprising in this Neolithic context and for this kind of material, especially knapped, which have standardized elements and often used without retouch. In this respect, Aknashen-Khatunarkh proves to be a typical Neolithic site, where great concern was given to the manufacture of homogeneous blades. The tools presented in Fig. 12 are the best examples to illustrate these agricultural functions. These include: harvesting (sickle blades) (Fig. 12:1-2); stripping (that is, harvesting with a blade in hand; Fig. 12:3); and threshing (with the threshing sledge; Fig. 12:4). These consists of the following stages: threshing the harvest in order to chop the straw and to separate the grains from their husks (these operations have been described in detail elsewhere, particularly in Anderson et al. 2004).

The marks characteristic of the harvest are indicated in Fig. 12, on two blades discovered in Horizon II, one of which was manufactured by applying pressure with crutch while standing (Fig. 12:2), and the other by indirect percussion/punch (Fig. 12:1). These marks are well represented by fine striae that are parallel to the edge, and sheen often seen on the sharp edge. It is probable that this function will be attested on all the levels. For the moment the sampling that has been analyzed also allowed us to observe these same marks, obtained by small pressure, on a blade from Horizon III, and on another specimen of Horizon II, but knapped by pressure using a lever. So every knapping technique used for the *debitage* of long blades seems to have provided blades that were cut in segments and then assigned to this task.

The traces characteristic of stripping (Fig. 12:3)-mainly stigmas in the form of perpendicular scratches all the way along the active edge-are caused by the collected plants and a motion comprised of the harvester firmly wedging the seed head between his thumb and the blade in hand, then pulling it toward himself; this way all the kernels are detached (see detailed description in Méry et al. 2007). There exists in only a few types of plants a seed head fragile enough to be collected this way: einkorn wheat, emmer wheat, and hulled barley (Méry et al. 2007). The last two types were identified at Aknashen-Khatunarkh (Hovsepyan and Willcox 2008).

Up to now, this harvesting technique was observed on two specimens. One of the blades shown here is dated to the Chalcolithic (Horizon I) and was probably manufactured by pressure flaking with a crutch; the other specimen is dated from the oldest horizon (V) and was knapped using indirect percussion. Even if our samples are relatively limited for the moment, it is nevertheless possible to see that this

kind of agricultural work was practiced in the most recent level and the oldest level of the site, and with the help of two different techniques of *debitage*.

Finally, three segments of blades show use-wear that can possibly be attributed to threshing sledge (*tribulum*). These stigmas are heavy patterns of scratches in all directions, that nonetheless show an overall parallel orientation to the edge.. The blade presented here (Fig. 12:4) comes from Horizon II but its technique of manufacture could not be understood (there was a mixture of lever and indirect percussion attributes). Two segments from Horizon V also carry such traces; one was knapped by pressure with a crutch, whereas the other was knapped by indirect percussion. Contrary to the use-wear left by the harvesting motion, the parallel scratches here are not fine dotted lines and the sheen is absent along the cutting edge. Also, the distribution of the traces is not solely along the edge, but is also observed inside both faces of the tool and then fades away little by little. This distribution coincides with what we already described for such obsidian tools found at Aratashen (Chabot et al. 2009) and for long blades from Northern Mesopotamia (Anderson et al. 2004; Chabot 2002; Chabot and Eid 2007).

The site of Aknashen-Khatunarkh contains an important quantity of obsidian tools, the homogenous morphology of which reveals a search for standardization. The aim of those who made these blades seems to have been to obtain relatively robust and regular flat segments of blades. That form was probably required for a functional purpose. The samples we have analyzed so far show that this functional goal might have been agricultural activities, but our ongoing research will surely reveal other key functions for other tools from this *corpus*. Furthermore, the technological advance in the making of such standardized material, found in great quantity as early as the Neolithic (6th millennium), is the most outstanding aspect of this lithic culture, as is also the case in the neighbouring village of Aratashen. But this raises a very difficult question to answer at this stage: Is such a great quantity of segments commensurate with the needs of such modest villages? Is it possible that a large proportion of these blade segments were traded or redistributed in an exchange network? Thus it will be very interesting to find if among all this material, a large number of raw blades show no traces of use.

GROUND STONE

On the site of Aknashen-Khatunarkh, ground stone tools are abundant, especially in the lower horizons. For the most part, they were found *in situ* in association with buildings in *pisé* or in the filling of structures in pebbles; some of these structures, where stones have been heated, were probably cooking pits. Most of the **material** used for objects associated with grinding, pounding and abrading is volcanic in origin (basalt, lava, tuff, etc.) and local in provenance; sedimentary and metamorphic rocks (sandstone, limestone, granite, etc.) play a secondary role for these tasks. Soft rocks (serpentine, sandstone, schist) were used for grooved stones and shaft-hole axes/adzes; siliceous rocks, green or black in color, were reserved for making polished axes.

The **grinding material** consists mainly of saddle-shaped querns, flat querns and bread-shaped handstones. The saddle-shaped querns are more frequent in the lower horizons (V-III), suggesting a chronological evolution similar to that observed in the Shulaveri-Shomutepe culture in Georgia (Hamon 2008: 109). The **pounding tools** consist of cylindrical pestles and massive mortars; a multi-facial pebble mortar (Horizon IV) with circular cavities on four of its faces is very similar to artefacts from the lowest levels of Aratashen (Levels IIc-IId). Among the **percussion tools**, a grooved hammer-stone, from the upper strata of the tell (Trench A, UF 1), has no parallel at Aratashen, but does have parallels with different sites of the southern Caucasus of the late phase of the Shulaveri-Shomutepe culture (Khramis Didi Gora; Hamon 2008: 104, fig. 19:d-g) and in that of Kültepe of Nakhichevan (Abibullaev 1982: 58, pl. IV:11).

In addition to several polishing and abrading tools, four **grooved abraders** have been found. Two of them belong to the lowest level (Horizon V) of Trench A; they are both made of ophicalcite (serpentinite), sub-rectangular in shape with several transverse grooves (Fig. 13:1/3-4). In the Neolithic and Chalcolithic of the Near East such stones with several grooves are rare. The closest parallels come from Tilki Tepe Level III, a context of the middle Halaf (in the mid-6th millennium) in southeastern Turkey (Korfmann 1982: 104, 106; figs 19:5; 20:3-5).

The other two grooved stones come from Horizon II, a transition phase between the Neolithic and the Chalcolithic. One is a basalt pebble, ovoid in shape (length 6,6 cm) with a faint transverse groove clearly V-shaped in profile (Fig. 13:1/1). The second, in ophicalcite (5,7 x 2,3 cm), presents on its rounded upper part a wide transverse (oblique) groove in a U-shape (Fig. 13:2/2-3). It is similar to the grooved stones found at Aratashen (Levels IId-IIb) and at sites of the Shulaveri-Shomutepe culture in the basin of the Kura (Shulaveri, Imiris Gora) (Badalyan et al. 2007). Such artefacts with a transverse groove are also characteristic of eastern Mesopotamia and the Zagros from the 11th millennium onward (Zawi Chemi, Karim Shahir, Jarmo, and so on), whereas in the Levant and western Mesopotamia, the groove generally lies along the longitudinal axis of the tool. According to ethnographic data, the stones with a U-section groove may have been used as shaft-straighteners or bead polishers, whereas the stones with a V-section groove may have served for the shaping of bone artefacts, arrow points, awls, etc. (Solecki and Solecki 1970).

Four *axes or celts* in polished stone (Fig. 13:2/4-7) were found at Aknashen-Khatunarkh, all in Horizon IV. Trapezoidal in form and measuring 5,9 to about 8 cm in length, they are in green or black siliceous rock. Three shaft-hole axes/adzes in siliceous stone have been found together *in situ* in Horizon I (Fig. 3:1); the proximal part of a similar artefact comes from another trench, in the same horizon. These artefacts, whose hafting is perpendicular to the cutting edge, belong to two variants: the smallest one (length 11 cm) is a 'perforated celt', with a cutting edge symmetrical in section (Fig. 13:2/1); the two biggest (length 15 cm and 19,4 cm) have an asymmetrical cutting edge with an upper surface that is convex and the opposite surface concave (Fig. 13:2/2-3). Such artefacts are quite rare in the Neolithic Near East: a hoe-like implement with a large perforation near the butt has been found at Matarrah, in northern Iraq (7th millennium) (Braidwood et al. 1952: 21) and another at Yarim Tepe I dating to the beginning of the 6th millennium (Munchaev and Merpert 1981: fig. 36:2). In the southern Caucasus, some perforated celts have been found on sites of the Shulaveri-Shomutepe culture (Shulaveri, Level IV) (Kiguradze 1986: fig. 11:33); however, the closest parallels to the Aknashen-Khatunarkh artefacts come from Kültepe of Nakhichevan (lower level), where four 'shaft-hole adzes' (lengths 13 to 18 cm) have been found (Abibullaev 1982: pl. IV:1-3, 13). According to the excavator, these tools could have served as hoes for turning earth, but not as axes for cutting wood, as the working edge carries no trace of removals due to blows, even though it is highly worn (Abibullaev 1982: 56-57).

Several *weights* in vesicular basalt, circular in shape (4 to 7 cm in diameter, 1,5 to 3,5 cm thick), have a double-beveled perforation in the centre. The smaller ones were probably used for weighting looms and the larger ones to make digging sticks heavier. A biconical artefact in basalt (about 7 cm in diameter) found in horizon III has a median ridge that is remarkably worked. This artefact may be a preform for a spindle whorl or a mace-head (?).

For the ground stone assemblage, the transition between the Neolithic (Horizons V-II) and the Chalcolithic (Horizon I) is manifested by the appearance of new categories of artefacts (shaft-hole axes/adzes and grooved hammer-stone), which have parallels on the sites of the latest phase of the Shulaveri-Shomutepe culture and in the lower level of Kültepe I of Nakhichevan. The existence of relations between this latter site and Aknashen-Khatunarkh, suggested by the pottery (chaff-tempered ware, globular jars with low necks, horizontal lugs, protuberances on the rim) is thus reinforced.

SMALL FINDS

At the site of Aknashen-Khatunarkh, the ornaments are varied, unlike at Aratashen, where (besides copper beads) only small discoid beads of whitish color were found. Such beads in white antigorite, with a diameter between 3,5 and 5,5 mm, are also present in all the horizons of Aknashen-Khatunarkh; in addition there are:

1. An obsidian pebble, flat and discoid in shape (2,7 cm diameter), with a cavity made in the centre of one of the faces (Horizon IV); is it possible that this is an unfinished pendant?
2. Animal teeth (wild boar, fox, dog, ox), perforated or grooved, found in Horizons II to V (Fig. 14:1/1-6); perforated tooth pendants were used in the Near East as early as the beginning of the Neolithic at Shanidar Cave in the Zagros (Solecki et al. 2004)

3. A discoid bead in bone (Horizon III) and tubular beads made from bird bones (Horizons IV-III) (Fig. 14:1/9); such tubular beads are very common beginning in the Proto-Neolithic in the Zagros (Shanidar cave) and in the Pre-Pottery Neolithic A of the southern Levant (Beidha) (Kirkbride 1966: 203-204; Solecki et al. 2004: 203).
4. A large fish vertebra perforated in the centre (Silurus - catfish) (Horizon III) (Fig. 14:11/7).
5. A pendant made from a marine shell, Conus sp., perforated at the apex (Horizon III) (Fig. 14:1/8). Among the many varieties of Conidae, the closest species to this pendant appears to be Conus inscriptus that lives in the Red Sea. In the Near East, the use of Conus shells as ornaments can be traced back to the Levantine Pre-Pottery Neolithic (Hayonim Terrace, Jericho), where Mediterranean and Red Sea Conus are found (Reese 1982), and in southeastern Anatolia (Körtik Tepe), where the origin of the species is not stated (Özkaya and Coşkun 2009: fig. 6). From the PPNB-PPNC onwards, there is an increase in shell quantities, owing to the increased exploitation of shells from the Red Sea (Bar-Yosef 2005: 181). For example, the Red Sea *Conus ebraeus* has been found in graves at Chalcolithic sites throughout Mesopotamia (Tello, Tepe Gawra) (Gensheimer 1984).

METAL

The Neolithic levels at Aknashen-Khatunarkh have produced two copper artefacts, several examples of copper ores, and a fragment of lead ore.

In Horizon IV, in the tomb discovered in Trench 7, a broken copper or bronze ring was uncovered under the skull (Fig. 6). In the lowest horizon (V), a fragment of a highly oxidized copper sheet bead was found in a hearth among faunal remains and broken obsidian artefacts (Trench A, UF 10, F. 5). This type of bead belongs to a tradition known on Neolithic sites of the northern Near East between the beginning of the 8th millennium and the end of the 6th millennium, when they disappeared (Schoop 1999). In the southern Caucasus, such beads are attested for the 6th millennium at sites belonging to the Shulaveri-Shomutepe culture Khramis Didi Gora, Gargalar Tepesi, Chalagantepe (Kavtaradze 1999: 69) and in Aratashen Level IIb, where 57 examples were found together (Badalyan and Lombard et al. 2004: 52, fig. 8).

Several fragments of green malachite and a few of blue azurite (copper carbonates) were found in horizons IV-II, in different parts of the site, the largest pieces of malachite (19 g each) coming from Horizon IV (Fig. 14:2/1-2). Copper ore is found at many locations in eastern Turkey, northwestern Iran, and the southern Caucasus, the nearest deposits being in northwestern and southeastern Armenia (Alaverdi and Kapan regions). However, only an analysis of lead isotopes will enable precise determination of the origin of the copper ores found at Aknashen-Khatunarkh. In the Near East, the use of blue and green copper ore for beads, pendants, and pigments is attested for the 11th-9th millennia at early agro-pastoralist sites such as Shanidar Cave and Zawi Chemi in northeastern Iraq, Hallan Çemi and Çayönü in eastern Turkey, and Rosh Horesha in the southern Levant (Roberts et al. 2009). For the 7th-6th millennia, such copper ore fragments are well attested on northern Mesopotamian sites Hassuna, Yarim Tepe I, *etc* (Stech 1999).

Malachite and azurite were also found at Aratashen, but not galena (lead sulfide), of which a large fragment (22 g) was found at Aknashen-Khatunarkh in Horizon III (Fig. 14:2/3). Fragments of lead ore were discovered at different Near Eastern sites of the 8th to 6th millennia, from central Anatolia (Çatal Höyük) to northeastern Mesopotamia (Jarmo, Hassuna Ia, Yarim Tepe I, Arpachiyah) (Schoop 1995), but much more rarely than copper ore. Galena was perhaps used for eye paint, a practice that survives in fact to the present day. In Armenia, the main deposits of galena are located in the northwest, Kadzharan region and in the southeast, Kapan region (Matveev et al. 2006; Melkonyan and Akopyan 2006).

BONE INDUSTRY

At Aknashen-Khatunarkh, 378 objects (whole or fragmentary) in bone, horn, and antler have been found, of which only four (three awls and one edged tool) come from Horizon I (Chalcolithic). In the Neolithic horizons the number of artefacts increases from Horizon II to Horizon IV; Horizon V (Trench A), with a density of 40 tools for 24 m^2, is the richest.

A majority of the objects are awls or punches (Fig. 15:7/9); however, their percentage decreases

from Horizon II (83 per cent) to Horizon V (50 per cent). The rest of the bone, horn, and antler artefacts from the Neolithic horizons belong to a large variety of types (although most of the types are represented by a few objects). R. Christidou is currently carrying out a functional analysis of the bone industry; we present below some of the most characteristic types.

Tools of 'dibble' type, consisting of a goat horn of which the proximal part is perforated to be fitted with a handle (Fig. 15:10; length 9,7 cm), are present in Horizon II. With them is a fragment of a bone arrow with a point having a lozenge-shaped section (Fig. 15:5). A similar example from Horizon IV consists of a point having a triangular section followed by a cylindrical tang. Horn dibbles and bone arrows have parallels in Level II of Aratashen.

In Horizons III-IV, the variety of types increases: beveled tools, made from deer antler or goat horn (Fig. 15:1/2), and wide palettes, made from the shoulder blades (*scapulae*) of large ruminants, of which one example has a toothed edge (Fig. 15:14). In Horizon III a finely carved spoon (3 x 3,8 cm) was found (Fig. 15:12); it is similar to the spoons from the lower level of Aratashen (in particular from IIb).

In Horizon IV, the bone assemblage includes shafts of cylindrical section pointed at their two extremities (bipoints) (Fig. 15:16; 13,5 cm long and 0,6 cm in diameter), which evoke pins for clothes rather than tools, a bone blade made from a rib (15 cm long and 1,8 cm wide) with perforations at both ends (Fig. 15:11), and flat piercing tools made from a rib with perforation at one end (Fig. 15:3-4). The function of a series of artefacts (Fig. 15:1-2) remains unclear.

The industry in bone, horn and deer antler from Aknashen-Khatunarkh is very similar to the assemblage from Level II of Aratashen. And both are doubtless close to the Shulaveri-Shomutepe culture, which developed at the same time in the neighbouring basin of the Kura.

FAUNAL REMAINS: NEOLITHIC SUBSISTENCE ECONOMY AT AKNASHEN-KHATUNARKH

As studies of fauna and archaeozoological data are not very numerous for the Neolithic and Chalcolithic periods in Armenia, the faunal material from Aknashen-Khatunarkh is of great significance. This material provides new information on the subsistence modes of the Neolithic societies in the Ararat plain during the first half of the 6th millennium BC, and the comparative study with the neighbouring site of Aratashen[8] (about 6 km away) gives elements for understanding how these settlements functioned.

Methods

The recovery of the bone remains was mainly by hand; certain sediments were sieved for the archaeobotanical studies, but the fauna from sieving was not abundant and very fragmentary. The anatomical and taxonomical determinations for the mammals were carried out using the works of Schmid (Schmid 1972), Fernandez (Fernandez 2001), and Brugal (Brugal 2009). The discrimination between goat and sheep is based, on the one hand, on analysis of the post-cranial elements (Boessneck et al. 1964; Clutton-Brock et al. 1990; Prummel and Frisch 1986), and on the other hand, on the dental remains determined according to the criteria established by Payne (Payne 1985), Helmer (Helmer 2000), Halstead et al. (Halstead et al. 2002). The dates for dental eruption are based on the data in Schmid (Schmid 1972); the estimates of age according to dental wear are based on the work of Payne (Payne 1973) and Helmer (Helmer 2000) for the Caprinae. The kill-off profiles for the Caprinae have been established based on the heights of dental crowns (see Helmer et al. 2007).

Inventory of species

At Aknashen-Khatunarkh, the excavation is in progress. The analysis presented here includes the faunal material recovered between 2005 and 2009, in trial Trenches A and B and in the Trenches 1-8. At the present time, about 13,000 remains of fauna have been studied, among which more than 5900 have been determined to taxonomic level (45 per cent of the total number of remains). Horizons II, III and IV have produced between 1600 and 5000 fragments; however, the sub-phases of Horizon V (V-1 to V-5) have produced less than 1000 fragments (Tab. 7). Horizon I and sub-phase V-5 do not appear in the figures as the number of remains is very low (fewer than 140 fragments).

Some 30 taxa have been identified: four fish- the common carp (*Cyprinus carpio*), the tench (*Tinca tinca*), undetermined Cyprinids and a catfish (*Silurus glanis*)- an amphibian, a reptile (the tortoise), a bird (*Otis tarda*), a micromammal, and some 21 species of mammal. The domestic species are Caprinae, *i.e.* sheep (*Ovis aries*) and goats (*Capra hircus*), cattle (*Bos Taurus*), pig (*Sus domesticus*) and dog (*Canis familiaris*). The wild taxa are numerous: aurochs (*Bos primigenius*), wild boar (*Sus scrofa*), horse (*Equus ferus*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), gazelle (*Gazella* sp.), bear (*Ursus arctos*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), wild cat (*Felis sylvestris*), a small mustelid (*Mustela* sp.), hare (*Lepus* sp.), beaver (*Castor fiber*), hedgehog (*Erinaceus* sp.) and wild Caprinae, i.e. mouflon (*Ovis* cf. *orientalis*) or wild goat (*Capra aegagrus*) (Tab. 7). In comparison with Aratashen (Badalyan et al. 2007), more wild species are observed in Aknashen-Khatunarkh (among others: horse and hedgehog).

Comparison of the frequencies of the domestic and wild animals on Aknashen-Khatunarkh and Aratashen shows a predominance of domestic species in all the sub-phases (Fig. 16:1) and an animal economy that clearly relied on herding. Overall in the two occupations, the frequencies of wild fauna are low and are slightly higher than 10 per cent only in Horizon Kha III and II, and Horizon Ara IIb (Vila et al. in press).

Frequencies of domestic species

At Aknashen-Khatunarkh the frequencies of Caprinae are very high and clearly dominate those of other domestic species from the earliest sub-phases to the latest sub-phases (Fig. 16:1). The Caprinae herds consisted mainly of sheep at Aknashen-Khatunarkh. Goats represent, depending on the sub-phase, from one-third to one-eighth or less of the herds. The remains of pig are very rare. The remains of dog are few on the site throughout the occupations.

A change is observed in the frequencies of the Caprinae between the horizons: they decrease with the increase of those of cattle over time. This is very clear at Aknashen-Khatunarkh beginning in Horizon Kha IV (Fig. 16:1). At Aratashen, the same phenomenon, although less marked, appears beginning with Horizon Ara IIa. Comparison of the earliest horizons (Kha V-IV and Ara II) with the latest horizons (Kha III-II and Ara I) clearly shows the change, with an increase in the exploitation of cattle in the latest horizons of both sites (Badalyan et al. 2007; Vila et al. in press).

Frequency of wild species

Wild fauna is present in all horizons of Aknashen-Khatunarkh. Its contribution increases gradually between the most ancient (5 per cent) and most recent (12-13 per cent) levels (Fig. 15:1). Hunting at Aknashen-Khatunarkh, as much in the earliest horizons (Kha V-IV) as in the latest (Kha III-II) is not very selective and does not concern any particular species. The major difference between Aknashen-Khatunarkh and Aratashen in the faunal spectrum concerns the proportions of the wild taxa found on the two sites (Badalyan et al. 2007; Vila et al. in press). Comparison between the earliest horizons (Kha V-IV) and the latest horizons (Kha III-II) shows that the proportions of Cervidae and rodents are less while those of suids, aurochs and equids (horses) are higher; the proportions of other taxons, small ruminants (gazelle, roe deer, wild Caprinae, etc.) and carnivores, do not vary.

If we consider the limited number of the remains of wild taxa, the anecdotal aspect of hunting activity is almost constant on both sites (Vila et al. in press). It must be noted, however, that this hunting concerns a very large spectrum of species: among these the large mammals, and dangerous species such as the aurochs, the wild boar, the red deer, the bear, and the wolf.

There is very little evidence for hunting birds or for fishing. The fish remains found on the two sites belong to local freshwater species: carp (*Cyprinus carpio*), tench (*Tinca tinca*) and catfish (*Silurus glanis*). Thus far the sizes of the individuals fished are medium and large. For example in the case of the catfish, its size corresponds to 1,5 m for a weight of 30 kg. These dimensions are not particularly characteristic of all the fish caught, as most of the material currently studied comes from samples taken directly by eye and by hand.

Herding and exploitation of Caprinae

The animal economy of Aknashen-Khatunarkh was based upon the herding of sheep and goats, sheep

being predominant during the entire duration of the occupation. Thus a study of age at slaughtering was carried out first of all to analyse the types of exploitation of the Caprinae. Age profiles of sheep and goats together were established to define the main orientations of the breeding strategies, with the knowledge that goats are less frequent on the site.

It is necessary to add that at Aknashen-Khatunarkh the age profiles at slaughter are based on the dental remains analyzed up to 2007. At Aknashen-Khatunarkh, the profiles suggest consumption of the tender meat of young animals (classes C and D after Payne 1973). At Aratashen, the more varied profiles of ages at slaughter suggest a more complex exploitation of the animals as the age classes absent at Aknashen-Khatunarkh are present at Aratashen: the very young animals and the juveniles (classes A and B) and the older breeding animals (class HI) (Figs 15:2; 16:1). All the age categories of a herd appear at Aratashen and thus all the stages of exploitation of the animals (Vila et al. in press). This is not the case for the horizons of contemporary occupations at Aknashen-Khatunarkh. A certain number of questions are to be asked in view of these differences. Are they due to a difference of function between the two sites? Should they be interpreted in terms of a difference in the status of the occupants of the sites or rather in terms of seasonality or at least periodicity of occupation? Could Aratashen have been, unlike Aknashen-Khatunarkh, occupied year-round, as suggested by the presence of very young and very old individuals? The presence of very young animals and juveniles suggests that lambing took place on the site of Aratashen. To attempt answers to these questions, isotopic analyses as well as studies of seasonality based on teeth will be carried out.

The comparison between Aknashen-Khatunarkh and Aratashen, occupied during the same periods of the Neolithic, shows that they share a large number of similarities in the exploitation of animals. Both had an animal economy based on herding with a predominance of Caprinae (especially sheep) exploited for their meat. At the end of occupation, on both sites, we observe the same change in the orientations of herding with an increase in the exploitation of cattle. Also on both sites, hunting does not appear to have had an important function in the food economy. Other activities such as fishing and hunting of birds have left only a little evidence. The frequencies, although low, of wild species are evidence of an exploitation of the plain with its fluvial network (beaver, fish) and the more distant mountains (wild goats), as well as the coexistence of forested and wooded zones (red deer, roe deer, wild boar, bear, wild cat) with less wooded and probably drier zones (gazelles). At Aknashen-Khatunarkh, the appearance of horses in the late levels also marks an important difference between the two sites.

The age profiles of the Caprinae that constituted the base of the animal economy also illustrate differences whose interpretation is essential for comprehension of the occupation of these two sites, and are probably evidence of their relationship and their function, linked to their geographical proximity. These different but almost complementary exploitations raise the question of rhythms of occupation. We may ask whether we are observing the effects of a system of herding with a sharing of the herd (females and juveniles on one side, young adults and adults on the other), which would correspond to a system of division of tasks.

The excavations at Aknashen-Khatunarkh have not been completed, and the faunal remains being analysed or to be recovered will add to the present data. The continuation of the study will certainly provide more elements that will confirm or invalidate these initial results and will contribute above all to the interpretation of the occupation of this site.

PALAEOETHNOBOTANICAL ANALYSES

Mostly charred plant macro-remains, that is, seed material and charcoal, some of which were mineralized and desiccated, were recovered from cultural deposits on the site either by flotation (mesh size 0,25 mm) or wet-sieving (mesh size 1 mm), during the excavation seasons of 2005-2008. Seventy-two samples of sediment, approximately 780 L in volume, were processed. Horizon I produced only a few finds. Most of the material came from Horizons II-V. In general, the richest from an archaeobotanical viewpoint is Horizon V.

Sediments were sampled from hearths, floors, contents of structures, etc. Besides plant remains, numerous impressions enclosed in building clay were also examined. The plant impressions visible in building clay and pottery represent chaff used as a

tempering material. Identifications of the samples recovered were conducted using a comparative seed reference collection and the relevant literature (Dobrokhotov 1961; Takhtajyan 1954-2001; Takhtajyan and Feodorov 1972; Zohary and Hopf 2000).

Already 42 flowering plant taxa have been identified in the archaeobotanical material from the site of Aknashen-Khatunarkh (Tab. 8). Most of the plant impressions concern cereal chaff (e.g. glumes of free-threshing wheat), capsules of alyssum and camelina and pods of lentil. Almost all pieces of building clay contain numerous impressions of cereal chaff and/or capsules of alyssum. Impressions of cereal grains, pulse seeds, pods of unidentified legumes, caper seeds, monocotyledon stems and leaves of dicotyledonous plants were found in building clay as well. These impressions sometimes contained carbonized or desiccated remains, some of which were very fragile and not resistant to contact with the air. The pieces of unbaked clay also fell apart after drying.

The following cultivated cereals were identified from the impressions and floated carbonized material: free-threshing wheat (*Triticum aestivum/turgidum*), emmer (*T. turgidum* ssp. *dicoccum* [= *T. dicoccum*]); naked barley (*Hordeum vulgare* var. *nudum*); and hulled barley (*H. vulgare*). Naked wheat and barley are predominant. Two species of cultivated pulses: small-seeded lentil (*Lens culinaris* ssp. *microsperma*); and bitter vetch (*Vicia ervilia*) were recovered, preserved in the same way as the cereals. The naked wheats, emmer, barley, lentil, and bitter vetch are traditional Armenian cultigens (Stoletova 1930). These cultigens belong to the Neolithic Near East crop assemblage (Zohary and Hopf 2000).

Capsules of crucifers recovered from site were identified as desert alyssum (*Alyssum desertorum*); and small-capsule false-flax (*Camelina microcarpa*; *Brassicaceae*) having oleiferous seeds. Except for false-flax and alyssum, other oil-producing plants were not recorded at Aknashen-Khatunarkh or neighbouring Aratashen. The presence and concentration of large quantities of alyssum and false-flax threshing waste (impressions of open capsules within building clay) suggest that these cruciferous plants were used (gathered or cultivated) at prehistoric Aknashen-Khatunarkh and Aratashen for their oleiferous qualities (Hovsepyan and Willcox 2008).

Seeds and fruits of the following weedy and wild plants were found at Aknashen-Khatunarkh (Tab. 8): *Buglossoides arvensis* (= *Lithospermum arvense*); *Lithospermum officinale* (Boraginaceae), *Rumex cf. crispus, Polygonum aviculare* (Polygonaceae), *Amaranthus sp.* (Amaranthaceae), *Chenopodium sp.* (Chenopodiaceae), *Vicia sp., Medicago sp.* (Fabaceae), *Capparis spinosa* (Capparaceae), *Bromus sp., Setaria sp.* (Poaceae), *Thlaspi sp., Brassica/Sinapis sp.* (Brassicaceae), *Galium sp.* (Rubiaceae), *Calystegia sepium* (Convolvulaceae), *Ranunculus sp.* (Ranunculaceae), *cf. Silene* (Caryophyllaceae), *cf. Cuscuta sp.* (Cuscutaceae), cf. *Rubus sp.* (Rosaceae).

The identified plant species have a comparatively diverse ecology. They tend to spread almost everywhere and infest mainly fields of annual crops (*e.g.* cornfields; Dobrokhotov 1961). They are known as semi-desert, steppe, and meadow elements (Mkrtchyan 2003; Takhtajyan 1954-2001; Takhtajyan and Feodorov 1972). The identified weeds now grow in the vicinity of the site and infest crops, mainly fields of cereals. *Medicago sativa* is also cultivated here in large areas.

The finds of hygrophilous plants: *Bolboschoenus* and *Carex* (Cyperaceae; Tab. 8), indicate the presence of wetlands not far from the settlement in the Neolithic period. Several bio-mineralized fruit stones of *Celtis sp.* (Ulmaceae) and a single carbonized fruit stone of *Elaeagnus* cf. *angustifolia* (Elaeagnaceae) were recovered among the remains of woody plants at Aknashen-Khatunarkh.

Preliminary charcoal studies

For the moment only three taxa were identified among the few poorly preserved charcoal fragments recovered: willow (*Salix sp.*) and unidentifiable willow family (Salicaceae gen. sp.); tamarisk (*Tamarix sp.*; Tamaricaceae); unidentifiable monocotyledon herb (Monocotyledones fam. gen. sp.). Species of *Salix* grow in moist soils, usually along rivers. Moisture is necessary for this tree and its presence is another indication of a river near the Neolithic settlement of Aknashen-Khatunarkh. Salicaceae gen. sp. is also probably willow, but poor preservation prevents observation of the anatomic details necessary for genus identification. *Tamarix* prefers a hot climate and grows very

well in deserts and semi-deserts with saline-alkaline soils, where the level of ground water is high. Species of both genera, *Salix* and *Tamarix*, grow today in the environs of the site. Monocotyledones fam. gen. sp., an undetermined monocotyledon herb, could be *Phragmites australis*, which grows along rivers, on the banks of lakes, in marshlands, etc., but again because of poor preservation of the charcoal remains and the anatomical similarity of most monocotyledon plants, identification was not possible, even to genus. In addition to the above, there are also very small (less than 2 mm) charcoal fragments, which it was possible to identify only as flowering plants (Angiospermae). All the above taxa identified in the charcoal from Aknashen-Khatunarkh were also identified in Aratashen (by H. Pessin; see Badalyan et al. 2007: 58-59).

The complex of cultivated plants of Neolithic Aknashen-Khatunarkh is similar to that of Aratashen (Tab. 8). Even the types of archaeobotanical materials preserved and the plants most commonly used in building are similar in these neighboring settlements. *Chenopodium*, *Bolboschoenus* and *Capparis* are found on both sites. The archaeobotanical materials of Aknashen-Khatunarkh are better preserved and thus it is taxonomically richer. The poor preservation conditions at Aratashen do not allow more objective and complete conclusions concerning the similarities or differences in weeds and wild vegetation between Aknashen-Khatunarkh and Aratashen.

The main crops at the Neolithic settlement of Aknashen were cereals, but the cultivation of pulses and oil-producing plants also had an important place in the plant economy. Naked wheat (*Triticum aestivum/turgidum*), emmer (*T. dicoccum*) and naked and hulled barleys (*Hordeum vulgare*) were cultivated as well. Pulses, small-seeded lentil (*Lens culinaris* ssp. *microsperma*) and bitter vetch (*Vicia ervilia*) were cultivated. Two cruciferous (*Brassicaceae*) plants, desert alyssum (*Alyssum desertorum*) and small-capsule false-flax (*Camelina microcarpa*) were probably used for oil and possibly cultivated at prehistoric Aknashen-Khatunarkh. The weeds and wild grasses at Aknashen-Khatunarkh during the Neolithic were almost the same as those today. The presence of cyperaceous plants (e.g. *Bolboschoenus* and *Carex*) indicates that wetland ecosystems were also present in the vicinity of the settlement in the Neolithic period. Presence of *Celtis*, *Elaeagnus*, *Salix*, and *Tamarix* species at the site of Aknashen-Khatunarkh suggests the existence of rare xerophile forests near the Aknashen-Khatunarkh and Aratashen settlements in Neolithic period.

CONCLUSION

The site of Aknashen-Khatunarkh is of major interest for the study of the cultures of the 6^{th}-5^{th} millennia BC, not only for Armenia, but for the whole of the southern Caucasus, because it is the first site to present clearly a continuous stratigraphic sequence covering the phases of the Late Neolithic and the Early Chalcolithic.

Indeed, the transition between these two phases was until now very poorly known for the central and eastern part of the southern Caucasus. In the plain of Ararat, at the nearby settlement of Aratashen, the upper layers of the tell, corresponding to this phase of transition, were destroyed. In the basin of the Kura and the steppes of Azerbaijan, the end of the Shulaveri-Shomutepe culture (at the beginning of the 5^{th} millennium BC) (Kavtaradze 1999: 71-72) is marked by the abandonment of almost all the sites and the establishment of new villages belonging to the Sioni culture in more diversified environments, valleys but also high plateaus.

At Aknashen-Khatunarkh, the lower horizons (Horizons V-IV) with circular architecture built in *pisé*, a rich bone tool and lithic industry, and the very beginnings of a pottery production characterized by grit temper, belong to the 'Aratashen-Shulaveri-Shomutepe' culture. Agriculture (mainly *Triticum aestivum* and *Hordeum vulgare*) and stockbreeding (sheep and goats represent about 90 per cent of the herd) are developed. An evolution is probably taking shape in economic strategy, since Horizon V (even if reached only in a restricted area) is by far the richest from an archaeobotanical point of view, whereas in Horizon IV a strong pastoral character is evidenced by the geomorphological analysis.

In the later horizons of the Neolithic phase (III-II), pottery increases rapidly with a clear predominance of Grit-tempered ware (70 per cent or more), whereas ground stone and bone artefacts decrease in quantity and variety (80 per cent of the bone tools

are awls). Herd exploitation is marked by an increase in cattle and evolution towards more milk and wool production (according to the slaughter ages). These elements suggest a gradual modification of the life towards more pastoral and mobile economy.

The Chalcolithic horizon (I) is characterized by a sharp change in the pottery production: Chaff-tempered pottery becomes predominant (68 per cent); this ware often preserves traces of combing and is decorated with perforations beneath the rim, knobs and notches on the rim; some features are characteristic of the Sioni culture (Kiguradze and Sagona 2003: 50, fig. 3.6-3.8; 3.13).

Therefore, the settlement of Aknashen-Khatunarkh sheds new light on the transition between the Late Neolithic and the earliest stage of the Chalcolithic. Two factors stand out: a) change is gradual and seamless, with no break between the two phases; b) despite overall cultural continuity, there are important developments in the variety and quantity of objects, especially those associated with subsistence economy, indicating a profound evolution in the way of life.

NOTES

[1] For preliminary information, see Torosyan et al. 1970. Some lots chosen from the lithic industry and the faunal remains were studied and published: See Korobkova 1987: 143 and 145, tab. 35; Mezhlumyan 1972: 166, annex 2. The objects are kept in the historical and ethnographic museum of Echmiadzine.

[2] Also participating in the fieldwork were H. Sargsyan (2005 to 2009), the architect and author of drawings (Figs. 4:1, 9-2-3, 13, 15), A. Hayrapetyan (2005) and S. Melkonyan (2006, 2008), to whom the authors express their sincere gratitude. We would like, too, to acknowledge Kh. Meliksetyan, A. Karakhanyan and R. Melkonyan (Institute of Geological Sciences, National Academy of Sciences, RA) for the definition of rocks and minerals and J. Leclerc (Canada) for the drawings of obsidian (Figs. 11,12). We are grateful to the French Ministry of Foreign Affairs for the funding of the archaeological mission "Caucasus".

[3] The sample UGAMS-2290 from Tr. 6 UF 5, dated to 840 ± 40 BP or 1151-1271 cal. AD, corresponds to the age given by the medieval pottery, based on analogies.

[4] After dissociation of the silt-sized elements in hydrogen peroxide (110 vol.), these were placed in suspension in distilled water, sampled using a syringe after 25 seconds of settling and deposited on a glass slide. This length of sedimentation enabled the recovery of the dusty fraction of the sediment. The water was then evaporated on a hotplate. Canada balsam, whose refraction index is perfectly adapted to the observation of these objects, was used as mounting medium. The examination, determinations, and quantifications were carried out using a petrological microscope at a magnification of 400 (Brochier 2002).

[5] Bone samples from the buried individual have been sent to the Center for Applied Isotope Studies (University of Georgia, USA) for radiocarbon dating.

[6] Fieldwork was performed by M. F. Marshall (University of Chicago).

[7] The petrographic analysis of 250 samples from the sites of Aknashen-Khaturnakh and Aratashen was carried out in the laboratory of the Institute of Geological Sciences of the Academy of Sciences of Armenia, thanks to grant no. 2007-RC-004 awarded by the association Project Discovery.

[8] The horizons at Aknashen-Khatunarkh are referred to as Kha II to Kha V in the text, the tables and the figures, while the horizons at Aratashen are referred to as Ara I and Ara II, in order to avoid confusion between the names of the sites, which are quite similar phonetically, and to simplify the reading of the figures. According to the objects and the similarity in dates, it would seem that the earliest horizons of Aknashen-Khatunarkh (Kha V and Kha IV) are approximately contemporary to horizon II of Aratashen (Ara II). Horizons II and III of Aknashen-Khatunarkh (Kha II and Kha III) could be attributed to the period immediately after, thus generally contemporary to horizon I of Aratashen (Ara I).

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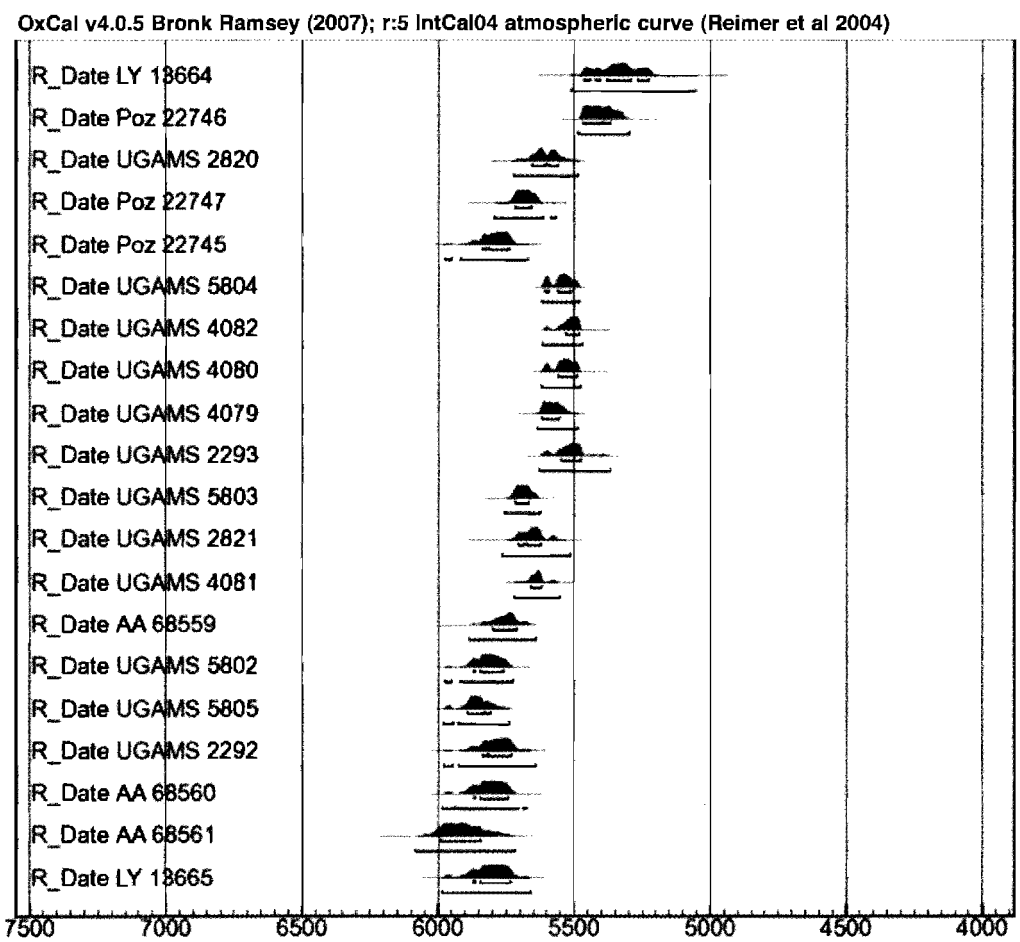
Trench. UF	Lab. code	BP	BC cal. 1 sigma	BC cal. 2 sigmas
Horizon III				
Trench A. UF 6	LY-13664	6350± 70	5465-5228	5511-5054
Trench 3. UF 6a	Poz-22746	6420±40	5468-5367	5487-5299
Trench 6. UF 6b	UGAMS 2820	6690±50	5658-5560	5723-5486
Trench 4. UF 6	Poz-22747	6790 ±40	5718-5659	5796-5569
Trench 1. UF 6	Poz-22745	6910±40	5837-5739	5975-5671
Horizon IV				
Trench 4. UF 8b	UGAMS 5804	6600±25	5608-5513	5621-5481
Trench 6. UF 7a	UGAMS 4082	6560±30	5531-5482	5617-5471
Trench 3. UF 7b	UGAMS 4080	6590±30	5558-5490	5620-5477
Trench 3. UF 7b	UGAMS 4079	6640±30	5618-5556	5636-5486
Trench A. UF 8	UGAMS 2293	6550±50	5550-5476	5629-5367
Trench 4. UF 7a, str.8	UGAMS 5803	6800±30	5718-5667	5756-5624
Trench 3. UF 7a F.7	UGAMS 2821	6740±50	5707-5623	5766-5515
Trench 5. UF 7a	UGAMS 4081	6720±30	5662-5621	5721-5555
Trench A. UF 7	AA-68559	6868±40	5800-5712	5888-5641
Trench 1. UF 8	UGAMS 5802	6940±30	5870-5760	5975-5725
Trench 5. UF 8a	UGAMS 5805	6970±25	5893-5810	5981-5740
Horizon V				
Trench A. UF 10	UGAMS 2292	6900±50	5837-5731	5980-5644
Trench A. UF 10/F5	AA-68560	6930±44	5868-5743	5984-5676
Trench A. UF 11	AA-68561	7035±69	5991-5846	6085-5717
Trench A. UF 12	LY-13665	6920±55	5871-5734	5986-5661



Tab. 1: Radiocarbon dates.

Horizon	*Debitage*	*Pyramidons* / bases of prismatic cores	Micro-flakes	Micro-fragments	Flake cores	Blade cores	**Total**	Fragments (not accounted in inventory)	Core fragments
I	50	3	4	26	3	2	**88**	219	12
II	350	3	9	81	6	4	**453**	717	22
III	128	2	11	5	2	4	**152**	168	2
IV	148	3	1	23	5	0	**180**	168	4
V	169	3	1	7	4	7	**191**	191	7
Total	845	14	26	142	20	17	**1064**	1463	47

Tab. 2: Obsidian - Debitage and cores.

Horizon	Retouched	Denticulated	Notches	Fine toothed / posteriori	Burins	Pointed	End-scrapers	Scrapers	**Total**
I	15	2	1	5	0	0	1	0	**24**
II	38	1	6	8	6	1	4	1	**65**
III	18	0	0	1	0	0	0	0	**19**
IV	9	0	1	3	1	1	1	0	**16**
V	45	1	5	4	0	1	0	0	**56**
Total	125	4	13	21	7	3	6	1	**180**

Tab. 3: Obsidian - Tools on flakes.

Horizon	Proximal	Proximal-Mesial	Mesial	Mesial-Distal	Distal	Whole blade	**Total**	Blade fragments
I	32	60	152	24	19	0	**287**	146
II	52	212	394	65	31	6	**760**	438
III	23	105	171	33	17	4	**353**	151
IV	44	106	159	33	18	2	**362**	164
V	18	147	154	36	3	7	**365**	185
Total	169	630	1030	191	88	19	**2127**	1084

Tab. 4: Obsidian – Non retouched (raw) blades.

Horizon	Retou-ched	Denti-culated	Notches	Fine toothed / posteriori	Burins	Trun-cated	Pointed	End-scrapers	Scrapers	Micro-liths	Varia	**Total**	Retouched fragments
I	136	9	26	28	26	1	2	2	1	2	2	**235**	51
II	388	19	55	111	53	10	6	4	0	7	0	**653**	193
III	185	12	24	69	21	1	0	0	0	3	1	**316**	50
IV	139	6	27	19	20	4	2	0	0	0	0	**217**	29
V	242	36	37	42	29	6	2	0	0	1	1	**396**	107
Total	1090	82	169	269	149	22	12	6	1	13	4	**1817**	430

Tab. 5: Obsidian - Tools on blades.

Horizon	Indirect percussion / punch	Standing up / crutch pressure	Pressure with lever	**Total**
I	0	1	2	**3**
II	2	9	3	**14**
III	0 (2 cores)	2 (+4 cores)	1	**9**
IV	0	3 (+ 1 core)	0	**4**
V	1	5 (+2 cores)	0	**8**
Total	5	27	6	**38**

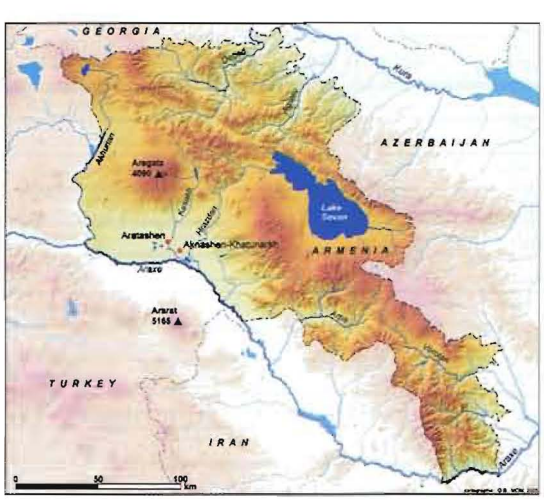
Tab. 6: Obsidian - Knapping techniques identified on long blades.

Horizons	I	II	III	IV	V-1	V-2	V-3	V-4	V-5	
Taxons	NRM	NRM	NRM	NRM	NRM	NRM	NRM	NRM	NRM	TOTAL
Ovis aries	3	23	78	97	37	20	29	51		338
Capra hircus		5	27	23	5	8	4	11		83
Ovis aries/Capra hircus	42	278	1077	1646	300	135	168	301	10	3957
Sus domesticus		3	2	1		1				7
Bos taurus	13	113	238	290	65	14	18	20	3	774
Bos taurus/Bos primigenius	1	12	2	7	1			5		28
Equus sp.	1	16	8	3						28
Capra aegagrus			2				1			3
Ovis sp./*Capra* sp			5	7	2	3	3	11		31
Capreolus capreolus		2	7	1	2					12
Gazella sp.	2	3	55	28			1			89
Sus scrofa		2	14	3	1					20
Sus sp.		9	16	10			1			36
Cervus elaphus		4	52	53	3			6		118
Bos primigenius		5	8	3			1			17
Ovis/Capra/Gazella/Capreolus		1	26	26			1			54
Bos/Equus/Cervus			15	12	4	1	2	5	1	40
Canis familiaris	1	7	13	11	2	5	1	4		44
Ursus arctos				1						1
Canis lupus				1						1
Vulpes		4	9	11						24
Felis sylvestris							1			1
Small carnivore			10	1						11
Small mustelidae		2	2	1						5
Lepus	1	12	24	28	3		1	2		71
Castor fiber			1	2						3
Erinaceus sp.				2						2
Total determined mamals	64	501	1691	2268	425	187	232	416	14	5798
Undetermined small mammals	66	1005	1675	2603	261	161	304	161	9	6245
Undetermind large mammals	3	107	430	203	29	24	24	15		835
Totals mammal remains	133	1613	3796	5074	715	372	560	592	23	12878
Micromammals				1						1
Birds		1	5	8						14
Reptilia		1	2							3
Amphibia			1							1
Fish	1	3	14	29						47
Cervus antler (shed)		9	16	10			2			37

Tab. 7: List of animal species at Aknashen-Khatunarkh by horizons.

Taxa		Aknashen-Khatunarkh	Aratashen
MONOCOTYLEDONES			
Poaceae	*Triticum aestivum/turgidum*	+	+
	T. dicoccum	+	+
	Triticum sp. (poor preserved, species unidentifiable)	+	+
	Hordeum vulgare L. (both naked and hulled species)	+	+
	Triticeae gen. sp.	+	+
	Bromus sp.	+	-
	Poaceae gen. sp.	+	-
Cyperaceae	*Bolboschoenus maritimus*	+	+
	Cyperus sp.	-	+
	cf. *Carex* sp.	+	-
	Monocotyledones fam. gen. sp.	+	-
DICOTYLEDONES			
Fabaceae	*Lens culinaris* ssp. *microsperma*	+	+
	Vicia ervilia	+	+
	cf. *Vicia* sp.	+	-
	cf. *Alhagi* sp.	+	-
	Medicago sp.	+	-
	Fabaceae gen sp.1 (Sophora sp.?)	+	-
	Fabaceae gen. sp.2	+	-
	Fabaceae gen. sp.3	+	-
Brassicaceae	*Camelina microcarpa*	+	+
	Alyssum desertorum	+	+
	Thlaspi sp.	+	-
	Brassica/Sinapis sp.	+	-
Boraginaceae	*Buglossoides arvensis* (=*Lithospermum arvense*)	+	-
	L. officinale	+	-
	Boraginaceae gen. sp.	+	-
Amaranthaceae	*Amaranthus* cf. *retroflexus*	+	+
Chenopodiaceae	*Chenopodium* cf. *album*	+	+
Polygonaceae	*Rumex* cf. *crispus*	+	-
	Polygonum aviculare	+	-
Ranunculaceae	*Ranunculus* sp.	+	-
Rubiaceae	*Galium* sp.	+	+
Solanaceae	*Hyoscyamus* sp.	+	-
Convolvulaceae	*Convolvulus arvensis*	+	+
	Calystegia sepium	+	-
Caryophyllaceae	cf. *Silene* sp.	+	-
Rosaceae	cf. *Rubus* sp.	+	-
Cuscutaceae	cf. *Cuscuta* sp.	+	-
Capparidaceae	*Capparis spinosa*	+	+
Vitaceae	*Vitis vinifera/sylvestris*	+	+
Eleagnaceae	*Elaeagnus* cf. *angustifolia*	+	-
Ulmaceae	*Celtis* sp.	+	+
Dicotyledones fam. gen. sp.		+	-
Unidentified species		+	+

Tab. 8: Taxa list of the higher plants recovered from the Neolithic settlements of Aknashen-Khatunarkh and Aratashen.



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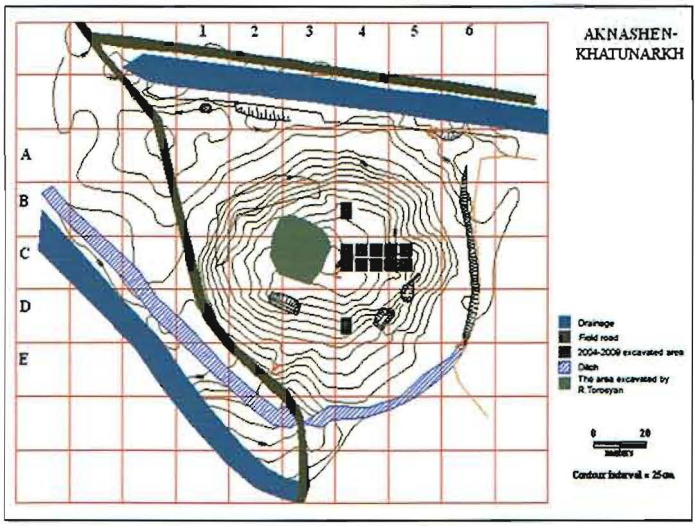


2

Fig. 1- 1. Location of the sites of Aknashen-Khatunarkh and Aratashen (Ararat plain, Armenia); 2. Topographic map of Aknashen-Khatunarkh.

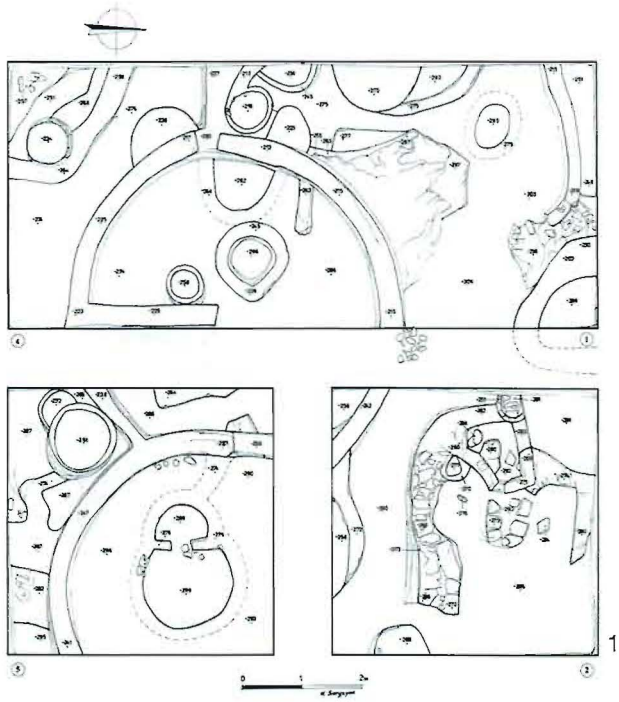
1

Fig. 2- 1. View of the Ararat plain looking south from the tell of Aknashen-Khatunarkh; 2. The trenches on the top of the tell.

2

Fig. 3- 1. Shaft-hole axes/adzes lying in situ on a floor (Horizon I); 2. Obsidian cores in situ in test trench A (Horizon III).

2



1

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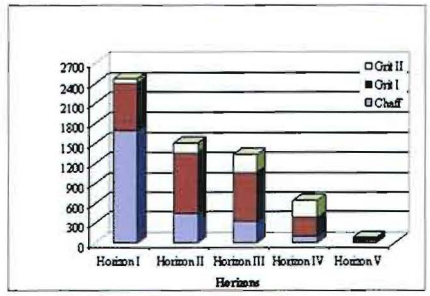
Fig. 4- 1-2. Architectural remains in Horizon IV (trenches 1-2, 4-5); 3. Architectural remains in the lower part of Horizon V (trench A).

1

2

Fig. 5- 1. Trench 4, north part of west section (horizon IV, UF7b) - a) usual photograph; b) false colour picture from Dstretch plugin (Jon Harman) to ImageJ. Scale bar 10 cm. Note the silty texture, the poorly differentiated units, the few large perturbations and the common concordant laminate features; 2. Opacified faecal spherulites and siliceous phytoliths from a burnt ruminant dung accumulation (Tr.1, UF6b, F11). Scale bar: 50 micrometers, plane polarized light (PPL).

Fig. 6- Neolitic tomb in Horizon IV (trench 7); in the upper part of the picture, the fragment of copper ring uncovered under the skull.



Horizons	Chaff-tempered	Grit-tempered I	Grit-tempered II	
I	1678 *(27.90%)*	717 *(12%)*	74 *(1.20%)*	2469
II	447 *(7.43%)*	909 *(15.10%)*	147 *(2.44%)*	1503
III	321 *(5.30%)*	747 *(12.40%)*	258 *(4.30%)*	1326
IV	96 *(1.60%)*	281 *(4.70%)*	264 *(4.40%)*	641
V	29 *(0.50%)*	32 *(0.53%)*	13 *(0.20%)*	74
Total	2571	2686	756	6013[1]

[1] Non-stratified and imported ceramic sherds did not include in the total amount.

Fig. 7- Distribution of the Neolithic and Chalcolithic pottery by horizons

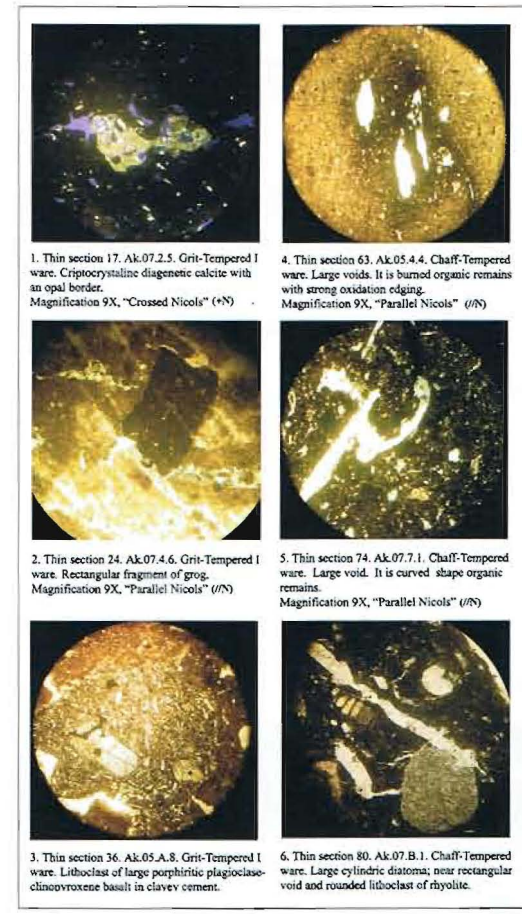
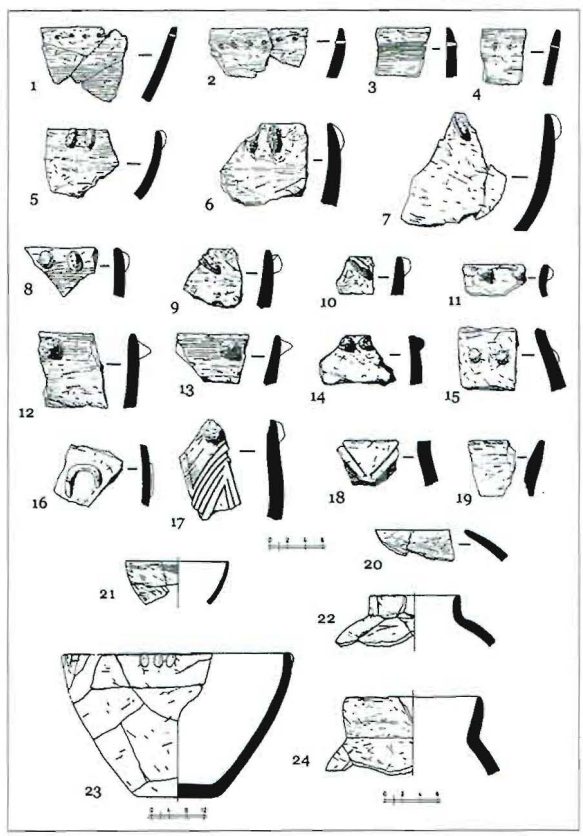


Fig. 8- Thin sections of pottery sherds.



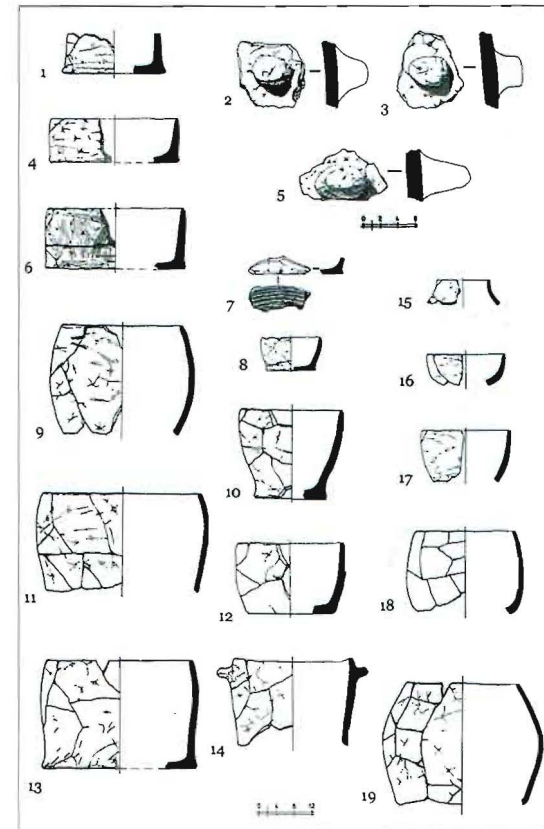


Fig. 9- 1. Imported painted sherds found in Horizon III (1, 3, 5-6), Horizon IV (2, 4, 7) and Horizon V (8-9). 2. Chaff tempered ware; 3. Grit-tempered wares: 1-14) Grit-I; 15-19) Grit-I.

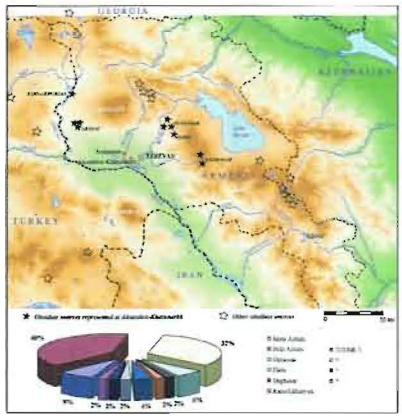
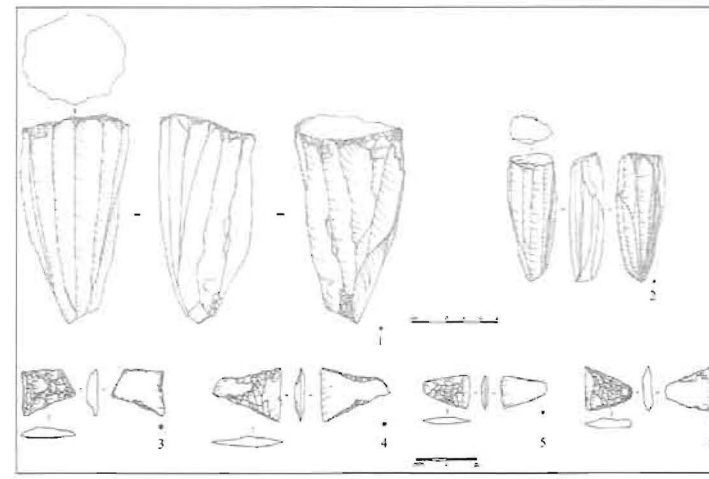


Fig. 10- Sources of the obsidian identified at Aknashen-Khatunarkh.



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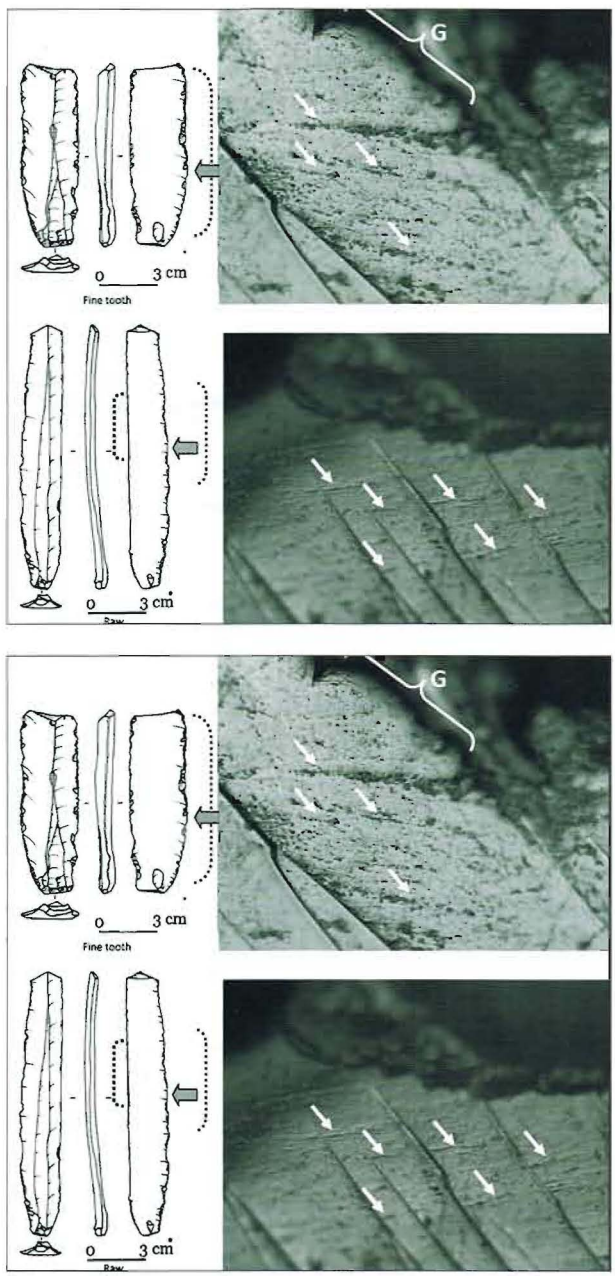
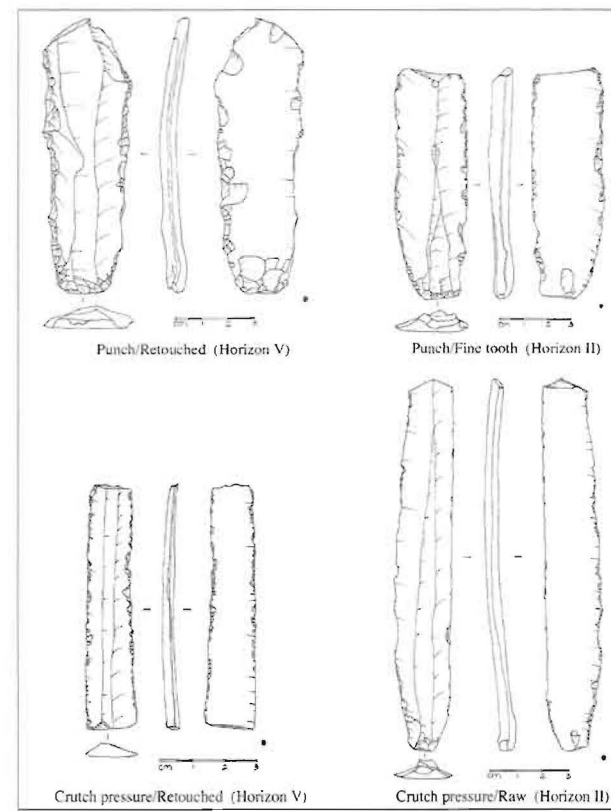


Fig. 12- 1. Obsidian showing use-wear (200X, DIC) from harvesting (1-2); 2. Obsidian showing use-wear (200X, DIC) from stripping (3) and threshing with a threshing sledge (4).



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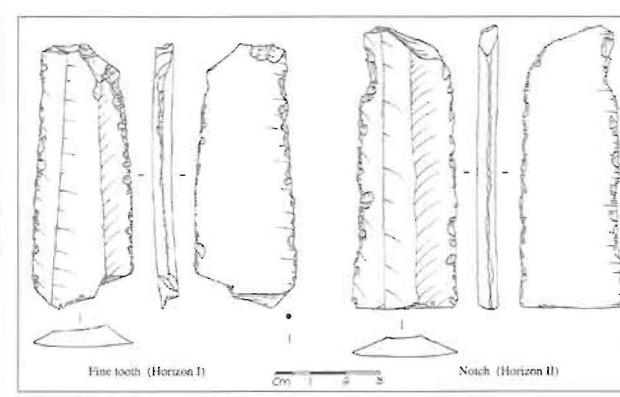

3

Fig. 11- 1. Obsidian cores and microliths; 2. Obsidian tools manufactured using indirect/punch percussion (1–2) and using a crutch to apply pressure while standing (3–4); 3. Obsidian tools showing lever pressure.

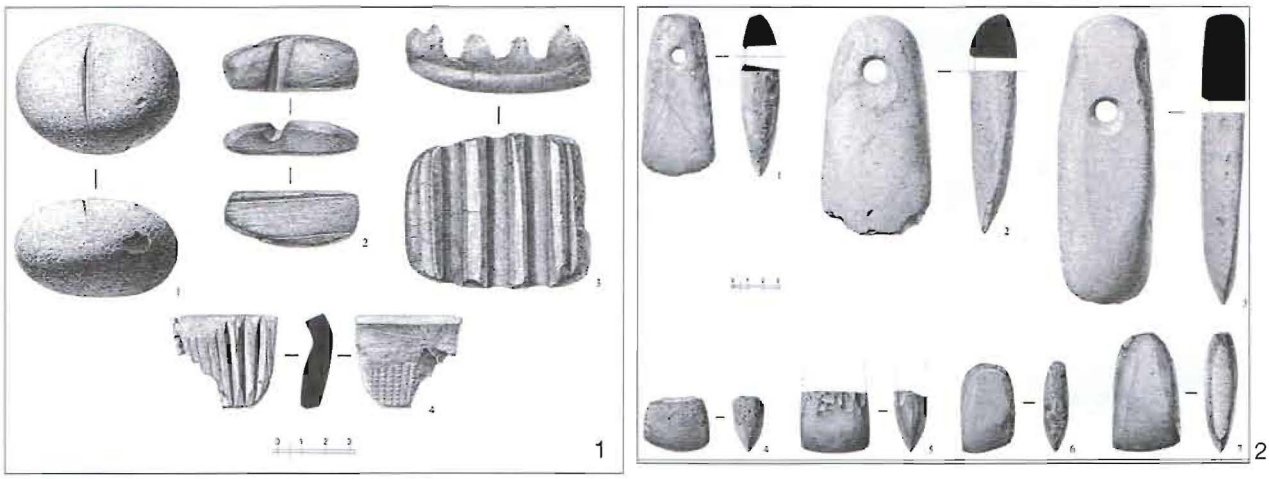

Fig. 13- 1. Grooved abraders; 2. Shaft-hole axes/adzes (1-3) and celts (4-7).

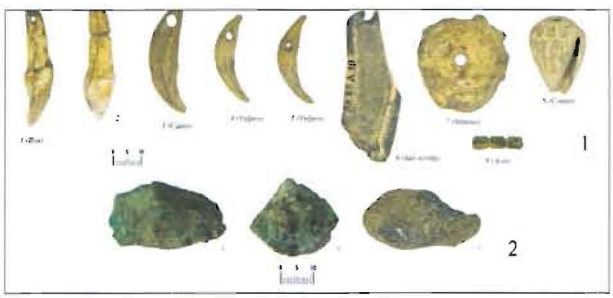

Fig. 14- 1. Pendants on teeth (1-6), fish bone (7), shell (8) and bird bone (9); 2. Copper ore (malachite) (1-2) and lead ore (galena) (3).

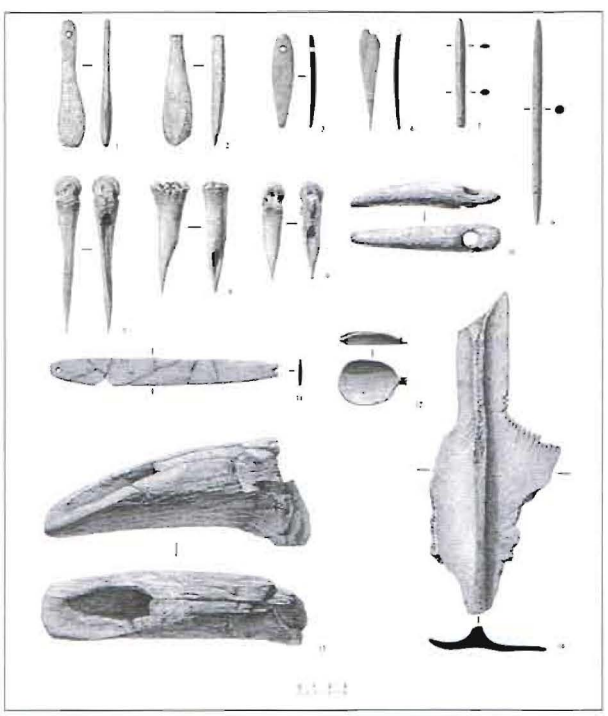

Fig. 15- Bone industry.

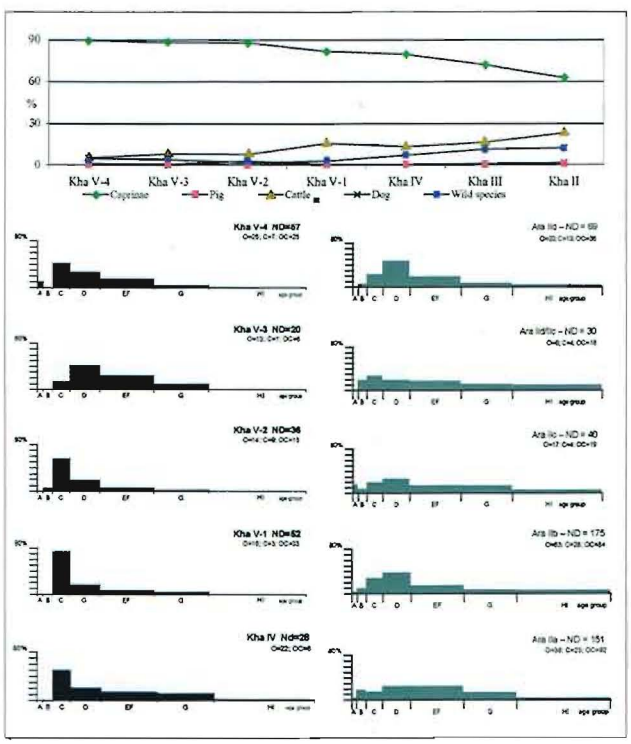

Fig 16- 1. Frequency of domestic species (caprinae, cattle, pig and dog) and wild species; 2. Profiles of age at slaughter of sheep and goats together, in the early horizons (Kha V-IV and Ara II). ND = number of teeth; O = Ovis aries; C = Capra hircus; OC = Ovis/Capra (class A ± 0-2 months; class B ± 2-6 months; class C ± 6-12 months; class D ± 1-2 years; class EF ± 2-4 years; class G ± 4-6 years; class HI > 6 years); 3. Profiles of age at slaughter of sheep and goats together, in the late levels (Ara I and Kha III-II) (for the legend, see fig. 15: 1).