CHAPTER VI
THE FAUNA

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Hunting game of the culture layer of Pavlov

1. Introduction

The processed osteological material comes from the culture layer of Pavlov, from the investigations of B. Klíma in the years 1952 and 1953. It was evaluated by two publications (Musil 1955, 1959) to which I therefore refer. In this paper I thus do not deal with the systematic procession of the fauna and the morphometry of bones and I process the material from another point of view. In this I start on one hand from papers published earlier, on the other hand from a new study of this osteological material.

2. The vertebrate species found

Most of the species found belong to hunted animals. That means that they represent only a smaller part of the whole animal association living in the surroundings. The found species can be evaluated quantitatively, but even this fact does in no case reflect accurately their relative representation in the then association. Their selection is purely utilitarian from the point of view of the then people. Only in systematically hunted animals can their quantity be evaluated from that viewpoint. In no case does it concern animals hunted at random.

The determined animals belong to the following species:

Aves: *Corvus corax* Linné, 1750; *Lyrurus tetrix* (Linné, 1758); ? *Alectoris* sp.; *Lagopus* sp.; *Phasianinae* gen. et sp. indet.; *Cygnus* sp.

Lagomorpha: *Lepus* sp.

Rodentia: *Citellus* sp.; *Cricetus cricetus* (Linné, 1758).

Carnivora: *Felis silvestris* Schreber, 1777; *Panthera leo* (Linné, 1758); *Lynx lynx* (Linné, 1758); *Canis lupus* (Linné, 1758); *Vulpes vulpes* (Linné, 1758); *Alopex lagopus* (Linné, 1758); *Vulpes* sp. or *Alopex* sp.; *Gulo gulo* (Linné, 1758); *Ursus arctos* Linné, 1758; *Ursus* cf. *spelaeus* Rosnm., 1793; *Ursus* sp.

Proboscidea: *Mammonteus primigenius* (Blumenbach, 1799).

Perissodactyla: *Equus germanicus* Nehring.

Artiodactyla: *Cervus elaphus* Linné, 1758; *Rangifer tarandus* (Linné, 1758); *Bos* sp. or *Bison* sp.

From the systematic point of view Carnivora prevail greatly. From the nutrition point of view it is above all Proboscidea, Perissodactyla and Artiodactyla. The found bones of small rodents belong to animals living in the proximity of man.

The list of species found does not say anything about their amount. The calculated amount of individuals is the minimum value, they could not have been fewer, but a higher number cannot be excluded. If we take the studied area as a whole, we get the following pattern from the quantity of the individual species:

(1) Very amply represented group (10 - 18 % of the total amount):

Lepus sp. (18.5 %), *Alopex lagopus* (16.9 %), *Canis lupus* (12.5 %), *Vulpes vulpes* (10.7 %), *Vulpes* sp. or *Alopex* sp. (2.0 %), *Rangifer tarandus* (10.1 %).

(2) Medium represented group (4 - 8 % of the whole amount):

Aves (8.3 %), *Mammonteus primigenius* (7.5 %), *Equus germanicus* (4.6 %), *Gulo gulo* (4.4 %).

(3) Sporadically represented group (0.2 - 0.7 % of the whole amount):

Ursus arctos (0.7 %), *Ursus* cf. *spelaeus* (0.2 %), *Ursus* sp. (0.7 %), *Panthera leo* (0.5 %), *Felis silvestris* (0.5 %), *Bos* sp. or *Bison* sp. (0.2 %), *Cervus elaphus* (0.2 %), *Lynx lynx* (0.2 %).

From the above it follows that big animals important from the viewpoint of nutrition are found above all in the second group, only reindeer is in the first group. In view of the fact that for the reason of safeguarding the nutrition the priority of their hunting must be assumed, the list indicates the fact that their number in the neighbouring landscape was not high already at that time. In that case they would be found in group 1. On the other hand, small animals occurred amply, prevailingly hares, foxes and wolves. The above deduction cannot be related to finds of birds, in that case it is rather the difficulty of hunting them.

The finds of bones and the finds of the individual species are not regularly deposited in the layer. They are concentrated prevailingly around the fires and settlement objects, further from them they become scarce. Therefore I divided the whole area into 11 parts. In the last part belonging as a whole to the 1952 investigation all osteological material was not unearthed by square metres, so that it is taken as one unit.

In the above area B. Klíma distinguished four settlement objects (in parts 1, 5, 6 and 11), only in part 6 the object is as a whole. All other objects are only outskirts of the found settlement objects.

The most important is thus part 6 with settlement object III. Looking at its ground elevation we find that the countersink is evident in its right half. Inside the settlement object osteological material is almost not found, only in the upper left part it is possible to see the concentration of bones. It is not excluded that it might have also been due to the delimited borderline of the settlement object. Of interest is the accumulation of bones near the object. It is found above all in front of its left part, which signals evidently the then entrance into the object and its complete closure on the right hand side.

Immensely interesting is not only the distribution of all bones, but also that of individual species. It is not accidental. In the upper left half mostly bones of hares, wolves, foxes and reindeer are found as well as small bones of a mammoth.

The second place of concentration is the lower left half in front of the settlement object. There, however, only bones of wolves, foxes and to a lesser extent also reindeer are found. Hares are missing altogether.

Quite exceptional is the concentration behind the settlement object, i.e. in its right lower part. It concerns wolves only.

The above three places of the concentration of osteological material near settlement object III are not accidental, but are certainly linked with intentional activity of the man who stayed in that object.

In part 1 there was settlement object IV. The distribution of osteological material is quite chaotic, mostly not exhibiting any concentration, and it is also found inside the object. It thus behaves quite differently from what it was in object III. It can be either due to the fact that the distribution of bones on that area occurred only after the destruction of the settlement object or its delimitation was only subjective. The former

alternative is more probable.

Settlement object II in part 5 does not exhibit any excessive concentration of bones. Only in its right part bones of the hare, wolf, reindeer and mammoth were found in greater amount. Due to the fact that only a small part of the object was uncovered its evaluation is not possible.

In settlement object I in part 11 osteological material was not collected according to individual square metres.

From the above a certain intention and/or some working organisation of the then people follows. In the opposite case osteological material would have been distributed chaotically.

All that indicates a certain work organisation of the then people and - which I consider the most important - that it was only within a small group dwelling in the settlement object. It follows from the fact that even that small unit formed to a certain extent an independent community.

3. Comparison with temporally close localities

To be able to draw further conclusions, we cannot study this locality isolated, but only as part of a certain unit. That means to mention also localities preceding in time as well as younger localities. Such localities are, unfortunately, not very numerous. It is Předmostí, Kůlna, Milovice and Willendorf.

Isotopic dating of locality Pavlov rendered the following data: 25 020 ± 150 BP. and 26 730 ± 250 BP. These data approach very much those from the loess base at Dolní Věstonice: 25 820 ± 170 BP. and 26 430 ± 190 BP. From the soil denoted as W 2/3 the data are 29 940 ± 300 BP. and 31 700 ± 1 000 BP. All these data were found from small pieces of coal. From humus the datum is substantially lower, i.e. 20 270 ± 210 BP. Also Předmostí yielded similar data: 26 320 ± 240 BP. and 26 870 ± 250 BP. A younger layer 6b from locality Kůlna (Gravettian): 22 990 ± 150 BP. and 21 630 ± 150 BP, and the upper culture layer from Milovice are dated to 22 100 ± 1 100 BP. The lower Aurignacian layer of the same locality which has not a large amount of osteological finds, gave the date 25 200 ± 950 BP.

From Austrian localities I use for comparison locality Willendorf II (culture layer 5 - 9) and Willendorf I. The Gravettien of that locality should correspond in time roughly to the age of Dolní Věstonice. Layer 5 of Willendorf II is of age of 30 000 + 900 -800 BP. (carbon) and 23 830 ± 190 BP. (humus). Layer 8 of Willendorf II is of the age of 25 800 ± 800 BP.

3.1. Předmostí

Předmostí was no doubt one of the largest, if not the largest of all Paleolithic stations of that time. Numerous investigations of the most varied specialists yielded a great amount of paleontological material. Unfortunately, it has never been processed systematically, so that our information must be drawn from individual partial papers.

Much information is found in a summary overview published by B. Klíma (1990a). Without quoting individual authors he drew information from, let us try here to reconstruct the then association of vertebrates and the distribution of osteological material. A list of species found will, however, be given later in a summary way.

Maška: Mammoth bones were scattered quite haphazardly, but they were also grouped according to the individual bones or parts of bones. Besides, some parts of

bodies were found in the anatomical order, such as part of a mammoth leg. This did not only concern mammoths, but also other species (part of a horse backbone). Mammoth bones were split, some of them also burned in fires.

Kříž: Fires were mostly fed almost exclusively with mammoth bones, but the ash layers originated only from burned wood. Bones of mammoths were also found in the overlying layers of the culture layer: "mammoths moved there long after the fires had become extinct". He also discovered an almost complete skeleton of a young mammoth.

Knies: In one place there were 18 mammoths of different ages, most of the bones were split. He mentions 16 tusks, 89 molars, 16 scapulae, 12 humeri, 14 ulnae, two radii, 18 tibiae. Besides mammoth bones also those of wolves, foxes and wolverines were present.

In my paper on mammoths from Předmostí (Musil 1958, 1968) I also mention some important information from earlier papers. In the culture layer there were not only whole parts of mammoth skeletons, but also those of wolves, horses, foxes and wolverines. Besides there also appeared heaps of sorted individual mammoth bones: pelvic bones, scapulae, molars, fragmental crania. In that way also individual parts of long bones were sorted, such as prox. epiphyses of femora or tibiae of mammoths.

To get an idea of the immense quantity of osteological material Kříž's paper (1896) is the best illustration. From a small section of the culture layer he gives the following numbers of the individual mammoth bones:

complete or almost complete skulls	6
maxillae	6
mandibulae	12
free molars	850
molar fragments	220
whole tusks	32
major tusk fragments	26
scapulae	86
carpal and ankle bones	340
phalanges	225
pelvices	29
rib fragments	5 076
diaphyses of long bones	600

Locality Předmostí was exceptional not only by the amount of osteological material, but also by sorting individual bones or their parts into units. This way is unknown in any other locality mentioned here.

The most detailed list of species and its quantitative evaluation is found in the paper by Pokorný (1951). The names of species were adapted according to present-day viewpoints and the species were ordered according to their quantity (see Table 1).

The overall number of bones, besides mammoths, is 9 585 pieces. The total number of individuals (mammoths are taken as 1 000 individuals) makes 1 388 individuals. As for the species *Alopex lagopus*, it is evident that also the species *Vulpes vulpes* is included there which at that time currently occurred at those places. In the species *Ursus spelaeus* it is probable that it will be the species *Ursus arctos* (Musil 1964). Finds of birds are not included in the list. From earlier literature it is, however, known that from Předmostí the following species are mentioned: *Corvus corax*, *Lagopus lagopus* and without a more detailed determination further 13 taxa.

From the mammals *Rupicapra rupicapra* is missing which occurred there rarely. The percentages of bones and individuals have been counted on the basis of the data mentioned.

Tab.1. Absolute and percentual representation of the individual species at Předmostí.

	No.of bones	%	No.of individuals	%
M. primigenius	unknown	-	>1000	72.05
Canis lupus	4 143	43.22	103	7.42
Alopex lagopus	2 250	23.47	96	6.92
Lepus timidus	860	8.97	79	5.62
Lepus europaeus	52	0.54	8	0.58
Rangifer tarandus	890	9.28	36	2.59
Gulo gulo	581	6.06	12	0.86
Equus germanicus	194	2.02	5	0.36
Ursus arctos	233	2.43	8	0.58
Ursus spelaeus	82	0.85	2	0.14
Coelodonta antiquitatis	5	0.05	1	0.07
Megaloceros giganteus	13	0.13	1	0.07
Alces alces	13	0.13	2	0.14
Castor fiber	4	0.04	2	0.14
Crocuta spelaea	4	0.04	1	0.07
Panthera spelaea	1	0.01	1	0.07
Panthera pardus	1	0.01	1	0.07
Bison priscus	25	0.25	2	0.14
Bos primigenius	9	0.09	1	0.07
Meles meles	23	0.24	2	0.14
Capreolus capreolus	2	0.02	1	0.07
Capra ibex	2	0.02	1	0.07
Ovibos moschatus	4	0.04	1	0.07
Lemmus lemmus	12	0.12	3	0.22
D. torquatus	16	0.17	4	0.29
Talpa europaea	25	0.26	2	0.14

Unfortunately, the publication does not mention and I do not know either from what size of area the above values come. Despite this drawback the table expresses certain information. The main hunted animal is no doubt the mammoth (72 %), all other species are far behind it in numbers. On the basis of these data it can be stated that the then people were fully specialised in this animal. The hunting of the other species, both from the point of view of their number and from the point of view of the amount of food obtained, was quite negligible and it was a mere addition. Besides mammoths also wolves, foxes, hares and reindeer were intentionally hunted.

All other species indicate only occasional hunting. It is interesting above all with horses in which it must be assumed that they lived there in large herds and from the viewpoint of the size of their bodies their hunting need not have been negligible. The

lack of their finds must necessarily be linked up with the technique of hunting, with the fact that the hunting of these highly mobile animals was very difficult to impossible for the people of that time.

Surprising is at the same time also the lack of bones of Felidae.

From the paleontological and stratigraphical aspects the presence of bears is interesting. In my papers on bears from this locality (Musil 1964) I could state that all finds I had available belong to the brown bear.A whole number of morphological characters and, after all, the metrics were very similar and in detail sometimes the same as in the cave bears, but still it was not that species. A whole number of signs on the bears' teeth has not species validity, but they are only phenotypical signs. The finds were, however, not identical with the present species *Ursus arctos* and they rather agreed with finds of arctoid bears from the Last Glacial which is denoted as *Ursus arctos priscus*. That means that even if some species penetrate in isolated cases from southern Europe as far as this area, it does not yet concern the brown bear living at that time in the Mediterranean region.

Conclusion: The chief hunted animal was the mammoth. As complementary animals can be mentioned reindeer, hares, foxes and wolves. All other animals were hunted more or less accidentally. The bones were splintered. In isolated cases individual parts of skeletons were found in anatomical order, which does not hold for mammoths only. Bones of mammoths or their parts were often sorted into separated heaps, evidently as starting material for further procession. This way of sorting osteological material is characteristic of Předmostí.

3.2. Dolní Věstonice I

If relatively little is known about Předmostí, still less is known about the fauna of Dolní Věstonice. It is impossible to take as basis written unpublished sources which would process in detail paleontological material or publications. In papers by K. Absolon dating back to pre-war years there are only lists of species found. The only paper that has appeared about paleontological material processed only finds of the time after World War II in an informative way is that of the investigation by B. Klíma of 1947 - 1951 (Musil 1959). That paper has become the basis of this chapter.

From the above investigation there comes material of two settlement objects (I and II), further from the site of a female grave and from a connecting ditch. Like in the preceding localities, osteological material can be divided into three parts according to its amount:

The most frequent and numerous species: *M. primigenius*, *Lepus timidus*, *Alopex lagopus*, *Vulpes vulpes*. Those species amounted to 51 % of all individuals, out of which hares and foxes 17 - 25 %. The mammoth must be considered the most numerous animal.

Numerous species: *Canis lupus* (11 %), *Rangifer tarandus* (11 %).

Medium represented species: *Equus germanicus*, *Gulo gulo*.

Sporadically occurring species: *Ursus* cf. *spelaeus, Panthera spelaea*, *Lynx lynx*, *Bison* or *Bos*.

From the pre-war years K. Absolon also lists the species *Castor fiber*, *Coelodonta antiquitatis*, from among birds *Corvus corax*, *Lagopus lagopus*, Lagopus *mutus*, *Nyctea scandiaca* and *Cygnus cygnus*.

The highest number of species and, at the same time, their greatest amount, was found in settlement object I. They were the following species: *Alopex lagopus*, *Vulpes*

vulpes, *Lepus timidus* (most numerous); *Canis lupus*, *Rangifer tarandus* (numerous); *Lynx lynx*, *Ursus* cf. *spelaeus*, *Panthera spelaea* (isolated). Near the female grave there was similar fauna as in the settlement object.

In settlement object II the following were found: *Canis lupus*, *Rangifer tarandus* (most numerous); *Equus germanicus*, *M. primigenius*, *Lepus timidus*, *Gulo gulo*, *Alopex lagopus* (numerous); *Ursus* cf. *spelaeus*, *Vulpes vulpes* (isolated).

In the dump prevailingly mammoth bones were found.

Summary: The most numerous hunted animal was the mammoth followed by hares and foxes. Numerous are also wolves and reindeer. All other species were hunted only accidentally or hunting them was not intentional. The same situation is repeated as was the case at Předmostí. The only difference is the fact that cumulation of some bones was not discovered.

Another aspect I consider important is the fact that mammoth bones do not occur in high numbers in settlement objects or immediately near them. Dumps of those bones constitute independent separated accumulations. It is not excluded that it may have been like that also at Předmostí and quite certainly at Pavlov.

3.3. Kůlna

Whereas the preceding localities were found in open air, in this case it is a cave in the northern part of the Moravian Karst. Its investigation in the years 1961 - 1976 was carried out by K. Valoch. In layer 6b Gravettian was found and its big fauna was processed by L. Seitl (1988) who mentions split fragments of bones of the following species: *Alces alces*, *Cervus elaphus*, *Equus* sp. (92 % of all species found), further *M. primigenius*, *Rangifer tarandus* (6 %). On the basis of this species composition a moderate climate is considered (Valoch 1988: Interstadial Tursac which in France is considered to be a weakly temperated and wet oscillation). According to Seitl the species composition corresponds to forest to forest-steppe fauna. It is, however, necessary to state that the number of bone fragments was relatively low, about 50 pieces.

3.4. Milovice

The procession of the fauna of the investigation led by M. Oliva has not yet been done, so that detailed basic information is missing. In a preliminary paper by Oliva (1989) the finds of the mammoth, horse, reindeer, wolf and lion are mentioned. In connection with this list he points out high specialisation in mammoth hunting, higher than at Dolní Věstonice and Předmostí. From mammoths there are: scapulae 14 pieces, pelvic bones 13 pieces, femora 7 pieces, humeri 6 pieces, mandibulae 7 pieces, broken skulls 4 pieces.

L. Seitl permitted me to have a look at the list of osteological material that is being made. It is only a part of it, but I think that it represents well the whole. With his consent I give here the quantitative values:

Mammoth bones thus strongly prevail over other species. It is not evident that they would be split to a great extent by the than man, their breaking was only due to natural processes. Another substantially lower quantitative group is that of the horse and the reindeer. As for the horse, according to L. Seitl some parts of extremities were still found in anatomical order. Another group of animals consists of isolated finds of: the fox (probably both species), the wolf and a felida somewhat smaller than the lion. Probably also bear bones were present.

Tab.2.

	No. of bones	%
M. primigenius	6 748	95.25
Equus germanicus	145	2.04
Rangifer tarandus	135	1.90
Alopex lagopus, Vulpes vulpes	7	0.09
Panthera cf. *leo*	12	0.16
Canis lupus	37	0.52
Ursus sp. ?	-	

Conclusion: The locality Milovice differs from all earlier mentioned ones. This difference is most probably not due to a different animal association living in the neighbourhood, but to quite a different function of the station. Its comparison will be possible only after a detailed procession of material, its time relation to the above stations, and after establishing the age of the mammoths hunted.

3.5. Willendorf

The only one near locality abroad that can be compared in time and on the basis of faunistic finds, is Willendorf. It is above all Willendorf II and I, particularly the following culture layers with the following species (Felgenhauer, 1959, I have done the quantitative viewpoint in bones according to published summaries, 1 = the number of bones, 2 = the percentage of the number of bones, 3 = the number of individuals, 4 = the percentage of the number of individuals, see Tab. 3.

The species differences of the individual layers of Willendorf II are not evident, even though they belonged to different time horizons. A marked accumulation can, however, be observed only in layer 9. I give the overall summary of finds from all layers.

The most frequent and numerous species: *Alopex lagopus*, *Vulpes vulpes*, *Capra ibex.*

Medium represented species: *Canis lupus*, M. *primigenius*, *Cervus* sp., *Rangifer* sp.

All other species occur only sporadically.

The fauna of Willendorf I does not differ from that of Willendorf II in the species hunted (the species *D. kirchbergensis* is most probably wrongly determined or it comes from an older horizon), but by the number of finds of the individual species.

The most numerous species: *M. primigenius*, *Capra ibex*, *Cervus* sp., *Rangifer* sp., *Bison priscus, Canis lupus.*

Medium represented species: *Equus* sp., *Lepus* sp.

All other animals were hunted occasionally.

From the above association of hunted animals the following conclusions can be drawn:

(1) The association is influenced by the region in which the locality is situated (e.g. a high number of the species *Capra ibex*).

(2) In the surroundings there also lived species in high numbers we do not meet at Dolní Věstonice, Předmostí and Milovice. They are: *Cervus* sp., *Bison priscus* and

Rangifer sp.

(3) Those species appear in time only after Předmostí and Dolní Věstonice, never immediately before them. It is basically the problem of an ecologically different association. From the faunistic point of view there can be two explanations:

(a) A more favourable climate in the surroundings of Willendorf set in much earlier than in south and central Moravia, which resulted in a change in the animal association.

(b) Radiometric data of the individual localities are not comparable and probably not correct, because the whole association at Willendorf indicates rather a period younger than that of the stations Předmostí, Dolní Věstonice and Milovice. A certain similarity is exhibited mostly by the fauna with layer 6b at Kůlna.

At present I am inclined to accept the second variant, although the evaluation is based of course on layer 9 of Willendorf II, which was the youngest and faunistically the richest, and further from culture layer marked as Willendorf I. It is not excluded that only those layers are younger than Dolní Věstonice and Předmostí.

Tab. 3. The fauna of culture layers of Willendorf II and I. Explanations in the text.

	Willendorf II														Willendorf I			
culture layer	5		6		7		8		9		total							
	1	3	1	3	1	3	1	3	1	3	1	2	3	4	1	2	3	4
Aves	2	1	-	-	-		-	-	-	-	2	0.67	1	1.13	1	0.44	1	2.08
Lepus sp.	3	1	-	-	-	-	1	1	-	-	4	1.35	2	2.27	9	4.00	2	4.16
Panthera spelaea	1	1	1	1	-	-	4	1	-	-	6	2.02	3	3.40	-	-	-	-
Panthera sp.	-	-	-	-	-	-	-	-	3	1	3	1.01	1	1.13	-	-	-	-
Lynx lynx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.44	1	2.08
Canis lupus	1	1	1	1	1	1	1	1	10	2	14	4.72	6	6.81	62	27.55	7	14.58
Vulpes vulpes	2	1	-	-	1	1	-	-	38	9	41	13.85	11	12.50	7	3.11	1	2.08
Vulpes sp.	-	-	-	-	-	-	1	1	-	-	1	0.33	1	1.13	-	-	-	-
Alopex lagopus	-	-	-	-	-	-	-	-	48	25	48	16.21	25	28.40	2	0.88	1	2.08
Gulo gulo	-	-	-	-	-	-	-	-	2	1	2	0.67	1	1.13	-	-	-	-
Ursus cf. *arctos*	-	-	-	-	-	-	-	-	3	1	3	1.01	1	1.13	-	-	-	-
Ursus sp.	1	1	1	1	1	1	-	-	-	-	3	1.01	3	3.40	1	0.44	1	2.08
M. primigenius	2	1	-	-	3	1	1	1	6	2	12	4.05	5	5.68	23	10.22	8	16.66
D. kirchbergensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	2.66	1	2.08
Equus sp.	-	-	-	-	-	-	4	2	9	1	13	4.39	3	3.40	7	3.11	3	6.25
Cervus sp.	2	1	-	-	-	-	2	1	8	2	12	4.05	5	5.68	13	5.77	5	10.71
Rangifer sp.	18	2	4	1	-	-	3	1	15	2	40	13.51	6	6.81	18	8.00	4	8.33
Bison priscus	-	-	-	-	-	-	-	-	2	2	2	0.67	2	2.27	17	7.55	4	8.33
Bison sp.	-	-	-	-	2	1	-	-	-	-	2	0.67	1	1.13	-	-	-	-
Capra ibex	13	2	2	1	-	-	20	3	52	4	87	29.39	10	11.36	57	25.33	8	16.66
Ovicaprinae	-	-	-	-	-	-	-	-	1	1	1	0.33	1	1.13	1	0.44	1	2.08
	45	12	9	5	8	5	37	12	197	53	296		88		225		48	

4. Similarities and differences in fauna

For the analysis of the species diversity of the period from Denekamp oscillation until the first half of the subsequent Stadial there are relatively few localities that would contain a large number of the processed osteological material. Let us first study

the species composition of earlier listed localities, but not from the systematic point of view, but from that of a deliberate and purposefully performed hunting. I would include here the following species:

(a) *M. primigenius*, *R. tarandus*, *Equus germanicus*, *Bos* sp. or *Bison* sp., *Alces alces*, *C. elaphus*, *Lepus timidus*, *Capra ibex*. In the hunting of this group the nutrition viewpoint prevailed.

(b) *Canis lupus*, *Vulpes vulpes*, *Alopex lagopus*. The nutrition viewpoint might be chief in an only critical situation, the hunting of those animals was conditioned by other reasons.

(c) Aves. The hunting of birds may have been conditioned by the most varied reasons, starting with the religious ones.

Besides the above species occasionally and evidently haphazardly a number of further animals were hunted, above all of beast of prey. This group of species is of importance only from the point of view of getting acquainted with the whole association of that time, from the point of view of reconstructing the natural environment, but not from the viewpoint of comparing the ecological basis.

The species composition of the first group of animals (a, b, c) is identical with Předmostí, Dolní Věstonice and Pavlov. It is like that because the period of the rise of the culture layer of the above localities is almost time identical and therefore does not exhibit great climatical differences. Somewhat different is the composition of the fauna of the cave Kůlna and of Willendorf, in the latter locality in at least some species no doubt affected by the relief of the surrounding landscape.

What remains is the quantitative evaluation which will show the number of individuals of the individual species and thus to a certain extent their quantity in the surroundings of the locality. This evaluation can be subject to some factors that cannot be completely excluded. They are above all the following circumstances that can be different in the individual localities:

(1) The heterogeneity of the given region for the life of the given species and/or for its migration, the heterogeneity of the landscape relief.

(2) For the study only a certain part of the material of the culture layer was unearthed which need not be exactly representative for the whole locality.

(3) The selection of above all small bones by the sedimentation environment.

(4) The objectivity of the relation of the number of individuals of the individual hunted species to the number of individuals of the individual species living in the surroundings.

The morphology of the landscape will probably play no role with Předmostí, Dolní Věstonice, Milovice and Kůlna. But it will be important with the locality Willendorf. As for point (2), with respect to a great amount of the unearthed material and to the size of the area uncovered those samples must be considered representative. Only Kůlna stands outside this view. Even though some colleagues are of the opinion that the sedimentation environment might play an important part in small bones, due to the fact that small bones are secondarily missing, I am of a contrary opinion. Not in a single studied locality could fossilisation processes on a relatively large area be the same on a relatively large uncovered area and at the same time so adversary that a complete loss of small bones should occur on the whole area. As for point (4), I think that in the case of intentionally hunted species the above relation exists, of course not in animals hunted occasionally.

Let us now try to make a quantitative analysis of the above localities from this

view, first of all Předmostí, Dolní Věstonice and Pavlov. Typical of those localities is a great number of individuals of the following species: *Canis lupus*, *Vulpes vulpes*, *Alopex lagopus*, *Rangifer tarandus* and *Lepus timidus*. The mammoth is very numerous only at Předmostí and Dolní Věstonice, at Pavlov it is only in the group of medium numerous animals. That may be due to two factors:

(1) Its number against the somewhat earlier Předmostí and Dolní Věstonice decreased. It is possibly the period of its gradual extinction. This point of view may be confirmed by the presence of young to very young animals, i.e. a substantial reduction of their average age.

(2) The investigation at Pavlov discovered only settlement objects and not mammoth-bone accumulations, as was the case at e.g. Dolní Věstonice. Mammoth bones, due to their size, were always thrown out outside settlement objects to dislocated dumps. If such a dump were found at Pavlov, the number of mammoths would be the same as at Dolní Věstonice.

By mere deduction it is difficult to solve the given problem. Only the established age of the hunted mammoths at Pavlov, which is on the average lower than at further localities, can signal the correctness of the first statement, but it cannot confirm it fully. On the other hand, a great amount of mammoth bones from the locality Milovice which is in time younger than Pavlov, would oppose that statement. But we do not know the average age of mammoths at Milovice. From everything it only follows that settlement objects and dumps of mammoth bones were found at different places, in the case of Pavlov the fact that they have not been discovered so far.

The locality Kůlna behaves quite exceptionally from the point of view of our present knowledge of the fauna of Moravia. Very numerous there are species which in earlier times (i.e. in the period of Předmostí, Dolní Věstonice and Pavlov) were found only isolated: deer, elks and horses. Such faunistic pattern at that time in Moravia is unknown, it is quite unique, and if it is proved at another locality, it must necessarily be counted with another temperature oscillation at that time. It would be climatically more conspicuous than the Denekamp oscillation (= W 2/3). Of interest is, of course, the fact that such a marked oscillation has not been found in any loess investigation where it would have to manifest itself.

An independent chapter is the fauna of Willendorf. Its composition, neglecting the regionally conditioned species, would indicate an age younger than that of Pavlov, maybe time identical with layer 6b (Gravettian) in the cave Kůlna. But that is somewhat opposed by radiometric data. Nevertheless, on the basis of the knowledge of the faunistic association of our territory I would include the localities studied into the following series from the time point of view.

The oldest: Předmostí, Dolní Věstonice

Roughly of the same age or younger: Pavlov (objectively possible only after finding of mammoth-bone accumulation and its evaluation). Milovice (maybe time identical with Pavlov, definitive inclusion only after processing paleontological material).

The youngest: Kůlna 6b, Willendorf I and Willendorf II (layer 9, possibly also some preceding layers).

As far as osteological material and its handling are concerned, I must draw the reader's attention to one more fact. There are minor differences between Předmostí on the one hand and Dolní Věstonice and Pavlov on the other hand. But Milovice differs substantially from all those localities. Those deviations must necessarily be linked up

with the working activity of the then man.

For the sake of clarity I mention the representation of the individual species and their amount at the studied localities in Tab. 4. Quantitative groups hold only for the given locality and their value is not quite the same in the relation of the individual localities.

Tab. 4. Quantitative representation of the individual species at the localities compared (%).
x1 - abundantly represented species
x2 - medium represented species
x3 - sporadically occurring species
x4 - without indication of number

	Předmostí	Dolní Věstonice	Pavlov	Kůlna	Milovice	Willendorf I	Willendorf II
Aves	x4	x4	8.3	-	-	0.44	0.67
Lepus timidus, L. europaeus, Lepus sp.	6.20	x1	18.5	-	-	4.00	1.35
Castor fiber	0.14	x4	-	-	-	-	-
Felis silvestris	-	-	0.5	-	-	-	-
Panthera leo	-	-	0.5	-	0.16	-	-
Lynx lynx	-	x3	0.2	-	-	0.44	-
Panthera spelaea	0.07	x3	-	-	-	-	2.02
Panthera pardus	0.07	-	-	-	-	-	-
Crocuta spelaea	0.07	-	-	-	-	-	-
Canis lupus	7.42	11	12.5	-	0.52	27.55	4.72
Vulpes vulpes	-	x3	10.7	-	⎫0.09	3.11	13.85
Alopex lagopus	6.92	x1	16.9	-	⎭	0.88	16.21
Gulo gulo	0.86	x1	4.4	-	-	-	0.67
Meles meles	0.14	-	-	-	-	-	-
Ursus cf. *spelaeus*	0.14	x3	0.2	-	-	-	-
Ursus arctos priscus	0.58	-	0.7	-	-	0.44	1.01
M. primigenius	72.05	x1	7.5	x3	95.25	10.22	4.05
C. antiquitatis	0.07	x4	-	-	-	-	-
Equus germanicus, Equus sp.	0.36	x1	4.6	x1	2.04	3.11	4.39
Cervus elaphus	-	-	0.2	x1	-	5.77	4.05
Capreolus capreolus	0.07	-	-	-	-	-	-
Alces alces	0.14	-	-	x1	-	-	-
Megaloceros giganteus	0.07	-	-	-	-	-	-
Rupicapra rupicapra	-	-	-	-	-	-	-
Ranfiger tarandus	2.59	11	10.1	x3	1.90	8.00	13.51
Bos or Bison	0.21	x3	0.2	-	-	7.55	1.34
Ovibos moschatus	0.07	-	-	-	-	-	-
Capra ibex	0.07	-	-	-	-	25.33	29.39

5.. Natural environment and biostratigraphic notes

A faunistic association is always in relation to the plant cover reacting much in detail to the climate at that time. Even though in our case it is only hunting game, its

composition is , nevertheless, indicated by the then environment. Despite the relatively great distance of the individual localities (Předmostí - Willendorf) the local climatic changes are not so great to prevail over the climate of that time. Taking this assumption into consideration, all essential changes in the faunistic composition must necessarily have a stratigraphic value.

The localities studied can, according to fauna, be at first sight be divided into two groups. The first includes Předmostí, Dolní Věstonice, and with certain deviations possibly also Pavlov and probably also Milovice. In the surrounding there lived abundant mammoths, reindeer, foxes, wolves and hares. In the association there also occur wolverines and horses, as for the last mentioned species I suppose that it was much more abundant than indicated by the number of hunted animals. In only isolated cases there occur deer, red deer, elks and bovids. From the summary it follows that the landscape could not be a loess steppe covered with only herb vegetation, but at that time species requiring light groves start penetrating into it, at least in the river valleys (Musil 1955, 1959). On the basis of the fauna it cannot be excluded that Pavlov might be younger than Dolní Věstonice and Předmostí.

The second group of localities includes the cave Kůlna (layer 6b) and Willendorf (above all layer 9 from Willendorf II and Willendorf I). Besides mammoths, species occurring only sporadically at the above mentioned localities increase in number. They are deer, elks, reindeer and bovids. The great number of ibex bones at Willendorf is due to the character of the landscape. It is thus a noticeable shift towards species requiring a different landscape, both climatically and from the viewpoint of the plant cover. I think that it must necessarily be younger than the localities of the first group, because their quantitative species composition is the continuation of what could be stated as the beginning with Dolní Věstonice and Pavlov.

In some authors there still prevails the opinion that the period of the end of the Pleistocene, with respect to its cold climate, was very unfavourable for the vertebrates and of course for plants. The loess steppe should have stretched from hilly land up to the lowest valleys and only isolated bushes and dwarfed trees could occur in it. Since it was a periglacial region, permafrost everywhere was automatically assumed.

In animals living at that time it was assumed that they were mostly so strongly adapted to that cold climate that they could not live in another one. Hitherto analyses, however, show that most of the then mammal species are not adapted to markedly warm or markedly cold climate, but rather to continental or oceanic climate. They are mostly eurythermic.

Sometimes, without major considerations, it is assumed that in the Glacials there was a meridian shift of present-day vegetation zones towards the south, without taking into consideration the fact that a number of important factors does not depend on glacial or interglacial time (the length of the day, the intensity of sunshine, etc.), but on geographic latitude. Therefore I believe that a thus conceived automatic shift of vegetation zones is not possible and that the biome typical of our region in the Last Glacial does not exist in present-day Europe (Musil 1988). This is also connected with the shifts of the animal association. A variety of American scientists have found that in North America there is no automatic shift of fauna towards the south in the Glacials, but rather to mingling of species of the individual zones. And that concerns a region where the shift north - south was very easy, not as it is in Europe where there are mountain ranges of the west-east direction.

And one more fact is conspicuous. Comparing the association of the end of the

Last Glacial and the beginning of the Holocene, the Last Glacial is characterised by a much greater species diversity than the Holocene. This incomparably higher species diversity assumes a much more heterogeneous biotope. That means that closed forest units developing in the Holocene were less advantageous for the species diversity and thus also for the number of species than the countryside at the end of the Pleistocene. If there were only a mere loess steppe in question at that time, the number of species would have to be the same, only other species would be concerned. Since this was not the case, it is necessary to admit a greater plant diversity.

This idea is also supported by big herbivores which need a great amount of food. In only a mammoth individual one must count with the amount of 200 kg plant food per day.

From all this it follows that the vegetation of that time was not monotonous, that it was not a mere steppe, but rather a forest-steppe and that it was also covered with small groves, maybe prevailingly in river valleys and at climatically more advantageous places.

An unexpected support for this claim at which I arrived years ago on the basis of fauna, is the paper on the vegetation from the peat-bog at Bulhary situated near Pavlov. This peat-bog is dated to 25 675 + 2 750 - 2 045 BP, i.e. it comes from the same time as the culture layer at Pavlov. It indicates forest vegetation with the species *Pinus silvestris*, *Pinus cembra*, *Larix europaea*, *Picea abies*, *Juniperus communis* together with steppe herbs. These conifera were also accompanied by deciduous trees: *Ulmus*, *Acer*, *Corylus*, *Quercus*, *Tilia* (Rybníčková-Rybníček 1991). Further data are given by Opravil (Chapter V) and Svobodová (199la,b).

From the composition the authors draw the conclusion that the climate had a continental character, was certainly cold, but the presence of the above deciduous trees absolutely excludes extremely cold climate and/or permafrost. It is in accordance with my conclusions following from the fauna, but also with present-day papers dealing with this period in North America.

The above conclusions are thus quite identical with those I obtained by the study of mammals. The countryside must therefore be imagined as a forest-steppe with alternating areas of steppes and forests. Culture layer 6b in the cave Kůlna and a part of Willendorf belong already to a climatically different period which can be only younger than the culture layer of Pavlov.

6. Areal distribution of the osteological material at Pavlov

In the investigations by B. Klíma the osteological material was recovered very carefully and sorted according to the individual square metres. This kind of work permits us to get acquainted with its areal distribution, possible accumulations and all conclusions following from it (see drawings of the areal distribution of bones of the individual species).

The areal distribution of bones of individual species is basically the same. There are places where there is accumulation of bones irrespective of the species, and places where bones are almost completely or completely missing. From that fact it follows that animal bones were not thrown away at will all over the area of the settlement, but they are concentrated to places where the hunted animals were processed. Those places must have been the same for the whole time of settlement, otherwise the above

phenomenon could not occur.

Despite this generally valid observation we are able to recognize in it three somewhat different variants of distribution.

(1) The accumulation of wolf and reindeer bones is quite identical. The two animals whose utilisation was certainly considerably different were processed at identical places. It is interesting that this group also includes finds of mammoth bones, differing partly in area 1. It cannot be assumed that mammoth bodies were processed at the given area, it is not their dump either, as is known e.g. from Dolní Věstonice. Evidently different factors play their role here.

(2) Also foxes and hares follow variant 1 in their distribution. Only at area 11 their accumulation does not correspond by their distribution to variant 1.

(3) This group includes all further species whose amount is too small to permit conclusions. Despite that their distribution at the area does not seem to be contrary to the above variants.

What conclusion follows from it? The hunted animals, irrespective of the species, were always processed in the same place in which also parts of their skeletons remained lying. It is difficult to assume that in this kind of work the area was utilised for a long time. The time of settlement must have been relatively short, which corresponds with my conclusions of earlier studies (Musil 1955, 1959). This kind also assumes a certain organisation of work and induces an idea that it could not be a too numerous group of people.

Let us now study in detail the skeleton material of the individual species and its distribution in the area. From some earlier investigations it is known that e.g. at Předmostí there was a sorting of the individual parts of mammoth skeletons to certain places and I was able to state something similar at some Magdalenian localities in Germany (e.g. Musil 1985). The two areas investigated, of 1952 (area 11) and of 1953 (area 1 - 10) are judged together in this study.

6.1. Foxes

In this case I do not distinguish the two fox species found at Pavlov. The overall amount of determinable bones was 1 063 pieces. All bones of the skeleton were found, mostly fragmentary. We are above all interested in extremity bones, altogether 405. If we do not take into consideration ulnae, 41 pieces, where the distal end is very easily broken off in the natural way, there were only 18 whole long bones, i.e. 4.71 % of long bones (besides ulnae). If we compare the present distal and proximal parts of long bones, a considerable disproportion is evident,there were many more distal parts, 63.18 %, and only 36.81 proximal parts.

From the distribution of the individual fox bones it follows that not even in one case was it possible to state their sorting to certain areas.

6.2. Hares

The total number of determined bones was 644 pieces. Like in foxes, also in this case it is possible to state the presence of all bones of the skeleton, the bones being again mostly fragmentary. There were altogether 42 ulnae, I do not take them into consideration for the above reasons. There were only 3 whole long bones, i.e. 1.11 % of long bones. Distal parts of long bones were altogether 72.18 %, proximal parts only 27.81 %. It is the same phenomenon as in foxes.

As for the distribution of the individual parts of the skeleton, again no

concentration of individual bones to certain areas is perceptible.

6.3. Wolves

The overall number of bones is very high, altogether 1 935 determined pieces. All skeleton bones are represented, mostly again in fragments. There were 57 ulnae, whole long bones 16.24 % The way of preservation is different from the above species and indicates evidently what the hunted animal served to. There were 57.83 % of distal parts of long bones and 41.81 % of proximal parts. Even this confirms the above opinion.

Dividing the finds of long bones of wolves to investigated areas of 1952 and in 1953, we would see that from the 1952 area there are more whole and fragmentary bones than from a much larger area in 1953. But one cannot speak about some intentional sorting of osteological material.

Bones were frequently thrown away still in connection with tendons and in the investigation they were found in anatomical order. Several whole hind legs were unearthed, sometimes also with the distal part of fibula, or part of the whole hind leg or the whole front leg, i.e. the humerus, the radius, the ulna and the paw, sometimes also part of the backbone with vertebrae in anatomical order. Very many bones belonged to young individuals.

One fragment of a mandible deserves attention in which the teeth were ordered in a zigzag way. This feature is considered to be a domestication sign and its more detailed procession should be paid more attention in the future. If it proved correct, it would be the oldest known domestication in the central European region.

As for the areal distribution of individual bones, it corresponds completely to that of the above species. A difference is found in the ratio of distal and proximal parts of long bones, in the presence of a larger number of whole long bones and in a relatively high amount of skeleton parts in anatomical order. From all that it follows unambiguously that the hunting of this animal was carried out for other reasons than for obtaining food.

6.4. Reindeer

The overall number of bones was relatively high, altogether 920. All bones are highly fragmentary, not a single long bone was intact. There were altogether 11 ulnae, 69.87 % of distal ends of long bones and only 30.12 % of proximal ends.

By the analysis of their areal distribution it was impossible to find any intentional concentration of individual parts of the skeleton. It is interesting that not a single tibia or humerus was found, only one femur. Due to the fact that the overall number of bones of this species is very high, they must have served as starting material for making tools. That is, after all, evident in preserved bones, above all in metapodia.

6.5. Horses

There were relatively few hunted animals, the number of bones is altogether 267. The highest number consisted of free teeth, further carpal and tarsal bones. All others served as raw material for making tools. No intentional distribution of individual bones is perceptible.

6.6. Mammoths

The overall number of bones was 661. They were mostly phalanges, rib fragments and molar fragments. Long bones, mere small fragments, were only three. A whole number of bones came from very young animals, from freshly born young animals, and even unborn individuals cannot be excluded.

6.7. Birds

There was a relatively great number of bird bones, altogether 129. Their bones were scattered all over the area.

6.8. Other species

Relatively most frequent were wolverines, fewer lions and fewest bears. By it isolated occurrence also deer belongs here. Bones of carnivores were preserved in a similar way as in wolves, whole long bones and metapodia are found. From that we can judge at the same way of utilisation as in wolves.

A great majority of the found bones was, of course, fragmentary, so that they are either indeterminable or their determination would be very difficult. They are altogether 10 210 fragments, their areal distribution being evident from the graph.

Several facts follow from the analysis of bones:

(1) The hunted animals were always processed in the same places, which assumes a relatively short time of settlement by a small group of people.

(2) Not all animals served as food. This is particularly evident in the beasts of prey. A relatively high number of hunted wolves, evidently for obtaining fur, therefore signals the settlement of the given area in winter months, at a time when the fur was at its best. Putting this assumption together with the amount of the hunted game, also the length of settlement follows from it. The amount of the hunted game probably corresponds to the period of one to two years, or one year with two winters.

(3) The disproportion of distal and proximal parts of long bones cannot be explained otherwise than that the proximal parts served for the production of some tools. The above disproportion is too conspicuous as not to be intentional.

(4) Individual bones of big and small animals (excepting the beasts of prey) evidently served as raw material for further products. But their concentration to certain places where they were processed is not evident, as it is known e.g. from some Magdalenian localities. This reveals a lower degree of labour organisation as compared with the localities of the Magdalenian.

7. Game Hunting

Hunting game constituted the main economic basis of the then people and their existence, the number of people and their cultural level depended fully on the success of hunting. But it did not serve them only for meeting the basic human needs, i.e. as food, but at the same time as the starting raw material for further activity. This of course did not only concern the hard parts of the body that are found, but also the soft parts (such as tendons, fur, etc.) which are, of course missing. I believe that the elaboration of this fact has not yet been paid sufficient attention which was rather oriented at stone tools.

From the study of osteological material certain deductions follow:

(1) Hunting was not concentrated to a certain species or to a certain age. Prevailingly all big herbivores were hunted, but the number of other small game is not negligible.

(2) The objects of hunting were both animals living in herds (such as mammoths, reindeer) and those living individually. That means that the way of hunting them must have been quite different.

(3) Finds of horse bones are relatively small. Despite that I believe that in the landscape of the forest-steppe character they lived in big herds and the fact that the number of hunted animals is so small witnesses rather that the method of their hunting had not yet been mastered by the then people. That is substantially different from the Magdalenian when many a time a complete specialisation sets in of their hunting; of course there was nothing else left for people if they wanted to survive.

(4) Animals were hunted in relatively near surroundings and they were carried to the settlement either whole or, big animals, in parts. The settlements were founded at places advantageous above all for hunting mammoths. Near Dolní Věstonice and Pavlov it is necessary to assume their migration on a relatively narrow territory between the stream of the river Dyje with numerous swamps (see also the peat-bog at Bulhary at the same time) and the steep slopes of the Pavlovské vrchy Hills. At Předmostí, on the other hand, there were effusions of warm waters not freezing even in winter; it was a place very advantageous particularly in the winter season owing to a high daily consumption of water by the mammoth.

(5) In some animals also seasonal annual hunting has to be assumed. Bone accumulation was due to man's activity and natural factors did not participate in it. I am sure that this also concerns Předmostí, when old opinions about a natural disaster appear again. It would be possible to mention a variety of factors contradicting it, but this is not the objective of the present paper.

(6) Individual settlement structures did probably not serve for a long time, it cannot even be excluded that they were only seasonal. On the other hand, it was a permanent place for inhabiting suitable evidently for its important position from the point of view of animal migration. Only with Milovice it is possible to consider a satellite camp.

(7) The high success of the hunting and thus also a high level of the economic basis allowed a relatively great upsurge of the then human community and liberated the possibilities of cultural development at an unpreceded level. One question remains unanswered, viz. why those advantageous places were deserted. Decisive must have been an essential change in their economic basis.

(8) A number of problems would be soluble in the case of a comprehensive procession of the whole set of problems by different branches of science on a broader geographical and temporal scale.

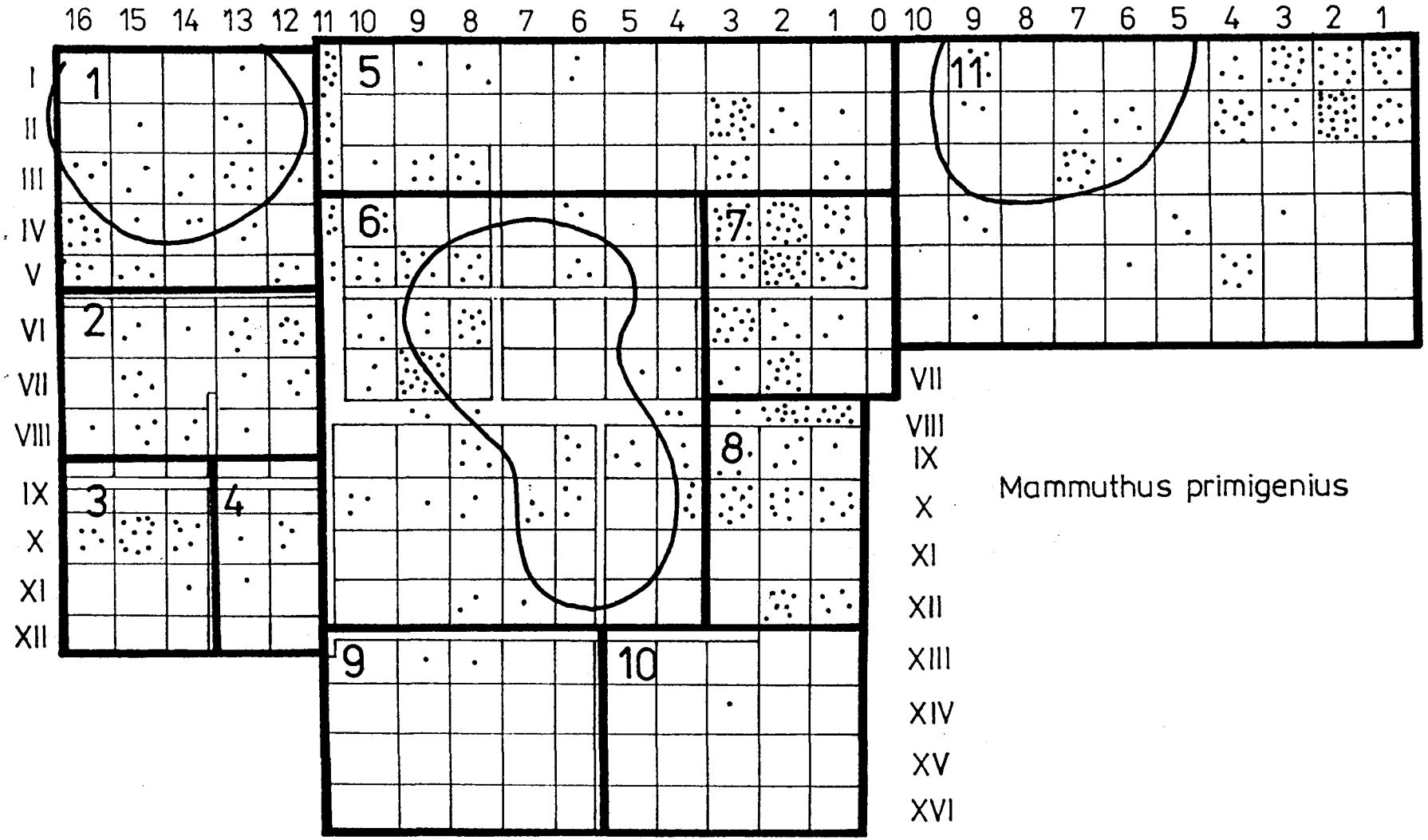

Fig.1. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

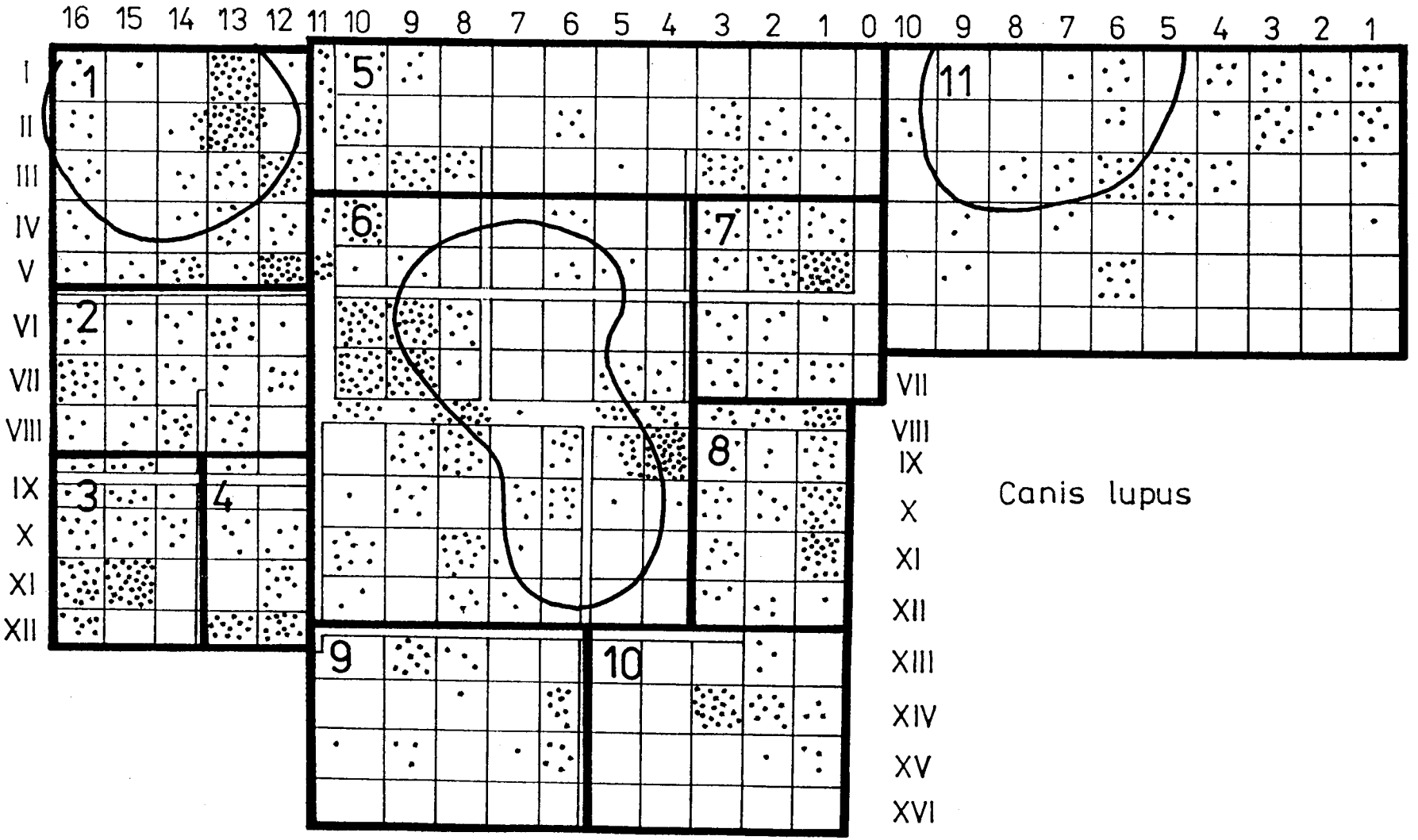

Fig.2. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

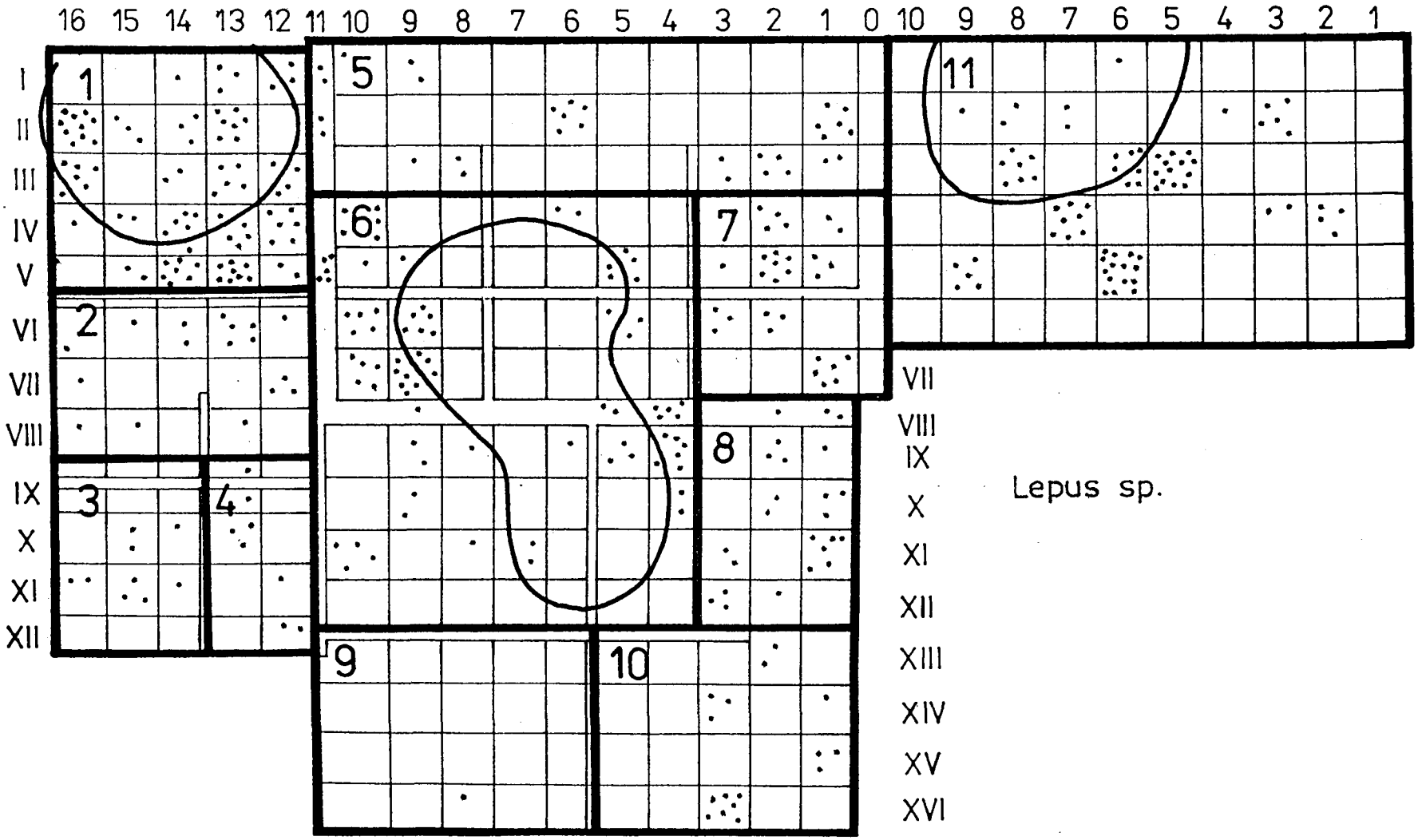

Fig.3. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

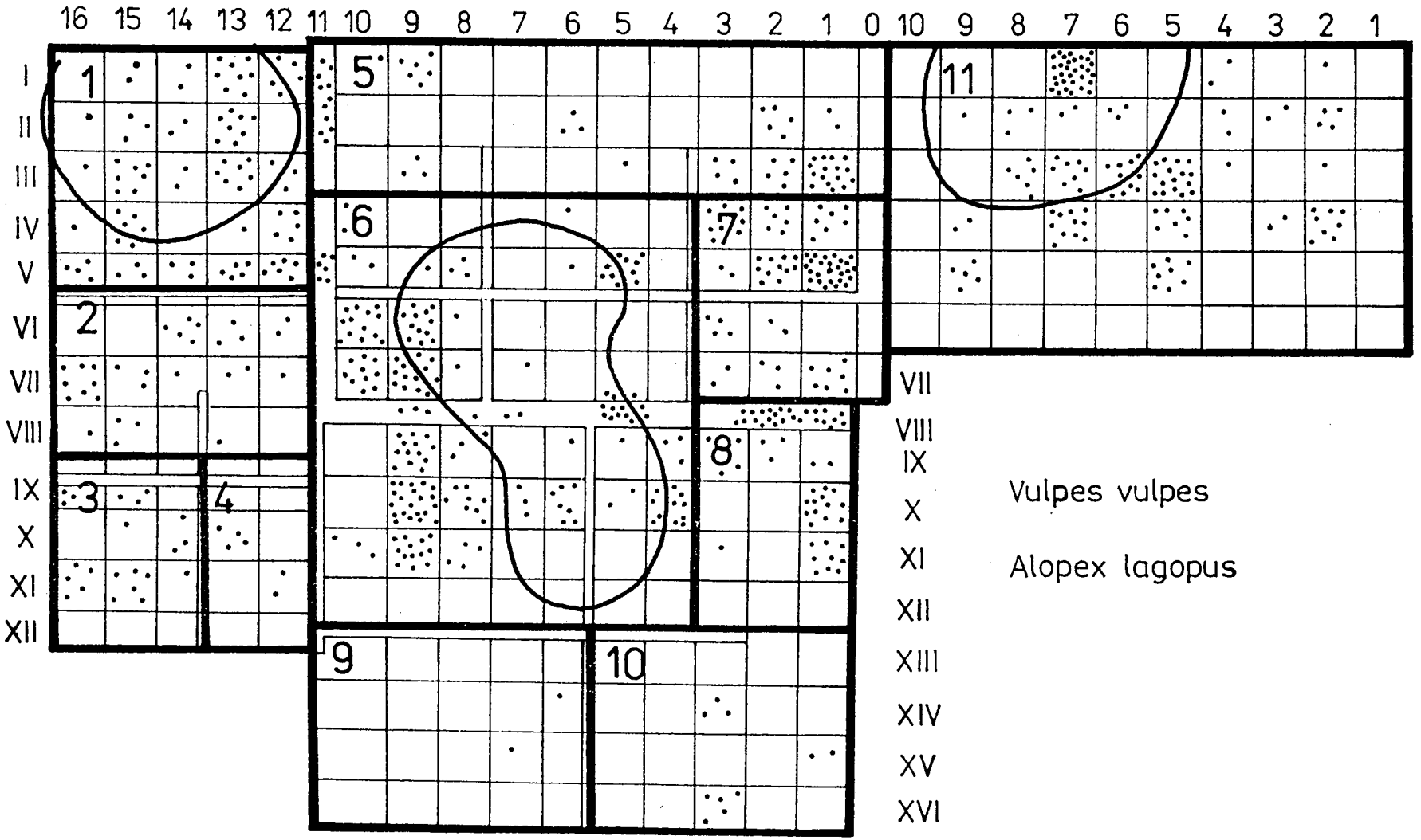

Fig.4. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

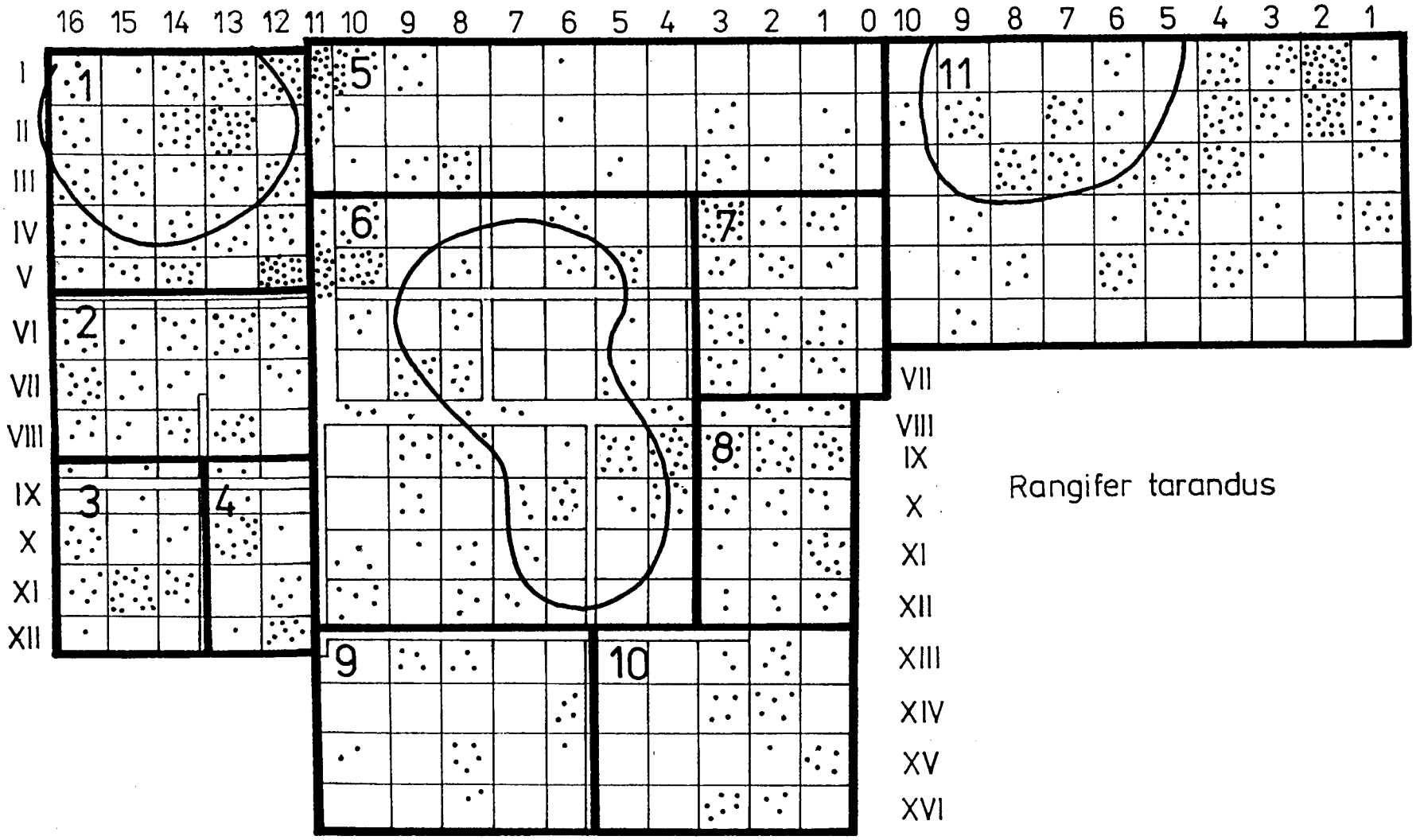

Fig.5. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

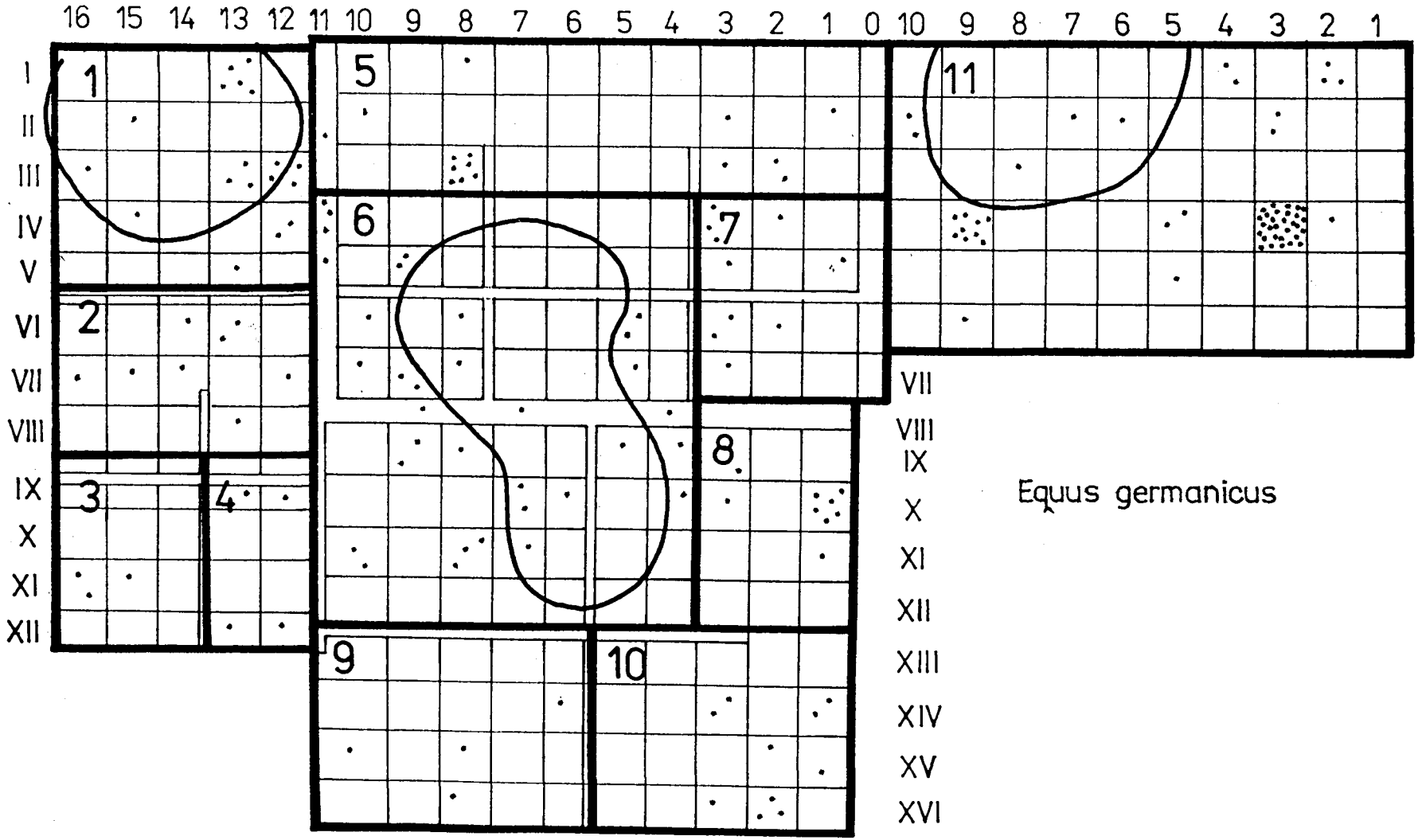

Fig.6. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

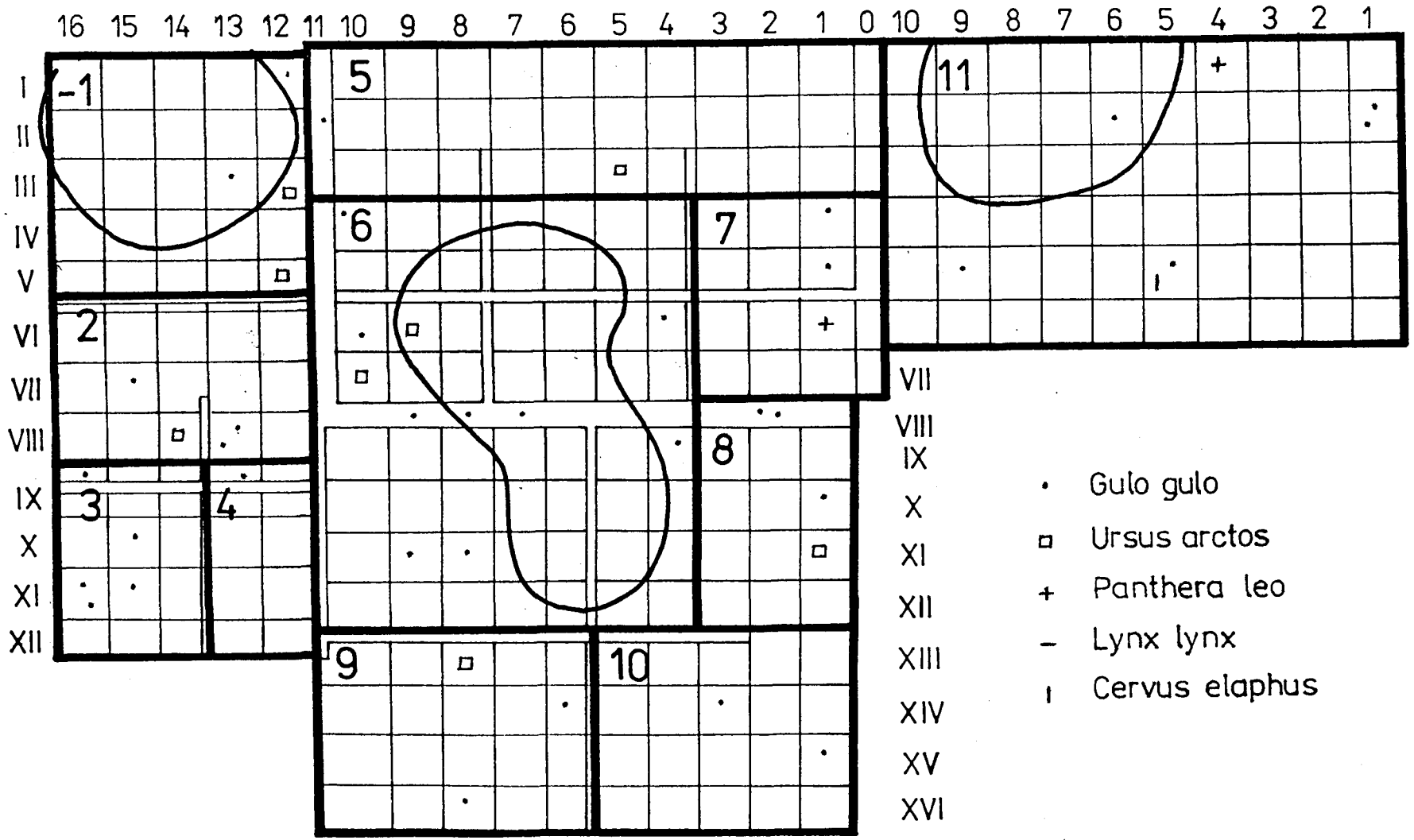

Fig.7. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

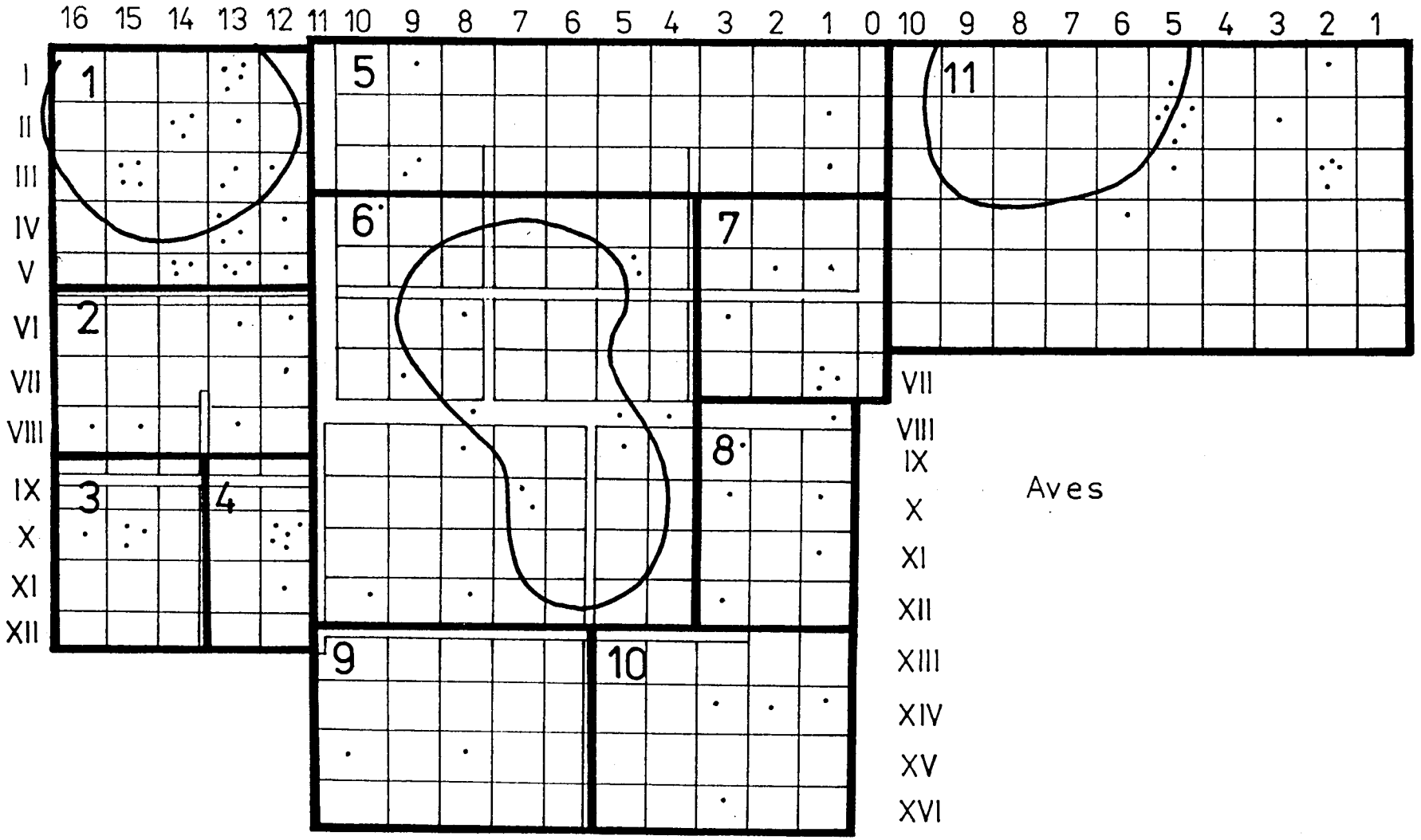

Fig.8. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3

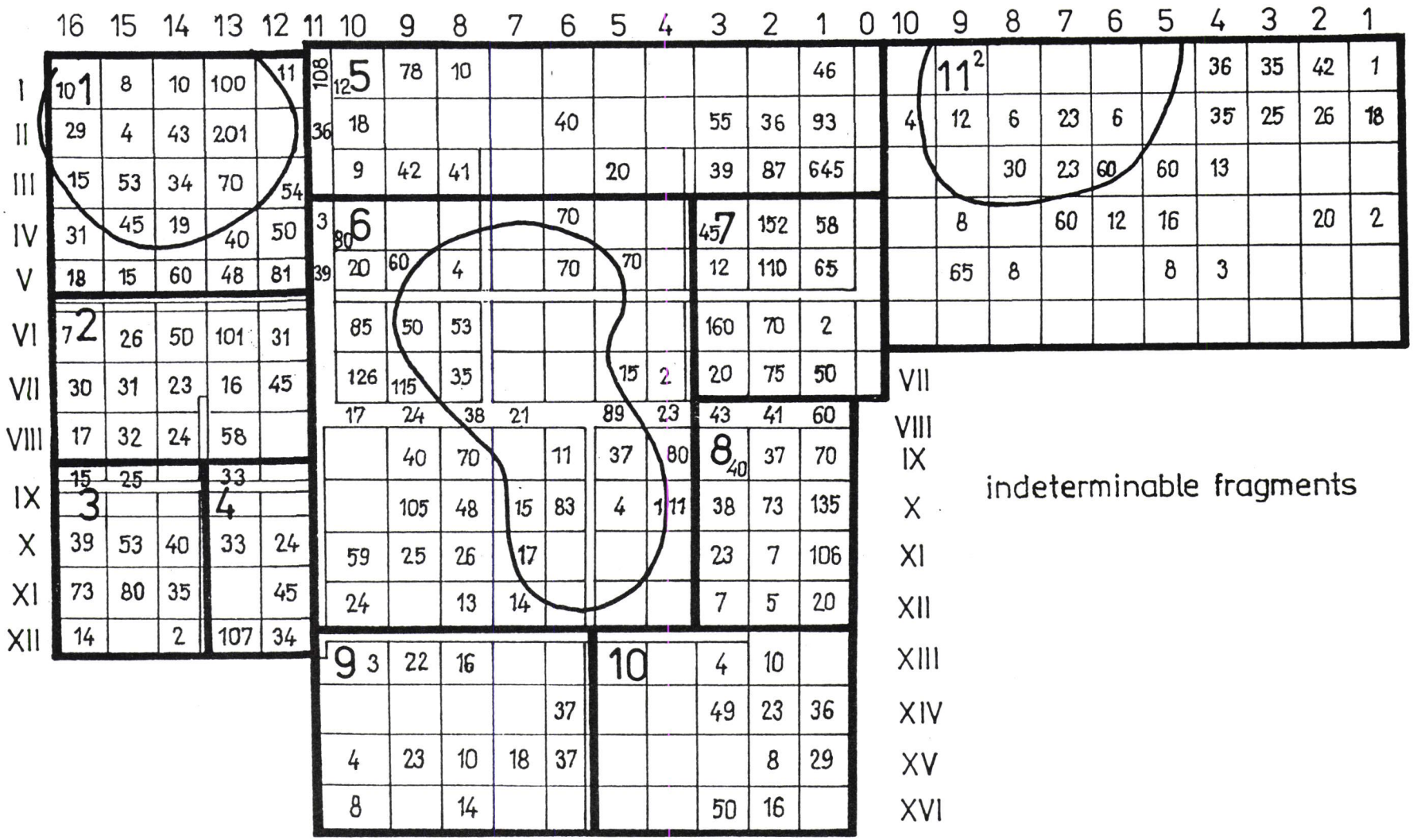

Fig.9. The spacing of bones in the culture layer of Pavlov in the separate square meters. Investigation in the year 1952 (part 11) and 1953 (part 1-10). In the part 6 the central feature 3. The numbers represent the quantity of bones (only interminable) in the square metre