HISTORY OF DOMESTIC MAMMALS IN CENTRAL AND EASTERN EUROPE

by S. BÖKÖNYI

AKADÉMIAI KIADÓ, BUDAPEST

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This book on the history of domestic mammals of Central and Eastern Europe is the result of the author's twenty years of research. Four hundred Hungarian archaeological sites provided the basic material for this work which was further complemented with data referring to these regions. The book gives a highly detailed, new account on the history of domestic mammals from these areas starting well back in the beginning of the Neolithic right through the ages to our Modern Times. Since the domestication of animals has been a revolutionary step in the history of mankind, the book is interesting both for natural and social sciences, archaeology and history in particular.

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PREFACE

Investigations into domestication, into the origins and development of domestic animals have advanced by leaps and bounds in the period since the Second World War. On the one hand, the biological basis of domestication has been explored with modern, experimental methods and, on the other hand, the investigation of domestic animals in prehistoric and early historic times has progressed considerably. In this latter field investigations have been launched in regions where before only initial attempts were made and, as far as time is concerned, research has sounded depths which were unthinkable before. Who would have thought, for example thirty years ago, that the earliest domestication activities could be traced back at least to 10,000 years and that in Europe, animal keeping existed almost 8500 years ago?

In the initial stages of the research on domestic animals many comprehensive works on the emergence of domestic animals appeared. However, as at that time the number of bone samples investigated was very low, these works were inevitably reduced to generalisations and offered very few concrete facts. Today, by way of contrast, a substantial quantity of material is available, and research has been able to clarify many questions of detail or, at least, has been aimed at clarifying them. Thus, the time seems to have arrived for a detailed investigation of the emergence of domestic animals and animal keeping of a large geographical unit.

For this purpose the region comprising Central and Eastern Europe appeared to be particularly suitable first of all because it is in the neighbourhood of the great domestication centres of the Near East, so that it was supplied with certain species of domestic animals direct, and secondly because there were highly important centres of domestication in the region itself. And moreover, in this region the wild ancestors of two important species of our domestic animals — cattle and pig — existed. One of them still exists today in great masses, so that their domestication can be examined under very favourable conditions. Finally, in a great part of the territory — perhaps with the exception of the Balkan Peninsula — good collaboration exists between archaeologists and zoologists, owing to which a great quantity of bone samples has been collected from different sites and then studied. Thus the degree of research carried out in the region may be considered as particularly good. This refers in particular to Hungary, where it has been possible to evaluate the animal remains from nearly 400 archaeological sites, which is a very high number in proportion to the size of the area; from this point of view only Switzerland is in a similarly advantageous position.

With respect to the geographical demarcation of the region we have taken the Rhine for the western boundary of Central Europe, the Schleswig-Holstein Peninsula for the north-western boundary and the Alps for the southern boundary. Thus we have excluded Italy and France, and Denmark and Finland in the north.

Chronologically we have limited our investigations to the period between the beginning of the Neolithic and the end of the Middle Ages or the beginning of our modern times respectively. This period comprises the era from the beginnings of domestication up to the commencement of scientific animal breeding. In discussing the material we proceeded, in general, according to archaeological periods, but when analysing the periodisation of animal keeping we have endeavoured to free ourselves from the framework of the archaeological order of periods. In our diagrams, too, we have grouped the material which was examined according to archaeological periods; moreover, on account of the special conditions of the Carpathian Basin and with a view to rendering the process of the evolution of domestic animals more comprehensible we have subdivided certain archaeological periods. Thus, in the material of the Migration Period we have dealt with bone samples of the Avar period and of the Period of the Magyar Conquest separately; in the Mediaeval material we have separated 10th – 13th century material from that of the Late Middle Ages, to which we have added bone samples of the early period of modern times and thus formed a group of bone samples of the 14th – 17th century period.

The material studied comprises animal remains from Hungarian archaeological sites of the above mentioned period, their number being nearly 400. To this material we have added bone samples, identified by ourselves, originating from some sites in the neighbouring countries. Our investigations are based on the Hungarian material, unique in its completeness, a material originating from modern excavations and comprising bone samples of all periods of the above mentioned span of time in more or less equal proportions. The investigations of the Hungarian material served as a model for our research with respect to the emergence of domestic animals of the whole territory discussed. As far as possible we have tried to examine the other materials of our fields of investigations by means of autopsies, or, if this was impossible, to include data of literature in our work. However, in this latter case we have not confined ourselves merely to take up literary data but have evaluated data published by others from new points of view.

Since the completion of the manuscript five years ago several articles have been published on subfossil bone samples of the mentioned area. Nevertheless, we included only the data of the Lepenski Vir fauna from the Iron Gate Gorge of the Danube as the only sample which made an essential contribution to our knowledge on the development of the domestic fauna outlined in this book.

Certainly, in investigating the history of the development of domestic animals, which are above all biological material, it is necessary to study animal remains which have been unearthed by excavations, for only such material can give a realistic picture. But to complete this picture, we have also used contemporary descriptions and representations of the animals.

It is to be emphasized, however, that these latter can only complete the conclusions drawn from the primary, biological material, in particular in the fields (colour, quality of skin and hair, condition of the animals related to their feeding, etc.) concerning which the animal remains found did not provide any information.

The bone samples which were examined were of two different kinds: those originating from excavated settlements and those from cemeteries. As a rule, settlements yielded large bone samples, in which, however, few skulls or large fragments of skulls suitable for examination were found. The settlement material mostly consisted of extremity bones, a great many of which had been broken open. On the other hand, skulls or even complete skeletons were often discovered in cemeteries, but the number of such remains lagged far behind those of settlements. Furthermore, the possibility cannot be excluded that animals which occur in cemeteries were chosen according to certain beliefs (rites) — both with respect to their species and to individuals — whereas the material of settlements — containing bones of consumed animals or of such as had perished at the settlement in question — reflected subsistence activities, i.e. the real picture of the population of domestic animals kept at the settlement.

As the material examined belonged to two such widely differing groups, our investigation methods could accordingly not be uniform. Methods of craniology could be applied to cemetery material, but not to that of settlements, for in the latter case we had to start from the evidence of the extremity bones. Our job would have been an easy one if we had had suitable material both from cemeteries and from settlements for every period — since the investigations of the two would have complemented each other. Unfortunately, the only period for which we have good settlement material as well as a fair number of complete skulls is that of the Roman Empire; though even from that period such bone samples — thanks to fortunate finds — are limited to the remains of dogs.

On account of the factors mentioned above there were periods and species regarding which we were able to perform craniological investigations; for example dogs in the Period of the Roman Empire or horses of the Migration Period (in the latter case we were searching for geographically far reaching connexions) could be examined in this way; in other cases, however, only the size and its changes, the proportions of the body, etc. could be determined. Nor is this to be belittled because, in our opinion, such examinations can aid in the biological reconstruction of certain animals and populations more than simple craniometrical examinations. The success of the former method of examination is shown by the fact that only by the examination of extremity bones has it been possible to prove the distinction between the eastern and western group of horses — with a result contrary to the view prevailing today. Where it was possible and necessary we used statistical methods in our investigations; however, we have not discussed these methods in detail in our monograph but only referred to the results.

Whenever possible we tried to combine craniological examinations with the study of extremity bones and have often achieved useful results, as for example in the case of horses in the Migration Period or dogs in the Period of the Roman Empire.

More than once we came to a dead-end in our investigations: in vain did we try to find certain differences or connexions (e.g. the effect of castration on the metapodial proportions of sheep, or the differences in the proportions of certain parts of the skull in different groups of horses, etc.). We have not discussed these cases in detail but only refer to them in passing.

There is another problem regarding the bone samples and the methods: there were species which in general, or in certain periods were represented by very little material only. With these we have not been able to achieve considerable results and thus their study is rather sketchy in some parts. But this only shows the present state of our knowledge or of the collected material; it cannot be remedied by any other method of investigations than the further collection of bone samples or by lucky excavations.

We used a new distinct method to investigate the quantitative composition of domestic fauna. The method is rooted in our earlier works, but it is in the present monograph that we give the method its final form and use it in investigating the complete total of the bone samples of Central and Eastern Europe from the beginnings of the Neolithic up to the end of the Middle Ages. As a result we have succeeded in establishing from the Hungarian material the domestic fauna which is characteristic of certain archaeological or early historical periods, and by this means we have been able to determine in detail the development of the domestic fauna of Hungary. This, furthermore has made it possible to determine the archaeological age of settlements on the basis of the domestic fauna excavated there; this means that a new method of archaeological dating based on biological foundations has been developed. Owing to the gaps in the bone samples of certain territories examined, this method of dating could not be extended to the whole territory of Central and Eastern Europe, — but the principal lines of development can be discerned even in these regions.

For financial reasons the illustrations of the monograph do not contain the complete material that should have been reproduced (e.g. skulls and diagrams). We have chosen typical pieces to illustrate our statements. Even more does this refer to representations of animals of the periods discussed, of which we are presenting only the most important.

On the other hand, we have included a complete register of sites and faunas, indicating the collections in which the bone samples examined can be found, in order to enable other researchers to avail themselves of the material. We have proceeded similarly with the measurement tables of the bone samples, in these we have not included data already published. But even in such cases we have indicated the data of the publications and — with a view to an easier orientation — even the inventory and catalogue numbers.

We should like to express our thanks to all the archaeologists who put the bone samples of their excavations at our disposal for examination purposes or who assisted us in questions of archaeology and chronology, and to all institutions and colleagues who helped us in our investigations.

It is our pleasant duty to thank all those who have contributed to the publication of this work: primarily to the Hungarian Academy of Sciences and the Hungarian National Museum, Professors J. Harmatta and M. Kretzoi, the revisors, Mrs. Lili Halápy, the translator of the book, and Dr. Ruth Tringham (Cambridge, Mass.) who was kind enough to undertake the stylistic revision of the English text.

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The Author

THE HISTORICAL DEVELOPMENT OF ANIMAL KEEPING IN CENTRAL AND EASTERN EUROPE

INTRODUCTION

The qualitative and quantitative composition of animal bone samples unearthed from settlements of ancient times throws light upon the beginnings of animal breeding, on its advance at the expense of hunting, as well as upon its further development.

The bulk of bone samples from settlements, in fact the decisive part, comprise occupation and food debris, there are also animal bones of a different kind to be found among them, including the bones of animals which have died. In general, this group is represented by complete or partial skeletons although bones of disarticulated parts of the body are not infrequent either. These latter may have been mainly amassed by the dogs of the settlement, although they may also have served as raw material for making tools: e.g. the shed antlers of the roe deer or red deer, the radii of horses (for making bone skates), the metapodia of horses (for the same purpose or for sinkers for fishing nets) but often for toys as well, like the astragalus of cattle is used even today. A very special role was played by certain skeletons or skulls which were buried under the threshold or floor as a foundation sacrifice and by the skulls which were stuck up in front of the dwellings to scare away the evil spirits.[1]

It is often difficult to decide which of the animal bones found at settlements were the result of occupation and food debris. In the case of whole skeletons, it is evident that they belonged to carcasses which were either buried in or thrown into a refuse pit. On the other hand, in the case of single bones the decisive criterion, in general, is whether they are broken up or not. Bones broken up for obtaining the marrow may in all probability be regarded as food debris, as can skulls of which the brain case has been opened[2] or broken into fragments. On the other hand, whole bones are generally not the result of food preparation (nor are the unbroken bones of horses to be found in mediaeval settlements of many countries). Of course, there are exceptions to the above rule, particularly the metapodial and toe bones, which are not so well padded with muscles.

[1] Herre, W., 1950a, p. 8; Smirnov, A. P., 1951, p. 204; Sedov, V. V., 1957, pp. 23 ff.; Hagberg, U. E., 1963, p. 72; Méri, I., 1964b, pp. 111 ff.; Bunte, C., 1964, pp. 18 ff.

[2] At the Bronze Age settlement of Tószeg dogs' brain cases, which had been neatly opened, were discovered. The traces of cuts can be seen on them very well (Reményi, K. A., 1952). See Fig. 137

There is another problem of whether the bone samples found at settlements give a true picture of the fauna of the settlements and their environs. Unfortunately, we have to give a negative answer both from a qualitative and a quantitative point of view. If a species occurs in the fauna of a settlement, this means that it lived in the settlement or its surroundings; that the dwellers of the settlement bred or hunted it. But if it does not occur in the settlement fauna, this does not necessarily mean that it was missing from the domestic or wild fauna of the place. As far as the quantitative picture is concerned with respect to domestic animals — particularly under prehistoric conditions — it approximately reflects the actual frequency. Due to the scarcity of food in the prehistoric period man would eat essentially all domestic animals (including embryos and dead animals). Thus, sooner or later this was generally the purpose of every domestic animal — apart from its other uses, milk, draught power, etc. Its bones were then thrown into the refuse pits of the settlement. In later periods, especially in Roman times and the Middle Ages, animals not used for alimentation or the carcasses of large dead animals, such as cattle, water buffalo, horses, or asses, were mostly buried outside the settlements. Their bones are not, therefore, found among the samples from the settlements.

The situation is quite different with the wild animals. The quantitative composition of the wild fauna found in the settlements corresponds only very roughly to the quantitative composition of the wild fauna that lived in their vicinity. The bone samples of wild animals found in the settlements strongly depended on the nature of the hunting activities. In the beginning of the Neolithic, for example, man hunted any species that could be killed. Later, when he had more thoroughly learned the use of domestic animals, he started domestication on a larger scale and simultaneously specialized in hunting first and foremost those species which could be domesticated (in Hungary this was chiefly the aurochs). He killed adult individuals to catch their young for domestication. This manner of hunting lasted roughly from the end of the first third of the Neolithic to the middle of the Copper Age. Bones of aurochs often comprise more than 40 per cent of the total faunal remains found on Hungarian sites of this period. In addition to domestication, however, the hunting of aurochs had another purpose which should not be underestimated: killing an aurochs provided the population of a settlement with a huge quantity of meat, in fact several hundred kilogrammes. When this "domestication fever"[3] died down and the aurochs population became greatly reduced, man turned to hunting other large species, especially red deer. Later when this species had also become rarer and the princely or royal laws began to protect the "noble" game, it was the turn of even smaller animals. Thus the brown hare became the most commonly hunted animal of the Middle Ages.[4] Since the above conditions hold good for the bone samples of all settlements however in that the bones of domestic and wild animals arrived in the refuse of all settlements in the

[3] Bökönyi, S., 1959a, p. 80; 1962c, p. 178
[4] Vogel, R., 1940, p. 93

same way, the faunas of all settlements can be compared with each other both from a qualitative and from a quantitative point of view.

It should be emphasized repeatedly that only bone samples of settlements are suitable for this kind of investigation. Although the animal bone samples of cemeteries give some guidance with respect to the development of animal keeping, the fact that the presence or absence of a species, and its frequency or rarity, depends particularly on the funeral rites, considerably limits the possibilities of our analyses. The best example to show that an examination of bone samples from cemeteries can give some additional information on the fauna of an associated settlement is provided by the material of the Polgár–Basatanya cemetery, which dates to the Early and Middle Copper Age.[5] At this site the bones of wild animals could often be found in the graves of the Tiszapolgár culture, belonging to the first period of the cemetery, but never in those belonging to the second period (the Bodrogkeresztúr culture). The Bodrogkeresztúr culture evolved from the Tiszapolgár culture,[6] and it may be regarded as representing the unbroken survival of the population. It would be rash, however, to infer that by the second period the population had abandoned hunting as a method of obtaining food, or that the bones of wild animals would also not be found among the bone samples of the settlement. We may conclude from the above, however, that the significance of animal keeping had naturally risen. It is interesting to note that in the graves of the cemetery, the bones of sheep and goats are highly frequent, which, no doubt, was first and foremost the result of the funeral rites. On the other hand, the actual quantitative composition of the domestic fauna of the settlements played a part in the shaping of the funeral rites. This is proved by the fact that in the Tripolye B settlements (contemporary with the Tiszapolgár culture) and in the Bulgarian Eneolithic settlements which were related to the former to a certain extent, the caprovines group, along with cattle, was the most frequent domestic animal.[7]

It was already realised that it was necessary to evaluate the fauna of settlements from such a point of view by Rütimeyer, one of the founders of the study of the history of domestic animals. But he himself only dealt with the relationship between animal keeping and hunting on the basis of the numerical proportions of domestic to wild animal bones. He stated that as time proceeded in prehistoric settlements the ratio of the former was increasing and that of the latter was decreasing.[8]

Almost without exception, the authors following Rütimeyer devoted some attention to this problem, but they confined themselves simply to registering the numerical proportion of the bones of domestic and wild animals. They did not compare the results of their analyses with finds from earlier or later settlements. They showed peculiarly little interest in the changes that appeared in the course of historical development in the numerical proportions of different species of domestic animals.

[5] Bognár-Kutzián, I., 1963, pp. 177 ff.
[6] Ibid.
[7] Pidoplitchko, I. G., 1956, pp. 38 ff.; Bibikova, V. I., Shevtchenko, A. I., 1862, p. 207; Hančar, Fr., 1955–56, p. 123
[8] Rütimeyer, L., 1862, p. 8

From this point of view Kuhn may have been the only exception for he tried to show the change in the numerical proportions of the different species of domestic fauna undergone in the Swiss lake dwellings.[9] Unfortunately, the available bone material was too small a sample. He studied the samples of nine settlements of the Neolithic and the Bronze Age (the dating of four of which was uncertain) so that he was unable to give a general picture.

In this field, Nobis's work[10] meant a considerable advance. He discussed the development of the domestic fauna of North-West and Central Germany, examining the fauna of settlements in the area in question during the Neolithic, late Roman Imperial, early and middle Mediaeval periods, and compared it with that of the neighbouring areas. However, since there were considerable chronological hiatuses between the faunas investigated by Nobis, he was only able in his analysis of the chronological part of the problem to evince the changes that had taken place in the relationship of domestic and wild animals; on the other hand, he found very interesting differences in the quantitative composition of the domestic fauna of settlements existing synchronously in different geographical surroundings.

In order to prove changes in the fauna that had happened in a settlement which existed throughout the Bronze Age, we examined the finds from Tószeg, a Bronze Age site in Hungary, which was already considered a type-site. During the final excavations there in 1948 the bone samples were collected by separate layers.[11] Similar analyses were made of the mediaeval bone samples of Buda Castle, which were compared with the bone samples of rural and urban settlements both in Hungary and abroad with a view to finding chronological and spatial differences.[12]

The analyses of the faunas of Tószeg and of Buda Castle were isolated experiments on the basis of which we elaborated the method of quantitative evaluation of prehistoric settlement faunas in our comprehensive paper on the prehistoric fauna of Hungary.[13] In this paper we investigated the vertebrate fauna of the first three main prehistoric periods of Hungary (Neolithic, Copper Age and Bronze Age, for at that time we did not yet possess material suitable for such analyses from settlements of the fourth period, the Iron Age) from the point of view of calculating ratios of domestic and wild animals and of the different species of domestic animals and of wild animals respectively. In evaluating together these two aspects of the fauna we were able successfully to distinguish the fauna of the main prehistoric periods of Hungary. Moreover, we were able to determine the differences in the faunas of the various cultures in the Neolithic and of the various periods (which are more or less identical to cultures of the Copper Age). We were not able to make such fine distinctions with the Bronze Age material, for in the Bronze Age settlements — at least in those where bone samples were collected and studied — assemblages belonging to several cultures occurred and

[9] Kuhn, E., 1938, pp. 253 ff.
[10] Nobis, G., 1955, pp. 1 ff.
[11] Bökönyi, S., 1952a, pp. 71 ff.
[12] Bökönyi, S., 1959a, pp. 455 ff.
[13] Bökönyi, S., 1958b, pp. 86 ff.

any detailed separation of the bone material was impossible. However, our work was considerably facilitated by the fact that the bone samples which we examined originated from settlements of essentially an identical geographical environment, we identified the bone material ourselves and the material from the three main prehistoric periods of Hungary was of approximately the same quantity. All these factors together made it possible to generalize on the basis of the faunal composition of the several settlements, and enabled us to delineate the faunal history of a small, fairly compact geographical unit.

The most important result was that we were able to ascertain that definite fauna types belonged to the specific prehistoric periods, and moreover to the various periods or cultures within them.[14] This is not surprising if one remembers that the fauna remains found in settlements provide information on two important aspects of a population's economy: hunting and animal keeping, their nature and their relationship to each other. Thus the investigation of the fauna covers not only zoology but economic history as well. And, moreover, on the basis of the above faunal types it is possible to trace back the archaeological age of the settlement in which they were found. The aim of all historical reconstruction is to determine the age of the investigated material on the basis of this material itself. In the case mentioned above these examinations are useful also for archaeological research in that they support chronological evidence by supplementary zoological-economic data.

Since our investigations, Hartmann-Frick has dealt with a similar question on the basis of the bone samples found at the prehistoric settlement of Lutzengüetle in Liechtenstein.[15] This site was occupied apart from breaks, from the Neolithic to the La Tène period; the author investigated changes in the fauna, comparing it with that of several Swiss prehistoric sites.

Zalkin's latest investigations are also very interesting: they deal with the composition of the fauna of Early Iron Age settlements in Russia and the Ukraine.[16] The amount of material from these sites was enormous (about 500,000 animal remains from 150 settlements) and it originated from sites in highly varied geographical environments. The classical towns and native aboriginal settlements of the Northern coastal district of the Black Sea, Scythian settlements, the settlements of the Tchernyakovo culture of the forest-steppe belt, and settlements of several cultures of the forest belt were all represented. The varied environments of the settlements had determined the direction of Zalkin's examinations: he investigated and succeeded in distinguishing different breeds, which had emerged not only due to the different surroundings but also under the effect of varied settlement and ethnic factors.

It is clear from the above description that until now it has been possible just on the basis of the material of prehistoric settlements in Hungary to

[14] Bökönyi, S., 1959b, pp. 96 ff.
[15] Hartmann-Frick, H., 1960 pp. 157 ff.
[16] Zalkin, V. I., 1960, pp. 104 ff.; 1964a, pp. 1 ff.; 1964b, pp. 25 ff.

determine the evolution of fauna in a fairly large contiguous area and a fairly long unbroken period and, at the same time, also to determine facies differences. It has been possible for the first time and on the basis of this material to connect certain periods and cultures respectively with certain types of the fauna, and from these latter — following a reverse course — to infer the archaeological age of the sites.

Nevertheless, the quantitative evaluation of settlement fauna and all investigations of the conditions of hunting and animal keeping activities of man in the past, have a common shortcoming: they cover only a short or long section of time from the beginning of the Pleistocene up to the end of the Middle Ages, and in space they cover at most the territory of a single country, but generally only of a single site. We decided therefore on the one hand, to fill up the gaps in the sequence of the evolution of prehistoric fauna which we had recognized in 1959[17] (at that time — for want of finds — it was the starting point of the evolution that was missing: we did not know the composition of the fauna of the earliest Neolithic culture in Hungary, the Körös culture); on the other hand we decided to insert our results into a European pattern of development: "A further, by no means less significant part is the intention to include the results achieved in a general picture of Europe gained by the utilization of rich and wide-ranged foreign sources. We have attempted to do this within the scope of this paper, but the attempt could only lead to partial results due to the incompleteness of the foreign data at our disposal. In this field essential progress can only be expected when the amount of European evidence has been increased to equal the evidence of the prehistoric sites in Hungary", whose faunal material has been analysed.[18]

We should like now to renew this attempt relying especially on Hungarian material and using the results achieved in its analysis as a framework for our examination of the development (we use this term for the sake of brevity, it refers to the relationship between hunting and animal keeping and the formation of this latter) of the faunal types of Central and Eastern Europe. It is for several reasons that we consider the Hungarian bone samples particularly suitable for this purpose:

1. The greatest quantity of settlement material has been studied in Hungary (in proportion to the area of the country's territory). For a quantitative examination of fauna the most suitable bone samples from settlements are those which have been collected without any selection and contain all identifiable animal bones found on the site. These should amount to at least five hundred. Our experiences have proved that with this number of specimens a realistic picture of the fauna can be obtained. (This was determined in the course of the examination of the bone samples of settlements which have been excavated in several seasons. The bone samples of each excavation season were analysed separately so that they could be compared with each other; e.g. at Békés–Városerdő of the Bronze Age.) However, is complete or partial skeletons occur in the sample the minimum number of bones

[17] Bökönyi, S., 1959b, pp. 96—97
[18] Bökönyi, S., 1959b, p. 96

naturally increases. In the archaeological excavations in Hungary at present practically all bones have been collected and there are about fifty settlements whose bone samples are suitable for such quantitative examinations. (In two or three cases settlements whose bone material is below five hundred were examined in this way; these however either support conclusions drawn from the bone samples of bigger sites, or had been collected at a site that yielded the highest number of bones of a certain culture, or originated from the earliest period of animal keeping in Hungary.)

2. The bone samples originating from Hungarian sites which have been investigated represent a continuous span of time and moreover, are more or less equally divided among the different periods. Only from the La Tène period and the Migration period are there no important quantities of bone samples in Hungary. It should be noted that faunal materials suitable for a quantitative analysis are rather rare from settlements of the latter period, in other parts of Central and Eastern Europe.

3. Thanks to its special location, the territory of modern Hungary, ever since prehistoric times, has been on the highway of all cultural trends and population migrations from all points of the compass; in many cases the Carpathian Basin comprised the last stage of their journey. Here we have in mind the people of the Körös culture, or of some of the Bronze Age cultures, or, in the Iron Age, the Scythians and Celts, and later, the Sarmatians, Romans, Avars, Hungarians, Turks, etc. These people brought with them not only their characteristic domestic artifacts but also their techniques of animal keeping — each with its characteristic composition, exploitation and possibly even breeds — as well. Thus in the emergence of modern animal keeping in Hungary that of a number of other peoples played a part. This development can be traced on the basis of the evidence of the bone samples from their settlements.

4. The analysis of the animal bone samples recently excavated in Hungary has been done by one author. This is important from several points of view. On the one hand, there are consistent observations and mistakes in the analysis of the bone samples of each site, e.g. at every site a consistent group of bone fragments would be classed as identifiable, and another consistent group as unidentifiable. On the other hand, the bones of wild and domesticated forms of a species would be distinguished (in the cases where both occurred on the same site) according to consistent criteria and standard dimensions. This was of particular importance in the case of cattle and pigs, for as we have seen, the local domestication of these two species was energetically pursued in the Neolithic and lasted up to modern times. To apply identical principles and methods was essential in calculating the number of individuals, for — irrespective of the problem of which method of determining the number of individuals yields the most accurate results — it is better to compare the number of individuals from different sites when they have been calculated according to the same principles, with the same accuracy and the same mistakes.

In the study of the development of animal keeping in Hungary, we should like to begin with the principles laid down in 1959, and to add to the facts recorded there in three ways.

First of all it is essential to clarify the state of the fauna associated with the earliest phase of animal keeping in Hungary which can be dated to the Körös culture in the 6th millennium B. C. (though its roots may go back even further, to the Mesolithic[19]). However, we have no authentic bone samples of this period which have been excavated by modern methods, by pursuing this course. Thus we should like to provide a firm basis to the framework of the evolution of the fauna. Unfortunately, it has not yet been possible to connect this evolution with the Pleistocene faunal evolution system, which is primarily a paleontological study. This could only be achieved if at one site — possibly in a cave where as a result of the activities of birds of prey a micro-fauna could also be found — with modern methods it was possible to excavate an undisturbed layer of rich material representing continuous deposition from the Pleistocene growing to the Holocene.

Secondly we should like to extend our 1959 study by covering the period (from the beginning of Prehistoric times) to the end of the Middle Ages. Unfortunately, as mentioned above, the evolution system set up in this connexion cannot be continuous, since there are certain periods for which we do not possess suitable settlement faunas.

Thirdly, we should like to expand our previous study by supporting the results of faunal development with morphological observations, in particular with evidence of the evolution of breeds and types and data obtained on the changes in the size of domestic animals.[20]

With this total information we should like to determine — as far as possible — the type of fauna, from the beginning of the Neolithic up to the end of the Middle Ages, that was characteristic of each period and of as many cultures and peoples as possible. This comprises the relationship between hunting and animal keeping, the qualitative and quantitative composition of the latter, and the species, types and sizes of the domestic animals. At the same time, we should like to give detailed data on the animal husbandry of the period of which we now have either written sources only or the written records are inaccurate, exceedingly incomplete and of a general character.

[19] Hančar, Fr., 1958, p. 140

[20] Here, however, he uses the results achieved by investigating the bone samples not only of settlements but of cemeteries as well

THE HISTORICAL DEVELOPMENT OF ANIMAL KEEPING IN HUNGARY

THE NEOLITHIC

Up till recently our knowledge of the fauna of the Körös culture was rather scanty, for, apart from the bone samples, which were very few and small, selectively collected and originating from one modern excavation (Hódmezővásárhely–Bodzáspart[21]) only the fauna lists of earlier authors were at our disposal.[22] Recently, however, O. Trogmayer has excavated in three settlements of the culture in the vicinity of Szeged,[23] and each, particularly that of Röszke–Ludvár, has yielded rich faunal material. At the same time Romanian settlements of the same culture have been partially excavated yielding smaller bone samples.[24] On the basis of the bone samples from the settlement of Maroslele-Pana (Fig. 1/1) we ventured a preliminary opinion on the fauna of the culture,[25] which has been confirmed by the bone samples, somewhat greater in number, found at Gyálarét (Fig. 1/2), Röszke–Ludvár (Fig. 1/3). (Meanwhile the inferences of Necrasov in evaluating the fauna of the Körös sites in Romania and, although working on very small samples have been confirmed by the analyses of the much larger samples from the Hungarian settlements.[26])

The geographical surroundings left a strong mark on the fauna of the settlements of the Körös culture.[27] This, however, applied in particular to wild animals and touched domestic animals much less. In the settlements on the islands of inundation areas there were large numbers of fish and water-fowl and, among mammals, animals of flood-plain copses and woods were frequent; on the other hand, in settlements on the boundary of forest-steppes, species which tolerated drought, such as the aurochs and the wild ass (*Asinus hydruntinus* Reg.) were more frequent. It survived the end of Pleistocene and seems to have existed up to the beginning of the Neolithic, characterizing the fauna of the Körös culture; in fact it can be considered as the "leading fossil" of this culture. (Although it also occurred in the Tisza culture settlement of Lebő,[28] it is clear that it belonged to the occupation

[21] Bökönyi, S., 1954a, pp. 9 ff.
[22] The literature is listed in Bökönyi, S., 1954a, pp. 9 ff.
[23] Trogmayer, O., 1964, pp. 67–86
[24] Necrasov, O., 1961, pp. 265 ff., pp. 167 ff.
[25] Bökönyi, S., 1964c, p. 88
[26] Necrasov, O., 1964, pp. 167 ff.
[27] Bökönyi, S., 1964c, p. 87
[28] Bökönyi, S., 1958b, pp. 61 ff.

Fig. 1. Frequency relations of species in the faunas of Hungary's archaeological sites (settlements). Lower line: number of specimens; upper line: number of individuals. 1. Maroslele—Pana, Neolithic (Körös culture), 2. Gyálarét, Neolithic (Körös culture), 3. Röszke—Ludvár, Neolithic (Körös culture), 4. Lebő, Neolithic (Tisza culture),

5. Szegvár–Tűzköves, Neolithic (Tisza culture), 6. Győr–Pápai vám, Neolithic (Linear Pottery Culture, Zseliz Group), 7. Neszmély–Tekeres patak, Neolithic (Linear Pottery Culture, Zseliz Group), 8. Polgár–Csőszhalom, Neolithic (Herpály culture), 9. Berettyószentmárton, Neolithic (Herpály culture), 10. Berettyóújfalu, Neolithic (Herpály culture), 11. Zengővárkony, Copper Age (Lengyel culture), 12. Aszód–Papi földek, Copper Age (Lengyel culture), 13. Tarnabod, Copper Age (Bodrogkeresztúr culture), 14. Budapest, XI. – Andor Street, Copper Age (Pécel culture), 15–16. Salgótarján–Pécskő, Copper Age (Pécel culture), 17. Tószeg–Lapos-halom, Bronze Age, 18. Csepel–Háros, Bronze Age, 19. Tápiószele–Tűzköves, Bronze Age, 20. Tiszaluc–Dankadomb, Bronze Age, 21. Dunaújváros–Koszider, Bronze Age, 22. Süttő, Bronze Age, 23. Mezőkomárom–Alsóhegy, Bronze Age,

24. Szebény—Paperdő, Bronze Age, 25. Békés—Városerdő, Bronze Age, 26. Felsőtárkány—Várhegy, Hallstatt Period, 27. Helemba Island, Hallstatt Period, 28. Tác—Fövenypuszta, Period of the Roman Empire, 29. Budapest—Albertfalva, Period of the Roman Empire, 30. Balatonaliga, Period of the Roman Empire, 31. Pilismarót—

I. őrtorony (watchtower No. I), Period of the Roman Empire, 32. Szilvásvárad, Sarmatian, 33. Szarvas–Rózsás, 10th–12th century, 34. Visegrád–Várkert dűlő (Castle Garden Baulk), 10th–12th century, 35. Tiszalök, Period of the Árpád Dynasty, 36. Kardoskút–Hatablak, Period of the Árpád Dynasty, 37. Buda–Castle, 13th–14th century, 38. Visegrád–Calvary, 14th–15th century, 39. Visegrád–Palace, 14th–15th century, 40. Visegrád–Palace, 16th–17th century, 41. Visegrád–Rév Street, 14th–16th century, 42. Visegrád Alsóvár (Lower Castle), 15th–17th century, 43. Túrkeve–Móricz, 15th–16th century, 44. Buda–Castle, the Pasha's Palace, Period of the Turkish Occupation, 45. Fonyód, Period of the Turkish Occupation debris of the Körös culture at the same site.) In the economy of the Körös culture animal keeping and hunting were, by and large, of equal importance, in some settlements hunting and in others animal keeping was more important. Apart from hunting, gathering was also important as a means of procuring food. The gathering of shells, snails and eggs is included in the term "gathering" — sometimes layers 30 cm in thickness of mollusca and snail-shells can be found — and so is the form of fishing in which fish — for example the giant catfish, sometimes weighing as much as 200 kg, so frequent at Maroslele[29] — were collected from the inundation area where they had become stranded as the water receded. Here hunting itself was not the only characteristic of the Neolithic, in fact, everything edible was hunted, including fish-eating birds (e.g. great crested grebes, grey herons, herring gulls, etc.), which, to present tastes, are very unpalatable with their smelly flesh.[30] The fact that, in spite of all this, in some settlements the aurochs was the most frequently hunted and killed animal was due to its abundance in a natural environment which was very favourable to the ancestor of modern cattle. Bones of locally domesticated cattle or of cattle-aurochs bastards are very rare indeed. This means that the first domestic animals arrived in Hungary together with the people of the Körös culture already in a domesticated state, and domestication was not begun locally to any significant extent in this period.

The people with the Körös culture, who swarmed northwards at the climatic optimum during the early Neolithic, brought with them a characteristically south-eastern composition of domestic livestock. Thus its animal keeping was alien to the geographic and faunal conditions of Hungary and not viable for a long time. For want of wild stock its most important species — sheep and goats — could not be increased by means of local domestication. On the other hand, in the environmental conditions of the Neolithic the natural increase was insufficient to meet the population's demand of meat and, at the same time enable an increase in the number of domestic animals. Moreover, as the domestic fauna was alien and non-viable here, it soon disappeared. From a quantitative point of view it is characteristic of the domestic fauna of the Körös culture that the sheep–goat group predominated leaving cattle far behind both in the number of bone specimens and of individual animals. Pigs and dogs occurred only in insignificant numbers and horses were completely missing.

From the great cultural groups of the second period of the Neolithic two have provided settlement material suitable for quantitative analysis: the Tisza culture (Fig. 1/4—5) and the Zseliz group of Linear Pottery culture (Fig. 1/6—7). (Unfortunately, the third important culture of this period, the Bükk culture, has produced only a few bone samples, which are unsuitable for investigations of this kind.) A further decrease in the importance of hunting and a rise in the significance of animal keeping were characteristic features of both cultures, though not in the same degree. Whereas in the Tisza culture the decline in hunting was very slight, in the

[29] Bökönyi, S., 1964c, p. 88
[30] Bökönyi, S., 1964c, p. 89

Zseliz group it was quite significant. In the Tisza culture the ratio between domestic and wild animals was scarcely over 1 : 1 in favour of domestic animals, but in the Zseliz group this ratio was nearly 9 : 1.

By this second period of the Neolithic in Hungary, the characteristic form of Neolithic hunting had become established. It was connected with domestication, whose purposes, in fact, it served.

Both with respect to the Tisza culture and to the Zseliz group there seemed to be a substantial advancement in animal keeping: it not only increased in significance but also its quality underwent a change in that during this period, more and more uses of domestic animals in addition to eating their flesh were discovered. Up to this period domestic animals had been considered as mere living reserves of meat that could be consumed at any time. Thus they made man independent of the luck of hunting, which had become more and more precarious with the increase of the human population and the decrease in the number of wild animals. Obviously, the first supplementary use of this kind was milking and the utilization by man of the superfluous quantity of milk would have been quite natural.[31] Although cattle at this low degree of domestication would have had hardly any milk besides the quantity they needed for feeding their calves, the cows could have been milked if the calves had perished or been killed. Later there was enough milk for human consumption in addition to the milk needed for feeding the calves. Cows were more willing to let themselves be milked if their calves were near them as is shown by a fine Egyptian picture.[32] The first representation of cattle being milked originates from Ur, from the temple of Nin-Hursag (after 2400 B.C.),[33] in which it is interesting to note that the cows are being milked from the rear, as is usual with goats. From this one may infer that the milking of cows may have emerged after the milking of goats, and was in fact modelled on this technique since, on the one hand, the domestication of goats took place much earlier than that of cattle and, on the other, goats are the most typical domestic animals to be used for milking: *a)* they give much more milk than cows compared to their weight, *b)* sometimes they can be milked before being with kid for the first time. Of course, the milking of cows can be set much before 2400 B.C., but unfortunately, the investigation of bone samples can not give any information in this respect. However, it would be interesting to subject early Neolithic vessels to chemical examinations with a view to finding remains of milk in them — as Grüss succeeded in doing with pottery of the Hallstatt period.[34]

The use of cattle as draught animals may also have begun at this time; though not harnessed to carts — this could hardly have been achieved prior to the Copper Age — but to some "Stangenschleife" like contrivance.[35]

However, the utilization of the wool of sheep may have been far more important. On the basis of our present evidence domesticated wool sheep

[31] Thévenin, R., 1947, p. 17
[32] Boesneck, J., 1953, Fig. 7 (11th Dynasty, 2133—1991 B.C.)
[33] Zeuner, F. E., 1963, p. 219
[34] Grüss, J., 1933, pp. 105 ff.
[35] Kothe, H., 1953, pp. 74 ff.

can be proved to have existed in the sixth millennium B.C. at the earliest, in West Iran.[36] They may have soon found their way to South and Central Europe; but they may have also appeared there as a result of mutation. Thus in the Mid-Neolithic in Europe the use of sheep for wool should also be taken into consideration.

All these newly discovered qualities of domestic animals must have been an inducement to the population of the Mid-Neolithic to increase their livestock by capturing and domesticating wild animals. This would only have been enhanced if in prehistoric times livestock was the basis of "wealth", which people endeavoured to increase by might and main.

For this purpose a form of hunting which specialized on the aurochs so became characteristic of the Neolithic in Hungary. The settlements of the Mid and Late Neolithic are full not only of the bones of the aurochs but also of transitional forms between domestic and wild cattle; nor are specimens of pig between the domestic and wild swine rare. Red deer, on the other hand, always lagged behind the aurochs in frequency.

Reverting to animal keeping in the Mid-Neolithic, cattle were by far the most frequent domestic animals both of the Tisza culture and of the Zseliz group of the Linear Pottery culture. In the settlements of the Tisza culture, pigs succeeded cattle in frequency followed by caprovines and dogs. In the settlements of the Zseliz group, on the other hand, caprovines always preceded pigs and dogs. Horses were missing in both groups. Of these two the Tisza culture seems to have adjusted its animal keeping better to the local environmental conditions of the Carpathian Basin, for it was based upon domestic animals whose domesticable wild forms lived locally and was thus more capable of development than the Zseliz group in the domestic fauna of which the relatively high frequency of caprovines perhaps reflected some southern characteristics.

At the end of the Neolithic the fauna of the settlements of the Herpály culture[37] (Fig. 1/8—10) shows a very interesting picture. Investigations of the ratio between domestic and wild animals show a certain decline as against previous periods of the Neolithic, the numerical proportion of domestic animals being much lower than that of wild ones; sometimes not even 30 per cent of domestic animals were found, whereas the frequency of wild animals always exceeded 64 per cent. This period was the peak of the above mentioned "domestication fever". This becomes clearly visible if we total the percentage of locally domesticable animals, cattle and pigs along with that of their wild forms, i.e. the aurochs and wild swine, and compare them with the percentages of the other domestic and wild animals (see table).

The table clearly shows that in the economy of the culture, locally domesticable species and their wild ancestors played the chief part, their numbers exceeding by far such domestic animals as had no wild ancestors locally and the non domesticable wild animals.

[36] Zeuner, P. E., 1963, p. 173

[37] The fauna of the Lengyel culture, which existed at the end of the Neolithic in Hungary partly simultaneously with the Herpály culture but surviving the latter and existing up to the middle of the Copper Age, is to be discussed in the part of the book dealing with the first period of the Copper Age

	Berettyószentmárton		Herpály		Polgár—Csőszhalom	
	specimen	individual	specimen	individual	specimen	individual
	%	%	%	%	%	%
cattle—pigs	20.71	25.90	18.93	23.00	27.29	30.04
aurochs + wild swine	57.98	45.52	59.93	48.84	47.38	37.52
domestic and wild cattle + domestic and wild swine	78.69	71.42	78.86	71.84	74.67	67.56
sheep—goats—dogs	1.91	3.75	5.01	7.51	3.13	6.01
undomesticable wild animals	19.40	24.83	16.13	20.65	22.20	26.43
caprovines—dogs and undomesticable wild animals	21.31	28.58	21.14	28.16	25.33	32.44

As is evident from the above, in the animal keeping of the Herpály culture, cattle took the lead with pigs second and caprovines and dogs lagging far behind. This type of animal keeping is strongly reminiscent of that of the Tisza culture and had evidently originated from it, which is also indicated by the archaeological data.[38] It was an animal keeping relying on the local wild fauna and excellently suited to the geographic and climatic conditions of the Hungarian Plain. It also follows from the above that the hunting of this culture was also a development of that of the Tisza culture in the direction of domestication on a larger scale. Of course, there were also slight local differences in the environment. Thus, for example at Berettyószentmárton (Fig. 1/9) and at Herpály (Fig. 1/10), which lie in a forest-steppe, there were relatively more aurochs than on the fringe of the steppe at Polgár–Csőszhalom (Fig. 1/8), which lies near the flood plain of the Tisza. On the other hand, at this latter site more wild swine and forest animals were found.

Essentially the peak of domestication in the Great Hungarian Plain can be set at the Late Neolithic period — in a culture that kept cattle and pigs and hunted and domesticated aurochs and wild swine. After this period there occurred a tremendous drop both in domestication and in hunting, and a completely new era in domestication ensued. The excessive killing off of domesticable aurochs could have been only one reason why domestication and hunting declined,[39] since the other domesticable species of wild animals, the wild swine, was still quite frequent. In addition another factor may have played an important role: animal keeping may have reached such a high degree by this time and achieved along with agriculture such significance in the economic life of the population that it was able to be firmly established and to provide subsistence for the population, and,

[38] Bognár-Kutzián, I., 1963, pp. 510 ff.
[39] Bökönyi, S., 1959b, p. 81; 1962c, pp. 185 ff.

moreover a numerical increase of the livestock was ensured without any further domestication. We assume that in the Herpály culture animal keeping was more highly developed in absolute values than in its predecessor, the Tisza culture; that is that there were more domestic animals per capita of the population than in the previous culture, in spite of the fact that the significance of animal keeping had decreased in comparison to hunting. Unfortunately this cannot be proved by our present evidence. We cannot state anything definitive in respect to this question until a settlement of both the Tisza and Herpály cultures has been completely excavated and its duration of occupation and number of inhabitants has been well defined.

THE COPPER AGE

The ethnic elements[40] which came to Hungary from the South-East and became components of the Tiszapolgár culture of the early Copper Age may have played a role in the rapid evolution of animal keeping after the Neolithic. In all probability these people had brought along a superior mode of animal keeping. In the northern part of the region between the Danube and the Tisza, as well as in Transdanubia with the Lengyel culture, the Neolithic type of animal keeping and hunting survived for a time but was later ousted by the new forms.

On the basis of the above evidence the pictures of the fauna of the two cultures may have been markedly different in the first period of the Copper Age. Animal keeping and hunting of the Lengyel culture, which survived from the late Neolithic and was strongly Neolithic in its character (Fig. 1/11—12), resembled those of the Neolithic: it did not comprise the domestic horse; cattle were by far the most frequent, followed by pigs and then, with a minimal numerical proportion, by caprovines and dogs. This composition of the domestic fauna resembles extraordinarily closely that of the Tisza culture (and of the Herpály culture). So also does the ratio of domestic and wild animals, which is slightly in favour of domestic animals. On the other hand, the wild fauna was no longer so Neolithic in character in that the aurochs and the red deer occurred in approximately the same numerical proportion, which is the first indication of a disintegration of the Neolithic hunting activities. The frequency of the aurochs, however, was still high, at about the same level as in the Tisza culture; numerous transitional forms between cattle and the aurochs — though not so many as in the Herpály culture — also occurred.[41] This again was a Neolithic feature.

It is interesting to note that the composition of the fauna was extraordinarily similar in all the settlements of this culture in spite of the great distances involved. Thus, for example, there is a distance of at least 200 km as the crow flies between the two settlements with the greatest fauna (samples: Zengővárkony (Fig. 1/11) and Aszód (Fig. 1/12)). Nevertheless, the composition of their fauna is exceedingly similar; the only essential

[40] Bognár-Kutzián, I., 1963, pp. 506 ff.
[41] Bökönyi, S., 1964c, p. 45

difference being that wild swine were more frequent at Aszód than at Zengővárkony. This, however, may have been the result simply of local geographic-climatic conditions: Aszód lies in the hilly country of North Hungary, which abounds in water, whereas Zengővárkony is situated at the fringe of the Mecsek Mountains which are much less watered.

The bone samples of the early Copper Age Tiszapolgár culture, which was wide-spread in the Great Plain, originate mainly from cemeteries; in addition the material from small sections of certain settlements has also been examined.[42] On this basis very little can be said about the quantitative composition of the fauna of this culture; we have to rely rather on guesswork (cf. Introduction).

From the second period of the Copper Age (the Middle Copper Age) our knowledge is based on the fauna of the Bodrogkeresztúr culture, of which a single settlement has provided large bone samples[43] (Fig. 1/13) as well as two smaller partially excavated settlements[44] and a smaller quantity originating from cemeteries. The material from the two smaller partially excavated settlements supports the conclusions we have drawn from the investigations of the bone samples of the large settlement (Tarnabod). At Tarnabod the numerical ratio of domestic animals is 81.02 per cent (on the basis of the number of specimens) and 68.38 per cent (on the basis of a calculation of individual animals), which is rather Neolithic in character.[45] There were no horses among the domestic animals and, although the frequency of ovicaprids equalled and even surpassed that of pigs, cattle had again become the predominant domestic animals but with a numerical ratio of the Neolithic. Hunting, too, differed from that of the Neolithic and formed, as it were, a transition towards that of the Bronze Age. Similarly to the wild fauna of the Lengyel culture, the aurochs and the red deer occurred more or less with a similar frequency.

In contrast to the preceding cultures we have three settlements of the Pécel (Baden) culture representing the last period of the Copper Age in Hungary which have provided material suitable for quantitative analysis (Fig. 1/14 – 15). (One of the three requires special attention since it comprises a settlement, possibly a kind of refuge, on the top of a hill,[46] and, for this reason, it will be discussed separately.) The fauna of the Pécel culture does not resemble that of the Neolithic in any way – at least as far as the settlements are concerned where the customary way of life was pursued, except in the lack of the domestic horse. This refers both to the ratio between animal keeping and hunting activities and the character of the animal keeping or hunting itself. The ratio of domestic to wild animals was about 9 : 1 (hunting in fact was of even less significance than this ratio implies, for the bones of wild animals were mostly those of fish or turtles and these do not belong to genuine hunted animals). This shows that animal keeping had

[42] Bökönyi, S., n.d., p. 78
[43] Bökönyi, S., 1959b, p. 60
[44] Bökönyi, S., 1959b, pp. 59—60
[45] Bökönyi, S., 1959, p. 60
[46] Bökönyi, S., n.d., II

advanced considerably. The composition of the domestic fauna was definitely of a south-eastern character with ovicaprids predominating followed by cattle and then pigs; dogs formed an insignificant percentage. Hunting, in general, was similar in character to that of the Bronze Age with red deer predominating over or more or less equalling aurochs. (On the other hand, there were some transitional forms between domestic cattle and aurochs still to be found.)

At Salgótarján–Pécskő, which has been interpreted as a refuge (Fig. 1/16), a markedly different fauna has been found, owing to the special way of living and the geographical situation. Here, in contrast to the usual Pécel settlements, there were a great many wild animals, practically Neolithic in their number. Among them, however, red deer greatly predominated over aurochs (similar proportions to those of the Bronze Age settlements). In addition numerous forest species were hunted. Horses, too, occurred in the domestic fauna. (On the other hand, the settlement comprised two culture layers with the upper layer dating to early Bronze Age. The single horse bone found in the Pécel layer may have seeped down from the upper layer.) The predominance of cattle among the domestic animals was similar to the Neolithic situation, but they were followed by ovicaprids — which was a reminder of the south-eastern origin of the culture —; pigs and dogs occurred with much less frequency.

THE BRONZE AGE

The animal keeping of the Pécel culture was another classic example of the animal keeping of a population originating in South-Eastern Europe, which could not and did not strike roots in the Carpathian Basin. Its effect, however, was long-lasting and played a great part in the formation of animal keeping in the Bronze Age. Of course, several other factors also contributed to the formation of the fauna of Bronze Age settlements. No doubt, animal keeping and hunting of the Bronze Age was developed on the Basis of that of the late Copper Age. In addition, however, at the beginning of the Bronze Age it was influenced by stimuli from three different directions. Firstly, the ethnic elements of South Russia (the Ochre Grave people) arrived at the beginning of the Bronze Age bringing with them — according to some theories[47] — the horse to the Carpathian Basin. The introduction of the horse meant a veritable revolution not only in animal keeping but also in commerce and warfare. Another ethnic element, the people with the Bell Beaker culture, may also have introduced large numbers of horses; at least this is indicated by the fauna of settlement of this culture excavated at Csepel–Háros (Fig. 1/18), where the horse was the most frequent

[47] Mozsolics, A., 1960, p. 133. — In contrast, in Hančar's opinion (1955—56, p. 122) the domestication of horses or an early, intensive horse-keeping cannot be proved in this culture. Mozsolics made her statement on the basis of Romanian data, but as there are some differences of opinion among Central European and Soviet archeologists in defining this culture, it is questionable whether Mozsolics and Hančar have the same culture in mind or not

species.[48] The third ethnic element, the people of the Vučedol-Zók culture, came to Hungary from the northern part of the Balkan Peninsula bringing with them numerous cultural innovations.

Of course, the above were only movements dating to the earliest phase of the Bronze Age. Such effects were continually increasing for more and more peoples and cultural innovations reached the Carpathian Basin throughout the Bronze Age. All the peoples that came brought with them the whole of their livestock, or, if not, they introduced the whole system and technology of their economy (animal keeping and hunting). Together they all exerted an influence on the formation of animal keeping and hunting in Hungary in the Bronze Age. These effects were but enhanced by a modification of the climate which took place during the Bronze Age as indicated by the fauna. The dry warm weather of the late Neolithic and of the Copper Age had become gradually humid and cool.[49]

It is obvious from the above that in consequence of the effect of so many factors, no uniform system of animal keeping was characteristic of the whole Bronze Age, of its periods or cultures. As already mentioned in our introduction we have not been able to determine a picture of animal keeping characteristic of the different periods or cultures of the Bronze Age, because the settlements were very rarely occupied, dwelt-in by one culture only in this period. In settlements with assemblages of different cultures the separation of their bone samples is practically impossible.

There can be no doubt, however, that animal keeping in the Bronze Age continued the same developmental trends seen at the end of the Copper Age, that is to say in that importance increased as hunting declined (Fig. 1/17–25); domestication processes had become insignificant. Cattle declined in importance although it remained the dominant species and ovicaprids and pigs occurred with increasing frequency. Ovicaprids increased in importance at the expense not only of cattle but also of pigs, but by the end of the period they had again declined. Evidently, this may be attributed to the change of climate mentioned above; pigs like humidity much more than sheep and particularly more than goats. In addition, the horse, which was represented in the Copper Age only by sporadic bones, appeared from the beginning of the Bronze Age in large numbers. This is the feature which most sharply contrasts the Bronze Age animal keeping with that of preceding periods.

Among the cultures of the Bronze Age, the fauna of the Bell Beaker culture seems to be the most distinguished by the high numerical proportion of horses. The fauna of the three settlements of the Hatvan culture (Tápiószele–Tűzköves; Fig. 1/19), Tiszaluc–Dankadomb[50] (Fig. 2/20) and Nyergesújfalu–Téglagyár (brickyard) are very similar: with sequence in frequency of cattle, caprovines, pigs, horses and dogs and with the dominance of the red deer in the wild fauna. It is interesting on the other hand that there

[48] In other settlements of the same culture horses appear to have been quite frequent (Lundholm, B., 1947, p. 168)

[49] Bökönyi, S., 1952a, pp. 108–109

[50] Bökönyi, S., 1960b, pp. 19 ff.

are only few horses in this culture which is considered to have been of eastern origin.

In contrast to animal keeping, hunting was much more homogeneous and characteristic all through the Bronze Age. In the wild fauna aurochs were always less numerous than red deer and more frequently less than other species of wild animals. This indicates not only that the aurochs was becoming rarer and rarer but also the decline of the domestication process; indeed the recession of domesticated cattle may have been to some extent also due to this. All in all, it can be stated that in the Bronze Age, animal keeping finally could support itself not only by increasing the stock of domestic animals without further domestication and providing the population with meat but also supplying other foodstuffs (milk), giving draught-power and material for clothing.

THE IRON AGE

As with many other activities animal husbandry underwent substantial changes in the Iron Age. Unfortunately, we have but scanty settlement material from this period, nevertheless it can be ascertained that at the beginning of the early Iron Age the relationship between animal keeping and hunting and the quantitative composition of the domestic fauna were still similar to those of the Bronze Age.

The fauna of the Hallstatt A–B settlement on Helemba-Sziget (Island) (Fig. 1/27) is the best example of this. On the other hand, at Felsőtárkány–Várhegy (Castle hill) (Fig. 1/26) there was a refuge of the same kind as the one at Salgótarján-Pécskő in the Late Copper Age, in which the place or opportunity for animal keeping was lacking. It goes without saying that the bone samples of this settlement do not present a characteristic picture of the fauna of the period. This becomes most evident if we compare it with the faunal remains — by and large contemporaneous — from Óhuta–Nagysánc. This latter, an earthwork of the Hallstatt period, had similar natural surroundings; however, as it was a permanent settlement with suitable accommodation for domestic animals, the bone samples — unfortunately few — show an overwhelming majority of domestic animals with wild animals being represented by a single bone each of a wild cat and of a fish. From the point of view of animal keeping and hunting Felsőtárkány–Várhegy (Castle hill) might safely be considered a Neolithic settlement — indeed, the way of life of its population could not differ much from that of the Neolithic. The occurrence of the domestic horse, however, and the rareness in the wild fauna of the aurochs immediately offer a distinctive mark.

The great changes in animal keeping mentioned above made themselves felt first with the Scythians and then with the Celts. It was in this period that the basis of present-day animal keeping came to be formed.[51]

[51] The hen is considered to be the "leading fossil" of today's Central European domestic fauna as the species that, since its first appearance in the domestic fauna of the territory, has without interruption become more and more frequent and important economically

With the Scythians this can be inferred only with uncertainty. Unfortunately the bone samples from Jászfelsőszentgyörgy, a partially excavated settlement of the Scythian period, are too small to provide the basis of any far-reaching conclusions. Even so they reveal the animal keeping activities of a fairly mobile population, with large numbers of cattle, horses, caprovines and a few pigs. The fauna of the Celtic period in Hungary is not known from any large settlement. Nevertheless, the bone samples of smaller settlements and, in particular from cemeteries, show clearly that in this period animal keeping was of a type quite different from earlier prehistoric periods. In the domestic fauna pigs had an important role as well as cattle. Moreover, as is testified by the cemeteries, the hen must have been a frequent domestic animal. Unfortunately, hens' bones from Budapest–Gellérthegy, a Celtic settlement with a relatively large bone sample, got lost; however, L. Nagy, who conducted the excavations, often mentioned them in his excavation reports.[52] According to our present data only bones of pigs and hens were found in the Celtic cemeteries of Hungary, which throws light not only upon the burial rites, but also upon the domestic fauna, at least inasmuch as both species had to be kept in sufficient numbers for providing the graves with offerings. It is to be regretted that we know even less about hunting. This is due on the one hand to the scanty settlement materials and, on the other, to the fact that no bones of wild animals have been found in the graves of cemeteries.

THE ROMAN IMPERIAL PERIOD

As we have seen, the last period of prehistoric times, the Iron Age and particularly its second half, had a mode of animal keeping quite different from that of previous periods. In the Roman Imperial Period, which followed it (1st—4th century A.D.) the development was even more striking. From the point of view of faunal evolution — and particularly of the evolution of the domestic fauna — the territory of Hungary is to be divided into two parts: Transdanubia, which under the name of Pannonia was a Roman province, and the Barbaricum, i.e. the rest of the country, which was not under Roman rule but belonged to the "Barbarians". The faunas of both territories evolved from the animal keeping and hunting of the autochthonous inhabitants, though under the influence of absolutely different factors.

The fauna of Pannonia, the region under Roman sway comprised a form of the animal keeping and hunting of the autochthonous Illyrian-Celtic population modified by Roman civilization and economic order. As the Roman influence was not identical in every area the emerging picture of the fauna — the ratio of animal keeping and hunting — was not uniform either. The aboriginal population of settlements farther from direct Roman influence lived, in all probability, the same life as prior to the Roman conquest. At the Celtic settlement of Gellérthegy, for example, which for a time

[52] Nagy, L., 1942, p. 241

also came under Roman rule, practically no trace of the effect of Roman animal keeping could be discovered.[53]

In lonely Roman watch-towers and remote smaller garrisons the situation was very similar. There the fauna was almost of the same character as that of the Bronze Age (e.g. Pilismarót–Watchtower No. I; Fig. 1/31), with a great number of wild animals, of which the red deer and the wild swine were the most frequent. The domestic fauna, too, was of a prehistoric type, with a minimal dominance of cattle, a fairly high occurrence of pigs and caprovines and quite a few horses. (Cavalry units often did service in these watchtowers and garrisons.) The domestic hen was often missing and, from the evidence of its composition, the fauna could well be thought to belong to the Bronze Age if Roman breeds did not occur among the domestic animals, especially among the cattle and dogs. However, we think that the husbandry pursued by the personnel of these remote outposts along the boundaries did not differ much from that of the Bronze Age.

An essentially different situation from that described above was found in the Roman castrums (Budapest–Albertfalva (Fig. 1/29)), in independent settlements (Balatonaliga (Fig. 1/30)) and in Roman villa-farms (Tác–Fövenypuszta (Fig. 1/28)). The genuine Roman fauna type was especially characteristic of these latter. An overwhelming majority of domestic animals as against wild ones was characteristic of this type (in the castrums there were somewhat more wild animals, which was the consequence of the freer way of life of the soldiers living there); at Balatonaliga and Tác the numerical proportion of wild animals was under four per cent even at the total numbers of individuals; at the total numbers of bones it comprised only 0.95 and 1.22 per cent respectively, but even this consisted in a fairly big part of wild fowl and fish. Mammals continued to predominate in the domestic fauna (with cattle first followed, alternately, by caprovines and pigs; then the horse and finally the dog), but among them there occurred species introduced by the Romans: the ass, the domestic cat, perhaps the camel and some improved breeds (Roman cattle and lapdogs) occurred; the number of domestic fowl sometimes exceeded that of horses and dogs.

Thus Roman animal keeping played an even greater role in the economy than in the preceding period and was characterized by the importation of species and breeds of domestic animals in large numbers (this had taken place to a lesser degree with the Celts too[54]), as well as the keeping of domestic animals for pets that served no practical purpose. In the wild fauna in general the four species which had predominated in prehistoric times — the aurochs, the red deer, the roe deer and the wild swine — were the most frequent, completed by increasing numbers of brown hare, other mammals and numerous species of birds and fish.

In the territories outside the boundaries of the Roman rule, in the Barbaricum, the picture of the fauna was transformed especially by the animal keeping and hunting of the peoples who had settled in this region after the autochthonous inhabitants. It would seem that Roman influence too may

[53] Bónis, É., 1969, p. 210
[54] Bökönyi, S., 1964d, p. 239

have had an effect on the animal keeping here as it did in all other fields of life, but this would be difficult to prove from our present evidence. These peoples were the Dacians, the Sarmatians and the Teutons. With respect to their animal keeping we have an idea only about that of the Sarmatians on the basis of the bone samples of one large settlement (Szilvásvárad (Fig. 1/32)) and several smaller ones. At the Sarmatian settlement of Szilvásvárad, domestic animals predominated in an overwhelming majority (97.63 per cent per specimen and 94.51 per cent per individual); thus the fauna resembled, in this respect, that of Roman settlements, with the difference that the numerical proportion of domestic hens was only minimal. Moreover, imported species and Roman breeds of domestic animals were completely missing. As far as the quantitative composition of the domestic fauna is concerned, cattle, with a high numerical proportion, was the dominant species, followed by pigs, which were also of a fairly high frequency, and then caprovines, horses and dogs, which were much rarer. The wild fauna included four species with a predominance of red deer. The Sarmatian settlements in the Great Plain may have had a similar fauna, but it should be taken into consideration that Szilvásvárad lies among mountains. It is possible therefore that more horses and caprovines would be found in the settlements of the Great Plain.

THE MIGRATION PERIOD

The end of the Roman rule and the withdrawal of the Romans from Pannonia meant a grave decline in animal keeping there. In the couple of isolated Roman towns that survived the tempests of the Migration Period, Roman animal keeping continued and some Roman breeds of domestic animals occurred. If this is compared to the whole territory, however, it was so insignificant a quantity that it could not produce any profound effect. Probably here too the same manner of animal keeping came into being as could be found in the Barbaricum during the Roman period, for the same peoples — or similar ones — invaded Pannonia as had lived in the Barbaricum during the Roman rule. Unfortunately, these peoples very often intermixed and stayed in the same place only for short periods; thus no noteworthy settlement material of theirs has been found so far. So, in this respect, we have to rely solely upon animal bones found in cemeteries, although their value in reconstructing animal keeping and hunting is questionable. From some peoples, e.g. the Huns (first half of the 5th century A.D.) we do not possess even cemetery evidence and from the Germanic cemeteries we have only a very limited quantity of material. To evaluate this evidence would be absolutely illusory. The situation is somewhat better concerning the Avar period (567—800 A.D.). Although no settlements from this period have yet been discovered, the graves, of which a great many have been excavated, have yielded such considerable quantities of bones that they provide clues from which we may infer, to a certain extent, the animal keeping of the Avars and the peoples that lived in this region with them.

Hunting may have played some role in the life of the Avars, for they used the antler of the red deer for making numerous kinds of implements, tools and objects of everyday use. Moreover, it was an important material for making bows, which played a decisive part in the Avar's technique of warfare. Thus, if for no other reason, they had to hunt to ensure this quantity of antlers. For a similar purpose, but to a much lesser extent, they hunted the roe deer too; the skull of a wild cat found in grave No. 60 of the cemetery of the Avar period at Bóly[55] proves (among others) that furred animals also occurred in the hunting spoils of the Avars. However, with the Avars, as is still the custom with the nomadic peoples of Central Asia, hunting was often not so much pursued with a view to providing food but rather a festive occasion and activity.[56]

Compared with hunting, animal keeping must have been overwhelmingly predominant. Bones of cattle, sheep, goats, pigs, horses, dogs, hens and geese have been found in Avar graves; it is assumed accordingly that all these species were kept in the Avar period. In what proportion they occurred is another question. Being an equestrian, nomadic people the Avars, no doubt, must have had a highly developed technique of horse keeping; besides — and here we have to refer to the fauna found in the Hungarian settlements of the period of the kings of the Árpád Dynasty (11th—13th century) — they must have kept animals predominantly belonging to those species that were suitable for a nomadic way of life. For this reason, beside the horse, cattle, sheep and goats would have been their most frequent domestic animals. Doubtlessly, having reached the Carpathian Basin the Avars gave up their former nomadic way of life up to a point; but the mediaeval Hungarians' example will show for how long the composition of the animal population characteristic of a nomadic way of life survives. The keeping of pigs and domestic fowl, no doubt is a proof of the more limited extent of the nomadic way of life. In all likelihood the Avars started keeping them in larger numbers only in the Carpathian Basin where they may have adopted the domestic hen.

It is not impossible that the keeping of pigs and hens during the Avar period was connected with the Slavs under Avar domination. The role the Slavs played in the diffusion of pig keeping is well-known. The keeping of domestic fowl is a branch of animal keeping as stationary as pig keeping and as such was very well suited to the Slavs' settled way of life. We have already pointed out that the animal bones of different species found in the Avar graves may mean different ethnic groups and that it would be useful to compare, from this point of view, archaeological, physical anthropological and zoological data.[57]

As already mentioned, the domestic and wild fauna in Hungary at the time of the Magyar conquest (9th—10th century) is very similar to that of the Avars. Here too we only have bone samples from graves, comprising,

[55] Bökönyi, S., 1964a, p. 93
[56] László, Gy., 1955, p. 153 (to demonstrate Avar hunting Gy. László has included a great many representations of hunting in his book)
[57] Bökönyi, S., 1964a, p. 95

especially, horses, then caprovines and pigs. But artistic representations and written sources testify to cattle keeping too. On the other hand, in reconstructing the keeping of domestic animals, we also have evidence from settlements — providing an abundance of animal bone samples — of the Period of the Árpád Dynasty, which date to immediately after the time of the Conquest (end of the 9th century). Of course, the animal keeping of the conquering Magyars would not have been completely identical with that of the Hungarian villages of the Period of the Árpád Dynasty (10th—13th century), for the latter represent a population which had been compelled by Géza and St. Stephen to become sedentary. In any case, domestic animals which could be easily driven would have been frequent, whereas there would have been a smaller number of pigs; the domestic cat and domestic fowls being completely absent.

THE MIDDLE AGES

In the villages of the Árpád Period, hunting was completely pushed into the background compared to animal keeping. Indeed, there are settlements where bones of wild mammals have not been discovered at all, only the bones of wild birds and fish (Szarvas–Rózsás (Fig. 1/33)). This was simply due to the fact that serfs were forbidden to hunt by law. The prohibition evidently may not have been enforced immediately after the Conquest but when the population had settled down and begun to increase. The earliest law we know of pertaining to this is Act 18 of the 1504 parliament, according to which "none of the serfs or peasants of the country should dare to hunt by any craft or in any manner the red deer, the roe deer, the hare and the wild swine nor shall they fowl or catch the pheasant and the hazel grouse. But every one of them shall till the soil, arable land, meadow or vineyard, of which he can gain profit both for himself and his squire. In default of the law the three Gulden penalty is to be exacted by the squire of the serf hunting or fowling, or by him on whose land he was caught."[58] However, it can be inferred that such regulations had existed long before the 1504 law from the fact that King Stephen V permitted, as a special favour in 1262 the inhabitants of Szőlős in Ugocsa County, and in 1272 the Saxon hospites settled in Ugocsa County to fish in the Tisza up to Máramaros and to hunt chamois, wild swine, red deer and bear.[59] In this period there was a similar situation in towns too, as is indicated by the fauna of a cellar-well unearthed on Dísz tér in Buda, in which apart from the bones of domestic animals, only one bone of a wild mammal and three of fish have been found.[60] On the other hand, there were many more bones of wild animals in castles and the royal, aristocratic and episcopal residences,[61] although the numerical proportion of wild animals points to an insignificant consumption of venison; hunting was rather a noble sport or pastime.

[58] Acsády, I., 1944, p. 183
[59] Komáromy, A., 1897, pp. 24, 26
[60] Bökönyi, S., 1966, p. 71
[61] Bökönyi, S., 1963a, p. 396

At the time of the Árpád Dynasty the high frequency of cattle, horses and caprovines (Fig. 1/33—36) and the rarity of pigs were the characteristic features of animal keeping in Hungarian villages of the Great Plain. (Deeds of the period also document the great frequency of cattle and caprovines.) This can partly be attributed to the fact that these species are the genuine domestic animals of vast plains; we think, however, that other factors were more important particularly those we have mentioned above in connexion with the animal keeping of the Avars: as a former nomadic people the Hungarians steadfastly adhered to the species of their nomadic animal keeping even after they had become sedentary. From this point of view these villages are basically different from the coeval settlements of the Germanic or Slavic peoples of Europe, where cattle and pigs alternate as the most frequent domestic animals with caprovines and particularly of much less importance. These differences are simply due to the fact that these latter peoples had been sedentary for a long time, whereas the Magyars had only just started to become so.

There were other reasons for the frequency of horse bones in Hungarian settlements in the Period of the Árpád Dynasty: horses were not only used as saddle or draught animals, but were also eaten as is proved by the great number of broken bones of horses, and smashed skulls to be found in the settlements.[62] This is a very interesting problem since, for the conquering Magyars, the horse — as is customary with most equestrian peoples — was a highly valued animal, and was often used for sacrificial purposes. After the conversion to Christianity, the eating of its meat represented a survival of old pagan rites. The long survival of such customs is also supported by the discovery in villages of the Árpád Period of several skulls of horses stuck on poles to keep away the evil spirits.[63] Horse meat was eaten by several peoples of Europe before they embraced Christianity, but after their conversion, traces of this custom almost completely disappeared. Evidently the Church did not approve of the adherence to this old pagan custom in Hungary. This is indicated by a record in an ancient chronicle according to which the reversion to pagan customs — for example the eating of horse meat — in Watha's 1044 rebellion is condemned.

But comparing the vestiges of the pagans it is interesting to note the custom of eating horsemeat with the pursuit of hunting we can state that in places which were remote from the central power the provincial nobility connived at (and perhaps even practised) the pagan customs, but at the same time enforced with might and main the prohibition of hunting, which protected their goods.

Villages of the Árpád Period in other regions of Hungary did not show exactly the same picture of animal keeping due mainly to geographical reasons. Everywhere, however, cattle predominated and horses were frequent (Fig. 1/33—34). In towns, naturally, animal keeping had a more sedentary character than in rural areas. In towns, though cattle dominated the scene, a great number of pigs could be found, whereas the numerical ratio of

[62] Bökönyi, S., 1958a, p. 458; Méri, I., 1964a, p. 43
[63] Méri, I., 1964b, pp. 11 ff.

caprovines and horses was much lower; in addition quite a number of domestic fowl, which were rare or completely missing in the villages, existed in the towns and the domestic cat was also more frequent.[64]

We have discussed the animal keeping during the Period of the Árpád Dynasty and along with it that of the Magyar Conquest separately from the later periods of the Hungarian Middle Ages because the former was a continuation of the nomadic way of animal keeping disturbed by very few alien influences though somewhat modified by the population becoming more sedentary. Alien influences may be seen at most in the introduction of the keeping of domestic fowl, the intensification of pig keeping and the introduction of certain new species or breeds (the domestic cat and the occidental, "cold blood" horse).

After the Period of the Árpád Dynasty, however, from the 14th century onwards, when the population had become completely sedentary, agriculture played a more and more significant role, so that the importance of keeping horses in stables or in a semi-contained manner markedly increased,[65] and the domestic faunal composition which was reminiscent of the former nomadic way of life survived only in certain areas of the Great Plain (Túrkeve-Móricz). Moreover, from this period onwards, Hungary became increasingly involved in the economic cycle of Europe. The economic links which Hungary's kings of the Anjou Dynasty had established proved to be strong enough to withstand the tempests of the turbulent times following their rule; furthermore, these connexions which were reinforced during King Mathias Corvinus' reign could survive even the period of the Turkish occupation.[66] In addition, Hungary's connexions with Austria and through her with West Europe also grew stronger. All these factors had a great effect on animal keeping too.

Thus a dual process was taking place, resulting on the one hand from the internal evolution of Hungarian animal keeping and on the other hand from external influences. (These influences, of course, were mutual: Hungarian animal keeping influenced the neighbouring territories, owing to the large-scale export of livestock and to the spread of certain better Hungarian breeds which were developed during the 14th—15th century.) Another factor contributing to this end was, in all probability conscious animal breeding, which was launched in Hungary in the 14th—15th century and which differed from animal keeping, first and foremost, in the introduction of breeding selection. The beginnings of animal breeding used to be considered as practically contemporaneous with domestication, but recently it has become increasingly evident that the former is a much later development. Another theory suggested that animal breeding began with the Romans, the idea being based on the data of Roman authors (Varro, Vergilius, Columelle, etc.) and supported by osteology.[67] However, having demonstrated in the Celtic oppidum of Manching the differences of breeds of dogs Boess-

[64] Bökönyi, S., 1963c, p. 357
[65] Belényesy, M., 1956, p. 29; 1961, p. 24
[66] Huszti, D., 1941, p. 87
[67] Boessneck, J., 1958a, p. 117; 1958b, p. 291; Herre, W., 1958, p. 34

neck recently dated the beginnings of breeding selection to an earlier period,[68] and we have dated even earlier in connexion with the Iron Age horses in Central and Eastern Europe.[69] It seems very probable that purposeful breeding selection and along with it, well-definable breeds of domestic animals emerged at different times concerning different species of animals. The conscious breeding of different species began when the individuals of the species in question, or at least certain individuals, were given individual treatment, i.e. when it was no longer the herd that was considered the smallest unit. There is no doubt that this began with the horse, for — particularly with nomadic peoples — the horse was man's fellow warrior on whom often the life of the warrior would depend. In the case of the dog quite different reasons played a part; here breeding was done merely for pleasure with no material interest as an end. That is why the first traces of conscious dog breeding were found in the Celtic oppidums and Roman villas. After the dog there developed the breeding of cattle as an important source of meat and milk and a powerful draught animal, and then, probably, the sheep on account of its wool. It is very likely that conscious breeding of the goat and pig was the last to be developed, the former on account of its slight economic significance and the latter because of its lower value, high prolification and the primitive conditions of its keeping, which have survived practically up to the present time. However, after the end of the Roman period the Migration of Peoples swept away not only the Roman breeds of animals, but also the knowledge of animal breeding. Indeed, this knowledge was only regained in the middle of Mediaeval times. (We think, however, that in the case of the horse and dog, its traces survived all along.) Anyhow, the new breeds and the general increase in the size of domestic animals that appeared from the 14th—15th century onwards can be attributed to the methods of animal breeding.

But reverting to the domestic fauna of Medieval Hungary, it can be stated that after the Period of the Árpád Dynasty the numerical proportion of all domestic mammals, but particularly the horse, caprovines and cattle, decreased (in that period horses and sheep were chiefly kept on the estates of the nobility, whereas the serfs kept predominantly cattle and pigs;[70] the eating of horse meat was on the wane even in the villages of the Great Plain). On the other hand, the numerical proportion of domestic birds was growing. The decrease in the numerical ratio of mammals was somewhat less in the villages of the Great Plain and in bigger towns, particularly from the 15th century on. At that time the numerical proportion of domestic mammals had fallen to such an extent that in towns it was sometimes lower than that of domestic birds, which had become very numerous there.[71] To supply choice morsels the peacock and guinea fowl (?) and perhaps even the turkey appeared in the material of the royal palaces of Buda and

[68] Boessneck, J., 1961b, pp. 378 ff.

[69] Bökönyi, S., 1964d, pp. 234 ff. We must point out that Herre (1958, p. 35) does not exclude the possibility of breeds of Central European domestic horses having come into being at about 300 B.C.

[70] Belényesi, M., 1956, p. 34

[71] Bökönyi, S., 1963a, p. 396

Visegrád. In this period the proportional significance of hunting and animal keeping did not undergo any essential change, i.e. wild animals continued to be rare in villages and bourgeois towns, whereas in royal and aristrocratic residences they occurred in much higher numbers. Among them the brown hare was very frequent, as well as the red deer, but a great many species of wild birds, signifying the Italian influence on the alimentation of the court, were also to be found.

By the end of the Middle Ages, however, the various regions showed very different faunal conditions. This was the period of the Turkish occupation, when economic order completely disintegrated in the regions occupied by the Turks and in the zone of the border fortresses. Naturally, neither the Turks nor the military in the Hungarian border fortresses observed the former prohibition of hunting, nor did the population of the villages in the occupied territories. Thus the numerical proportion of hunted animals increased as against that of previous periods. On the other hand, with respect to the composition of the domestic fauna we must differentiate between the bone samples of territories not under Turkish rule, the Turkish castles and settlements, the Hungarian villages and towns under Turkish occupation as well as the border fortresses, which were sometimes controlled by the Hungarians and sometimes the Turks.

In the territories unoccupied by the Turks the evolution begun in previous periods of the Middle Ages continued: the decrease of the numerical proportion of domestic mammals went on and domestic birds, especially the hen, predominated. This situation, however, prevailed only in towns and on serfs' farms; on large estates the predominance of mammals continued. In some areas the number of livestock was high, when compared with the extent of plough-land. Thus, e.g. about the year 1640 on the estates of György Rákóczi I in Hungary and in Transylvania there were 1270 horses, 756 oxen, 5037 other cattle, 10,593 pigs and 24,756 sheep[72] on plough-land of approximately thirty thousand cadastral acres.[73] The serfs and the bourgeoisie of market towns owned even more animals.[74] Thus, about the year 1640 the 19,711 serf households of György Rákóczi I possessed around 47,000 oxen and horses, 40,000 cows, 80,000 pigs and 12,000 sheep,[75] which, in terms of standard animals was over ten times as much as the livestock of their squire.[76] Of course, animal keeping was not universally of the same high level. Thus, e.g. in the last decade of the 16th century in the nine villages of the estate of Sárvár there were altogether only 150 oxen, 170 cows, 191 calves, and 175 pigs; forty years later, only 95 oxen, 128 cows, 208 calves and 250 pigs were registered.[77] In these areas conscious animal breeding also flourished as is proved by numerous extant instructions.

[72] Makkai, L., 1954, p. 414

[73] Éber, E., 1961, p. 49

[74] Animal keeping pursued on a large scale by citizens of market towns in the great Hungarian Plain was mentioned already by Miklós Oláh (1536) (Szamota, I., 1891, pp. 536, 545) but particularly detailed information on it was offered by Takáts, S.

[75] Makkai, L., 1954, p. 408

[76] Éber, E., 1961, p. 49

[77] Tholt, J., 1934, p. 59

In Turkish castles and towns it was mainly the laws of Islam that determined the composition of the fauna: the bones of sheep and goats were most frequent, whereas bones of pigs occurred only sporadically, due to the religious prohibitions. Cattle fell far below its former numerical proportion but poultry was also rare. Thus at the Pasha's palace in Buda Castle the percentage of caprovines was 85.27 per cent of the total number of bones and 61.70 of the total number of individuals, whereas the same figures for cattle were 10.34 and 17.02, for pigs 0.34 and 2.13 and for hens 1.85 and 5.67 (Fig. 1/44). This type of animal keeping was also characteristic of a people arriving from South East Europe too. Thus after the two types of prehistoric faunas (that of the Körös and the Pécel cultures) there was now a third south-eastern type that had reached the territory of Hungary. But unlike the previous ones, there was an essential difference in that the Turks brought with them very little of their animal population — mostly military horses and beasts of burden — and acquired the animals for their alimentation locally.[78]

Animal keeping in the territories under Turkish rule showed a sorry picture indeed. Due to the ravages of the Turks and to the precariousness of life the villages became depopulated, the surviving inhabitants took shelter in towns and animal keeping dropped. Whereas the population of towns such as Nagykőrös and Kecskemét multiplied during the time of the Turkish occupation, the livestock fell to half of its former number.[79] Cattle, which could be more easily saved from looters and could be driven on foot to fairs abroad, was the main animal bred, whereas the breeding of other domestic species was pushed into the background. Proof of this may be found not only in the bone samples from settlements but also in a number of written documents.[80] The great masses of cattle earmarked for export seem to have been kept in areas that were considered as direct estates of the Sultan, for these were subject to less harassment. The majority of brokers running the trade of cattle originated from Debrecen, a city in such an area.[81]

In the border fortresses (Nagykanizsa, Visegrád, Kőszeg), which were alternately controlled by the Turks and by the Hungarians, the remains of the two types of animal keeping were intermixed. There cattle was the most frequent among the domestic animals, mostly followed by caprovines, then pigs; horses, dogs and poultry were rather rare. Skulls of Arab horses, introduced by the Turks,[82] could be found there but so could the remains of occidental "cold blooded" horses.

[78] No live animals at all were mentioned among the goods on which customs duty was levied at the Buda ferry at the time of the Turkish occupation (Fekete, L., Káldy Nagy, Gy., 1962, p. 77)

[79] Fekete, L., 1944, p. 247

[80] Takáts, S., n.d., p. 118; Hankó, B., 1935, p. 8

[81] Takáts, S., n.d., p. 8

[82] Bökönyi, S., 1958a, pp. 464—465

SUMMARY

In the above description we have tried to sketch out in a summary way the evolution of the domestic and wild fauna of Hungary, or rather not of the whole fauna, since — as mentioned in the introduction to this chapter — the bone samples found at settlements do not represent the whole fauna or its exact proportions, but only the part that, through animal keeping or hunting, has found its way among the bone samples of the settlements. We have discussed animal keeping in the greatest detail because, since the Neolithic, it played a gradually increasing role in the economy; hunting has been dealt with only as a supplementary source in the acquisition of food or where it was involved in domestication. Intentionally we have not dealt with all the questions of the evolution of animal keeping, but have chosen those which are necessary in the construction of a framework of development. For — as mentioned in the introduction to the chapter — our ultimate aim is to construct such a line framework which may be elaborated for the purpose of dating.

In summary we can distinguish the faunas of the different periods and cultures respectively as follows.

Neolithic. The Körös culture is characterized by a predominance of caprovines and by a high numerical ratio of wild animals. (In the Baden culture too caprovines are considered the most frequent of domestic animals, but the numerical proportion of wild animals is very low compared to the 50 per cent frequency of wild animals in the Körös culture.) A similar or even higher numerical ratio of wild animals can be found, on the other hand, in the Tisza and Herpály cultures. In these cultures, however, the aurochs was always the most frequent wild animal and among domesticated cattle were by far the most numerous, caprovines taking the third place after pigs. The Herpály culture is distinguished from the Tisza culture by the high number of wild animal bones greatly exceeding that of domestic ones with a marked predominance of the aurochs and an intensified domestication of cattle. In the Zseliz group of Linear Pottery cattle was by far the most frequent domestic animal; however, unlike other Neolithic cultures in Hungary, it was not followed by pigs but by caprovines, with a relatively low number of wild animals: 10—20 per cent. On the other hand the fact that the aurochs predominated among wild animals connected it with the other Neolithic cultures and separated it, at the same time, from the cultures of the Copper Age. The absence of horses is characteristic of the whole Neolithic.

Copper Age. The fauna of the early Copper Age in Transdanubia (Lengyel culture) was definitely of a Neolithic character, resembling that of the Tisza culture (the frequency order of its domestic animals being: cattle, pigs and then caprovines, with horses absent). Its hunting activities too, were developed to the same degree as in the Tisza culture but differed from it in so far as in its wild fauna the red deer was of the same frequency as the aurochs.

In the fauna of the Bodrogkeresztúr culture of the Mid-Copper Age, the proportion between domestic and wild animals was almost Neolithic, and the horse was still absent. Among the domestic animals cattle predominated, but caprovines had reached or surpassed the frequency of pigs, which distinguishes the fauna of this culture from those of Neolithic cultures. The fauna of the Pécel (Baden) culture of the Late Copper Age showed few wild animals and a dominance of caprovines among domestic animals. The order of the other species was: cattle, pigs, dogs; and the domestic horse seems to have occurred sporadically.

Bronze Age. The occurrence of horse bones in large numbers and the predominance of red deer rather than aurochs clearly distinguishes all the settlements of the Bronze Age from those of preceding periods. For want of adequate material we are unable at present to separate the Bronze Age settlements from those of the Hallstatt period. On the other hand they can be clearly distinguished from those of the Late Iron Age by the absence of the hen (which is characteristic of the Late Iron Age). In addition cattle maintained their predominance in the domestic fauna of the Bronze Age (the only exception being the settlement of the Bell Beaker culture at Csepel–Háros, where the horse predominated the numerical proportion of caprovines and that of pigs varied greatly depending on the geographical surroundings but was fairly similar to that of cattle). At the beginning of the period caprovines seem to have followed cattle in the order of frequency, while towards its end the second place was taken by pigs.

Iron Age. As mentioned in the summary the fauna of early Iron Age settlements was very similar to that of the Bronze Age. So far it has not been possible to distinguish any independent characteristics. No Late Iron Age settlement has yet been found in Hungary but in this period the domestic hen appeared.

Roman Imperial Period. In Pannonia, a territory under Roman rule, the fauna of the military camps, the independent Roman settlements and the villa farms was characterized by a minimal occurrence of wild animals, by the frequency of domestic fowl exceeding that of dogs and often even that of horses, and, moreover, by the occurrence of species introduced by the Romans (asses, cats and perhaps camels) and of improved breeds (Roman cattle, greyhounds, lapdogs). Cattle predominated among the domestic animals, followed alternately by caprovines and pigs and then by horses and dogs these latter being much less frequent. Thus the fauna of these settlements can be clearly distinguished from those of earlier or later periods, (e.g. cattle of the size of the Roman breed appeared again only from the 14th–15th century A.D. onwards although their horn forms differed from those of the Roman cattle) and from the fauna of contemporary settlements in regions, which were not ruled by the Romans. Although in these latter also hunting played an insignificant role, hens were very seldom found, and Roman breeds of animals only occurred occasionally or not at all. Apart from these territories, in the watchtowers along the limes of Pannonia and in the smaller garrisons, hunting was much more important; fowl were rare or completely missing from the domestic fauna. The Roman breeds of domestic animals however, distinguish even these faunas from those of previous periods, especially that of the Bronze Age, of which they are otherwise highly reminiscent due to their high numerical ratio of wild animals.

Middle Ages. As early as in the first period of Mediaeval Hungary, the Period of the Kings of the Árpád Dynasty (10th—13th century), we have to differentiate between the fauna of villages, towns and castles (royal and aristocratic residences). The faunas of towns and villages are both characterized by an almost complete lack of wild animals and by the predominance of cattle among domestic animals. Whereas, however, there were many horses, generally more caprovines than pigs and only few poultry in the villages, in the towns there were relatively few horses, the numerical proportion of pigs reached or exceeded that of caprovines and the numerical ratio of domestic fowl was also high. In the castles the numerical ratio of wild animals was somewhat higher, whereas the domestic fauna was like that of towns. On the basis of the high numerical proportion of cattle, horses and caprovines and the scarcity of domestic birds, the fauna of the villages can be clearly distinguished from that of later periods. That of the towns and castles ,however, can be distinguished from later faunas only by the fact that in the period in question only small sized cattle existed there. The occurrence of the type of Mediaeval Hungarian sheep and the lack of special, primigenius type of cattle are the most characteristic criteria of this fauna.

With respect to the 14th—15th century settlements the distinction between the faunas of villages, towns and castles still prevailed with the same differences in the proportion of domestic and wild animals as described above. Cattle still generally predominated among the domestic fauna although in some places domestic fowl were more numerous. There was a decline in the number of other domestic mammals, especially the horse. In the fauna of the residences of the nobles a number of luxury animals appeared. The faunas of the 14th—15th century can be distinguished from those of the Árpád Period by the appearance of large, primigenius cattle and from earlier faunas by the occurrence of the Mediaeval Hungarian type of sheep.

During the period of the Turkish occupation the numerical proportion of wild animals showed certain increase compared with previous periods. In the domestic fauna of the Turkish settlements caprovines predominated, whereas in areas that escaped Turkish occupation poultry occurred in the highest numbers in towns and cattle in rural parts. The picture of the fauna of Hungarian settlements under Turkish sway is by no means a uniform one; it is most reminiscent of that of the 14th—15th century though a far greater number of primigenius type of cattle was to be found among the domestic animals. This, by the way, was characteristic also of Hungarian settlements in territories not occupied by the Turks.

THE HISTORICAL DEVELOPMENT OF ANIMAL KEEPING IN CENTRAL AND EASTERN EUROPE

The foregoing outline of the historical development of animal keeping in Hungary has created a framework upon which our investigations of the development of animal keeping in Central and Eastern Europe can be based. It should be indicated at this point, however, that our aims in the examination of animal keeping in Central and Eastern Europe are not so far-reaching as in the examinations of the development of animal keeping in Hungary. That is to say, we do not wish to reconstruct the development of animal keeping in such great detail in order to obtain the characteristic fauna types of the different periods and regions. There are a number of reasons for this.

Firstly we might mention the relatively small quantity of settlement material at our disposal. If we consider the vast extent of Central and Eastern Europe and the number of biotopes in this huge territory the bone samples found in about 400 settlements are relatively few. The material comprises an even smaller sample if we consider that it originates from a span of nearly eight thousand years and when it is divided among the seven principal periods (Neolithic, Copper Age, Bronze Age, Iron Age, Period of the Roman Empire, Migration Period and Middle Ages), each period has less than sixty settlements. In addition, the spatial distribution of the settlement faunas that can be used is not even. The quantity of studied settlement material is fairly rich in certain regions (the European regions of the Soviet Union, Switzerland, Germany), whereas in other areas it is moderate (Austria, Poland, Czechoslovakia, Romania), and there are regions from which we have but few data or none at all (Yugoslavia, Bulgaria, Albania, Greece, Turkey). The situation is similar in the chronological distribution of the settlement fauna suitable for quantitative examinations. Certain periods, e.g. the Neolithic, are more fully represented than others, e.g. the Migration Period. This distribution also varies in that that in certain territories archaeological explorations have centred on one particular period more than on others. So there are practically no settlement faunas in certain regions from the most interesting periods, for example from the Classical period in Greece. In this case it is necessary to supplement the poor animal bone evidence with inferences drawn from the sporadic written sources and artistic representations for information on the total domestic fauna.

Another reason for our lack of detail is that the dating of settlement faunas is in many cases very dubious. It often happened for example that the finds of two immediately subsequent periods were discovered on the same site and that their bone samples were mixed up by the archaeologists or zoologists. Although such cases have now become fairly rare, there still occur dates which are too broad to be meaningful from the archaeological point of view. For example, we can no longer content ourselves with such a dating as "Neolithic", or "Chalcolithic", or even "Early Bronze Age", but require a more exact indication, such as the culture or people in question. Unfortunately, with the exception of the material from the most recent excavations, such accurate dating occurs only very infrequently.

Let us now examine the main problems which we hope will be clarified by analyses of the settlement faunas of Central and Eastern Europe.

The first certainly is the question of the early appearance of different domestic animals in the various regions. Connected with this is the problem of the emergence of animal keeping, and furthermore changes in the significance of animal keeping and hunting in the various territories and periods.

Another question is that of the qualitative and quantitative changes of the domestic fauna in time and space. And a third problem concerns the relationships between animal keeping and the natural environment, ethnic and economic relations of animal keeping, etc.

THE EARLIEST DOMESTICATION: NEOLITHIC–COPPER AGE

The domestication of animals was one of the most successful experiments of mankind.[83] But domestication — in associations with agriculture — was not only simply a successful biological experiment of Man, but was also a step which led to an economic revolution of such proportions that it brought about a basic change in human economy. From the uncertainties of hunting and gathering, Man switched over to productive agriculture and animal keeping. We do not wish to go into the principles of domestication, but should like to emphasize that the domestication of animals was by no means due to chance. Even if we adopt the view that the first animals were perhaps not domesticated by Man but that they domesticated themselves (for example the dog joining Man practically against the will of the latter)[84] and that Man did not consciously domesticate the first animals,[85] it should be stressed that it was only after he had reached a certain stage in the material development that the primitive hunter decided to rear, to propagate and to tame, that is to domesticate the animals he had caught while hunting. Domestication demanded for this activity a mass of knowledge accumulated by thousands of generations, referring to the life, qualities, habits — we may well say biology of animals.

The origins of domestication go back to the very end of the Paleolithic. According to Clark, domestication was started when certain groups of

[83] Herre, W., 1955, p. 801
[84] Szilády, Z., 1927, p. 43
[85] Zeuner. F. E., 1963, p. 55

hunters specialized in the hunting of a certain species, which could have happened in Europe at the time of the Upper Paleolithic.[86] This concept was further developed by Pohlhausen, who suggested that three forms of hunting existed from which sprang three forms of domestication.[87]

However, these theories are only partly valid — at least as far as Europe is concerned; in the Paleolithic, domestication based on hunting could have been started for sure only in the case of the reindeer, which Zeuner suggests was not impossible,[88] and perhaps in the case of sheep,[89] if the "pre-pottery" domestic sheep of the La Adam cave in Dobrudja[90] were really of the pre-pottery period and really of local origin. In Europe, specialized hunting was in fact flourishing in the Neolithic, when the peoples of certain cultures (Tripolye, Tisza, Herpály, Lengyel, and Linear Pottery) hunted the aurochs and domesticated it as cattle. This, however, was no longer analogous with the Paleolithic hunting of herds, for by the Neolithic, Man had been familiar with domestic animals — including domestic cattle too — for a long time. Thus he knew their uses and domesticated them for this very reason and this was already conscious domestication. On the other hand, the domestication of dogs in Europe may have taken place towards the end of the Pleistocene. Degerből considered the canids of Starr-Carr and of Maglemose[91] to have been domestic dogs;[92] the dating of the Starr-Carr dog is 7538 $\pm$ 350 B.C. and since this was a genuine domestic dog and not a first generation wolf, domestication must have taken place — in West Europe or somewhere else — at an earlier period.[93] More or less coeval with them is the dog of the Senckenberg swamp,[94] thought by Degerből to have been a feral dog (European dingo)[95] and by Zeuner to have been a genuine domestic dog.[96] Remains of domestic dogs were found in nearly a dozen Mesolithic sites on the Crimean Peninsula.[96a] However, it was not only in Europe that the dog became a domestic animal prior to the Neolithic: in Asia Minor, in the Mesolithic Natufian culture (in Jericho dated by C_{14} to 8940 B.C.[97]) the dog also occurred in a domesticated form.[98]

However, both in Europe and in Asia Minor the domestication of dogs was only the forerunner of real domestication, and the era when mankind produced food began only after Natufian.[99] This era began with the domestication of sheep and goats. The earliest domestic sheep have been found at

[86] Clark, G., 1949, p. 95
[87] Pohlhausen, H., 1953, pp. 67 ff.
[88] Zeuner, F. E., 1964, p. 19
[89] Radulesco, C., Samson, P., 1962, pp. 282 ff.
[90] Fraser, F. C., King, J. E., 1949, p. 69; 1950, p. 128
[91] Degerből, M., 1969, pp. 35 ff.; 1962, pp. 334 ff.
[92] La Baume, W., 1948, pp. 76 ff.
[93] Degerből, M., 1961, p. 53
[94] Mertens, R., 1936, pp. 499 ff.
[95] Degerből, M., 1961, p. 53
[96] Zeuner, F. E., 1963, p. 85
[96a] Hančar, F., 1958, pp. 139 ff.
[97] Zeuner, F. E., 1963, p. 28
[98] Zeuner, P. E., 1963, p. 24; Clutton—Brock (1962, pp. 326 ff.) considers the domestication of these Canidae to be only probable
[99] Zeuner, F. E., 1963, p. 28

Zawi Chemi Shanidar (c. 9000 B.C.)[100] and at the Belt Cave on the southern coastal district of the Caspian Sea (c. 6000 B.C.),[101] whereas the earliest domestic goats are known from Asiab (West Iran, c. 8000 B.C.), from Jericho,[102] Qalat Jarmo[103] (c. 6500 B.C.) and from the Belt Cave (c. 6000 B.C.).[104] Soon after followed the domestication of pigs and then of cattle. According to Reed, domestic pigs were found at Qalat Jarmo in layers from 6500 B.C. and the earliest cattle in the Halafian layer (c. 5000 B.C.) in Banahilk in North Iran.[105] In our view the domestication of cattle was commenced before the period suggested by Reed, because the bones of domestic cattle were found in the pre-pottery layers of settlements, dated to the 7th millennium B.C. in Thessaly; moreover cattle occur in the Carpathian Basin in the Körös culture assemblages dated to the 6th millennium B.C. and in the Bandkeramik assemblages in Germany by the 5th millennium B.C.[106] Thus it would seem that the domestication of cattle was first performed in Europe, from where it spread.

A domestic fauna based on caprovines reached South East Europe from Asia Minor the latest in the 7th millennium B.C. This fauna including cattle can be found in the pre-pottery Neolithic of Greece.[107] In Thessaly the domestic fauna of Asia Minor found a natural environment identical with those of its country of origin and for a long time the climate also was identical, for in that period the climatic optimum following the Pleistocene began and remained unchanged there for a considerable time. This domestic fauna was characterized by the predominance of caprovines and the rareness of pigs, cattle and dogs (Fig. 2/1). Wild animals also occurred but in very small numbers in the settlement fauna of this period.

Besides this in remote areas or places difficult of access and without any Near Eastern influences, the aboriginal human population made attempts with wolf domestication. The best example is the pre-Starčevo population of Lepenski Vir in the Iron Gate gorge of the Danube, which had the dog as only domestic animal and covered the overwhelming part of its animal protein needs with fishing and hunting.[107a] (In this way its animal bone sample represented a very unique faunal type.)

With the progression towards the climatic optimum the south-eastern type of fauna proceeded northwards. Unfortunately, the course of this advance cannot be closely followed on the basis of faunistic data; it can be traced only archaeologically, in particular at its termini, in the settlements of the Körös culture in Yugoslavia (Fig. 2/2), in Hungary and Romania.[108]

The animal keeping of the Körös culture is completely identical with that of pre-pottery Neolithic in Thessaly, with the difference that here, in the

[100] Reed, C. A., 1961, p. 34
[101] Coon, C. S., 1951, pp. 49—50
[102] Zeuner, F. E., 1955, pp. 70 ff.; 1963, p. 132; Reed, C. A., 1960, p. 132
[103] Reed, C. A., 1960, p. 132; 1961, p. 35
[104] Coon, C. S., 1951, p. 50
[105] Reed, C. A., 1961, pp. 32, 34
[106] Müller, H. H., 1963, pp. 1 ff.
[107] Boessneck, J., 1961, pp. 39 ff.; 1962, pp. 27; Higgs, E. S., 1962, p. 272
[107a] Bökönyi, S., 1969, pp. 157—158; 1970, p. 1703
[108] See Notes 22—28

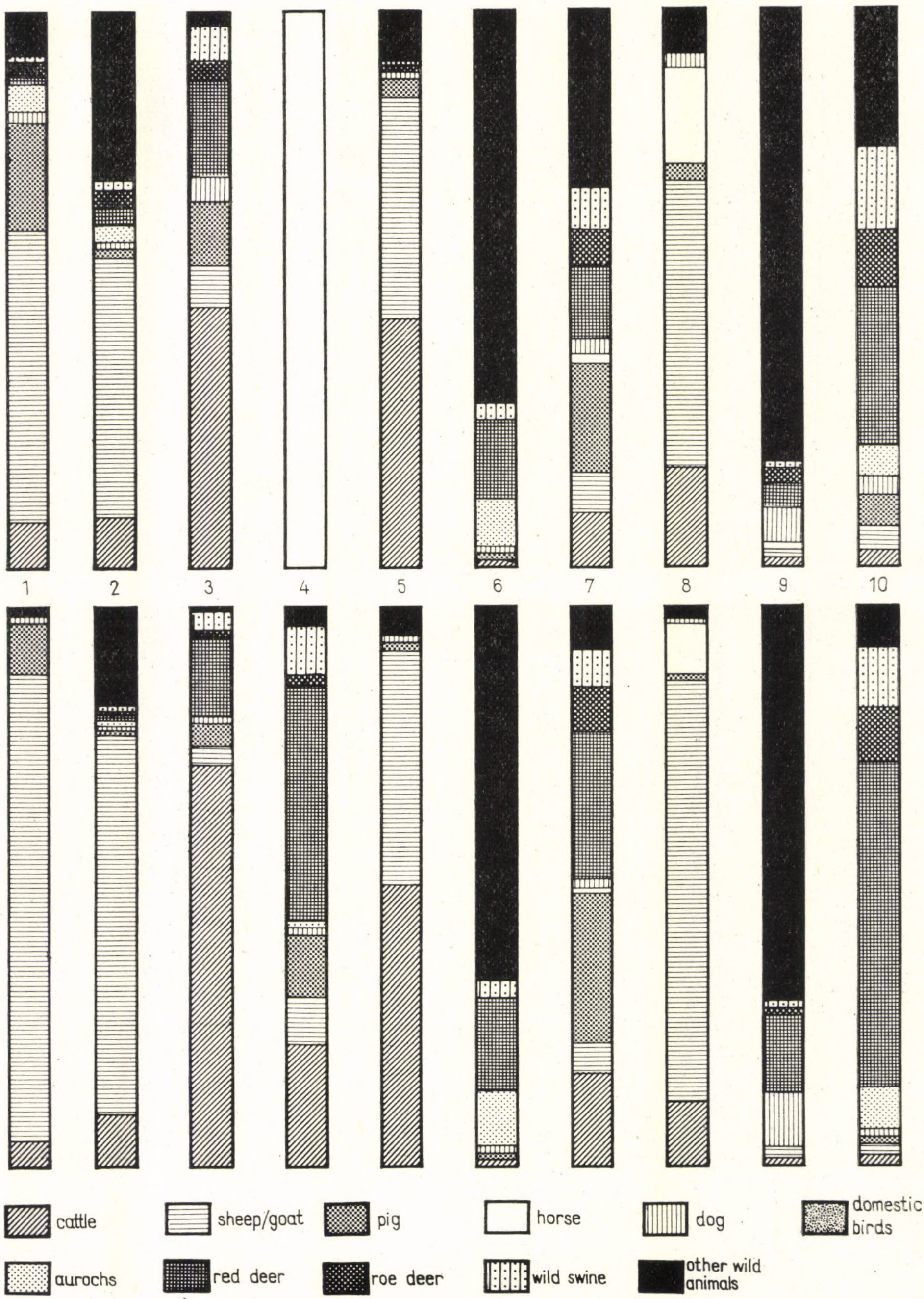
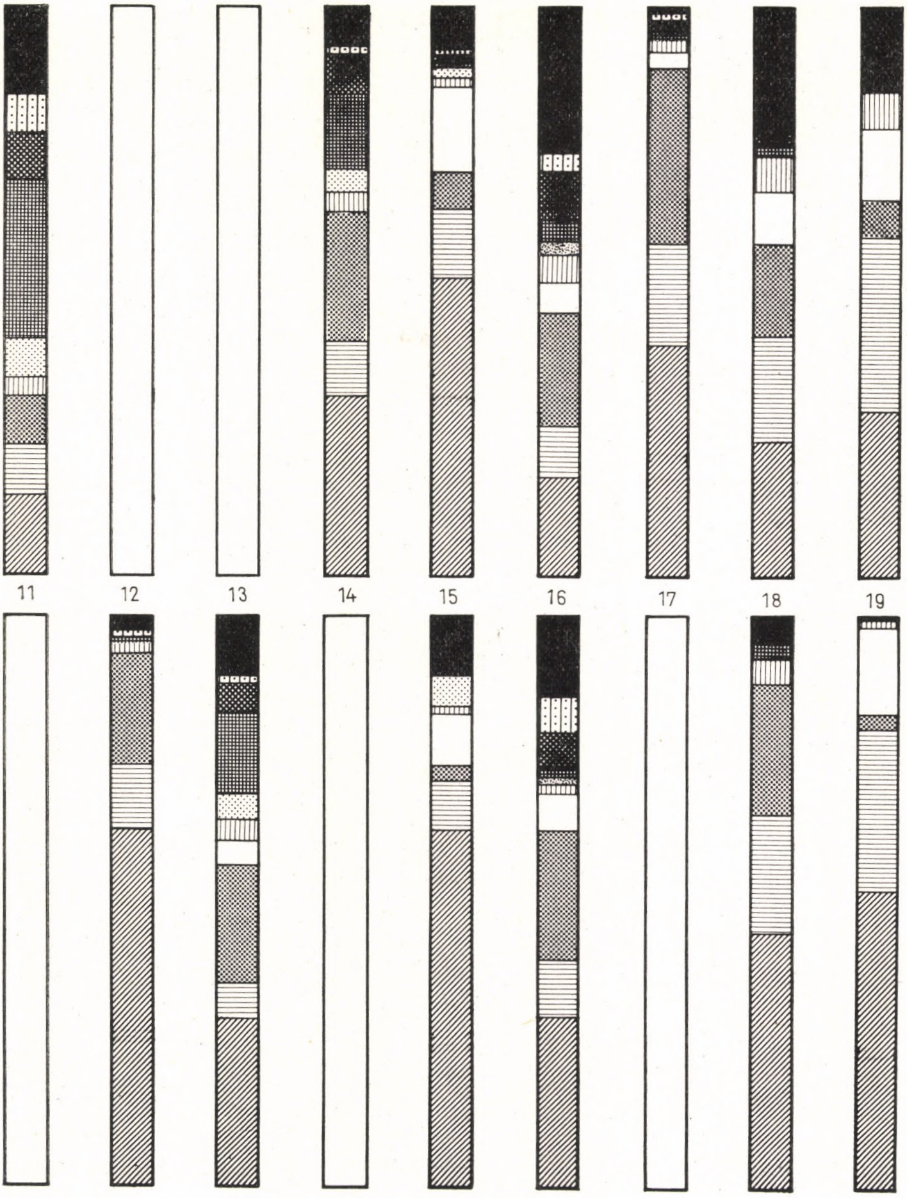
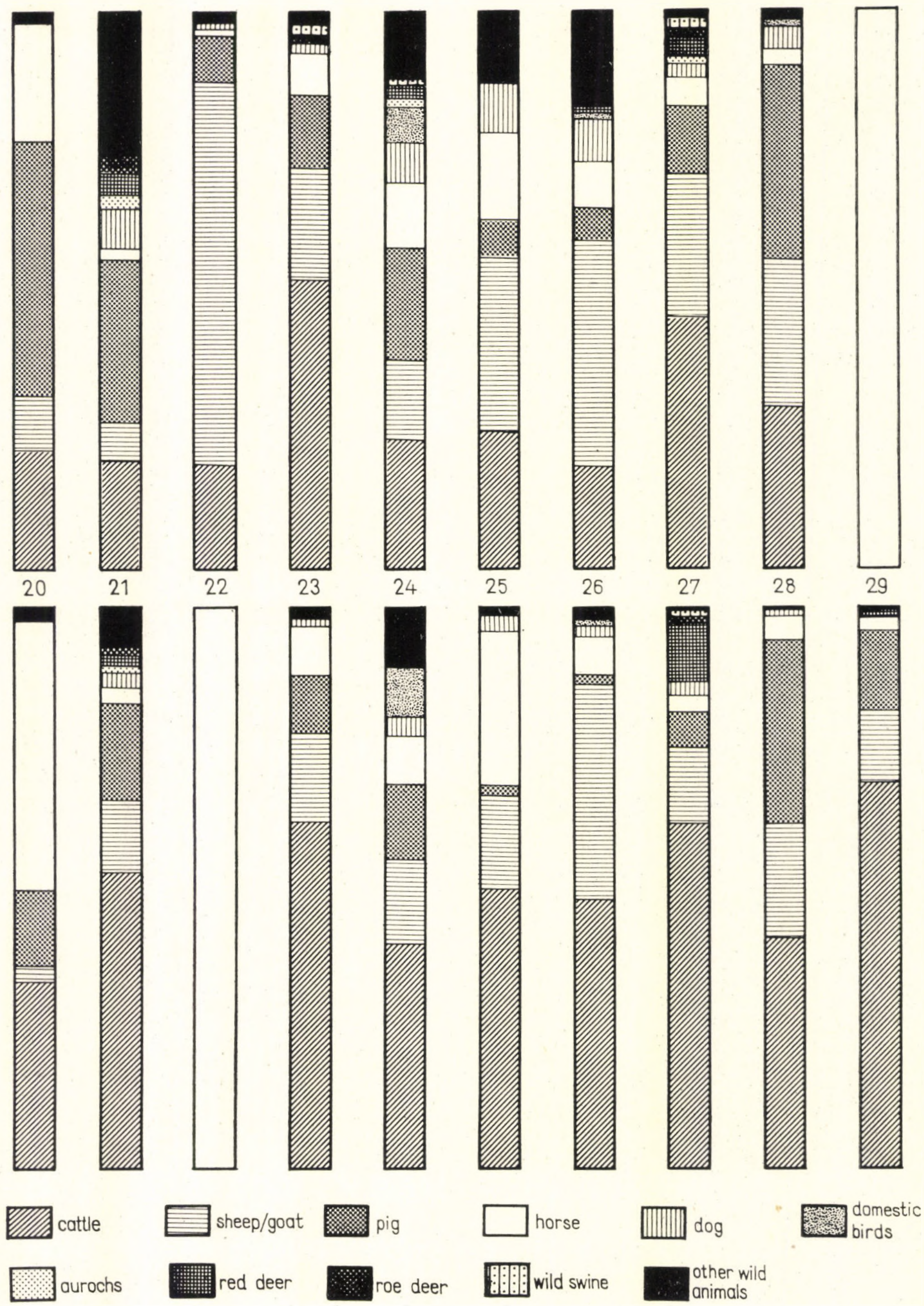


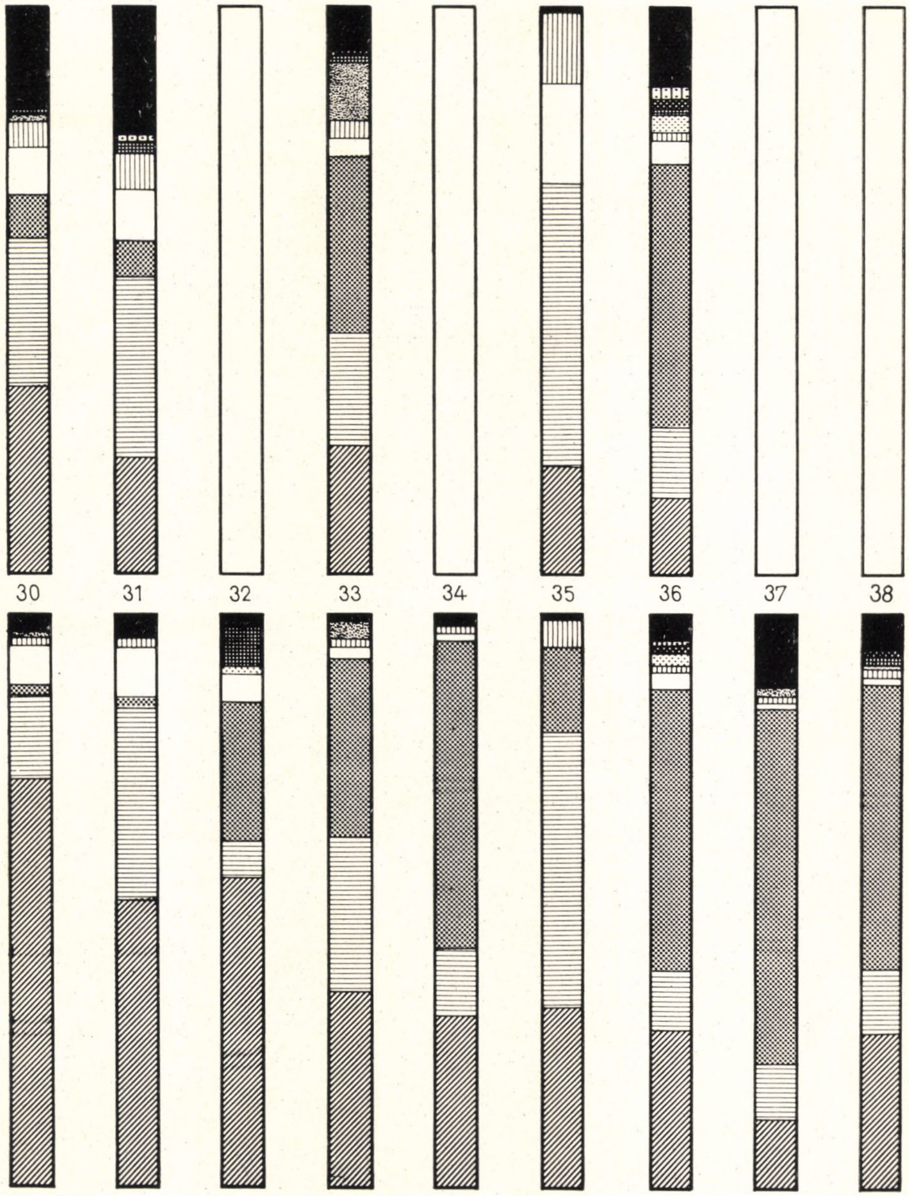
Fig. 2. Frequency relations of species in the faunas of Central and East European archaeological sites (settlements). Lower line: number of specimens; upper line: number of individuals. 1. Argissa-Magula, Greece, Pre-Pottery Neolithic, 2. Ludas—Budzsák, Yugoslavia, Neolithic (Körös culture), 3. Dealul Viei, Romania, Neolithic



(Precucuteni I), 4. Traian, Romania, Neolithic (Cucuteni B), 5. Techirghiol, Romania, Neolithic (Hamangia culture), 6. Voloske, Ukraine, Early Neolithic, 7. Luka—Vrublevetskaya, Ukraine, Neolithic (Tripolye A culture), 8. Usatovo, Ukraine, Neolithic (Tripolye B culture), 9. Mikolske, Ukraine, Neolithic, 10. Seeberg—Burgäschisee-Süd, Switzerland, Early Neolithic (Cortaillod culture), 11. Egolzwil 2, Switzerland, Neolithic, 12. Gródek—Nadbuzny, Poland, Neolithic (Funnel Beaker culture), 13. Ustowo, Poland, Neolithic (Funnel Beaker culture), 14. Uerikon, Switzerland, end of Neolithic—Copper Age, 15. Terpinnia, Ukraine, Early Copper Age, 16. Gerodske, Ukraine, Late Copper Age, 17. Bleiche von Arbon, Switzerland, Early Bronze Age, 18. Zimne,



Ukraine, Early Bronze Age, 19. Suskanskoye I, Russia, Late Bronze Age, 20. Atabayevskaya, Russia, Late Bronze Age, 21. Gánovce, Slovakia, Bronze Age, 22. Crestaulta, Switzerland, Middle Bronze Age, 23. Valea Lupului, Romania, Late Bronze Age, 24. Sobkivka, Ukraine, 11th—8th century B.C., 25. Didova hata, Ukraine,



4th – 3rd century B.C., 26. Olbia, Ukraine, 6th – 1st century B.C., 27. Seuthopolis, Bulgaria, Thracian, 28. Manching, Bavaria, Celtic, 29. Hüfingen, South Germany, Period of the Roman Empire, 30. Olbia, Ukraine, 1st – 5th century A.D., 31. Pitukhivka, Ukraine, c. 1st cent. B.C./1st cent. A.D., 32. Sroda Slaska Slup, Poland, 2nd – 3rd century A.D., 33. Burgheim, Germany, 7th – 9th century A.D., 34. Bonikowo, Poland, 8th – 10th century, 35. Velikij Bolgar, South Russia, 12th – 13th century, 36. Mezhotne, Latvia, 9th – 13th century, 37. Szczeczin – Msiecino, Poland, 9th – 10th century, 38. Szczecin – Rynek, Poland, 10th – 13th century

North, important hunting, fishing and gathering activities were added to animal keeping. In fact, this was nothing more than a variant of the fauna of Thessaly under different geographic conditions. This type of animal keeping, which was alien in the geographic milieu of the Carpathian Basin — this question has been discussed in greater detail in the section analysing the evolution of the fauna in Hungary — survived for a long time; after which it vanished yielding to a type of animal keeping which arose literally from the local wild fauna and was better suited to local conditions.

With the exception of dogs,[109] the domestic animals of the Neolithic found their way to the other parts of Central Europe by means of the Körös culture. However, the possibility has not yet been excluded that in Western Europe sheep may have had a smaller independent centre of domestication during the Mesolithic sites in France and England the bones of sheep have been found dating to the 4th millennium B.C.[110] But this evidence still needs confirmation, and it is possible that domestic sheep may have reached the above territories from South-East Europe.

As far as the Neolithic domestic animals of Central Europe are concerned, it would seem that in the early Neolithic individual animals only were moved from one settlement to the other either by trade or as spoils of war and that the major part of the domestic fauna was not diffused by way of a migration. The type of fauna characteristic of Asia Minor and South-East Europe that occurred in the pre-pottery Neolithic of Thessaly and in the Körös culture did not reappear in Central Europe north and west of the Carpathian Basin. Its place was taken by a type of animal keeping better adjusted to the geographic and climatic conditions of this region, in which cattle were the most frequent species among the domestic fauna, with pigs and caprovines alternating in the second place and with dogs as the least numerous of the domestic animals. No domestic horses occurred.

Depending on the location of the settlements and on ethnic conditions, the relationship between animal keeping and hunting varied in different sites in Central European region. Thus in some place for example in Switzerland, wild animals were very frequent in the early Neolithic. For instance, in Seeberg–Burgäschisee-Süd (the beginnings of the Swiss Neolithic, Cortaillod culture) there were 93.99 per cent wild animals according to total number of bones and 84.62 per cent according to the total number of individual.[111] Even if this high proportion of wild animals is not to be found in other sites of the culture, in Burgäschisee-Südwest there were still 47.1 per cent,[112] and 68.2 per cent[113] respectively and at Lüscherz 34.6 per cent[114] bones of wild animals discovered. No doubt, hunting continued to be important in Switzerland during the rest of the Neolithic; with one exception — Lützen-

[109] No doubt, dogs were domesticated in Europe too, but with the domestic fauna that spread from the Near East dogs also found their way to Europe

[110] Zeuner, F. E., 1963, p. 22

[111] Boesneck, J., Jéquier, J., P. Stampfli, H. R. 1963, pp. 10–11; Stampfli, H. R., 1962, p. 32

[112] Josien, Th., 1956, pp. 30–31

[113] Stampfli, H. R., 1964, p. 117

[114] Josien, Th., 1956, p. 49

güetle (Liechtenstein), Horgen Culture[115] — the proportion of wild animals' bones was always above 10 per cent.

It is interesting that the process so clearly demonstrable in Hungary can be observed in the whole of Central Europe, viz. that the decline of hunting was not regular[116] and that towards the end of the period another increase of hunting took place. This is well illustrated by the proportions of wild animal of late Neolithic — early Copper Age settlements of Switzerland and Germany.[117]

It is interesting to note that in these territories the character of hunting differed from that of the Carpathian Basin. Whereas — as we have seen — in the Carpathian Basin, Neolithic hunting was based upon the aurochs (on the whole European continent, it was in the Carpathian Basin that there was the greatest abundance of aurochs[118]), in most of Central and Eastern Europe red deer was the most frequent wild animal. That is why Rütimeyer termed the Swiss Neolithic the "Period of the Red Deer".[119] This kind of hunting also resembled that pursued in Hungary, but in the early Neolithic of Europe it was not at all or only very rarely accompanied by domestication[120] (which proves that it was not the idea of domestication which was diffused to these regions but the domesticated animals themselves). In the later phases of the Neolithic, however, the people living in Central Europe also practised the techniques of domestication.

The best picture of the early Neolithic fauna of the wooded-mountainous regions of Central Europe is offered by the Swiss settlement of Seeberg–Burgäschisee-Süd (Fig. 2/10).[121] This settlement belongs to the earliest period of the Swiss Neolithic: the Cortaillod culture, in all likelihood to its very early phase at a time when in this region it was in its earliest stages of development. In this period only domestic animals that had been imported were kept and the population did not go in for domestication themselves in addition; animal keeping played only a very small part in the economy. The other Cortaillod settlement of Burgäschisee (Burgäschisee-Südwest[122]) and Lüscherz,[123] furthermore Seematte-Gelfingen[124] and Egolzwil 2 (Fig. 2/11)[125] probably belonged to a later phase of the culture, in which animal keeping had become of increasing importance. In these sites cattle were the most frequent domestic animals, with pigs following in the second place but only slightly more frequent than caprovines; dogs were the least com-

[115] Hartmann-Frick, H., 1960, Table 81

[116] Hescheler and Kuhn already called attention to this (1949, p. 308)

[117] Volgel, R., 1933, p. 5; Kuhn, E., 1935, p. 323; Hescheler, K., Rüeger, J., 1940, p. 63; Rüeger, J., 1944, p. 292; Boessneck, J., 1956, p. 13; Hartmann-Frick, H., 1960, Table 81

[118] Bökönyi, S., 1959b, pp. 79 ff.; 1962c, pp. 182 ff.

[119] Rütimeyer, L., 1862, p. 9

[120] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, p. 160; Stampfli, H. R., 1962, p. 33

[121] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, pp. 10—11

[122] Josien, Th., 1956, pp. 30—31; Stampfli, H. R., 1964, p. 117

[123] Josien, Th., 1956, p. 49

[124] Hescheler, K., Rüeger, J., 1940, pp. 61—62; 1942, pp. 384—385

[125] Hescheler, K., Rüeger, J., 1939, p. 309; 1942, pp. 384—385

mon. Burgäschisee-Süd is an exception in that, although cattle comprised the highest proportion of the total number of bones, in a calculation based on the total number of individuals they were preceded by the other domestic animals. (The analysts of the fauna material did not attach too great an importance to this point.)[126] The earliest culture of the Swiss Neolithic appears to have had in its fauna in general a higher numerical ratio of wild animals than of domestic ones; red deer were the most frequent among the wild animals, although there were also a large number of aurochs-bison and wild swine. With the exception of the earliest phase, cattle predominated among the domestic animals, followed by pigs, caprovines and dogs. Horses were missing. Another characteristic feature of this fauna is the fact that local domestication occurred only very seldom or not at all.

The fauna of later periods of the Swiss Neolithic cannot be unequivocally determined. As already mentioned it featured a decline of hunting and an increased importance of animal keeping although neither shows a regular process. It is characteristic of the fauna of every settlement that the red deer was the most frequent wild animal, but this was not characteristic only of the Neolithic. Generally cattle predominated among the domestic animals, although in some places it was preceded by caprovines and by pigs respectively.[127] (On the other hand, this may be due to a poor collection of the bone samples, as was formed only with the finds of old excavations.) Sometimes horse bones occur, but — apart from the horses of the late Neolithic—early Copper Age — these have been identified by most authors as wild animals.

So far there has not been any considerable quantity of bone samples studied from Neolithic settlements of the southern part of Germany. Although 505 fragments of animal bones have been found at Regensburg–Pürkelgut (Linear Pottery culture – Rössen culture – Stroke-ornamented Ware culture), they were collected in a selective way[128] and are thus unsuitable for a quantitative analysis. Regensburg–Kumpfmühl–Karthauserstr. 19 (Rössen culture) yielded only 124 bones.[129] Without indicating any more exact dating Vogel described Neolithic bones originating from Dullenried; among them wild animals were predominant and cattle predominated among the domestic animals.[130] However, there were no pig bones among the finds from which we may infer that the bones were collected selectively. The best late Neolithic—early Copper Age material was found at the settlements of Polling, Altheim, Altenerding and Pestenacker, but here too the bones may have been selectively collected. Moreover the sample quantity is smaller than 500, which makes it unsuitable for evaluation.[131] In these settlements there were large numbers of wild animal bones, especially red deer and wild swine, and among the domestic animals the frequency order was cattle, pigs, caprovines and dogs; at Altenerding horses occurred. The

[126] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, p. 13
[127] Kuhn, E., 1938, pp. 259—260
[128] Boessneck, J., 1958, pp. 4 ff.
[129] Boessneck, J., 1958, p. 9
[130] Vogel, R., 1929, pp. 455—461
[131] Boessneck, J., 1956, pp. 8, 32

fauna of the Linear Pottery culture (4500—3500 B.C.) of Central Germany is reminiscent of that of the Zseliz group in Hungary (Győr–Pápai vám, Neszmély–Tekerespatak) — with which it is also related — with few wild animals and a predominance of cattle followed by caprovines and in some cases pigs among the domesticated animals.[132] There is no convincing evidence that the horse bones which occur sporadically belong to domestic animals.[13]

From Austria we have studied Neolithic bone samples only from the two connected and partially excavated settlements of the Linear Pottery (Notenkopf-Keramik) — Rutzing and Hain. Unfortunately, the sample is rather small (277 bones), which reduces the value of the conclusion that might be drawn. Hunting at the settlement was not unimportant (the numerical proportion of wild animals is 36.5 per cent) — among which red deer were the most important hunted animals, although aurochs and wild swine also frequently occurred. Among the domestic animals, cattle were by far the most important, with pigs, caprovines and dogs following in that order. There were no horses.

Very little faunal material has been studied from the early and middle Neolithic settlements in Czechoslovakia and Poland.

In Czechoslovakia a distinction should be made between the fauna of Bohemia and Moravia on the one hand and of Slovakia on the other. As early as the Pleistocene period, the former was connected more with the fauna of Northern Europe, a situation which continued during the Holocene. The latter, on the other hand, belongs to the faunal area of the Carpathian Basin and is thus connected to the territory of South-East Europe. The evolution of its domestic fauna — apart from the differences caused by the different geographical environment — resembles very much that of Hungary.

With respect to Bohemia and Moravia we have to rely on the few data of Skutil and Stehlik,[134] but these are unsuitable for the purposes of our examinations partly due to the uncertain dating and inaccurate collection and partly to the small bone samples.

The late Neolithic cultures of Czechoslovakia and Poland are contemporaneous with the Copper Age cultures in Hungary and South-East Europe and should be compared with them. Contemporaneous with the late Neolithic—early Copper Age Lengyel culture[135] in Hungary, and in some respect related to it are the Painted Pottery culture settlements of Lužianky and Mlynarce in Slovakia, whose faunas are described by Ambros.[136] Unfortunately only 57 identifiable bones were found at the former site and only 224 at the latter. Thus, only Mlynarce can be used — and even then to a limited extent — in our fauna evaluation. Here, similarly to the Lengyel culture, the number of wild animals was high, surpassing 40 per cent of the

[132] Müller, H. H., 1964, pp. 61 ff.
[133] Müller, H. H., 1964, p. 53
[134] Skutil, J., Stehlik, A., 1939, pp. 67—84
[135] Here, and from this point onwards, dating and synchronization of the Neolithic and Copper Age have been indicated according to Bognár-Kutzián, I. (1963)
[136] Ambros, C., 1961, pp. 81—93

total numbers of individuals. It is also a feature of the Lengyel culture that the aurochs was the most frequently hunted animal (Ambros considers the frequency of aurochs bones a characteristic feature of the Slovakian Neolithic).[137] In both settlements cattle, caprovines and pigs occurred among the domestic animals (it could not be decided whether the three horse bones found at Lužianky were of domestic or wild animals);[138] there was an overwhelming majority of cattle, whereas the numerical proportion of pigs (including transitional forms) and of caprovines was equal. Thus in Slovakia also, the economy was based on the keeping of cattle, in association with the hunting of aurochs, as was the case in the Lengyel culture, in addition to a minimal keeping of caprovines and pigs.

From Poland the greatest evidence of the Neolithic fauna originates from the Funnel Beaker culture (Trichterbecher-Kultur; TRB) (Fig. 2/12–13)[139] which was coeval with the Tiszapolgár culture. The fauna of the Funnel Beaker culture was fairly uniform. With the exception of the Ustowo settlement on the northern boundary of the diffusion area of the culture, there were only 6–10 per cent of wild animals in these settlements indicating that hunting was only of slight importance in the economy of the settlements (at Ustowo there were 34.4 per cent of wild animals). In its quantitative composition the domestic fauna was definitely of a Neolithic character and relied on the local wild fauna. It contained large numbers of cattle, fewer pigs and very few caprovines and dogs. Horses also occurred, but there is disagreement as to whether they were wild or domestic animals. Thus this culture also closely resembled the Tisza–Lengyel complex, with the exception of its hunting activities, which was of far less importance, perhaps due to climatic differences. The evidence of the fauna of the Jordansmühl culture in the south west of Poland (Silesia), a culture by and large contemporaneous with the Trichterbecher culture, is much more incomplete. We know only that the domestic animals included cattle, sheep, pigs and goats and the wild animals included aurochs.[140]

Turning once again to the south-eastern part of Europe we should point out that our faunal evidence is particularly poor. We have a small bone sample including wild sheep, goats, pigs and the Mesopotamian fallow deer (*Dama mesopotamica* Brooke) from Cyprus, from the sites Khirokitia (c. 3700 B.C.) and Erimi (c. 3000 B.C.). Cattle were missing from the domestic fauna.[141] Zeuner considered this fauna peculiar[142] and did not exclude the possibility of the goats having been locally domesticated.[143] We, on the other hand, consider some of the pigs at least to have been domestic animals. (The average length of the lower M_3 is 35 mm; evidently those under 35 mm originate from domestic pigs. Similarly the upper M_3 of 25 mm length also originates from domestic pig.)

[137] Ambros, C., 1961, p. 92
[138] Ambros, C., 1961, p. 91
[139] Krysiak, K., 1950–51, p. 228; 1952, p. 289; Kubasiewicz, M., 1958, p. 48
[140] Holdefleiss, F., 1905, p. 269
[141] King, J. E., 1953, pp. 431 ff.
[142] Zeuner, F. E., 1963, p. 175
[143] Zeuner, F. E., 1963, p. 133

Boessneck has described some Neolithic faunas of Greece; among them we have already discussed that from the pre-pottery and early Neolithic layers at Argissa Magula. The fauna of the Dimini culture from the same site with its predominance of caprovines and scarcity of wild animals[144] is closely similar. Boessneck has also described faunas of the Dimini culture from Otzaki Magula and Arapi Magula near Larissa. These two samples are dated to a period between 3500 and 2600 B.C. and, although they comprise relatively few bones, they indicate the rareness of wild animals and, in the domestic fauna, the frequency of sheep and the much lesser significance of cattle and pigs.[145] There were no horses in either site. We can consider the animal keeping of both sites as a direct continuation of the pre-pottery Neolithic period, well adjusted to the environmental, economic and zoological conditions of the region.

In Bulgaria, Popov has identified animal bones from Neolithic sites[146] (mostly from caves, where an exact dating leaves much to be desired and where bones of a later date have often become mixed with the Neolithic material). Popov has ascertained that in every site domestic animals were more frequent than wild ones[147] and proved that there existed a well developed animal keeping in the Bulgarian Neolithic.[148] In most cases caprovines were the most frequent domestic animals[149] preceded sometimes by cattle.[150] Horse bones were very rare and could be found only where Neolithic layers were mixed with those of the Bronze Age. Red deer predominated among wild animals, though aurochs were also fairly frequent. Recently excavated material from Yasatepe at Plovdiv (Late Neolithic to Early Aeneolithic) has been studied by Ivanov.[151] Here the number of wild animals at this site was not low, 17.7 per cent of the total number of individuals, with red deer and wild swine taking the lead, which may point to an increase in hunting at the end of the Neolithic. Among domestic animals cattle were by far the most important, with caprovines taking the second place and pigs following; then came the dog. There were no horses. By the end of the Neolithic the importance of caprovine keeping seems to have somewhat decreased — perhaps because of the lack of direct replacement from the domestication area.

From Yugoslavia so far the fauna of three Neolithic sites has been studied: from Nosza–Gyöngypart and Ludas–Budzsák (in North-East Yugoslavia) (Fig. 2/2) and the top level of Lepenski Vir in the Iron Gate Gorge of the Danube all of them being settlements of the Körös-Starčevo culture. The fauna of the first two closely resembles that of the Körös settlements in the vicinity of Szeged, which is not surprising, since they are no more than

[144] Boessneck, J., 1962, p. 38
[145] Boessneck, J., 1956d, pp. 7, 10
[146] Popov, R., 1908, pp. 1—22; 1909, pp. 506 ff.; 1913, pp. 450 ff.; 1914, pp. 220 ff.; 1918, pp. 153—154; 1920, pp. 20—21
[147] Popov, R., 1908, p. 2
[148] Popov, R., 1920, p. 20
[149] Popov, R., 1908, p. 16
[150] Popov, R., 1909, p. 507; 1920, p. 21
[151] Ivanov, St., 1959, pp. 81—86

15–20 km as the crow flies from the southernmost Körös sites near Szeged. There is a substantial difference only in the wild fauna. The settlements were situated on the border of the forest-steppe and not on one of the islands rising from the inundation area of the Tisza; there were therefore fewer fish and marsh and forest species among their wild animals, whereas steppe mammals, especially wild asses (*Asinus hydruntinus* Reg.), which was the most frequent wild animal at Ludas, were more numerous.

The third site, Lepenski Vir, has a very high (74.5 per cent) wild ratio that is due to its very wild geographical environment. Its domestic fauna is very similar to that of the Transylvanian and North Moldavian Körös sites (see below) with a cattle predominancy and a high caprovine ratio.[151a]

Necrasov described faunas in the Romanian settlements of the Körös culture very similar to the early Neolithic ones in Hungary.[152] On the basis of the bone samples of five fairly smaller settlements of the Körös culture with 49–300 bones (two in Transylvania and three in North Moldavia) she stated that domestic animals predominated over wild ones, although at times the frequency of the latter was nearly 50 per cent. However, the wild fauna in which red deer and wild swine were the most frequent was by no means as rich in the variety of species as that of the Körös settlements in Hungary (this is due to the different geographic milieu). Among domestic animals cattle took the lead closely followed by caprovines. Pigs were very rare and dogs' bones occurred in one site only. Necrasov identified the horse bones as belonging to wild animals. We can see that the fauna of the Körös culture settlements in Romania was – in spite of the great distances – similar to the Hungarian ones in many respects.

In the other early Neolithic culture of Romania, the Hamangia culture, animal keeping was markedly increasing. At least in its only settlement with a large quantity of bone samples, at Techirghiol (at the coast of the Black Sea near Constanţa), there were 89.5 per cent domestic animals (by the individual) as against 10.5 per cent wild ones (Fig. 2/5).[153] It is interesting to note that the wild ass (*Asinus hydruntinus* Reg.) was the most frequent wild animal. Animal keeping was similar to that of the Körös culture: the total of cattle and caprovines made up 94 per cent of the domestic fauna; besides these only a few bones of pigs and dogs and none of horse were found.

At Tangiru, belonging to the Boian culture, which shows connexions with Karanovo III and with the Tisza culture, there were only approx. 10 per cent of wild animals; in this respect it resembles the Hamangia culture. However, among the domestic animals cattle were by far the most frequent, followed by caprovines and pigs in about an equal proportion; dogs came last. There were again no horses at this site.[154] In the upper layer of the same settlement, which belonged to the Gumelnita culture (synchronous with the Tripolje A–B culture), the percentage of wild animals was only 3.14; the numerical proportion of cattle had fallen and was closely

[151a] Bökönyi, S., 1969, pp. 157–158; 1970, p. 1703
[152] Necrasov, O., 1961, pp. 265–272; 1964, pp. 167–181
[153] Necrasov, O., Haimovici, S., 1962, p. 177
[154] Necrasov, O., Haimovici, S., 1959, pp. 563 ff.

followed by caprovines, which preceded pigs whose ratio remained unchanged; that of dogs on the other hand had decreased.[155] Domestic horses were not found here either. At Traian–Dealul Viei, which belonged to the roughly contemporaneous Precucuteni culture (Fig. 2/3), there were as many as 30 per cent (by the individual) of wild animals with a predominance of red deer; cattle were by far the most frequent among the domestic animals, then followed pigs closely by caprovines and finally dogs.[156] There were no domestic horses. In the Cucuteni A–B layers of the same site synchronous with the Tripolye B II and with the Mid-Copper Age Bodrogkeresztúr culture in Hungary the number of wild animal bones (the individual numbers have not been determined) exceeds that of domestic animals. Three-quarters of the former are red deer. Among the domestic animals cattle were the most frequent, then came pigs, caprovines and dogs.[157] It could not be determined whether the horse bones found at the site were bones of domestic or of wild animals.[158] There was a similar proportion of hunting and animal keeping at the Cucuteni A settlement of Trușești. But here, with respect to wild animals, wild swine were almost as numerous as red deer, whereas, among the domestic animals pigs preceded caprovines and dogs, which were very rare, with a predominance of cattle.[159] There were no horses here either.

In the European terrritory of the Soviet Union domestication began towards the end of the Mesolithic: from the Crimean Peninsula we know of no less than ten occurrences of dogs of Late and Post-Pleistocene origin.[160] In the south western part of the European territory of the Soviet Union, in the Bug-Dniester culture, more or less contemporaneous with the Körös settlements of North-East Romania, there was an animal keeping based on cattle, with pigs and dogs. Caprovines, however, were missing from the domestic fauna. This indicates that the diffusion of the early Neolithic fauna already mentioned (which had started from the south east of the Balkans and proceeded northwards as far as the Carpathian Basin) did not reach this territory; only certain species of domestic animals were taken up. In the Crimea on the other hand — after attempts at the domestication of pig in the Mesolithic period — the two species of small ruminants occurred in this period alongside cattle, pigs and dogs. The situation was similar in the early Neolithic period in the Dnieper Basin too.[161]

In the early phase of the Tripolye culture hunting played a significant role; in some settlements the numerical proportion of wild animals' bones comprised up to 50 per cent.[162] Cattle and pigs were predominant in the domestic fauna,[163] followed by caprovines and dogs. The couple of horses'

[155] Necrasov, O., Haimovici, S., 1959, pp. 563 ff.
[156] Necrasov, O., Haimovici, S., 1962, p. 262
[157] Necrasov, O., Haimovici, S., 1959b, pp. 179—180
[158] Necrasov, O., Haimovici, S., 1959b, p. 179
[159] Haimovici, S., 1960, Table I
[160] Hančar, Fr., 1958, p. 40
[161] Tringham, R., 1969, pp. 383 ff.
[162] Bibikov, S. N., 1950, pp. 57 ff.; Pidoplitchko, I. G., 1956, pp. 8, 64, 77
[163] Quitta (1950—51, p. 27) drew somewhat exaggerated conclusions from the faunal composition of Luka Vrublevetskaya concerning the predominance of pigs

bones found in these settlements very probably belonged to wild animals. The high frequency of cattle and pigs in the early Tripolye culture (Fig. 2/7) is reminiscent of the fauna of some Hungarian cultures (Tisza, Herpály), particularly if we take into consideration also the abundance of aurochs and the vigorous domestication of cattle.[164] Later the significance of hunting decreased more and more; among domestic animals the numerical ratio of pigs fell and in the middle phase cattle and in the late phase sheep often became overwhelmingly predominant in the domestic fauna (Fig. 2/8).[165]

Proportion of domestic and wild animals in the Tripolye culture[166]

site	period	domestic animals %	wild animals %
Luka – Vrublevetskaya	A	47.4	52.4
Sabatinovka II	B_1	69.2	30.8
Vladimirovka	B_2	76.0	24.0
Kolomijshchina	C_1	79.5	20.5
Usatovo	C_2	88.4	11.6

In fact, the end of the Tripolye culture belongs to the beginning of the Bronze Age, with very strong southern influences; the increase of caprovines also agrees with the general European picture. Probably the first domestic horses appeared in the middle phase of the culture.

However, the fauna of some of the Neolithic settlements of the Ukraine, such as Voloske (Early Neolithic)[167] and Mikolske,[168] both by the waterside, was unusual in that it comprised hardly any domestic animals and the wild fauna mostly comprised fish (Fig. 2/6, 9).

In the Fatyanovo culture, a late Neolithic culture in C. Russia (dated to the end of the 3rd millennium B.C. to approx. 1250 B.C.) hunting played a significant part.[169] Dogs were the most frequent among domestic animals, followed by pigs, cattle and caprovines.[170] In two settlements, evidently late ones, horses also occurred. The Fatyanovo culture exerted a marked influence on the Neolithic of the Volga – Oka region[171] and it may have been

[164] As we have stated by means of autopsies, there are a great many bones of wild cattle and of transitional forms among the bones of cattle found in the settlements of the Tripolye culture. With respect to the hunting activities in the culture Hančar also stated (1956, p. 67) that it was a higher form of hunting, closely connected with the aurochs. Cf. with the hunting of the aurochs for domestication purposes in Neolithic cultures in Hungary

[165] Kritshevsky, E., 1941, p. 250; Pidoplitchko, I. G., 1938, III; 1956, pp. 35, 71,145; Korotkevitsh, O. L., 1956, p. 131

[166] Bibikov, S. N., 1953, p. 186

[167] Pidoplitchko, I. G., 1956, p. 16

[168] Pidoplitchko, I. G., 1956, p. 26

[169] Bader, O. M., 1937, pp. 23 ff.

[170] Bader, O. M. 1939, p. 113

[171] Hančar, Fr., 1956, p. 195

from this culture that the first domestic animals found their way here, because prior to the last decades of the 2nd millennium B.C. there had been no domestic animals here at all.[172] After this date, however, along with imported objects cattle, pigs and horses occurred simultaneously (Pozduyakovo culture).[173]

In the Neolithic of the forest areas animal keeping played a minimal role compared to hunting. Dogs used to be considered to have been the only domestic animals in the forest belts during this period.[174] Recently, however, at Kreiči, in southern Latvia (dated by C_{14} from the second half of the 3rd millennium B.C. to the 2nd millennium) teeth of caprovines have been found.[175] The overwhelming majority of the approximately 8200 bones of the settlement were wild animals' bones, including those of wild horses. However, it seems likely that caprovines could have reached this area only in the later Neolithic period, for at Käapa in southern Estonia, which has been dated by C_{14} to the first half and middle of the 3rd millennium B.C., the dog was the only domestic animal to occur in a very large bone sample (about 5000 bones).[176] Dogs were hunting companions and they were used to draw sledges, but they were also eaten.[177]

THE BRONZE AGE

Three factors affected the composition of the Bronze Age fauna of Europe.

1. Owing to the increase of the human population, the wild fauna decreased. This and the natural multiplication of domestic animals (accelerated by constant domestication) resulted in a decreasing importance of wild animals in the human economy. As in the Neolithic, however, this was not a regular evolution in the Bronze Age. In Thessaly, for example, the number of wild animal bones definitely rose,[178] and in Switzerland too, a certain increase in the numerical ratio of wild animal bones could be observed towards the end of the Bronze Age.[179]

2. A climatic change during the Bronze Age (the warm and dry climate of the Neolithic became cool and humid by the end of the Bronze Age) may have been a further factor in the decrease of wild animals. This climatic change may also be demonstrated zoologically in the occupation layers of the settlement of Tószeg in Hungary which was occupied throughout the Bronze Age.[180]

3. Moreover, compared with the Neolithic and the Copper Age much stronger cultural and ethnic movements began in the Bronze Age which

[172] Hančar, Fr., 1956, pp. 208—209

[173] Hančar, Fr., 1956, p. 209

[174] Anutchin, D. N., 1886, pp. 1 ff.; Gandert, O. F., 1930, pp. 65—66; Gromova, V. I., 1933, p. 117

[175] Paaver, K. L., 1961, p. 357

[176] Paaver, K. L., 1961, p. 357

[177] Gandert, O. F., 1930 pp. 65—66

[178] Boessneck, J., 1962, p. 35

[179] Würgler, F. E., 1962, p. 40

[180] Bökönyi, S., 1952a

influenced, among other things animal keeping and its spread. Since in the Bronze Age, particularly its early phase, the currents coming from the south and south-east were the strongest, these had the greatest influence on modifying animal keeping. One effect of this was the development of sheep and goat keeping but an even more significant result was the spread of horse keeping. In its turn horse keeping promoted the development of communication (trade and military) between peoples. Some horse bones had occurred already in Copper Age settlements, but the development of horse keeping was the merit of man of the Bronze Age. In fact, this was the most characteristic feature of animal keeping in the Bronze Age, separating it basically from animal keeping in previous periods.

As mentioned above, in the Bronze Age layers of Argissa Magula in Thessaly the number of wild animal bones increased at first but fell again by the end of the Bronze Age. Cattle were the most frequent domestic animals in the Early Bronze Age; in the Middle Bronze Age predominance was gained by caprovines but regained again by cattle by the end of the Middle Bronze Age. By the end of the Bronze Age the numerical ratio of pigs rose to the detriment in particular of cattle.[181] Horses were evident first from the beginning of the Middle Bronze Age.[182]

In the Bronze Age of Bulgaria cattle were again predominant with caprovines next although horses were also fairly frequent as is seen in the bone samples from caves.[183]

From the Bronze Age of Yugoslavia we have only the old Ljubljana material, which is mixed with Neolithic finds and not very usable. The fauna list of this material does not give any clue as to the frequency of different species and the proportion between domestic and wild animals. Cattle, caprovines, pigs and dogs occurred among domestic animals, whereas the wild ones were represented by the aurochs, the red deer, the roe deer, wild swine, badger, beaver and the brown bear.[184]

The horse occurred also in the Austrian Bronze Age material but played only a very small role there. Whereas complete skeletons were found[185] in the Schnurkeramik (Corded Ware) burials at Föllik in Burgenland, not a single horse bone occurred in the Urnfield culture (late Bronze Age) site at Kelchalpe by Kitzbühel in the Tyrol.[186] In this settlement, at an altitude of 1800 m, Amschler has suggested that an Alpine economy may have been pursued with 61.1 per cent cattle, 14.9 per cent caprovines and 24 per cent pigs,[187] but no wild animal bones (which seems to be very mysterious). In the transitional late Neolithic – early Bronze Age settlements of Upper Austria, at Rebensteiner Mauer, Brückler Mauer, Langensteiner Wand and Sonnbichl, all situated quite near one another, horses were also very rare (only in the first two of the above mentioned sites there was one and two

[181] Boessneck, J., 1962, p. 38
[182] Boessneck, J., 1962, p. 39
[183] Popov, R., 1912, p. 91; 1912b, pp. 92 ff.; 1913, pp. 450–451
[184] Riedel, A., 1947–48, pp. 189 ff.
[185] Amschler, W., 1949, pp. 14–15
[186] Amschler, W., 1937, p. 97
[187] Amschler, W., 1937, p. 97

bones found respectively). Owing to their geographic situation and to the high numerical ratio of wild animals occurring there these sites appear to have been refuges like Salgótarján–Pécskő or Felsőtárkány–Várhegy in Hungary, of the four settlements only Rebensteiner Mauer produced a relatively large bone sample (464 bones) comprising mostly, as already mentioned, wild animal bones, in particular red deer. The poorly developed animal keeping was based predominantly on cattle and caprovines; pigs and dogs were very rare. This composition of the domestic fauna is characteristic of the Bronze Age.

Horses occurred also in the Swiss Bronze Age and, although fairly widespread, it was not a frequent domestic animal, for reasons similar to those prevailing in Austria. Thus it was represented at the early Bronze Age site of Bleiche von Arbon (Fig. 2/17) by 2.3 per cent of the total bone sample[188] at the Middle Bronze Age site of Crestaulta (Fig. 2/22)[189] with only 0.11 per cent, but at Baldegg, too, it was very rare,[190] and at Zürich–Alpenquai, a late Bronze Age site, it occurred only in 3.61 per cent.[191] On the other hand, there was a clear development of caprovines everywhere. Studer was the first to call attention to this[192] and although his statement, that in the Swiss Bronze Age caprovines had become the most frequent domestic animals, holds good only for the Lake District in the west of Switzerland,[193] it is a fact that in all other areas too they had become more frequent than in previous periods. Tschumi suggested that the large-scale development of caprovines in the Bronze Age was due to the change-over from leather and skin garments to woollen ones,[194] but, in addition to this, southern and south-eastern cultural elements must also have had a role to play. In the Bronze Age the numerical proportion of wild animals fell markedly,[195] far beyond that of the Neolithic, but forest animals continued to be exploited.

So far no significant bone samples of the Bronze Age of Germany have been studied.[196] In Slovakia Ambros worked on Bronze Age settlement faunas from Dvory and Žitavou[197] and Gánovce (Fig. 2/21).[198] The bone sample from the first site is too small to be evaluated; in the second site the occurrence of wild animals (chiefly forest animals and birds) was fairly high (37.77 per cent of the individuals); pigs were the most frequent among

[188] Kuhn, E., Güller, A., 1946, p. 365
[189] Rüeger, J., 1942, pp. 252—253
[190] Hescheler, K., Rüeger, J., 1940
[191] Wettstein, E., 1924, pp. 78 ff.
[192] Studer, Th., 1900, p. 107
[193] Hescheler, K., Kuhn, E., 1949, p. 323
[194] Tschumi, O., 1949, p. 602
[195] Hescheler, K., Kuhn, E., 1949, p. 319
[196] Three small Bronze Age bone samples studied by Boessneck (1958b, pp. 10 ff.) are not high enough to serve as a basis for such an evaluation. Of the Wasserburg material described by Vogel (1929, pp. 455 ff.) we only know the faunal list (domestic animals: cattle, sheep, goats, pigs, horses, dogs) and the fact that red deer was the species most frequently hunted, but there were also large numbers of wild swine, whereas cattle were the most important among domestic animals
[197] Ambros, C., 1958, pp. 66—81
[198] Ambros, C., 1959, pp. 47—70

domestic animals, with cattle and caprovines following but very few horses.[199]

In the Romanian Bronze Age, too, a development in animal keeping and a decline of hunting could be observed, particularly when compared with the Neolithic and Copper Age fauna samples from the same sites, for example, at Valea Lupului, where layers of the Copper Age Cucuteni B culture were stratified below those of the late Bronze Age Noua culture (end of the 2nd millennium B.C.) (Fig. 2/23).[200]

Composition of the Valea Lupului fauna[201]

	Cucuteni B				Noua culture			
	speci-men	%	indivi-dual	%	speci-men	%	indivi-dual	%
cattle	294	56.76	25	35.21	787	63.06	102	52.05
caprovines	38	7.32	8	11.27	189	15.14	39	19.90
pig	28	5.40	6	8.45	124	9.94	24	12.24
domestic or wild pig	6	1.15	2	2.82	4	0.32	2	1.02
horse	—	—	—	—	118	9.46	16	8.14
dog	3	0.57	2	2.82	7	0.56	3	1.53
aurochs	11	2.13	4	5.63	—	—	—	—
red deer	96	18.57	12	16.90	4	0.32	2	1.02
other wild animals	—	—	—	—	5	0.40	3	1.53
domestic animals	363	70.05	41	57.75	1225	98.16	184	93.88
wild animals	148	28.61	27	38.02	19	1.52	10	5.10

As can be clearly seen from the above table here, too, caprovines increased considerably in the Bronze Age, first especially to the detriment of wild animals; in addition horses were not as rare as in the Bronze Age settlements of Central Europe. Pigs firmly held their third place. The situation was very similar to Piatra Neamţ and Bîrlad, two other settlements of the Noua culture, but in these latter there were more wild animals.[202] It is interesting to note that the bones of the aurochs were missing from all three settlements, indicating that intensive domestication of local animals had been terminated.

In the Ukraine the end of the Tripolye culture coincided with the Bronze Age and in this same period there was a marked increase of caprovines and horses and decrease in the frequency of wild animals. In the settlement of the Catacomb culture, which by and large corresponded with Tripolye C_2 culture, at Kobjakovo Gorodishtche, on the grassy steppes, there occurred 12 per cent cattle, 27.5 per cent caprovines, 12 per cent horses, 36.5 per cent

[199] Ambros, C., 1959, p. 63
[200] Haimovici, S., 1962, pp. 296—297
[201] Haimovici, S., 1962, pp. 296—297
[202] Haimovici, S., 1964, p. 220

dogs and 12 per cent wild animals, but no pigs.[203] This fauna gives a telling example of the effect of the environment on the formation of animal keeping. No less striking is the example provided by the two settlements on the steppes belonging to the Timber Grave culture in the late Bronze Age at Suskanskoye 1 (Fig. 2/19) and at Moyetchnoye Ozero I.[204] At these sites a large number of cattle and caprovines were found, with a medium number of horses, very few pigs and a minimal quantity of dogs, and a medium number of wild animals. On the other hand, at two settlements of the same period but belonging to the Prikazanskoj culture at Atabayevskaya (Fig. 2/20) and Balynskaya[205] which were not located on the steppes, there were a great many cattle and horses, a medium amount of pigs and caprovines, and a minimal quantity of wild animals or no wild animals at all. But in several other Bronze Age sites an increase in caprovines and horses and a decrease in the number of wild animals could be demonstrated.[206] On the Northern Steppes this development was not so marked. For example the bone sample from Kostyonki comprised 64 per cent cattle, only 10 per cent caprovines and 1.6 per cent horses, but 20 per cent pigs.[207]

THE IRON AGE

From the last period of prehistory, the Iron Age, we have much fewer data on the fauna than from previous eras. Only of Austria, Switzerland, Germany and Bulgaria do we possess fauna evaluations — rather sporadic ones at that. But this is balanced by the huge quantity of material from the early Iron Age settlements of the European USSR.[208] This material contains about five hundred thousand animal bones from 150 settlements. These 150 settlements include Classical Greek from the northern shore of the Black Sea,[209] settlements of the Scythian period,[210] settlements of the Tchernyakovo culture from the forest-steppes but also settlements of Yuknov, Dyakovo, Upper-Oka, Ananino and Vetluga cultures in the forest belt. In the following we give Zalkin's description of the animal keeping and hunting of these settlements:

The population of the above settlements earned their livelihood by agriculture performed with the plough or with the hoe, by animal keeping, hunting, fishing and other activities. The importance of these different activities varied from tribe to tribe. In the forest belt, hunting was the most significant. Two-thirds of the bones found in the settlements on the river Vetluga belonged to wild animals; so had 52.4 per cent on the settlements

[203] Hančar, Fr., 1956, p. 96
[204] Zalkin, V. I., 1958, p. 276
[205] Zalkin, V. I., 1958, p. 276
[206] Pidoplitchko, I. G., 1956, pp. 10, 14, 30, 51, 145—146
[207] Yefimenko, P. P., 1934, p. 52
[208] Zalkin, V. I., 1960, pp. 7—109; 1964a, pp. 25—39; 1964b, pp. 1 ff.; Liberov, P. D., 1960, pp. 110—154
[209] Pidoplitchko, I. G., 1956, pp. 91 ff. Bibikova, V. I., 1958, pp. 143—155
[210] Zalkin, V. I., 1954, pp. 253 ff. Pidoplitchko, I. G., 1956, pp. 110, 125

of the Ananino culture. On the other hand the percentage of wild animal bones in the settlements on the Upper-Oka was 41.6 per cent, in those of the Yuknov culture 27 per cent and in the settlements of the Dyakovo culture 20.6 per cent. Among the settlements of the forest-steppe zone, those in the territory of Orel—Kursk are, from this point of view, closer to the settlements of the forest belt than to those of the steppes with a 40 per cent frequency of wild animals. In the other settlements of the forest-steppe, however, the number of wild animals was considerably lower, particularly in the Scythian settlements in the middle reaches of the Volga and in the area of the river Vorskla in the Ukraine, west of the Dnieper. There were even fewer wild animals in the settlements of the Tchernyakovo culture. Among the agricultural tribes of the steppe the role of hunting must have been very slight, with the exception of the settlements of Kamensk and Gavrilov, where the frequency of wild animals was higher, 18.9—21.3 per cent. Among the Scythian tribes only distinguished personages participated in hunting activities, chiefly for the sake of sport. In the economy of the towns of the northern coastal region of the Black Sea hunting played a completely insignificant role; in general, the occurrence of wild animals was below 5 per cent. The situation was similar in the Scythian settlements of the lower reaches of the Dnieper and of the Bug, of the area of the river Ingulet and of the Kimmer Bosporus region.

Most of the hunted animals were ungulates. These were particularly frequent in the settlements of the steppes, where they comprised two thirds of the wild animals. In the steppe zone hunting was pursued in order to procure food. In the forest belt on the other hand, where the chief purpose of hunting was to acquire fur, only one quarter—one third of the hunted animals were ungulates.

Among the domestic animals cattle were the most important, their bones having been found in every settlement. They occurred in the greatest number in the settlements of the Tchernyakovo culture, in spite of the fact that in these settlements horses were preferred for draught animals. In the forest belt the numerical proportion of horses rose to 30 per cent; in the Scythian settlements of the forest-steppe belt their frequency was generally 25—30 per cent. In other settlements of the forest-steppe belt and of the steppe belt their numerical ratios varied greatly. On the other hand, on the northern coastal region of the Black Sea they were frequent in the period of the Roman Empire but in the Hellenistic (and particularly in the Classical Greek) period they were very rare, which shows that towns of Ancient Greece became rural only gradually. The castration of bulls was customary with a view to obtaining draught animals; in the settlements of peoples who tilled the soil with ploughs an especially high number of oxen may be found (with the exception of the settlements of the Tchernyakovo culture, where — as we have pointed out — horses were used as draught animals. In settlements where hoes were used for tilling the soil, the bones of oxen are rarer.

Among the small ruminants sheep were more frequent; goats were especially rare in the forest-steppe belt, but they were more frequent in the northern coastal region of the Black Sea, where in the Ancient Greek colonies

Distribution of cattle according to sex on the settlements of peoples using the hoe and the plough respectively for tilling the soil[211]

	type of agriculture	female	male	oxen
settlements of the northern coastal region of the Black Sea	ploughing	75.2	7.9	16.9
Scythian settlements of the forest-steppe belt	ploughing	75.7	5.7	18.6
settlements of the Tchernyakovo culture	ploughing	94.0	3.0	3.0
settlements of the Dyakovo culture and of the Upper Oka	hoeing	76.2	18.2	5.6

they made up 40 per cent of the small ruminants. Caprovines were rare in all the settlements of the forest belt, but particularly in the settlements of the Ananino and Dyakovo cultures. In the settlements of the Upper Oka they comprised 20 per cent of the total sample. On the other hand, they were frequent everywhere in the steppe belt. In the coastal region of the Black Sea their proportion among domestic animals exceeded 30 per cent in the Period of the Roman Empire and was over 50 per cent in the early Hellenistic and particularly in the Classical Greek period (Olbia, Kimmer Bosporus). In the settlements of the middle reaches of the Volga, as well as of the forest-steppe zone in the Orel—Kursk region and of the middle reaches of the Don — similarly to the settlements of the forest belt — caprovines were insignificant. In the other settlements of the forest-steppe belt, on the other hand, small ruminants made up 20—30 per cent of the total inumber of domestic animals; thus, these sites have a transitional character between the settlements of the forest belt and of the steppe belt.

In the coastal region of the Black Sea the numerical ratio of pigs was insignificant and never rose above 20 per cent; at Kamenskiye Kuntchugury and the Scythian settlements of the lower reaches of the Dnieper, of the Ingulets and of the southern area of the Bug their proportion was below 10 per cent. This may have been due to the fact that pigs were unusual domestic animals for the Scythian tribes that had settled down in this region[212] (moreover the nature of the soil in the steppes of South Russia were not favourable to large-scale pig breeding). Among the cultures of the forest belt pigs' bones made up half of the total of bone samples in the Dyakovo culture and a quarter in the other forest cultures. In the sites of the forest-steppe belt, on the other hand, the numerical proportion of pigs varied greatly, being high in the area of the river Vorksla and in the West Ukraine and low in the region of the middle reaches of the Don.

[211] Zalkin, V. I., 1960, p. 53; 1962, p. 107

[212] Cf. the conditions of animal keeping in Hungary during the Period of the Árpád Dynasty

In settlements of the forest belt the horse was one of the most frequent species: in the settlements of the Ananino culture it occurred with a frequency of 36.5 per cent and its frequency never fell below 20 per cent (Dyakovo culture). But with the steppe tribes, who had become sedentary, it was much rarer, its numerical proportion fluctuating between 10.5 per cent (Olbia) and 17.9 per cent (Gavrilovo), and so far reaching only 7.2 per cent in the Classical Greek layers of Kimmer Bosporus. It is significant that only a few horse bones occurred in the settlements in the lower reaches of the Dnieper, fewer than in the settlements of the forest belt with the lowest numerical poportion of horse bones. There were a few exceptions to this; e.g. the Kamenka settlement with 38 per cent of horse bones. From this point of view the settlements of the forest-steppe zone are also highly varied. The Scythian settlements of the middle reaches of the Volga resemble those of the Ananino culture, with a great many horse bones. There are slightly fewer horse bones is the forest-steppe settlements of the Orel—Kursk area and of the middle reaches of the Don; on the other hand, there were much fewer horse bones in the settlements of the northern Donets region and of the Ukraine west of the Dnieper (these settlements resemble the sites of the Dyakovo culture). The proportion of horse bones was similar in the settlements of Seim, Sula, Psel and Vorskla, in the West Ukraine and Moldavia. There are particularly few horse bones in the material of the Ukraine and of the Tchernyakovo culture. Their occurrence in the forest and the forest-steppe belts may have been due to the fact that the tribes living there pursued crop rotation system and tribes of the steppe and some of the southern forest-steppe tilled the soil with a plough. The former kept horses chiefly for their meat and the latter for their draught power.

Among other domestic animals donkeys were introduced to the northern coastal region of the Black Sea by the Greeks, who brought them to the Greek colonies and their vicinity. Camels were rare and occurred only in settlements of the steppe belt, to which they had spread from the regions in the lower reaches of the Volga and the territories beyond the Caspian Sea. The earliest occurrence of camels originates from Kamenskiye Kuntchugury (5th—3rd century B.C.). Dogs, although rare, were widely scattered; cats appeared with the Greek colonization and were found, almost exclusively, in Greek town colonies. But the Scythians quickly adopted them: in the 6th—5th century B.C. they were the domestic animals of Scythian lords. Cats, however, did not find their way into the forest belt during the Iron Age.

Although Zalkin does not mention domestic fowl, they have been found both in the Greek and in the Roman layers of Olbia[213] and occurred most probably in the larger Scythian towns too. Their connexions with the Persians, who played the principal role in spreading the domestic hen, are well known; but hens may have been adopted from the Greeks as well.

With respect to Bulgaria, in the Thracian town of Seuthopolis (4th—3rd century B.C.) 9 per cent of the bones were from wild animals (red deer and wild swine were the most frequently hunted species), and the rest were

[213] Pidoplitchko, I. G., 1956, pp. 90, 92; Bibikova, V. I., 1958a, pp. 143 ff.

domesticated species comprising 45 per cent cattle, 25 per cent caprovines, 12 per cent pigs, 5.5 per cent horses, 2.8 per cent dogs and a single bone of the domestic cat (Fig. 2/27).[214]

The only Iron Age bone samples from Yugoslavia came from the cemeteries of the Hallstatt period in the vicinity of Ljubljana, in which large numbers of horses and cattle were found.[215] In Austria, material has been found at Hallstatt, the eponymous site of the early Iron Age, dating to transition from the Hallstatt period to the La Tène period up to the end of the Period of the Roman Empire.[216] Part of the bone sample was found in settlements and part in cemeteries and their attribution to the several Iron Age periods is not always accurate. Thus it can only be stated that the fauna comprised a large number of cattle, caprovines and pigs with few horses, dogs and wild animals. Amschler described the bone sample from Bludenz (dating to the transition of the late Bronze Age to the Urnfield Culture up to the Period of the Roman Empire, i.e. from 1000 B.C. to 300 B.C.), as about 10 per cent wild animals, in particular red deer, about 50 per cent cattle, a large number of caprovines, few horses, fewer pigs, about 4 per cent, and very few dogs.[217] In Amschler's opinion only the uppermost classes of the population kept horses; on the other hand, there was probably local domestication of pigs.[218]

Of the early Iron Age in Switzerland faunas originating from Sissacherfluh,[219] Montlingerberg (on the northern edge of the Alps) and Motatta–Ramosch (Central Alpine region)[220] have been published. At the first site mostly cattle and pigs along with some caprovines and horses were found. At the two latter sites in the lower layers of which there was Bronze Age material, the decrease in the numerical proportion of wild animals compared with their ratio in the Bronze Age is clearly discernible. In addition, a decrease in the numerical ratio of cattle can be observed at Montlingerberg and of pigs at Motatta–Ramosch in the Hallstatt C–D periods.

In addition to the above, Wittnauer Horn also yielded a late Bronze Age–early Hallstatt period fauna,[221] in which cattle were the most frequent domestic animals, followed by pigs, whereas the other species of domestic animals were considerably rarer.

We have much better information on the fauna of the late Iron Age in Switzerland. At La Tène, the classic site of the period, Keller concluded that the horse was the most frequent domestic animal (with an occurrence of 30 per cent).[222] A similar situation was found at this site also by Schwerz.[223] For this reason the settlement was considered to have been a military outpost. We would suggest that it is due rather to defects in the collection

[214] Markov, G., 1958, p. 135
[215] Bökönyi, S., 1964d, pp. 277 ff.
[216] Amschler, W., 1949, pp. 36 ff.
[217] Amschler, W., 1937, p. 242; 1939, p. 223
[218] Amschler, W., 1937, p. 242; 1939, p. 223
[219] Leuthard, F., 1930, pp. 589 ff.
[220] Würgler, F. E., 1962, pp. 39 ff.
[221] Rüeger, J., 1945, pp. 105 ff.
[222] Keller, C., 1913, pp. 140 ff.
[223] Schwerz, F., 1918, p. 466

of the bones, in the course of which it was chiefly the conspicuous well-preserved bones of horses (horses were not eaten and therefore their bones were not broken up) which were collected. According to Schwerz hunting played only a minor role.[224]

Stampfli has described a relatively small faunal sample from Engehalbinsel bei Bern, in which wild animals were represented only by a single roe deer (with two bones), whereas domestic animals comprised, in order of frequency, caprovines, pigs, cattle, dogs, horses, and hens.[225]

At the Celtic settlement in the area of the Basel Gas Works, cattle were the most frequent domestic animals, with pigs and caprovines next, and horses far behind. Hens were very rare and so were wild animals.[226] The fauna of the Celtic settlement at Geneva was very similar; cattle and pigs, with an approximately equal numerical ratio were by far the most frequent; caprovines were much rarer, and then dog, horse and three bones of birds.[227]

Finally, Kuhn has described the faunas of three smaller late Iron Age sites (Borscht,[228] Bonaduz,[229] and Schneller[230]) emphasizing the predominant role of animal keeping as opposed to hunting.

In the settlement fauna of Heuneburg in South Germany (dating from the early Urnfield Culture to the early La Tène in five layers)[231] no (quantitative or qualitative) changes took place in the course of the occupation apart from the fact that domestic hens occurred from the late Hallstatt period onwards. Hunting was insignificant (5 per cent wild animals). Among the domestic animals pigs were the most frequent, followed by cattle; caprovines were much rarer and there were very few horses and dogs (about 1 per cent).

Boessneck described the fauna of some smaller sites from Bavaria with bone samples of no importance.[232]

From the late Iron Age the greatest quantity of bone samples (several hundred thousand bones) were found in the Celtic oppidum at Manching in South-West Germany (Fig. 2/28).[233] In the life of the population of this Celtic settlement, which was a veritable town, hunting played only a very slight role and the number of wild animals remained below 2 per cent. Among the domesticated species pigs were the most frequent species (32.7 per cent of the individuals), then came cattle (29.25 per cent) and caprovines (27.98 per cent), leaving dogs (4.37 per cent), horses (3.22 per cent) and hens (0.55 per cent) far behind. Thus there was evidence at this site also of the process which could be well observed in Switzerland and Germany in that

[224] Schwerz, F., 1918, p. 472
[225] Stampfli, H. R., 1959—60, pp. 417 ff.; 1961—62, p. 505
[226] Stehlin, H. F., Revilliod, P., 1914, pp. 1—2
[227] Revilliod, P., 1926a, pp. 11 ff.; 1926b, pp. 65 ff.
[228] Kuhn, E., 1937, pp. 4 ff.
[229] Kuhn, E., 1946, pp. 163 ff.
[230] Kuhn, E., 1951, pp. 251 ff.
[231] Schüle, W., 1960, pp. 1—36
[232] Boessneck, J., 1958b, pp. 12 ff.
[233] Boessneck, J., 1958b, pp. 16 ff.; 1961, p. 371

towards the end of the Hallstatt period and the beginning of the late Iron Age cattle became less important as compared with smaller animals (caprovines and pigs). The increase in the importance of pigs was particularly striking; this domestic animal is characteristic of sedentary peoples and suited the settled Celts very well. In this region, of course, the suitable natural environment — fairly thick-foliose woods and greater moisture — promoted the development of pig keeping on a larger scale than amongst the Scythian tribes of South Russia. (These latter were a sedentary population, but the dry steppe environment hindered the development of any significant pig keeping.) In addition, the hen seems to have become well established in the La Tène period.

THE ROMAN IMPERIAL PERIOD

In Austria, Switzerland and South Germany the transition of the La Tène period into that of the Roman Empire can hardly be distinguished. Thus the material from Manching and several Celtic settlements in Switzerland shows that even before the Roman conquest the population had been subject to a number of Roman influences, which left their mark, among other things, on animal keeping. A large number of late Iron Age settlements continued to be occupied during the Roman rule either with an unchanged way of life or transformed into a Roman settlement or camp. The high level of animal keeping (even of stock breeding) of the Roman Empire summarized by a number of Roman authors had a strong influence during the Roman rule upon the animal keeping of these territories, even of those settlements which were located beyond the frontiers and therefore not exposed to the direct effect of Roman civilization. Keller wrote the following: "Wherever Roman colonization continued for a considerable time it contributed significantly to raising the standard of agriculture. By the improvement of the local stock and the importation of new breeds, livestock breeding experienced a vigorous upswing. In the Celtic provinces this is most conspicuous in the breeding of cattle."[234]

During the Roman rule the fauna of aboriginal settlements did not differ much from that of the Romans. Animal keeping dominated both, the significance of hunting being minimal, and the numerical ratio of the different species of domestic animals was also similar. However, there was one difference: in the aboriginal settlements species introduced by the Romans (ass, camel, peacock, guinea fowl, etc.) did not occur at all and the typically Roman breeds of animals appeared only rarely. A good example of an original aboriginal settlement that remained unchanged during the Roman rule is to be found at Engehalbinsel bei Bern, in whose Roman layers Kuhn identified a single bone of a wild animal, whereas he found cattle the most frequent domestic animal, followed by pigs, then came unequally very small numbers of caprovines, horses and dogs.[235]

[234] Keller, C., 1919, pp. 48, 235
[235] Kuhn, E., 1932, pp. 531 ff.; 1933, p. 24; 1933, p. 24

In the Roman camps, canabae and towns of Switzerland and South Germany the numerical proportion of domestic animals was similar,[236] but caprovines were more numerous than horses and dogs and hens occurred everywhere, sometimes in quite high numbers, e.g. at Regensburg-Kumpfmühl Altersheim with approx. 10 per cent.[237] The Roman villa at Alpnach was perhaps the only place where cattle were not the most frequent domestic animals, but were preceded by pigs and caprovines.[238] The significance of the increase in cattle keeping in the Period of the Roman Empire was, in all likelihood, a sign of a breakaway in the late Iron Age from the trend to wards ruralization, which is also indicated by the introduction and spread of Roman breeding animals.

From the Germanic settlement of Wittislingen (2nd–4th century A.D.), in the part of Germania not under Roman rule, faunal material similar to that of Roman settlements was excavated. Here wild animals were represented by three individuals of red deer only; the frequency order of domestic animals was: cattle, pigs, caprovines, horses, hens and dogs.[239] At Oberdorla, the sacrificial site of the western Germanic tribes, domestic animals also predominated (cattle, sheep, goats, pigs, horses and dogs), with cattle in the majority.[240]

At Sroda-Slaska-Slup, in the west of Poland (Fig. 2/32) (2nd–3rd century B.C.) there was a greater proportion of wild animals (9.17 per cent) found than in the previously mentioned places; pigs were very frequent, compared with caprovines and horses, which were very rare; there were no hens at all.[241] The whole fauna resembled that of a late Bronze Age or Hallstatt period settlement. From the settlements of the Period of the Roman Empire in South-East Poland there was only a fauna list originating from old excavations (cattle, caprovines, pigs, horses, dogs, red deer and roe deer), from which the frequency of the species could not be ascertained.[242]

We have already mentioned the domestic and wild fauna of the Roman sites on the northern coastal region of the Black Sea (Fig. 2/30) and have indicated that the numerical ratio of wild animals was low; among the domestic animals, cattle were the most frequent followed by caprovines, pigs, horses and dogs. Water buffaloes, asses, cats and hens were also found among the domestic animals and the numerical proportion of mules often exceeded that of horses.[243] In the "Barbarians'" settlements also dating to the Period of the Roman Empire (Fig. 2/31) cattle were the most frequent domestic animals followed, depending on the geographic situation of the

[236] Schlosser, M., 1888, pp. ff.; Sickenberg, O., 1938, pp. 150 ff.; Neumann, A., 1951, p. 17, Note 80; Habermehl, K., 1957, p. 67; Boessneck, J., 1957a, p. 103; 1958b, p. 20; Würgler, F. E., 1959, 278; Dannheimer, Fr., 1964, p. 13

[237] Boessneck, J., 1958, p. 21

[238] Kuhn, E., 1932, p. 532; 1933, p. 23; Stampfli, H. R., 1959–60a, pp. 417–418

[239] Boessneck, J., 1958b, p. 21

[240] Teichert, M., 1962, p. 74

[241] Sobocinski, M., n.d., p. 151

[242] Myczkowski, K., 1934, pp. 57–58

[243] Pidoplitchko, I. G., 1956, pp. 92–93; Bibikova, V. I., 1958, pp. 143 ff.

settlements, by caprovines, pigs or horses; in general the number of wild animals was low, though sometimes it was strikingly high.[244] In these settlements hardly any traces of Roman animal breeding could be discerned, apart from the sporadic presence of hens.

THE MIGRATION PERIOD

In many ways these latter settlements belonged to the Migration Period. As already mentioned, we have very few settlement faunas from this period for the very reason that people of this era did not settle in one place for very long, and in a great many cases they were genuine nomads. Bones are often found in their cemeteries as grave goods; they are single bones or partial or complete skeletons; they originate mostly from domestic animals that could be easily driven (horses, cattle, sheep). But in the graves of these cemeteries bones of the domestic animals which are characteristic of sedentary population (pigs, hens) can often be found. This raises the question of whether the placing of these animals in graves indicates that the autochthonous inhabitants were conquered by nomads and buried their dead in the cemeteries of the conquerors, or that they were absorbed by the conquering people, or whether it indicates the settling down to a certain extent of the former nomadic people. No doubt, a great many inferences can be drawn from the bone samples of the cemeteries. But the clarification of this question requires collation with archaeological and physical anthropological evidence.

On the basis of the fauna of the few Germanic settlements at our disposal, e.g. that of Xanten (Batavian),[245] Nauen-Bärhorst (Langobard), Kliestov bei Frankfurt a. Oder (Burgundian) and of Kablow (Semn)[246] the importance of animal keeping far exceeded that of hunting. Cattle were the most frequent domestic animals, followed by pigs, horses and finally caprovines. The great frequency of cattle and pigs is to be expected but what is surprising with Germanic peoples, who fought in particular on foot, is the frequent occurrence of horses. Is it possible that they especially used horses for draught animals instead of cattle?

THE MIDDLE AGES

The data on animal keeping in the Middle Ages, particularly on the early and middle phases, are as abundant as those for the Migration Period are scanty. Moreover, archaeological research of the Middle Ages has started vigorously but only recently so that the publications comprise the material of modern excavations, in the course of which the collection of the bone samples, the study of stratigraphy and separate analyses of the material

[244] Pidoplitchko, I. G., 1938, p. 143; 1956, p. 136; Zalkin, V. I., 1960a, pp. 104 ff.
[245] Sickenberg, O., 1938, p. 150
[246] Gandert, O. F., 1937—38, pp. 335 ff.

of each layer, archaeological dating, etc. have all been carried out using the most up-to-date methods. However, most Mediaeval faunas have one drawback: Mediaeval settlements generally comprise several habitation layers and, since later disturbances in the settlements are more difficult to discern than in cemeteries, the possibility of the material becoming mixed is always present. Naturally the material from a stratified Mediaeval settlement is valuable for the investigation of the evolution of animal keeping, since the changes which take place in the material of a single settlement are more reliable than those seen in the material of two different settlements which followed each other in time. In the former case the effect of even minimal differences in the environment can be eliminated. However, for the purposes of dating the appearance or disappearance of a certain species or breed it is more reliable to use the material of settlements with only one occupation layer.

In Switzerland the only Mediaeval fauna investigated comes from castles and this is characterized by a relatively high numerical ratio of wild animals: at Burg Grenchen (11th – 13th century) it is 11.7 per cent,[247] at Starkenstein (first half of the 13th century – middle of the 15th century) nearly 20 per cent,[248] and at Oberwangen (12th – 13th century) also, wild animals are represented in a considerable numerical ratio and by 12 species.[249] Rather fewer wild animals were found at Schwandiburg (end of 13th century)[250] and at Burg Heitnau (13th – 14th century).[251] In this latter site the wild birds were not included among wild animals although their number would have raised the ratio of wild animals considerably. A frequency of pigs, cattle and caprovines is characteristic of Mediaeval animal keeping; domestic fowl are rarer and the numerical proportion of horses and dogs is minimal. The former are often completely missing, the latter occasionally are. In all probability pigs were the most important animals providing meat; cattle were kept more for their milk and draught-power and sheep for their wool and meat.

In the Mediaeval castles of Germany there is a very similar relationship between domestic and wild animals: at Burgheim (7th century)[252] there were 9.4 per cent of wild animals (Fig. 2/33), at Hoher Bogen (end of 12th century) there were 9.6 per cent,[253] at Potsdam (Poztupini, a 6th – 12th century Wendic fortress) there were about 28.2 per cent,[254] and at Berlin–Köpenick (9th – 14th century) there were no less than 46 per cent[255] of wild animals. (Actually in this latter site the numerical ratio of wild animals is somewhat lower, because domestic fowl, which may have occurred at least in the fourth, that is the highest horizon in a frequency of a few per cents, have not been

[247] Stampfli, H. R., 1962, p. 164
[248] Würgler, F. E., 1956, p. 74
[249] Küenzi, W., 1959, pp. 77 ff.
[250] Küenzi, W., 1939, pp. 79 ff.
[251] Hartmann-Frick, H., 1957, p. 54
[252] Boessneck, J., 1958b, pp. 34 ff.
[253] Boessneck, J., 1958b, p. 38
[254] Enderlein, H., 1930, pp. 241 ff.
[255] Müller, H. H., 1959, p. 189

included among the domestic animals.) As is shown in the following table there was no difference between the Slavic and Germanic layers:[256]

horizon	number of bone specimens		number of individuals	
	domestic %	wild %	domestic %	wild %
1st	54.9	45.1	59.4	40.6
2nd	38.9	61.1	51.9	48.1
3rd	42.5	57.5	57.0	43.0
4th	44.1	55.9	54.0	46.0
Total	41.8	58.2	54.0	46.0

1st horizon = middle Slav period (9th–10th century)
2nd horizon = late Slav period (11th–12th century)
3rd–4th horizon = early Germanic period (13th century).

However, in the towns hunting played a much less important part in the castles, in the Hannover of the 11th—15th century only 1.6 per cent of wild animal bones occurred.[257] Animal-keeping on the other hand, based on the keeping of pigs and cattle, was of the same character both in castles and towns. These two species were alternately the most frequent domestic animals of all settlements and from this point of view no difference can be observed between German and Slav settlements. Caprovines were much rarer and horses occurred very seldom (the highest frequency of the horse was 5 per cent) and there were sites with no horses at all, e.g. Hoher Bogen) as did dogs. The numerical proportion of poultry varied greatly; in the fauna lists of some sites they do not occur because their bones were not taken into consideration by the excavators or the analysts of the bone samples.

A dwelling-place of the nobility in Württemberg has produced a most interesting animal bone sample (Unterregenbach, 10th—15th century).[258] There were a great many wild animals (13.8 per cent) and numerous pigs (41.6 per cent) found there, but fewer caprovines (20.6 per cent) and cattle (9.1 per cent) and very few horses and asses (2.9 per cent), dogs and cats (1.9 per cent); on the other hand a markedly high number of domestic birds (10.1 per cent) occurred.

In Poland a very rich material has been studied, for in recent years archaeological investigations have centred on the excavation of sites dating to the period of the foundation of the Polish state. In these settlements hunting played a very small part compared with animal keeping. In Poland, however, towns and settlements located especially by the sea or on rivers have been excavated, so that the numerical ratio of wild animals' bones

[256] Müller, H. H., 1962, p. 102
[257] Müller, H. H., 1959, p. 189
[258] Schatz, H., 1963, p. 7

is often higher than in German towns of the same period. Most of the wild animal bones belong to fish, indicating that they originate from fishing settlements. Most of the excavated towns were royal, princely, aristocratic or episcopal residences, which explains the higher numerical ratio of wild animals. Few wild animal bones were found at Wolin where Reich found 2.6 per cent (in 10th—14th century layers)[259] and Kubasiewicz found 2.0 per cent in the suburb (10th—12th century) and somewhat more in the town (9th—13th century).[260] These figures do not include the quantity of fish bones, whose number Reich did not indicate; in the material studied by Kubasiewicz they raise the numerical ratio of wild animals to 10 per cent.[261] At Bonikowo (8th—10th century) the proportion of wild animals was similarly low (1.77 per cent) (Fig.2/34)[262] and also at Milicz (10th—13th century) where it was 3.9 per cent.[263] At the same time in the town of Szczecin (9th—10th century) there were about 10 per cent of wild animal bones (Fig. 2/37),[264] in the suburb (10th—13th century) nearly 13 per cent (Fig. 2/38),[265] at Kamien–Pomorski (10th—13th century) 16.71 per cent,[266] and in Wroclaw–Ostrów–Tumski (10th—13th century) wild animal bones represented about 9.03 per cent.[267]

Animal keeping was based on pigs. In every site pigs were the most frequent domestic animals; in some places (Gdansk, 12th—13th century,[268] Kamien–Pomorski,[269] Szczecin,[270] Wolin,[271] Bonikowo,[272] Wroclaw–Ostrów–Tumski[273]) the number of pigs' bones found was as much as that of all the other domestic animals put together. Cattle followed pigs in the order of frequency (with the exception of Wroclaw–Ostrów–Tumski, where with only 0.18 per cent, cattle fell behind caprovines), and in general caprovines lagged far behind. Horses were very rare and occurred generally in 1 per cent only. (Only at Milicz there were 5.5 per cent and in Gdansk 7.3 per cent.) Dogs were even rarer and domestic birds, too, were found in very small numbers only.

Ambros described the fauna of four Slav settlements of the early Middle Ages in Slovakia.[274] Three of them yielded only very small bone samples but the fourth, Nitriansky Hrádok, contained 356 identifiable animal remains. In the fauna of this latter site the numerical proportion of wild animals was very low (3.95 per cent). Among the domestic animals the

[259] Reich, H., 1937, p. 2
[260] Kubasiewicz, M., 1959, Table 6
[261] Kubasiewicz, M., 1959, Tables 2, 5
[262] Sobocinski, M., 1963, p. 9
[263] Kubasiewicz, M., 1957a, p. 180
[264] Kubasiewicz, M., 1957b, p. 191
[265] Kubasiewicz, M., 1955, p. 74
[266] Kubasiewicz, M., 1958b, p. 242
[267] Myczkowski, K., 1960, p. 152
[268] Krysiak, K., 1955, p. 238; 1956b, p. 8
[269] Kubasiewicz, M., 1958b, p. 242
[270] Kubasiewicz, M., 1955, p. 74; 1957b, p. 191
[271] Reich, H., 1957, p. 2; Kubasiewicz, M., 1959, Tables 2, 5, 6
[272] Sobocinski, M., 1963, p. 9
[273] Myczkowski, K., 1960, p. 152
[274] Ambros, C., 1958, p. 415; 1962a, p. 255

frequency of cattle was high above the others (48.59 per cent) followed by pigs (26.96 per cent). Caprovines and horses were very rare. Strangely enough it is only in the rareness of horses and caprovines that the animal keeping of this settlement resembles that of neighbouring settlements in Poland. The total number of wild animal bones was similar at Budmerice (14th – 15th century)[275]: the total number of individuals represented by the wild animal bones reached 9 per cent which, in the Mediaeval context, is quite considerable. The advance of poultry at the end of the Middle Ages was clearly visible in the domestic fauna, for domestic birds were the most frequent among domestic animals, their numerical ratio being over 30 per cent, a proportion cattle and pigs, following each other closely, did not reach. Caprovines were also rare; horses, on the other hand, were strikingly frequent (10 per cent) and so were dogs (8.5 per cent) and domestic cats (9.3 per cent).

In the fauna of Popina in Bulgaria (a village of the 4th – 7th and of the 8th – 12th centuries, the bone samples of the two periods, unfortunately, not being kept separate) wild animals were extraordinarily rare, representing a mere 0.73 per cent. Among the domestic animals there was a tremendous predominance of cattle (66.6 per cent) followed by pigs (14.5 per cent). Caprovines and horses were rather rare (9.9 and 7.7 per cent respectively); dogs and hens also occurred in very low numbers.[276]

Animal keeping in the greater part of the European USSR, the Mediaeval Russ, has been studied in great detail. Bogolyubsky,[277] Andreyeva,[278] Gromova,[279] Zalkin[280] and Pidoplitchko[281] dealt with the question from the point of view of zoology, Lebasheva[282] approached it from the side of archaeology and ethnography.

It can be stated that here too in the Middle Ages hunting was generally of little significance compared with animal keeping. The bones of wild animals are mostly below 10 per cent of the total fauna, though their number rises considerably in the settlements located in the great swampy forests. In fact in this latter region they exceed even 50 per cent, e.g. at Grodnó (12th – 16th century),[283] or in the 9th – 10th century settlements in the area of Voronezh.[284] However, whereas at Grodnó 98.2 per cent of the wild animals were made up of ungulates hunted for their flesh (red deer, bison, wild swine, roe deer, elk in this order of frequency) and in one of the settlements of the Voronezh area (Kuznetsova dacha) the four ungulate species (roe deer, wild swine, elk, red deer) made up 70.8 per cent of the hunted animals with the remainder comprising fur-bearing animals, in another settlement of the Voronezh area (Borševo I) the same ungulates and the saiga antelope made

[275] Ambros, C., 1962a, p. 268
[276] Ivanov, St., 1956, p. 94
[277] Bogolyubsky, S. N., 1929, pp. 75 – 89
[278] Andreyeva, V. G., 1940
[279] Gromova, V. I., 1948, pp. 113 – 123
[280] Zalkin, V. I., 1956, pp. 5. ff.
[281] Pidoplitchko, I. G., 1956, pp. 40 – 41, 59; pp. 63 ff., 122
[282] Lebasheva, V. P., 1956, pp. 76 – 93
[283] Zalkin, V. I., 1951, p. 521; 1956, pp. 178 – 179
[284] Cromova, V. I., 1948, pp. 122 – 123

up only 35.1 per cent of wild animals, the remainder comprising — with the exception of the hedgehog and vole — fur-bearing animals; the beaver, with its particularly valuable fur being represented by 44.7 per cent. In the early Mediaeval settlements of Latvia, in similar environmental surroundings, wild animals were also frequent but their numerical ratio never reached 50 per cent of the total number of individuals.[285] Here the character of hunting was like that found at Borševo I; predominantly fur-bearing animals, in particular beavers were hunted. Thus at Grodnó and Kuznetsova dacha the aim of hunting was to provide food, at Borševo I and in the settlements of Latvia it was aimed at acquiring furs.

Pigs and cattle were by far the most frequent domesticated species.[286] Caprovines and particularly horses lagged far behind them. In the northern part of Mediaeval Russ (Staraya Ladoga, Kamno, Pskov) pigs were the most frequent among the species of domestic animals, then came cattle and caprovines, with horses far behind them. In the north-east of Russ (Suzdal, Staraya Ryazan) cattle were more frequent than pigs and caprovines were very rare. In the so-called Tchornaya (Black) Russ (Grodnó) cattle and pigs constituted the bulk of domestic animals; here too caprovines and horses were seldom to be found. On the other hand, in the south, in the region of Kiev and Volin the importance of pig keeping diminished and that of caprovine keeping increased. This was due to the effect of the drier climate, but the fact that numerous peoples or ethnic groups to a greater or lesser extent of Turkish origin had given up their nomadic way of life and settled down in this southern region, also contributed to caprovines having become more important. It was also due to the same peoples that horse keeping was more important in this region than in the central and northern territories. Up to the 14th—15th century the keeping of domestic birds was not important anywhere; it is interesting, on the other hand, that the 12th century Russkaya Pravda mentioned cranes and swans amongst domestic birds.[287]

The composition of animal keeping in Mediaeval Russia as outlined above, is greatly reminiscent of the character of animal keeping in the Middle Ages in Poland, Germany and Switzerland, but proceeding further westward, it also resembles the animal keeping of the Slav settlements in Schleswig—Holstein (Oldenburg, Scharstorf[288], and of Mediaeval Lübeck,[289] Haithabu,[290] etc.). On the other hand it differs from the animal keeping of Hungarian settlements dating to the beginning and middle periods of the Middle Ages which were characterized — as already mentioned — by the marked frequency of cattle and horses, by the rather lesser number of caprovines and by the small numerical ratio, smaller even than that of caprovines, of pigs.

[285] Zalkin, V. I., 1961, p. 221
[286] Zalkin, V. I., 1956, pp. 143 ff.; Lebasheva, V. P., 1956, pp. 178—179
[287] Lebasheva, V. P., 1956, p. 179. In the period of the Turkish occupation, and perhaps even earlier, tamed cranes (and herons) were often kept in castles and manors in Hungary too (Takáts, S., 1917, pp. 67 ff.)
[288] Stampfli, H. R., n.d., p. 111
[289] Nobis, G., 1955, p. 6
[290] Herre, E., Novis, G., Requate, H., Siewing, G., 1960, p. 15

Two types seem to be discernible in the quantitative composition of the domestic fauna in Mediaevel Europe: the first associated with peoples who settled down earlier and the second with people who settled down only at the end of the Migration Period or the beginning of the Middle Ages. This is confirmed in an interesting way by the situation of animal keeping in Volga–Bolgaria.[291] Here, in the 12th—13th century layers of Velikij Bolgar (Fig. 2/35) a great many caprovines were found; then came cattle and horses but pigs did not occur at all. The situation was similar in 13th—14th century layers, though the numerical ratio of caprovines had fallen somewhat and that of cattle and horses had risen; pigs had appeared, though they remained rare and reached the frequency of horses only by the 17th—19th century. (Of course, religious factors also played a part in this; the population belonged to the Islam religion which prohibited the consumption of pork.)

Composition of the fauna of Veliky Bolgar
(After Zalkin)

	12th—13th cent.		13th—14th cent.		17th—19th cent.	
	specimen %	individual %	specimen %	individual %	specimen %	individual %
cattle	31.72	18.95	40.21	25.53	30.13	19.32
caprovines	48.34	48.42	35.69	34.05	47.48	47.34
pig	—	—	0.98	5.67	3.21	10.23
horse–ass	14.70	16.84	18.64	17.73	15.56	10.61
camel	0.22	1.05	0.06	0.71	—	—
dog–cat	4.95	13.69	3.50	10.64	2.80	9.09
domestic animals	99.93	98.95	99.08	94.33	99.18	96.59
wild animals	0.07	1.05	0.92	5.67	0.82	3.41

SUMMARY

Summarizing the development of animal keeping in Central and Eastern Europe it can be stated that the sporadic and isolated domestication of dogs and perhaps of sheep carried out in the course of the Mesolithic did not launch any genuine animal keeping in this area. European animal keeping was started with the domestic animals — caprovines in an overwhelming majority — which, in the 7th millennium B.C., in the pre-pottery Neolithic in Thessaly found their way from South-West Asia to the Balkan Peninsula. It was from there that domestic animals spread towards the north and north-west at the very beginning of the Neolithic. By this time the whole European Neolithic domestic fauna of cattle, sheep, goats, pigs and dogs had come into being. The domesticated horse did not occur until the Copper Age. The influence of the animal keeping being introduced from South-West Asia and the local geographical and climatic conditions resulted in the initial

[291] Zalkin, V. I., 1958, p. 277

phase of the Neolithic of emergence in the animal keeping based on caprovines and cattle in the Balkan Peninsula and in the Carpathian Basin as well as on the latter's eastern border regions. In some places, however, this animal keeping was hardly more important than hunting and gathering. In the Starčevo culture hunting was still of vital importance in the subsistence economy.[292] Thus in this region the Neolithic Revolution was not as yet established. In this initial phase of the Neolithic the domestication of locally domesticable animals had not yet begun in any significant measure: the local population possessed the animals but they had not learned or developed a method of domesticating them. As against the above mentioned territories animal keeping in other regions of Central Europe (e.g. Switzerland) and in Eastern Europe was of even lesser significance; domestication had not been started here yet, or only to a very slight extent.

The next phase in the evolution of animal keeping is characterized by the local development in Europe of the techniques of domestication so that the settlements became independent of the importation of domestic animals Domestic animals were bred locally and their numbers were increased by domestication. This process may have taken place in the Middle Neolithic (from the 4th millennium B.C. at the earliest) and lasted, approximately, to the end of the Copper Age. In this period caprovines were pushed into the background by cattle and pigs which were locally domesticable, with the exception of South Russia, the Southern Ukraine and the Balkan Peninsula, where special geographical conditions prevailed; moreover, the latter area always maintained its contacts with South-West Asia. In numerous regions, such as the Carpathian Basin, the Ukraine and Wallachia hunting itself served the purposes of domestication.[293] In the same period the importance of hunting considerably decreased but rose again to a certain extent towards the end of the Neolithic. Of course, the proportion between hunting and animal keeping as well as the quantitative composition of the domestic fauna was subject to strong fluctuations according to regions and cultures. It is very interesting to note, on the other hand, the correspondence in the fauna composition of settlements of the Tisza—Herpály—Lengyel complex, the early Tripolye culture, the Funnel Beaker culture (=TRB), the Zseliz group and the Linear Pottery culture and the Bandkeramik. In this period also there was a certain influx of elements from the south-east associated with a certain domestic fauna, as seen for example in one of the components of the Tiszapolgár culture. But the domestic fauna underwent substantial changes only at the end of the Copper Age and the beginning of the Bronze Age. The horse made its first appearance towards the end of this period but its domestication became widespread only in subsequent periods.

The next phase of animal keeping began with the beginning of the Bronze Age and the end of the Copper Age, when immigrants from the south and south-east brought with them a domestic fauna, which was similar both

[292] Childe, V. G., 1958, p. 49

[293] In Kritchevsky's opinion (Childe, 1958, p. 134) an economy based chiefly upon animal breeding and hunting may have been the most efficient way of achieving success with Neolithic tools and under European soil conditions

in its origin and in its composition to that of the early Neolithic. The leading element of this fauna was again the caprovine. Although caprovines could not retain the high numerical ratio they had had at the end of the Copper Age — this decrease being due to the environmental situation in the temperate belt of Europe — and often fell behind cattle, they were more important than pigs. From the middle of the Copper Age onwards, the large-scale local domestication in these regions ceased so that the numerical ratio of cattle and pigs, which could be locally domesticated, fell considerably. The appearance of the horse in large numbers was the characteristic feature of animal keeping in this period. This new species of domestic animals became particularly frequent in the animal keeping of the steppe cultures of South Russia, though it was quite frequent also in the Bell Beaker culture. In this period, the significance of animal keeping compared with hunting increased and, generally, the numerical ratio of wild animals fell to about 10 per cent. This phase in the evolution of animal keeping lasted until the appearance of the Scythians and Celts and the Romans respectively.

These latter peoples promoted animal keeping substantially by introducing breeding selection and an expedient feeding of domestic animals, thus laying the foundations of conscious animal breeding. Moreover in a way which is not yet fully understood these peoples introduced the most frequent species of our modern domestic fauna: the domestic hen. This phase in the development of animal keeping might be termed the starting point of animal breeding, characterized as early as in the husbandry of the Scythians and Celts by the appearance of well definable breeds. Moreover, in the Roman husbandry the improvement of domestic animals can be proved not only on osteological grounds but also by the special contemporary literature dealing with this subject. In this period social and economic differences grew more sharply defined and are manifested to a certain extent in the numerical composition of the domestic fauna. The Scythians — at least a part of them — retained the animal keeping characteristics of an equestrian nomadic people, with a large number of domestic animals which could be easily driven (cattle, caprovines, horses). In contrast the Celts who were a sedentary people, bred predominantly pigs and cattle; in their settlements caprovines and especially horses were very rare. In the settlements of the Roman Empire cattle were generally the most frequent domestic animals, followed by caprovines and pigs in alternating numerical ratios. Horses were rare with the exception of military outposts and camps where cavalry were also stationed. Domestic hens could be found in practically every Celtic and Roman site; in Roman towns and villas they often occurred in considerable numbers. Hunting, on the other hand, was insignificant with all the three peoples, with the exception of some military garrisons along the borders, whose fauna showed the same features as that of the Bronze Age, from which it could be distinguished only by the occurrence of Roman breeds of domestic animals. In the regions of Central and Eastern Europe which were not under Roman rule during the Period of the Roman Empire the settlement faunas were characteristic of those of the Iron Age, and even sometimes of the Bronze Age: hunting played a fairly important role, animal keeping was archaic; among the domestic animals individuals of large (Roman) breeds could only sporadically be found in settlements near the borders of the Roman Empire.

The domestic fauna of the few Germanic settlements of the Migration Period was very similar. Here too, the domestic animals were without exception small, primitive breeds, as if the Migration of Peoples has swept away the improved Roman breeds of domestic animals from Central and Eastern Europe. The essential difference between the faunas of settlements of the Migration Period and of the Period of the Roman Empire, those areas which were not under Roman rule, was the rarity of wild animals in the former settlements. With the Migration Period, of whose fauna we know rather little, a new phase of animal keeping began, which was characterized by a certain decline. In this period breeding selection and therefore conscious animal breeding was in most cases brought to an end. This phase of development lasted until the late Middle Ages.

Thus, Mediaeval animal breeding was developed from a basis which was practically devoid of the results of the Roman Imperial Period. Doubtless, owing to the increasing density of the population in this period and the rapid growth of territories embraced by agriculture, cultivation and hunting diminished almost completely and ceased to play a role in the acquisition of food (with the exception of some East European territories where the environmental situation was exceedingly unfavourable for agriculture). In fact, hunting became a sport of people in the upper strata of society and remained a source of income in the north-eastern part of Europe. Animal keeping on the other hand increased in volume but not in quality. (Breeding selection, which would have meant an advance in quality, survived at most sporadically predominantly with respect to horses and dogs.) Differences in the fauna associated with differences in social position and settlement forms which had been evident since the period of the Celts and the Romans, became even more conspicuous in the Middle Ages. By Mediaeval laws hunting was only permitted to the nobility (commoners were allowed to hunt only as a result of special royal privileges granted to them and then they could hunt only certain animals in certain determined areas). Thus a large number of wild animal bones was found only in the material of royal, aristocratic or episcopal residences, castles and manor houses. The bones found in villages or common towns comprised virtually without exception exclusively domestic animal (or fish) bones. Among the bone samples from royal residences there occurred imported species of domestic animals (peacocks and perhaps also guinea fowl and turkeys). In towns there were more domestic fowls and fewer horses than in villages. The importance of poultry, especially hens, continued to increase in the course of the Middle Ages until finally its numerical proportion exceeded that of the most frequent domestic mammals. With respect to the composition of the fauna of domestic mammals the early Mediaeval settlements can be divided into two groups. The Slav and Germanic settlements of Central and Eastern Europe, towns and villages alike, belong to the first group, as do Hungarian towns. The second group comprises the Hungarian villages of the Period of the Árpád Dynasty as well as the settlements of peoples who had settled down in Southern Russia and the south of the Ukraine not long before.

The animal keeping of the first group is characterized by an alternating predominance of pigs and cattle; caprovines being much rarer, and horses being very rare or completely missing. (In these settlements horses were not eaten in general, or, if they were eaten, as was the case e.g. at Grodnó,[294] they occurred in very low numbers only.) With the other group cattle or caprovines were the most frequent domestic animals, though the numerical proportion of horses in the domestic fauna was also fairly high (often greater than caprovines); pigs, on the other hand, were very rare. (In this group horses were eaten, as is indicated by the great number of broken up bones of horses.) Animal keeping of the two groups differed also in its quantitative composition but also in the utilization of the different species. In the first group cattle were used predominantly for their draught power and were thus animals of agriculture. This is indicated by the relative infrequency of cattle in those settlements which were surrounded by marshes and thus could only possess agriculture on a very limited scale. In these settlements the numerical ratio of pigs also decreased although not to such an extent, their place being taken by animals hunted for their flesh. In settlements where the environment was not very suitable for agriculture, but where wild animals were hunted not primarily for their flesh but for their fur (9th—10th century settlements in Latvia) cattle declined as a draught animal, but pigs which provided meat retained their high frequency. The numerical proportion of sheep on the other hand, which were bred mainly for their wool, remained unchanged. With the second group horses were at least as important draught animals as cattle; cattle, horses, caprovines and pigs played a part as meat animals, whereas sheep had an additional use with their wool. Within the first group there was no essential difference between the animal keeping of Slav and Germanic peoples; neither within the second group was there a difference between that of the Magyars and of the peoples of Pontus. Thus the differences between the two groups were not of ethnic origin; they were the differences in animal keeping between those people who had been sedentary a longer time and those who had been settled for a fairly short time but had preserved the traditional numerical ratio in the composition of their livestock.

The next phase in the evolution of animal keeping began in the final phase of the Middle Ages, in the 14th—15th century, and lasted till the beginning of modern times, when scientific animal breeding was launched. In this period conscious animal breeding commenced again and resulted in the appearance of new breeds of domestic animals. No essential change in the relationship between animal keeping and hunting took place, though hunting gained ground temporarily in areas where long-lasting wars disturbed the order of the economy (e.g. the time of the Turkish occupation of Hungary). A decrease in mammals and an increase in birds was characteristic of the evolution of the domestic fauna. In the same period a final wave of south-eastern domestic fauna invaded certain territories; the Turks introduced to some regions they had occupied an animal keeping dominated by caprovines. This, however, neither spread generally nor did it exert a lasting effect.

[294] Lebasheva, V. P., 1956, p. 121

FACTORS INFLUENCING THE DEVELOPMENT OF THE DOMESTIC FAUNA

Finally we should like to investigate another group of questions, viz. the factors which influence or bring about the quantitative and qualitative character of domestic fauna, that is the causes which — separately or combined — render a species frequent or rare in the domestic fauna. The answers to all these questions have been included in the discussion of the historical evolution of animal keeping; here we attempt only to group and to summarize them.

Indeed, the problem is rather complex. It is possible here to enumerate at least seven groups of factors which contribute to quantitative composition of the domestic fauna:

1. Geographical and climatic factors.
2. Factors connected with zoogeography and domestication.
3. Factors connected with the use of the domestic animals.
4. Ethnic reasons.
5. Factors associated with class-structure and types of settlement.
6. Factors connected with the techniques of husbandry.
7. Religious causes.

The effect of these factors may, of course, become mixed, they may follow from each other or they may overlap. In addition, the effect of each factor is not identical in different periods. Thus, for example there is no doubt that environmental factors are universally the most important; similarly it is clear that in prehistoric times zoogeographic factors and questions of function were of decisive importance, but later the significance of these diminished compared with the increasing effect of the four last factors mentioned above; nevertheless the environmental factors maintained their decisive significance. It is impossible at present, however to judge the reasons in a particular case for some of the subsidiary factors exerted a stronger influence than the others.

1. Geographical and climatic factors are closely linked and in fact cannot be separated. From the very beginning of domestication they affected its development and do so even today, although to a lesser extent. These factors can influence the spread and frequency of a species of domestic animals not only through the conditions of the soil and the temperature but also through the fodder reserves.

We do not want to refer at this point to such extreme examples as the case of the arctic regions under the special conditions of which only reindeer and dogs can survive. It can also be observed in the temperate zone that on large plains, unless they comprise the steppes, the domestic animals are large species. A good example of this is the Great Hungarian Plain where from the Neolithic up to the end of the Middle Ages cattle were the most frequent domestic animals. (Horses may also be taken into consideration, but they did not occur in this region in the Neolithic, and in later periods their number was smaller than that of cattle for reasons to be discussed in two points below.) During the above period cattle were pushed into the background only when people arrived from other geographic surroundings bringing along their livestock, whose composition had been adapted to a different environment. The animal keeping of peoples intrusive to the Great Plain, however, was quickly transformed to adapt to local environmental conditions.

With large plains of steppe character, as e.g. in the settlements of South Russia and the South Ukraine, sheep take the place of cattle.[295] Among the karstic and dry mountains of Mediterranean or Sub-Mediterranean areas which provide only scanty pasture of a poor quality, sheep and goats are frequent[296] and pigs are more important in wooded, humid and marshy regions.

Climatic changes also influence the formation of the domestic fauna. From this point of view there is an essential difference between wild and domestic fauna: if the climate changes to one to which the wild species are not suited, they may migrate, but domestic animals are unable to do so. And yet, the climate has an effect on the composition of the domestic fauna in that man, the master of domestic animals, is compelled to transform his animal keeping to suit the changed climate. Transformations in the fauna of the Bronze Age settlement at Tószeg is the best example of this.[297] This settlement by the river Tisza was occupied throughout the Bronze Age. During the 1948 excavations the bone samples were collected according to layers. Analysis of the bone samples indicated the effect of the climate which had become humid and cool during the Bronze Age in transforming not only the wild, but also the domestic fauna: the number of species more suited to a dry climate decreased whereas those which like humidity increased. (Since domestic animals cannot escape the change of climate they try to adapt themselves to the new conditions by changing their character — this problem is discussed in the relevant chapters.)

2. There is a close connexion between the frequency of domestic animals and zoogeography and domestication conditions. This was already evident in the early stages of domestication, for a species can only be domesticated in a place where its wild form exists.[298] Moreover, in the initial stages of animal keeping a particular domestic species was only frequent in places where its domesticable wild form lived and where man actually domesticated it. Thus, for example caprovines found their way in a very high numerical

[295] Pidoplitchko, I. G., 1956, pp. 90 ff.; Zalkin, V. I., 1958, p. 277

[296] See R. Popov's works, as well as Boessneck, J., 1956d, pp. 1 ff.; 1962, p. 28; Josien, Th., 1956b, p. 724

[297] Bökönyi, S., 1952a, pp. 108–109

[298] Dyson, R. H., 1953, p. 661

ratio to the Carpathian Basin in the beginning of the Neolithic in vain, since they had no domesticable wild ancestors in this area and thus they had soon to surrender their predominance to cattle and pigs, which had wild ancestors locally. As already mentioned, this was due to the fact that under the prevailing conditions of the Neolithic and the early Copper Age and the poor knowledge man had about animal keeping, the progeny of domestic animals was unable to ensure meat and, at the same time, to increase the quantity of livestock. For this reason man — who learnt the other uses of domestic animals — made use of the possibility of domestication too with a view to increasing his livestock. Thus it is understandable that the species that could not increase their number except by natural multiplication became less important than those which were able to increase their number both by natural multiplication and by long-term domestication.

As we have seen, there are two species in the temperate belt of Europe that have local wild forms: cattle and pigs. And, indeed, in the course of prehistoric times and particularly of the Neolithic and the Copper Age these two species were the most frequent in this area. In the case of cattle local domestication explains why this species was the most frequent domestic animal in the Great Hungarian Plain. The horse as rival species had no domesticable form in the area but in the Pontus region, where its wild ancestors lived; horses became very frequent as soon as domestication started.

3. Use also had a role in deciding whether a species of domestic animals should spread or become rare. Boettger has classified useful domestic animals into six groups: 1. hunting companions and watch animals, 2. animals supplying meat, 3. animals producing foodstuffs, 4. animals yielding clothes and decorative articles, 5. saddle and draught animals and beasts of burden, 6. animals carrying messages.[299]

The above enumeration reveals that certain domestic animals can be included in one group only, i.e. they have only one use; while others can be referred to several groups. Excepting horses and dogs all our domestic mammals passed the stage of one use (at the beginning each was only a meat animal), some, e.g. the pig, has remained at this stage, while the others proceeded towards several uses.

Under prehistoric conditions man preferred the species of domestic animals — whose number increased in the domestic fauna — that had the highest number of possible uses. (Today the tendency prevails to breed for one use only, since the increase of the yield can be achieved only by specialization.) Thus, within the species of cattle, which used to have three uses — milk, meat and draught power — man attempts to select breeds for milk and others for meat, whereas the draught power is wholly neglected because it is almost entirely replaced by machines. (It is on account of its threefold use that cattle are so frequent in the prehistoric sites of the European temperate belt, and this is the third reason why it preceded the horse in the prehistoric fauna of the Great Hungarian Plain, since the horse has but two uses: meat and draught power.)

[299] Boettger, C., 1937, p. 2345

In the course of time the use of different domestic animals has also undergone a change. The above discussion has shown the evolution from one use into several; but it has to be pointed out that a new use often eclipses an old one. And if the new use did not occur with another species and was particularly valuable for man he — perhaps even at the expense of other domestic animals — started breeding that species, whose numerical ratio consequently increased in the fauna. Sheep is an example to illustrate this. In the early Neolithic, and later again at the beginning of the Copper Age large stocks of sheep were introduced to Central Europe, but the geographic-climatic conditions were not conducive to their multiplication nor did their domesticable wild form live here, thus sheep could not reach a considerable frequency in the domestic fauna. But by the end of the Copper Age, the ratio of woolly individuals, which had occurred but sporadically in the Neolithic, rose within the species and owing to peoples changing over from leather and skin garments to wool, sheep acquired the second place in frequency and at times even preceded the cattle.

4. Doubtlessly there is a connexion between the frequency of the domestic fauna and ethnicalism. For how could it be otherwise explained that the quantitative composition of the animal keeping of two peoples, living at the same time under similar geographic conditions and identical possibilities of domestication should differ? Here is an example to show this in the Carpathian Basin: the faunal compositions of the Tisza culture and of the Zseliz group of Linear pottery. Both cultures kept cattle, first of all. However, with the former pig was the second important domestic animal and caprovines with the latter, and this is consistently shown at every settlement of either people.

But the reverse may also be true that cultures evolving from each other, or bearing close relations have a domestic fauna of a very similar or often identical composition. The Tisza culture again provides a good example; its animal keeping being identical practically in every detail with the Herpály and Lengyel cultures, which developed from it. The latter is also similar to the Lužiánky group in Slovakia being a close relation. Economic conditions should have more weight in determination of prehistoric cultures (besides animal keeping, hunting should also be considered, for these two pursuits represent a highly significant part of prehistoric economy). The exploration of this economic basis will certainly throw a different light upon the other factors too.

However, not only in prehistoric times but in later periods too the differences in ethnicalism brought about changes in the composition of the domestic fauna, but these divergences were often linked with dissimilarities in geographic conditions, manners of husbandry or religious prescriptions. Thus, e.g. the Scythians chiefly kept species that could be easily herded (cattle, caprovines, horses), whereas in the livestock of the Celts the pigs dominated and there were only a few horses. But the difference in the early Middle Ages between the animal keeping of the Germanic and Slav peoples on the one hand and of the Magyars and the peoples of the steppes in South Russia and in the Southern Ukraine on the other was not of an ethnic character but was much influenced by date of settling down, the more so as the contemporaneous domestic fauna of the Hungarian towns and castles was like that of Slav and Germanic settlements.

5. The differences in animal keeping caused by class structure and various forms of settlements emerged at the time of the Celts and also during the period of the Roman Empire. We have already seen the differences between the domestic faunas of a Roman villa farm, military camp, canabae, a border outpost or the village of the native population. The origins of modern animal keeping can be seen in the first three, whereas the latter is quite prehistoric in this character; i.e. the domestic fauna reflects not only the manner of the settlements but also the differences in the way of life. (In the first three types of settlement the beginnings of a civilized way of life can be observed, whereas in the latter two a practically prehistoric way of life is pursued.) Likewise there are marked differences between the domestic fauna of Mediaeval villages, towns, royal, aristocratic and episcopal residences and manor houses of the nobility.

We shall not dwell upon the differences important in animal keeping and hunting but shall discuss only the dissimilarities in animal keeping. In the development of animal keeping villages were always lagging behind towns and castles, etc. Here, no doubt, tastes played a role, for the bone samples of settlements do not represent accurately the numerical composition of the domestic fauna. Moreover, animal keeping in towns and castles was minimal for the greater part of the meat requirements was covered by animals driven up from the villages. It is obvious that they procured such animals from the villages — be it by means of purchases or compulsory deliveries, or, in the case of the nobility and aristocracy from their estates — whose meat they liked. On the other hand, the peasantry ate the meat they liked or rather what had been left for them. It is also doubtless that certain species (pigs and hens), whose bones frequently occurred among the samples found in towns could be kept there too for they needed little space only, moreover, because they could be fed almost entirely on the garbage of the household.

Ever since the Roman Period the fare of the privileged often comprised imported animals (peafowl, guinea fowl, etc.), unaccessible to the poorer classes, which stratification also contributed to the differences in the domestic fauna.

6. The fact that different ways of husbandry entail domestic faunas of different quantitative compositions is quite obvious. Evidently, nomadic herdsmen will keep, first and foremost, domestic animals that can easily be driven (cattle, caprovines, horses); tilling the soil with a plough demands a number of draught animals (cattle, horses) but if the natural surrounding is not suitable for this type of agriculture the numerical proportion of these species will decrease even with the same people. This group of factors is often blended with many previous ones (geographic-climatic and ethnic reasons, structure of society and settlement forms), consequently it is often impossible to decide which factor has played a part.

7. Finally, religious rules may also play a role in the quantitative composition of the domestic fauna. Herodotus reported on the Scythian tribes not eating pork (Zalkin also referred to settled Scythians that they were

reluctant to keep pigs[300]), and the same was noted down on the Semitic and Hamitic pastoral people, too.[301] The best known example is the prohibition forbidding Jewish and Muslim people to eat pork. And that this prohibition was observed – at least by Muslims – is evinced by the bone samples found at the residence of the Pasha of Buda, in which out of the 1460 identified bones only five originated from pigs. Of course, these religious restrictions can in most cases be traced back to geographic, ethnic, social and even hygienic reasons (in the case of the pig, e.g. to trichinosis).

[300] Zalkin, V. I., 1964a, p. 15
[301] Antonius, O., 1922, p. 242

THE EMERGENCE OF THE SPECIES OF DOMESTIC MAMMALS IN CENTRAL AND EASTERN EUROPE

CATTLE

THE IMPORTANCE OF CATTLE

If we regard the domestic animals of the temperate zone from the viewpoint which is nearest and most closely linked with man, no doubt the horse and the dog will stand first; but considering usefulness and the manifoldness none can vie with cattle. Zeuner is absolutely right when he writes: "It is no exaggeration to say that the domestication of cattle was the most important step ever taken by man in the direction of exploitation of the animal world, after the initial step of the domestication of the dog."[1] Indeed, the domestication of cattle opened up new paths in animal keeping, the species spread very quickly as a domestic animal and became the leading member in animal keeping.

In Central and Eastern Europe this has been our most important domestic animal and even if in certain periods, regions or with certain peoples some other species were more favoured as meat animals, up to modern times its economic importance has not been surpassed by any other species. In analyzing the reasons we have to refer to examples in Hungary.[2]

In Hungary, cattle were not only the most important but — with the exception of two or three epochs or cultures — up to the end of the Middle Ages — also the most frequent domestic animals. This can be traced back to three reasons.

The first is *geographic and climatic* in character. Plains, unless they are of the steppe type, are primarily suitable for the keeping of large animals. Among small ones goats are the domestic mammals of mountainous and hilly regions, sheep of drier plains, pigs of wooded areas rich in waters. Under such circumstances cattle in Hungary had only one rival: the horse. But horses appeared only in the Copper Age and in greater numbers at the very beginning of the Bronze Age, and they could not compete with cattle for the following two reasons: as far as climatic conditions were concerned the warm and drier climate of the Neolithic gave an advantage to cattle, which is proved by its number, sometimes amounting to 80—90 per cent, in the domestic fauna of the settlements. In the Bronze Age, however, when the

[1] Zeuner, F. E., 1963, pp. 240—241
[2] Bökönyi, S., 1962a, pp. 77—78

climate was cooler and more humid, its ratio declined to two-thirds or to half of the former.

The other reason why cattle were so frequent is connected with *domestication*. To reach a high frequency in a certain region under the conditions of prehistoric times it was also necessary for a domestic species to have a considerable number of the species of wild animals inhabiting the territory in question, i.e. animals suitable for domestication. It was from this wild stock that prehistoric man could increase his stock of domestic animals.

The third reason why cattle played a predominant role in Hungary's domestic fauna too was its *threefold use*. Already from the end of the Neolithic onwards cattle were equally useful for their meat, milk and draught power and from these points they had no rivals under temperate conditions.

GROUPING OF TYPES

Before going into the question of the origin of cattle let us survey in brief the types into which this species can be grouped.

The grouping is based on differences of the skull. The classification according to types of domestic cattle was started by Rütimeyer, who distinguished three types from the bone samples of Swiss lake dwellings.[3]

1. The *primigenius* type; characterized by its craniological correspondence with the aurochs (*Bos primigenius* Boj.). The skull of this type is a reduced replica of that of the aurochs and is characterized, primarily, by long and thick horn cores, a broad and straight frontal ridge and a flat and not uneven front. Spanish cattle kept for bull-fights and Scottish park cattle may be considered as characteristic representatives of the *primigenius* type.

2. The *brachyceros* type: as evinced by its name this type is characterized, first and foremost, by the short and thin horn cores. Other features are a narrow, wavy frontal ridge hollowed in the middle and the narrow and relatively long front (on account of this characteristic it is mostly termed in Anglo-Saxon literature rather as *longifrons*), which, in contrast with the front of the former type, is very uneven. Cattle of the brown group of breeds are the best known representatives of the *brachyceros* type.

3. The *frontosus* is characterized in the first place by its wide front, roof-like frontal ridge and short horns. At first Rütimeyer supposed that this type had had an independent wild ancestor but later he proved that essentially it is only an improved form developed from the *primigenius* type. Swiss piebald cattle are considered to be its most characteristic representative.

Wilckens added a fourth type: the *brachycephalus*.[4] In addition to short horns and a wide, uneven front a marked shortening of the facial part is characteristic of it. The latter feature in an extreme may produce a pug-head. The describer considered Ering and Tux-Zillertal cattle to be the characteristic *brachycephalus* breeds. But it soon turned out that in the

[3] Rütimeyer, L., 1861, pp. 135 ff.
[4] Wilckens, M., 1877, pp. 165 ff.

course of domestication the skull and particularly its facial part generally becomes shorter and that individuals with such shortened facial parts can be found in every species and breeds alike. Consequently, the *brachycephalus* cattle should not be considered as an independent type.

Arenander described the fifth type, calling it *akeratos*.[5] This type is characterized by its hornlessness. The describer thought that proceeding northwards one would find an increasing number of hornless cattle, which state was not attributed to human interference. This approach was not new since it had been described as early as in the 5th century B.C. by Herodotus: : "... in warm areas horns will quickly appear but in bitterly cold ones cattle will not have any horns or if they have any they will be very short."[6] Strabon, a contemporary of Augustus, was of the same opinion and he noted that in cold regions some cattle are hornless by nature, but he also pointed out that "... some have their horns cut off (because that part of their bodies is very sensitive to the cold)."[7] Rütimeyer[8] and David[9] did not consider hornless cattle an independent type but a variant of other types. This view is even better founded today when — the keeping of hornless cattle having become virtually a fashion — hornless individuals can be bred by will in any breed through human breeding selection.

The *orthoceros* was established by Stegmann[10] as the sixth type. This group includes certain steppe cattle of Central Asia and Eastern Europe (Kirghizean, Kalmuck cattle of the Don, of Nogai, etc.) which have relatively long, erect horns. Their skull is elongated and wedge-shaped tapering forwards and its height measurements are great. The frontal crest between the horns is narrow and straight and sometimes has a small protuberance in the middle. The describer separated these from the *primigenius* group and believed that they had zebu interbreeding. However, it is highly probable that these cattle belong to the *primigenius* group, being local variants. (Later we shall see that the aurochses of dry regions were lighter, had narrower skulls and more erect horns than was usual.) No doubt, the narrow skull and frontal ridge of the *orthoceros* group point to links with the zebu. Besides, long horned Hungarian grey cattle are close to this type, which again shows that the type corresponds with the *primigenius* of dry territories.

The last group comprises the zebus, characterized by their fat lump (neck or withers hump; segregable into two sub-groups), but their very narrow and elongated skulls and their narrow frontal ridge between the two horns. There are both short and long horned variants among them. They are not discussed here because they do not play any part in the animal keeping of the areas under investigation.

Essentially European domestic cattle can be classified into two types: the *primigenius* and the *brachyceros*. There are such great craniological differences between the two types that quite a number of researchers in-

[5] Arenander, E. O., 1896, pp. 15 ff.
[6] Herodotus, IV. p. 29
[7] Strabon, Geographica, VII — 3, p. 18
[8] Rütimeyer, L., 1865, p. 220
[9] David, A., 1897, p. 28
[10] Stegmann, F. P., 1912, pp. 39 ff.

sist on their different origins. Frantzius was the only author who supposed that all types of European domestic cattle had non-European wild ancestors,[11] Zengel, on the other hand, excluded the aurochs from a direct lineage of the ancestors of domestic cattle because he considered the *primigenius* type to have been bastards of the aurochs and of domestic cattle,[12] Arenander again supposed a hornless ancestral form.[13] Apart from these, other authors agreed that the aurochs was the wild ancestor of at least one type of cattle, the *primigenius*.

But there was another question to be answered. What was the wild ancestor of the *brachyceros* type of domestic cattle? The first group of authors traced their origin back to the banteng holding the view that the zebu was the link between the banteng and the *brachyceros* type. Rütimeyer was the first to profess this view,[14] which was then spread by C. Keller and his school.[15] However, this camp soon lost its adherents when the thorough examinations pursued by Gans proved that the skull of the banteng, especially its occipitals, differed so much from that of the taurine forms that no link of origin can be found between the two.[16]

Another group of authors attempted to derive the *brachyceros* type from a separate, short horned wild species. Owen was the first to describe small cattle allegedly found in Pliocene and Pleistocene layers in England, which he, at first, called *Bos brachyceros*. Later, however, when it turned out that Gray had given the same name to a West-African water buffalo, he termed it *Bos longifrons*.[17] Later similar finds were discovered in different parts of Europe, the most significant of which were found in different late diluvial and early alluvial sites in Galicia and Poland and described by Adametz under the name of *Bos europaeus brachyceros*.[18] It was on the grounds of these finds that Adametz first professed *brachyceros* domestic cattle to have originated from the short horned wild cattle. This theory gained acknowledgement in a very wide circle and stimulated Amschler to describe just before the Second World War the short horned "wild cattle", the *Bos brachyceros arnei*, from South West Asia.[19] And although as early as in 1927 Koch doubted the wild character of Adametz's *Bos europeaus brachyceros*[20] and Szalay contested it in 1930,[21] its legend vanished only after the Second World War. La Baume proved that in all probability Adametz's short horned cattle was alluvial domestic cattle,[22] and that Amschler's *Bos brachyceros arnei* was the cow of the aurochs.[23] The skull found at Pamiat-

[11] Frantzius, A., 1877, p. 35
[12] Zengel, W., 1910, p. 168
[13] Arenander, E. O., 1896, p. 42
[14] Rütimeyer, L., 1861, p. 142
[15] Keller, C., 1909, p. 74
[16] Gans, H., 1915, pp. 48 ff.
[17] Owen, R., 1846, p. 213
[18] Adametz, L., 1898, pp. 37 ff.; 1915, pp. 1 ff.
[19] Amschler, J. W., 1939a, p. 115; 1939b, pp. 106 ff.
[20] Koch, W., 1927, p. 358
[21] Szalay, A. B., 1930, p. 185
[22] La Baume, W., 1947, p. 313
[23] La Baume, W., 1947, p. 315

kowo and described by Adametz was considered by Lengerken too to have belonged to domestic cattle, on account of its asymmetric horns.[24]

A third group of authors derives all types of domestic cattle (most of them even the zebu) from the aurochs. Nehring was the forerunner of this group, who set forth that the *brachyceros* domestic cattle too originated from the aurochs or from one of its variants.[25] Today Nehring's theory is widely recognized, though its followers are split into two groups: the first considers the typical *Bos primigenius* to have been the wild ancestor of all types of domestic cattle, whereas the other one deems it to have been the wild ancestor only of *primigenius* type of cattle, and derives the *brachyceros* type from a small variant of the former.

It is most likely that in the question of the origin of cattle the assumption of a monophyletic origin is the right one. However, to give final decision it would be necessary to examine the bone samples of the aurochs — accumulated in considerable quantities by now — on grounds of the same principles and by means of a uniform method. The investigation of the bone samples of the Ice Age to ascertain whether they show differences of subspecies or breeds that could have been essential in the evolution of the two types of domestic cattle would be of particular importance. The examination of the so-called "dwarf aurochs" (Zwergur) would be especially important, for they were considered by Nehring to be degenerated aurochses,[26] by Leithner to be cows of the aurochs,[27] and by Hilzheimer to be domestic cattle in the first stage of domestication.[28] It would be highly important to decide what role dwarf aurochs could have played in the development of the *brachyceros* type. In our view this is the cardinal point of the whole question about the origin of cattle. Today it is customary to separate finds of the aurochs from those of cattle on grounds of order of magnitude. The essence of this separation, based on practical experience, is that bones above certain measurement limits are said to belong to the aurochs and below them to cattle. (Quite recently this separation has been rendered more subtible by examining the fine structure of the bones through Roentgen methods.[29] However, this has not altogether solved the problem.) If the selection is based on bone measurements as described above, in Neolithic sites — where bones both of wild and domestic cattle may be encountered — in cases when bones of small aurochses turned up they would almost certainly be identified as those of domestic cattles. For this very reason the examinations should be performed on Pleistocene aurochs bones, because here the possibility of the occurrence of domestic cattle's bones is excluded and so is the error of identification.[30]

However, small aurochses keep on appearing again and again in literature. Thus, lately Burtchak-Abramovitch described Pleistocene small

[24] Lengerken, H. v., 1955, p. 15
[25] Nehring, A., 1888a, p. 230
[26] Nehring, A., 1888a, pp. 230–231
[27] Leithner, O. V., 1927, p. 27
[28] Hilzheimer, M., 1928, p. 108
[29] Bökönyi, S., Kállai, L., Matolcsi, J., Tarján, R., 1964, pp. 3 ff.; 1965, pp. 330 ff.
[30] Bökönyi, S., 1962a, p. 79; 1962c, p. 182

aurochses from Baku'[31] and Perkins from the Shanidar Cave in North Iraq.[32] Unfortunately, the stratigraphic position of Burtchak-Abramovitch's finds is yet to be checked. Concerning the "phalanxes of aurochses" in Shanidar it has already been stated that they either originated from red deer, or else they were bones of domestic cattle washed in from upper layers.[33] On the other hand, it is a fact that to breed small domestic cattle it was not absolutely necessary to domesticate small aurochses, for, in the course of domestication, the size of the animals diminished considerably within a very short period of time. And because only young animals could be domesticated man was not obliged to seek for the smaller variants of aurochs, which should be broken in more easily as was supposed by Leithner[34] and by several other authors who adopted his view.[35] However, under unfavourable natural conditions small individuals or even whole populations may have developed among aurochses. Here we have in mind, first of all, the dwarfing tendency in an island stock, but poor conditions of nourishment, an unsuitable biotope, etc. may also cause a decrease in size.

Besides, in the emergence of *brachyceros* domestic cattle it may have happened that the *brachyceros* skull form represented a more advanced state of domestication. In this case domesticated cattle had to pass the *primigenius* "phase", at which some of their groups remained; others evolved further and reached the *brachyceros* "phase". Why certain groups kept on developing and others failed to do so — is not known. The above may be supported by the finds in the Neolithic settlements of Hungary where the *primigenius* type emerged during the domestication of aurochses, but simultaneously, though in smaller numbers, *brachyceros* cattle also occurred, with more advanced features of domestication. Whether these latter were the result of local domestication or had found their way there from other places remains an open question.

THE AUROCHS

The aurochs is of Indian origin, for the first known representative of the bovids in the strict sense of the term — first of all of the *Bos* subgenus — is the wild cattle known by the name of *Bos planifrons* Rüt. found in Pleistocene layers in India. One of its descendants, evolved in the later part of the Pleistocene, was the aurochs, which already during the Pleistocene began to advance westwards. In South West Asia this advance split into two branches: one proceeded along the southern coastal region of the Mediterranean and reached as far as North West Africa.

These were the southern aurochses of especially slender individuals. On grounds of their slender bones and their erect and open horn form Hilzheimer described a separate subspecies, denominated *Bos primigenius hahni*.

[31] Burtchak-Abramovitch, N. I., 1957, p. 165; pp. 184 ff.
[32] Reed, C. A., 1960, p. 141
[33] Reed, C. A., 1961, p. 34; Perkins, D., 1964, p. 1565
[34] Leithner, O. V., 1927, p. 134
[35] Hilzheimer, M., 1917, p. 87

Modern research, too recognized this sub-species[36] and Lehman even raised it to the rank of a species, which, in his view, may have constituted a link between the *Bos primigenius* and the Asian *Bos namadicus*.[37] The other branch evaded the Mediterranean in the north and reached Europe by this way.

(Aurochses of the former branch could not get to Europe through Gibraltar since this continent was separated from Africa by straits already in the Pleistocene.[38])

The type of aurochs referred to in literature evolved in Europe. The withers height of the females was 150—155 cm, that of the bulls reached 170 cm.[39] (These figures refer to the aurochs of the Holocene; those of the Pleistocene were even bigger and more powerful and their horn cores longer and thicker.[40]) A broad and straight frontal ridge bulging only seldom and very gently between the horns, but slightly protruding orbits and deep temples were typical of their skull being narrow and longish. The horns and horn forms were also highly characteristic. The typical Central European form had horn cores without necks and with the bulls bone-beads around the base. There the horns point outwards and a bit upwards only to turn forwards and outwards in a wide curve, whereas the tips point inwards and a bit upwards. Thus the span between the tips of the horn cores is smaller than the distance between the largest curves. This horn form can be observed not only on the skulls but also in prehistoric, first of all Paleolithic, pictures, etc. representing aurochses. The aurochs was often represented in prehistoric art even in periods when the species, owing to excessive hunting, had become quite rare (Fig. 3).

The same representations contributed — side by side with the bone samples — to the reconstruction of the animal's stature, too. The aurochs had a strong neck, without a dewlap, but the other parts of its body may have been poor in muscles compared with our present meat cattle. Its withers hardly protruded, its rump was relatively short and its legs long. (On these grounds the Augsburg picture of the aurochs originating from the first half of the 17th century[41] presents a correct picture of the animal — with the exception of the horn form, which resembles rather that of the southern form — as against the reconstructions of Herre[42] and Lengerken[43] where the horn form is authentic but otherwise the animal looks like a breeder bull of today.) The values of withers heights show that there were significant size differences between the two sexes of the aurochs.[44] The colours of the two sexes also differed considerably. Concerning the colour of the aurochs the authors set out from the Schönebeck find, where the hide survived on a small part of the skull. The part behind the horn cores

[36] Requate, H., 1957, p. 330
[37] Boessneck, J., 1957b, p. 65
[38] Requate, H., 1957, p. 306
[39] Boessneck, J., 1957b, p. 65
[40] Leithner, O. V., 1927, p. 3; La Baume, W., 1947, pp. 302 ff.
[41] Nehring, A., 1898, pp. 79 ff.
[42] Herre, W., 1953, pp. 1 ff.
[43] Lengerken, H. v., 1955, p. 7
[44] Herre, W., 1953, p. 3

had long, red hairs while the front short, white ones.[45] However, in the opinion of some authors the Schönebeck skull had belonged to domestic cattle of the late Middle Ages.[46] (This, by the way, is strongly supported by the white hairs on the front.) Thus, one could not but resort to contemporaneous representation and descriptions, whose critical evaluation has been performed by Szalay. He demonstrated that the colour of the aurochs resembled that of the bison, but was somewhat darker, almost blackish. In South

Fig. 3. Gold statuette of an aurochs from Maykop. Hermitage, Leningrad

Europe, however, it was a lighter brown, sepia-brown and greyish brown, whereas in Africa it turned into a light reddish brown but the abdomen and the inner sides of the limbs being a shade lighter. The horns were white with black tips.[47] Having examined the pictures of the aurochs at Lascaux, Zeuner adopted more or less the same view. He found the bulls to have been black or reddish black with a lighter stripe along the back and on the frontal ridge between the horns. The cows were reddish brown with darker heads and

[45] Auerbach, M., 1907, p. 11
[46] Szalay, A. B., 1930, p. 261
[47] Szalay, A. B., 1930, p. 262

legs, sometimes with a lighter stripe along the back. In the south there were probably lighter, yellowish brown cows, too.[48] (The colouring of the aurochs as described above often occurs in case of intercrossing different breeds of domestic cattle, such as, e.g. with the hybrids of the Hungarian white cattle and the Kostroma breed.)

Although the aurochs of the Pleistocene was bigger than that of the Holocene, the species could not spread in the Pleistocene to such an extent as it did in the Early Holocene. This was due to the fact that the aurochs were warmth-loving animals and could find suitable living conditions in the Ice Age when it was getting warmer, or in the southern parts of Europe. However, with the warming up of the Holocene — and particularly of the optimum climate introducing it — the species multiplicated tremendously and pushed the bison into the background which had been more frequent in the Pleistocene than the aurochs. It spread in the continent northward as far as the 60th degree of latitude.[49] In an interesting statistical study, Szalay tried to determine the proportion of aurochses and bisons in different regions of Europe by comparing the proportion of names of places and persons derived from the name of either animal. The result he obtained was 5 : 1 in favour of the aurochs (in Germany, e.g. he found 299 names derived from the name of the aurochs as against the 62 names connected with that of the bison), with the exception of Galicia and Poland, where the ratio was 3 : 1.[50]

Ever since the beginning of the Holocene the aurochs was subject to merciless hunting, which may have been performed primarily by laying traps (considering the formidable strength of the well-developed animals); but various animals were also used as bait as it is mentioned in ancient Frankish, Alaman and Longobard laws.[51] Hunting the aurochs from chariots was probably spread rather in Asia Minor, as is evinced by numerous representations. In Europe it was also hunted with arrows, a venture requiring great courage and skill. This is proved by a late Neolithic aurochs atlas (Polgár—Csőszhalom, Herpály culture) in the caudoventral surface of which a stone arrow-head got ossified, missing the spinal canal by a few millimetres only (Fig. 4). The animal survived and was killed some years later.

The hunt of the aurochs was mainly connected with the domesticability of the species. This is proved for example in Hungary by the fact that it became the most frequently hunted animal at the time when the large-scale domestication of cattle began in the Carpathian Basin: at the time of the "domestication fever" in the late Neolithic when man wanted to increase the number of his domestic animals by hook or by crook. As a result man had almost exterminated the aurochs in the Carpathian Basin, so much so that by the end of the Copper Age it ceased to be the most frequent species of hunted animals. In other regions of Europe a similar process was under course, though not to such an extent, because there the stock of

[48] Zeuner, F. E., 1953, p. 69
[49] Requate, H., 1957, p. 306
[50] Szalay, B., 1915b, p. 49
[51] Zeuner, F. E., 1955, p. 337

aurochses had never been as big as in the Carpathian Basin. The frequency of the aurochs in the Carpathian Basin can be accounted for by two reasons:[52] 1. the aurochs was an animal of the plains; 2. in addition, it was a species of the Atlantic type, which could endure the continental climate only with difficulties. In West Europe and in the western part of Central Europe, where the climate was more favourable for the aurochs, there are no great plains; in East Europe there are vast plains, though the climate is very continental. Thus it could find the most favourable conditions of life in the Carpathian

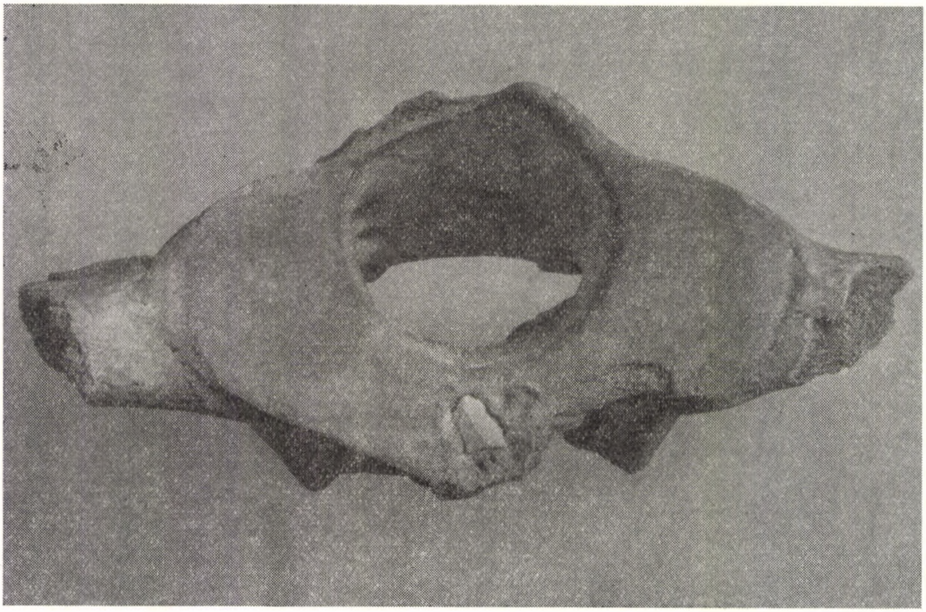


Fig. 4. Atlas of aurochs with arrowhead embedded in the bone. Polgár—Csőszhalom, Neolithic, Herpály culture

Basin. By the Copper Age the first period of the killing off of aurochs had come to an end.[53] The second phase ended toward the end of the Migration Period and by then — notwithstanding the laws by which it was protected up to the 6th—10th century in certain regions, e.g. in France[54] — the aurochs had become a rare animal. In Hungary this period fell upon the 7th—9th century A.D.[55] The third period, that of complete extermination, came to pass in various territories of the continent at different times depending on the density of the population, on geographic conditions and historical

[52] Bökönyi, S., 1962c, p. 184
[53] Bökönyi, S., 1959a, pp. 80—81
[54] Szalay, B., 1915a, p. 92
[55] Bökönyi, S., 1959a, p. 81

events. In the Balkans the aurochs still lived in the 9th century,[56] in Switzerland[57] and Schleswig-Holstein[58] at the turn of the first millennium. In France, Brunswick and Hungary it became extinct in the 13th century,[59] in East-Prussia in the 15th and in Lower Bavaria at the beginning of the 16th.[60] Under royal protection the species survived longest in Poland, where the last cow was killed by a poacher in 1627.[61]

Fig. 5. Drinking horn made of an aurochs horn. Primatial Treasury, Esztergom. Early 15th century A.D.

Nowadays attempts are being made at re-breeding the aurochs.[62] The essence of these experiments is that by cross-breeding different species of cattle, possibly of the *primigenius* type, the wild ancestor of our domestic cattle is expected to be produced. These efforts were criticised by Herre[63] and particularly by Koehler[64] who explained that from the viewpoint of genetics the endeavour was unfounded and hopeless. We are of the opinion that if someone wishes to breed *cattle* resembling the aurochs in its external features for the mere purpose of showing it in the zoo, that may be approved, however, we do not think the rebreeding of the original aurochs possible.

Ever since classic Antiquity the aurochs was considered a royal game in the Middle East and since the end of the Migration Period in Europe. Belts

[56] Szalay, B., 1938, p. 36; n.d., p. 58
[57] Szalay, B., n.d., p. 58
[58] Requate, H., 1965, p. 33
[59] Szalay, B., n.d., p. 58
[60] Lengerken, H. v., 1955, p. 106
[61] Wrzesniowski, A., 1878, p. 110
[62] Heck, H., 1949, pp. 406–407; 1952, pp. 107 ff.
[63] Herre, W., 1953, p. 4
[64] Koehler, O., 1952, pp. 498–499

were made from its hide and ornate drinking horns from its horns. These latter were first mentioned during the time of the Roman Empire. In a Greek epigram the Emperor Hadrian mentioned that Trajan, having defeated the Dacians, sacrificed from his booty, among others a goldstudded horn of Dacian aurochs (urus) to Jove.[65] In 1408 the grand master of the Order of Teutonic Knights presented Sigismund, King of Hungary and Emperor of the Holy Roman Empire, with two drinking horns made of the aurochs's horn[66] and Vitold, Prince of Lithuania, gave him a third one in 1429.[67] The former two (Fig. 5) are in the treasury of the Cathedral of Esztergom and the third may also be there.[68] In the treasuries of some other European cathedrals[69] and in the collections of some families[70] drinking horns and cups made of the horn of the aurochs are also preserved; the horn of the last aurochs cow killed in Poland also found its way into a collection: the royal treasury in Stockholm.[71] Belts made of the hairy hide of the aurochs were also considered valuable gifts.

The identification of aurochs remains among archaeological finds is very easy if complete skulls, bigger parts, first of all of brain skulls or horn cores are discovered. Identification is more difficult when the bones of the postcranial skeleton and particularly of their fragments are given. The problem here is their differentiation from the bones of the bison in the first line and of domestic cattle in the second. In the first case the works of Schertz,[72] Lehmann,[73] Bibikova,[74] Olsen[75] and Stampfli[76] offer valuable assistance, whereas Koch,[77] Hescheler and Rüeger,[78] Degerből,[79] Boessneck,[80] Bökönyi,[81] Stampfli[82] and Imhof[83] have published measurement limits for the latter. In discriminating between the bones of the aurochs and domestic cattle the Roentgen method[84] mentioned in the introduction is also very useful.

[65] Hilzheimer, M., 1910, p. 74; Szalay, B., n.d. p. 12
[66] Némethy, L., 1899, pp. 140 ff.
[67] Hilzheimer, M., 1910, p. 74; Szalay, B., n.d. p. 20
[68] Bökönyi, S., 1956, pp. 145 ff.
[69] Hilzheimer, M., 1937, pp. 101 ff.
[70] Stone, P., 1960, pp. 102–104; 143–145
[71] Arenander, E. O., 1910, pp. 325–326
[72] Schertz, E., 1936, pp. 37 ff.
[73] Lehman, U. v., 1949, pp. 171 ff.
[74] Bibikova, V. I., 1959b, pp. 23 ff.
[75] Olsen, S. J., 1960, pp. 1 ff.
[76] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, pp. 117 ff.
[77] Koch, W., 1927, pp. 446 ff.
[78] Hescheler, K., Rüeger, J., 1942, p. 479 ff.
[79] Degerből, M., 1942, p. 130
[80] Boessneck, J., 1957b, pp. 56 ff.
[81] Bökönyi, S., 1962c, pp. 189 ff.
[82] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, pp. 159 ff.
[83] Imhof, U., 1964, pp. 153 ff.
[84] Bökönyi, S., Kállai, L., Matolcsi, J., Tarján, R., 1964, pp. 3 ff.; 1965, pp. 330 ff.

Domestication brought about substantial changes in the constitution of animals. First of all their size decreased. As a matter of fact, if we consider the withers height of aurochs cows we can find a decrease in size of nearly 30 cm as early as in the Neolithic. However, it was not only the length and breadth of bones that diminished, changes took place in their fine structure and density, too. The special Roentgen examinations have thrown light

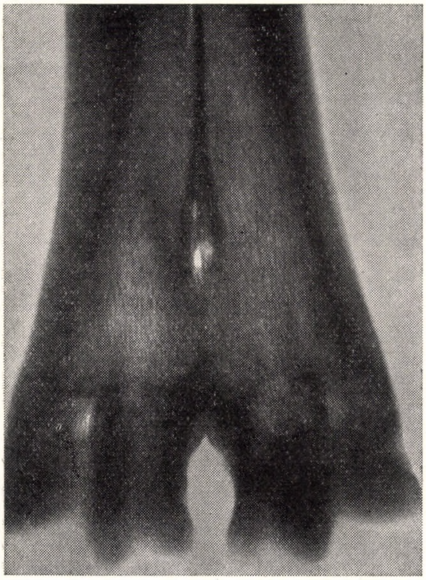


Fig. 6. X-ray photograph of distal side of an aurochs metacarpal. After Bökönyi—Kállai—Matolcsi—Tarján (1964)

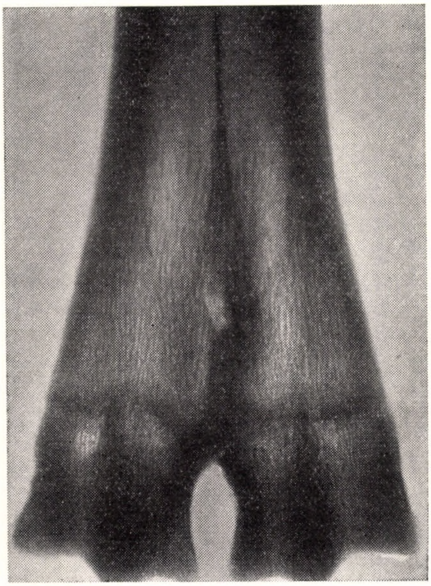


Fig. 7. X-ray photograph of distal metacarpal of domestic cattle. After Bökönyi—Kállai—Matolcsi—Tarján (1964)

upon these latter problems.[85] By these examinations it could be proved that as a result of domestication the cortical substance of the bones gets thinner and the medullary canal extends. Metacarpals have been examined and it has been stated that proceeding towards the distal epiphysis their cortical substance becomes gradually fibrous and changes to a spongious substance. Even the structure of the latter is finer than the corresponding bones of aurochses, moreover, its structural elements are placed in the direction of the greatest strain (Figs 6—7). The degree of thinning could be metrically measured on the (the compact substance) diaphysis of the bones. It could also be stated that the density of bones of the domestic cattle decreases

[85] Bökönyi, S., Kállai, L., Matolcsi, J., Tarján, R., 1964, pp. 7 ff.; 1965, pp. 335 ff.

(Fig. 8) which is caused by a reduction in the content of inorganic mineral substances. This fact along with the placing of the structural elements in the direction of the greatest strain evinces the "measures of economy of material" the constitution takes; for the organism always strives to utilize the least quantity of mineral substances in an economically more efficient way; of course, some functional reasons may also play a role here.

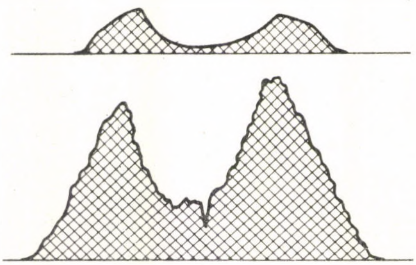


Fig. 8. Densitogram of metacarpal of cattle (above) and aurochs (below). After Bökönyi—Kállai—Matolcsi—Tarján (1964)

The changes brought about by domestication occur on the skull, first on its cerebral part and, to a lesser extent, on the facial portion. The wavy frontal ridge and the uneven front of the *brachyceros* cattle seem to be symptoms of domestication as is the roof-like frontal ridge of the *frontosus* cattle. However, these changes took place very soon: the earliest example being the part of a *brachyceros* brain skull from Nosza, in N.E. Yugoslavia (Körös culture; turn of the 5th—6th millennium B.C.). On the other hand, the typical change brought about by domestication on the facial part of the skull, i.e. its shortening, appeared rather late. Würgler found pug-headed cattle in the late Roman castrum of Schaan in Liechtenstein.[86]

The horns are particularly liable to changes caused by domestication. Already at the very beginning of domestication — as is shown by the Nosza example — they got markedly smaller and soon became shorter too; in other cases they grew longer like in some recent African breeds (Watussi, Wahima). The flattening of the horn cores is a specific transformation, a result of domestication. This often appeared together with the parietal parts becoming as thin as paper — which might be the outcome of castration — and it emerged first at the late Neolithic, to spread very soon afterwards. In the Bronze Age this phenomenon was encountered frequently but subsequently it became scarcer again, to disappear completely by the Middle Ages.[87]

Of course, the horn form also underwent changes in the process of domestication. The horns of the aurochs bending forwards and running almost parallel with the plane of the front gradually rose more and more; they often turned outwards, got twisted, etc. By the Middle Ages there was a great variety of horn forms so that — in spite of the fact that only fragments of the various forms survived — e.g. with the Hungarian white cattle, we can find at least twenty-five different horn forms.

Hornlessness is a special change caused by domestication. As we have seen no hornless aurochses existed. As against hornless sheep, the first hornless domestic cattle appeared relatively late: in Egypt about 2500

[86] Würgler, F. E., 1959, p. 269
[87] Bökönyi, S., Kubasiewicz, M., 1961, p. 28

B.C.[88] and in Central Europe at the end of the Neolithic and the beginning of the Copper Age, some time after their first appearance in Egypt.[89] Cattle were unlike sheep for hornless cattle spread but very slowly and appeared in masses only from modern times onwards and even today they are far behind hornless sheep in numbers.

As against the sporadic appearance of hornlessness the variations in colouring emerged quite early. The white spot on the front may have been the earliest and is indicated in a number of Neolithic statuettes with a triangle in a material different from that of the sculpture itself. To ascertain the great number of colours and colouring variations as early as in the 3rd millennium B.C. suffice it to observe the Egyptian burial models or representations of the counting of animals.

Also the high yield of milk of domestic cattle as against that of the wild ancestor appeared soon. Pictures and so on of the Middle East in the 4th millennium B.C. show cows with markedly large udders and this makes one infer the use of milk.[90] The earliest representation of milking comes from Ur, from the temple of Nin-Hursag, after 2400 B.C.[91] Unfortunately, there are no similar representations from Europe although the small sculptures of the middle phase of the Tripolye culture showing cattle with well-developed udders may well have been cattle used for milking, too.[92] The indirect proof of the use of milk is also late: in a vessel of the Hallstatt Period Grüss found carbonized milk at Mühlbach-Bischofshofen.[93] However, it would be worth while to examine Neolithic vessels as traces of milk might be found in them.

But the early use of milking has philological proofs as well. The western Indo-European languages have a common word for milking: **mlg-/*melg-* and for milk: **mlag-ti*, actually "milking, milked", which originate from the time prior to the separation of the western Indo-European languages, at least from the beginning of the Neolithic.[93a]

THE FIRST DOMESTIC CATTLE

By and large the domestication of cattle may have taken place simultaneously in several places in the whole area where the aurochs was spread in the early Alluvial. On analogical grounds with the other early domestic animals one would expect the earliest finds of domestic cattle in South West Asia. But this was not the case. As far as we know today the oldest centre for domesticating cattle was in South East Europe. The oldest finds until now of domestic cattle were discovered in Pre-Pottery Neolithic settlements in Thessaly,[94] in the southern part of the Balkan Peninsula and in

[88] Zeuner, F. E., 1963, p. 211
[89] David, A., 1897, p. 38; Hoyer, H., 1923, p. 14; Müller, H. H., 1963, pp. 149 ff.
[90] Brentjes, B., 1965, p. 38
[91] Zeuner, F. E., 1963, p. 219
[92] Hančar, F., 1956, p. 67
[93] Grüss, J., 1933, pp. 105–106
[93a] Harmatta, J., kindly supplied information
[94] Boessneck, J., 1962, pp. 30–31

another one in Greek Macedonia.[95] One of the two sites (Nea Nikomedeia) has radiocarbon dating, too. This is from about 6200 B.C.[96] and is thus older than Banahilk in North Iraq (c. 5000 B.C.), the earliest site in South West Asia where domestic cattle occurred.[97] Although there is no radiocarbon dating on Argissa Magula in Thessaly but on a typological basis this site is older than Nea Nikomedeia and the bovid bones found there originated — as ascertained beyond doubt by measurements — from domestic cattle. Unfortunately, the bones found at the site are very fragmentary and their examination evinces at most that their size corresponds with that of the Central European Neolithic cattle. There are also bones among them that probably belonged to transitional forms, or to individuals of the initial stage of domestication.[98] So far no data on the measurements of the Nea Nikomedeia cattle have been published; on the basis of preliminary publications Higgs considered them domestic cattle because their bones and teeth were smaller than the remains of the European *Bos primigenius*.[99]

From their domestication centre in South Balkans domestic cattle soon spread over other regions of Europe (and to South West Asia too). They were swept along by the wave of peoples moving northwards, peoples that had spread animal keeping based on caprovines being of South West Asian origin. The rapid advance of this wave soon introduced domestic cattle into the northern part of the Balkans and subsequently into the Carpathian Basin — according to our present knowledge — sooner than into South West Asia. (Cattle reached the Carpathian Basin before the end of the 6th millennium B.C.). Nevertheless, in the earliest period of the Neolithic cattle were not too frequent anywhere and, in general, lagged far behind caprovines and sometimes even behind pigs.

Cattle of the Körös culture were large; they were close to the wild form[100] and the few remains of their horn cores point to the *primigenius* type.[101] However, the *brachyceros* type, which probably represented a more advanced phase of domestication, also appeared in the same culture, though with one fragment of a skull only. After the arrival of the first domestic cattle in the Carpathian Basin no further domestication appears to have taken place there. It was conspicuous to find that in the material of the earliest Körös settlements there were almost no transitional forms between wild and domestic cattle,[102] and now, after the examination of a large quantity of Körös settlement bone samples from Hungary and Yugoslavia, the above statement can only be confirmed.

Cattle also arrived at the south-western territories of the Soviet Union[103] and the north-western part of the Balkan Peninsula. Unfortunately much

[95] Higgs, E., 1962, p. 272
[96] Rodden, R. J., 1965, p. 83
[97] Reed, C. A., 1961, p. 34
[98] Boessneck, J., 1962, pp. 30—31
[99] Higgs, E., 1962, p. 272
[100] Bökönyi, S., 1954a, pp. 11—12
[101] Bökönyi, S., 1964b, p. 91
[102] Ibid.
[103] Pidoplitchko, I. G., 1956, pp. 54—55

less is known about these cattle, but it is unlikely that they greatly differed from those of the Balkans or the Carpathian Basin. With greater delay did domestic cattle reach to other territories of Central and Eastern Europe and — like in the other regions — there too they represented the primitive type.

The upswing of European cattle keeping began in the second third of the Neolithic. But no longer was the south of the Balkans the starting point of this upswing, for there seemed to be no significant domestication pursued any longer: Arapi Magula and Otzaki Magula in Greece yielded no aurochs bones in the Middle Neolithic and only one cattle bone, a metacarpus of 72 mm proximal width, that might have come from a specimen in the initial stage of domestication was found.[104] However, in the Carpathian Basin, in the southern part of Eastern Europe and in certain regions of the western part of Central Europe the domestication of cattle came into the foreground and with it the significance of cattle keeping too. Obviously, this must have been the period when the population of these territories fully adopted, and may even have improved the domestication technique of cattle. Indeed, this was an improvement for in Thessaly and Macedonia there had never been such a large-scale domestication of cattle than in these territories of Central and Eastern Europe.

It would be well worthwhile to examine more closely the proofs of local domestication. In Central and Eastern Europe there are two important species of domestic animals that had local wild ancestors: cattle and pigs; thus their domestication took place here, or here too. Cattle is the more important one of the two, moreover, the bone samples that are available for examination are ample and better, so it is profitable to probe into the question with regard to cattle.[105]

There can be four proofs of local domestication having taken place in some prehistoric settlement:

1. Bones both of the wild and the domesticated form of the species in question can be found at the same locality.
2. Transitional forms between the wild and domesticated form occur at the site.
3. The ratio of the sexes and ages of the wild form suffers a change.
4. Implements or buildings for catching the wild form, or some representation of its capture are found at the site.

The first point needs no further explanation. Evidently the domestication of a given species could only take place where its wild form existed. Moreover, man had to hunt a wild species in order to get better acquainted with it and to realize that it was worth domestication; to acquire all the biological, physiological, anatomical, ecological, etc. knowledge needed for domestication.

Concerning the second point, the transitions between wild and domesticated forms belong to two groups: *a)* products of cross-breeding between the wild and domestic form (these are less frequent), *b)* newly domesticated

[104] Boessneck, J., 1956d, p. 12
[105] We also touched on this question in our lecture given in London in May 1968

individuals at a primitive, initial stage of domestication (representing an overwhelming majority). If skulls or bigger portions of skulls are available it is fairly easy to differentiate between these two groups.[106] Whereas the latter are practically small-scale replicas of the aurochs, the former do not show the well-proportioned forms, varying between very narrow limits, forms that had emerged with the wild animals. The bred forms often have for instance large horns with small skulls or vice versa; they may have large horns with narrow, wavy frontal crests between them, or uneven fronts and so on.

In the case of local domestication transitional forms, mainly the newly domesticated individuals form a bridge between the wild and the domesticated form. Bone samples of cattle are particularly suitable to demonstrate it. In the case of cattle or pigs domestication involves a definite reduction in size, clearly shown by the extremity bones. Thus, when the bone samples of a settlement are examined where no domestication of cattle took place[107] there is always a hiatus between the measurements of the bones of the wild and domestic cattle, which are not connected with the values of the transitional individuals. On the other hand, e.g. at Berettyószentmárton (Herpály culture), a typical settlement of the domestication "fever" of the late Neolithic where the domestication of cattle was one of the most important parts of animal husbandry, masses of such transitional forms have been found. In the frequency diagrams of the bones of wild and domestic cattle found at this settlement the transitional forms connect the bone values to such an extent that the two populations can hardly be separated.

The breakdown of the wild form according to age and sex shows quite surprising changes in settlements where domestication was pursued. Not only present experiments of domestication but even prehistoric data prove that only young animals can be domesticated. Thus prehistoric man had to catch young animals to be able to domesticate them. But to do that first he had to kill the adults defending their young. Thus, it is hardly surprising that in sites where large-scale domestication was pursued only a few bones found or none at all were of young individuals of domesticable wild animals. The bones all originate from adult or old animals. Indeed, this was the case at Berettyószentmárton, too, for among the aurochs bones (1106 specimens with age identified) only 8.6 per cent (95 bones) originated from young or subadult animals, whereas the rest: 91.4 per cent (1011 bones) belonged to adult or old animals. A similar picture, though not so strikingly expressive, is shown by the bone samples of Hungarian sites of a similar kind (Herpály, Polgár–Csőszhalom, Aszód–Papi földek). In turn, at Seeberg–Burgäschisee-Süd, where no domestication took place 26 per cent of the aurochs bones (on the basis of the mandibulae as much as 55 per cent) originated from young or subadult animals,[108] evincing clearly that no selection was borne in mind during hunting; on the contrary, man hunted young animals for they were easier to kill.

[106] Bökönyi, S., 1962a, p. 87, 1962c, pp. 204 ff.
[107] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, pp. 160 ff.
[108] Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, p. 165

TABLE 1

Frequency diagram of the proximal width (mm) of wild and domestic cattle's metacarpals

		50–51	52–53	54–55	56–57	58–59	60–61	62–63	64–65	66–67	68–69
Seeberg – Burgä-schisee-Süd	domestic	2	2	1	4	0	0	0	0	0	0
	wild	0	0	0	0	0	0	0	0	1	3
Berettyószent-márton	domestic	0	0	0	1	3	3	3	3	4	0
	wild	0	0	0	0	0	0	0	0	0	1

		70–71	72–73	74–75	76–77	78–79	80–81	82–83	84–85	86–87
Seeberg-Burgä-schisee-Süd	domestic	0	0	0	0	0	0	0	0	0
	wild	4	2	0	1	0	0	0	0	0
Berettyószent-márton	domestic	0	0	0	0	0	0	0	0	0
	wild	5	1	1	3	6	0	1	0	1

In the temperate belt of Europe the proportion of sexes among wild animals living at large in their natural surroundings is 1 : 1. In the highly developed stage of hunting (Begleiten[109]), which led in the case of cattle to domestication, man "husbanded" the wild animal population in the same way as his domestic animals. This "husbandry" meant the saving of young animals and females and the killing of supernumerary males. Accordingly, the greatest part of aurochses killed at domesticating Berettyószentmárton were bulls, whereas at Seeberg–Burgäschisee-Süd the number of cows' bones exceeded those of bulls. (Among the aurochs bones of Seeberg indicated in Table 1 there is only one that definitely belonged to a bull.)

Unfortunately, the pieces of evidence relating to point four are rare and mostly of recent date. As far as buildings for capturing animals are concerned, it may be more successful to look for corrals in which whole herds could be captured. (With species of large animals corralling into previously prepared pens in which whole herds could be caught may have played an important part.[110]) Representations of capturing and breaking in wild animals are also rather late. The famous gold cups of Vaphio (c. 1500–1450

[109] Pohlhausen, H., 1963, pp. 67 ff.
[110] Downs, J. F., 1960, pp. 37–38

B.C.) e.g. show the capturing of wild cattle at a time when cattle had been domesticated for about 4500 years, moreover, the cups were made in a region where hardly any wild cattle lived by then.

In the Mid-Neolithic the Carpathian Basin was the centre of the domestication of cattle and can thus be considered the most important, if not the earliest domestication centre of the species in Europe. The reason was, no doubt, the sheer abundance of aurochses in the territory but geographical factors especially favourable for keeping cattle may also have played a part. The region of the Tripolye culture was almost of similar significance. In settlements of the early phases of this culture, transitional forms of cattles are found fairly frequently. Hančar deemed the hunting of the culture to be of the same higher level serving domestication,[111] as was the hunting, even more markedly, of the middle and late Neolithic in Hungary.[112]

At that time the Neolithic domestic cattle of Central and Eastern Europe belonged to one breed, which, however, was rather variable. *Primigenius* type cattle were in the majority; this was simply the result of local domestication for the domestication of the aurochs always produced *primigenius* type cattle. But we think it probable that on large plains and in steppe regions this type was more likely to spread (dry, steppe climate results in long horns while a cool, humid one in short horns),[113] whereas *brachyceros* type cattle tended to spread in cooler and wetter mountainous regions. An interesting example is offered by Switzerland. Here in the Neolithic lake dwellings the predominance of the *brachyceros* type was so overwhelming that for quite some time the opinion prevailed that in the earlier periods of animal keeping only the *brachyceros* type cattle occurred there.[114] This view survived in spite of the fact that in 1938 Gerber found a few *primigenius* type cattle at Port bei Nidau belonging to the earliest period of the Neolithic, besides the majority of the *brachyceros* type,[115] and that Hescheler and Rüeger discovered domestic cattle's horn cores resembling those of the aurochs among the bone samples of Egolzwil 2 and Seematte-Gelfingen.[116] Furthermore, in 1945 there was an author who still doubted that the domestication of aurochses had ever been attempted in Switzerland.[117] It is interesting, on the other hand, that the masses of *brachyceros* cattle in a fairly advanced stage of domestication appearing in the early Neolithic in Switzerland finally support Rütimeyer's statement who says that *brachyceros* cattle had been introduced to Switzerland. (Only the few *primigenius* type cattle are the results of local domestication.) Since the majority of the *brachyceros* cattle were smaller than the *primigenius* type often domesticated only a few generations earlier, thus not much diminished in size, the cattle of the Swiss Neolithic were smaller than the average in Central Europe.

[111] Hančar, F., 1956, p. 67
[112] Bökönyi, S., 1959a, pp. 80 ff.; 1962c, pp. 184 ff.
[113] Nehring, A., 1888a, p. 231
[114] David, A., 1897, p. 10; Studer, Th., 1900, p. 106–107; Keller, C., 1919, p. 15; Hescheler, K., 1929–30, p. 18; 1933, p. 205; Hescheler, K., Kuhn, E., 1949, p. 285
[115] Gerber, E., 1938, XII
[116] Hescheler, K., Rüeger, J., 1942, p. 478
[117] Thalheimer, H., 1945, p. 33

Boessneck set the average withers height of Central European Neolithic cattle at 125 cm.[118] But, in all probability it might have been less for the Boessneck method[119] produces somewhat higher values than the actual ones. The Neolithic cattle of the eastern part of Central Europe and of

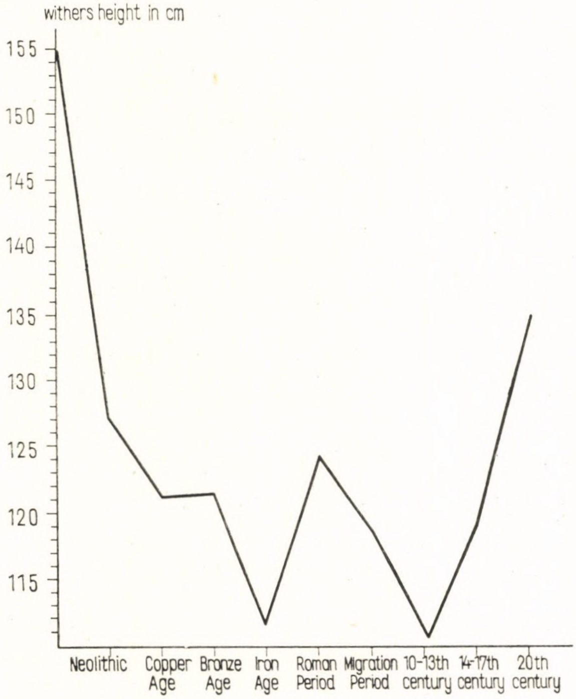


Fig. 9. Changes in cattle withers height since domestication

East Europe were larger than that. We used to determine the withers height of Neolithic and Copper Age cattle in Hungary and Poland with Boessneck's method at 133.9 and with Zalkin's[120] at 126.8 cm[121] (Fig. 9). Today, on the basis of a greater quantity of material, the height of cattle in Hungary in the Neolithic has been calculated to yield an average of 132.7 cm (Boessneck's method) and 127.0 cm (Zalkin's method). The Hungarian material was the first to yield dwarf cattle with a withers height of 107.7 cm (Győr—

[118] Boessneck, J., 1958b, p. 115

[119] Boessneck, J., 1956b, p. 88

[120] Zalkin, V. I., 1960b, p. 126. The withers height values determined by this method are closer to reality, since in calculating his index numbers Zalkin only used the measurements of extremity bones of primitive cattle, whose proportions are closer to those of cattle in prehistoric or early historical times

[121] Bökönyi, S., Kubasiewicz, M., 1961, p. 53

Pándzsa dűlő, Zseliz group of Linear Pottery) and 112.6 cm (Polgár—Basa-tanya, Szilmeg culture)[122] (Figs 10—12). The first hornless cattle appeared at the Copper Age in Switzerland,[123] in Poland,[124] and in Germany[125] and at about this time the castration of bulls was started.[126]

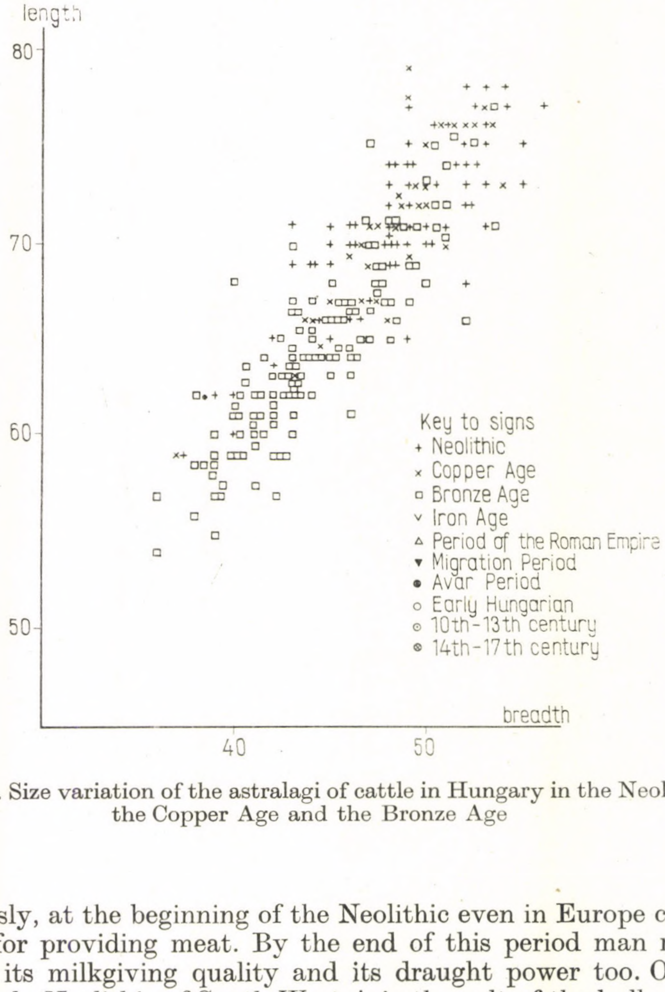


Fig. 10. Size variation of the astralagi of cattle in Hungary in the Neolithic, the Copper Age and the Bronze Age

Doubtlessly, at the beginning of the Neolithic even in Europe cattle were only used for providing meat. By the end of this period man recognized first of all its milkgiving quality and its draught power too. Originating from the early Neolithic of South-West Asia the cult of the bull emerged in the course of the Neolithic.[127] The bull-games flourishing in Crete about

[122] Ibid.
[123] David, A., 1897, p. 38, Table XI
[124] Hoyer, H., 1922, p. 14
[125] Müller, H. H., 1963, pp. 149 ff.
[126] Krysiak, K., 1950—51, p. 228; 1952, p. 289; Nobis, G., 1954, p. 160
[127] Brentjes, B., 1965, p. 38

3000 B.C. can be traced back to this cult.[128] The animals used in the games were domestic bulls; unarmed acrobats including women leaping on the back of long-horned bulls performed stunts there.

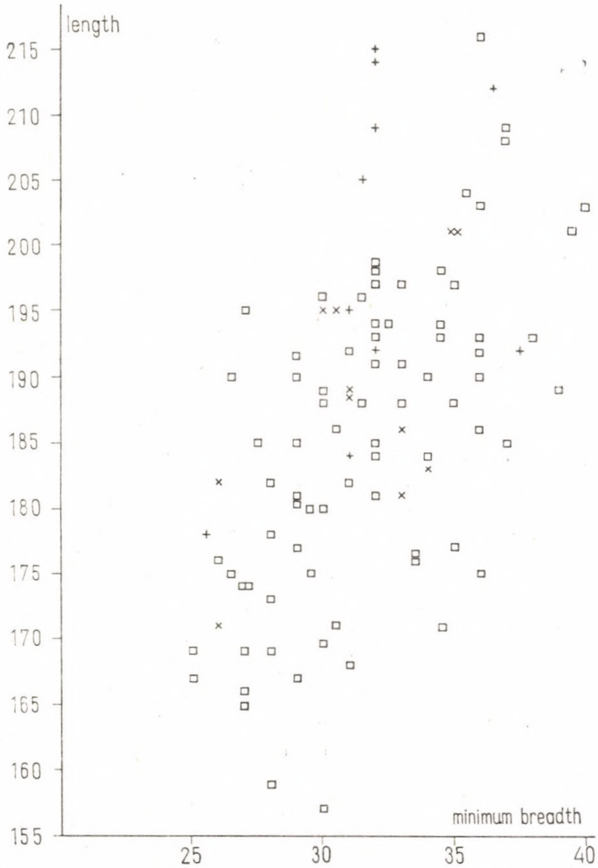


Fig. 11. Size variation of the metacarpals of cattle in Hungary in the Neolithic, the Copper Age and the Bronze Age

There were no substantial changes in the cattle population of Central and Eastern Europe in the Copper Age and the Bronze Age with the exception of the very beginning of the Copper Age (Lengyel culture in Hungary and related cultures of the neighbouring territories) when domestication declined due to the large-scale extermination of the aurochs. The size of cattle continued to diminish which was connected with the fact that by the end of

[128] Evans, A., 1921, p. 44

the Copper Age and the beginning of the Bronze Age, perhaps with the Baden culture, a great number of dwarf cattle reached Central Europe. In the grave finds like for instance at Föllik in Austria the withers height

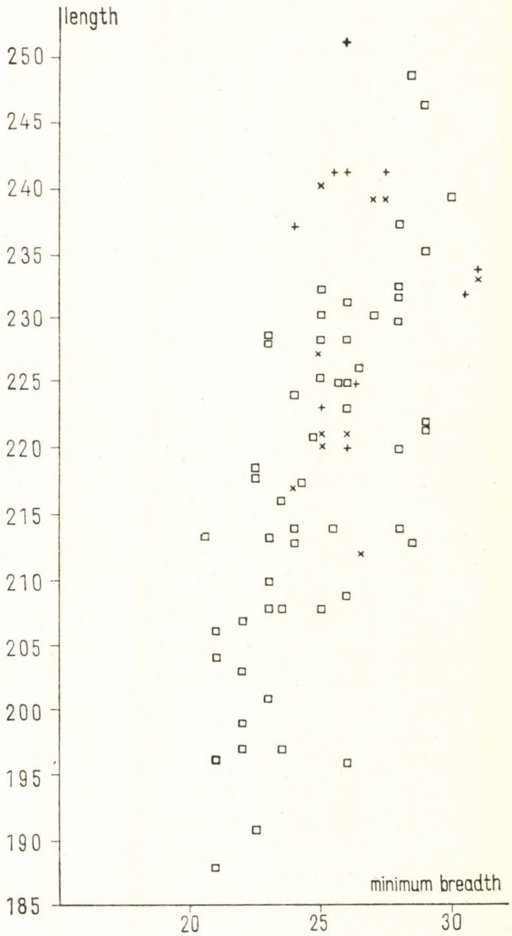


Fig. 12. Size variation of the metatarsals of cattle in Hungary in the Neolithic, the Copper Age and the Bronze Age

attained 108 and 117.5 cm[129] whereas the same at Adolfin and Brzesc-Kujawski in Poland was 108.9—110.4 cm and 111.6 cm, respectively.[130] The decrease in the size of Swiss cattle of the Bronze Age as against Neolithic has

[129] Amschler, J. W., 1949, pp. 19 ff.
[130] Bökönyi, S., Kubasiewicz, M., 1961, p. 54

been discussed by Studer.[131] Boessneck has shown that the withers height of Central European cattle decreased by approximately 10 cm from the Neolithic to the Bronze Age.[132] Similar decrease in size can be observed on Hungarian cattle too, but the value did not exceed 6–7 cm (Table 2). A decrease in size can also be demonstrated on material from the Balkans[133] but of a smaller magnitude. Thus, Zalkin determined the average withers height of cows to have been 117.5 cm, of bulls 125.5 and of oxen 133.3 cm in the European territories of the Soviet Union and in East Romania in the late Bronze Age.[134]

It is mostly the representations that give information on cattle in the eastern basin of the Mediterranean in the Copper and Bronze Ages. The bull games of Crete had by this time gained full recognition and in pictures, etc. we can always see long-horned (occasionally piebald) bulls. However, these may have been animals selected for the sole purpose of the games, as they are chosen today for bull-fights in Spain. It is sure that cattle were milked in the Mediterranean basin: Zeuner presented a late Minoan representation of Knossos in Crete, on which the milking of cows is depicted.[135] It might be of interest to note that the cow is milked from the rear, as is usual with goats (Fig. 13). The linear B tables of Pylos and Knossos contain interesting data on cattle keeping at Knossos and Mykene. The Knossos tables show oxen in pairs and are given the attribute "wergatai" ("working"), thus, oxen were used as draught animals and for ploughing. At Pylos oxen are included in a delivery list, probably for sacrificial purposes. On another Pylos table the oxen, probably also meant to be sacrificed, are indicated as "evenly white", which is considered to be one of the earliest written data on the colour of cattle.[135a]

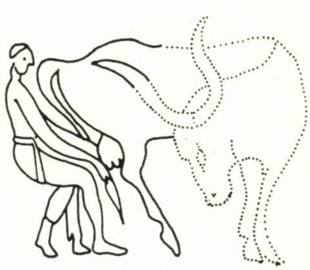


Fig. 13. Milking represented on a seal. Knossos, c. 1500–1400 B.C. After Lengerken (1955)

In the Bronze Age long-horned cattle were common in Eastern Europe. From the late Bronze Age, Zalkin described strikingly long horn-cores reaching even 300 mm with the cows.

Owing to the scarcity of horn cores (0.06–0.065 per cent) Zalkin supposed that hornlessness had become predominant in Eastern Europe in the late Bronze Age.[136] However, this is difficult to accept for two reasons: 1. no parts of brain skulls of hornless cattle have been found in these sites, for had these been great masses of hornless cattle they would most certainly have occurred; 2. a population of chiefly hornless cattle would inevitably

[131] Studer, Th., 1883, p. 113
[132] Boessneck, J., 1958b, p. 115
[133] Boessneck, J., 1962, p. 40
[134] Zalkin, V. I., 1964b, p. 26
[135] Zeuner, F. E., 1963, p. 231
[135a] Ventris, M., Chadwick, J., 1956, pp. 131–132; Stella, L. A., 1965, pp. 160 ff.
[136] Zalkin, V. I., 1964b, p. 26

have had an influence on the stock of the neighbouring territories. No such effect has been proved so far.

Cattle found their way to the forest belt of Eastern Europe at the times of the Fatyanovo culture (1500–500 B.C.). Due to the unfavourable natural conditions dwarfed cattle developed and throughout the region small and short-horned cattle of fairly stable character occurred.[137]

At the turn of the Neolithic and the Copper Age the domestication of cattle was still under way in the Carpathian Basin, in the Lengyel cul-

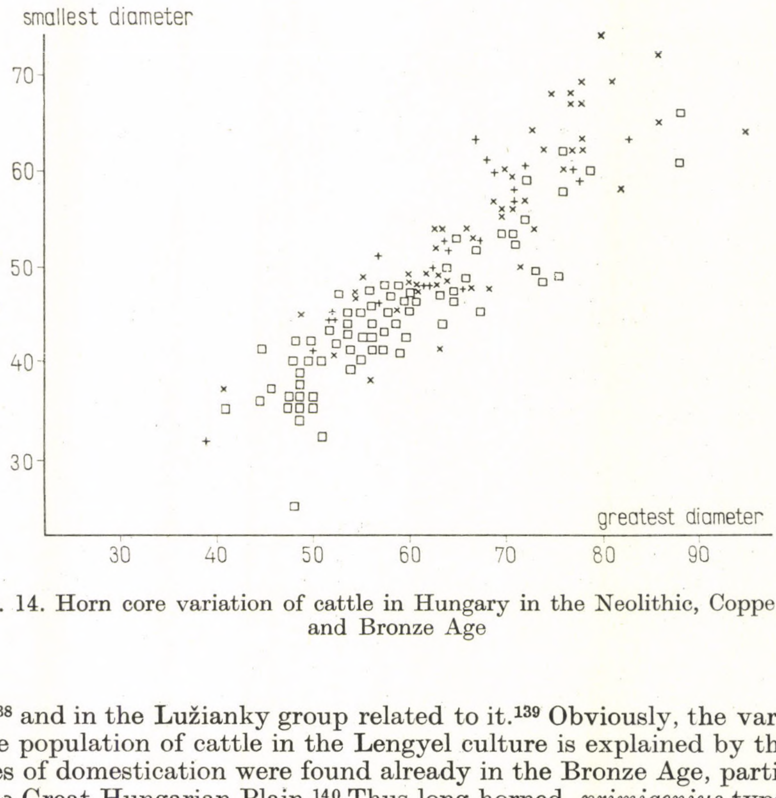


Fig. 14. Horn core variation of cattle in Hungary in the Neolithic, Copper Age and Bronze Age

ture[138] and in the Lužianky group related to it.[139] Obviously, the variability of the population of cattle in the Lengyel culture is explained by this fact. Traces of domestication were found already in the Bronze Age, particularly on the Great Hungarian Plain.[140] Thus long-horned, *primigenius* type cattle are fairly often found in the Bronze Age sites of Hungary (Fig. 14). Besides them the *brachyceros* type cattle were rarer. Innumerable transitional forms of the two groups are also encountered linking the whole population into one breed. At Tápiószele–Tűzköves two incomplete brain skulls have been unearthed displaying *brachyceros* features (narrow, wavy ridge between the horns, uneven front, etc.) but having thick horn cores (Fig. 15). It is

[137] Gromova, V., 1933, p. 117
[138] Bökönyi, S., 1962a, p. 87
[139] Ambros, C., 1961, p. 91
[140] Bökönyi, S., 1952a, p. 103

not unlikely that they were the offspring of aurochs-cattle bastards. In a late Copper Age grave (Pécel culture, Üllő) a *frontosus* type skull with horn cores broken off[141] (Fig. 16) was also found showing how early this "improved" variant of our domestic cattle had emerged.

Fig. 15. Fragments of cattle skulls, Tápiószele—Tűzköves. Note the wavy frontal ridge, which occurred together with long horns

Fig. 16. Skull of cattle. Üllő. Late Copper Age (Pécel culture)

In this period chiefly *brachyceros* type cattle lived in Austria (Fig. 17), besides a less frequent, stockier form declared — rather boldly — by Amschler to have been the ancestral form of the Simmenthal cattle[142, 143]. The situation is quite the same in Switzerland.[144]

[141] Bökönyi, S., Kubasiewicz, M., 1961, p. 26—27
[142] Amschler, W., 1939c, p. 222
[143] Amschler, W., 1937a, p. 347; 1939c, p. 222; 1949, p. 19 ff.
[144] Kuhn, E., 1935, p. 320; Rüeger, J., 1942, p. 265

In the Foreland of the Bavarian Alps in Germany Boessneck found a highly variable population, chiefly small and medium-sized cattle[145] of the late Neolithic and early Copper Age (Altheim culture and others of the similar period). Some of these animals were difficult to differentiate from the aurochs,[146] a fact that may point to local domestication. In a site of the early Urnenfelder culture at Heuneburg, Schüle found markedly variable cattle of about the same size.[147] Here, too, strongly flattened horn cores, so frequent in the Bronze Age in Hungary, also occurred.[148]

Fig. 17. Skull of cattle. Neufeld a. Leitha, Austria, Neolithic

In North Germany, in the late Neolithic and early Copper Age, first of all in the Megalith, the Trichterbecher and in similar cultures the placing of cattle into graves was a widespread custom (Fig. 18). Gandert knew about at least 25 burials of skeletons and of 20 skulls;[149] according to Behrens at least 44 skeletons of cattle have been unearthed from graves.[150] Strangely enough, they were almost all *primigenius* type animals[151] (the same type as at Alsónémedi,[152] and in Dózsa György út at Baja (Fig. 19) and some Polish sites of the same period).[153]

In the Bronze Age of Slovakia cattle by and large resembled those in Hungary. *The primigenius* type frequently occurred among them (Fig. 20), but, in general, in the same settlements skulls of the *brachyceros* type (Fig. 21) were also found.

The Trichterbecher culture of Germany saw the emergence of the first hornless cattle at about this time. In Poland hornlessness developed some-

[145] Boessneck, J., 1956b, pp. 27 ff.
[146] Boessneck, J., 1956b, p. 7
[147] Schüle, W., 1960, pp. 3 ff.
[148] Schüle, W., 1960, p. 4
[149] Gandert, O. F., 1950, p. 201
[150] Behrens, H., 1964, p. 49|
[151] Gandert, O. F., 1950, p. 201
[152] Bökönyi, S., 1951, pp. 74 ff.
[153] Kubasiewicz, M., n.d. p. 271

what earlier: from there the first hornless cattle's skull is known from the Zlota culture.[154] At the same time Krysiak described *primigenius* cattle from Biskupin (early Bronze Age, Iwno culture).[155]

In the Iron Age cattle became suddenly even much smaller. As a matter of fact the values were so low that lower ones could only be found in the early Middle Ages. Thus, according to Zalkin, in the northern coastal region of the Black Sea the withers height of cattle was 113.5 cm on the average in the early Iron Age.[156] The same for Hungary calculated by Boessneck's method was 117.1 cm, and by Zalkin's 112.1 cm. The majority of cattle in Hallstatt[157] and Ovilava[158] (in Austria) were small (the withers height of a Hallstatt animal was only 98.5 cm), then, with the influx of the Romans in both places big, Roman cattle appeared. The average withers height of cattle in the huge material of the Celtic oppidum at Manching in Germany was 113 cm; but the smallest were below 1 metre, on the other hand, oxen reaching 135 cm also occurred, probably imported by the Romans.[159] The cattle of the late La Tène settlement at Schönburg were similar.[160] Kuhn's remark is characteristic of the late Iron Age cattle in Switzerland: they were small even if compared with *turbary* cattle.[161] Concerning Poland, the size of cattle in the Halstatt period and in the Middle Ages hardly differed[162] and from the Hallstatt period site at Kotlin (Hallstatt C, Lausitz culture), cattle with 114 cm (Boessneck's method) and with 108 cm (Zalkin's) withers height were unearthed.[163]

Fig. 18. Three cattle buried together at Zauschwitz. Late Neolithic. After Behrens (1964)

[154] Hoyer, H., 1922, p. 14
[155] Krysiak, K., 1954, p. 260
[156] Zalkin, V. I., 1960a, p. 34
[157] Amschler, W., 1949, p. 41
[158] Amschler, W., 1949, p. 51
[159] Schneider, F., 1958, pp. 17 ff.; Dürr, G., 1961, pp. 32 ff.
[160] Teichert, M., 1964, p. 850
[161] Kuhn, E., 1946, p. 171
[162] Kubasiewicz, M., 1962, p. 96
[163] Schramm, Z., 1965, p. 179

Fig. 19. Skull of cattle. Baja, Dózsa György út 233. Late Copper Age (Pécel culture)

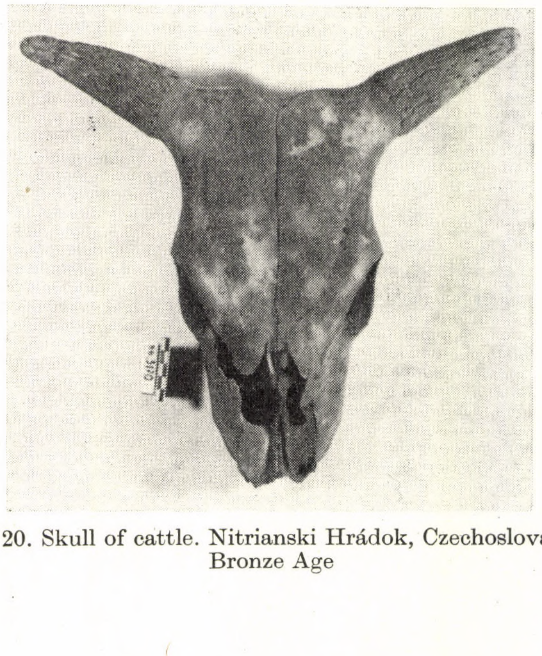


Fig. 20. Skull of cattle. Nitrianski Hrádok, Czechoslovakia, Bronze Age

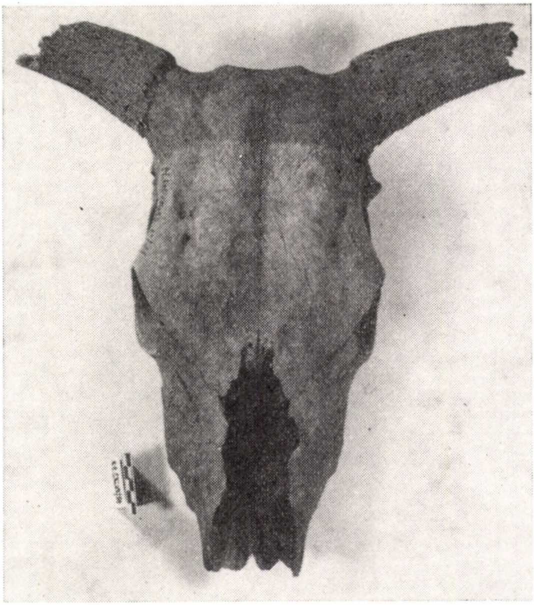


Fig. 21. Skull of cattle. Nitrianski Hrádok, Czechoslovakia, Bronze Age

Fig. 22. Polychrome terracotta statuette of a bull. Cyprus, Early Iron Age (600—1000 B.C.) Metropolitan Museum of Art, Cesnola Collection (purchased by subscription, 1874—76)

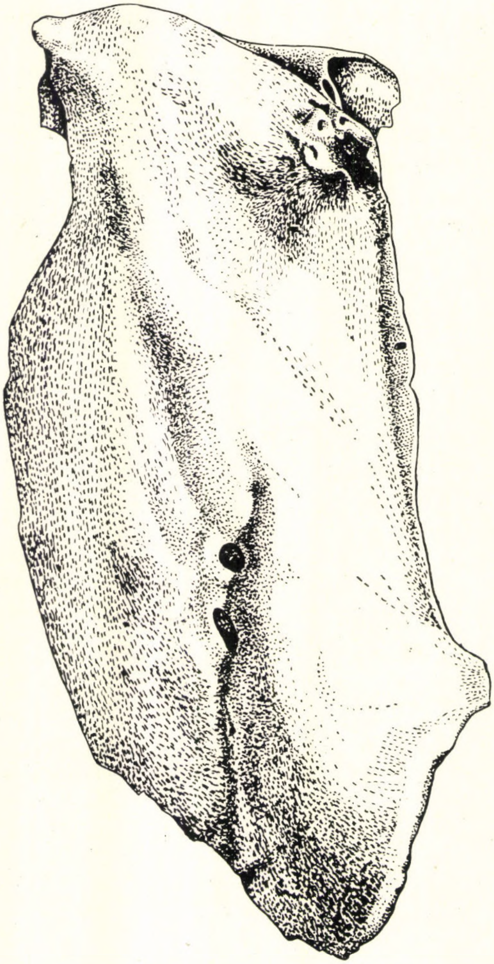


Fig. 23. Part of a hornless cattle skull. Jászfelsőszentgyörgy, Scythian

Current Greek and Cyprian cattle representations show them both short- and long-horned (Fig. 22), whereas only small, *brachyceros* type cattle were found at the Thracian town of Seuthopolis in Bulgaria.[164]

Zalkin distinguished three local breeds in the early Iron Age in Eastern Europe:[165] *a)* the horned, small cattle of forest tribes, *b)* the Scythians' hornless cattle and *c)* the very small, short-horned cattle of the Tchernyakovo culture. The hornlessness of the Scythian cattle was also mentioned by Herodotus (cf. Note 6) and Zalkin was able to prove this feature on an osteological basis. In the town of Olbia, a Greek colony, Bibikova found both *brachyceros* and *primigenius* cattle.[166]

Zalkin drew attention to an interesting connexion between the form of agriculture pursued in the settlements of Eastern Europe during the early Iron Age and the frequency of oxen.[167] He discovered that where the soil was tilled with hoes the numerical ratio of oxen was low, but it was high where ploughs were used. The only exception to this rule was the Tchernyakovo culture where horses substituted oxen as draught animals apparently for the first time in Europe.

The left side portion of the brain skull of a hornless cattle (Fig. 23) was found in the Scythian material of Hungary at Jászfelsőszentgyörgy; a protrusion of the bone indicated the place of the horn core. Side by side with hornless cattle, of course, the majority of cattle in Scythian sites were horned, sometimes thick-horned individuals occurred. Various representa-

[164] Markov, G., 1958, p. 161
[165] Zalkin, V. I., 1964a, pp. 5–6
[166] Bibikova, V. I., 1958a, p. 147
[167] Zalkin, V. I., 1964a, p. 13

tions testify the existence of individuals with erect horns, resembling *orthoceros* cattle and zebus (Fig. 24). This is in accord with the origin of the Scythians and the course of their migration, i.e. the chief territory of the occurrence of *orthoceros* cattle. At other places cattle with aurochs-like horn forms known both osteologically and from representations (Fig. 25) were present.

The scanty Celtic material in Hungary comprises relatively small *brachyceros* cattle.

Fig. 24. Statuette of long-horned cattle. Nagytarcsa. Scythian. Hungarian National Museum, Budapest

Fig. 25. Bronze statuette of cattle. Transdanubia, Hallstatt Period. Hungarian National Museum, Budapest

The cattle population of Austria, Switzerland and Germany in the Iron Age is characterized by animals of the *brachyceros* type. This cattle population small in size belonged to the local aborigines and the Celts who had settled there. The few big individuals may have originated from Roman imports but up to the time of the Roman conquest they scarcely exerted any essential influence on the local stock. The Celts seemed to have invented the metal knobs to be put on the horn tips of fierce bulls. Several such Celtic representations were found in Switzerland, France and England.[168]

THE ROMAN CATTLE

The expansion of the Roman Empire brought about fundamental changes in the cattle keeping of Central and South East Europe. These changes were fully disclosed in regions which for some time belonged to the Roman Empire.

[168] Déchelette, J., 1927, pp. 419 – 915, p. 1018

The method of Roman animal breeding made itself felt also in regions adjacent to the Empire, of course to a lesser extent.

It was the Romans who launched conscious animal breeding (see the chapter on the historical development of animal keeping), which produced breeds, larger in size and greater in output, particularly among cattle and sheep. Among the two species it was cattle whose new and we may well say "improved breed" can be better demonstrated in the bone samples of settlements, because it strongly differed both in its osteological characteristics and in its horn form from the primitive cattle of the local population of Central and South East Europe. With sheep the difference appeared, first of all, in the quantity and quality of the wool, although a certain increase in the size could also be observed.

Roman cattle, as can be demonstrated both by bone samples and by representations of the Imperial Period of Italy[169] were animals with withers height of 120–140 cm and long and thick horns. (It is interesting, on the other hand, that in religious sacrifice, e.g. the Suovetaurilia — evidently on account of ancient traditions — always small, *brachyceros* cattle were used, as is proved by the bone samples found at Niger Lapis;[170] cf. the use of *primigenius*-type cattle at the burials in the late Neolithic and early metal ages.) Their long horn cores were wide open and by them they can be differentiated from long-horned breeds that developed by the late Middle Ages, e.g. from Hungarian white cattle (Fig. 26). The most characteristic horn cores of this kind were found in Roman villa settlements (in Tác—Fövenypuszta there is a long series of them); that is to say in places where the most intensive Roman animal breeding was pursued. Some of the individuals were so big that it is very difficult to tell their extremity bones from those of the aurochs. But this differentiation is facilitated mostly by the thinner walls and highly variable forms of their bones and by their often spread epiphyses. These latter, together with the frequent lack of the lower first premolars and not unfrequent other irregularities of the dentition, as well as with the exostoses often found at the extremity bones can be considered as phenomena of overbreeding. Pug-headedness, observable on cattle at Vindonissa[171] and in a Roman castrum at Schaan in Liechtenstein[172] is a similar feature.

It is interesting to note that hornless individuals, representing a more advanced stage of domestication, have up to now not been found among the Roman breed of cattle. This, evidently, was due to selective breeding for breeders must have preferred individuals with bigger horns and might have simply eliminated those without horns. Breeders of long-horned cattle do this even today.

Bull castration was often performed by the Romans. By doing this they wanted to get primarily draught oxen, but castration may have been done to produce fatted animals. Roman oxen were large individuals with withers

[169] Blanc, G. A., Blanc, A. L., 1958–59, p. 42
[170] Blanc, G. A., Blanc, A. L., 1958–59, pp. 21 ff.; p. 46
[171] Krämer, H., 1899, p. 241
[172] Würgler, F., 1959, p. 269

height of 135—140 cm. They reached Celtic regions prior to the Roman conquest and, at the time of the Roman Empire, even territories not belonging to the Empire.[173]

It is very likely that at the time of the Roman Empire, Asian or African cattle were also introduced to Europe by the Romans themselves or by the peoples resettled by them, or possibly by Roman military units. In this connexion the zebu should be considered first for the area in which it lived

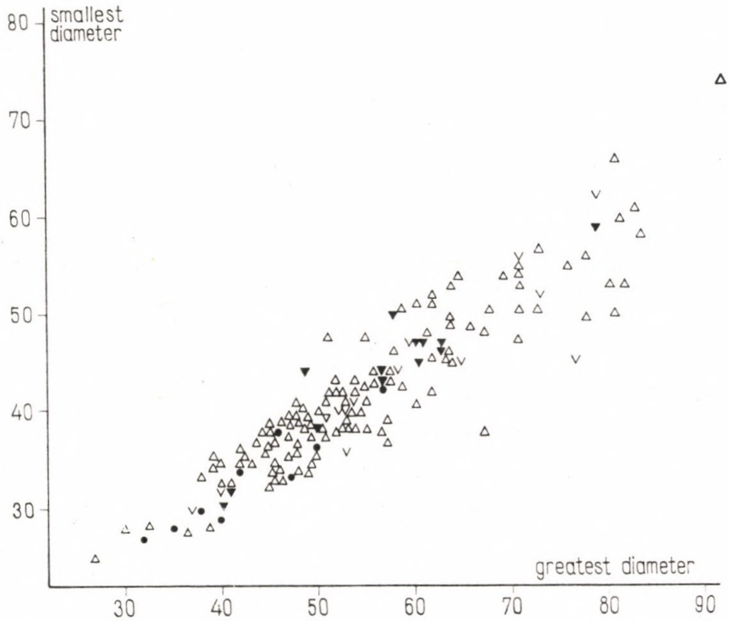


Fig. 26. Horn core variation of cattle in Hungary in the Iron Age, the Period of the Roman Empire and the Migration Period

reached the Asian or African provinces of the Roman Empire. For the time being we have no osteological proofs to support this statement, but the figure of a humped cattle is shown on a Roman tombstone found at Plovdiv (Fig. 27).

Roman cattle introduced to Roman provinces had a twofold effect on the local population: 1) through their large size they raised the average size of local cattle, 2) through cross-breeding they contributed to the improvement of the small cattle of the original settlers. In this latter field, however, their effect could not have been too great since to achieve an improvement better feeding and a proficiency in animal breeding — both lacked by the original settlers mostly living under prehistoric conditions — would have

[173] Boessneck, J., 1958b, p. 116; Schneider, F., 1958, p. 19; Dürr, G., 1961, pp. 32 ff.

been needed. Thus the situation emerged that on big Roman estates and possibly on smaller ones belonging to the settlers from Italy large Roman cattle were bred, whereas the local population, some of the settlers and other elements reaching the Roman provinces from beyond the boundaries of the Empire, kept, first of all, the small local breed. The latter kind of cattle were kept on territories outside the Roman Empire, such as in the Carpathian Basin and the free parts of Germania, too.

Fig. 27. Zebu represented on a Roman tombstone. Archaeological Museum, Plovdiv, Bulgaria

In Pannonia, now part of Hungary, the average withers height approached the highest values of the Neolithic: 129.7 cm (Boessneck's method) or 124.2 cm (Zalkin's) (Fig. 9). Side by side there was a breed of 100—120 cm and one of 120—140 cm in the population. The former comprised rather variable, mostly *brachyceros* type cattle, the latter the Roman breed. (Along with them bones of the aurochs could also be found in some sites.) At the villa settlement of Tác—Fövenypuszta the ratio of the two breeds was 7 : 3 in favour of the Roman breed but in other places the proportion was worse. Some individuals of the large Roman breed got across the Danubian limes: the bones of some exceptionally large individuals were found in Sarmatian settlements (Apagy, Tiszavasvári, Derecske; Figs 28—30). But these individuals did not particularly influence Sarmatian animal keeping (most of them were oxen), and after the fall of the Roman Empire, when the Romans left the Carpathian Basin, they completely vanished from the region without leaving a trace behind.

Large Roman cattle found their way to Austria in the period directly preceding the Romans or with the Romans.[174] But the bulk of the cattle population continued to consist mostly of small, *brachyceros* animals,[175] in some places (e.g. Vienna[176]) with very small individuals.

In some Roman settlements in Switzerland the *brachyceros* and *primigenius* cattle and their transitional forms were found side by side (Vindonissa,[177] Alpnach,[178] Engehalbinsel bei Bern,[179] Vidy Lausanne[180]). But in

[174] Amschler, W., 1949, p. 41; 1950, p. 483
[175] Amschler, W., 1950, p. 484
[176] Neumann, A., 1951, p. 17
[177] Krämer, H., 1899, pp. 246 ff.
[178] Kuhn, E., 1933, p. 23
[179] Kuhn, E., 1933, p. 24; Stampfli, H. R., 1959—1960a, p. 422
[180] Gavillet, E., 1945, pp. 2 ff.

certain Roman villas and castrums only the large Roman breed was bred (Krichdorf,[181] Buchsi,[182] and Schaan in Liechtenstein[183]).

In parts of Germany belonging to the Roman Empire individuals of the Roman breed were rarer since Pannonia or Raetia were nearer to the centre of the Empire than Germania. The average withers height (125 cm with Boessneck's method)[184] was also nearly 5 cm less than for example in

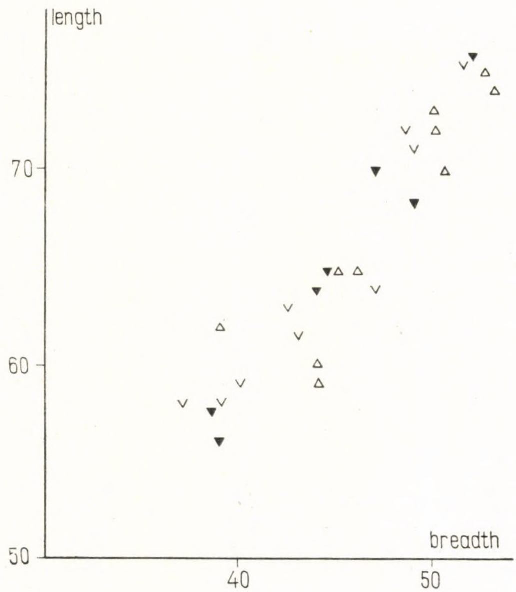


Fig. 28. Size variation of the astragali of cattle in Hungary in the Iron Age, the Period of the Roman Empire and the Migration Period

Pannonia. Furthermore, there was only one site where no small cattle were found only medium-sized or good medium-sized ones: Boiodurum (Passau—Innestadt).[185] In other places small and large cattle occurred together, generally with the local small breed in the majority.[186] Along with them bones of the aurochs were also excavated in several sites, which is proved, first of all, by Butzbach's individuals of 157 and 159 cm withers height.[187] By no means could they have been domestic cattle.

[181] Rüeger, J., 1944, pp. 236 ff.
[182] Stampfli, H. R., 1959—60b, pp. 436—437
[183] Würgler, F. E., 1959, p. 269
[184] Boessneck, J., 1958b, p. 116
[185] Boessneck, J., 1956a, p. 79
[186] Schlosser, M., 1888, p. 19; Sickenberg, O., 1938, p. 150; Boessneck, J., 1957a, pp. 108 ff.; 1959, pp. 13 ff.; 1964, pp. 224—225; Habermehl, K. H., 1957, pp. 74 ff.; Dannheimer, F., 1964, pp. 36—37
[187] Habermehl, K. H., 1957, pp. 75, 77

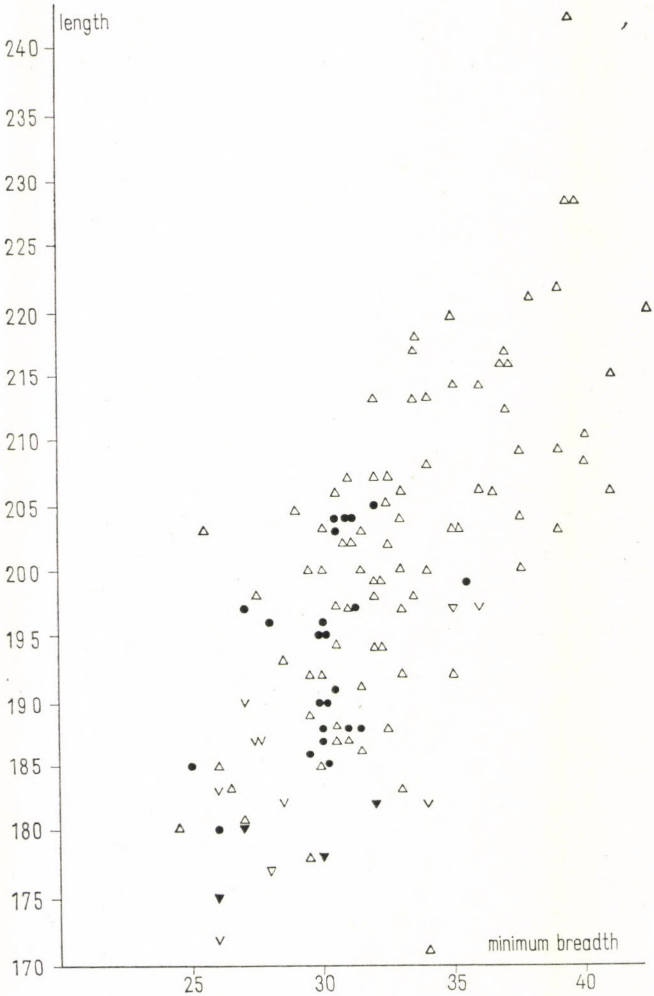


Fig. 29. Size variation of the metacarpals of cattle in Hungary in the Iron Age, the Period of the Roman Empire and the Migration Period

In Herre's view, Roman cattle in free parts of Germania did not play any significant role in improving the local population.[188] Nevertheless, they must have had some effect in certain places because in the 2nd—6th century A.D. in the West Germanic sacrificial place of Oberdorla cows of average withers height of 110 cm and bulls of 125 cm were found.[189] At the same time the

[188] Herre, W., 1958, p. 33
[189] Teichert, M., 1962, p. 79

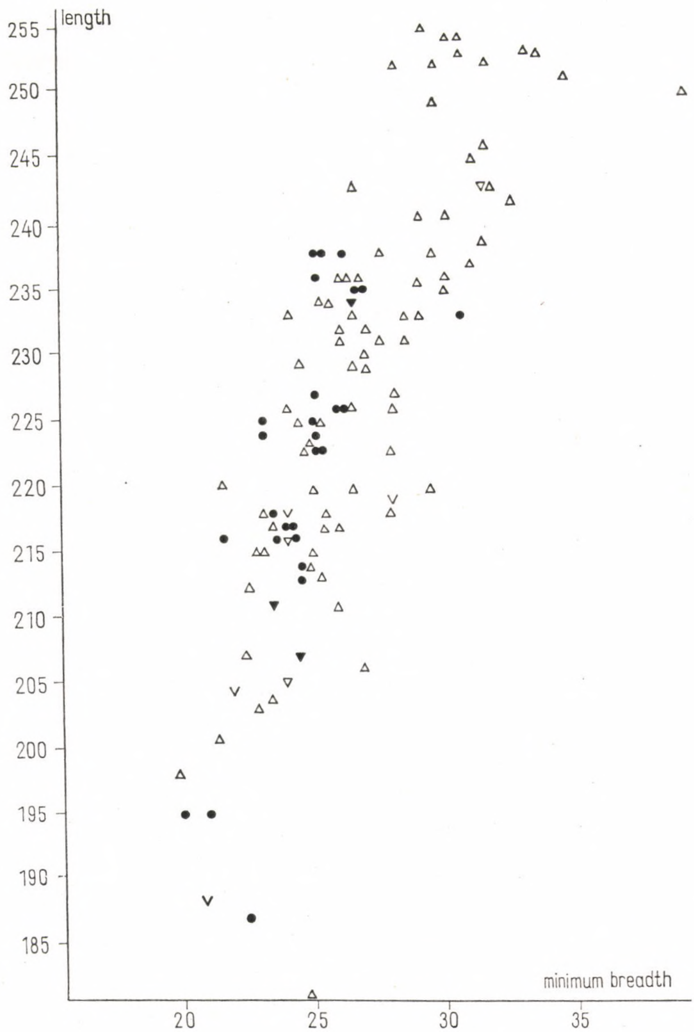


Fig. 30. Size variation of the metatarsals of cattle in Hungary in the Iron Age, the Period of the Roman Empire and the Migration Period

domestic animals of Wölpke of the 3rd—4th century A.D. corresponded with those of the same period in North and South Germany.[190]

Primigenius type of cattle have only sporadically been found in the very few sites of the Roman Imperial Period but not belonging to the Empire in Poland.[191]

[190] Laser, R., Müller, H. H., 1962, p. 41
[191] Myczkowski, K., 1934, p. 57

When the Romans left Central and South East Europe the Roman breeds of animals also disappeared, and they were replaced by the small animals of the local population and by the domestic animals introduced by the waves of the migration period. Our knowledge of them is rather scanty, nevertheless it can be stated that the size of cattle again began to decrease in this period. In Hungary, e.g. the average withers height dropped below 125 cm (Boessneck's method) or below 119 cm (Zalkin's) and a similar process took place in other territories, too.

Among the peoples of the migration period it is the Avars (567—800 A. D.) whose cattle we know most of, for the graves of Avar cemeteries sometimes included cattle skeletons but more often only odd extremity bones. Cattle were buried in three different ways: 1) the whole body was placed in the grave, 2) only the skull and the end of the legs were buried, or 3) the brain skull with the horns was put into the grave. The two latter types are particularly interesting.

The joint burial of the skull and the end of the legs is a custom originating from Asia Minor.[192] The first skinned hides buried together with the skull and feet of cattle originated from Alaca Hüyük (3rd millennium B.C. contemporaneous with Troy IIg). At Osmankayashi (17th—15th century B.C.) horses and asses were put into graves in a similar way. The same form of burying animals was customary in the Timber Grave culture in the south of Russia and was later introduced to Central and North-West Europe by the peoples of the eastern steppes. The horse burials reached as far as Bornholm westward and were most typical of the Magyars at the time they conquered the present territory of Hungary. The Avars placed sheep[193] and cattle[194] into their graves. It seems likely to assume that the meat was consumed at a funeral feast and only the bones were in the hide.[195]

Evidently, the situation was similar when the part of the brain skull with the horns was placed in the grave.[196] This occurred mostly with cattle and seldom with sheep[197] and was connected with the veneration of the cattle-ancestor.[198] It prevailed chiefly with the ethnic group of Avars, who, after the fall of the Avar Empire, asked Charlemagne to settle them down between Carnuntum and Savaria.[199] In this custom, too, the cattle were skinned but only the brain skull was left in the hide, with which they covered the coffin.[200]

[192] Piggott dealt with this question in detail (1962, pp. 110—118), and here we have given essentially his analysis

[193] Bökönyi, S., 1960a, p. 109

[194] Török, Gy., 1954, p. 56; Bökönyi, S., 1963a, p. 110

[195] Herodotos, IV. p. 72

[196] Bökönyi, S., 1963a, p. 110

[197] Török, Gy., 1962, pp. 83 ff.

[198] Török, Gy., 1962, p. 84

[199] Török, Gy., 1962, p. 92

[200] Ibid.

Most of the Avars' cattle were small and belonged to the *brachyceros* type. Such cattle were found at Žitawska Tôň,[201] at Bóly,[202] at Mór and in a number of graves of the Sopronkőhida cemetery (Fig. 31). On the other hand, several skeletons of medium-sized cattle were found in the Avar graves of Szeged—Makkoserdő, but unfortunately, their skulls were com-

Fig. 31. Fragments of cattle skulls of the Avar cemetery at Sopronkőhida

pletely smashed and therefore unsuitable for identifying their types. The average withers height of the Avar cattle was 125.0 cm (Boessneck's method) and 119.7 cm (Zalkin's).

In the ancient Bulgarian cemetery of Novi Pazar in Bulgaria, cattle of 109—117 cm were found.[203] At Popina, 4th—7th century A. D., the remains of mostly *brachyceros* cattle were excavated with a few *primigenius* types.[204]

[201] Musil, R., 1956, p. 161
[202] Bökönyi, S., 1963a, p. 111
[203] Ivanov, S., 1958, pp. 210—211
[204] Ivanov, S., 1956, p. 94

Excepting the last two centuries, the Middle Ages brought the least development of cattle, for in this period the species degenerated most. This degeneration may have been due to the joint effect of several factors. The chaotic centuries after the decline of the Roman Empire brought about general impoverishment. The situation was but aggravated by a general ignorance of animal breeding. Purposeful animal breeding was pursued only with horses used in warfare and of dogs serving the pastime of the high-born. The cattle population was devastated by the frequent wars too, because the chief meat consumed by the armies was beef and what the soldiers did not eat they drove off. Early mating may also have caused the degeneration no less than the early use of animal as draught power. The small *brachyceros* cattle of the Middle Ages were not an independent breed nor were they a geographic variant or a breed characteristic of a people or of an ethnic group. This breed group was simply an indication of the very primitive conditions of Mediaeval animal keeping.

Thus, in the Middle Ages a uniform population of small cattle lived in Europe from the Urals to England. With respect to their skull form they mostly belonged to the *brachyceros* type. Occasionally some hornless cattle also occurred. In this veritable sea of small cattle isolated bigger individuals appeared particularly in less disturbed places where on marshy or mountain pastures there was a possibility of cattle breeding. These animals, however, by no means constituted an independent breed but only populations of larger animals developed under the more favourable conditions of animal husbandry. Zimmermann described such cattle from Wädenswil in Switzerland (11th—12th century),[205] Reich and Kubasiewicz from Wolin in Poland (9th—13th century),[206] and Nobis from Hessen (10th—13th century)[207] and from Bremen (11th—13th century).[208]

Contrary to the above Zalkin found the average withers height of cattle from early Mediaeval sites in Russia to have been: Grodno 95.55, Pskov 99.20, Novgorod 99.90, Moscow 100.10, Staraya Ryazany 101.25 and Staraya Ladoga 102.00 cm.[209] Generally a type of cattle fairly uniform in stature and skull form was spread in Ancient Russia[210] and the Baltic in the early Middle Ages.[211]

In the early Middle Ages cattle in Poland were not much bigger than those in Ancient Russia. Kubasiewicz described cattle of 97—109 cm withers height from Sieradz (10th—13th century);[212] he also described small cattle without figures from Milicz (10th—13th century),[213] from Kamien—Pomor-

[205] Zimmermann, H., 1920, pp. 28 ff.
[206] Reich, H., 1937, p. 6; Kubasiewicz, M., 1958a, p. 133; 1959, p. 98
[207] Nobis, G., 1954, pp. 155 ff.
[208] Nobis, G., 1954, p. 186; 1964, p. 44
[209] Zalkin, V. I., 1956, p. 47
[210] Zalkin, V. I., 1961a, p. 205
[211] Ibid.
[212] Kubasiewicz, M., 1963, p. 233
[213] Kubasiewicz, M., 1957b, p. 195

ski (10th–14th century).[214] The overwhelming majority of cattle in Wolin were small. At Kolobrzeg (9th–13th century) cattle of 97–112 cm withers height were found,[215] whereas the same values of cattle from Bonikowo (8th–10th century) were 100–123 cm (Boessneck's method) and 91.5–106.5 (Zalkin's),[216] and the same from Kruszwica (6th–11th century) was about 1 m.[217] Finally, Schramm and Gedymin found cattle in Radacz (8th–11th century) with 102–111 cm withers height (Boessneck's method) and 97–107 cm (Zalkin's).[218] In Slovakia, Ambros identified small cattle from Bešenov and Nitriansky Hrádok (early Slav)[219] and from Budmerice (14th–16th century).[220] The withers height of this latter was 113 and 119 cm by Zalkin's method.[221]

In the Wallachian part of Romania similar cattle were unearthed: at Bucov near Ploiesti (9th–10th century) animals with 119.4 cm withers height (Boessneck's method) and 112.7 cm (Zalkin's) were excavated.[222] In the Balkan Peninsula such small cattle, mostly of the *brachyceros* but sometimes of the *primigenius* type, occur even today (Fig. 32), in certain areas their yoke is of definitely prehistoric type (Fig. 33).

Small cattle were found in Switzerland by Würgler at Iddaburg (11th–14th century),[223] at Starkenstein (13th–15th century)[224] the latter had a withers height of 94–104 cm; by Hartmann-Frick at Burg Heitnau, withers height 110–121 cm (Düerst's method)[225] and by Stampfli at Burg Grenchen (11th–13th century)[226] where the withers heights were 100–114 ♀, 110–117 ♂ and 118–122 ♂.[227]

The situation was similar in Germany. From mediaeval Hamburg, Herre described small cattle, with dwarf individuals of 90–100 cm.[228] Nobis found cattle in Lübeck (1000–1138) and from Hessen (10th–13th century) with average withers height of 105–115 cm.[229] Cattle with average withers height of 105–115 cm ♀♀ and 120–125 cm ♂♂ were found at Hoher Bogen (12th century)[230], of 108 cm ♀♀ and 105.5 cm ♂♂ on the average in Hannover (11th–14th century)[231] and of 119 cm oxen whereas cattle of Berlin–Köpenick (9th–14th century) were with an average withers height of 112.2 cm.[232]

[214] Kubasiewicz, M., 1958b, p. 250
[215] Kubasiewicz, M., Gawlikowski, J., 1965, p. 104
[216] Sobocinski, M., 1963, p. 81
[217] Sobocinski, M., 1964, p. 191
[218] Schramm, Z., Gedymin, T., 1965, p. 189
[219] Ambros, C., 1958b, p. 416
[220] Ambros, C., 1959a, p. 568; 1962b, p. 302
[221] Ambros, C., 1962b, p. 302
[222] Haimovici, S., Onofrei, M., 1967, p. 188
[223] Würgler, F. E., 1956, p. 15; 1957, p. 24
[224] Würgler, F. E., 1956, p. 71
[225] Hartmann-Frick, H., 1957, p. 63
[226] Stampfli, H. R., 1962a, p. 175
[227] Stampfli, H. R., 1962a, p. 174
[228] Herre, W., 1950, p. 106
[229] Nobis, G., 1954, p. 185
[230] Boessneck, J., 1958b, p. 40
[231] Müller, H. H., 1959, p. 213
[232] Müller, H. H., 1962, p. 107

Fig. 32. Cart drawn by a yoke of small Balkan cattle. Stanke Dimitrov, Bulgaria

In this latter settlement cattle of the same type and size lived both in the early Slav period and during the German conquest. Burgheim (7th – 9th century) was the only site where oxen of a larger size occurred but even these animals, with a withers height of 130 cm, were smaller than those bred by the Romans.[233]

The dwarfing of cattle in the Middle Ages seems to have been more pronounced in Eastern Europe (Russia, the Ukraine, the Baltic countries and Poland) than in Central Europe and the Balkan Peninsula. It is interesting that the latter region corresponds with the territory of the European colonies of the Roman Empire or is adjacent to it. Thus some effect of the highly developed animal keeping introduced by the Romans to their colonies appears to have survived and had an influence at least on a small area around them.

The measurements of cattle in Hungary in the Middle Ages can be well linked with the above.[234] The average withers height of these cattle was 116.3 cm (Boessneck's method) and 111.3 cm (Zalkin's) in the 10th – 13th century. Here again the oxen were somewhat bigger, but by their slender

[233] Boessneck, J., 1958b, p. 36

[234] Bökönyi, S., 1958a, p. 462; 1961b, p. 87; 1962b, p. 3; 1963c, pp. 338 ff.; 1966, p. 74

Fig. 33. Bosnian cart drawn by cattle with a prehistoric yoke made of a shaft bar and two branches bent into a U-shape. Obre, Yugoslavia

metapodials they can be determined easily. It is evident that they never belonged to a larger breed. On the other hand, in Hungary very dwarfed individuals occurred, though in the whole material of the early mediaeval Hungary (10th – 13th century) there were only two: the metacarpus of a cow with 94.2 cm withers height from Tiszalök and another cow with 96.7 withers height from Kardkoskut (Table 2).

The withers height of Hungarian cattle in different periods based on the length of metapodials determined with Boessneck's (B) and Zalkin's method (Z) is shown in Table 2.

THE HUNGARIAN WHITE CATTLE

Now let us turn to the origin of the Hungarian white cattle. This large, long-horned cattle (Fig. 34), well-nigh on the point of extinction, is well-known from the literature of animal breeding, and to the European public at large.

TABLE 2

Withers height of cattle in different periods based on the length of metacarpals

period	n	method	min.	max.	M.
Neolithic	12	B	117.12	140.80	131.57
		Z	112.00	134.64	125.82
Copper Age	10	B	112.64	132.48	122.75
		Z	107.71	126.68	117.35
Bronze Age	85	B	103.68	141.44	129.04
		Z	99.14	135.25	123.39
Iron Age	8	B	110.08	126.08	118.40
		Z	105.26	120.56	113.22
Period of the Roman Empire	101	B	109.44	145.98	130.67
		Z	104.65	139.54	124.95
Migration Period	28	B	112.00	113.20	122.51
		Z	107.10	125.46	117.15
10–13th century	20	B	98.56	122.24	112.13
		Z	94.25	116.89	107.22
14th–17th century	77	B	105.60	141.44	123.56
		Z	100.98	135.25	118.16
based on the length of metatarsals					
Neolithic	11	B	125.62	143.32	133.87
		Z	120.34	137.30	128.24
Copper Age	12	B	121.05	140.79	130.61
		Z	115.96	134.56	125.13
Bronze Age	49	B	107.35	141.61	124.74
		Z	102.84	135.66	119.50
Iron Age	3	B	106.78	131.62	115.82
		Z	102.29	126.08	110.95
Period of the Roman Empire	82	B	101.64	145.03	128.77
		Z	97.37	138.94	123.36
Migration Period	37	B	106.21	138.18	125.82
		Z	101.74	132.37	120.53
10th–13th century	10	B	113.63	127.33	120.37
		Z	108.85	121.98	115.31
14th–17th century	78	B	106.78	146.75	125.48
		Z	102.29	140.58	120.21

Brummel was the first to establish a connexion between the Magyar who conquered the territory of present Hungary and the Hungarian white cattle, saying that it had found its way to the Carpathian Basin at the time of the Magyar conquest[235] (end of the 9th century A.D.). He never supported his statement with any proof, simply declaring it as a self-contained fact.

In a number of papers Hankó also proceeded in almost the same way.[236] He started from the point that the Hungarian white cattle was an old scrub breed, but this concept then was pushed into the background; that it was

Fig. 34. Hungarian white bull and cow. Hortobágy, Hungary

an indispensable requisite of the Hungarian steppe, the "puszta" — and thus it must have been introduced by the conquering Magyars. To support his view he set forth two proofs. One was that the Russian zoologist and animal breeder Brauner had found skulls of long-horned cattle in the Magyar "servants' graves" (sic!) in South Russia. The other was the resemblance between the skull of the aurochs and of the Hungarian white cattle, this similarity giving him the clue that it was a direct descendant of the aurochs.

As far as the above proofs are concerned, archaeologists dealing with the prehistory of the Hungarians are not aware of Hungarian "servants' graves" in South Russia, moreover not even a single specimen of long-

[235] Brummel, Gy., 1900, p. 34
[236] Hankó, B., 1936b, pp. 53 ff.; 1943, pp. 45 ff.; 1950, p. 271 ff.; 1954, pp. 39 ff.

horned large cattle from the migration period in South Russia or from the early Middle Ages is known. And although the skull of the Hungarian white cattle is indeed very much like that of the aurochs, differing only in its horn form, this bears no significance, since the skull of every cattle of the *primigenius* type resembles the skull of the aurochs. Actually, all domestic cattle are direct descendants of the aurochs, since, according to our present knowledge, no other wild ancestors have so far been found, moreover, the domestication of aurochses always produced cattle and nothing else.

Though Hankó mentioned a number of mediaeval sources to trace back the origin of the Hungarian white cattle to the time of the Magyar conquest none of these documents were dated earlier than the 15th century. He was never able to support his theory by the examination of cattle skulls from the time of the Hungarian conquest for such skulls have not been found until recently. So far no settlement from the time of the Magyar conquest has been unearthed; and it was not a custom to place cattle or their skulls into the graves by the deceased at the time of the Magyar conquest. On the other hand, we know about a metal ornament from this time, discovered in grave No. 12 of cemetery No. II at Tiszaeszlár—Bashalom, that represents the head of cattle (Fig. 35).[237] But this is not the head of long-horned cattle, on the contrary, it shows the short-horned, *brachyceros* type. Cattle of the very same type were found at settlements of the Árpád Period immediately proceeding the Conquest (Fig. 36). It was as late as in the 14th—15th century that the first long-horned cattle appeared in Hungary (Figs 36—40)[238] and along with them "blond" and "dun" — colour variants of Hungarian white cattle — as the most frequent colours of cattle.[239] In all probability this breed was the result of a purposeful animal breeding, which — within the scope of the universal upswing of European economy bearing relation to the Renaissance — began in the 14th—15th century.

The origin of this breed has not yet been fully clarified. It may have been introduced by the Cumanians fleeing from the Mongolians in the mid-13th century and it took 150—200 years for the breed to spread in Hungary. On the other hand, in the South of Russia, the original home of the Cumanians, no traces of their long-horned cattle have been found so far. The Hungarian white cattle might also be of Italian origin. There are similar though somewhat smaller breeds in Italy even today and as Hungarian—Italian connexions grew strong in the 14th century when the Neapolitan Anjous acceded to the Hungarian throne, it is possible that the breed found its way to Hungary at that time. But we do not know whether such cattle existed in Italy in the early Middle Ages. Nor is it impossible that Hungarian white cattle are of Roman origin, though there is no proof whatever to support this supposition. The most probable answer to the question is that Hungarian white cattle emerged through selective breeding from the local cattle population that yielded a standard type of the Carpathian Basin

[237] Here we should express our thanks to I. Dienes, who kindly drew our attention to the metal mount

[238] Bökönyi, S., 1958a, p. 462; 1961b, p. 87; 1962b, p. 4

[239] Belényesy, M., 1956, p. 25; 1961, p. 19

and the adjacent regions: large cattle with beautiful horn-form (breeders have always attached great importance to this) uniformly white or dun in colour, resistant to diseases, easily driven on foot a long way; primarily producing beef and their oxen giving very good draught power.

Fig. 35. Metal mount representing the head of short-horned cattle. From a Magyar grave of the time of the Conquest. Tiszaeszlár—Bashalom. After I. Dienes

Fig. 36. Fragment of short-horned cattle skull. Zalavár. Period of the Árpád Dynasty

Recently Gaál contested the above opinion and adopted Hankó's view: "The supposition . . . that this breed appeared in Hungary only in the 14th century is a biological absurdity, because without a nationwide exchange of the stock or central control no breed can spread within a century and a half to such an extent that it can supply, in the form of export goods, a great part of Europe with characteristically uniform animals, amply documented by foreign sources a long time before the battle of Mohács."[240] Meanwhile this statement was refuted by Matolcsi, who accepted the emergence of the Hungarian white cattle in the 14th—15th century and calculated that, if we take only 50 cows as a starting point for producing a new breed, over 3,200,000 individuals can be bred within 150 years. Thus

[240] Gaál, I., 1966, p. 40

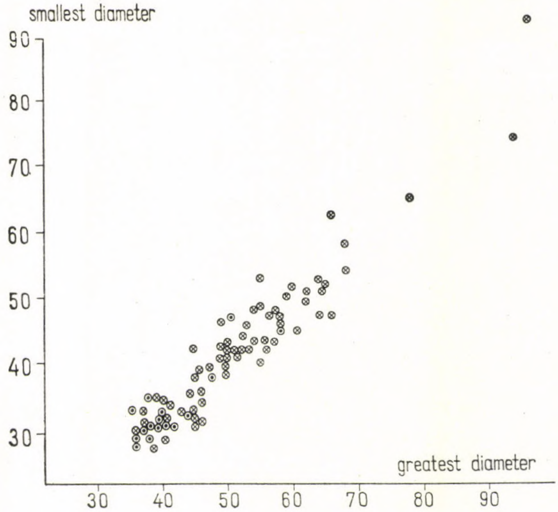


Fig. 37. Horn core variation of cattle in Hungary in the Middle Ages

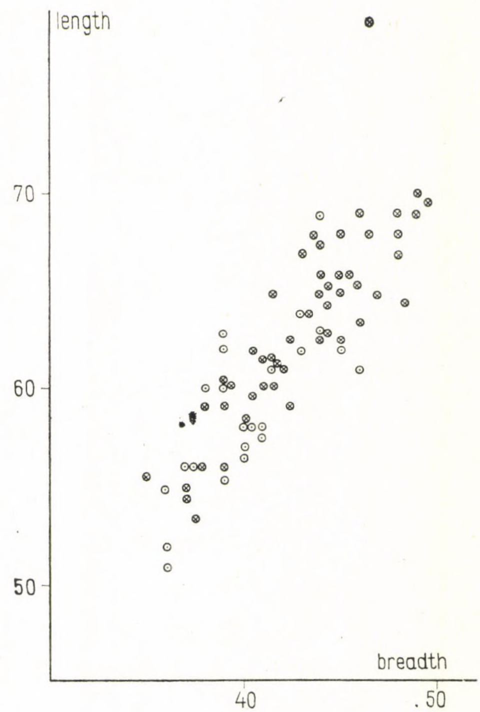


Fig. 38. Size variation of the astragali of cattle in Hungary in the Middle Ages

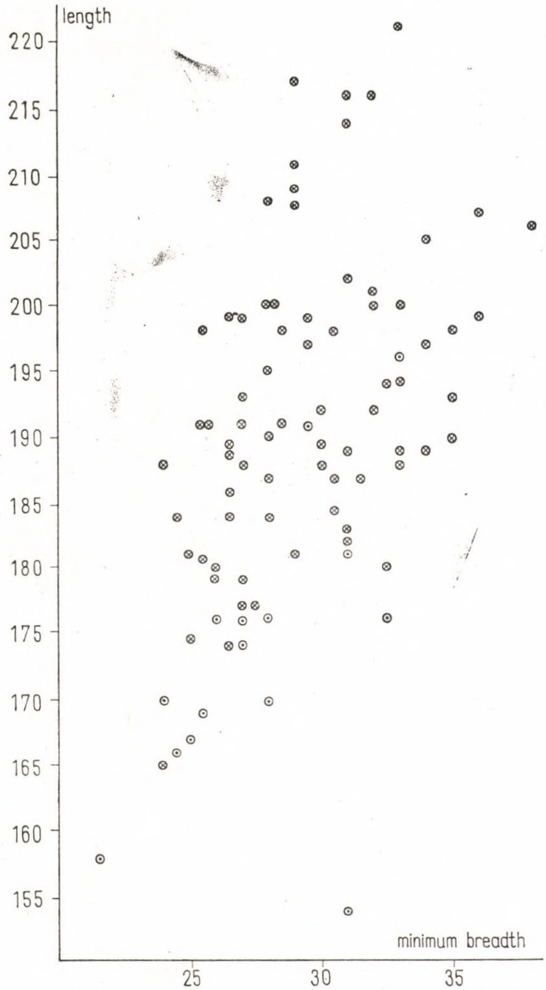


Fig. 39. Size variation of the metacarpals of cattle in Hungary in the Middle Ages

the biological possibility was given for a century and a half after the appearance of the breed to have produced plenty of animals for even export purposes.[241]

With the emergence of the new breed the average withers height of the Hungarian cattle suddenly rose by nearly 10 cm (Fig. 9), in spite of the fact that the small breed lived on for centuries side by side with the new one.[242]

[241] Matolcsi, J., 1965, pp. 24—25
[242] Bökönyi, S., 1961b, p. 87; 1962b, p. 4

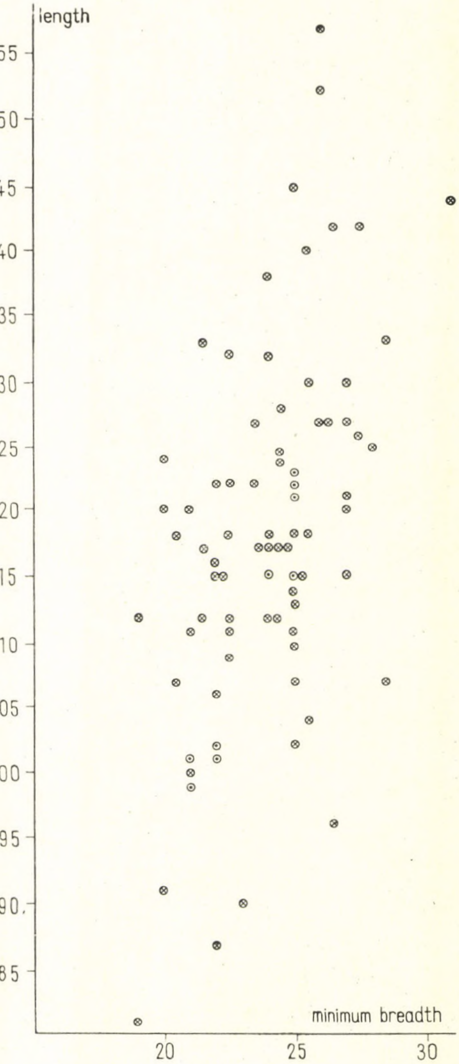


Fig. 40. Size variation of the metatarsals of cattle in Hungary in the Middle Ages

But it was the new breed that boosted the breeding and export of the Hungarian cattle by leaps and bounds. The first written data about a considerable export of Hungarian cattle are dated at the same time when this breed appeared. The big towns of the Great Plain, Debrecen and Kecskemét, had an especially significant cattle breeding and export. Miklós Oláh wrote in 1536: "I knew here (Debrecen) a rich bourgeois, Gáspár Biró, who had

10,000 oxen for sale."[243] He also stated that "the Venetian province of Italy, Austria, Moravia, Bohemia, Swabia and the part of Germany that stretches as far as the Rhine are all provided with cattle by Hungary".[244]

Even when a great part of the country had been occupied by the Turks cattle driving to the above territories continued. Wholesale dealers in cattle, veritable merchant princes emerged who had vast numbers of cattle, driving several hundreds of thousands a year to West-European markets. In the autumn of 1560 on a single day as many as 7418 heads of cattle crossed the Danube at the ferry of Vác on their way westwards.[245] In Germany the meat of the Hungarian cattle was highly appreciated, which is shown by the regulations for the butchers. A datum from the archives of Augsburg dated 1526: "Die hungarisch als die pesten Ochsen, so jetzo dieser Zeit zu gemeiner Stadt ham gebracht . . . dass zwischen polnisch und hungarisch Ochsenfleisch ein grosser Unterschied sei . . ."[246] (The Hungarian that is to say the best oxen, recently introduced to the city . . . that there is a great difference between Polish and Hungarian beef . . .). Or the rule about butchers' shops issued in Munich in 1599, according to which as long as there is Hungarian beef in the shop no other beef shall be sold, ". . . damit nichts ungerechts das nicht ungarisch Fleisch unser gewegen".[247]

In view of the above it is by no means impossible that the finds in Upper Austria of long-horned cattle reminiscent of the aurochs[248] and those unearthed at the Nikolauskapelle in Munich (15th—16th century) approaching the sizes of today's cattle[249] had originated from animals exported from Hungary.

Soon the draught oxen of the Hungarian white cattle were also put to use. Miklós Oláh also mentioned that salt was transported from Máramaros partly on boat partly by carts drawn by eight yokes of oxen to the Northern Uplands of Hungary.[250]

No doubt the number of the Hungarian white cattle was strongly reduced during the time of the Turkish sway (16th—17th century) and even more so during the liberation wars following the Turkish occupation. But the breed soon recovered from these ravages. The fact that later it lost importance and is today on the point of extinction, was caused by the undiscriminating importation of improved West-European breeds. This began at the end of the 17th century (at that time Prince Pál Eszterházy introduced the first Swiss cows to Hungary[251]) instead of endeavours to breed the Hungarian cattle of adequate use.

[243] Szamota, I., 1891, p. 545
[244] Szamota, I., 1891, p. 551
[245] Fekete, L., 1944, p. 246
[246] Takáts, S., n.d., p. 352
[247] Ibid.
[248] Knecht, G., 1966, pp. 53 ff.
[249] Boessneck, J., 1958b, p. 41
[250] Szamota, I., 1891, p. 554
[251] Hankó, B., 1935, p. 14

THE WATER BUFFALO

WILD ANCESTORS

On the basis of morphology, origin and distribution Rütimeyer divided the subgenus of the bovids including the water buffalo into three groups: *Probubalus, Bubalus* and *Buffelus*.[1] The first group comprises some primitive forms since extinct, the second the African water buffaloes and the third the Asian congeners. This grouping of Rütimeyer's has not been accepted by all authors. Lydekker[2] and Weber[3] united the two latter groups under the name of *Bubalus*. Duerst did the same with the African and Asian Pleistocene water buffaloes,[4] so did Boule and Teilhard — at least this can be inferred from their having described the Upper Pleistocene buffalo of Sjara-osso-gol under the name of *Bubalus wansjocki*[5]. Trouessart, also merged the two latter groups into one under the name *Buffelus*.[6] Zittel,[7] Berckhemer[8] and Schertz,[9] on the other hand, accepted the Rütimeyer grouping and so did Antonius.[10] We think it right to adopt Rütimeyer's grouping since there are such essential anatomical differences between the African and the Asian water buffaloes that have to be expressed in taxonomy.[11]

Which are these anatomical differences? Here we should only like to refer to those of craniology, mainly originating from the different forms of the four bones of the temple, the fossa temporalis (Fig. 41). In the group of African water buffaloes the frontal bone (os frontale) and the temporal bone (os temporale) touch each other, whereas the parietal bone (os parietale) and the ala temporalis (= alisphenoid) of the sphenoidal bone do not touch. This latter apophysis of the Asian water buffaloes is so much elongated that it touches the parietal bone and thus prevents the meeting of the frontal and temporal bones. Another difference between the two groups is the form of the choana opening. Whereas the ploughshare bone (vomer) definitely

[1] Rütimeyer, L., 1865, p. 334; 1867, p. 52
[2] Lydekker, R., 1885, p. 27
[3] Weber, M., 1904, p. 678
[4] Duerst, U. J., 1900, p. 82
[5] Boule, M., Breuil, H., Licent, E., Teilhard, P., 1928, pp. 71 ff.
[6] Trouessart, E. L., 1904—1905, p. 743
[7] Zittel, K., 1895, p. 913
[8] Berckhemer, F., 1927, pp. 146 ff.
[9] Schertz, E., 1937, p. 58
[10] Antonius, O., 1922, p. 139
[11] Berckhemer, F., 1927, pp. 148 ff.

divides this opening into two parts with the Asian group, the opening is not cut into two with the African buffaloes, whose ploughshare bone takes up a dorsal position as against the plans of the palatal bone (os palatinum) in front of the choana opening. Moreover, this opening is pointed in the Asian and rounded in the African water buffaloes.[12] In the skull form of the two groups there are differences in the position and shape of the horn cores, moreover, in the extent to which the bone bead spread as the lower part of the horn cores.

On the basis of these cranial differences it can be clearly ascertained that all domestic water buffaloes belong to the Asian group, thus, their wild ancestors must be sought after there. The systematization of the fossil forms has not been completed yet but the Pleistocene form from Sivalik in India, *Bubalus (Probubalus) sivalensis* Rüt.,[13] seems to be the starting point, followed by *Bubalus platyceros* Lyd.[14] The next member is *Bubalus palaeindicus* Falc.[15] from the Pleistocene of Nerbadda in India, and it is this latter one from which the present Arnee water buffalo *(Bubalus arnee)* can be derived. It is almost improbable that the series of origin is as simple as this; the above-mentioned forms are but links in the chain of evolution, unfortunately no details have been discovered yet.

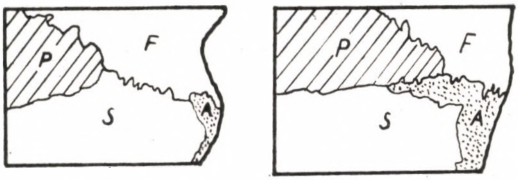


Fig. 41. Position of bones constituting the temporal fossa with African (on the left) and Asian water buffaloes (on the right). P = os parietale, F = os frontale, A = alisphenoides, S = squamosum. After Berckhemer (1927)

From India, as it were from a focal point, the water buffaloes on account of climatic changes in the Pleistocene, spread most likely in several waves towards the northeast and northwest direction. Manchuria is the farthest point in the northeast, whereas to the northwest they reached the eastern part of Germany. Chinese fossil water buffaloes are the best known of all, with five described species, moreover, in the descriptions the conditions of their origin are fairly well clarified.[16] On the other hand, water buffalo finds of the Pleistocene in Europe have been discovered only in three sites:[17] at Steinheim a. Murr,[18] at Shönebeck a. Elbe,[19] and in the Peneios

[12] From W. Staudinger's unpublished work. See: Berckhemer, F., 1927, pp. 148 ff.

[13] Rütimeyer, L., 1878, Plate II, Figs 4–5

[14] Lydekker, R., 1880, p. 127, Plate XVIII

[15] Rütimeyer, L., 1878, pp. 141–142

[16] Boule, M., Breuil, H., Licent, E., Teilhard, P., 1928, pp. 71 ff.; Young, C. C., 1936, pp. 505 ff.; Minchen, M., Chow, Hsu Yu-Hsian, 1957, pp. 457 ff.

[17] Concerning the third find described by Stehlin as belonging to the Upper Pliocene of the Val d'Arno (1934, pp. 407–412), Hilzheimer (1939, pp. 254–256) proved that it had not been a water buffalo but a bison; as such, nevertheless, it was the earliest find in Europe

[18] Berckhemer, F., 1927, pp. 146 ff.

[19] Schertz, E., 1937, pp. 57 ff.

Valley near Larissa in Thessaly.[20] When the water buffalo find of Steinheim was described first it was dated in one of the interglacials of the Ice Age; since then Adam – on grounds of the rich fauna found at the site – set the water buffalo into the Mindel–Riss interglacial.[21] On the other hand, the find at Schönebeck originates from the second interglacial of North Germany,[22] whereas the Pleistocene water buffalo bones found in Greece can be dated at the Riss–Würm-interglacial and the beginning of the Würm glaciation, respectively.[23] These wild water buffaloes – like those from North China – could stand on their own only in the interglacials, and at the end of the last interglacial moved to south for good. But in the early Holocene, at the time of the climatic optimum of the Neolithic, the wild forms of the Indian water buffaloes found their way once more to Europe however, then they did not get further than the Carpathian Basin. The course by which they got in can be easily followed. Hilzheimer was the first to describe Mesopotamian representations of water buffaloes from the middle of the 3rd millennium B.C. He pointed out that they meant a spread of the South Asian fauna towards the west, which was evidently due to a change in the climate.[24] In Europe wild water buffalo finds were discovered in two Neolithic sites: Frumusica in Moldavia[25] and Csóka in North-East Yugoslavia,[26] furthermore, in an early Holocene site in Bukovina undetermined in particulars.[27] The fact that it was not an importation of animals but the advance of the fauna is proved simultaneously by the gaur representations in Mesopotamia[28] and osteologically by the finds of the *Asinus hydruntinus* Reg. which is also a member of the thermophilous fauna, in Hungary[29] and in South-East Europe.[30] Of course, when the climatic optimum had terminated the wild buffaloes withdrew from Europe but persisted for a long time in the Near East. The representation of a water buffalo hunt on a Sassanid silver dish indicates that in Iran wild water buffaloes occurred even in the 3rd–4th century A.D.[31]

THE DOMESTICATION AND SPREAD OF THE WATER BUFFALO

In South and South East Asia the use of domestic water buffalo is connected with rice cultivation thus it can well be assumed that its first domestication had taken place in the rice-growing belt:[32] Indo-China or South

[20] Boessneck, J., 1965, pp. 56–67
[21] Adam, K. D., 1954, pp. 131 ff.
[22] Schertz, E., 1937, p. 68
[23] Boessneck, J., 1965, pp. 56–57
[24] Hilzheimer, M., 1926, pp. 140 ff.
[25] Matesa, G., 1946, p. 42
[26] Bökönyi, S., 1957b, p. 43
[27] Bökönyi, S., 1957b, p. 44
[28] Bodenheimer, F. S., 1960, p. 50
[29] Bökönyi, S., 1957b, p. 44
[30] Bökönyi, S., 1959a; Necrasov, O., Haimovici, S., 1959, pp. 563 ff.
[31] Brentjes, B., 1962, p. 28
[32] Zeuner, F. E., 1963, p. 251

China rather than India. Unfortunately, no archaeological proofs are available. It has not been ascertained yet that the water buffalo was a domestic animal already in the late Neolithic–Copper Age (Indus culture). However, its representations on seals[33] in the Harappa culture (c. 2500 B.C.) evince this fact. At the same time it was kept in Mesopotamia as a domestic animal,[34] whence it spread but slowly. Thus it reached Egypt only in the Middle Ages, and was not known in Antique Rome at all.[35] In the Post-Hittite layers of Boghazköy (12th–7th century B.C.) some bones of the water buffalo were found[36] and a marble capital of a column, representing the head of a short-horned, thus certainly domestic water buffalo, originating froma a castle of Herod that has been built in a mosque in Samaria (today Sebastie).[37] The water buffalo reached the Arabs in the 1st century A.D. and since the 2nd century A.D.[38] it is often mentioned in Arabic poetry. In the 4th century A.D. it found its way to Persia,[39] and from there most probably directly to South Russia, where it was very rare and occurred only in the 5th century A.D. layers of Olbia.[40] The South Russian was one of the routes by which the water buffalo reached Europe; the other led through Greece where it appeared sporadically in the 6th century A.D.[41]

The Avars took the water buffalo along from South Russia and brought it to the Carpathian Basin in 560 and subsequently introduced it to Italy in 596; The Bulgarians brought it in the Balkan Peninsula in 679.[42] Apparently only small stocks reached both Italy and Bulgaria, which is indicated by St. Willibald, who while travelling through Italy and Sicily to Palestine in 723, to his great astonishment found water buffaloes for the first time in this latter place.[43] Moreover, the inscription of a marble column evinces that in the peace treaty Khan Omortag concluded with Byzantium in 814 he demanded for the return of every Byzantine prisoner of war two water buffaloes.[44] No doubt, the Avars introduced the first water buffaloes to Germany, where the earliest place name referring to the animal's name (Buffileba, near Gotha) emerged in 874.[45]

It seems to be probable that the Hungarians also introduced a good many domestic water buffaloes to Europe because from the turn of the first millennium onwards data referring to them became more frequent. Szentkirályi mentioned water buffaloes from Transylvania in the 11th century.[46]

[33] Zeuner, F. E., 1963, p. 249, fig. 9: 6
[34] Zeuner, F. E., 1963, p. 249
[35] Boettger, C. R., 1958, p. 182; Zeuner, F. E., 1963, p. 250
[36] Vogel, R., 1952, p. 152
[37] Antonius, O., 1920, p. 48
[38] Szalay, B., 1914b, p. 65
[39] Ibid.
[40] Pidoplitchko, I. G., 1956, p. 52
[41] Szalay, B., 1914b, p. 65
[42] Ibid.
[43] After O. Keller, Zeuner, F. E., 1963, p. 251
[44] Ivanov, P., Sachariev, S. J., 1960, p. 241
[45] Szalay, B., 1914a, p. 98
[46] Szentkirályi, A., 1889, pp. 8 ff.

In King Béla II's foundation deed of Dömös Abbey (1183) water buffaloes were also mentioned.[47] At the end of the 12th century there was an estate in South Hungary named Biwol, and in documents of later centuries in the Middle Ages, too, place names deriving from the water buffalo occurred.[48] A document dated from the mid-13th century mentioned a pen for water buffaloes (byolokol,[49] in Hungarian: bivaly akol) which can be taken as the most important evidence of the keeping of water buffaloes. When analysing written data on buffaloes difficulties arise, for in the mediaeval Latin chronicles water buffaloes, bisons and aurochses are equally referred to as "bubalus". Thus, in a great many cases, it was rather hard to decide which species was meant in a given case. The "Insula bubalorum", e.g. mentioned in a letter by Endre II, King of Hungary, is not likely to refer to water buffaloes.[50] On the other hand, the data according to which the same king gave to the Serbian King Stephen (1195—1224) horses, bisons and "Saracen buffaloes" among others most certainly refer to water buffaloes.[51] One has to think of water buffaloes concerning the documented data according to which Wladislas, King of Poland, visiting Sigismund, King of Hungary and Emperor of the Holy Roman Empire in 1412, was taken ill from water buffalo cheese.[52]

In France the earliest written sources mentioning the water buffalo as a domestic animal came from 1154 and from England in 1252.[53] However, these latter data evidently refer to occasional specimens only, for the northwestern boundary of the mass distribution of water buffaloes in Europe was the chain of the Carpathians.

WATER BUFFALO FINDS IN EUROPE

Water buffalo finds are very rare in Europe, which points to the slight economic importance of the species in Mediaeval Central and Eastern Europe. But the Balkan Peninsula should be considered more closely for water buffaloes are very frequent in this part even today; thus a great many data scarcely investigated from archaeolo-zoological points of view can be expected to turn up in the future. Apart from the six bones of water buffaloes (of two individuals) found at Olbia and from the undated water buffalo finds without particular dating from Bulgaria ("Golema Zhelezna" Cave) two horn cores were brought to light and from the vicinity of Tirnovo odd teeth,[54] water buffalo finds were only discovered in Gdansk and in two Hungarian sites. V. Baer and Röhmer were the first to examine the Gdansk finds and described a new species which they named *Bubalus*

[47] Meller, P., 1912, p. 14
[48] Szamota, I., Zolnai, Gy., 1902—1906, p. 75
[49] Ibid.
[50] Meller, P., 1912, p. 15
[51] Szamota, I., 1891, p. 22
[52] Meller, P., 1912, p. 15
[53] Szalay, B., 1912b, p. 66
[54] Ivanov, P., Sachariev, S. N., 1960, p. 241

pallasi.[55] Later La Baume checked the finds again and stated that they were not from a new species of water buffaloes; the horn cores were simply those of the domestic water buffalo, living in Gdansk during the rule of the Order of the Teutonic Knights.[56] The two Hungarian finds: a horn core each of an adult and a subadult bull were found in the 16—17th century layers of the Buda—Vár (Castle)[57] and in the 15th—17th century layers of Nagykanizsa—Vár (Castle),[58] respectively (Figs 42—43). It is not impossible, of course, that more water buffalo finds were unearthed in Hungarian Mediaeval settlements, where the animals' bones had been in the kitchen midden; it was impossible to identify the species merely on the basis of extremity bone fragments.

The few Central and East European finds of domestic water buffalo bones show that these animals differed from the wild form of the species only in having shorter and thinner horns. On the other hand, they did not differ from modern domestic water buffaloes with respect to the form and size of their horns. This shows that the recent breeds of the water buffalo — at least from the point of view of the form of their horns — had evolved by the end of the Middle Ages and have not undergone any essential change since then.[59] This is quite understandable if we take into consideration the fact that since the Middle Ages the water buffalo has lived under essentially identical conditions, environment, husbandry and feeding and that no particular breeding selection was performed to change its external appearance — except most recently, here and there, with a view to improving its milk yield.

Of course, in Central and Eastern Europe the water buffalo was not an animal used in the service of rice cultivation but was a prototype of draught animal. Here its distribution was restricted above all by the climate, because it requires warmth, and under primitive conditions of husbandry it could not endure the winter in most of Europe even if it was kept in a stable. It requires a great deal of water, because it needs muddy ponds for bathing, and this hindered its large-scale distribution in the steppes of Southern Russia and the Ukraine or in the Mediterranean Basin. However, it is also due to other reasons that it is less important than cattle and horses even in such regions of Europe where suitable climatic and geographic conditions prevailed. It is a fact that in the temperate belt, as an animal supplying milk and meat, it cannot compete with cattle or with horse as a draught animal In the tropics it could oust cattle on account of its higher resistance to epidemics. In Egypt, for example it spread significantly in the last century when the rinderpest creeping through from the East destroyed almost completely the stock of cattle.[60] As a draught animal it can compete with the horse only in places where heavy loads are to be transported over short distances on bad roads. From the point of view of speed it certainly lags

[55] La Baume, W., 1909, p. 49
[56] La Baume, W., 1925, pp. 435 ff.
[57] Bökönyi, S., 1959b,' pp. 154—155; 1961b, pp. 91—92; 1963b, p. 404
[58] Bökönyi, S., 1961b, pp. 91—92
[59] Bökönyi, S., 1959b, p. 155; 1961b, p. 92; 1963b, p. 404
[60] Boettger, C. R., 1958, p. 225

Fig. 42. Horn core of water buffalo from Buda Castle. 16th—17th century

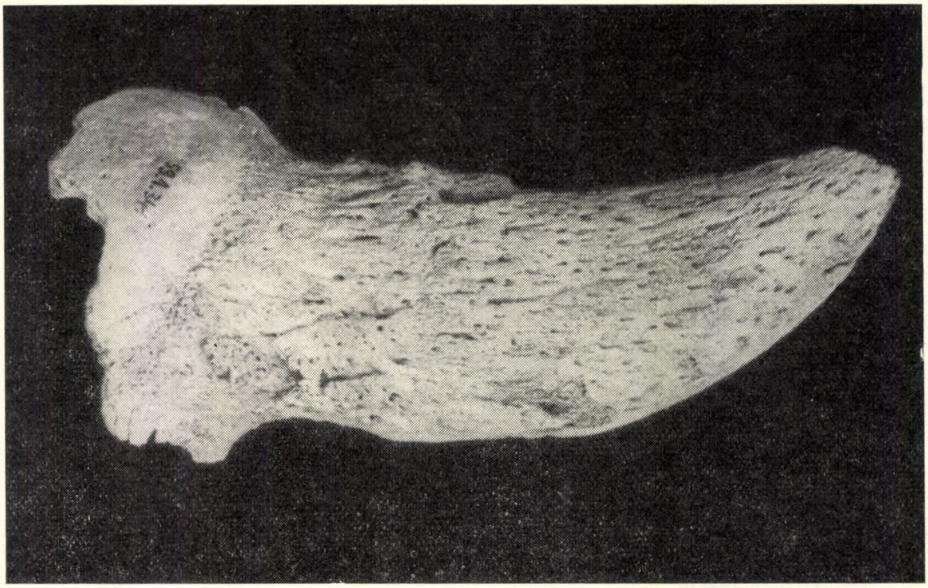


Fig. 43. Horn core of water buffalo from Nagykanizsa Castle. 15th—17th century

behind the horse; on the other hand it can exert unbelievable strength. Albertus Magnus, the eminent natural scientist of the 13th century, states that one water buffalo substitutes the power of two horses.[61] (He, by the way, gave such a faithful, true to life description of the water buffalo that by it the domestic animal is immediately recognizable even though it was unknown to him before but then he saw it in Italy. He gave an exact description of its appearance and also of the way in which it dragged along heavy loads and how it sometimes rushed to the nearest pond to submerge up to its mouth "... iratus mergit se in aqua usque ad os ...".[62]) Indeed, as a draught animal it is easy to handle. However, if it goes several days without submerging in a pond, it is likely to run into the water, cart and all.

With the advent of motor vehicles the importance of the water buffalo has declined — at least in Europe. In Hungary there are only a few hundred alive and the time can be foreseen when the water buffalo population of the Balkan Peninsula will also be pushed into the background — or will even vanish completely.

[61] Pitzl, H., 1959, p. 25
[62] Ibid.

SHEEP

THE SIGNIFICANCE OF SHEEP

In general, animal domestication is usually connected with the beginnings of agriculture. This is not quite correct for there are certain domestic animals which came into man's possession in periods prior to the emergence of agriculture.[1] Sheep are among these and as such belong to one of the oldest species of domestic animals. Only the dog was possibly domesticated earlier, but its economic importance cannot be compared to that of sheep. Indeed, the domestication of sheep meant a revolution in the economy, upon which it had a decisive effect for several thousand years.[2]

WILD FORMS

In the Pleistocene — at least in some of its periods — the wild ancestors of sheep also occurred in Europe, but did not survive the Pleistocene in this region. Two finds attributed to wild sheep of the Holocene have been found: one at Bodrog—Monostorszeg[3] and the other in Jutland[4] which, however, — in accord with Boessneck[5] — we do not consider wild but domestic sheep's bones. The question is not so clear concerning the finds in the Balkans, suspected to have originated from wild sheep — a point we shall revert to later.

Nowadays four chief types of wild sheep exist: the moufflon (*Ovis musimon* Pall.), the urial (*Ovis orientalis* Blyth), the argali (*Ovis ammon* L.) and the Canadian wild sheep or bighorn (*Ovis canadensis* Shaw).

Among them the moufflon lives wild, in South West Europe — in Sardinia and Corsica — and in South West Asia. From the former territory it has been introduced to many European countries and has become acclimatized there. It was first introduced in 1840 to the game reserve of Lainz[6] and then soon into other parts of Central Europe, where now a stock of about a thousand individuals can be found in several countries.

[1] Zeuner, F. E., 1956, p. 6; 1963, p. 63
[2] Zeuner, F. E., 1963, p. 64
[3] Koch, A., 1902, pp. 347 ff.
[4] Herre, W., Kesper, K. D., 1953, pp. 204 ff.
[5] Boessneck, J., 1956d, p. 20
[6] Schmidt, W., 1935, p. 32

In summer the colour of the moufflon is fox-red with the lower parts of the abdomen being almost white; in winter it is dark brown with a saddle-shaped white spot on either side of the back. The ram has large horns turned outward and curving two-thirds or three-quarters of a circle, with horizontal rings around them. The horns of the ewe are much smaller. It lives in groups of ten to twenty in summer, but in winter it congregates in groups of as many as thirty animals. However, these groups comprise only the ewes and the lambs aged one or two years, the adult rams are in separate smaller groups and visit the females only in the period of mating.

The distribution of the urial group stretches from the trans-Caspian territory through Turkestan, North Iran and Afghanistan up to West Tibet and the Punjab, particularly in mountainous regions, though some of their subspecies occur in the steppe too. They are long-legged, fallow-coloured animals, more greyish in winter, and have a dark spot behind their shoulders; their abdomen, legs and tail being white. It is very interesting that on their throat the rams have a strong mane, which stretches down to their chest. Their horns are like those of the moufflon, with strong horizontal protuberances.

The distribution of the argali ranges from Central Asia through Tibet and Mongolia as far as Kamchatka. This is the largest among wild sheep, its withers height reaching 120 cm. Its trunk is greyish brown with a wide white mane on its neck. It has very strong horns, twisted several times. The horns of the subspecies of the Pamir are particularly long, at times exceeding even 180 cm.

The Canadian wild sheep lives on the western coastal region of North America, though its distribution stretches over Kamchatka and North East Siberia (west of the delta of the Yenisei). Its withers height reaches approx. 80 cm; its colour varies from greyish brown to cream. The horns are long and relatively smooth and form approximately a full circle.

Recently Zalkin has classified the first three of the above groups into one, naming it *Ovis ammon* and recognizing its 27 subspecies.[7] He also considers the bighorn to be independent with four subspecies.[8] By this he has, when all is said and done, decided the essence of the debate about the origin of domestic sheep.

When Rütimeyer[9] described the *turbary sheep* with short and untwisted horns *(Ovis aries palustris)* of the Swiss lake dwellings he himself suggested that the animal could not be of local origin. On this issue all further authors agreed, but they did not agree about the wild ancestor of this "breed" of domestic animal. C. Keller represented the most surprising view of all. In his opinion the *turbary sheep* was a product of the domestication of the North East African Barbary sheep (*Amotragus lervia* Pall.).[10] But the Barbary sheep, which takes up a special position in the systematics, could by no means have been the wild ancestor of domestic sheep, for there are numer-

[7] Zalkin, V. I., 1951, pp. 218 ff.
[8] Zalkin, V. I., 1951, pp. 265 ff.
[9] Rütimeyer, L., 1861, p. 191
[10] Keller, C., 1909, pp. 88—89

ous essential anatomical differences between the two. Moreover, they cannot be crossbred. In any case, Barbary sheep are perhaps closer to goats, although these cannot be taken into consideration as the wild ancestors of this latter species either — notwithstanding the fact that they have been successfully crossbred.[11]

Evidently, Keller must have been influenced by the fact that early Egyptian sheep often had — as shown by representations — a mane on the edge of the throat and the lower part of the neck. But this is not necessarily a characteristic of the *Ammotragus;* moreover, the rams of the urial and argali groups of wild sheep also have such a mane.

Other authors, such as Duerst,[12] Ewart,[13] Antonius,[14] Hilzheimer,[15] etc. looked for the wild ancestors of *turbary sheep* rather among Asian sheep. When Duerst described the *copper sheep (Ovis aries studeri)*, considering this animal with its thick, three-edged, spirally twisted horns, to be a different breed,[16] the moufflon also soon found its way among the supposed wild ancestors. In Duerst's opinion the *copper sheep* was the product of cross-breeding between *turbary sheep* and the moufflon, but other authors considered it for a long time to be a pure descendant of the moufflon.

The situation underwent a radical change as soon as it had been proved that *turbary sheep* and *copper sheep* do not represent independent breeds. The hornless sheep — the "*bronze sheep*" — formerly considered to belong to a third breed; soon turned out not to represent an independent breed, for hornless sheep may come into being in any breed. (Hornlessness — as in the case of cattle or goats — is a domestication change in sheep also.) Eugster was the first to point out the link between *turbary sheep* and *copper sheep*. According to him, the *turbary sheep* is at present on the point of extinction and the Bündnerschaf, whose females have horns like those of goats whereas the rams have stocky, twisted ones, are its direct successors.[17] The question was finally solved by Reitsma, who carried out detailed investigations of recent Drente sheep, the Dutch sub-fossil terpen sheep and the sheep of Swiss lake dwellings. In the course of his examinations it became clear that the typical horn cores of *turbary sheep* all originate from ewes (the hornless "*bronze sheep*" are also females), the "*copper sheep*" on the other hand are the males of the same breed.[18]

But however useful Reitsma's results were, they only referred to the grouping of prehistoric domestic sheep. With respect to the question of the wild ancestors, they only achieved the simplification that now the wild ancestors of only one breed had to be found. Zalkin's results meant a really great advancement in the research of the wild ancestors (see note 7), for he determined the monophyletic origin of domestic sheep and excluded from

[11] Petzsch, H., 1957, pp. 295 ff.
[12] Duerst, U. J., 1908
[13] Ewart, J. C., 1913, pp. 160 ff.
[14] Antonius, O., 1922, p. 217—218
[15] Hilzheimer, M., 1927, p. 57; 1936, pp. 195 ff.
[16] Duerst, U. J., 1904b, pp. 17 ff.
[17] Eugster, E., 1921, p. 82
[18] Reitsma, G., 1932, p. 45

among the possible wild ancestors the other genuine wild sheep, the bighorn.

The question is which subspecies of the *Ovis ammon* took part in the evolution of domestic sheep, moreover, in what proportion, still remains unanswered. Zeuner's view is a very interesting one. In his opinion most of the woolly breeds of sheep descended from the urial group and the bulk of hairy sheep from the moufflon group.[19]

Kaczkowski indicated a significant new way to solve this question but it has not been pursued since. By a serological method (iso-agglutination) he divided domestic sheep into two chief groups: the A group and the O group, the latter having two sub-groups depending on the presence or absence of the anti-A in them. On the other hand, when examining moufflons he proved that without exception they all belong to the A-group. The same group prevailed with the majority of Polish domestic sheep (thus he suggested that their origin from the moufflon was probable), English Southdown sheep, on the other hand, do not show any kinship with the moufflon.[20]

CHANGES CAUSED BY DOMESTICATION

Domestication brought about substantial changes in sheep, woolliness being the most important of them. Wild sheep, too, have some winter wool, particularly those which have to endure cold and snowy winters, but their wool is short and not curly. Only domesticated animals have a mass of woolly hairs. On the basis of representations the earliest woolly sheep could be demonstrated from the Jamdat—Nasr period (c. 3000 B.C.) in Asia Minor.[21] But quite recently a small clay figurine representing a woolly sheep (Fig. 44) has been found in a settlement of the 6th millennium B.C. at Tepé Sarab in Eastern Iran.[22] The artist who had made it was very skilful in conveying the curliness of the wool. But in the Neolithic period woolly sheep were in all likelihood quite rare and appeared in great masses only in the Copper Age. However, by the end of that period and in the Bronze Age they became widespread also in Europe. At that time Man changed over from leather clothes to woollen ones.[23] Of course, side by side with woolly sheep great numbers of hairy ones continued to live on. The sheepskin found in one of the Pazyryk kurgans of the 5th century B.C. had belonged to a hairy sheep, which was still close to a wild sheep.[24]

The other change which domestication brought about in the hair of sheep was its becoming white. As we have seen above, none of the groups of the wild ancestors of domestic sheep are white; wild sheep have whitish abdo-

[19] Zeuner, F. E., 1963, p. 169
[20] Kaczkowski, B., 1929, pp. 10—14
[21] Zeuner, F. E., 1963, p. 172; Brentjes, B., 1965, p. 29
[22] Here we should like to thank Prof. R. J. Braidwood, Oriental Institute, University of Chicago, for having kindly put the statuette at our disposal for examination purposes
[23] Vogt, E., 1937, pp. 44—45; Tschumi, O., 1949, p. 602
[24] Ryder, M., 1961, p. 248

mens and legs at most. But on domesticated animals the white colour is a general phenomenon, which appeared very early with sheep, evidently even earlier than the woolly hairs. Thus, for example the Pazyryk sheep mentioned above was already white, although it had no woolly hairs yet. Today the wool of all improved breeds is white, except the breeds that are intentionally bred in different colours (karakul sheep). It is very interesting that when the trunks of domestic sheep become white, simultaneously their heads and feet often become black. Black heads and feet do not occur with any group of wild sheep, this too is a symptom of domestication.[25] This

Fig. 44. Clay statuette representing a woolly sheep. Sarab, Iran, c. 5000 B.C. Oriental Institute, Chicago

phenomenon occurs with primitive breeds (Tzigaya, Zackelschaf) and with improved ones (some English mutton sheep) alike.

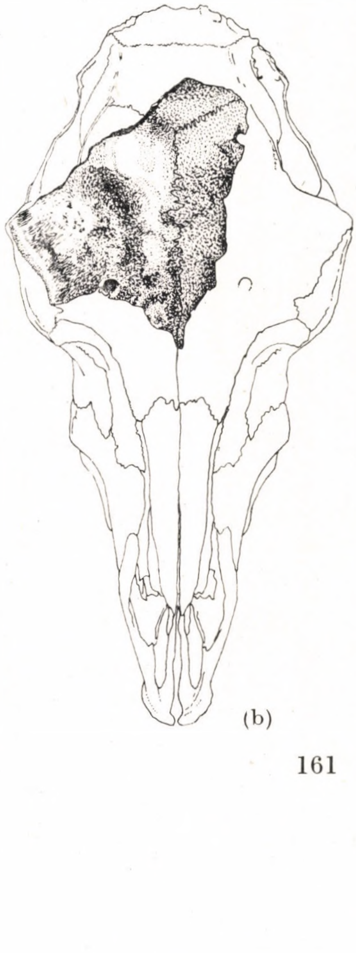
A third, essential change caused by domestication is the hornlessness of sheep. This is even older than the two former features. The earliest hornless sheep — like the woolly ones — emerged in South West Asia. The earliest find of this kind was unearthed from the stratigraphic horizon of Ali Kosh C_2 (Bus Mordeh phase, c. 7500 B.C.) in South West Iran (excavations of Hole and Flannery). Among female sheep hornlessness had spread widely in South West Asia by the 6th millennium B.C. and in the course of the 6th millennium hornless sheep had found their way through South East Europe as far as Central Europe too. The earliest hornless sheep were found at the early Neolithic settlement of Maroslele—Pana (Körös culture, c. 5000 B.C.) in Southern Hungary.[26] Since then fragments of the skulls of hornless sheep have been discovered in further sites of the Körös culture at Gyálarét, Röszke—Ludvár, Ludas—Budzsák too (Fig. 45). It was only in the middle

[25] Zeuner, F. E., 1963, p. 168
[26] Bökönyi, S., 1964b, pp. 90—91

(a)

Fig. 45. Fragments of a hornless sheep skulls. (a) Röszke—Ludvár, (b) Early Neolithic (Körös culture)

Ovis aries



(b)

Neolithic that hornless sheep began to spread in Eastern and Central Europe and they became common from the Bronze Age onwards. Today they are the most frequent in both sexes of domestic sheep; horned ones are in a marked minority.

Four-hornedness is a domestication phenomenon akin to the previous one. This too appeared fairly early: the earliest find, part of a four-horned sheep's skull, was found at a Neolithic peat-bog settlement in Zarnowice in Poland.[27] It had stocky, three-edged horn cores, like those of *copper sheep*. Glur described a four-horned sheep skull found at the Celtic—Roman settlement of the Engehalbinsel.[28] Part of a similar skull — unfortunately without exact dating — was found at the prehistoric lake dwelling at Gägelow (near Wismar) (Museum für Natur- und Völkerkunde, Basel[29]). Its horn cores have

[27] Krysiak, H., 1937, pp. 129 ff.
[28] Glur, G., 1894, p. 32
[29] Here we should like to thank Dr. H. Schaeffer for having kindly put the fragment of the skull at our disposal for examination purposes

three blunt edges and are relatively long: about 250 and 230 mm respectively. The medial horn core starts steeply upwards and curves forewards; the lateral one starts horizontally outwards and backwards then curves downwards. It is somewhat thinner than the former. Today four-horned sheep are quite frequent among the short-tail sheep of West Europe (Fig. 46) and among the Tibetan sheep.[30] It is interesting that in the stock of sheep of the Celtic population of Ireland, four-horned individuals were always frequent.[31]

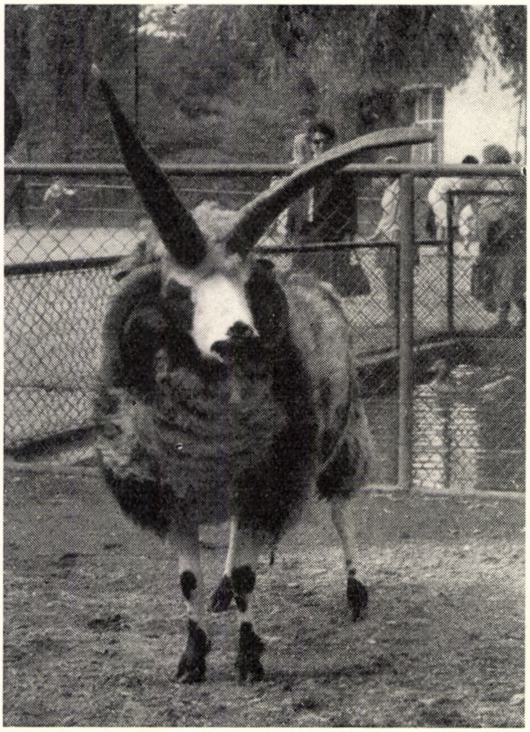


Fig. 46. Four-horned sheep from Duisburg Zoo, G.F.R.

According to Krysiak, multi-hornedness is a characteristic of the Caprovinae but does not occur in the Bovinae kept under similar conditions and thus may be independent of domestication.[32] We agree with the first part of this statement but not with the second for there are never any four-horned individuals to be found among wild sheep.

Another change caused by domestication is the increase in the number of vertebrae of the tail. Whereas among wild sheep, the longest tails have 8—10 vertebrae[33] or 13[34] at the most, among domestic sheep a tail with 13 vertebrae is considered a short tail; there are many more tail vertebrae in most breeds of domestic sheep. Indeed, there are breeds whose tails — with a maximum of 35 vertebrae of the tail — reach the ground. Primitive breeds (Soay, Faroes and Heidschnucken sheep) belong to the short-tail breed of domestic sheep, whereas — with a few exceptions only — all the European sheep with fine wool (as well as their descendants in other continents, North African, etc. hairy sheep) belong to the long tails.

Fat on the rump or tail should also be mentioned among the changes caused by domestication. With European sheep these changes do not play

[30] Zeuner, F. E., 1963, p. 167
[31] Paor, M. L., de, 1960, p. 93
[32] Krysiak, K., 1937, p. 133
[33] Antonius, O., 1922, p. 66
[34] Zeuner, F. E., 1963, p. 163

an important part. Fat-tail sheep emerged from long-tail breeds, fat-rump ones from short-tail breeds, the former having come into being in all probability in desert areas and the latter in mountainous steppe land.[35] A huge amount of fat gets accumulated on the above mentioned parts of their bodies and this quantity can even be raised by forcibly feeding the animals by hand, as is customary in Lebanon.[36] The earliest primitive fat-tail sheep are known from their representation at Uruk III, c. 3000 B.C.[37] From there they got to Africa c. 2000 B.C. Fat-tail sheep of Arabia were also mentioned by Herodotus (III, 113). According to him their tails were so long and heavy that the animals carried them by drawing a small cart behind them. This appears to have been an exaggeration, although a description dated 1682 recalled similar stories about Ethiopian fat-tail sheep. Moreover, the same occurs in India and in Asia Minor even today.[38] Fat-tail and fat-rump sheep have a particular importance with nomadic peoples who do not eat pork; they like it because instead of lard they use the accumulated suet from sheep for cooking.

Hanging ears are also a phenomenon of domestication, occurring also with goats and pigs. The earliest date of their appearance is rather vague, but can at least be shown in the Old Kingdom of Egypt.[39]

THE EARLIEST DOMESTIC SHEEP

Up to quite recent times it has been rather difficult to prove when sheep were first domesticated. This is due to the fact that research in the history of domestic animals was centred on Europe and most of the researchers had been trained on European material. Furthermore, investigations, aimed at separating domestic animals from wild ones, were performed almost exclusively on domestic animals that had had European wild ancestors. To this group belong dogs but particularly cattle and pigs. With respect to the two latter species there are particularly detailed examinations available, which show quite clearly the decrease in size observable even at the most initial stage of domestication — a fact which forms the basis of proving domestication. However, there are no such examinations available concerning sheep (and goats) and on the basis of the few measurement data it appears to be probable that there occurred no decrease in size of this kind.

The assumption seemed to be evident that no changes had taken place on the skull and on the horn cores at the most initial period of domestication; thus the question had to be approached from another angle. To prove Man's controlling and modifying influence on a certain population of sheep seemed to be the most practicable way. (One of the essential criteria of domestication is that certain groups of the given species of wild animals live and breed under human control.) Coon was the first to pursue such investigations

[35] Bogoljubskij, S. N., 1959, p. 18
[36] Antonius, O., 1922, pp. 213—214
[37] Zeuner, F. E., 1963, p. 173
[38] Zeuner, F. E., 1963, p. 164, fig. 7: 6
[39] Zeuner, F. E., 1963, p. 165

on the material of the Belt Cave in North Iran (near the southern shore of the Caspian Sea).[40] In the Early Mesolithic layers of the Cave he did not find a single sheep bone, and in the Late Mesolithic only 2.7 per cent sheep bones occurred. On the other hand, in the Pre-Pottery Neolithic of the Cave, which has been dated by the C_{14} method to 6000 – 5000 B.C., the numerical proportion had grown to 36.4 per cent. Coon supposed that here a primitive keeping of sheep was pursued in which the animals were chiefly kept for their meat and skin and at most one eighth of the lambs were slaughtered. In the Pottery Neolithic of the Cave there were 21.1 per cent sheep bones with a predominance of young individuals, killed for their meat, whereas adult ewes were used for breeding purposes and perhaps for milking.

Though the chain of Coon's thoughts is interesting his evidence is not convincing enough. No doubt, there must have been some reason for the appearance of sheep bones and their subsequent frequency in the bone samples of the Cave, but the examination results of a total of 12 sheep bones of the Pre-Pottery Neolithic do not offer a firm enough basis to presuming the existence of local domestication. The predominance of young sheep in the Pottery Neolithic, on the other hand, might be considered as sufficient proof. We ourselves have found a part of a skull of a hornless domestic sheep among the bone samples excavated by Coon in the nearby Hotu Cave (Hotu B, 5.80 – 6.30 mm; Pennsylvania University Museum, Philadelphia).

More convincing than the former are Perkins' data, based on the examinations of bone samples of the Proto-Neolithic settlement at Zawi Chemi Shanidar in North Iraq.[41] On grounds of radiocarbon determination the settlement is dated to 10,870 $\pm$ 300 B.P. The composition of the fauna showed that big-game hunting was the basic means of providing food: bones of sheep, goats and red deer amounted to over 90 per cent of the fauna. The author based his idea of the domestication of sheep on the fact that proceeding upwards in the layers the frequency of sheep and the numerical proportion of its young individuals (under one year of age) increased – which points to cultural control. In addition, morphologically the sheep did not differ from the wild form, that is to say no changes caused by domestication could be demonstrated on them. Perkins believed that it had not been a case of local domestication but that the domestic sheep had been introduced from another place.

Though Perkins' data are more convincing, there is a single unclarified point in his argumentation corresponding to Coon's. He identified, without any qualification, the increase in the numerical ratio of young animals with the process of domestication. In an unpublished paper J. Hopkins dealt with the question in a very witty manner proving that in the Mousterien (layer D) material of the Shanidar Cave,[42] which is not only quite close to Zawi Chemi Shanidar but even connected with it, there were approximately as many bones of young sheep as in the earliest Neolithic layers of Zawi Chemi, though the Neanderthal man of the former site obviously did

[40] Coon, C. S., 1951, p. 46
[41] Perkins, D., 1964, pp. 1565–1566
[42] Solecki, R. S., 1963, pp. 179 ff.

not domesticate animals.[43] Hopkins definitely found the weakest point in the research of domestication when he pointed out that the connexion between domestication and the increase in the frequency of young individuals had to be proved. Indeed, it is still to be ascertained what compositions according to age in the quarry (with and without domestication) are produced by what forms of hunting; the seasonal changes in the quarry must yet be examined and so must, above all, the normal composition of herds of domesticable wild animals according to age.

Ali Kosh supplied the first indubitable proof of the domestication of sheep (see note 25). In this site, hardly 1000 years after Zawi Chemi, such highly advanced animal keeping was pursued that even hornless individuals had emerged, a fact that renders it probable that domestication had been launched in the 9th millennium B.C.

Thus, along with goats and dogs, sheep are among our domestic animals of the longest standing. Moreover, from their domestication centre in South West Asia they soon found their way to Europe too. On the islands of the Aegean, on the way to Europe, there lived wild sheep, which can be demonstrated from archaeological sites dating to the Neolithic.[44] Whether domestication of the local stock was started under the effect of domestic sheep that had spread to the islands is a point still to be proved, though a highly probable one. In Thessaly, the southern edge of the Balkan Peninsula,[45] and in Greek Macedonia[46] the first domestic sheep appeared towards the end of the 7th millennium B.C. and spread northwards from there.

Recently the idea has arisen that sheep were domesticated also in Europe, in two centres: on the Balkan Peninsula[47] and in South West Europe.[48] The La Adam Cave in Dobrudja is said to have been the scene of the former; there the authors found two early post-glacial levels: a Mesolithic one and a Pre-Pottery Neolithic one. Middle and late Neolithic levels were above these. Wild sheep were discovered from the Mousterien layers onwards in two groups, one of them being identified with great probability with *Ovis ammon orientalis*, the other having been a special, small sheep. In the authors' opinion this latter represents a new sub-species, which, according to them, was domesticated in the post-glacial period (in the Mesolithic). Since the authors did not find any morphological differences between the recently domesticated sheep and their wild ancestors they based their theory of domestication only on the increasing frequency of sheep when they proceeded upwards in the layers and on the high numerical proportion of young animals. (In the Mesolithic layer sheep were the most frequent species of the fauna and in the Pre-Pottery layer practically its only element.) There is no doubt that a possible domestication of sheep in Dobrudja would be very surprising. As mentioned in the introduction, up to the Mid-Pleistocene there were finds of wild sheep — though only sporadically — in Central

[43] Hopkins, J., 1966, pp. 2 ff.
[44] King, J. E., 1965, p. 434
[45] Boessneck, J., 1961a, pp. 41—42; 1962, p. 28 ff.
[46] Higgs, E. S., 1962, p. 272
[47] Radulesco, C., Samson, P., 1962, pp. 282 ff.
[48] Zeuner, F. E., 1963, p. 193

and South East Europe. However, we do not know of any authentic find of wild sheep in the same region in the late Pleistocene and early Holocene. The evidence of the "wildness" of the "wild sheep" in the La Adam Cave is not convincing enough. There might be some confusion in the stratigraphy of the cave, so that we do not know whether the sheep finds are perhaps of the pre-pottery period or even of the mid-Neolithic, the more so as the post-Pleistocene fauna of the Cave is strongly reminiscent of that of the early Neolithic in South East Europe. However, until further, well dated finds are discovered we had better wait before accepting the assumption that sheep were domesticated in South East Europe.

The question of domestication in West Europe seems to be simpler than the former. Teeth and bone fragments of small "wild sheep" were discovered in Late Mesolithic sites (c. 4th millennium B.C.) in France and England. But already Zeuner raised the possibility that the sites in question were younger than the pre-pottery Neolithic in South East Europe, thus it seems to be probable that from this latter region sheep continued to spread to the former. We should go even further and derive the finds in question without any doubt from domestic sheep. This is very simple if we consider that domestic sheep having got from South West Asia to the Balkan Peninsula had reached the Carpathian Basin by the end of the 6th millennium and rapidly spread from there.

THE OLDEST DOMESTIC SHEEP OF EUROPE

The earliest sheep of South East Europe, which in Boessneck's view too, had originated in all probability from Asia Minor,[49] were small and their horn forms resembled those of wild sheep.[50] Two singularly strong horn cores from Argissa were very much like those of the wild sheep of Cyprus and also like the strong horn cores from the Neolithic layers of Sialk, which Vaufrey grouped with the *Ovis vignei*. It is remarkable that their cross-section is not the usual triangular one, but rather lentil-shaped with flat medionuchal and markedly curved orbital sides. This cross-section, however, is not characteristic of wild sheep only: a similar horn core of sheep was found at Győr—Pápai vám (custom house) in a settlement of the Zseliz group of the Linear Pottery culture, though it would be rather improbable to find wild sheep in the mid-Neolithic of North West Hungary by the Danube. The resemblance, however, is rendered probable by domestication having taken place not long before. The horn cores of female sheep were smaller; on the other hand it is interesting that no remains of hornless sheep have so far been discovered in the southern Balkans. The lack of excavations may also have played a role, of course. The material of only

[49] Boessneck, J., 1956d, p. 21

[50] Boessneck, J., 1962, p. 29. Unfortunately, only a short, preliminary publication of the bone samples of Nea Nikomedeia — far greater in number than those of Argissa — has appeared. With respect to sheep we only learned from it that the material contained parts of horn cores and skulls. (Higgs, E. S., 1962, p. 272)

one settlement in this region has been published in detail and that of another one has only been given preliminary publication, in contrast to the studied fauna of four big and five smaller Neolithic settlements and a number of minor data from the Carpathian Basin. In Thessaly the earliest hornless sheep could be shown to have existed in the middle Neolithic (Dimini culture).[51]

The domestic fauna with which sheep got from South West Asia to the southern part of Europe soon found its way to the Balkan Peninsula and from there to Central Europe. Thus it is quite natural that a homogeneous group of sheep came into being at first in the Balkans, then in the greater part of Central and East Europe. This group was like the one in the southern Balkans: it was small, with the rams having big and stocky horns twisted and turning outwards, triangular in their cross-section, whereas the horns of the females were short, like those of goats and were not twisted and their cross-section was a markedly flattened triangle. Thus the rams had the horn form of the *copper sheep*, which used to be considered an independent type, whereas the ewes had horns like those of *turbary sheep*, which also used to be considered an independent type. In addition, in the Carpathian Basin hornless individuals appeared among the females very early on at the very beginning of the Neolithic, approximately at the end of the 6th millennium B.C. (Fig. 45). The average withers height of the animals — determined on the basis of the maximum length of the metapodials by Zalkin's method[52] — was about 60 cm or rather less and up to the end of the Copper Age this withers height did not increase. These sheep could be found not only among the bone samples of settlements but often in representations too (Fig. 47). These latter generally show big-horned rams displaying their characteristic twisted and outward curving horns.

It seems very probable that these sheep were used, almost exclusively, as animals providing meat. This is indicated by the fact that in the bone samples of settlements — particularly in the initial period of the Neolithic — there were mostly remains of young and subadult animals, whereas adult animals were somewhat rarer and mature or old individuals were only very rarely found. We do not think it probable that milking of sheep played an important role either towards the end of the Neolithic or in the Copper Age, nor that woolly sheep had spread considerably in these periods. Bones of young and subadult animals evidently represented supernumerary males in the fauna, whereas, on this basis, the bones of adult animals originated mostly from females and only in an insignificant number from males, or perhaps from wethers. Accordingly adult rams and ewes were individuals simply used for breeding purposes and for nothing else.

This may also give an explanation to a strange phenomenon. In a number of Neolithic sites, particularly in Switzerland, there were only horn cores of *turbary sheep* among bone samples of sheep. Thus at Schaffis,[53] Wauwyl,[54]

[51] Boessneck, J., 1956d, p. 19; 1962, p. 43
[52] Zalkin, V. I., 1961b, p. 132
[53] Studer, Th., 1900, p. 106
[54] Hescheler, K., 1920, p. 302

St. Aubin,[55] Thun,[56] Auvernier,[57] Burgäschisee-Sud-Ouest,[58] Burgäschisee-Süd,[59] etc. there occurred only *turbary sheep*. This gave rise to the assumption that *turbary sheep* constituted an independent type, the only one supposed to have occurred in the first half of the Neolithic.[60] But what has happened was evidently that the horn-cores of rams, whose number was insignificant as against that of ewes, were not discovered in the small excavations of the Early and Middle Neolithic in Switzerland, where bone samples of sheep were generally scanty. This view is confirmed by the fact that at Port bei Nidau[61] and Egolzwil 2,[62] which belong to the earliest

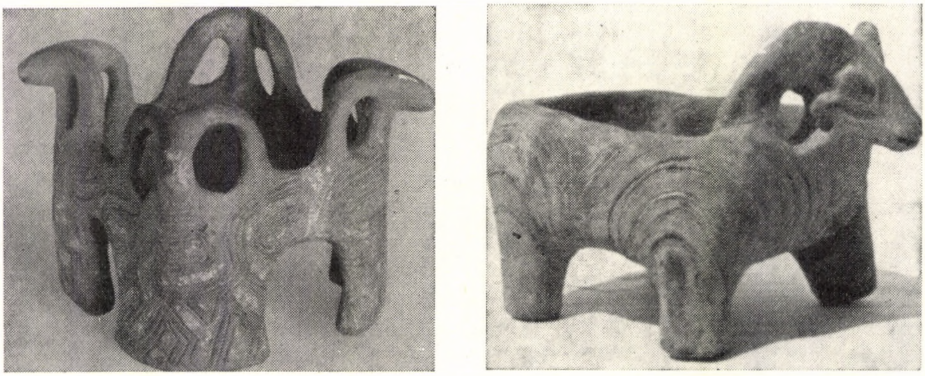


Fig. 47. Clay "altar" and clay vessel with the representations of long-horned sheep heads. Vicinity of Szeged, Neolithic (Tisza culture), and Kapitan Dimitrievo, Bulgaria. Hungarian National Museum, Budapest, and Museum, Plovdiv

period of the Neolithic in Switzerland, as well as at Greng,[63] which is also a Neolithic site, *copper sheep* with thick, twisted horns were found side by side with the *turbary sheep*. In the early Neolithic sites of the Linear Pottery culture in East Germany, sheep with stocky horns have also been discovered.[64]

Of course, within the above mentioned group of Neolithic sheep in Central and East Europe there may have been local sub-groups somewhat different from the above. But these cannot be considered independent breeds since they did not owe their existence to Man's conscious breeding activity.

[55] Reverdin, L., 1920—22, p. 252; 1921, pp. 188—189
[56] Stehlin, H. G., 1930, p. 22
[57] Josien, Th., 1955, p. 57
[58] Josien, Th., 1956, p. 36
[59] Danegger, E. A., 1959, p. 6; Boessneck, J., Jéquier, P., Stampfli, H. R., 1963, p. 114
[60] Rütimeyer, L., 1961, p. 191; Hescheler, K., 1929—30, p. 18; 1933, p. 205
[61] Gerber, E., 1938, XII
[62] Hescheler, K., Rüeger, J., 1942, p. 432
[63] Thalheimer, H., 1945, pp. 42, 44
[64] Müller, H. H., 1964, pp. 36—37

Essentially the sheep population described above lived on unchanged up to the end of the Copper Age (though sheep keeping itself spread further northwards and reached the Baltic Sea by the 3rd millennium B.C.).[65] At the end of the Copper Age and the beginning of the Bronze Age the great movements of peoples starting from the eastern basin of the Mediterranean and from South West Asia and proceeding towards Central Europe brought with them from the domestication area of sheep new masses of these animals to Europe. This resulted not only in an increase in the number of sheep kept (as is evident from the chapter discussing the historic development of animal keeping) but also by means of the better breeding, animals which improved the European population of sheep. South West Asia had always been in the vanguard of sheep keeping and in the 3rd millennium B.C. there was virtually a conscious breeding pursued in Mesopotamia. From there we have sheep shearing lists from the turn of the 3rd and 2nd millennia,[66] which indicate that woolly sheep had spread and that the new use of sheep had become important. This developed manner of sheep keeping of South West Asia reached Europe at the end of the Copper Age, in all probability both along the southern and the northern shores of the Black Sea.

The newly introduced sheep did not bring about great changes in the skull form. (Of this point we know rather little, for we possess almost exclusively settlement material of this period in which the skulls are mostly smashed.) The same refers also to the horn form. Nevertheless, horns had grown bigger, particularly on the females. Boessneck considered this latter phenomenon a proof of the re-introduction of South West Asian sheep,[67] for in their local forms ewes had stocker horns than was usual. However, the proportion of hornless individuals in Europe (Fig. 48) showed at most a moderate rise.

On the other hand, the newly arrived sheep considerably raised the size of the European sheep. This growth was general; compared with sheep of the Neolithic and Copper Age those of the Bronze Age showed an increase of withers height of about 10 cm. Thus in Russia and in the southern part of the Ukraine the average withers height was about 70 cm (though there occured individuals with 78 cm withers height too[68]) and in Hungary 69.6 cm; but sheep of about the same withers height were also found at sites in the western half of Central Europe.

This means that with respect to sheep the changes in size since the beginnings of domestication were different from those concerning cattle (Figs 49—56). A common feature of both species was the fact that no particular change in size took place in the Copper Age as against the Neolithic. But whereas with cattle the decrease in size began in the Bronze Age to stop for a short time in the Period of the Roman Empire and then to continue

[65] Paaver, K., 1961, p. 357
[66] Kraus, F. R., 1966, pp. 121 ff.
[67] Boessneck, J., 1962, p. 47
[68] Zalkin, V. I., 1964a, p. 26

up to the Middle Ages, the size of sheep rose to such an extent in the Bronze Age that it was in that period — with the exception of modern times — that European sheep grew to the largest size. It seems to be very probable, how-

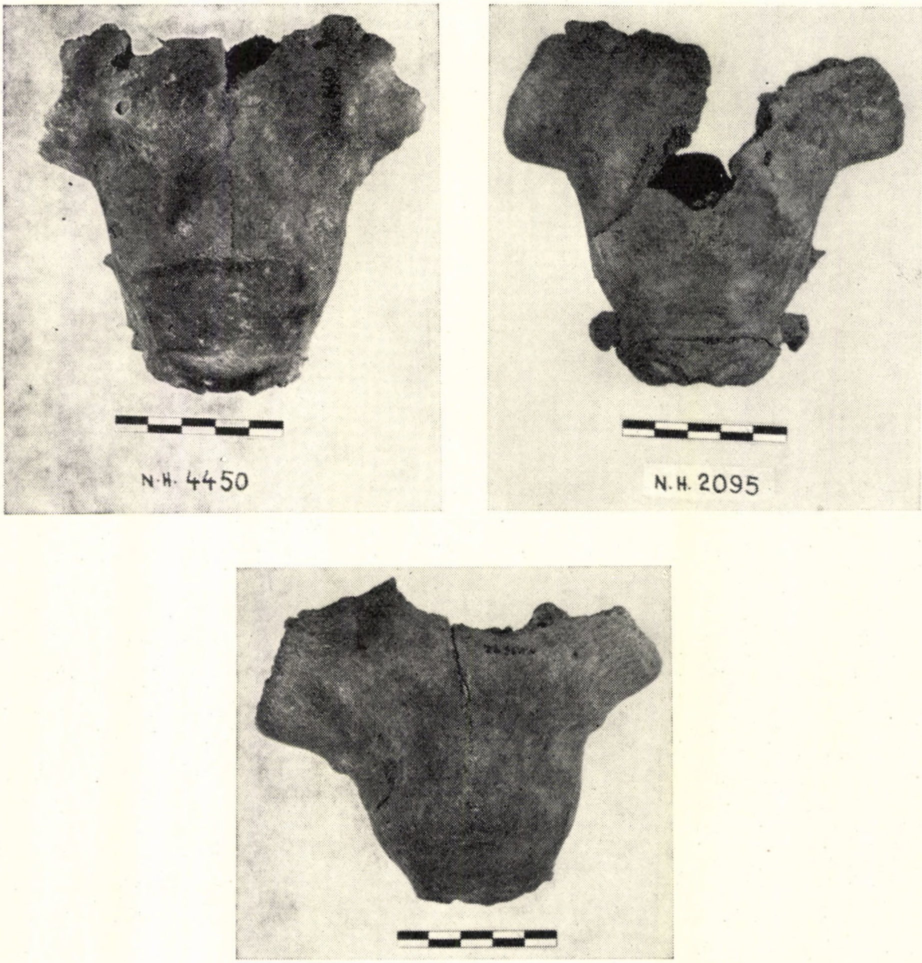


Fig. 48. Fragments of hornless sheep skulls of the Bronze Age settlement of Nitriánsky Hrádok (Czechoslovakia)

ever, that, whereas the cattle population was kept on a primitive level of technique and — since domestication had been pushed into the background at the beginning of the Copper Age — had been but rarely refreshed by inbreeding with larger individuals, in the case of sheep the cross-breeding with the population of the Near East, which had been improved by practically conscious breeding methods, resulted in the increase in the size of the animals. Of course, it is also possible that here special genetic effects appearing after the cross-breeding of (geographically) distant breeds contributed to this result.

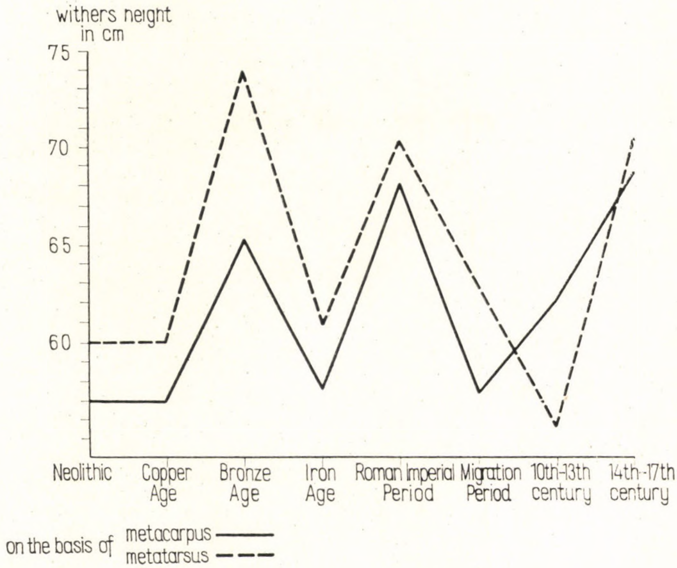


Fig. 49. Changes in domestic sheep withers height between the early Neolithic and the end of the Middle Ages

There was another point too in which sheep of the end of the Copper Age and the beginning of the Bronze Age must have been considerably different from those of previous periods. This point was their wool. As already mentioned in the introduction it was in the Bronze Age that man in Europe changed over from leather clothes to woollen ones. Although we have no direct evidence gained from biological material, there is indirect evidence which can tellingly convey this basic transformation.

The new use of wool, exceeding in importance the use of meat, was, by the way, one of the reasons why sheep keeping experienced an upswing in the Bronze Age and perhaps why, among the bone samples of sheep found in settlements, the numerical proportion of adult individuals rose and the bones of mature and old sheep became more frequent.

The small statuettes of sheep, found in great numbers in Bronze Age settlements, represent woolly sheep. By no means is it due to chance that all of them show stocky and roundish individuals, whose characteristic horns scarcely protrude from their wool (Fig. 57).

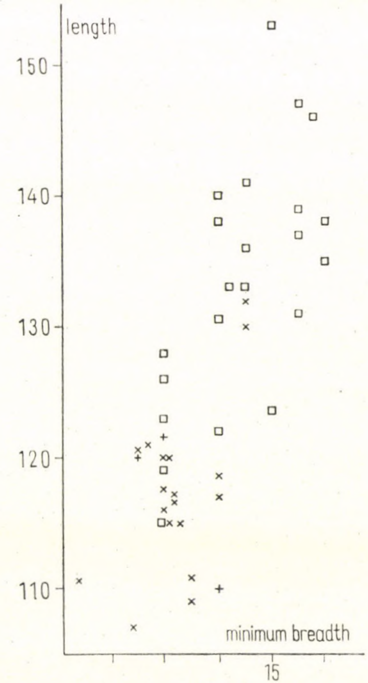


Fig. 50. Size variation of the metacarpals of sheep in Hungary in the Neolithic, the Copper Age and the Bronze Age

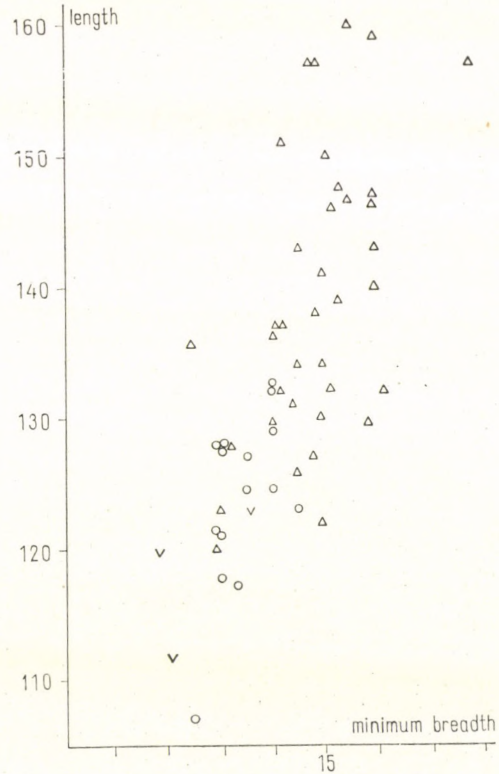


Fig. 51. Size variation of the metatarsals of sheep in Hungary in the Iron Age, in the Period of the Roman Empire and in the Migration Period

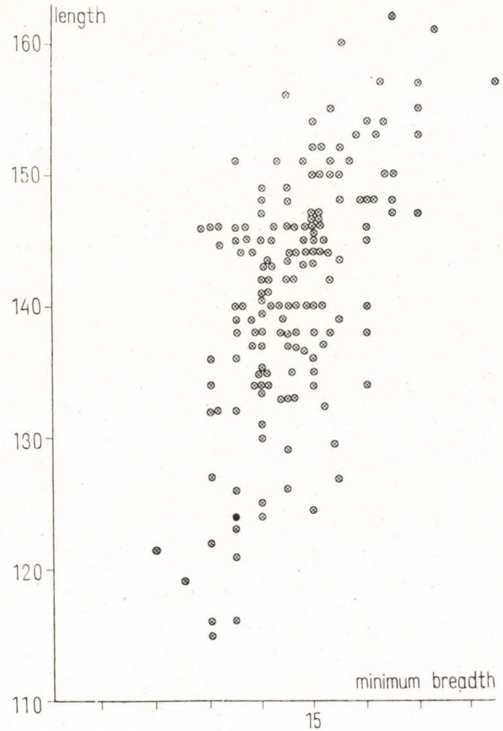


Fig. 52. Size variation of the metacarpals of sheep in Hungary in the Middle Ages

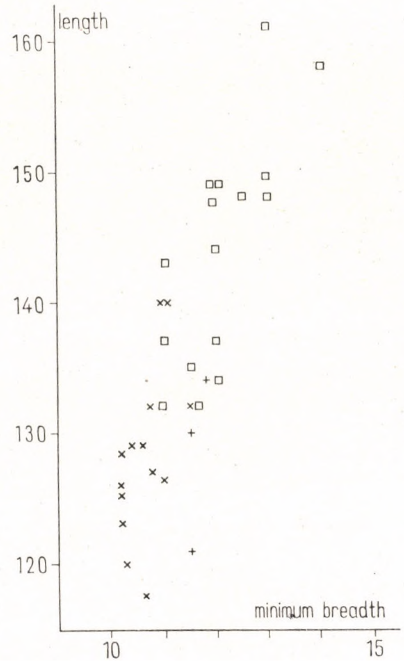


Fig. 53. Size variation of the metatarsals of sheep in Hungary in the Neolithic, in the Copper Age and the Bronze Age

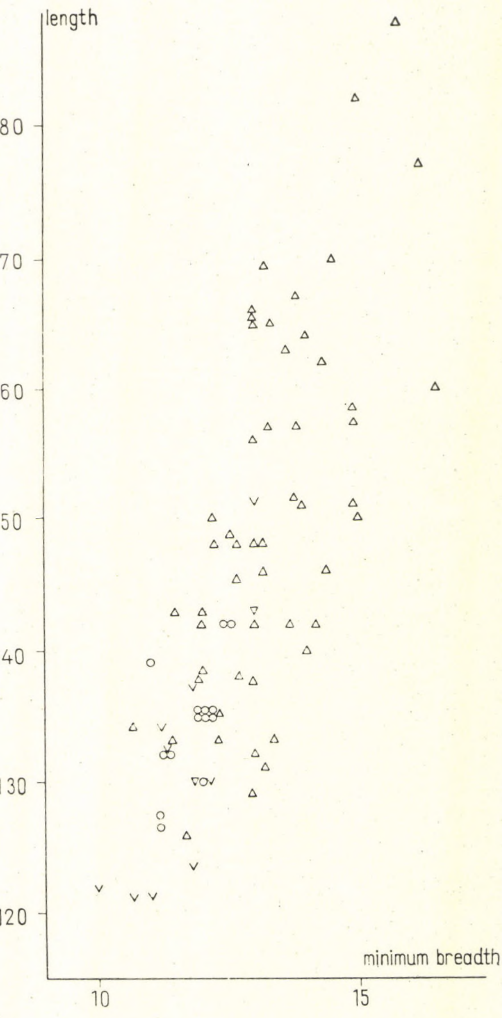


Fig. 54. Size variation of the metatarsals of sheep in Hungary in the Iron Age, in the Period of the Roman Empire and in the Migration Period

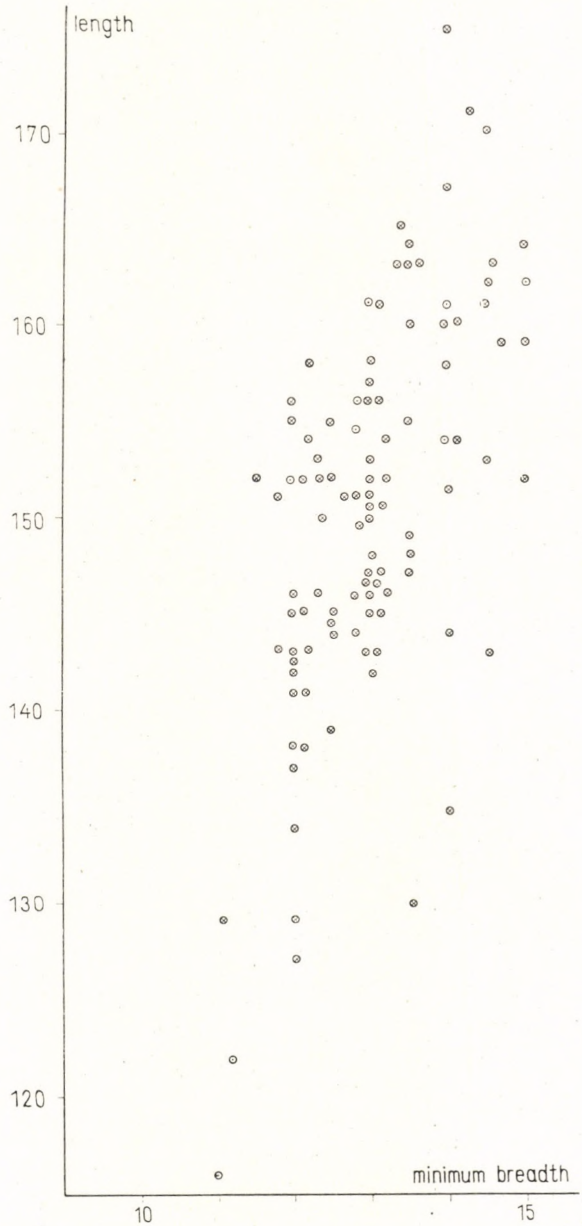


Fig. 55. Size variation of the metatarsals of sheep in Hungary in the Middle Ages

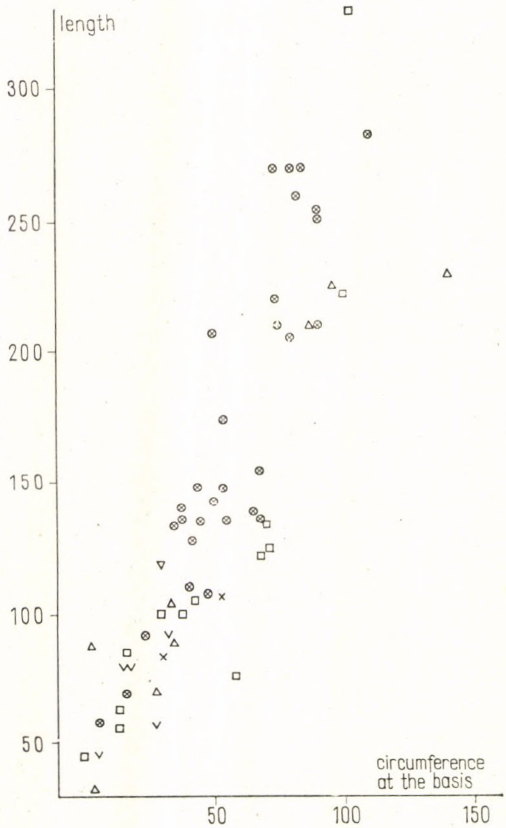


Fig. 56. Size variation of the horn cores of sheep in Hungary between the early Neolithic and the end of the Middle Ages

Fig. 57. Clay statuette of a sheep. Piliny, Bronze Age. Hungarian National Museum, Budapest

The ruralization following the Bronze Age in the Iron Age had an influence on sheep keeping too, but only concerning the size of the animals. Compared with sheep of the Bronze Age those of the Iron Age, particularly of the early Iron Age, had become much smaller. This was the situation in East Europe,[69] where the sheep of peoples living in the forest-steppe belt were relatively the largest, then came those of steppe peoples and finally those of the forest belt.[70] In the Carpathians Basin too a marked decrease in size took place and with their withers height below 60 cm Iron Age sheep fell back to the level of Neolithic–Copper Age ones. Sheep in the western part of Central Europe were somewhat bigger, at least in the Late Iron Age. On the basis of the 737 metacarpals in the huge material of the Celtic oppidum of Manching the average withers height of the sheep on the site was 62.98 cm and on the basis of the 621 metatarsals it was 65.99 cm.[71] On the other hand, another factor here was the effect of well-developed Roman animal keeping.

At this point, however, we must first return to Greece. The Greeks had learned conscious sheep breeding in their colonies in Asia Minor, to which it had found its direct way from Mesopotamian cultures. Then, along with a high level of the processing of wool the Greeks brought the methods of sheep breeding to Europe. Although no bone samples of sheep of this period originating from Greece have been examined so far, it can be stated on the basis of representations and written sources that as early as in Classical Period a systematic sheep breeding was pursued. The emergence of definite breeds is the best proof of this. The breeds in question are clearly marked off from the geographical breeds of primitive animal keeping, for the former lived side by side in the same area but their appearance differed from one another and so did their use; they had come into being as a result of human activity (breeding selection), and were kept and bred separately.

Among these breeds, the Miletos breed had especially fine wool, said to be due to the fact that the sheep were always wrapped in leather.[72] In Attica, too, there was a particularly fine woolly breed, whose individuals were kept in a covered fold for the greatest part of the year. In Epeiros there lived two breeds side by side, one with coarse and the other with fine wool; the former being particularly large. Of the former a hundred were entrusted to a shepherd and of the latter fifty. The shepherds drove their flocks to the mountain pastures in April and returned only in October, which is still the custom in several parts of the Balkan Peninsula.[73] These Greek sheep have been shown in numerous representations. The Athens rhyton with red figures (Fig. 58) in the Metropolitan Museum also represents such a ram with fine wool and shows that the woolly locks markedly spread onto

[69] Ibid.

[70] Zalkin, V. I., 1964a, p. 6

[71] Calculated on the basis of the measurement data of K. Pölloth (1959, pp. 27, 28, 39) and of D. Pfund (1961, pp. 25, 30)

[72] Aristophanes, Lysistrata, p. 732

[73] Paulys—Wissowa, 1921, p. 381

the head; moreover, it shows the form of the horns making nearly a complete circle like those of the moufflon.

No doubt, Greek sheep had an effect on the sheep keeping of the peoples of South Russia, who had brisk connexions with the Greek town colonies on the northern shores of the Black Sea. On the other hand they seem to have had a lesser influence upon the sheep of other regions of Eastern Europe and of the eastern part of Central Europe. But Roman sheep breeding had originated entirely from that of the Greeks and had started from the Greek colonies in South Italy – Magna Graecia. However, at this instance we do not wish to discuss sheep breeding in Italy, for geographically it does not belong to the scope of this monograph. On the other hand, we have to deal with the sheep keeping of the Roman Provinces in Central and South East Europe.

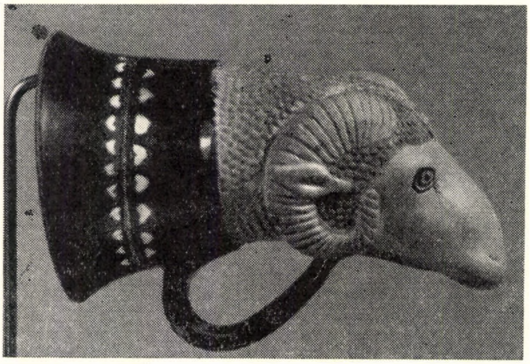


Fig. 58. Rhyton, representing a sheep's head with long, twisted horns. Greek (from Athens), second quarter of the 5th century B.C. Metropolitan Museum of Art, Fletcher Fund, 1939, New York

The villa-farms of the Roman Provinces, in which animal husbandry was pursued at the highest level of those times, had introduced from Italy numerous large breeding animals, whose yield was very high. A smaller number of these animals occurred in other Roman settlements and even fewer in the villages of the original inhabitants of the territory; on the other hand, these animals found their way even to regions which were not under Roman rule. It is very probable, for example, that in the relatively high withers height values of the sheep population of Manching, the effect of Roman sheep is reflected in the same way as importation can also be shown with respect to cattle and horses.[74] The same is perhaps proved also by the high numerical proportion of hornless individuals – one third of the sheep are hornless – among the Manching sheep.[75]

The average withers height of Roman sheep in Hungary is somewhat above 69 cm (just a bit below that of Bronze Age sheep), but on Roman villa settlements, individuals of 84–88 cm withers height also occurred. These latter are mostly wethers, for castration was by no means infrequent. Nevertheless, there is high variation, for there were small individuals with withers height below 60 cm among local sheep. As far as horn forms are concerned, rams were heavily horned and there were some individuals with capital horns

[74] Pölloth, K., 1959, p. 48
[75] Pölloth, K., 1959, p. 48; Pfund, D., 1961, p. 35

among old individuals (evidently they were highly appreciated breeding animals kept for a long time); among females, all variants occurred from horn forms of *turbary sheep* to hornlessness.

On Roman sites of a different type the average withers height of sheep was lower, since on these individuals of Italian breeds occurred more rarely. Thus Traininas described from the Roman–Celtic site of Engehalbinsel medium sized sheep;[76] small sheep were described by Rüeger from Kirchdorf,[77] by Sickenberg from Xanthen,[78] by Habermehl from Butzbach[79] and small sheep and medium sized sheep from Cambodunum by Boessneck.[80] In general, the authors emphasize the small horns or hornlessness of these sheep, though strong horned sheep were described from Vindonissa by Krämer,[81] from Canstatt,[82] from Saalburg and Zugmantel[83] and from Küln-Müngersdorf[84] by Hilzheimer, from Oerlingen by Kuhn,[85] from Engehalbinsel by Traininas[86] and from Ovilava by Amschler.[87]

But it was not only in the increase of size that the keeping of Italian sheep showed its influence in the Roman Provinces and in the "Barbarian" regions adjacent to them — as did the keeping of Greek sheep in the coastal region of the Black Sea. As a matter of fact the improvement in the quality of wool was the principal effect. Sheep of the Bronze Age had a considerable amount of coarse hair and thus their wool was suitable only for the making of rather coarse cloth. Italian breeds and the sheep of the neighbouring territories which were crossbred with them produced much finer wool. The extent to which sheep with fine wool spread is proved by the fact that in textiles made in Denmark during the time of the Roman Empire only two hairs were to be found among twelve fibres of wool,[88] whereas in the Bronze Age the hairs amounted to 31 out of 36 fibres.[89] With respect to animals' ages the proportion of sheep bones in settlements was by and large the same as in the Bronze Age, indicating that no significant change in use had taken place.

SHEEP OF THE MIGRATION PERIOD

Strangely enough we know very little of the sheep of the Migration Period, although sheep, a species of domestic animals that could be easily driven, must have taken an important part in the animal keeping of nomadic peo-

[76] Traininas, D., 1933, p. 28
[77] Rüeger, J., 1944, p. 236
[78] Sickenberg, O., 1938, p. 151
[79] Habermehl, K. H., 1957, p. 104
[80] Boessneck, J., 1957a, p. 111
[81] Krämer, H., 1899, p. 212
[82] Hilzheimer, M., 1920, pp. 293 ff.
[83] Hilzheimer, M., 1924, pp. 105 ff.
[84] Hilzheimer, M., 1933, pp. 122 ff.
[85] Kuhn, E., 1932, p. 741
[86] Traininas, D., 1933, p. 28
[87] Amschler, W., 1949
[88] Geijer, A., Ljungh, H., 1937, pp. 266–275
[89] Thomsen, T., 1900, pp. 257 ff.

ples at least. This is due to the circumstance that archaeologists dealing with the Migration Period have chiefly excavated cemeteries; settlements were unearthed almost exclusively in Sarmatian sites. Only seldom were there sheep to be found in graves, particularly rarely were there skulls, horn cores or extremity bones of full length, suitable for more exact zoological investigations.

It is evident from the examples of other species of domestic animals – above all cattle and hens – that after the surrender of the Provinces, Roman breeds of domestic animals generally became extinct in Central and South-East Europe. (For want of appropriate material we do not know whether they survived in certain Roman settlements that outlived the fall of the Roman Empire in former Provinces; nor do we know whether these breeds survived in Italy. Has anybody indeed ever conserved the bone samples excavated in Mediaeval sites in Italy?)

In the excavations of smaller Sarmatian settlements (1st–4th century A.D.) the fauna contained *turbary sheep* (Szolnok–Szanda, Apagy) or small sheep on the point of hornlessness (Mezőkövesd). On the basis of two undamaged metatarsals the withers height of Sarmatian sheep could be defined at 63.88 cm. On the other hand, since primitive sheep's metatarsals are relatively long, the actual withers height may have been about 62 cm. Thus their size hardly exceeded that of Iron Age sheep.

Among the cemeteries only those of the Avars (567–800 A.D.) contained a relatively higher number of sheep's bones. They, however, were mostly extremity bones, vertebrae or ribs, of which in most cases it could not even be decided for sure from which of the two small domestic ruminants they had originated. But in some graves, skulls – at times together with feet – were also found. From this point of view, the Avar cemetery of Bernolakovo (Slovakia) was particularly rich, for in 31 of its graves such remains of sheep were discovered.[90] Sheep's skulls with feet were excavated from six graves at Bóly–Sziebert puszta,[91] and sheep's skulls from three graves at Žitavska Tôň (Slovakia).[92] There were several cemeteries with a sheep's skull, or a part of it in each grave.

The skulls in question had mostly belonged to young or subadult animals; skulls of adult individuals are very rare and there is only one skull of a mature animal we know of (Szentes–Nagyhegy). Most of the skull fragments have horn cores of the *turbary sheep* type, in some cases (Szentes–Nagyhegy, Bernolakovo, Žitavska Tôň) the horn cores are rudimentary and circular in their cross-section, or the skulls had belonged to hornless sheep (Žitavaska Tôň, Bóly, Oroszlány); less frequently the horn cores were thick, three-edged, turned outwards and twisted (Žitavska Tôň, Bernolakovo). The animals with stocky horns were evidently rams, the rest were mostly females. On the other hand, we do not know how many of the skulls attributed to even originated from rams or wethers. The examination of feet buried together with the skulls does not give an answer to this question

[90] Ambros, C., 1963, p. 252
[91] Bökönyi, S., 1963a, pp. 92 ff.
[92] Musil, R., 1956, p. 161

either, for the animals were mostly subadult individuals. With such animals the metapodials had not yet grown to their final breadth and therefore the possible remains of rams cannot be distinguished on the basis of their relative thickness; nor did the bones of withers have time to form the characteristic special length, which can be explained by the late closing of the margins between the epiphyses and diaphyses.

When calculated on the basis of the metapodial lengths, the average withers height of Avar sheep was somewhat below 60 cm. But as it was chiefly subadult animals which had been put in the graves, it is probable that the withers height of the whole population was 2—3 cm higher, which more or less tallies with that of Sarmatian sheep.

THE APPEARANCE OF THE ZACKELSCHAF

In the centuries following the Migration Period (9th—13th centuries) the size of sheep — like that of cattle — reached its lowest point after the Neolithic–Copper Age. But this decrease in size was not the same everywhere. Thus, for example, the average withers height of sheep in Mediaeval Russia was about 65 cm,[93] that of sheep in Poland at the same period was somewhat above 61 cm,[94] whereas in Hungary it was below 59 cm. The variation in size is not too great if we consider that in the largest sample (Mediaeval Russia) the withers height of the smallest sheep was 53.5 cm and of the biggest 70 cm. With respect also to skull and horn form the overwhelming majority of the population was fairly uniform; the rams had thick, three-edged *copper sheep* type horns, the horns of females were like those of *turbary sheep* or rudimentary; but hornless individuals were also not infrequent.

However, in this homogeneous population there appeared, like an island, another group of sheep; the *Zackelschaf*. It is characteristic of the *Zackelschaf* that their horns are not spirally twisted like those of goats as are the horns of the former group, but they protrude horizontally outwards or in a broader or narrower V-form, twisted outwards in wide curves; they may be twisted corkscrew fashion. Depending on breeds there are some where both sexes are horned — and here the horns of the ♀♀ only differ in their smaller size from the horns of the ♂♂ — and there are herds where the ♀♀ are hornless. So far we have not heard of hornless males; evidently such animals have only occurred in crossbreds with other breeds of sheep. Their wool is coarse and hangs in long locks. Their origin is rather obscure but it is not impossible that their wild ancestor belonged to a subspecies other than that of the former group of sheep.

Zackelschaf appeared in Mesopotamia in the 4th millennium B.C.[95] There they had long horns, protruding almost horizontally and twisted in wide

[93] Calculated from Zalkin's data (1956, p. 112)

[94] Calculated from the data of Kubasiewicz (1959, p. 78) and Kubasiewicz, Gawlikowski (1963, pp. 159 ff.)

[95] Zeuner, F. E., 1963, p. 187

curves — animals well known from numerous representations. We do not know when they got from there to Europe. Without mentioning his source, Brentjes writes that *Zackelschaf* occurred in South East Europe as early as in the 2nd millennium B.C.[96] Indeed, it is possible that odd individuals found their way to Europe at that time, but they did not leave any lasting effect, palpable osteologically, in sheep breeding.

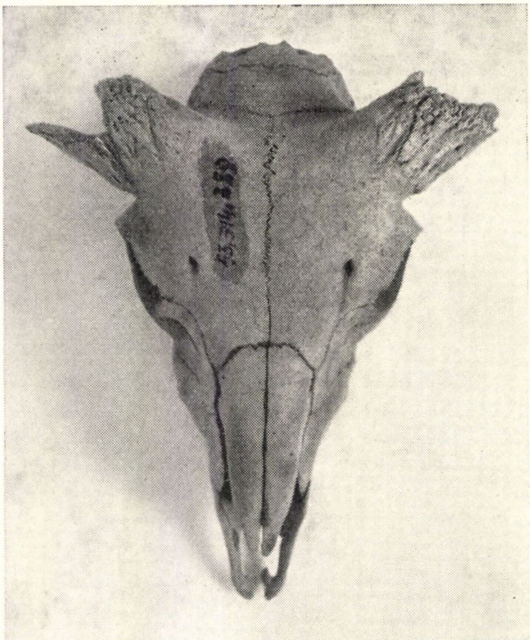


Fig. 59. Skull of sheep. Bágyog—Gyűrhegy, Avar cemetery

They reached Europe in greater numbers towards the end of the Migration Period. The skull found in a grave of the Avar cemetery at Žitavska Tôň[97] may have belonged to a sheep of this group of breeds, but this is impossible to decide for certain on the basis of the photograph in the publication. One of the sheep's skulls of the Avar cemetery of Bágyog–Gyűrhegy (Fig. 59) may have belonged to the same group, but since only the beginning of its horn cores has been preserved, the full line of the horn cores cannot be reconstructed.

There is no doubt, on the other hand, that the conquering Magyars introduced this breed to the Carpathian Basin. Though we do not know any from graves of the time of the Conquest, for in that period it was not the custom to place sheep's skulls with the deceased person in the grave, fragments of several skulls and horn cores have been excavated from settlements of the Period of the Árpád Dynasty (10th—13th century).[98] In the 10th—13th century these sheep lived in Hungary side by side with sheep belonging to the ancient European breed found in the territory by the conquering Magyars, but later the former almost completely ousted the latter.

[96] Brentjes, B., 1965, p. 29
[97] Musil, R., 1956, p. 161
[98] Bökönyi, S., 1961b, pp. 93 ff.; 1962b, pp. 7—8

Both sexes of the Mediaeval breed of Hungarian sheep seem to have had horizontally placed horns, curving in wide arches (Fig. 60). It is still an open question whether Hungarian Mediaeval sheep with rudimentary horns (Fig. 61) or hornless (Fig. 62),[99] both being rather rare, belonged to the same breed or not. The customs tariff, dated 1255, of King Béla IV provides some information on the colour of sheep for it mentions black and piebald lamb- and sheepskins.[100]

The breed was not identical with the present Hungarian *Zackelschaf*, which has horns twisted like a corkscrew and protruding in a V-form (Fig. 63), considered by former Hungarian authors to have been an ancient Hungarian breed introduced to the country by the conquering Magyars.[101] On the other hand, it seems to be likely that as the westernmost member of the ancient *Zackelschaf* group of breeds, which at that time had been less specified, the above mentioned breed of Mediaeval Hungarian sheep was very closely linked with the *Zackelschaf* of a number of adjacent regions. In Bulgaria and in the Carpathians, primitive *Zackelschaf* with horn forms reminiscent of those of Mediaeval Hungarian sheep can be found even today (Fig. 64). This Hungarian breed survived the Middle Ages and has been represented several times also in modern times. The best of its likenesses is to be found on the altarpiece of Master M.S. of the first years of the 16th century A.D. (Fig. 65). It was only in the 16th—17th century that, side by side with the breed in question, the *Zackelschaf* with corkscrew-twisted horns in a V-form first appeared. We do not know whether this latter emerged as a result of conscious animal breeding and breeding selection, or had been introduced to the country from the south, for they first occurred at the time of the Turkish rule when lively connexions with the south really came into being. Aesthetic reasons also played a part in their emergence, which is shown by shepherds' endeavours to produce this horn form by an artificial shaping of the horns.[102] Nevertheless, *Zackelschaf* with V-form horns — henceforth called the recent Hungarian *Zackelschaf* — took a long time to spread and lived on for quite a long time side by side with the Mediaeval breed of Hungarian sheep. There were two separate denominations for the two breeds: Hungarian sheep and *Zackelschaf*, and 19th century data show[103] that they really meant two separate breeds: In 1864 the council of the City of Debrecen sent a committee to Hortobágy to supervise the conditions of sheep grazing lands. The committee appointed separate pastures for "sheep" (i.e. for merinos) and for "Hungarian sheep" and finally issued the order that: ". . . the hitherto unmentioned *racka* sheep *(Zackelschaf)* bred by several people is to graze together with the Hungarian sheep."

[99] Bökönyi, S., 1963b, p. 406; 1964a, p. 370
[100] Hankó, B., 1937b, p. 78
[101] Brummel, Gy., 1900, p. 38; Hankó, B., 1937a, pp. 1 ff.; 1937b, pp. 47 ff.; 1941, pp. 1 ff.; 1943, pp. 16 ff.; 1954, pp. 16 ff.
[102] Hankó, B., 1937a, pp. 2 ff.; 1937b, pp. 68 ff.; 1941, pp. 7—8; 1954, p. 19
[103] Balogh, I., 1958, p. 553

Fig. 60. Fragments of skulls of the Hungarian Mediaeval breed of sheep. Szolnok—Castle, Period of the Turkish occupation

Fig. 61. Sheep skulls with rudimentary horns. Nyársapát, 15th century

Fig. 62. Fragments of hornless sheep skulls. Buda Castle, the Pasha's Palace, Period of the Turkish occupation

Fig. 63. Black *Zackelschaf*. Hortobágy, Hungary

Fig. 64. Karakatchan sheep, with horn form reminiscent of that of Mediaeval Hungarian sheep. Rosen, Bulgaria

Fig. 65. Head of sheep in the painting "Calvary" by Master M.S. Christian Museum, Esztergom, Hungary

Thus Mediaeval Hungarian sheep still existed at the middle of the last century, but today only their name survives. In many places even that has been transferred to today's *Zackelschaf* with horns in a V-form (in such territories with *Zackelschaf*, merino crossbreds are meant by the name of *Zackelschaf*).[104]

SHEEP OF THE LATE MIDDLE AGES

With the emergence of conscious animal breeding, which meant, above all, breeding selection and better keeping conditions (better feeding both with respect to quality and quantity) Mediaeval domestic sheep were becoming larger towards the end of the Middle Ages, from the 14th–15th century onwards. Unfortunately, for want of adequate bone samples, we have data confirming this point only from the Carpathian Basin. Thus the withers height of sheep in Hungary in the 14th–17th century reached 69.5 cm, having risen by over 10 cm against that of 10th–13th century sheep. As at the time of the conscious Roman animal breeding, the variations in size were strikingly great: alongside small examples of 56 cm, there were large individuals of 82 cm too. However, even these latter only just came up to the size of today's Hungarian sheep, for at present the average withers height of adult *Zackelschaf* is 82 cm.[105]

Moreover, and this was the result of breeding selection, at the beginning of modern times new breeds also appeared. Thus in 1646 György Rákóczi I, reigning Prince of Transylvania, mentioned five breeds of sheep: 1. Transylvanian white sheep, 2. Transylvanian black sheep, 3. flat-tail sheep, 4. Hungarian sheep, 5. Wallachian sheep.[106] We agree with Hankó that the first two are the "*purzsa*" and the "*curkan*" sheep which came in with Wallachian shepherds (the Wallachian shepherds spreading gradually northwards from the Balkans into the Carpathians have kept up to this very day sheep belonging to the *Zackelschaf* group),[107] the third are a certain breed of fat-tail sheep, the fourth, of course, the old Hungarian sheep and the fifth may have been the *Tzigaya*. In addition to these breeds there may also have occurred in the western part of the country sheep of Austrian and of German origin.

It is interesting to note that in the above enumeration are fat-tail sheep, which in all probability were of Turkish origin. S. Takáts recorded that when György Szelepcsényi, Archbishop of Eger, went as an envoy to the Sultan to Constantinople in 1643 he brought back from there two fat-tail sheep.[108] Under the name of plate-tailed sheep the same breed was also mentioned in 1725. It was grouped with sheep of Turkish origin,[109] and it is said to have been quite frequent in South Hungary during the Turkish

[104] Nyárády, M., 1959, p. 167; Paládi-Kovács, A., 1965, p. 86
[105] Hankó, B., 1937b, p. 88
[106] Hankó, B., 1937b, p. 80
[107] Dobrowolski, K., 1961, pp. 113 ff.
[108] Takáts, S., 1915, p. 244
[109] Takáts, S., 1915, p. 343

occupation of the country.[110] The breed cannot have flourished for long; and by now it has completely disappeared without any trace. The cause of its disappearance must have been not only the withdrawal of the Turks from Hungary (the people living here do not use mutton suet but pigs' lard in cooking), but also the introduction, beginning in the 17th century, of fine wool merino sheep, which then ousted all other breeds.

In the Middle Ages the most important use of sheep was their wool and skin. The wool may still have been rather hairy, for fine wool sheep achieved their golden age only in our modern times. The particularly coarse wool of the *Zackelschaf* (the wool of the Hungarian *Zackelschaf*, the *racka*, contains even today 70 per cent of hair) was rather suitable for producing felt and coarse cloths (in Debrecen there were records as early as in 1396 about a guild of craftsmen who produced frieze and made cloaks of it)[111] but its hairy skin was most perfect for making sheepskin cloaks. The fur of its lambs is especially fine and before the lambs are more than two weeks old it is nearly as curly and shiny as that of the *karakul*. (This is the origin of the numerous lambskins indicated in the customs tariff of 1265.) As an animal providing meat, sheep were of lesser significance in the Middle Ages; though as such they were often fattened — as is evident from a diploma of 1108. According to this document the village of Győ (today Felgyő) was obliged to deliver on St. Margaret's day to the Provost of Dömös 30 fat sheep among others.[112]

[110] Bohm, J., 1878, p. 478
[111] Hankó, B., 1937b, p. 106
[112] Acsády, I., 1944, p. 66; Győrffy, Gy., 1963, pp. 895—896

THE GOAT

THE IMPORTANCE OF GOAT

Two facts predestined goats to become domestic animals very early on. One was their well-known hardiness, a feature important not only in the early phases of its existence as a domestic animal, but in many places significant even today: goats are the cows of poor people. The other was their wild ancestors, which lived in the region of the South West Asian cultures that had the lion's share of the earliest domestication activities.[1] In addition, in the initial stages of agriculture, when forests were felled to obtain arable land, goats as animals which destroy woods may have been preferred to sheep, which eat grass, and which gained significance once Man had acquired large open spaces at his disposal.[2] (In the domestic fauna of the early Neolithic in South West Asia, goats were predominant in mountainous regions and sheep on plains.)

WILD FORMS

Concerning the investigation of the wild ancestor or ancestors of goats, our position is not too difficult. Among genuine wild goats the *bezoar (Capra aegagrus)* and the screw-horn goat *(Capra falconeri)* can be taken into consideration as ancestors of the domestic goat. The others — the *ibex* and the *tur* — although they can be successfully crossbred with the domestic goat, show such anatomical differences when compared with the latter that they can by no means be connected with the origin of the domestic goat's.

In a subfossil state the *bezoar* can be found in some mountains of South West Asia and in most recent times from Sind through Persia up to Asia Minor and the islands in the eastern part of the Mediterranean Basin. Through distribution channels it spread as far as Turkmenia and the Caucasus. It is somewhat smaller than the *ibex*, its withers height being about 80—90 cm. The background colour of its hair is reddish grey with variable black markings. On the neck the hair is generally lighter and the colour of the beard, to be found on both sexes, is black. In its stature it resembles our domestic goats, from which it differs only in its colour and in the long horns, which are sometimes 750 mm long, of the males. With old he-goats the horns curve more than a semi-circle, they are flattened on the sides and have

[1] Brentjes, B., 1965, p. 24
[2] Zeuner, F. E., 1963, pp. 145—146

sharp fore and rear edges. On the front edge there are knob-like protuberances rather far from another. The horns of the females are much smaller and simpler. It is characteristic of the horn cores that they run in one plane for their whole length and are scimitar-shaped. (On examining an ample sample of *bezoars* from the Caucasus, Amschler found that there are alongside the usual individuals with scimitar-shaped horns, also those which have strongly twisted horns.[3] Of course, we do not know whether this twisting is not due to the addition of blood of domestic goats, though K. Zimmermann, on the basis of observations made in Crete, did not think it probable that wild *bezoars* crossbred with local domestic goats.[4]) The cross-section of the horn core is like a fat drop of water with a sharp frontal edge and a blunt rear (nuchal) edge. The horn cores of the females are also scimitar-shaped but much smaller than those of the males.

Screw-horn goats are the other wild species of goats that can be considered as the wild ancestors, but only of some Asian domestic goats whose westernmost distribution stretches to the Caucasus[5] and easternmost to the Altai Mountains.[6] The screw-horn goat lives in the northern part of East India and in Afghanistan. Its colour is like that of the *bezoar* with the difference that it has a well-developed mane on its neck. The horn form is highly characteristic: the horns are turned in the opposite direction from that of the European domestic goat's (perverted horn form). If we look at the left horn we can see that it is twisted in a counter-clockwise direction. With some regional variations of the screw-horn goat, the horns show at most only one or three large curves, but with others the horns are definitely like corkscrews. According to Amschler, out of the six subspecies of screw-horn goats, only the *Capra falconeri chialtenensis* has horn cores with a cross-section identical to that of screw-horn domestic goats; thus only this subspecies can be taken into consideration as a wild ancestor.[7]

For a long time the *Capra "prisca"*[8] described by Adametz and Niezabitowski played an important role among the supposed wild ancestors. The two authors described goats which they deemed to have been wild first from Zloczów in Poland from the border of the Diluvial and Alluvial periods,[9] then from Neolithic Zlota;[10] following their footsteps Bilek thought to have found the above species in the early Alluvial period in Bohemia.[11] According to the authors twisted horns turning outwards were charactristic of this species of goats. The horns had a monomymous twist, i.e. they were twisted like the horns of European domestic goats: the left horn core clockwise,

[3] Amschler, W., 1929, p. 467
[4] Zimmermann, K., 1953, p. 66
[5] Amschler, W., 1929, p. 468
[6] Amschler, W., 1931, p. 467
[7] Amschler, W., 1933, p. 5
[8] *Capra "prisca"* is a preoccupied name (correctly *Capra adametzi;* see Kretzoi, M., 1942, p. 262). On the other hand, it has become familiar among zoologists dealing with the investigation of domestic animals, and therefore putting it between quotation marks, we ourselves use it
[9] Adametz, L., Niezabitowski, L., 1914, pp. 759 ff.; Adametz, L., 1915, pp. 4 ff.
[10] Adametz, L., 1928, pp. 66 ff.
[11] Bilek, F., 1918, pp. 18—19

thus in an opposite direction from that of the *Capra falconeri*. On account of the twisted horn cores they were considered for a long time to have been the wild ancestors of European domestic goats with twisted horns. From the Pleistocene deposits of Lower Austria, Sickenberg described a similar goat.[12] But doubts about the Pleistocene existence and the wildness of the *Capra "prisca"* arose already in 1935, and indeed it turned out that the finds of Zloczów dated to the Neolithic.[13] Nevertheless the assumption that *Capra "prisca"* was a wild ancestor prevailed for a long time. Thus, for example Seitz, in agreement with Hilzheimer's view, in 1941[14] professed that the only wild ancestor of the domestic goat was the *Capra "prisca"*.[15] Herre was the first to refute categorically the supposition that *Capra "prisca"* had been a wild goat. He pointed out that only *Capra aegagrus* could have been the wild ancestor of all European domestic goats.[16] On the basis of combined examinations of fluorine content and X-ray analysis, it has recently turned out that the finds from Lower Austria originated not in the Pleistocene but in the Bronze Age,[17] and thus the assumption of the wild character of the *Capra "prisca"* has become untenable. Obviously, the finds described above represent extraordinarily strong domestic he-goats, which occurred in the prehistoric period of South-East and Central Europe more than once.

CHANGES BROUGHT ABOUT BY DOMESTICATION

The changes caused by domestication in goats are not so manyfold as with sheep. The earliest feature appeared on the horn cores. Already in a very early stage of domestication the cross-section of the *bezoar* goat's horn core became almond-shaped, its medial surface became flattened and simultaneously the scimitar-shaped horn core started to curve outwards.[18] As a consequence of domestication the horns — particularly those of males — also became smaller and thinner. But it is interesting to note that whereas the decrease in the size of horns was inevitable with every domestic goat (in spite of the fact that even in millennia long after domestication there occurred long-horned he-goats, whose horns, however, mostly approximated those of wild forms), domestication did not always bring about a twisting of the horns. In prehistoric times there were numerous domestic goats with scimitar-shaped horns; there can be no doubt that these animals were domestic, and such goats also occurred in the Middle Ages and can be found here and there even today. We do not know whether this is a case of atavism or whether the goats with twisted horns which appeared as mutations could only slowly supplant scimitar horns. At this instance some comparisons

[12] Sickenberg, O., 1930, pp. 92 ff.
[13] Schwarz, E., 1935, pp. 433 ff.
[14] Hilzheimer, M., 1933b, p. 369
[15] Seitz, W., 1941, p. 112
[16] Herre, W., 1943, p. 40
[17] Thenius, E., Hofer, F., Preisinger, A., 1962, pp. 321 ff.
[18] Zeuner, F. E., 1954, p. 41; 1963, p. 138; Reed, C. A., 1959, p. 1632; 1960, p. 131

can be made. Woolly sheep, which also appeared as mutations, were able to spread quickly and oust hairy ones because Man was interested economically in their spread, and tried to promote it. On the other hand, Man had evidently no economic interest in raising goats with twisted horns instead of those with scimitar-horns and thus, for want of human intervention, this process took a very long time.

With goats, hornlessness appeared much later than with sheep. Probably this too emerged first in the Near East, for the earliest representations we know of are from Egypt, from the 3rd millennium B.C. (Lisht, 5th Dinasty, c. 2450 B.C.). Hornlessness spread only very slowly to Europe, probably through Italy. It may have taken place rather late, for the earliest hornless goats we know of date back to the period of the Roman Empire. But even today the hornlessness of goats is not so frequent as it is with sheep. But, on the other hand, it is found more often with goats than with cattle.

Whiteness of the hair and a related feature, piebald hair, are of uncertain date as symptoms of domestication. The Egyptians represented piebald goats already in Predynastic times,[19] but, on the other hand, the original wild colour has survived with some breeds — even with improved ones — up to the present.

Even more uncertain is the time of the earliest appearance of wool. Woolly goats are very rare but their wool is much finer than that of sheep. Although there is a long-haired goat depicted in Ur-Enlil's tablet of Nippur (Sumerian, c. 2000 B.C.)[20] it cannot be ascertained whether it has hair or wool. *Angora goats* represent the only woolly breed we know of today. In the Middle Ages however, and in modern times — as is shown by representations — several breeds of woolly goats were to be found from Central Asia to the Far East.

We know much more about the beginnings of the use of goat's milk. Earlier authors supposed the goat to have been the first milk animal.[21] We have indirect evidence of the early milking of goats from the Nin-Hursag temple of Ur (after 2400 B.C.). It represents cows being milked[22] from the rear in the manner which is usual with goats. This indicates that goats had been milked earlier and that the same method of milking was also applied to cows.

THE EARLIEST DOMESTIC GOATS

The earliest domestication of goats took place in South West Asia at about the same time and place as the domestication of sheep, perhaps somewhat later. According to the present state of knowledge the earliest evidence of domestic goats occurs in the 9th millennium B.C. (Asiab, West Iran); the domestic goats of Jericho and Qalat Jarmo date to the middle of the 7th millennium B.C.,[23] whereas the goats of the Belt Cave date to the

[19] Zeuner, F. E., 1963, p. 139, fig. 6: 5
[20] Zeuner, F. E., 1963, p. 137, fig. 6: 4
[21] Stegmann, v. Pritzwald, F. P., 1933, p. 13
[22] Zeuner, F. E., 1963, p. 219, fig. 8: 18
[23] Reed, C. A., 1959, p. 1632; 1960, p. 132; Zeuner, F. E., 1963, p. 133

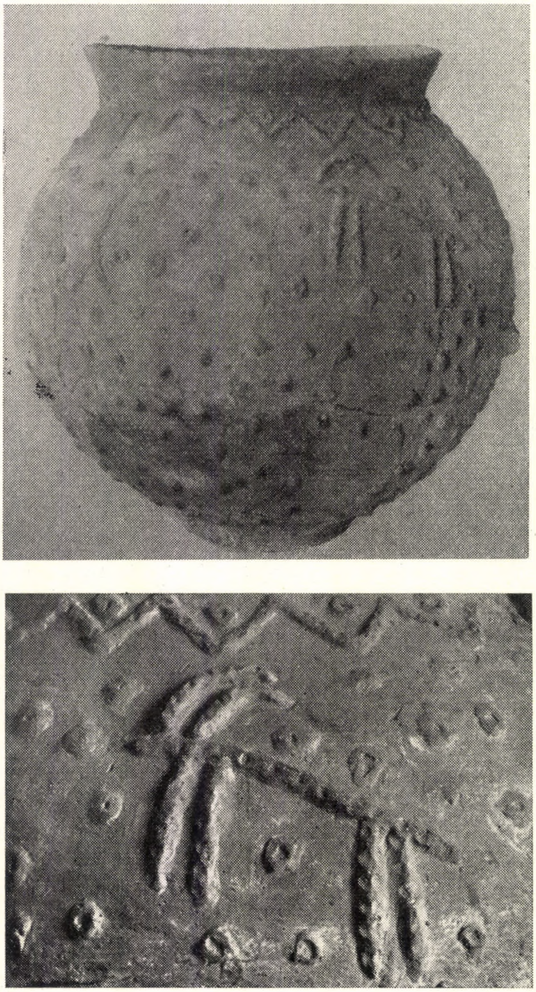


Fig. 66. Goat represented on a grain container. Kopáncs—Zsoldos Farm. Neolithic (Körös culture). Hungarian National Museum, Budapest

6th millennium B.C.[24] After their early domestication the two small domestic ruminants proceeded side by side: their frequency changed depending at first on the natural environment and on the conditions of animal keeping. But from the second half of the Neolithic onwards in most regions goats were always of secondary significance behind sheep. In Europe, on the other hand, the predominance of sheep as compared to goats can be observed from the beginning of the Neolithic onwards.

According to our present knowledge, it was not possible to identify goats for certain at Argissa Magula, the earliest site of European pre-pottery Neolithic,[25] but at Nea Nikomedeia small goats with scimitar horns were found.[26]

Mainly scimitar-horned goats were also excavated at the early Neolithic sites of North East Yugoslavia and Hungary although alongside them were goats with twisted horns (Ludas-Budzsák, Yugoslavia, Körös culture). In the early Neolithic there also occur representations of goats. One of the finest likenesses of Neolithic goats, displaying an animal with large horns like those of wild goats (Fig. 66) adorns a large vessel for grain belonging to the Körös culture. The goats excavated from the Neolithic settlement of Khirokitia on Cyprus (c. 3200 B.C.) are of a somewhat later date. The author could not decide whether they were domestic or wild animals.[27] If they were domestic goats,

[24] Coon, C. S., 1951, p. 50
[25] Boessneck, J., 1962, p. 28
[26] Higgs, E. S., 1962, p. 272
[27] King, J. E., 1953, p. 434

which would be quite natural, for Cyprus is on the route through which the domestic fauna of South West Asia reached Europe, and which moreover, is very likely on the basis of the length measurements of the two smaller horn cores (155 and 170 mm), they would provide data on the occurrence of scimitar-horned domestic goats also in the archipelago of the eastern part of the Mediterranean Basin in the Middle and Late Neolithic. If they were wild ones, they would prove that *bezoar* goats also lived on Cyprus in the early Post-Glacial period.

From the Middle Neolithic onwards goats with twisted horns became more frequent. Such goats were found in Greece,[28] Bulgaria,[29] Romania,[30] Hungary,[31] Germany,[32] Switzerland,[33] Poland,[34] and the Ukraine[35] alike. Among them there were often he-goats with large horns (the *Capra "prisca"* originally considered to have been wild may have been such an animal). Thus for example a horn core of this kind was found at Otzaki Magula (Dimini culture),[36] and at Zengővárkony (Lengyel culture),[37] and Müller found as many as eight horn cores of the same type at sites of the Linear Pottery culture in Central Germany.[38] In the more recent Hungarian bone samples a fragment of such a large horn core was found at Dévaványa—Sártó (Tisza culture). These sturdy horn cores definitely originate from domestic goats: some of them show definite twists, their sizes do not come up to the sizes of wild he-goats' horns, and besides, there is no reason for us to look for Post-Glacial wild goats in Central Europe, and particularly in its north-western part.

In Boessneck's opinion goats may have increased in size after the Neolithic.[39] Because of the very scanty bone samples this cannot yet be confirmed. Nor do we have bone samples on the basis of which we could infer the proportion of age groups and from this the use, or any possible changes in the use of goats. With respect to the horn form goats with scimitar horns continued to occur — in some sites there was only this type (Tószeg, Bronze Age[40]) — and here and there a he-goat with very big horns was also found (Szentendre–Cementárugyár, Celtic, Fig. 66).

[28] Boessneck, J., 1956c, p. 24
[29] Detev, P., 1954, p. 155, fig. 9
[30] Necrasov, O., Haimovici, S., 1959a, p. 565
[31] Bökönyi, S., 1957a, p. 74
[32] Vogel, R., 1929, p. 360; 1933, p. 83; Müller, H. H., 1964, p. 37
[33] Hescheler, K., Rüeger, 1942, p. 427
[34] Krysiak, K., 1950—51, p. 228; 1952, p. 290
[35] Gromova, V., 1933, p. 116
[36] Boessneck, J., 1956c, p. 24
[37] Bökönyi, S., 1962a, p. 89
[38] Müller, H. H., 1964, p. 37
[39] Boessneck, J., 1958b, p. 116
[40] Bökönyi, S., 1952a, p. 104

It was in the period of the Roman Empire that the first substantial changes in the goat population occurred. First, hornless goats appeared. They may have probably originated from Roman imports and were very rare: they are known from two sites only, from Butzbach[41] and Albert-

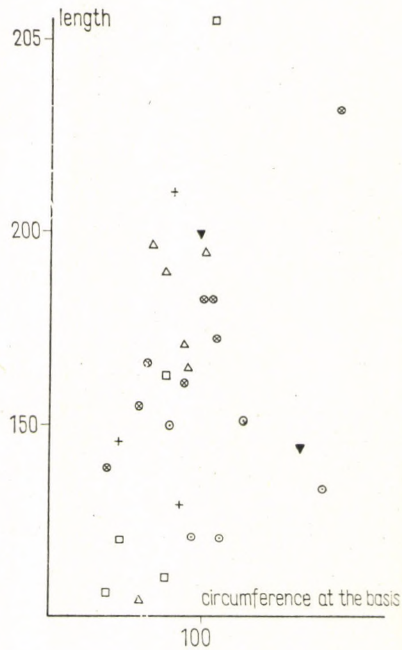


Fig. 67. Size variation of the horn cores of goats in Hungary from the early Neolithic to the end of the Middle Ages

falva, both of which were Roman castra. In addition, the size of goats generally increased during the Roman Period. Such an increase can be seen first and foremost in territories under Roman rule, in particular on the bone samples from big estates or villa farms, where up-to-date animal keeping of those times was pursued. Goats of the Period of the Roman Empire were much bigger than those of preceding or subsequent periods, in the material of which there were only certain outstandingly large individuals that could have equalled them. Owing to the scantiness of the bone samples at our disposal, it would be useless to work out the averages, but the diagrams convey very well the differences in size (Figs 67—69). The effect of

[41] Habermehl, K. H., 1957, p. 89

imported Roman goats even reached territories which were then not yet — nor did later become — under Roman rule. Thus, in the Celtic oppidum of Manching the size of goats exceed the measurements of subfossil goats of

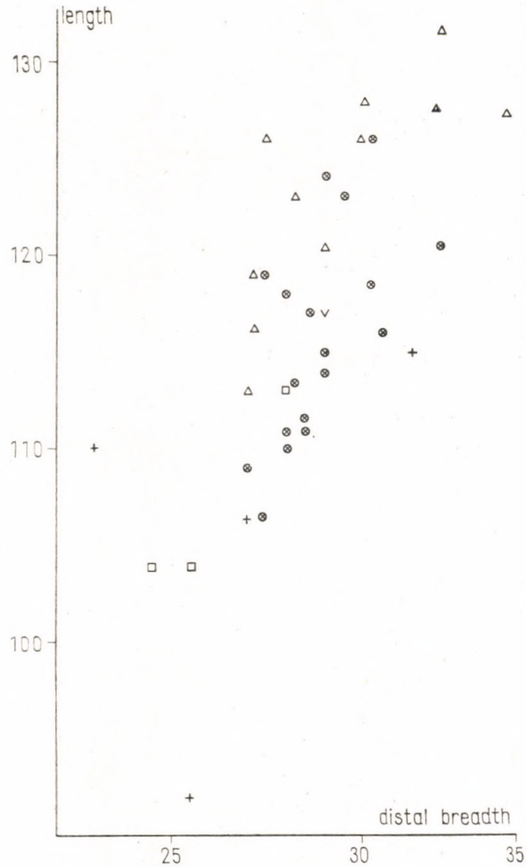


Fig. 68. Size variation of the metacarpals of goats in Hungary from the early Neolithic to the end of the Middle Ages

Central Europe.[42] In Pölloth's opinion, by the way, goats were mainly kept by the poorer population as cheap milking animals.[43]

As was the case with other domestic animals, a marked decline of goats followed the fall of the Roman Empire. Very few finds of goats are known from the Migration Period, although there is no doubt that — on the basis

[42] Pfund, D., 1961, p. 35
[43] Pölloth, K., 1959, p. 48

of recent ethnographic analogies — peoples kept goats in their flocks of sheep. And that this was so in the Middle Ages also is shown by the altar-piece Master M.S. painted in 1506 "The Nativity," Hontszentantal—

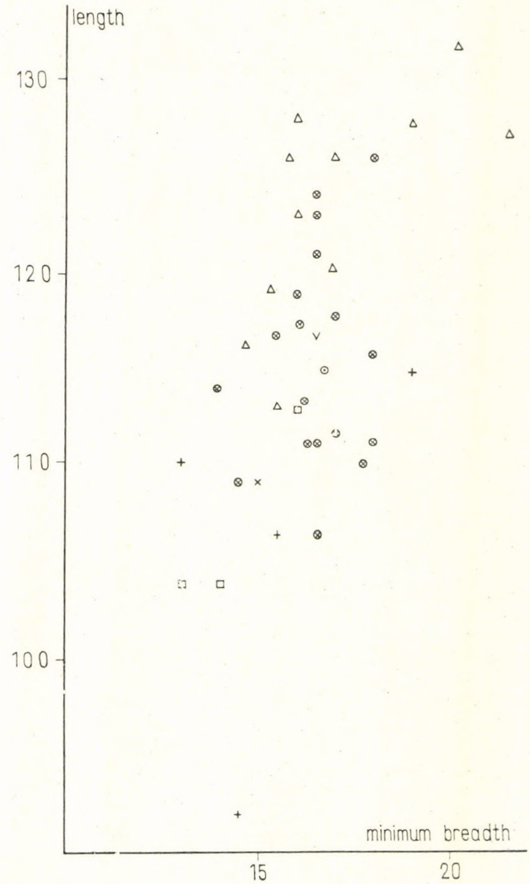


Fig. 69. Size variation of the metatarsals of goats in Hungary from the early Neolithic to the end of the Middle Ages

Sv. Antol), in which a few goats are also grazing in the flock of sheep represented in the picture (Fig. 70).

Up to the 14th century, mediaeval goats were rather small, but after this they began to increase in size. There occurred among them animals with scimitar horn cores,[44] and in some sites these were even in the

[44] Bökönyi, S., 1954c, p. 283; 1961b, p. 97; 1962b, p. 9; 1963c, p. 349; Würgler, F. E., 1956, p. 73; 1961, p. 34; Krysiak, K., 1956b, p. 11

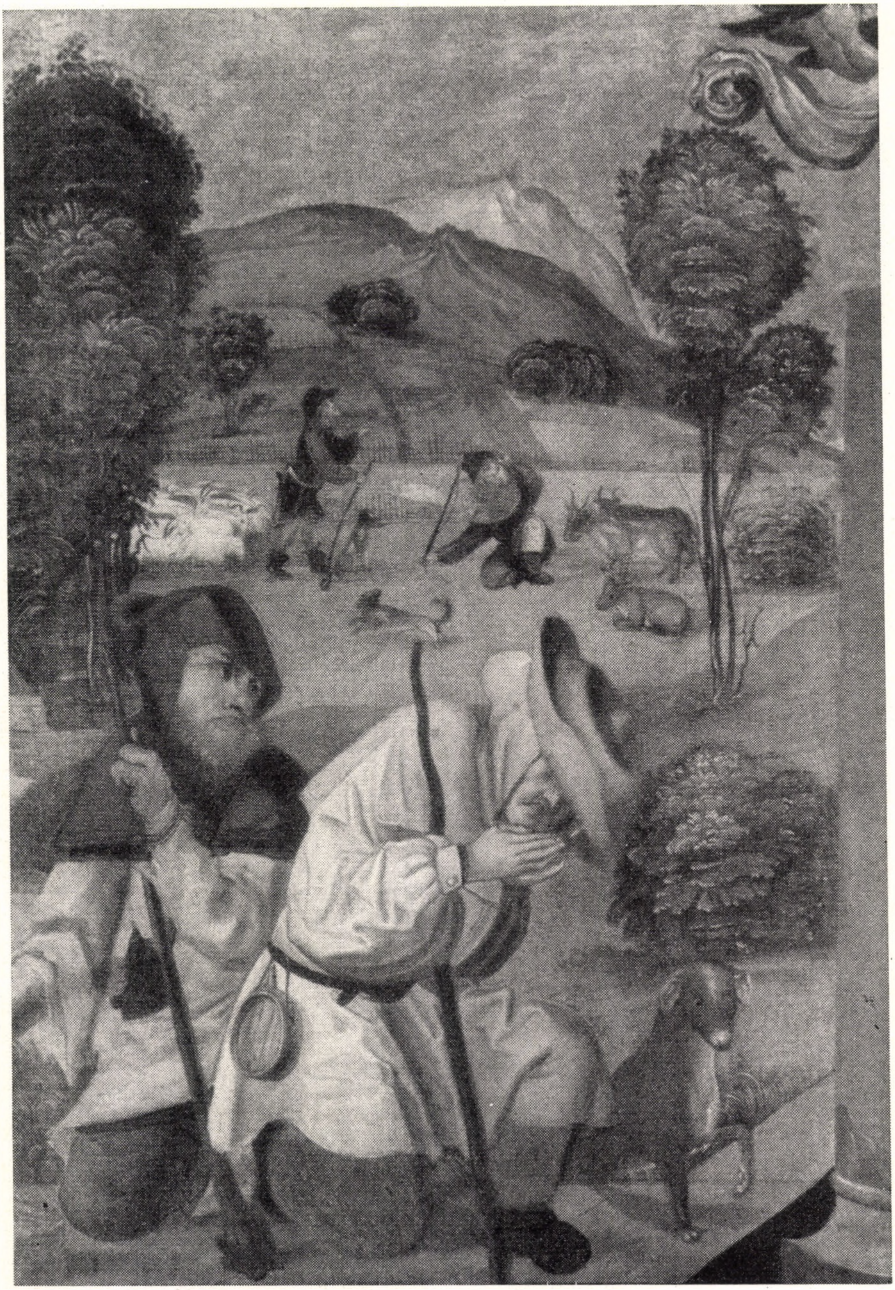


Fig. 70. Flock of sheep and goats in the painting "The Nativity" by Master M.S., 1506. Hontszentantal—Sv. Antol, Czechoslovakia

majority.[45] Since they were found mostly in the northern part of Central Europe, we have to consider it as a case of survival in border areas. Among the males there occurred some animals with very large horns, which were always twisted. Evidently they were old he-goats. Hornless goats, on the other hand, were very rare in the Middle Ages; for example in the whole Hungarian material there is only one fragment of a skull of this kind (Buda Castle, the Pasha's residence, Turkish period, Fig. 71). Only with the spread of conscious animal breeding have hornless goats spread in modern times.

Fig. 71. Part of a hornless goat skull. Buda Castle, The Pasha's Palace, Period of the Turkish occupation

[45] Kubasiewicz, M., 1959, p. 150; Müller, H. H., 1959, p. 234

THE PIG

THE IMPORTANCE OF THE PIG

Pigs are perhaps the most typical species of meat animals among our domestic animals. Practically all domestic animals were meat animals at first, in that Man domesticated them to cover his requirements of meat. Only later did he recognize their other uses, which had also existed before domestication, but had not been utilized by Man (e.g. milk) or else which emerged under the effect of domestication in its more advanced stages (wool). These secondary uses, which were recognized or evolved in later phases of animal keeping, became so significant that in some species they became the primary purpose of husbandry. The case of sheep is a very good example, since they became important domestic animals in temperate Europe after the emergence and spread of woolly sheep and their wool became incomparably more important than their meat. Pigs did not undergo such changes; they remained the same meat animals as they were at their original stage of domestication — at most their yield of meat and fat was increased. Thus pigs did not leave their status as meat animals; rather it was in this quality that they achieved a specialization exceeding all the rest.

Man domesticated numerous species to obtain meat animals, but they did not survive, evidently they must have been lacking a certain psychological quality that has not been yet defined but that was needed for a species of wild animals to become genuine domestic animals; they may not have been able to compete with other species of domestic animals. Pigs, however, were very well able to compete with other meat animals, evidently owing to their quicker growth and their higher prolification. No doubt, cattle or horses, for example, provide a greater quantity of meat but they take a much longer time to grow and with respect to prolification they cannot be compared with pigs. Sheep and goats give much less meat and although their growth is not much slower, their prolification lags far behind that of pigs.

We consider these to have been the reasons why pigs have attained the first place in the list of meat animals and why they spread so quickly after their first domestication.

WILD FORMS

Observing the rules of the research of domestic animals we must look for the wild ancestors of domestic pigs among such wild pigs as have a skull form and teeth identical with theirs. The basic formula of the teeth of domestic pigs is $\frac{3\ 1\ 4\ 3}{3\ 1\ 4\ 3}$. This formula of the teeth can be found with all early domestic pigs. (With the advance of domestication and the shortening of the jaw the only change that occurs is that the lower first premolars do not cut open. This phenomenon also happened in prehistoric times, but became frequent only in Roman times. On the other hand, modern domestic pigs with lower first premolars are very seldom found.) Only the *Sus* genus, taken in the strictest meaning of the term, can be considered from this point of view but not even all its members. Thus *pigmy hogs* (*Porcula*) and the *Sus barbatus*, *verrucosus*, etc. differ in their skull structure and their general body structure so much from domestic pigs that there is no way in which they could have been the wild ancestors of the latter.[1] Even recently Mohr professed that *pigmy hogs* could have been the wild ancestors of certain breeds of domestic pigs, for example of the flop-eared Vietnam pig;[2] but Herre has definitely refuted this view.[3]

For a long time there prevailed a confusion in the systematics of the *Sus* genus, concerning the forms that could be taken into consideration as domesticable. Rütimeyer, the Swiss pioneer of the historical research of domestic animals, drew a sharp line separating the European *Sus scrofa* from the Asian *Sus vittatus*.[4] On the basis of wild swine bones found in Swiss lake dwellings he described a subspecies of wild swine, the *Sus scrofa antiquus*, different from the modern one and extinct since then.[5] (Schröter was the first to prove that the *Sus scrofa antiquuus* falls within the size variation of the recent European wild swine,[6] and then Herre showed that the difference between the *Sus scrofa attila* and the *Sus scrofa antiquus* was only in size.[7]) Nathusius also definitely distinguished European wild swine from the Asian one.[8] Stehlin pursued a threefold grouping suggesting that the Asian *Sus vittatus* and *verrucosus* were independent species in addition to the European *Sus scrofa*.[9] Apart from the European *Sus scrofa* and the Asian *Sus vittatus* a third form, the South East European wild swine was described by Ulmansky, who called it *Sus mediterraneus*. Its main characteristics was midway between European and Asian wild swine.[10] Jaworski, too, adopted the same grouping.[11] Filiptchenko classified the wild swine of the Soviet Union and Central Asia into five subspecies *(scrofa, attila, nigripes, raddeanus, orientalis)*[12]. He considered the first three subspecies to be-

[1] Antonius, O., 1922, p. 232
[2] Mohr, E., 1960, p. 71
[3] Herre, W., 1962, pp. 265 ff.
[4] Rütimeyer, L., 1861, pp. 188 ff.
[5] Ibid.
[6] Schröter, H., 1923, p. 341
[7] Herre, W., 1949, p. 332
[8] Nathusius, H., 1864, pp. 164 ff.
[9] Stehlin, H. G., 1899, p. 234
[10] Ulmansky, S., 1914, pp. 17 ff.
[11] Jaworski, Z., 1927, p. 327
[12] Filiptchenko, J. A., 1933, p. 180

long to the species *Sus scrofa*[13] and the latter two to the *Sus orientalis*.[14] According to him the latter species was close to *Sus vittatus* from the point of view of craniology. Thus, in his opinion, domestic pigs had three wild ancestors.[15] In opposition Adlerberg declared four such types of wild swine, among which the wild ancestors of domestic pigs are to be sought: the western subgroup of the *Sus scrofa* (Europe, North Africa, Asia Minor, Western and Central Asia, East Turkestan, Tian Shan, North West Mongolia), the eastern sub-group of the *Sus scrofa* (North Mongolia, Transbaikalia, the region of the Amur and the Ussuri, Manchuria, China, Japan and Taiwan), the *Sus cristatus* (India, Ceylon, Vietnam, Thailand and Malaya) and the *Sus vittatus* (Sumatra, Java and some neighbouring islands).[16] He considered the *Sus scrofa* to have been the wild ancestor of prehistoric pigs and of today's primitive ones and suggested a similar role for the eastern group of *scrofa* breeds, for example in the case of Chinese pigs. On the other hand, he attributed a lesser importance to the *Sus cristatus* and an even lesser one to the *Sus vittatus*.[17]

It is the merit of Adlerberg and Filiptchenko that, in spite of the fact that their work shows some trends towards over-specification, it has revealed that a number of intermediary forms connect the westernmost and easternmost forms of wild swine on the Eurasian continent, although these latter show a marked difference in the shape of the lacrymal bone. Proceeding from east to west we can observe that the lacrymal bone gradually becomes shorter and higher. Generally, forms of wild swine with a lacrymal bone index below 1 were grouped with the *Sus vittatus* and those with an index above 1 with the *scrofa*. But, in fact, this was not such a simple problem, since there were wild swine belonging, on the basis of their lacrymal bone index, to the *vittatus* but on the basis of other characteristics to the *scrofa* — and *vice versa*.

The question was finally solved in a satisfying way by Kelm's investigations. He proved that it was impossible to demarcate sharply the *scrofa* group from the *vittatus* group, for the European *scrofa* and the Asian *vittatus* wild swine represented the two extreme members of a single series of forms.[18] Kelm's view on why researchers could not reach an agreement for such a long time on the taxonomy of Eurasian wild swine is very interesting:[19] "Man könnte es fast als eine gewisse Tragik bezeichnen, dass vom Weltformenkreis der Wildschweine Eurasiens als erste gerade die extremsten Vertreter, das mitteleuropäische Wildschwein und das indische Bindenschwein bekannt wurden. Sie dienten als Ausgangsformen für einen Vergleich später beschriebener Wildschweine. Wäre die historische Entwicklung der Kenntnis der eurasischen Wildschweinformen von der ostsibiri-

[13] Filiptchenko, J. A., 1933, p. 183
[14] Filiptchenko, J. A., 1933, p. 184
[15] Ibid.
[16] Adlerberg, G. P., 1933, p. 208
[17] Adlerberg, G. F., 1933, p. 20[illegible]
[18] Kelm, H., 1938, p. 505
[19] Kelm, H., 1939, p. 365

schen ausgehend nach Westen und Südwesten fortgeschritten, wäre wohl kaum von zwei verschiedenen Wildschweinarten die Rede gewesen."

On the basis of Kelm's results it is clear that domestic pigs are of monophyletic origin: early domestic pigs were produced by the domestication of the local wild swine subspecies of different regions or of the geographic races. However, as will be shown further on, a part at least of the earliest European domestic pigs originated from imported animals.

CHANGES CAUSED BY DOMESTICATION

The earliest symptom of domestication was perhaps the decrease in size. As early as in the Neolithic there was a considerable difference in the size of wild and domestic swine and on the basis of this difference their bones could be easily separated. This difference in size — with slight fluctuations — lasted up to modern times when modern breeds were developed; only these latter approximated the size of the wild ancestor.

Besides the decrease in size, the proportions of the body remained unchanged for a long time. As is shown both by bone samples and by representations, primitive domestic pigs, when lean — for fattening was started already in prehistoric times (see below) — showed the body proportions of wild swine. Only after the introduction of conscious breeding did significant changes appear, in particular in the decrease of the head size, the lengthening of the trunk and the shortening of legs.

Skull changes followed long after those of size. In general, the skull became shorter and relatively broader. The facial part and the mandibles show a particularly marked shortening. The occipital squama turned upwards so that the line of the profile became broken, sometimes to such an extent that a right angle was reached, which, together with the shortening of the facial part, may produce the so-called pug-head. The shortening of the skull is shown clearly on the lacrymal bone (os lacrymale). With European wild swine this bone is like an elongated oblong, but as a result of domestication it becomes shorter and shorter and finally its breadth exceeds its length (in such cases the lacrymal bone index — lower length/breadth — which is above 2 with wild swine, sinks below 1).

Fig. 72. Primitive pigs with hairy crests along their backs, like those of wild swine. Rosen, Bulgaria

Another consequence of domestication is the significant changes in the quality and colour of the hair. The coarse bristles of wild swine become softer with domestic pigs and although the hairy crest stretching along the back survived for a long time and is to be found on some primitive domestic pigs even today (Fig. 72), as a whole the hair becomes finer and with certain breeds *(mangalica)* it becomes wavy. The thickness of the hair also diminishes and with some modern breeds almost completely disappears. As far as the changes of colour are concerned, it is probable that the colour of the wild animal survived domestication for a long time. We do not know when the domesticated colour variants first appeared, but they have certainly supplanted the wild colours almost completely by now. However, on piglets of primitive breeds the stripes of wild swine will often appear. Most of our modern domestic pigs are white (lacking pigments) or black, but piebald pigs are also quite frequent.

Flop ears are also a symptom of domestication in the pig and so is the curly tail. This latter appeared already in the Neolithic on the basis of which it was easy to identify certain figurines representing pigs.

Wild swine were among the most frequent hunted animals of prehistoric Europe. In settlements their frequency was generally behind red deer and aurochs, although in more than one place it preceded this latter; indeed, sometimes it approximated or even exceeded the frequency of red deer as well. In this respect Northern Europe was the only exception; in this region, wild swine — being a typically southern species — were somewhat rarer,[20] and did not occur at all north of the 57th degree of latitude.[21] The extensive hunting of wild swine in prehistoric times was connected with several factors: killing a wild swine supplied the hunters with an ample quantity of meat and when game was plentiful in the prehistoric period it was an essential aim in hunting to kill the individuals of species with as large bodies as possible. On the other hand — and this factor is even more important than the previous one — in prehistoric times the hunting of wild swine was connected with domestication. (As in the case of the aurochs, the adult animal had to be killed before the domesticable young animals could be captured.) Towards the end of the prehistoric period the hunting of wild swine declined, because the number of wild swine had decreased and thus, by the Middle Ages wild swine no longer played an important role among hunted wild nimals.

In contrast to modern wild swine of Europe, those of prehistoric times were remarkable on account of their size, a fact pointed out by every author who dealt with them. They had tusks suited to their considerable size, which is demonstrated best by the jaws of wild boars found in the graves of the Copper Age cemetery of Polgár–Basatanya. The length of the biggest lower tusks was approx. 300 mm and their widest breadth 31 mm. Thus they outrival by far all the prize-winning trophies of the 1937 world exhibition of hunting (Fig. 73).

[20] Degerből, M., 1935, pp. 263—264
[21] Hübner, F., 1939, p. 235

Fig. 73. Mandibles of domestic pig (two upper lines) and of wild swine (lower line) from the graves of the Copper Age cemetery of Polgár–Basatanya

Later the size of wild swine gradually diminished, parallel with the decrease in their numbers. Essentially, this can be traced back to two groups of causes.

The first is that since the prehistoric period the feeding and living conditions of wild swine have steadily deteriorated. Herre pointed out this fact; namely, that the decrease in size is due to the expansion of agriculture at the expense of woods.[22] It can be assumed that in prehistoric times it was not only owing to larger forest regions that wild swine had a better chance of getting food, but also to a warmer climate than present, which prevailed up to the beginning of the Bronze Age; particularly important were the milder winters of those times, for winter is the critical season in the feeding of wild swine. For want of other food it feeds on uliginal or aquatic plants, or eats hibernating small mammals in winter; its weight decreases markedly and with young, growing animals this temporary undernourishment has a detrimental effect upon development and growth, an effect that lasts for their whole life.[23]

With the increase of the agricultural grassland wild swine formed smaller, more isolated populations which may have been another cause of their diminishing size. With the exception of the western region of the Soviet Union and some areas of Poland there are now no contiguous, large forests in the whole of Europe, that is, forests where large populations of wild swine could live. In isolated populations, phenomena like the changes brought about by domestication will occur, the first being the decrease in size. (Ingebrigsten was the first to point out this phenomenon on red deer in the islands near Trondheim, these animals being much smaller than red deer in continental Norway.[24]) The trophies of wild swine from different regions of Europe demonstrate the same connexions:[25] the biggest recent trophies come from Poland and the smallest from Holland and Belgium.

Wild swine, if captured when young, can be tamed and domesticated very easily.[26] Thus it is only natural that pigs were among the earliest domesticated animals. In certain areas the capturing and domestication of wild piglets was customary up to quite recent times. Thus, for example, prior to 1914, when large numbers of Armenians lived in the Turkish Empire, it was a widespread custom with them to capture the piglets of wild swine, to rear and later to slaughter them because no pig keeping could develop in a Moslem state.[27]

[22] Herre, W., 1949, p. 332

[23] Antonius, O., 1920, p. 5

[24] Ingebrigsten, O., 1922, p. 1 ff.

[25] Out of them Hübner (1938, p. 236) has drawn the conclusions — which, in our opinion are unacceptable — that there is a negative correlation between the size of the tusks and the local annual mean temperature, that is to say the lower the annual mean temperature, of a certain given area, the bigger the tusks of wild swine living there

[26] Boettger, C. R., 1958, p. 21

[27] Zeuner, F. E., 1955, p. 332

Apart from some Mesolithic finds of uncertain dating from the Crimea[28] the earliest domestication of pigs took place in South West Asia. The earliest domestic pigs known so far were found in the upper, Pottery Neolithic layer of the at Qualat Jarmo,[29] dated by radiocarbon analysis to c. 6500 B.C. But these pigs were not domesticated locally, for there is no trace that would point to this fact; they had spread there from another place. Thus it is possible that somewhere else in the Near East pigs had been domesticated before that date.[30] There may have been an early domestication centre in South East India too, but this territory has until now been only scantily explored archaeologically, thus we could only proceed on assumption in this respect.

Like the other domesticated animals, pig also, having been domesticated, soon spread in all directions, in spite of the fact that it has always remained the domestic animal of sedentary peoples. This is shown by the occurrence of domestic pigs in Predynastic sites in Upper Egypt (Badari, Toukh),[31] as well as in the Pre-Pottery Neolithic of Greece (Argissa Magula,[32] Nea Nikomedeia).[33] It is particularly interesting to note that as early as in the second half of the 7th millennium B.C. pigs occurred as domestic animals in South East Europe and had also been locally domesticated there. Thus, its domestication in Europe was scarcely behind its domestication in the Near East.

From South East Europe too, pigs spread quickly further northwards reaching, along with the peoples proceeding in that direction at the time of the climatic optimum of the Early Neolithic, the Carpathian Basin and the southern Ukraine. It was from this wave of peoples that the population of other parts of Europe in the Neolithic adopted the pig. It is strange, however, that — as happened in the case of cattle — the knowledge of its techniques of domestication did not spread to Central Europe alongside the spread of the domestic pig itself. In the Early Neolithic of Europe bones of transitional forms between wild swine and domestic pigs are very rare indeed. This has been subsequently confirmed by Rütimeyer, in whose view Swiss Neolithic *turbary pigs* could not originate from local wild swine but were imported animals.[34]

Concerning the earliest European domestic pigs there have been highly opposing views — particularly in the initial stages of the research of domestic animals. The starting point of these clashing views was Rütimeyer's description of another prehistoric breed of "*domestic pigs*" domesticated at the end of the Neolithic from local wild swine,[35] side by side with the imported

[28] Hančar, F., 1958, p. 140
[29] Reed, C. A., 1961, p. 32
[30] Reed, C. A., 1961, p. 33
[31] Ibid.
[32] Boessneck, J., 1962, pp. 30—31
[33] Higgs, E. S., 1962, p. 272
[34] Rütimeyer, L., 1861, p. 189
[35] Rütimeyer, L., 1861, p. 188

turbary pigs: for he thus definitely separated two different groups of prehistoric domestic pigs. Studer,[36] Otto,[37] Duerst[38] and a number of other authors adopted this view. However, there soon appeared opponents of Rütimeyer's view. As early as in 1888 Nehring set forth the opinion that the characteristics separating the *turbary pig* from the "*domestic pig*" are not specific but are due to a stunting caused by primitive husbandry. The skull and teeth of badly fed and stunted modern *scrofa* pigs cannot be distinguished from those of *turbary pigs.*[39] In his opinion stunted individuals were also not infrequent among wild swine particularly among those born in autumn. They will occur in nature but even more often in the population of game reserves. Such stunted wild swine resemble *turbary pigs.*[40] Accordingly, Nehring suggested that a single type of domestic pig existed in prehistoric times. His view is shared by Van Giffen,[41] Hilzheimer,[42] Hescheler,[43] Hescheler and Rüeger,[44] and Rüeger[45] too. The problem has been most clearly analysed by Reitsma, who proved that *turbary pigs* and "*domestic pigs*" are identical forms of the domesticated pig, and that the differences between them were brought about only by different degrees of domestication, by geographical surroundings and the climate.[46] So strongly rooted was the Rütimeyer division that even Zeuner divided the pigs of the Swiss lake dwellings into herded pigs and sty-pigs in this way.[47]

Today, after a very large amount of evidence has been accumulated, it has become clear that no such division is possible. If we examine the Neolithic pigs of any territory of Central and East Europe we shall find small and primitive pigs with long heads strongly reminiscent of wild swine in their skull form everywhere (Fig. 74). They can be found in Switzerland[48] and Germany,[49] in Hungary,[50] in the Balkans[51] or in the European territories of the Soviet Union[52] alike. In all likelihood they all belong to a homogeneous European group of swine, which only show local differences

[36] Studer, Th., 1900, p. 107
[37] Otto, F., 1901, pp. 43 ff.
[38] Duerst, U. J., 1904a, p. 236
[39] Nehring, A., 1888d, pp. 12—13
[40] Nehring, A., 1888c, pp. 182—183
[41] Giffen, A. E. v., 1913, p. 45
[42] Hilzheimer, M., 1927, p. 80
[43] Hescheler, K., Rüeger, J., 1942, p. 423
[44] Hescheler, K., 1929—30, p. 22
[45] Rüeger, J., 1942, p. 256
[46] Reitsma, G. G., 1935, p. 55
[47] Zeuner, F. E., 1963, p. 256
[48] Reverdin, L., 1921, p. 189; 1920—22, p. 252; Pittard, E., Reverdin, L., 1920—22, pp. 259 ff.; Hescheler, K., 1920, p. 303; Hescheler, K., Rüeger, J., 1942, p. 422; Rüeger, J., 1944, p. 282; Thalheimer, H., 1945, p. 76; Josien, Th., 1956, p. 35; Danegger, E. A., 1959, p. 6; Stampfli, H. R., 1962, p. 33; Boessneck, J., Jéquier, J. P., Stampfli, H. R., 1963, p. 55
[49] Nehring, A., 1888b, p. 11; Rickmann, K., 1921, p. 11; Müller, H. H., 1964, p. 51
[50] Bökönyi, S., 1957a, p. 74
[51] Boessneck, J., 1956d, p. 30; 1962, p. 30; Higgs, E. S., 1962, p. 272; Necrasov, O., Haimovici, S., 1959, p. 565; Haimovici, S., 1960, p. 390; 1962, p. 326; Necrasov, O., 1964, p. 176
[52] Bibikova, V. I., Shevtchenko, A. I., 1962, p. 243

Fig. 74. Skull of a pig. Berettyószentmárton, Neolithic (Herpály culture)

according to the extent to which local wild swine and the earliest domestic pigs which had diffused to the place in question from South East Europe or from South West Asia respectively, had contributed to their evolution.

As already mentioned, in this period local wild swine were only rarely domesticated in Central and South East Europe. Such locally domesticated pigs were found by King in Cyprus,[53] by Boessneck in Thessaly,[54] by Higgs in Macedonia,[55] by ourselves in Hungary[56] and by Müller in Germany.[57] Only in the Middle Neolithic was there a rise in domestication activities which reached a peak in the period between the end of the Neolithic and the end of the Bronze Age. Local domestication always and everywhere meant an increase in size and for this reason pigs, which exceeded the size of typical *turbary pigs* were found more and more frequently from the end of the Neolithic onwards. Such pigs were discovered, among others, by Studer at Mörigen,[58] and at Schaffis,[59] by Wettstein at Zürich-Alpenquai,[60] by Kuhn at Obermeilen,[61] by Boessneck at Altenerding and Pestenacker,[62] by Ambros at Dvory nad Žitavou (Slovakia),[63] by Haimovici at the Bronze Age layer of Valea Lupului (Noua culture) in Romania,[64] by Krysiak at Cmielów[65] and Gródek Nadbuzny[66] and by ourselves lately at the Neolithic and Bronze Age sites of Rutzing, Rebensteiner Mauer and Brückler Mauer in Austria and Hajdúkovo–Kővágó in North East Yugoslavia. Similar pigs also occurred in sites of the Tripolye culture[67] and in Late Bronze Age settlements of the European territories of the Soviet Union.[68] In the same period these large domestic pigs were also quite frequent in Hungary, as were transitional forms between wild swine and domestic pigs. Evidently, most of them were newly domesticated animals, but the possible occurrence of products of interbreeding cannot be excluded.

Under the primitive conditions of husbandry of domestic pigs in prehistoric times, chance interbreeding of this kind could have occurred quite easily. Herds of domestic pigs were fed chiefly on forest produce (in general, prehistoric pig breeding was developed in areas where there were large forests of oak or beech; according to Quitta, for example, the predominance of pigs in the animal keeping of the Tripolye culture was due, above all, to the fodder basis provided by the mixed oak forests in the vicinity of the

[53] King, J. E., 1953, p. 435
[54] Boessneck, J., 1956d, p. 30; 1962, p. 31
[55] Higgs, E. S., 1962, p. 272
[56] Bökönyi, S., 1957a, p. 74; 1964b, p. 90
[57] Müller, H. H., 1964, p. 51
[58] Studer, Th. 1883, pp. 113 ff.
[59] Studer, Th., 1900, p. 107
[60] Wettstein, E., 1924, p. 101
[61] Kuhn, E., 1935, p. 288
[62] Boessneck, J., 1956c, pp. 16, 18
[63] Ambros, C., 1958a, p. 77
[64] Haimovici, S., 1962, p. 326
[65] Krysiak, K., 1950–51, p. 228
[66] Krysiak, K., 1956a, p. 60
[67] Bibikova, V. I., Shevtchenko, A. I., 1962, p. 243
[68] Zalkin, V. I., 1964b, p. 27

settlements[69]) and in the forests an interbreeding with wild swine was inevitable. The fact that these transitional forms constituted an unbroken link between populations of domestic and wild swine could be a reason why the largest pigs lived in Hungary during the Bronze Age; indeed, their size was exceeded only by pigs of modern times (Figs 75—76). This seems to be somewhat contradictory to Boessneck's opinion according to which Central European domestic pigs in the Bronze Age were somewhat smaller than those of the Neolithic and that this decrease in size lasted at least until the beginning of the Roman Period.[70] This contradiction springs from the fact that, when writing his summarizing paper, Boessneck was not familiar with a considerable quantity of bone samples of domestic pigs from the initial period of the Neolithic in Europe, that is to say from the period when domestic pigs were really small.

From many points of view the skulls of Bronze Age pigs (Fig. 77) resemble those of the Neolithic; they still belong to the primitive type but, at the same time, they reveal a trend towards shortening, particularly of the lacrymal bone. The fattening of pigs, by the way, appears to have been started as early as the Bronze Age, as is shown by the great number of Bronze Age statuettes representing fat pigs (Fig. 78).

After the Bronze Age the size of pigs diminished all over Central and Eastern Europe. This may have been connected with a gradual discontinuation of local domestication, that is to say a lack of interbreeding with large wild swine. In almost every Iron Age site in Switzerland small individuals of a size tallying with that of early Neolithic *turbary pigs* were found.[71] Only at La Tène were larger pigs, considered to be crossbreds of wild swine and *turbary pigs*, discovered.[72] Similar small pigs were excavated from the Celtic oppidum of Manching[73] and from Heuneburg (early Urnenfelderkultur — early La Tène)[74] in Germany. A certain decrease in size — particularly in the Late Iron Age — could also be observed on bone samples of pigs in Hungary and in the European territories of the Soviet Union. But among these latter there were marked local differences. Thus the biggest pigs of the period were kept by the tribes of the forest belt (better fodder bases), whereas the smallest lived in the coastal area of the Black Sea. Pigs of the Scythian tribes in the forest-steppe belt were between the two.[75] Pig keeping was not especially significant among the Scythians, according to Herodotus (IV. 2) with them "... sacrifices of pigs are not customary nor is pig keeping prevalent in their country". This, of course, referred to the Scythian tribes of the steppe region adjacent to the Greek city colonies, whereas tribes of the forest-steppe kept pigs in suitable ecological surroundings; and yet, pigs were never frequent with them either.[76]

[69] Quitta, H., 1950—51, p. 27
[70] Boessneck, J., 1958b, p. 116
[71] Leuthardt, F., 1930, p. 589; Kuhn, E., 1937, p. 17; 1942; p. 79; 1946, p. 168; 1951, p. 254
[72] Schwerz, F., 1918, p. 470
[73] Opitz, G., 1958, p. 25; Nanninga, O., 1963, p. 22
[74] Schüle, W., 1960, p. 10
[75] Zalkin, V. I., 1962, p. 40; 1964a, p. 6
[76] Zalkin, V. I., 1964a, p. 15

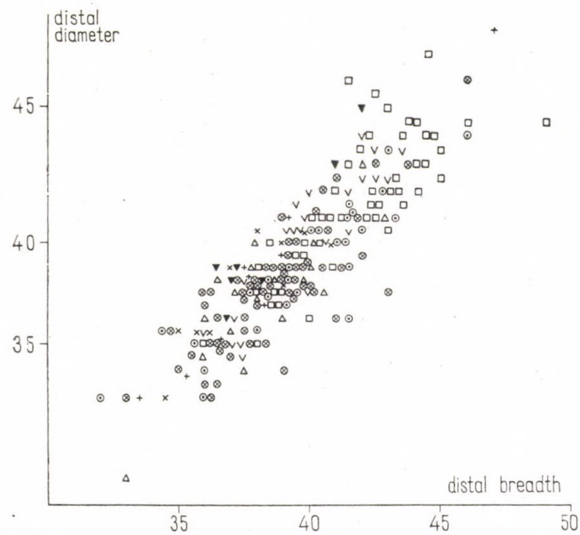


Fig. 75. Size variation of the humeri of pigs in Hungary between the early Neolithic and the end of the Middle Ages

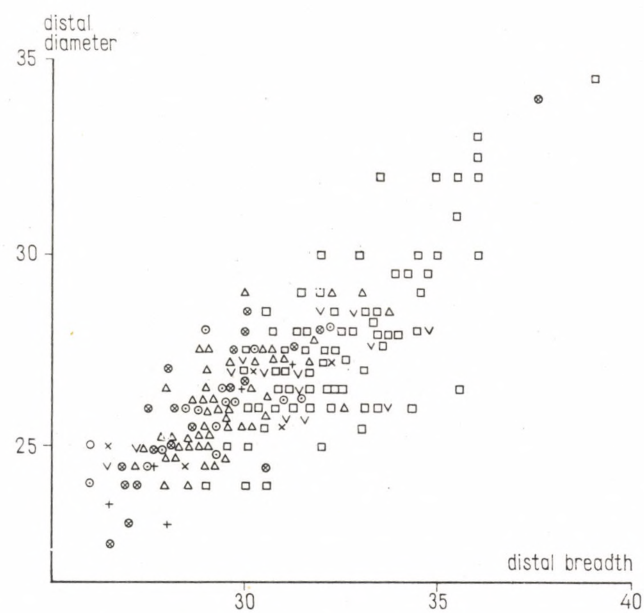


Fig. 76. Size variation of the tibiae of pigs in Hungary between the early Neolithic and the end of the Middle Ages

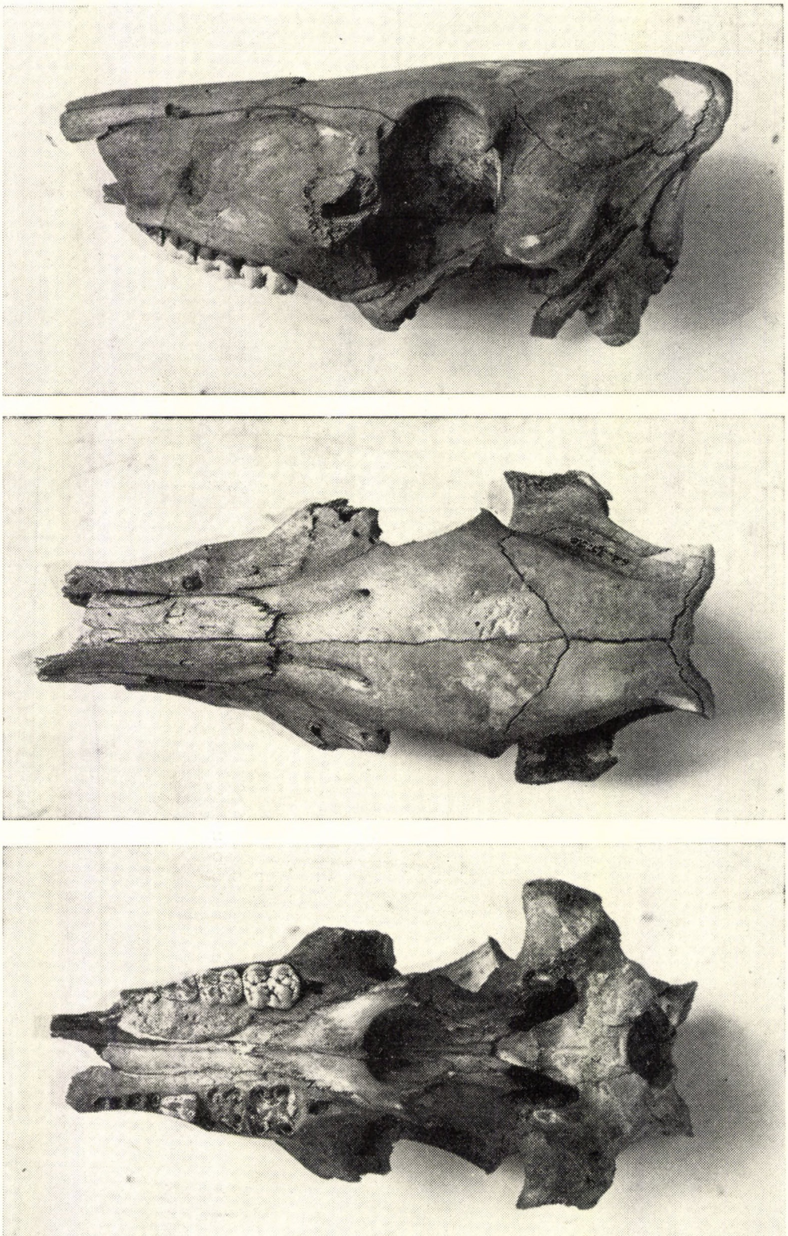


Fig. 77. Skull of a pig. Csongrád Petőfi Tsz, Bronze Age (Zók culture)

Pigs were not only the most frequent domestic animals of the Celts, but they also played a role of a *quasi* totemic animal. This is shown by the extraordinary frequency in Celtic graves of pig bones, skulls or skeletons cut in two along their whole length, but also by their statuettes found at the settlements. These sculptures are relatively uniform and show primitive domestic pigs with long heads, big tusks, erect crests of hair along their back, with narrow trunks, carp's backs and long legs (Fig. 79). On the basis of these features one would be inclined to take them for wild swine, but the statuettes always show animals with tails curling upwards, a feature which only occurs with domestic pigs.

Fig. 78. Clay statuette of pig. Tószeg—Laposhalom, Bronze Age

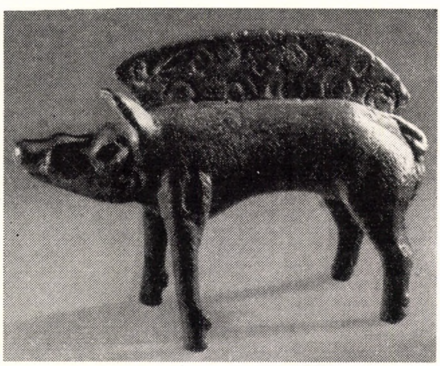


Fig. 79. Bronze statuette of pig. The hairy crest running along the back is reminiscent of wild swine, but the tail, curling upwards, no doubt points to a domestic pig. Báta, Celtic. Hungarian National Museum, Budapest

THE FIRST FLOURISHING OF CONSCIOUS BREEDING

At the same time, or perhaps even earlier, the beginnings of conscious pig breeding occurred in Greece. Thus, for example in Book XIV of the Odyssey we can read about herds of pigs kept by Eumaios. In the absence of his master, he surrounded with a stone wall a courtyard in which there were twelve sties, each for 50 sows. There was a separate sty for piglets, moreover, he kept the boars for fattening, also separated from the others.

Fig. 80. Statuette representing a fattened pig. South-Italy, 4th century B.C. Museum of Fine Arts, Budapest

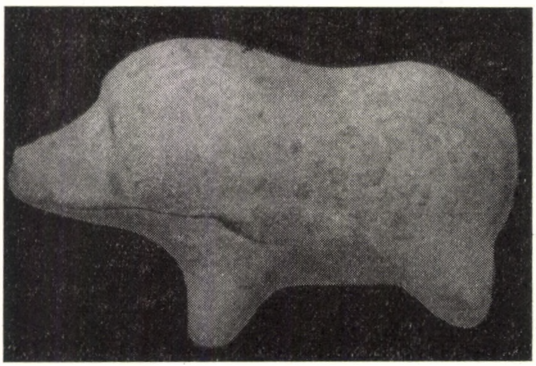


Fig. 81. Clay statuette of a pig. Varna, 5th—3rd century B.C. Museum, Varna

The boars were on grazing land in the daytime, and were watched by four strong dogs in the courtyard.

The Greek pigs would often be longlived for in the Odyssey (XIV, 419) a five-year old boar was killed for an honoured guest, whereas another passage (X, 390) describes a porker nine years old. The Greeks kept pigs above all for their meat, but they used them as sacrificial animals too, and sacrificed them to all deities connected with agriculture, especially to Demeter. When killed the pigs were first singed (Odyssey, II, 300; XIV, 75) then they were cut in pieces, sprinkled with white flour and baked on a spit (Odyssey, XIV, 437). As testified by representations (Figs 80—81), the Greeks knew how to fatten pigs. They fattened them on peas and figs. Piglets were not appreciated as food and were mostly consumed by servants.

As with the other domestic animal species the decrease in the size of pigs stopped in the Period of the Roman Empire. Moreover, the extremity bones grew somewhat larger if compared with those of Celtic pigs.[77] This — along with the diminishing dentition — showed the improvement in the conditions of animal keeping and the beneficient effect of conscious Roman animal breeding.[78] Of course, such pigs were found particularly in Roman villa settlements, towns and military camps. In addition to these large animals, small local pigs became widespread. Thus, for example in the Roman villas of Alpnach,[79] Buchs[80] in the castrum of Schaan,[81] at Abodiacum[82]

[77] Boesneck, J., 1958b, pp. 94 ff.; 1964, p. 227
[78] Boessneck, J., 1964, p. 229; Stampfli, H. R., 1959—60a, p. 421
[79] Kuhn, E., 1933, p. 23
[80] Stampfli, H. R., 1960b, p. 436
[81] Würgler, F. E., 1959, p. 276
[82] Boessneck, J., 1964, p. 277

and at the villas of Tác large pigs, evidently of Roman origin were also found. On the other hand, at Kirchdorf,[83] Xanthen,[84] Butzbach,[85] etc. only pigs — evidently of local origin — of the size of *turbary pigs*, occurred.

From this time onwards actual domestication was pushed completely into the background and the bones of transitional forms between wild and

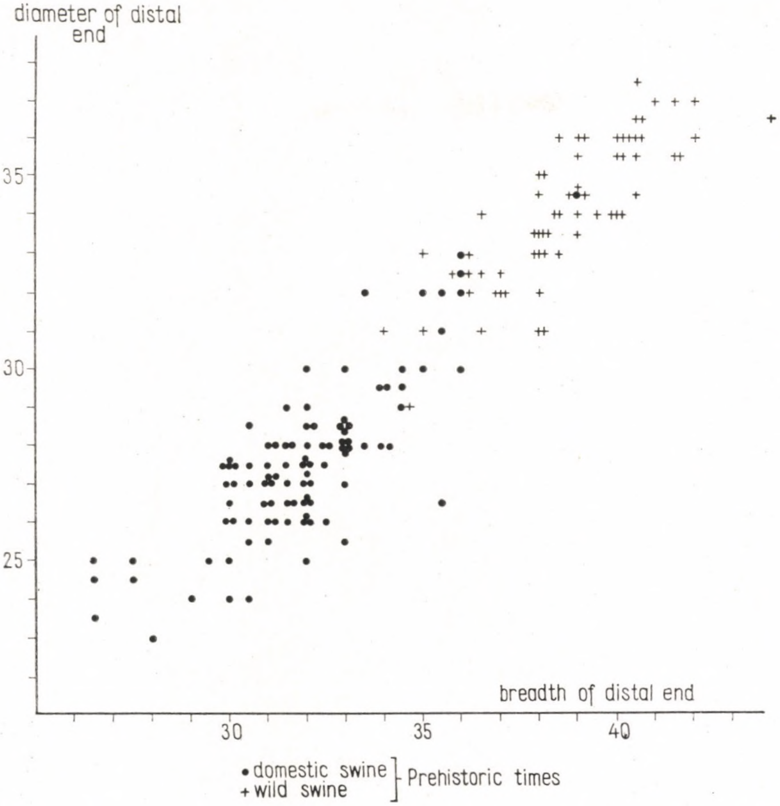


Fig. 82. Size variation of the tibiae of domestic pigs and wild swine in Hungary in prehistoric times

domestic pigs were extremely rare. When comparing the bone measurements of prehistoric domestic and wild swine in Hungary with those of the Roman Period, of the Migration Period and of the Middle Ages (Figs 82—83) we obtained very interesting results. Whereas there is a gradual transition between the bone measurements of prehistoric domestic and wild swine

[83] Rüeger, J., 1944, p. 237
[84] Sickenberg, O., 1938, p. 151
[85] Habermehl, K. H., 1957, p. 96

of prehistoric times, and the size variations of the two forms slightly overlap, in later periods clear measurement boundaries can be established between the two and one or two transitional individuals at most can be found.

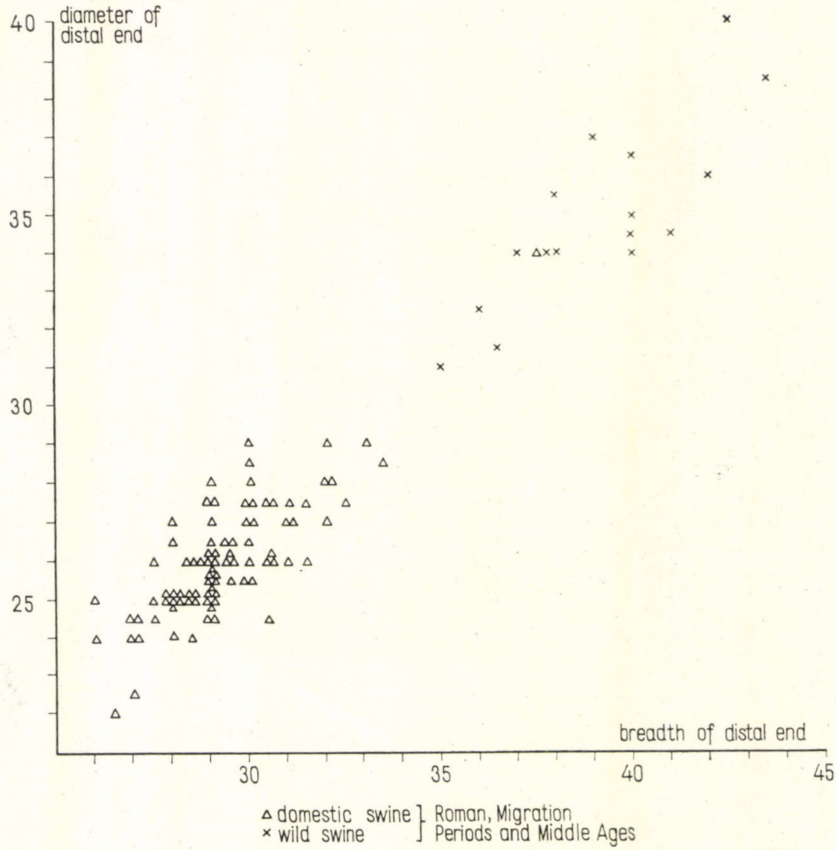


Fig. 83. Size variation of the tibiae of domestic pigs and wild swine in Hungary between the Period of the Roman Empire and the Middle Ages

In the Period of the Roman Empire the fattening of pigs was a well-known practice. Numerous sculptures or vessels representing fattened pigs are extant. Even in the smallest provincial household bacon was produced, if at all possible, from home-bread pigs (Varro r.r.I. 22). In contrast to the Greeks, the Romans considered the flesh of piglets — especially of sucking ones — to be a delicacy. The womb, vulvula and udder of pigs were also choice morsels.[86] They knew several ways of conserving pork, ham, etc. and

[86] Zeuner, F. E., 1963, p. 263

Fig. 84. Skull of a pig. Szentes – Nagyhegy, Avar

the manufacture of sausages was also widespread. In big cities a number of sausage vendors sold their wares. In addition, pigs were among the oldest Roman sacrificial animals.

Roman authors on agriculture gave much useful advice on the breeding of pigs, which may well be followed even today. They described in detail the dropping sites, similar to modern ones, with small boxes kept immaculately clean. A sow of good breed would produce a litter twice a year (Pliny, VIII, 205). Boars to be fattened were castrated and sometimes sows were spayed.

In the Migration Period pig breeding suffered a decline and increased only towards the end of the period with the Slavs. We know relatively ittle about the pigs of this period because there is very scanty settlement

Fig. 85. Metal mount representing a pig's head. Nemesvölgy, Avar, Hungarian National Museum, Budapest

material and pigs were seldom put into graves except parts of juvenile animals. The pig's skull in the Avar cemetery of Szőreg, described by Hankó, showed some southern features.[87] On the other hand, the Avar pig's skull with its long lacrymal bone (Fig. 84) found at Szentes–Nagyhegy can be connected with local wild swine. Similar pig's heads can be seen on Avar metal plaques (Fig. 85). Unfortunately, the Langobard pig from Vörs was too young and no inferences could be drawn from the examinations of its skull. Ambros described small pigs from the Slav settlements at Bešeňov and Nitriansky Hrádok in Slovakia.[88] In general, it is improbable that the eastern peoples of the Migration Period brought along large numbers of pigs, for pigs do not belong to a species of domestic animals that can be driven for long distances. Thus the European population of pigs during the Migration Period had lived there, almost exclusively, since the end of the prehistoric period and was built upon a population somewhat modified by the Romans. Therefore it is not surprising that the skull of the pig of the Avars of Szentes–Nagyhegy is reminiscent of local wild swine, nor that the Szőreg one reveals southern features.

[87] Hankó, B., 1958b, p. 85
[88] Ambros, C., 1958b, p. 418

In the Middle Ages there were considerable differences between pigs living in different regions of Central and Eastern Europe. This is rooted, above all, in the different conditions of keeping and feeding, but is also influenced by the regional differences in the natural environment. Thus, first of all, the size of pigs living in the western part of Central Europe was very different from that of pigs in the eastern part of Central Europe and in East Europe. The former were all small[89] and even induced dwarf pigs for example in the 13th—15th century Starkenstein in Switzerland.[90] In contrast in the eastern part of Central Europe and in East Europe there also occurred small individuals but alongside them larger individuals were not infrequent. Thus the average size of the whole population was bigger. Large pigs were described by Enderlein from the early Slav site of Poztupimi (Potsdam),[91] by Müller from Mediaeval Hannover,[92] by Kubasiewicz from 10th—13th and 9th—13th century sites at Milicz,[93] and Wolin[94] respectively, by Sobocinski from Bonikovo,[95] an 8th—10th century site, by Ivanov from Popina in Bulgaria (4th—7th and 8th—12th centuries)[96] and from Dždedžovi Ložja (6th—11th century).[97] Gheorghiu and Haimovici described primitive but large pigs found at Garvan (Dinogetia, 9th—12th century) in Romania.[98] Similar pigs were excavated from the mediaeval sites of Ancient Russia though the majority comprised small pigs like those of West Europe and reminiscent of *turbary pigs*.[99] In Hungary large forms prevailed, small pigs seldom occurring.[100]

Hankó has carried out detailed investigations concerning Hungarian breeds of pigs in the Middle Ages. Examining only a single skull of the period of the Árpád Dynasty (10th—13th century) he distinguished eight ancient Hungarian breeds of pigs[101] almost exclusively on the evidence of written sources. These were the following: 1. Mountain or Surány pigs, 2. spiny bristled mountain pigs, 3. Bakony pigs, 4. Siska pigs, 5. Turmező pigs, 6. small] lard pigs of the Great Plain, 7. meadow hogs and 8. Szalonta pigs. With respect to the origin of these breeds he declared that the Szalonta pig had been brought in from the East by the conquering Magyars. Concerning the other ones he professed that "... doubtlessly the mountain pig lived in the valleys of the ring of the Carpathians, kept by the Slav folk

[89] Würgler, F. E., 1956, p. 11; 1961, p. 33; Hartmann-Frick, H., 1957, p. 56; 1962 p.33
[90] Würgler, F. E., 1956, p. 73
[91] Enderlein, H., 1930, p. 297
[92] Müller, H. H., 1959, p. 227
[93] Kubasiewicz, M., 1957a, p. 195
[94] Kubasiewicz, M., 1959, p. 150
[95] Sobocinski, M., 1963, p. 81
[96] Ivanov, S., 1956, p. 94
[97] Ivanov, S., 1965, p. 225
[98] Gheorghiu, G., Haimovici, S., 1965, p. 8
[99] Bogolyubskij, S. N., 1929, pp. 75—76; Zalkin, V. I., 1956, pp. 98 ff.
[100] Bökönyi, S., 1954c, p. 283; 1958a, p. 463; 1961b, p. 99; 1962b, pp. 9—10; 1963b, p. 408; 1963c, p. 352
[101] Hankó, B., 1938a, pp. 1 ff.; 1939, pp. 33 ff.; 1954, p. 101 ff.

who had taken shelter there, the place where it is found even today. Nor is it impossible that the spiny bristled domestic pig already lived in the valleys of the Transylvanian mountains at that time. No doubt, the Bakony breed of pigs already lived at that time in the region of the Bakony—Vértes Mountains, whereas the Siska breed lived south of Lake Balaton in the Zselic region and along the two banks of the river Drava. The ancient breed of pigs of the plain around Zagreb, the Turmező breed, existed as early as this, whereas the ancient breed of the Great Hungarian Plain, the small lard pig, lived between the rivers Danube and Tisza. In all probability, meadow hogs had been bred since prehistoric times in the inundation areas of the Tisza, the Körös and the Berettyó."[102] However, the only pig's skull from the Period of the Árpád Dynasty which he examined may not have originated from the breed introduced by the Magyars, for it looks like another evolved form of pig that lived in the Carpathian Basin during the Avar period.[103] The effect of Avar pigs can be demonstrated also in the Bakony and Szalonta breeds and in the small lard pig of the Great Plain.[104]

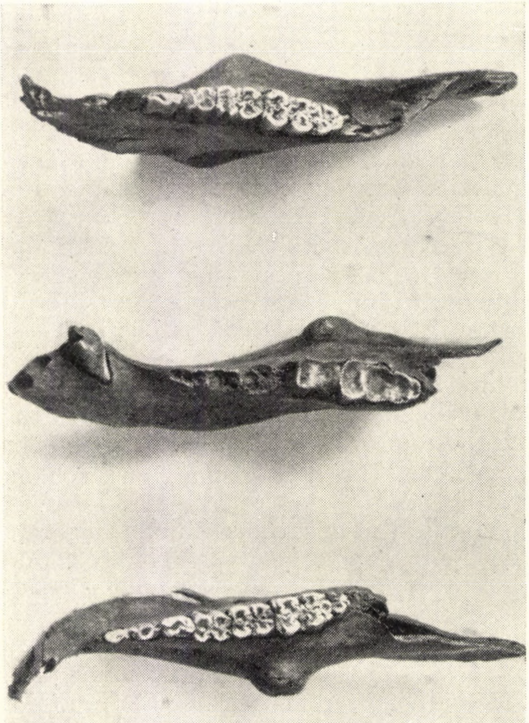


Fig. 86. Mandibles of pigs with the protuberance caused by the distorted tusks on their lateral side. Zalavár, Period of the Árpád Dynasty

As already pointed out,[105] the existence of the eight breeds supposed by Hankó to have existed cannot be confirmed on the basis of the mediaeval bone samples found in Hungary. On the basis of skulls and extremity bones two breeds can be distinguished, a larger one (which however is far smaller than our present domestic pigs), which can be connected with local wild swine (odd bones of transitional forms between domestic and wild swine occur even among the bone samples of mediaeval sites)[106] and a small-

[102] Hankó, B., 1939, p. 12
[103] Hankó, B., 1939, p. 43
[104] Hankó, B., 1954, pp. 101 ff.
[105] Bökönyi, S., 1961b, p. 98; 1962b, p. 9; 1963b, p. 407
[106] Bökönyi, S. 1964a, p. 370

er one, which shows signs of improvement. These refinement symptoms are visible on the skull too, above all in the shortening of the whole skull and particularly of the lacrymal bone, in the crowded setting of certain teeth, which are sometimes revolved on their longitudinal axis up to as much as 90°. But the changes to the mandibles (Fig. 86) are even more characteristic, for they became shortened to such an extent that the teeth which became shorter only at a later stage, had no room in the alveoles. Thus the first premolar was missing from practically every mandible. Nor was there any room for the big canines of the boars;[107] they could not grow properly but became distorted and their roots pushed out the lateral wall of the horizontal part of the jaw. Thus protuberances often occur there the size of a hazelnut, and sometimes the wall of the mandible is missing on them. In such cases the root of the canine can be seen deep down. The canines found inside or removed from the damaged mandible clearly reveal the distortion. The canines, which otherwise run on one plane in a semicircle, lean out of this plane in such cases, and, moreover, there are strong horizontal circles visible on them. As this breed of pigs was first discovered at Zalavár, a Slav site in Hungary, we formerly believed it to have been connected wih the Slavs. But apart from this one case it has never been found in any Slav site in Hungary nor in the neighbouring territories and, therefore, we now think that it was a breed evolved in the territory of Hungary and was distributed there, a breed that cannot be specially connected with Slavs. Its characteristic mandibles and lower tusks also occurred in other Hungarian mediaeval sites, for example in 13th—14th century layers of Buda Castle,[108] in a 17th century grave in Debrecen[109] and recently in 15th—17th century layers of Gyula Castle and an 18th century layer of Sárospatak Castle.

In the Middle Ages the changes brought about by domestication occurred very rapidly. Whereas in the period from the early Neolithic up to the end of the Migration Period the changes caused by domestication were showing in the shortening of the brain skull and in the occipital squama's upward turn becoming weaker, in the Middle Ages the nose began to turn markedly upwards which broke the profile line. In addition, the breadth measurements began to increase. This process can be well observed on the pigs of Buda Castle, where a good series of skulls from the period between the 13th and the 17th century was found and demonstrated the above changes very well.[110] But similar tendencies towards shortening are shown by the skull with a lacrymal bone index of 1.06 found at Budmerice in Slovakia (14th—15th century) and described by Ambros.[111] Reich described pigs found at Wolin, and appearing first in very early layers of the settlement from 1050—1170 as animals with very short noses, bordering on pug-headedness.[112]

[107] Bökönyi, S., 1954c, p. 283; 1958a, p. 463; 1961b, p. 99; 1962b, pp. 9—10; 1963b, p. 408; 1963c, p. 408
[108] Bökönyi, S., 1958a, p. 463; 1963b, p. 408
[109] Ibid.
[110] Ibid.
[111] Ambros, C., 1962b, p. 303
[112] Reich, H., 1937, p. 6

They can probably be identified with pigs which were found during more recent excavations at the site, and to which Kubasiewicz attributed mostly Asian characteristics.[113] It is likely that the pigs on whose lacrymal bones Sobocinski thought he had discovered signs that might point to an intermixing with the *Sus vittatus*[114] may also have been individuals whose skulls revealed phenomena of more advanced domestication. And finally, the pigs of Zalavár, with markedly shortened mandibles, also bear the marks of a more advanced domestication.

Thus, in general there is evidence to show that over the whole territory of Central and East Europe there lived in the Middle Ages a primitive population of pigs, which was very variable but of homogeneous origin. Here, in addition to different conditions of keeping and feeding as well as environmental factors, the different degrees of domestication may also have played a part in bringing about variations. Pigs in a more advanced phase of domestication (refined animals) seem to have become separated from the more primitive stock as early as at the turn of the first millennium A.D. and they may have even constituted an independent breed. Thus two breeds had emerged: one, more primitive and larger, resembling in the form of its skull wild swine with which it often interbred; and the other, smaller in size, reminiscent by its markedly shortened skull and lacrymal bone of the Asian wild swine, with which indeed it has often been connected; this second domestic breed showed phenomena of refinement. Of course, the boundaries of these breeds – as is the case with every breed in general – have been demarcated arbitrarily. It is also clear that they were rather groups of breeds within which there were regional variations in colour, development, tendency to get more or less fatter, etc. But these groups are not to be taken for genuine breeds for they did not come into being in consequence of man's intentional intervention. In the case of pigs a case of deliberate development of breeds, of conscious breeding can only be spoken of after the end of the Middle Ages. In 1643 Archbishop György Szelepcsényi wrote the following to Ádám Batthyány: "In every farm of mine I keep animals of a different colour, in one the blond ones, again in another the piebald, the black and white or spotted ones and again in another the black ones."[115] This clearly showed the beginnings of conscious animal breeding and breeding selection which, however, became fully developed only in the 18th century when the Turks had been driven out of the country.

After cattle, pigs were the most important meat animals of the Middle Ages, particularly with Slavic and Germanic peoples. In most cases juvenile or subadult pigs were killed, although there are sites, e.g. Wolin,[116] where only the bones of adult pigs were found. In mediaeval sites in Hungary bones of adult pigs were also excavated, but on the other hand, a deed by which King Géza I donated the village of Ártánd to the Abbey of Garamszentbenedek in 1075 contained, among others, the prescription that the

[113] Kubasiewicz, M., 1959, p. 150
[114] Sobocinski, M., 1963, p. 81
[115] Takáts, S., n.d. p. 238
[116] Reich, H., 1937, p. 6

village was obliged to deliver twelve five-year-old pigs every year.[117] The fattening of pigs was also mentioned quite early: in 1051, King Endre I sent to the army of Henry II, Emperor of the Holy Roman Empire, among other commodities two thousand sides of bacon.[118] According to a document dated c. 1240, Pannonhalma Abbey, which owned ten villages in Somogy County with a population of mostly swineherds, was entitled to demand the annual delivery of a fattened hog after every pair of sites for cottages.[119]

The chronicle of the Englishman John Stow (A Survey of London, London, 1603)[120] reveals an interesting use of pigs in the Middle Ages. The chronicle, written in the second half of the 16th century, mentioned fights between pigs which were trained for the purpose; the fights were held in the winter before every feast. Unfortunately, the writer did not describe how the fights were performed, whether the contestants had to fight until one of them was killed, and whether some kind of weapon had been fastened to the animals, etc.

In the Middle Ages pigs were kept for the most part in serfs' farms, for on the squires' estates mostly larger animals were kept. — But in the towns there were also plenty of pigs; they are omnivorous animals and the kitchen midden provided their primary food source. There are data available from all parts of Europe about pigs having been kept in towns.[121] Thus, in England, in the early Middle Ages the pigs of St. Anthony's hospital, with a bell around their necks, were allowed to walk in streets where other hogs were not. In a suburb of Paris the horse of Prince Philip, son of King Louis VI (1108—1137), took such a fright from a pig that it threw its rider and crushed him to death.[122] In his chronicle Ottakar von Horneck (c. 1265—c. 1309) tells us about the Viennese people's quarrrel with their Prince. In the course of the strife, the Prince marched to the Kahlenberg and prevented the people from driving their cattle and pigs to the grazing land so that the animals perished.[123] From Fiume, on the shore of the Adriatic, a decision of the council, dated 1437, mentioned pigs being kept in the town.[124]

[117] Györffy, Gy., 1963, p. 595
[118] Hankó, B., 1939, p. 13
[119] Acsády, I., 1944, p. 82
[120] Kulcsár, Zs., 1964, p. 215
[121] Kulcsár, Zs., 1964, p. 72
[122] Kulcsár, Zs., 1964, p. 200
[123] Kulcsár, Zs., 1964, p. 199
[124] Fest, A., 1914, p. 668

THE CAMEL

Nowadays two species of camels live in Eurasia: the two-humped camel (*Camelus bactrianus* L.) and the one-humped camel (*Camelus dromedarius* L.). The distribution of the former stretches from the Balkans through Central Asia as far as Manchuria, and that of the latter from the Caspian to North Africa. To what extent they are independent species is still an undecided question for recently some researchers have suggested that the one-humped camel is only a domesticated form of the two-humped one.[1] This view is supported by the fact that the embryo of the one-humped camel has two humps.[2]

The ancestors of the camel family reached Europe from North America through the Bering Strait's route during the Pleistocene. We do not know the time and place of its earliest domestication because osteologically there is practically no difference between domestic and wild camels. Duerst demonstrated camels from Anau (3000—2800 B.C.),[3] and Amschler from Shah Tepé (3000—2500 B.C.).[4] However, it has not been proved that they were really domestic animals. Similarly the authenticity of the camel bones of the Tripolye culture is very doubtful.[5] The earliest representation of two-humped camels is known from Uruk-Warka (4th millennium B.C.),[6] but it is so highly stylized that it cannot be decided whether the animal represented was wild or domesticated. However, the first domestication must have taken place at the latest in the course of the 2nd millennium B.C.[7] At the time of Cyrus and Zoroaster, in the 6th century B.C., the camel was a well-known domestic animal in Iran; but even earlier it had found its way to Mesopotamia, where fine representations of it have been preserved. For example on the bronze door of Balawat (Shalmaneser, c. 850 B.C.) easily identifiable two-humped camels originating from Armenia can be seen.[8]

Of the two species it was the two-hamped camel that reached Europe first. It appeared first in southern Russia, to which it had spread via the Caspian Sea region and the lower basin of the Volga. It first occurred at

[1] La Baume, W., 1953, p. 65; Herre, W., 1958, p. 32
[2] Krumbiegel, I., 1952, p. 10
[3] Duerst, U. J., 1908, p. 410
[4] Amschler, W., 1939a, p. 115; 1939b, pp. 77 ff.
[5] Zeuner, F. E., 1963, p. 359
[6] Schauenburg, K., 1955—56, p. 61
[7] Zeuner, F. E., 1963, p. 360
[8] Ibid.

Kamenskiye Kuntchugury (5th—3rd century B.C.).[9] Camel bones were also found in the Greek city colonies on the northern coastal region of the Black Sea, although they were very rare. One or two specimens were found in the Hellenistic-Roman layers of Scythian Neapolis, Pantikapaeon, Ilurat, and Phanagoria; 46 specimens (of 5 individuals) were discovered at Tanais,[10] and 12 specimens of camels' remains (2 individuals) were unearthed from the 1st—5th century A.D. layers of Olbia.[11] Their measurements correspond to those of modern two-humped camels.[12]

Among the 6th—12th century A.D. bone samples of Mediaeval Kiev, camel bones[13] were also found, and they occurred in Borševo I (9th — 10th century A.D.)[14] among the Slav gorodishtches in the vicinity of Voroniezh, and in the 12th—13th and 13th—14th century A.D. layers of the capital of Volga-Bulgaria.[15] This indicates that the finds of camel bones from Russia and the Ukraine were limited to the steppe regions of the two territories. Gărvan (Dinogetia, 9th—12th century A.D.) in Romania, where a single camel bone was excavated, lies in similar geographical surroundings.[16]

Camel bones found in Central Europe are associated with the Period of the Roman Empire and with the Middle Ages. Kramer found bones of camels in Vindonissa in Switzerland,[17] Berger and Thenius in the Roman layers of Vienna,[18] and Boessneck at Epfach (Abodiacum);[19] all of them probably belonged to *C. batrianus*. The fragment of a mandible excavated at the Roman villa settlement at Tác–Fövenypuszta should be grouped with them; however, it was found in a layer disturbed by mediaeval additions, so that its authenticity is not certain. Military units transferred from Western Asia or North Africa to Europe brought with them those camels which date to the Roman Period, but when these forces were ordered back the camels also disappeared from the region.

Only in the eastern part of Central Europe, including Hungary, did camels again occur after the Migration Period. These, however, were not of Roman origin but spread during the Migration Period from the Caspian and the Black Sea northwards of the latter until they reached the Carpathian Basin. When one examines the route which the migrating Magyars followed, this is quite comprehensible.

The Illustrated Chronicle of Vienna, a 14th century illuminated manuscript, representing the entry of the Huns, who were thought at that time to have been the Magyars' ancestors, shows two warriors riding camels (Fig. 87). Evidently, it was due to defects in the artist's knowledge that only

[9] Zalkin, V. I., 1964a, p. 7
[10] Zalkin, V. I., 1960a, p. 50
[11] Pidoplitchko, I. G., 1956, p. 92
[12] Zalkin, V. I., 1960a, p. 51
[13] Pidoplitchko, I. G., 1956, p. 65
[14] Gromova, V. I., 1948, pp. 122—123
[15] Zalkin, V. I., 1954, p. 277
[16] Gheorghiu, G., Haimovici, S., 1965, p. 181
[17] Keller, C., 1919, p. 42
[18] Berger, W., Thenius, E., 1951, pp. 20 ff.
[19] Boessneck, J., 1964, p. 218

the heads and necks of the camels can be seen, their trunks being covered, so that it is impossible to tell whether they are one- or two-humped animals, but the heads have been so well depicted that they can be recognized as camels immediately. Their only visible harness is the halter, running in a single strap along the left side of the animal — and not in a double one as is usual with horses — and this halter is held by the rider. It is reminiscent of modern camels' harnesses. It is interesting to note that whereas the limner depicted the majority of the Hun army in western attire, in knightly armour, the two men riding camels wear oriental apparel: caftans. This shows that the artist was aware of the eastern origin of camels.

Fig. 87. Detail of the miniature representing the arrival of the Huns, shown in the Illuminated Chronicle. 14th century, National Széchényi Library, Budapest, Hungary

Written sources, too, bear witness to the occurrence of camels in Hungary in the Middle Ages. The Austrian clergyman Amsbert recorded that when Frederic Barbarossa passed through Hungary in 1189 at Esztergom King Béla III gave the crusaders bread and wine, oats for the horses and furthermore presented them with oxen, sheep and three camels.[20] The fate of the camels introduced to Hungary from the East is unknown; according to the above they must have belonged to the two-humped species of camels. Nor is it known how long they lived in the Carpathian Basin.

The only authentic camel bone found in Hungary originated from the period of the Turkish occupation. Part of a maxilla was excavated from the 15th—17th century layers of Diósgyőr Castle. Unfortunately, it cannot be ascertained whether it belonged to a one-humped or a two-humped animal.

In the Balkan Peninsula there are camels although only a few — even today. They belong to the two-humped species, but it is difficult to ascertain whether they were introduced during the Period of the Roman Empire or found their way there during the Migration Period (which would have

[20] Szamota, I., 1891, p. 19

been easily possible through the medium of the Bulgarians), or, whether they spread there from Turkey. The phalanx of camel found at Gărvan in the north of Dobrudja (see Note 16), points more to their origin in the Migration Period. In this case they would have been brought along by peoples proceeding westwards near the northern coastal region of the Black Sea; the animals also spread to the Balkans along the west coast of the Black Sea.

Camels have always been kept predominantly as saddle- and pack-animals. Alexander the Great had the treasures of Persepolis transferred on two-humped camels (Curt. Vb, 10). As a riding animal it was first used in large numbers at the battle of Sardis (546 B.C.), whose outcome was sealed in Cyrus' favour by camels, for the horses of Croesus' army took fright at the camels and created a panic in the army (Herodotus, I. 80). In Central and East Europe the camel has never been of great importance since it is not prolific and it can be broken in and handled only with difficulty, it needs longer periods for grazing and finally, it is vicious; as a matter of fact, the male can be definitely dangerous. Therefore in places where other beasts of burden or saddle animals can be more easily fed and provided with water the camel cannot compete with them. This was the situation in Central and East Europe. On the other hand, camels are indispensable in deserts. Camel's meat is not very popular, although joints of camel were served at Darius' table,[21] and once, when Alexander the Great's army was starving Sysimithres, satrap of Baktria, gave 2000 camels to provide the army with meat (Curt. VIII. 4,19). Camel hair, which is very valuable today, was highly appreciated already by the Persians. In other parts of the Near East priests and the aristocracy wore camel hair garments.

On account of its strange appearance camels were exposed to mockery in Europe. In 1121, for example, the Pope Calixtus II had his adversary the Pope Gregory VIII captured, bound to the back of a camel facing the animal's rear parts and then driven around in a mocking procession.[22]

[21] Zeuner, F. E., 1963, p. 348
[22] Schauenburg, K., 1955—56, p. 91

THE HORSE

THE IMPORTANCE OF HORSE

The horse has a special place among the domestic fauna. Although it does not belong to the oldest domestic animals — for it was domesticated much later than the five neolithic species: sheep, goats, pigs, cattle and dogs — it acquired an outstanding importance as early as the prehistoric period. As a quick draught animal it created a revolution in transport and thus in commerce. It had the same influence upon the development of warfare. As early as the very beginning of the Bronze Age, i.e. soon after its first domestication, it became one of the most frequent domestic animals in the animal keeping of certain peoples and in the Early Iron Age, when the first equestrian nomadic peoples appeared, it began to play a role in the shaping of history.[1] This significance of the horse fully developed in the Migration Period, when the waves of equestrian nomadic peoples overwhelmed Europe and defeated the Roman Empire, peoples that gave quite a new character to the whole continent.

The importance of the horse is reflected not only in the material of settlements but also of cemeteries. This reveals that the horse retained the significance it had achieved in earthly life in the people's imagination about the afterlife. The practice of putting it into graves was started towards the end of the Neolithic and the beginning of the Metal Ages and became quite frequent from the Bronze Age onwards. From that period onwards it was more important than all species of wild and domestic animals in that it was placed in graves and maintained this position up to the time when Christianity was considerably gaining ground.[2]

The horse was the domestic animal which had the closest relationship with Man and in this respect it has been surpassed by the dog only in the most recent times. This followed from its role as a comrade-at-arms, a rank no other domestic animal has ever attained. For this reason the horse was the first species of domestic animals to be treated individually, rather than *en masse* as a herd. This, at the same time, meant the beginnings of conscious breeding selection and purposeful animal breeding, indeed, the occurrence of different breeds. Strangely enough, this breeding selection, commenced so very early on, developing the horse exclusively to produce power, as a specialized draught- or a saddle-animal, may have been one of the causes

[1] Clark, G., 1941, pp. 50 ff.
[2] Behrens, H., 1962, p. 189

of the horse's tragedy, which is taking place before our very eyes. As the horse has practically no other use and cannot vie with the engine, it has been rapidly pushed into the background in our century. And we think it quite likely that the horse will be the first species among our present domestic animals to disappear.

GROUPING OF TYPES. QUESTIONS OF ORIGIN

There is perhaps no other domestic animal which has been discussed so often from the point of view of its breeds, of its classification into types and, in this connexion, of its possible ancestors. The theories set forth about these questions are exceedingly varied and it is rather difficult to orientate oneself among them. It is particularly difficult to correlate the types described by the different authors. We have recently dealt with this question and present here a summary with minimal alterations.[3]

Essentially the theories on grouping domestic horses into types and on their ancestors can be classified into six big groups:

1. Sanson[4] and following him Pietrement[5] grouped the domestic horse into eight types, tracing them back to different species of wild horse.

2. Skorkowski[6] pursuing the Czekanowski method used in anthropology, grouped domestic horses on the basis of their skull characteristics into six groups assuming that each had had a different wild ancestor.

3. Stegmann[7] classified domestic horses into five groups, deriving them from several wild types. Three of Stegmann's groups essentially correspond with the three types of Ewart (see next paragraph), the fourth being the desert horse of Duerst (see next paragraph), and the fifth a Central Asian steppe group of local origin.

4. Ewart[8] classified horses into three groups with three different wild ancestors. His groups are: a) steppe horses, their wild ancestor being the *Przevalsky horse,* b) forest horses, their wild ancestor being the wild horse of Solutré, and c) mountain horses, their basic type being the so-called Celtic pony, derived by Ewart from the fossil horses of England. Substantially the same theory was professed by Brinkmann,[9] Noack[10] (their groups: the light "*warm blood*" horse — *Equus orientalis;* the heavy "*cold blood*" horse — *Equus robustus* and the pony — *Equus przevalskii*) and also by Duerst[11] (the latter denominating Ewart's third type desert horse instead of calling it mountain horse, or by Antonius,[12] who called his three types *Equus orientalis* (its wild ancestor being the *Przevalsky horse*) and *Equus robustus* (its

[3] Bökönyi, S., 1964d, pp. 228–229
[4] Sanson, A., 1869, pp. 1204 ff.
[5] Pietrement, C. A., 1870, pp. 1 ff.
[6] Skorkowski, E., 1938, pp. 1 ff.; 1946, pp. 1 ff.; 1956, pp. 42 ff.
[7] Stegmann, F. P., 1942, p. 180
[8] Ewart, J. C., 1909, pp. 219 ff.
[9] Brinkmann, A., 1921, pp. 18 ff.
[10] Noack, Th. 1903, p. 373
[11] Duerst, U. J., 1908, pp. 339 ff.
[12] Antonius, O., 1922, pp. 275 ff.

wild ancestor being the big West European horse of the Ice Age) and even by Hilzheimer,[13] who called the three categories: horses of the *tarpan* group, Celtic ponies and the group of heavy "*cold blood*" horses.

5. In contrast to the above, the researchers Franck,[14] Forsyth-Major,[15] Nehring,[16] and Wilckens[17] classified domestic horses into two groups: a western one (heavy, "*cold blood*" horses) and the eastern one (light, "*warm blood*" horses), tracing back the two groups to two wild ancestors. (The western group corresponds with Ewart's forest horse and the eastern one with Ewart's steppe horse.) The above grouping based upon Franck's examinations of the molars has been widely accepted and practising horse breeders are classifying horses even today on this basis. As far as wild ancestors are concerned Lundholm[18] has adopted the same point of view in its essence, accepting two types of wild horses that could be taken into consideration as having been domesticated. Ebhardt[19] was also an adherent of the diphyletic theory and he classified domestic horses into two groups "*ponies*" and "*horses*" (and each of these groups into two sub-groups).

6. Finally the monophyletic theory supposing the domestic horse to have had only one wild ancestor is also to be mentioned. Darwin[20] was its first advocate and a long time after his theory had been set forth the investigations of Schwartz[21] advanced the theory again. Recently Herre[22] and his school have represented this theory most staunchly. According to them there was only one species of wild horses in the Mesolithic and Neolithic in Europe, this species was, in all likelihood, identical with the *Przevalsky horse* and to it the domestic horses both of the past and of the present can be traced back.

As is very clear from the above, the theories on the origin and classification of the domestic horse have covered a long and varied course to return from the eight types of Sanson, i.e. from eight wild ancestors, to the monophyletic theory, which supposes only one wild ancestor.

WILD FORMS

In order to investigate the wild forms of the *Equidae* and their evolution, it is necessary to go back to the lower Pleistocene, when the *Equus genus* became divided into four groups, which correspond with sub-genera.[23] Among them the zebras occupied the southern part of Africa. True asses became

[13] Hilzheimer, M., 1926, p. 118
[14] Franck, I., 1874, pp. 1 ff.
[15] Forsyth-Major, C. J., 1880, p. 411
[16] Nehring, A., 1884, pp. 1 ff.
[17] Wilckens, M., 1888, pp. 114 ff.
[18] Lundholm, B., 1949, pp. 49 ff.
[19] Ebhardt, H., 1962, pp. 145 ff.
[20] Darwin, Ch., 1868, p. 51
[21] Schwartz, E., 1922, pp. 56 ff.
[22] Herre, W., 1939, pp. 342 ff.; 1958, pp. 28 ff.; 1959, p. 90; 1961, pp. 71 ff.; Nobis, G., 1955, pp. 201 ff.
[23] Simpson, G. G., 1961, pp. 21 ff.

distributed in the northern and north-eastern part of Africa, whereas the distribution of half-asses stretches in Asia from the coastal region of the Mediterranean up to Mongolia and in Europe in the southern steppe of the Ukraine and Russia. (In Central and East Europe there lived another half-ass, the *Asinus hydruntinus*, which has long been extinct.[24]) Genuine horses, which may be taken into consideration as the wild ancestors of the domestic horse, lived in Asia in the region north of the distribution of half-asses, and in Europe. As can be seen from the above the distribution regions of the four sub-genera overlap in some places, but nevertheless, no interbreeding takes place between the groups in nature. Under the artificial conditions of domestication or in zoos it can be crossbred, but, as a rule, the progeny is usually sterile.

In the course of the Pleistocene genuine horses underwent a complex process of evolution, which has so far not been clarified in detail. We can summarize this evolution by stating that in the Ice Age large and medium-sized horses lived side by side in various periods. Among them the over-specialized large forms became extinct by the end of the Pleistocene. Unfortunately, we know very little about the medium-sized wild horses, which survived the Pleistocene. We do not know what their distribution was nor in what part of Europe they survived the Ice Age, if they survived it at all. There now seems no doubt that for example in the territory of Hungary no wild horses existed in the Holocene, for among the Neolithic bone samples, which are of considerable quantity, there is not a single authentic horse bone. The first horse bones date to the period after the domestication of horses; starting from with a sporadic occurrence in the Copper Age but increasing to great masses from the beginning of the Bronze Age onwards. We know equally little about the anatomical features, the variations, and the relationship of different groups of early Holocene wild horses, which served as a basis of domestication.

Much better known are the wild horses that survived to modern times: the *tarpan* and the *Przevalsky horse*. The *tarpan*[25] was the wild horse of the Southern Ukraine and of South Russia. Compared with modern (domestic) horses it was a small, strongly built animal, with a small, short head, a broad, flat forehead, a nose like a ram's and small, pointed ears. It was mouse-grey or ash-grey with a sharp, black stripe along the back, with a short, erect dark mane, a short tail with long hairs growing from its root and dark, muscular legs. In East Europe the *tarpan* was fairly numerous and lived in small groups with several stallions in each (but in spring the strongest stallion drove out the weaker ones). When changing its hair in autumn it grew white downy hair, so that in winter its trunk was almost grey, the head, legs, mane and tail remained dark.[26] In this way the animal's colour shaded into the white of the surrounding countryside which was covered with snow. Owing to this quality the *tarpan* can be identified with the white

[24] Stehlin, H. G., Graziosi, P., 1935, pp. 1 ff.; Bökönyi, S., 1954a, pp. 12 ff.; 1957a, pp. 66 ff.; 1959a, pp. 78–79; Necrasov, O., 1964, pp. 141 ff.

[25] Description after Falz-Fein (1919, pp. 197 ff.)

[26] Vetulani, T., 1938, pp. 148 ff.

wild horses which Herodotus described (IV, 52) as living beside the marshes of the Hypanis (Bug).[27] After the Russian—Turkish war when the steppes became populated the *tarpan* was gradually forced into the background. The horse breeders of the region refused to put up with the stallions which were driven out of the *tarpans*' groups eloping with mares of their own herds. Therefore an unbridled hunt of the *tarpan* began, which by the end of the last century led to the extinction of the wild horse of South Russia. By now there is only one complete skeleton and a skull extant in the Institute of Zoology of the Soviet Academy of Sciences in Leningrad and in the Evolution-Morphological Institute in Moscow.

The other wild horse, the *Przevalsky horse* of Mongolia, still exists today. It is somewhat bigger than the tarpan,[28] its withers height being between 124 and 145 cm. It is a stocky animal, with a large head in proportion to its trunk, and with a long muzzle, which is often like that of a ram. The neck is thick and the withers only slightly protrude. Two basic colour types can be distinguished. One is like the colour of a dark bay, whereas the other is chestnut with a reddish and faded brownish tints. A dark stripe runs along the back, often accompanied by a cross-stripe across the shoulders; this latter, however, is never as strong as that of asses. Around the mouth, the colour is quite light, and the short, erect mane, and the tail and the feet are dark. It is an interesting feature that the whole length of the tail is not covered with long hairs; at its root the hairs are short. In summer the hair is smooth and short, but in winter it grows long and shaggy. The *Przevalsky horse* used to live in large areas of Asia; for example at the end of the 19th century it existed even in Dzungaria, and its distribution was limited on the north by the river Urungu and by the northern foothills of the High Altai Mountains.[29] Formerly it also occurred in Europe but recently, in its flight from Man, it has withdrawn into the mountains and deserts. In our century it has only been found in steppe areas at an altitude of 1000—1400 m and in semi-deserts. Colonel Przevalsky found (1876—77) the wild horses, which were named after him[30] in groups of ten to fifty animals; an adult stallion was not only the master of these groups but also their defender. Here too wild stallions will cover domestic mares; but on the other hand, the domestic horses very rarely interbred with *Przevalsky horses*, through the domestic mares being lured away, because the stronger wild stallions would mercilessly conquer, and often kill their domesticated rivals if they appeared.

Since the end of the last century the Mongolian wild horse has rapidly decreased in number, above all because of exorbitant hunting of them. The most frequent way was to capture foals which became exhausted while the herd was being chased over a long distance. These foals were simply included among the foals of domestic horses and reared together with them. (Another example of continual domestication. In this way numerous Przevalsky foals found their way to the zoos of Europe and America where they have

[27] Ibid.

[28] Description after Mohr (1959, pp. 21 ff.) and after Garrut—Sokolov—Salesskaia (1966, pp. 377 ff.)

[29] Bannikov, A. G., 1958, pp. 152 ff.

[30] Bannikov, A. G., 1961, p. 20; Dobtchin, N., 1961, p. 26

been successfully bred.) The decline of the wild horse occurred in this century but was aggravated by the fact that breeders — predominantly cattle breeders — occupied the withdrawal area of the wild horses (Baytag-Bogdo and Takhin-Shara-Nuru), and took possession of all the springs, thus depriving the wild horses of the vital necessities of their existence.[31] Thus the number of *Przevalsky horses* has been reduced to such an extent that recently special expeditions have been searching for it in vain. At long last, in the summer of 1966 Kaszab again found a group comprising seven mares and a stallion in the Takhin-Shara-Nuru Mountains,[32] and proved that the last wild horse lives not only in zoos but in nature as well.

It is rather difficult to determine the place in systematics of the two species of wild horses, which survived into historical times, and to set them in the line of the evolution of the horse. After a great many earlier attempts Nobis tried to solve the question by including the big Pleistocene wild horses under the name of *Equus caballus robustus* Pomel, the medium-sized late Diluvial ones under the name of *E. c. germanicus* Nehring, the Mesolithic, Neolithic and recent wild horses under the name of *E. c. przevalskii* Poliakoff as members of a single line of evolution. He considered only the latter as having been a possible wild ancestor of the domestic horse.[33] Herre did not think the unity of the species of the line *robustus-germanicus-przevalskii* as proven.[34] Herre considered the *tarpan* to be a feral domestic horse,[35] and his view was shared by Boessneck with the difference that, although in his opinion the *tarpan* had been a domestic horse, he did not exclude the possibility of *tarpan*-like wild horses having lived in the past.[36] In turn, Lundholm believed the *tarpan* to be a wild horse[37] and so did numerous Soviet authors headed by Gromova,[38] whose opinion was shared also by Zeuner.[39] Later Nobis modified his view; he criticized some authors who derived certain breeds of domestic horses from separate wild ancestors and professed that these breeds had not undergone any changes in the course of several thousand years. He considered this theory to be rooted in a rigidity of typological thinking.[40]

When judging the problem we think that one should set out from this latter opinion of Nobis. In the *tarpan*, preserved in collections in a single skeleton and a skull, and in the *Przevalsky horse* we are facing the final forms of a long line of evolution, and there is no doubt that these forms differ. For this reason we must consider them as independent taxonomical units; but, on the other hand, we do not know whether they represent the values of a species or sub-species. On the analogy with the wild ancestors of other domestic animals the latter seems to be more likely. Both of them have

[31] Bannikov, A. G., 1961, p. 19
[32] Kaszab, Z., 1967, pp. 63 ff.
[33] Nobis, G., 1955, p. 206
[34] Herre, W., 1961, p. 63
[35] Herre, W., 1958, p. 29; 1961, p. 70
[36] Boessneck, J., 1958a, p. 293
[37] Lundholm, B., 1949, p. 103
[38] Gromova, V. I., 1959, p. 124
[39] Zeuner, F. E., 1963, p. 303
[40] Nobis, G., 1955, p. 206

played a part in the evolution of the domestic horse. However, since Europe, especially its eastern part, was the territory where the earliest domestication — moreover the most significant one with respect to the European continent — took place, and it was from this region that masses of horses reached Central Europe and since, moreover the region in question belonged to the distribution territory of the *tarpan*, the *tarpan* may have been the wild ancestor of the European domestic horse. We do not know, on the other hand, where to group Central and West European wild horses of prehistoric and early historic times, which appear to have been smaller than the former and perhaps different in their skull form too.

CHANGES BROUGHT ABOUT BY DOMESTICATION

Domestication has not brought about such great changes in the horse as it has in other species of domestic animals. This holds particularly good for prehistoric domestic horses, and may be due to the fact that under the conditions of primitive animal keeping their way of life did not differ much from that of their wild ancestors.

We do not know much about a decrease in size caused by domestication, but there is no doubt that by the Iron Age the domestic horses of the western part of Central Europe had become considerably smaller. Later, as a result of conscious animal breeding, the size of horses increased and the horse belongs to the few species of domestic animals of which certain present breeds exceed the size of the wild ancestors. Pigmy breeds appeared as early as the Middle Ages and so did the ponies with their special proportions.

Domestication also brought about but minimal changes to the skull of the horse. If anything, a decrease in the volume of the brain case, a broadening of the forehead, a shortening of the facial part and a narrowing down of the muzzle may be included among them. With the teeth only a decrease in their size can be observed; no irregularities in their positioning nor any missing teeth are observable.

In the hair, the most conspicuous change is that the short erect mane of wild horses has grown longer in consequence of domestication so that it hangs down. This, according to Heck, sometimes occurs also with *Przevalsky horses* if they are in a poor condition, if they are old, or kept alone.[41] The colouring shows considerable changes, such as white colour, piebaldness, markings and, in general, a great variety of colours. The lack of pigment in the feet, which often extends to the hoofs as well is also a domestication change. However, it is impossible to ascertain when the changes of colour first appeared.

It is clear from the above that osteologically the remains of domestic and of wild horses can hardly be separated from each other in the material of archaeological sites. For this reason G. Hermes's method prevailed for long in deciding whether the remains of horses found at a site had belonged to a domestic or a wild horse: "Wo die Trense, dort ist der Regel auch

[41] Heck, H., 1936, pp. 179 ff.

das gezähmte Pferd . . ."[42] However, as bridle bits made of bone or of antlers — the predecessors of bits of metal — did not appear before the middle Bronze Age,[43] if one followed this method, it would be impossible to consider early Bronze Age horses as domestic animals. This fact encouraged Arcikhovski to approach the question from another angle. In his opinion the presence of very old animals, the equal numerical proportion of stallions and mares and the lack of vertebrae and breast-bones among the bone samples of a settlement point to a wild population, whereas a lack of old animals, an overwhelming majority of mares and the occurrence of complete skeletons indicate a domesticated population.[44] Indeed, this is a very interesting theory for it takes into consideration not only the shift caused by domestication in the proportion of age groups and sex groups but links it with the occurrence or lack of certain kinds of bones (having killed a big animal the hunter left those parts of the skeleton which only had a little flesh on them at the site of the killing, so that certain bones would not be found in settlements; domestic animals were killed on the settlement site and therefore all bones of the skeleton, or even complete skeletons, can be found there). On the other hand, there is a defect in Arcikhovski's theory in that it can be put into practice only when a very large bone sample is available. With the exception of some sites in the south of the Ukraine, however, there is not a single late Neolithic—Copper Age site where large numbers of horse bones occurred. However, completed with the observation that in the case of a domestic population there will be greater variation — this is a well-known fact and can be observed very early with domesticated animals — we can say that the method may be very useful in determining early domestication. Moreover, it would be very good to complete the method with the investigation of material objects connected with horse keeping.

THE EARLIEST DOMESTIC HORSES

With respect to the domestication centres of the horse, Gandert suggested that there were two centres:[45] one in the central part of Europe in the region stretching from South Scandinavia to Central and North Germany and another in Central Asia; Vogel[46] suggested the existence of three domestication centres (Central Asia, South Russia and North West Germany). Lundholm was of the opinion that in Europe there had been domestication centres in the coastal region of the North Sea, in the British Isles, by the Black Sea and in Spain.[47] In Hančar's opinion the domestication of the horse was begun simultaneously in the middle of the 3rd millennium B.C., in the forest region of the Upper Dniester, in Northern Europe (in the area of the Tripolye culture) and in the Siberian steppe region (South-Transural, Aeneo-

[42] Hermes, G., 1935, p. 815
[43] Mozsolics, A., 1953, pp. 70 ff.
[44] Arcikhovski, A. V., 1947, p. 27
[45] Gandert, O. F., 1939, n.d.
[46] Vogel, R., 1933, p. 87
[47] Lundholm, B., 1949, pp. 182 ff.

lithic, Afanasyevo culture).[48] Herre assumed the existence of only one domestication centre in Europe in the central part of the continent,[49] Huppertz thought he had discovered the earliest area of horse domestication in the Turanian — Altaian region.[50] Finally, Zeuner, starting from biological and not archaeological evidence considered Turkestan to have been the oldest centre of horse domestication,[51] although he also believed that the existence of a separate domestication centre in Spain was possible.[52] We were of the view,[53] which we profess even today that "... the earliest and most important domestication of horses may have taken place in the steppes of Asia or Eastern Europe, for only in this region in the Neolithic large numbers of wild horses which had survived the Pleistocene could be found. An effect of the first domesticated horses spreading from this region to Europe was that here too domestication was started. But in Europe domestication never attained the same significance, since the principal role was always played by horses that had spread there from the east."

According to our present knowledge horse was first domesticated at the Aeneolithic settlement of Dereivka (second half of the 4th millennium B.C.)[54] on the right bank of the Dnieper, about 70 km from Krementchug in the South Ukraine. The composition of the fauna itself was highly interesting, as out of 3703 identifiable bones of mammals approx. 60 per cent (2255) originated from horses. Even if it had been purely a case of hunting, its specialization to such an extent might suggest a case of local domestication (as with the abundance of aurochs in late Neolithic settlements in Hungary). However, a complete skull with a jaw was found among the bones and detailed examinations indicated that it was from a domestic animal. (It is interesting, by the way, that when in Kiev in 1962 we surveyed the material previously excavated at the site, we thought that these were the bones of a domestic population because of the great variability in the extremity bones.) Although an absolute date seems to be somewhat exaggerated, we consider Dereivka — on grounds of analogies from Hungary — to be of a later date than 3000 B.C. and by and large contemporaneous with period B of the Tripolye culture. The first phase of this latter (B_1) is contemporaneous with the Tiszapolgár culture in Hungary, moreover there is also a certain genetic connexion between the two. In grave No. 3 of cemetery B at Deszk, which belongs to the latter culture, a wrought part of the metacarpal of a small steppe horse was found.[55] There is not a single authentic horse bone

[48] Hančar, F., F., 1956, p. 542
[49] Herre, W., 1958, p. 29
[50] Huppertz, J., 1961, p. 22; 1962, p. 191
[51] Zeuner, F. E., 1963, p. 315
[52] Zeuner, F. E., 1963, p. 331
[53] Bökönyi, S., 1964d, p. 230
[54] Bibikova, V. I., 1967, pp. 106 ff.
[55] Bökönyi, S., 1959a, p. 56. — After the completion of the manuscript, 3 horse bones were found at the early Copper Age (Tiszapolgár culture) site of Kisköre—Szingehát (excavated by P. Patay); and part of a horse's metacarpal carved like the one found at Deszk was discovered at grave No. XXVII of the middle Copper Age (Bodrogkeresztúr culture) cemetery of Magyarhomorog (excavated by I. Dienes and P. Patay), which confirm the above.

originating from the Neolithic in Hungary, and this proves that in this region wild horses had not survived the end of the Pleistocene. The horse bone from Deszk belonged, in all probability, to a domestic horse. A horse bone was found at the Kenderes–Kulis settlement and one at the Kenderes–Telekhalom settlement. Although in the two sites the bone samples of the Neolithic and those of the Copper Age could not be separated, we consider the two bones, on the basis of the above-mentioned evidence, to have originated from domestic horses in the Copper Age. The Dereivka finds confirm this supposition, whereas the Deszk bone proves that after the first domestication domestic horses found their way to distant regions within a very short time indeed.

Bones of small horses were also found at Znojmo (Moravia) at a site which belonged to the Tiszapolgár culture.[56] It is not impossible that these bones also belonged to domestic horses. Horse bones of the early Copper Age (Kisrétpart group) have also been described from the Zalay brick factory of Hódmezővásárhely–Tatársánc. In addition horse remains were excavated from 18 pits of the early Copper Age and of the Pécel culture (late Copper Age) at Hódmezővásárhely—Bodzáspart — and along with them the fragment of a bridle bit made of bone.[57] This latter has become widely known in the literature although Mozsolics considers it to have been a fisherman's arrowhead.[58]

A single lower molar of a horse was found in grave No. 44 of the Copper Age cemetery at Polgár–Basatanya (middle Copper Age = Bodrogkeresztúr culture, which was contemporary with the Tripolye B_2—C_1).[59] However, as the grave had been disturbed the find cannot be considered authentic. Similarly, we can accept only with reservations the single horse bone found at Salgótartján–Pécskő and the twenty-five bones found at Budapest—Békásmegyer, Pécel culture, since in the former site there were early Bronze Age (Zók culture) pits and in the latter there were pits of the early and middle Bronze Age and of the Celts; in the case of settlement excavations, materials of different periods may easily get disturbed by diggings at various times.

In other parts of Europe — with the exception of the Balkan Peninsula — the first domestication of the horse was performed at the transition from the Neolithic to the Copper Age. (However, in terms of absolute chronology, this took place later than the domestication in Eastern Europe.) Thus for example in the region of the foothills of the Alps in Bavaria in several settlements of the Altheim culture and other cultures related to it in the late Neolithic and Copper Age (dated to the first two centuries of the 2nd millennium B.C., that is to say at least 1000 years after the domestication in the Ukraine) there occurred horses considered by Boessneck probably to have been domestic ones.[60] The withers height of these horses was about

[56] Childe, V. G., 1929, p. 78
[57] Banner, J., 1939, p. 166
[58] Mozsolics, A., 1953, p. 69
[59] Bökönyi, S., 1959a, p. 59
[60] Boessneck, J., 1956a, pp. 13 ff.

135 cm, and these animals corresponded with the horses of Föllik (see below).[61]

Amschler had described the skeletons of two adult horses and of a foal, along with a more or less contemporaneous horse skull, found at a Corded Ware culture site at Föllik, in Burgenland, Austria. The author considered the Föllik horses to have been of medium size animals close to the Arab horse.[62] Various authors consider the horse finds of the Swiss Neolithic to have been wild horses and do not believe the domestic horses of the Bronze Age to have descended from them.[63] The few horse bones found at Rebensteiner Mauer and Brückler Mauer in Upper Austria probably belonged to wild horses.

Horse bones were discovered at the late Neolithic site at Lužianky synchronous and connected with the Lengyel culture in Slovakia, but the sample is too small to be able to decide whether they originated from domestic or wild animals.[64] These horses were small and lusty, their withers height being about 128—136 cm. On the other hand the horses of the Funnel Beaker culture settlements in Poland (Cmielów,[65] Ustowo[66]) were probably domestic.

With the exception of the South Ukraine, horse keeping in the late Neolithic—Copper Age was of hardly any significance at all; it developed only in the Bronze Age, when, at the very beginning of the period, great masses of domestic horses occurred. (This also shows that there must have been antecedents in the Neolithic and Copper Age.) The domestic horse population of Europe then was established from three sources: 1. from South West Asia one wave proceeded north eastwards through the eastern part of the Mediterranean basin and reached the Balkans, 2. the second wave set out from South Russia and from the South Ukraine proceeding towards the Carpathian Basin and to territories north of it, and finally, 3. domestic horses spread from the Central European domestication centre.

In Greece the first domestic horses appeared in the middle Helladic Period (1900—1570 B.C.), on Crete about 1600 B.C., and in Cyprus at the time of the transition to the middle Bronze Age.[67] It was also in the middle Bronze Age that the horse appeared at Argissa Magula in Thessaly.[68] Recently several horse graves of the Bronze Age have been discovered in Greece: a double grave of horses was found at Marathon (15th century B.C.), and in a Mycenaean grave at Argos there was also a horse's skeleton. The burying of horses was a Mycenaean custom and was described by Homer in the Iliad (Achilles had four horses killed at Patroclus' funeral), a custom that may have been introduced by Achaean settlers at the end of the 2nd millennium B.C.[69]

[61] Boessneck, J., 1956c, p. 27; 1958b, p. 115
[62] Amschler, J. W., 1949, p. 19
[63] Hescheler, K., Kuhn, E., 1949, pp. 304 ff.
[64] Ambros, C., 1961, p. 85
[65] Krysiak, K., 1950—51, p. 228; 1952, p. 290
[66] Kubasiewicz, M., 1958c, p. 48
[67] Hančar, F., 1956, p. 28.; Anderson, J. K., 1961, p. 2
[68] Boessneck, J., 1962, p. 39
[69] Karageorghis, V., 1965, pp. 284 ff.

From Romania we know of domestic horses in the Noua culture (end of the 2nd millennium B.C.)[70] but evidently they had already occurred there earlier owing to the proximity of the South Ukrainian domestication centre. In Bulgaria domestic horses were found at Pod-Grada[71] where they were quite frequent, in the Malkata Podlissa Cave near Tirnovo,[72] at Vardaroptcha in Macedonia,[73] in the later layers at Vesselinovo,[74] and at Karanovo B.[75] They also occurred in the early Bronze Age at Ripać in Yugoslavia,[76] although only seldom.

In Russia and in the Ukraine horse keeping flourished all through the Bronze Age. At Ussatovo, which belongs to the Tripolye C_2 period and is thus contemporaneous with the Ochre Grave culture, there were not only 13 per cent horse bones found in the collection but also a bit, showing clearly that horses had been domesticated.[77]

In Catacomb graves, originating in the same period, there sometimes occurred horse ones, nor were horse bones rare in the settlements of the same culture.[78] A late kurgan of the Timber Grave culture (of the period immediately preceding the Scythian period = beginning of the 1st millennium B.C.) is highly interesting. The two horses buried in it had been harnessed with bridle bits which were perforated by six holes and made of hollow bones.[79] On the other hand, it is very strange that no horse keeping could be demonstrated in the sites of the Ochre Grave culture in the Soviet Union,[80] in spite of the fact that this culture is known as the chief distributor of horse keeping. Horse bones were also found at the Moldavian settlements of the Noua culture, at sites of the Khazan region culture and of the Andronovo culture too.[81] Quite frequently there were great numbers of horse bones in these sites, the horses belonging to a strong-bodied population close to wild forms. The withers height of animals of the late Bronze Age was between 128 and 152 cm, mostly 136—144 cm and 139 cm on the average.[82] On the other hand, the horses of the northern forest belt were much smaller.

At the beginning of the Bronze Age great masses of domestic horses found their way to the Carpathian Basin. Although no horse bones have been found in the Zók layers of Salgótarján–Pécskő, nor at Csongrád–Petőfi TSz, a site also belonging to the Zók culture, the lower layers of Tószeg[83] and the early Bronze Age settlement of Tiszaluc–Dankadomb[84] contained

[70] Haimovici, S., 1962, p. 326
[71] Popov, R., 1912a, p. 91; 1912b, p. 93
[72] Popov, R., 1913, p. 451
[73] Childe, V. G., 1947, p. 83
[74] Mikov, G., 1941, p. 222
[75] Gaul, J. H., 1948, p. 44
[76] Woldrich, J. N., 1897, pp. 108 ff.
[77] Hančar, F., 1956, pp. 70, 72
[78] Hančar, F., 1956, pp. 95—96
[79] Alihiva, A. J., 1955, pp. 91 ff.
[80] Hančar, F., 1965, p. 122
[81] Zalkin, V. I., 1964a, pp. 24 ff.
[82] Zalkin, V. I., 1964a, p. 24
[83] Bökönyi, S., 1952a, pp. 101 ff.
[84] Bökönyi, S., 1960b, pp. 15 ff.

ample remains of horses, let alone the site of the Bell Beaker culture of Csepel–Háros, a settlement whose horse keeping surpassed that of all other sites. Bronze Age horses in Hungary were somewhat smaller than those in Russia and had a withers height of approx. 135 cm.[85] Their structure was sturdy and they comprise the population with the thickest legs in the whole history of the domestic horse in Hungary.

In different Bronze Age sites in Hungary several skull fragments of domestic horse were found and at Dunaújváros–Koszider a complete skull and large fragment of another one were excavated (Figs 88 – 89). These were medium-sized skulls with spacious vaulted brain cases, flat foreheads, not very broad and with straight profiles. The frontal index of the complete Dunaújváros skull is 42.64, that is, fairly high. The first representation of a horse in Central Europe was found at Ottlaka in Transylvania, in the Carpathian Basin. On a gold disc from the middle Bronze Age two stallions facing each other (Fig. 90) are depicted. Unfortunately, from the stylized representation only the species and the sex of the animals can be discerned, nothing else.

An interesting process can be observed in the samples of horse bones at the Tószeg settlement, which was occupied practically all through the Bronze Age.[86] In the early Bronze Age, steppe horses with narrow hoofs reached Hungary and found there very good living conditions in the dry warm climate prevailing then. But in the course of the Bronze Age the climate underwent a change resulting finally in cool, humid conditions. The wild fauna of the settlement also changed accordingly in that forest species favouring — or at least tolerating — cold and humidity became predominant. A certain shift also took place in the stock of domestic animals in favour of pigs which like humidity. However, since domestic animals could not migrate in the same way as wild ones, it was necessary for them to adjust themselves to the changed conditions. Thus the narrow-hoofed steppe horse also changed into a stockier animal with spread hoofs. Since then it has been possible to observe the same process in other sites, and it seems to have taken place in Eastern Europe in a similar way. According to oral information from Zalkin the horses with spread hoofs also appeared in Central and South Russia (for example in the Timber Grave culture), moreover, the effect of the change of the climate made itself felt even in West Kazakhstan, where such horses, looking virtually like the heavy "cold blood" animals, were discovered in sites of the Andronovo culture.

At Bludenz in Austria (Tumulus Grave culture, c. 1000 B.C.), Amschler identified predominantly small, pony-like horses. But there also occurred big individuals, which the author linked with Alpine "cold blood" horses.[87] This connexion is hard to imagine. But it is probable that the population had been highly variable; in addition it is not inconceivable that the larger individuals were wild horses.

[85] Kiesewalter, L., 188, pp. 1 ff.
[86] Bökönyi, S., 1952a, p. 102
[87] Amschler, J. W., 1939a, p. 223

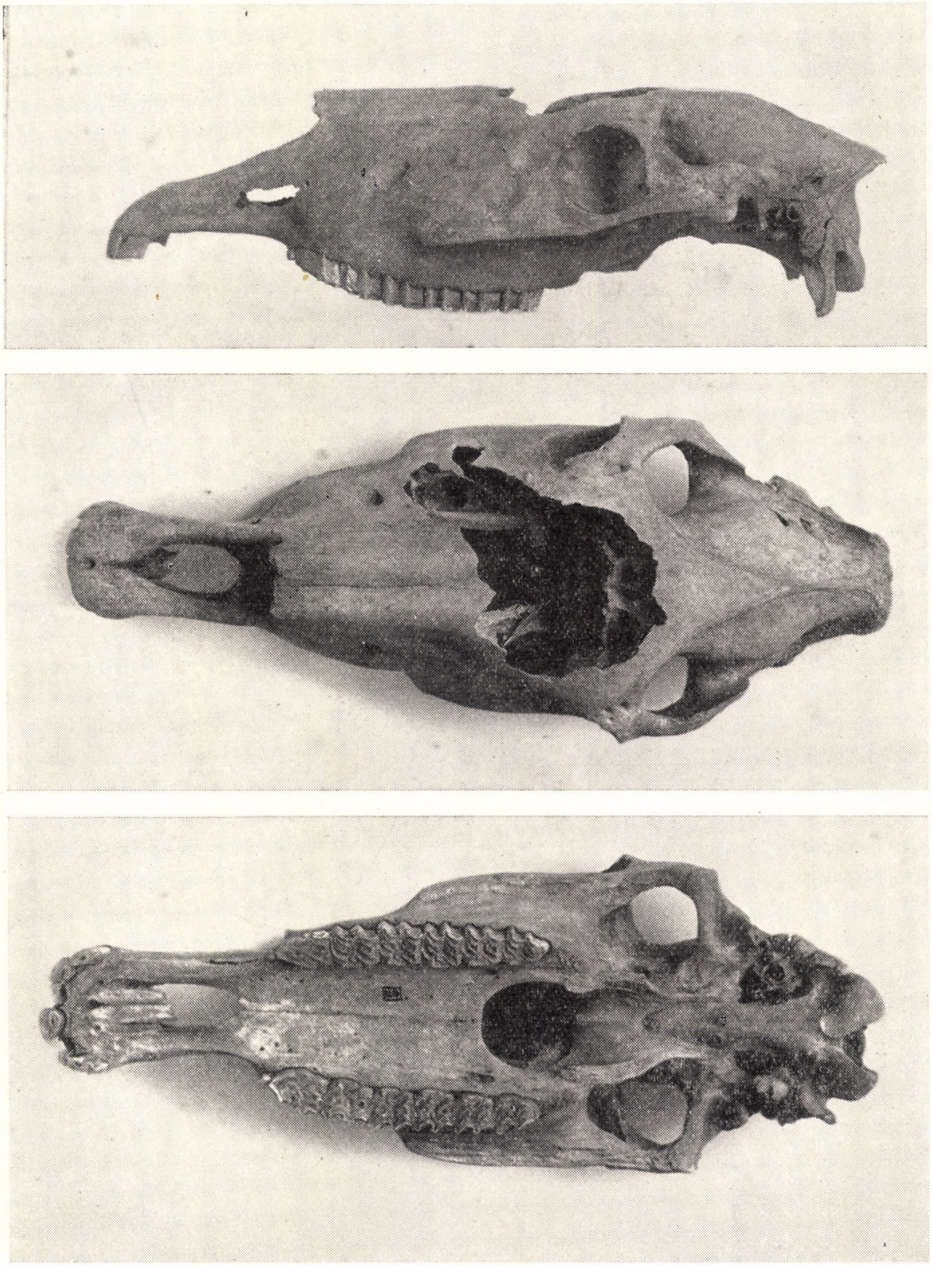


Fig. 88. Skull of a horse. Dunaújváros—Koszider, Bronze Age

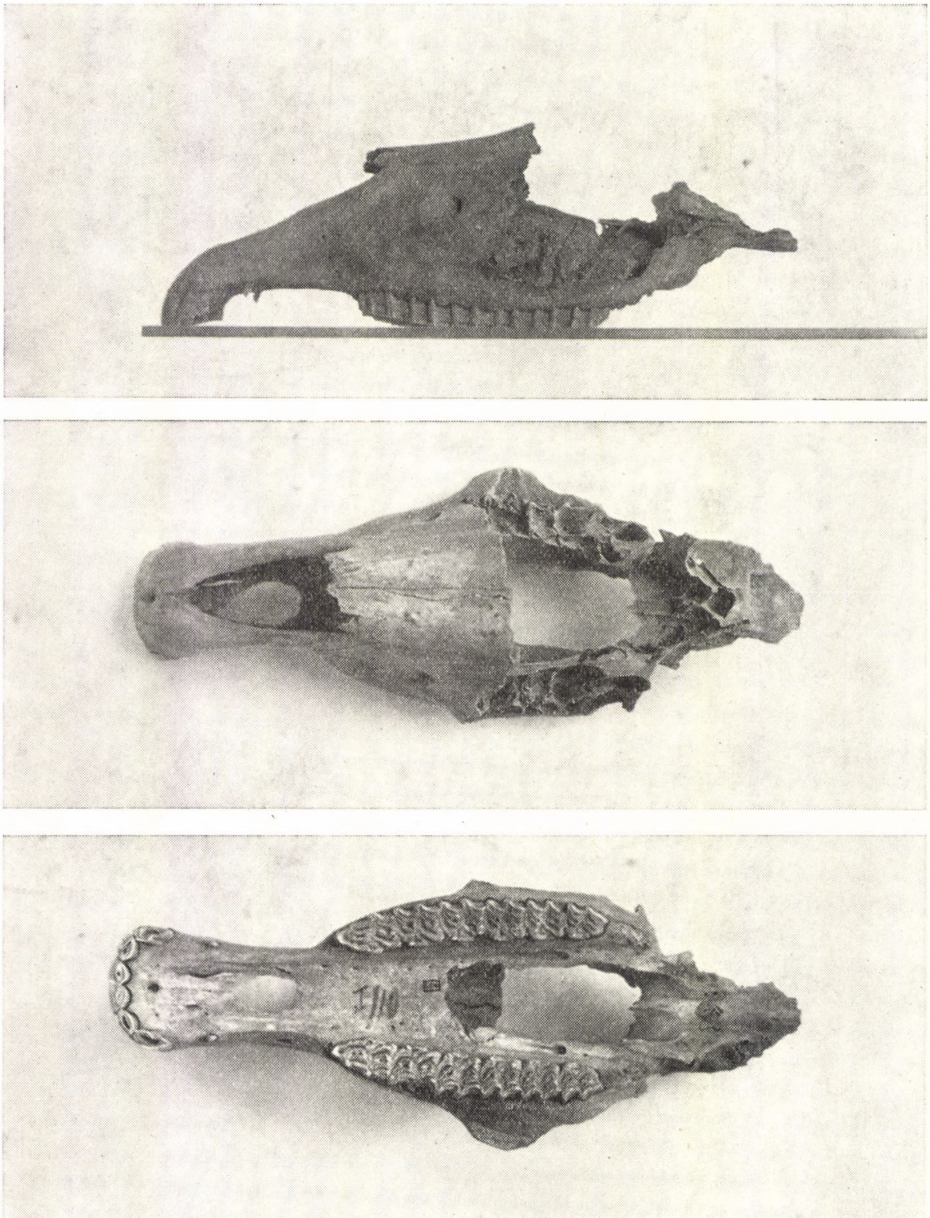


Fig. 89. Part of horse skull. Dunaújváros – Koszider, Bronze Age

Fig. 90. Horses represented on a late Bronze Age gold disc. Ottlaka, Transylvania, Romania. Hungarian National Museum, Budapest

Domestic horses were found in all Bronze Age sites in Switzerland and were unanimously described by all authors as small animals with fine features.[88] Some authors referred to the oriental type of these horses,[89] as with horses of other periods. This, however, did not necessarily indicate an eastern origin, it was only meant to express the smallness of these horses. The roots of this idea go back to Franck's classification according to which small, light

[88] Studer, Th., 1900, p. 107; Hescheler, K., 1929—1930, p. 24; 1933; p. 208; Kuhn, E., 1937, p. 33; Kuhn, E., Güller, A., 1946, p. 251; Rüeger, J., 1942, p. 255
[89] Studer, Th., 1900, p. 107; Hescheler, K., 1929—30, p. 24; 1933, p. 208

TABLE 3

Withers height of horses in different periods on the basis of the long bones (with Kiesewalter's method)

		scapula	humerus	radius	metacarpus	femur	tibia	metatarsus	
Bronze Age	n	—	1	5	17	—	3	15	Bronze Age
	withers height	—	142.50	135.84	131.86	—	132.83	135.10	
Iron Age	n	7	12	12	13	5	15	19	Iron Age
	withers height	142.46	137.96	138.26	131.31	132.40	137.37	132.72	
Period of the Roman Empire	n	1	5	21	47	1	11	26	Period of the Roman Empire
	withers height	147.66	145.20	140.53	138.36	144.26	143.13	136.91	
Migration Period	n	—	—	—	7	—	—	5	Migration Period
	withers height	—	—	—	132.50	—	—	131.44	
Avar Period	n	31	81	84	117	43	89	125	Avar Period
	withers height	146.47	142.47	138.58	134.85	137.01	139.94	137.15	
Magyar Conquest Period	n	—	—	—	85	—	—	94	Magyar Conquest Period
	withers height	—	—	—	136.07	—	—	137.00	
10th–13th century	n	—	—	4	16	—	1	16	10th–13th century
	withers height	—	—	141.05	136.53	—	134.28	134.18	
14th–17th century	n	—	—	6	10	—	6	11	14th–17th century
	withers height	—	—	143.65	136.60	—	142.49	140.57	

TABLE 4

Slenderness index of horses in Hungary in different periods

Metacarpals

Period	n	min.	max.	M
Bronze Age	15	14.6	17.6	16.04
Iron Age	21	12.5	16.8	15.24
Period of the Roman Empire	43	12.04	16.0	15.05
Migration Period	7	14.2	16.0	15.20
Avar Period	115	13.5	17.5	15.12
Magyar Conquest Period	84	13.0	16.3	14.76
10th – 13th century	17	12.9	17.2	15.21
14th – 17th century	11	12.4	16.7	14.95

Metatarsals

Period	n	min.	max.	M
Bronze Age	14	10.6	12.9	11.80
Iron Age	17	10.5	12.2	11.59
Period of the Roman Empire	26	10.6	14.4	11.91
Migration Period	5	11.0	12.4	11.68
Avar Period	117	10.4	13.2	11.70
Magyar Conquest Period	92	10.0	12.6	11.45
10th – 13th century	13	10.1	13.5	11.88
14th – 17th century	11	10.8	11.7	11.30

horses belonged to the eastern group of breeds and the large, heavy ones to the western group of breeds. This grouping has become so deeply rooted in breeders' thinking that a great many people will use it even today without having in mind the real origin of the horses. However, ever since it has turned out that large, cold-blooded horses came into being only in the Migration Period and the early Middle Ages (see below), the eastern origin of prehistoric horses of Central and West Europe has hardly ever been mentioned; more recent authors have traced back the origin of these horses mainly to local wild horses. (An exception is provided by the Bronze Age and Scythian horses of the eastern part of Central Europe, for on the basis of the migration routes, these animals can justly be considered as horses of eastern origin.[90])

Rather little is known about the Bronze Age horses of Germany. Vogel described a domestic horse excavated at Federseemoor which had a fine structure, and was of the approximate size of the Mongolian wild horse, and declared it to belong to the *tarpan* type.[91] The Bronze Age horses of North West and Central Germany were smaller than Neolithic wild horses.[92] Pohle described a Bronze Age horse's skull from Schneeberg in Brandenburg,[93] which, though somewhat smaller than the Dunaújváros one, closely resembles it in the structure of the brain case, and particularly in its broad forehead and the occipital squama receding backwards. The frontal index is 43.2. At Heuneberg, a settlement that was occupied from the early Tumulus Grave culture up to the early La Tène, the remains of powerful animals, which were stockier than the Celtic ones, were excavated.[94]

In order to compare the Bronze Age horses of Central and Eastern Europe we have to rely, almost exclusively, on Hungarian, Soviet and Swiss material, because the evidence — particularly that of measurements — originating from other territories is rather sporadic. Skulls are too rare among the finds to prove any differences in craniology. Even measurements of extremity bones are rather rare from territories west of the Carpathian Basin, although they do supply a basis for some cautious inferences. Comparing the measurements of the extremity bones, above all the most frequent among them, i.e. the metapodials, it can be stated that the Bronze Age horses of the Carpathian Basin and of Eastern Europe were bigger than those in the western part of Central Europe (Fig. 91). The size variations of the two groups partially overlap, but it is clear from the diagrams that there are two well-defined groups. Furthermore, the metapodials of the horses belonging to the western group are slenderer, which is perhaps an even more conspicuous feature than the difference in size. Unfortunately, the material is insufficient for a statistical evaluation, but we shall revert to the explanation of this phenomenon.

Concerning Bronze Age horses, the question arises as to what they were used for. The answer is that above all they were eaten. The crushed bones

[90] Bökönyi, S., 1952a, pp. 102—103; 1954b, pp. 100 ff.
[91] Vogel, R., 1929, p. 461
[92] Nobis, G., 1955, p. 207
[93] Pohle, H., 1960, pp. 132 ff.
[94] Schüle, W., 1960, p. 17

and skulls found at the settlements prove that the eating of horse-meat was a widespread custom in the Bronze Age. However, this was not the most essential use of Bronze Age horses. No doubt, the first carts were drawn by cattle, but these animals were soon substituted by the *equids*, which were so much quicker, first with half-asses (in the Near East, where they could be tamed), and then with horses.[95] At the turn of the 3rd and 2nd millennium B.C., the cart reached the Carpathian Basin, and about 1400 B.C. its variant with spoked wheels also appeared.[96] Evidently, horses were used for drawing these carts and there is no doubt that the carts with spoked wheels were horse drawn, since spoked wheels had been introduced with a view to speed. From Knossos inventories not only the parts of horse-drawn carts are known but the names of horses as well.[97] There were large numbers of chariots in Knossos and, in view of the strong links between the Carpathian Basin and the south-east in the Bronze Age, it is very likely that the use of chariots diffused also there.[98] It is possible that horses were first used for drawing carts and only later for riding. If this is so, the appearance of bridle bits may have been connected with riding. All these questions have yet to be clarified, but one thing is sure: as early as in the Bronze Age the horse, as an animal producing power, was of very great significance.

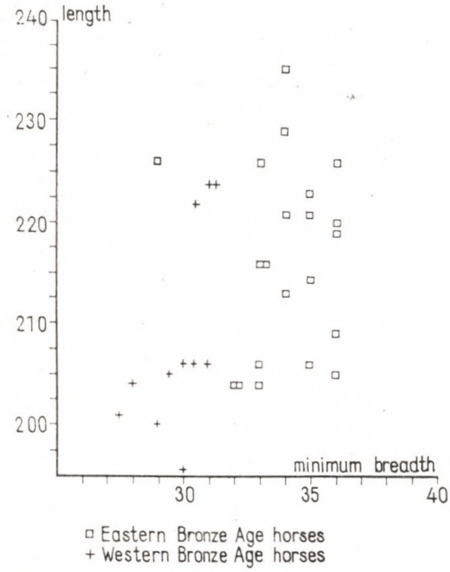


Fig. 91. Size variation of domestic horses in Central and East Europe in the Bronze Age

Marek was the first to examine European horses of the Iron Age.[99] Of the "Helvetian – Gallic" horses of Switzerland to which he had access, he stated that they belonged to the eastern group of breeds and resembled, apart from their size, Arab horses.[100] Schwertz, too, considered the Celtic horses of Switzerland to have been of eastern origin.[101] The only horse bone found at the Hallstatt settlement of Sissacherfluh near Basel belonged, according to

[95] Zeuner, F. E., 1963, p. 329
[96] Bóna, I., 1960, p. 110
[97] Hampe, R., 1956, p. 49
[98] Foltiny, S., 1965, p. 51
[99] Marek, J., 1898, pp. 40 ff.
[100] Marek, J., 1898, pp. 39 ff.
[101] Schwertz, F., 1918, p. 458

Leuthardt, to an animal of a small breed, but the author did not indicate the origin in detail.[102]

The analyses of the vast quantity of horse bones found at the Celtic oppidum at Manching traced them back, with the exception of a few specimens, to small eastern type horses with fine bones, whose withers height ranged between 112 and 137 cm.[103] But, in addition to this group, a certain number of large individuals, whose greatest withers height was over 150 cm, also occurred.

From the eastern part of Central Europe we formerly had data only on the Scythian horses, which were said to have been small animals with fine features, belonging to the eastern group and which could be connected, from the point of view of origin, with the *tarpan*, the wild horse of South Russia, irrespective of whether we adopt the theory of the *tarpan*'s wild character or not.[104]

From the Iron Age of South East Europe, Ivanov[105] and Markov[106] described Thracian horses, considered by both of them to be slender horses with slim legs, belonging to the eastern breed.

Bibikova[107] and Zalkin[108] investigated Iron Age horses from the southern part of Eastern Europe. The results achieved by them are more or less identical, both of them having found a single — though highly variable — type of horse, which was in general larger and more powerful than the Celtic animals. Numerous links connected these horses with the Iron Age horses of Central Asia.

Recently we have had the opportunity to examine using a uniform standard all the bone samples of the Early and Late Iron Age found in Central and Eastern Europe.[109] The material consists chiefly of extremity bones; skulls or fragments of skulls suitable for comparison are only found very rarely. On the basis of these latter it may only be stated that the horses originating from the eastern part of Central Europe and from Eastern Europe had broad foreheads, long skulls and short facial parts, whereas those originating from the western part of Central Europe had somewhat narrower foreheads, and, though their skulls were of similar length, the facial parts were relatively long.

With respect to the extremity bones, it was possible to ascertain that the Iron Age horses of Central and Eastern Europe were not of a homogeneous type, but that they constituted two well definable groups (Figs 92–93). The first group included Scythian and Russian horses of South Russia, Scythian horses of Hungary, Hallstatt period horses of Slovenia, Thracian horses of Bulgaria, and early Iron Age horses of Romania. The second

[102] Leuthardt, F., 1930, p. 593
[103] Liepe, H. U., 1958, p. 21; Förster, U., 1960, p. 33
[104] Bökönyi, S., 1952b, pp. 173 ff.; 1954b, pp. 93 ff.; 1955b, pp. 23 ff.
[105] Ivanov, S., 1954, pp. 229 ff.
[106] Markov, G., 1958, p. 144
[107] Bibikova, V. I., 1958a, p. 147
[108] Zalkin, V. I., 1960a, pp. 35 ff.
[109] Bökönyi, S., 1964d, p. 233

group comprised horses of the Hallstatt period in Austria and Germany, as well as the Celtic horses of Germany and Switzerland. (Through the Scythian horses of South Russia horses of the Scythian kurgans of Altai

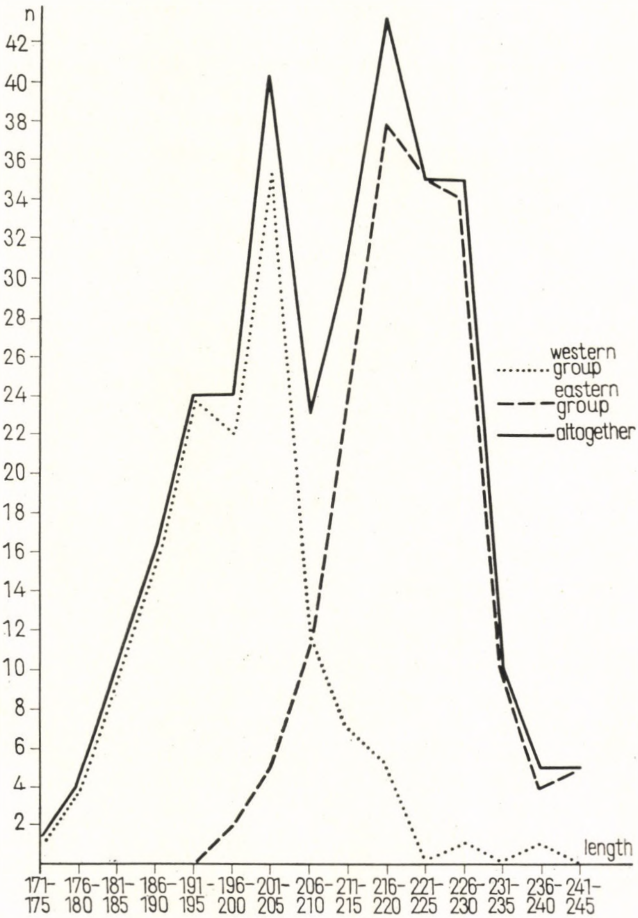


Fig. 92. Size variation measured on the basis of the metacarpals of horses in Central and Eastern Europe in the Iron Age

could well be linked with the first group.) As is clearly shown by the above, the two groups are also separated geographically, for the distribution of the first stretched over the eastern half of Europe (hereinafter to be called, for simplicity's sake, the "eastern group", without our wishing to identify it with Franck's eastern type of horses), whilst the second group stretched over the western half of Central Europe (to be called hereinafter "western group", without identifying it with Franck's type of western horses). The boundary line of the two groups coincided approximately with the line stretching from Vienna to Venice.

There was predominantly a difference in size between the two groups, but their independent existence can also be confirmed by mathematical-statistical method. With the eastern group the withers height, determined on the basis of the length of the metacarpals with Kiesewalter's method, was

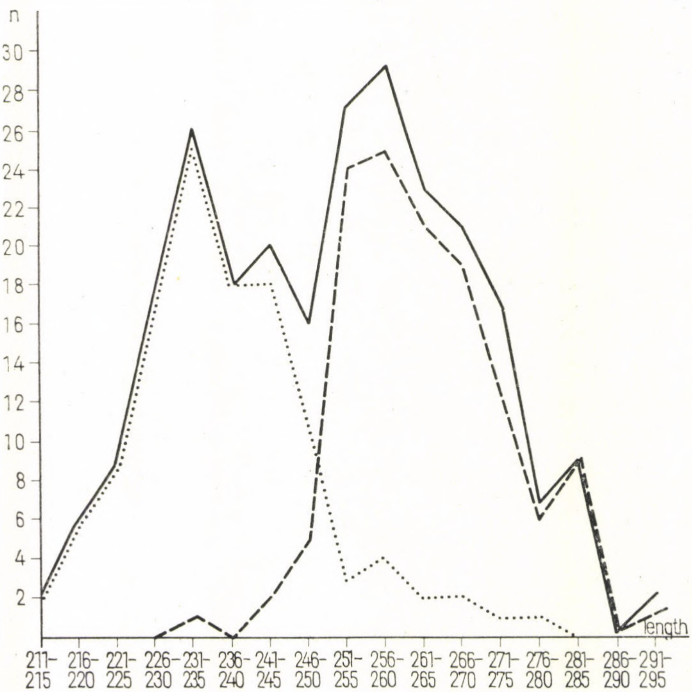


Fig. 93. Size variation measured on the basis of the metatarsals of horses in Central and Eastern Europe in the Iron Age

121.1—149.4 cm, or 136.15 cm average, and with the western group it was 109.9—149.4 or 126.07 cm average; if determined on the basis of the metatarsals, the eastern group's withers height was 120.4—151.9 or 137.12 cm average and the western group's withers height was 112.5—153.5, or 126.69 cm average. Thus there was a considerable difference — approx. 10 cm — of size between the two groups, quite unexpectedly in favour of the eastern group. Thus, on the basis of size, we are confronted with the very opposite of Franck's grouping, which was based on recent horses. But examination of the slenderness indexes results in the opposite of the above grouping for it reveals that the metapodials of the eastern group are relatively, although not significantly, thicker than those of the western group; that is to say, the western mountain and forest horses had slenderer legs than the members of the eastern steppe group (Figs 94—45).

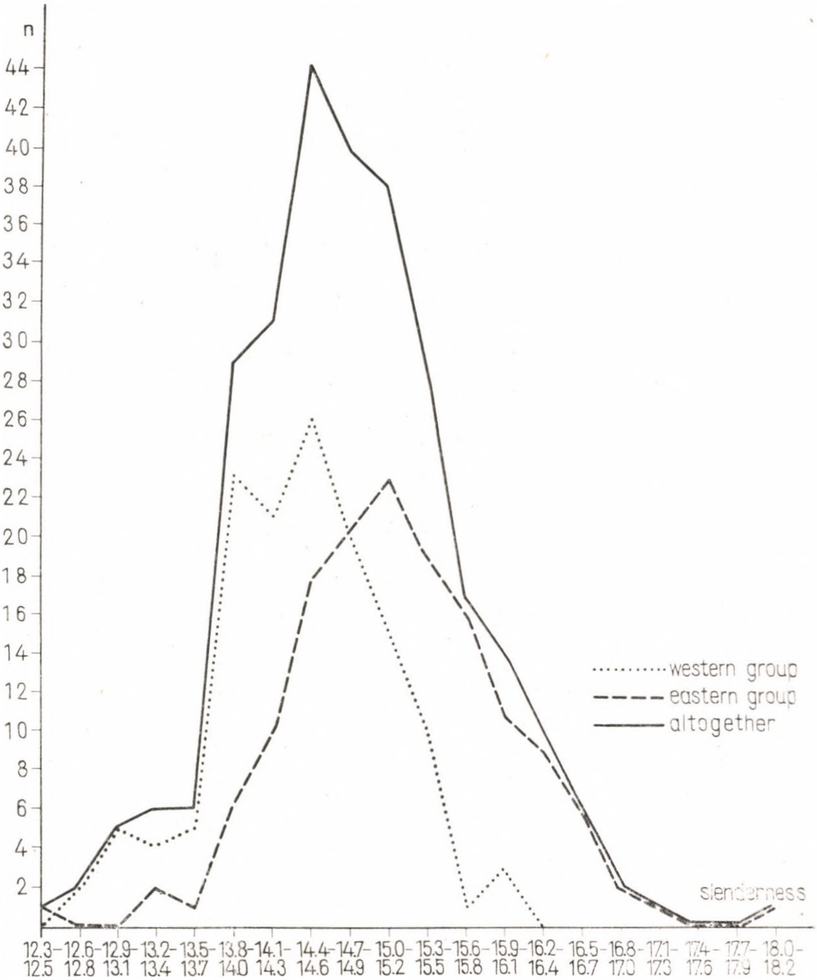


Fig. 94. Slenderness correlations on the basis of the metacarpals of horses in Central and East Europe in the Iron Age

On the basis of the considerable difference in size in favour of eastern horses they could be deemed better animals from the point of view of horse breeding, for, owing to the greater mass of their bodies, they were able to carry heavier loads, to move more rapidly with a rider of equal weight, and to carry more easily riders wearing armour (at that time the first forms of

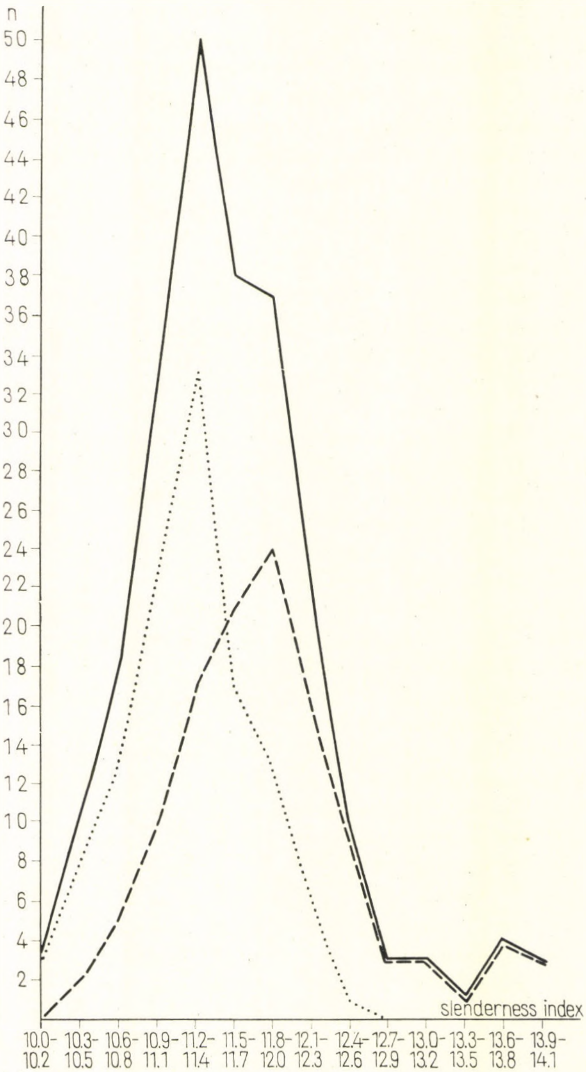


Fig. 95. Slenderness correlations on the basis of the metatarsals of horses in Central and East Europe in the Iron Age

armour were appearing), and to cover longer distances. All these qualities provided reasons why the peoples, who lived in the distribution area of the western group of horses, were anxious to acquire the eastern horses, which were better than their own. This, of course, could be achieved mostly by outstanding personages, which is proved by the fact that in the area of the western group of horses, eastern horses with oriental gear were mostly discovered in graves, in which only rich people (chieftains, heads of families, etc.) were buried with horses. At the same time, they were very rare in settlement materials, which reflected the whole population. These horses, by the way, found their way not only to Europe but also to Africa; Vitt identified as such a horse, which was discovered in a 7th – 6th century B.C. Egyptian grave on the basis of its skull form and it having been placed in the grave with Scythian horses. The horse's 148 cm withers height also tallies with that of the best Scythian horses.[110]

Thus the foundation of the eastern group was provided by Scythian horses, which, owing to the Scythian expansion on the one hand, and on commercial connexions on the other, spread from North Iran and South Russia to Central Europe and North Africa and in Asia as far as the Altai Mountains. The domestic horses of this vast territory were fairly uniform in the Iron Age and most of them showed only slight differences when compared with European horses.

The Scythian horse was depicted innumerable times on various works of art and objects of everyday use of the Scythian Period, but perhaps the best likeness of an average Scythian horse is to be seen on the electrum vase discovered in the kurgan at Chertomlyk (4th century B.C.) (Fig. 96). On the frieze of the vase, scenes of the keeping and training of horses are represented true to life. The horses would be considered very fine animals even by present breeders' standards; they are mostly reminiscent of Arab thoroughbreds (a relatively small head with a concave profile, a flag-like carriage of the tail, which is characteristic of Arab thoroughbreds even today), though some features a thick neck and trunk) are different. Some of the horses represented have short manes, but this does not necessarily mean that they are wild ones, for one of the short-maned horses to be seen on the Chertomlyk vase has a bridle and a saddle (this latter is one of the earliest representations of the saddle and as such provides evidence of a developed form of riding). The Scythian custom of trimming the mane may be explained by the fact that the archers would have been inconvenienced by their horses' long manes. Comparing the figures of men standing beside the horses on the Chertomlyk vase we can infer the size of the animals. The horses' withers come up to the breast of the men, moreover in case of the slave with his arm cut off (?) they almost reach the shoulders, which points to withers height of at least 140 cm.

Celtic horses were the most typical representatives of the western group. In this connexion we have to destroy the romantic supposition created at the end of the past century and alive in some places even today that the Celts were the best horse breeders of the Iron Age and their horses the best individuals of the period. This assumption, by the way, was refuted by Boessneck, who proved that Celtic horses were at the lowermost and smallest stage in a process of decreasing size.[111] Indeed, Celtic horses were very small; several animals the size of an ass with withers height below 1 m have

[110] Vitt, V. O., 1952, p. 45
[111] Boessneck, H., 1958b, p. 67

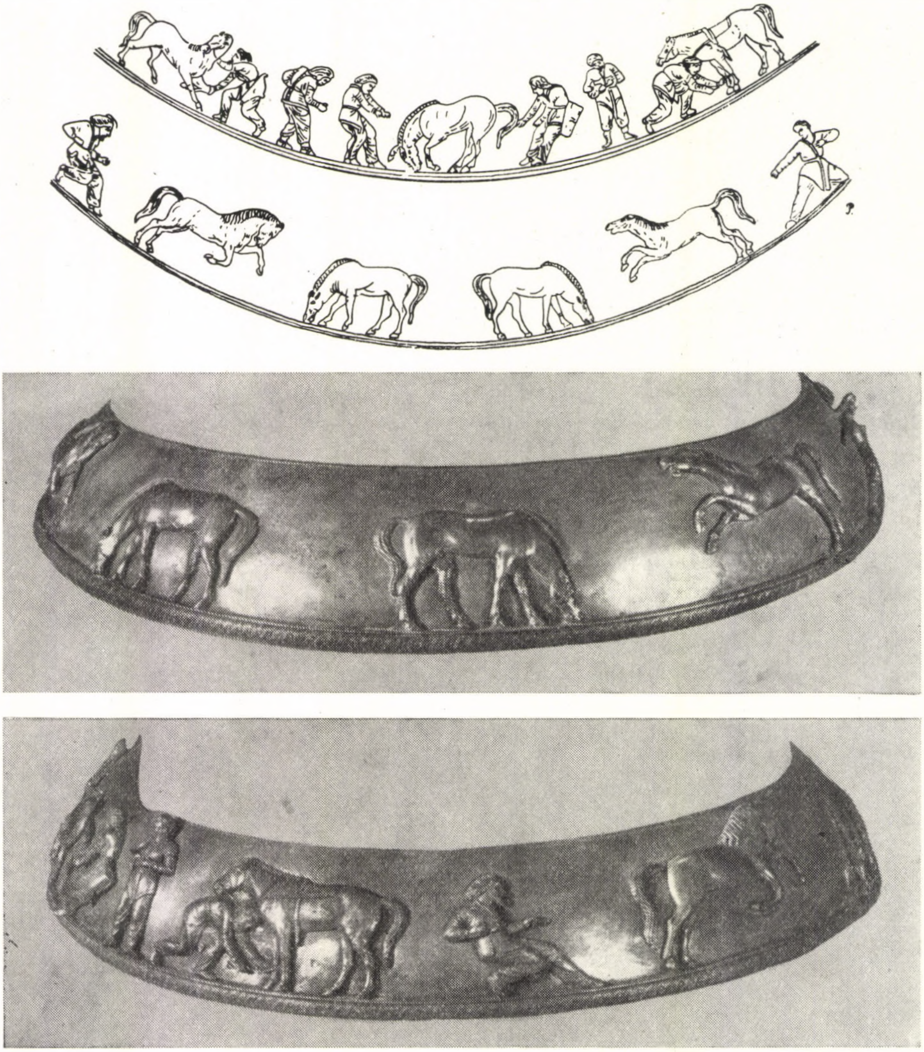


Fig. 96. Scythian horses on the frieze of the electrum vase of Chertomlyk (Ukraine). Hermitage, Leningrad

also been found. Nevertheless, there is no doubt that with the Celtic horse-keeping, a significant phase in the European history of the horse began: West European equestrian traditions originated from the Celts. They held horses in esteem and also granted them a rank in their mythology, for the veneration of Epona, goddess of fertility, had started in all probability from the veneration of a horse deity. They often represented their goddess seated on horseback or surrounded with mares with foal or with horses

(Fig. 97). The extent to which horses were honoured by the Celts is also indicated by the frequency these animals were represented on coins, tombstones and ornamental vessels alike. The representations are often rather stylized, though they also often display realistically the characteristic features of Celtic horses: the long facial part of the skull (Fig. 98) and the small dimensions of the body (Fig. 99).

Fig. 97. The Celtic goddess Epona with her horses. Pannonia (?), 1st – 2nd centuries A.D. Museum of Fine Arts, Budapest

Originally Greek horses may have been small ones, like those belonging to the western group. This is evident from a piece of advice given by Xenophon to a Greek rider to get hold of the highest point of the mane near the horse's ear with his left hand as soon as he has mounted it. But the gold comb of the Soloha kurgan (Fig. 100) also shows clearly how small the Greek horses were, for the withers of the Greek warrior's horse hardly come up to the waist of the foot-soldier standing beside it. These small horses were later improved by interbreeding with Scythian horses, the latter having been imported to Greece in great numbers. Let us consider at this point the twentyt housand Scythian mares seized by Philip of Macedonia or the fifty thousand eastern horses in Alexander the Great's Persian booty. It is interesting to note another way in which Scythian horses got to Greece.[112] Their route started in the Carpathian Basin, where the Sigyns sold their horses to the Veneti, by whom these eastern horses were transferred to Greece. In Greece the Veneti horses were famous, above all, as horses for chariot races. By the introduction of the blood of eastern horses — through horses that had got to Greece and from there to Italy, or from the Carpathian Basin through the intermediary of the Veneti to Italy — direct the large, Roman military horses were evolved; these animals are not only well known from Roman emperors' monuments but also provable osteologically.

When first dealing with the Iron Age horses of Central and Eastern Europe we did not know enough about bone samples of Bronze Age horses

[112] Harmatta, J., 1968, p. 156

Fig. 98. Heads of horses on the Celtic relief of Roquepertuse. After Moreau (1958)

Fig. 99. Horses represented on the Celtic silver dish of Gundestrup. After Moreau (1958)

or their immediate predecessors and thus we attributed the emergence of the above-mentioned eastern and western groups predominantly to the effect of a different natural environment. However, having seen since that the differences (in size and slenderness) of the Iron Age and Bronze Age horses of the two territories in question are exactly the same and moreover that the distribution of the two groups was by and large similar in the two periods, we are inclined to believe that differences of origin may also have played a part in the emergence of the two groups. We are not referring to a polyphyletic origin but only to possible differences between the wild horses of Central and of Eastern Europe. The distribution of the two groups mentioned above more or less tallies with the regions to which domestic horses spread from one domestication centre in Central Europe and one in Eastern Europe and became very numerous. In addition, the environment also naturally exerted an effect on the emergence of the above groups.

After the evolution of the two groups the peoples living in the distribution area of the western group also adopted, as we have seen above, the better horses of the eastern group, along with eastern equipment and utilized them in improving their own horses. In this way conscious animal breeding was developed in Central and Eastern Europe.

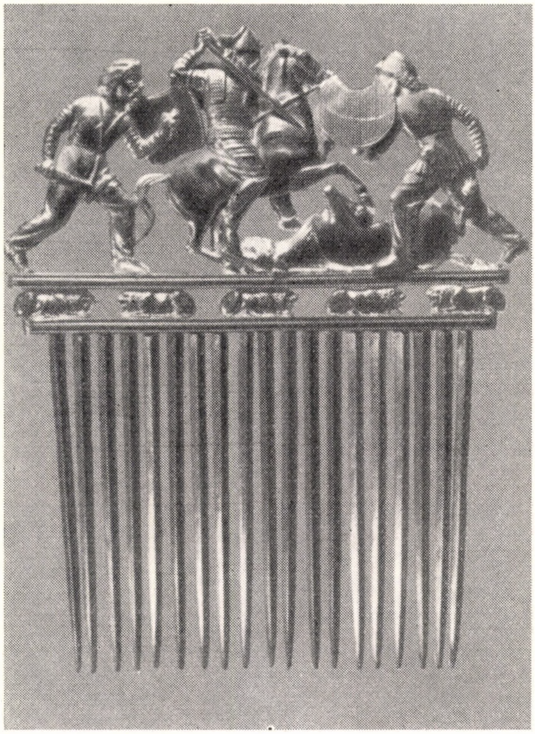


Fig. 100. Horse represented on the gold comb of Soloha. 5th century B.C. Hermitage, Leningrad

It is only from representations that we have been able to obtain any data on the Iron Age horses of Greece and the eastern part of the Mediterranean Basin. In fact, horse burials together with carts have recently been discovered in Cyprus, but a preliminary examination of these finds only reveals that the horses buried there were smaller than modern horses.[112a] On the other hand, large numbers of terracotta figurines have been found in Cyprus. Most of them represent riders on their horses with a great variety of primitive saddles.[113] The carts represented are generally very primitive, the horses having been attached to them with yokes which were of a type generally used for cattle. If compared with the human figures, these horses appear to have been rather small (Fig. 101).

[112a] Karagheorghis, V., 1965, pp. 282 ff.
[113] Young, J. H., Young, S. H., 1955, pp. 54 ff.

Fig. 101. Statuette of a cart (carriage) drawn by two horses. Kourion, Cyprus, 540—480 B.C. Metropolitan Museum of Art, New York, Cesnola Collection, purchased by subscription, 1874—1876

Fig. 102. Equestrian statuette of bronze. Boeotia, End of 7th century B.C. Museum of Fine Arts, Budapest

Representations from archaic Greece are rather poor from our point of view and they mostly show small horses. However, some bigger individuals have also been represented, for example, the statuette of Boeotia from the end of the 7th century B.C. (Fig. 102). In general, under the impact of the introduction of eastern horses, beginning about 700 B.C. and increasing after that, the representation of horses became more and more frequent in Greece; as a result of the same effect, riding was introduced into the Olympic games in 648 B.C.[114] The horses of the Classic period clearly show improved forms; their bodies were more powerful, their heads nobler and smaller. No doubt, these likenesses are connected with the prevailing style of artistic representation, but it seems hardly possible for the painters of the vases to have depicted such animals if they had not existed. It is highly probable that the whole population of horses in Greece did not comprise just this kind of horses, but that such individuals occurred with it.

There must have been a great variety in the colouring of horses according to their surviving names. On a lekythos (an oil jar) of Corinth (Metropolitan Museum, New York, c. 560 B.C.) one of the horses of a quadriga is called Melanas (black); in the same collection, on another Corin-

[114] Anderson, J. K., 1961, p. 13

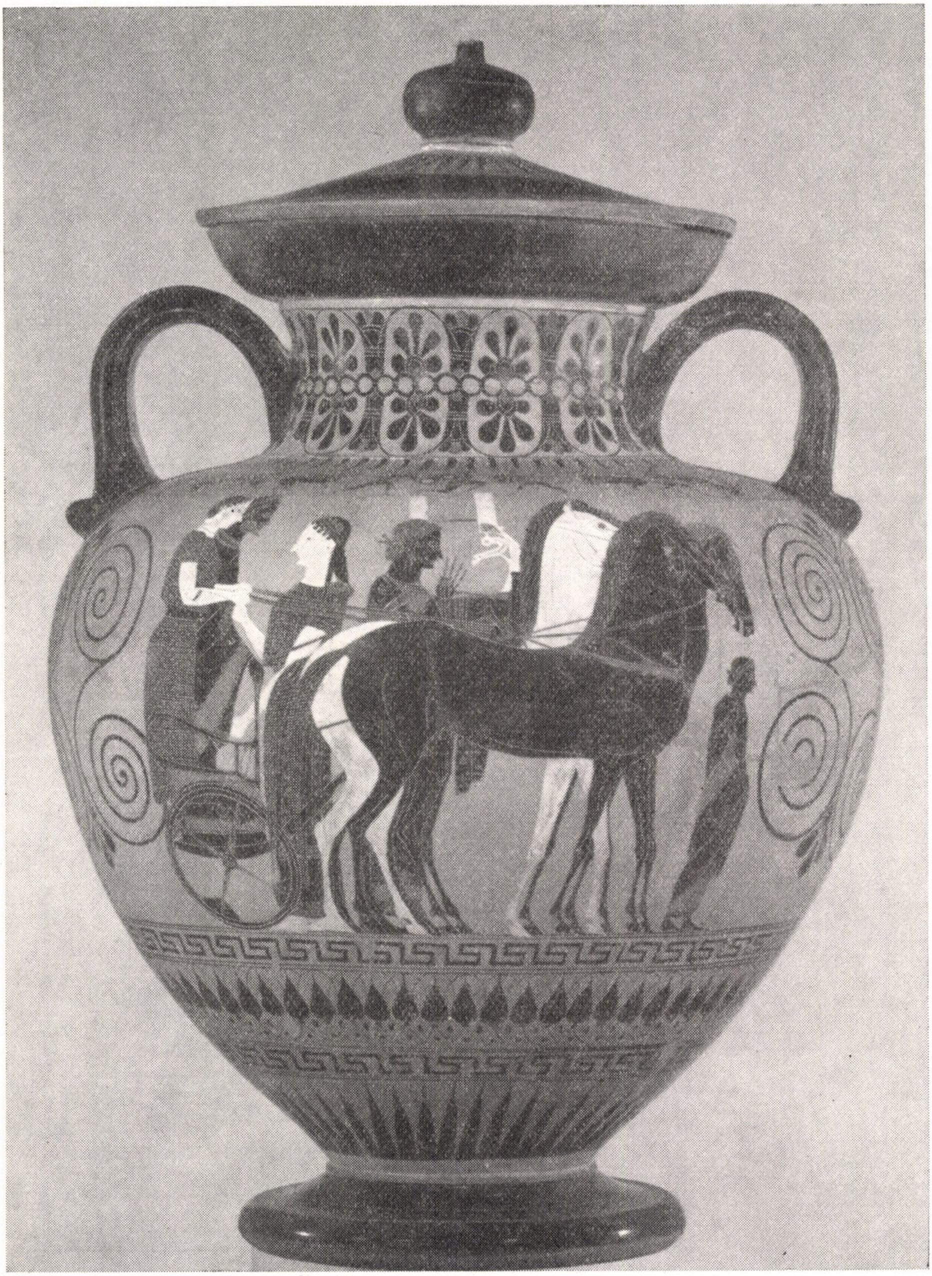


Fig. 103. Quadriga represented on an Attic black figure vase, c. 540 B.C. Metropolitan Museum of Art, New York, Rogers Fund, 1917. Quadrigas are often represented on Greek vases but the solution seen here with one white horse is rather rare

thian representation, one of the horses has the name of Xanthos (chestnut). In addition, on several black-figure vases one of the horses of quadrigae (the inner right hand one) is white. On a Boeotian terracotta statuette, preserved at the National Museum in Athens, the four horses of the quadriga are bay, white, grey and chestnut. The harnessing and the manner in which the horses were yoked to the cart can be very well observed in the representations on the vases (Figs 103 – 104). Horse breeding in general (for in the Classic era its existence may well be taken for granted) already had a literature; we need only mention the works of Aristotle and Xenophon.

Fig. 104. Quadriga represented on an Attic black figure vase, c. 525 B.C. Metropolitan Museum of Art, New York, Rogers Fund, 1906

ROMAN HORSES

It seems most probable that the conscious horse breeding of the Romans developed through the intermediary of the Greeks. Although it may not have occurred in the Republican Period, horse keeping increased in both quantity and quality in the Imperial Period, predominantly for military reasons, but also for civilian ones. For army purposes new, large breeds were developed and these were later also put to civilian uses. Varro and Columella are the authors on agriculture who discussed most thoroughly questions of horse breeding. The latter described breeds, particularly with respect to their appearance, he also discussed the deliberate feeding and keeping of horses and a number of practical questions on breeding (the role of test stallions, the selection of mares, etc.), as well as animal diseases.

As a result of conscious breeding, different breeds — evidently originating mainly from Italy — were evolved in the territory of the Roman Empire. One of these was a large breed which can be demonstrated osteologically practically everywhere alongside the local small horses of different regions. This was the so-called Roman "military horse", probably evolved by interbreeding with (by improvement through) Scythian horses via the Greeks and Persian or Hispanic ones. Essentially it was a large, powerful breed; it was not, however, identical with "*cold blood*" heavy horses of our present days. It is best represented by the horse on the equestrian statue of the Emperor Marcus Aurelius on the Capitol at Rome. Within this breed, Hilzheimer,[115] and Habermehl[116] distinguished different horses for soldiers and for officers; others considered it to be an identical breed.[117] Probably the large horse believed to be a wild horse, which Amschler described from the Roman settlement of Magdalensberg, belonged to the same breed.[118] Of course, this breed was frequent, above all, in Roman castra and in villa farms; with its big body it considerably raised the withers height of the horses of that period compared to that of previous periods; but after the Roman Period the breed vanished.

In late Iron Age settlements of the local population the usual primitive type of horses predominated; sometimes it was the only type which occurred. The bone samples from certain sites of the Period of the Roman Empire in Switzerland[119] and Germany,[120] which have only small domestic horses, provide the best examples of this.

In Pannonia, the breed of large Roman horses also occurred, as seen for example in the bone samples from Tác, Albertfalva and Győr. They indicate powerful animals with withers height of 145—155 cm. A statuette discovered at Tarhos—Vincesziget (Hungarian National Museum, Budapest, 2nd—3rd century A.D.) is a fine representation of the type, for it displays perfectly the stature and body proportions of the animal (Fig. 105). A similar horse may be seen on a clay mould of a night-light from Pannonia (Fig. 106). The horse skull found at the castrum of Albertfalva (Fig. 107), with its 44.2 frontal index would seem to have an eastern origin (it was, by the way, an old animal with overgrown teeth), but the fine facial part indicates that, in all probability, it had belonged to the same Roman breed. The in-

[115] Hilzheimer, M., 1924, p. 151

[116] Habermehl, K. H., 1958, p. 105

[117] Nobis, G., 1955, p. 208; Boessneck, J., 1957a, p. 108; 1958a, p. 293; 1958b, pp. 68—69; p. 115; 1964, p. 223; Herre, W., 1958, p. 35

[118] Amschler, J. W., 1950, p. 483

[119] Traininas, D., 1935, pp. 26—27; Rüeger, J., 1944, p. 236; Würgler, F. E., 1955, p. 266

[120] Sickenberg, O., 1938, p. 151

Fig. 105. Bronze statuette of a horse. Tarhos—Vinceszigeт, Roman (2nd—3rd centuries A.D.). Hungarian National Museum, Budapest

complete skull from the castrum at Dunaújváros (Fig. 108) may have originated from the same breed, but this has not yet been ascertained.

Roman horse keeping in Pannonia has been studied in great detail mostly on the basis of written sources, but also in consideration of the rare earlier osteological examinations.[121] The dissertation states that since "in the early Iron Age the eastern horses of the Illyrians had supposedly become interbred with the western horses of the Celtic tribes that had settled

[121] Pető, M., 1966, pp. 1 ff.

Fig. 106. Horse represented on the imprint of a clay mould of a night-light. Pannonia, Period of the Roman Empire. Hungarian National Museum, Budapest

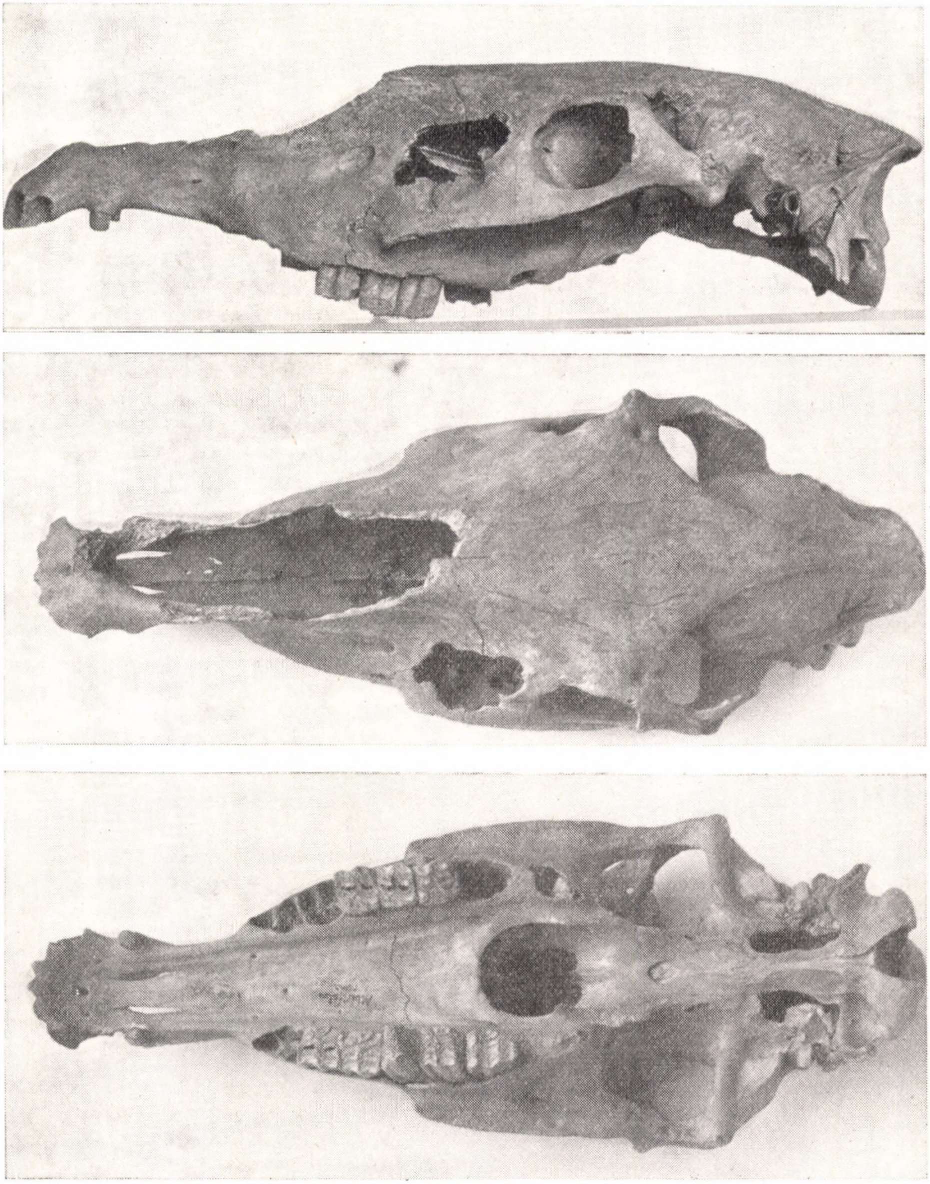


Fig. 107. Skull of a horse. Budapest—Albertfalva, Period of the Roman Empire

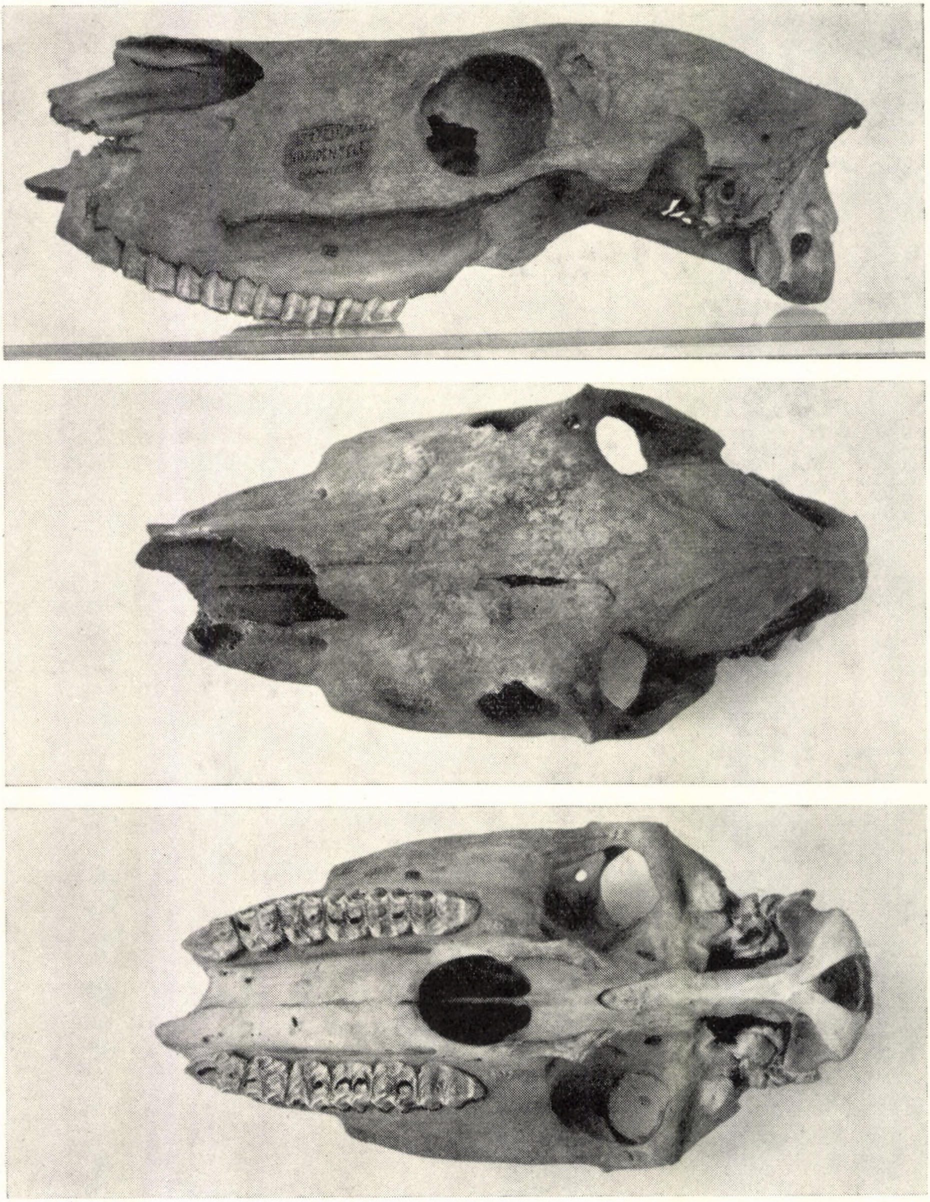


Fig. 108. Skull of a horse. Dunaújváros. Roman

in the territory" "we cannot speak of a homogeneous (i.e. Pannonian) population of horses even in the period prior to the Roman Conquest."[122] The horses of Europe in this period became very mixed by the Roman Conquest, by which were introduced horses from diverse Asian and African provinces and horses were transferred by military units from different regions of the Empire to distant territories. Thus, for example, when in the 2nd century A.D. eastern cavalry were transferred to Pannonia "the Syrian and Thracian horses may have impregnated the Pannonian population of horses with strong eastern and southern elements".[123] In the paper, an attempt has been made to establish the breed of horses which was introduced on the basis of the names of the troops garrisoned in Pannonia, from their former garrisons and from the names of the soldiers.[124] In this way, it would seem that it was chiefly western horses which reached Pannonia, although in some cases these may have been mixed with eastern and African elements. However, since after a certain time, only the names of the different units were maintained and it must have been necessary to renew the stock of their horses several times, the results of these attempts are to be taken with strong reservations, a fact which, by the way, was emphasized by the author herself.

HORSES OF THE MIGRATION PERIOD

Unfortunately, we know very little about the horses of the people of Central and Eastern Europe, who lived beyond the territory of the Roman Empire. Evidently, the horses of the Germanic and Celtic peoples were like those belonging to the western group of horses in the Iron Age. The Sarmatians who were famous as horsemen (1st—4th century A.D.) had bigger horses than the former, although even their horses were somewhat smaller than those of the Romans. Their withers height may have been 132.50 cm (on the basis of the metacarpals) and 131.44 (on the basis of the metatarsals). Strabon (who was more or less a contemporary of Augustus) gives an interesting description of these horses:[125] "The castration of horses is customary with all Scythian and Sarmatian peoples to make the animals obedient; for their horses are small, yet very fiery and disobedient."

We know very little of the Huns' horses. It is interesting that not a single usable horse bone has been found in the territory of the whole empire of the Huns. This is all the more deplorable as contemporary sources mention these horses with high appreciation. According to Vegetius Renatus for example ". . . For the purposes of war the Huns' horses are by far the most suitable, on account of their endurance, working capacity and their resistance to cold and hunger." "The Hunnish horses have large heads, curved like hooks, protruding eyes, narrow nostrils, broad jaws, strong and rigid necks; their manes hang down to their knees, their ribs are big, their back-

[122] Pető, M., 1966, p. 49
[123] Pető, M., 1966, p. 50
[124] Pető, M., 1966, pp. 51 ff.
[125] Strabon, Geographica, VII. 4—8

bones curved, and their tails shaggy; they have very strong shinbones and small feet, their hoofs being full and broad, and the soft parts hollow. Their whole body is angular with no fat at all on the rump, nor are there any protuberances on the muscles; the stature is rather long than tall; the trunk is vaulted, and the bones are strong; and the leanness of the horses is striking. But one forgets the ugly appearance of these horses as this is set off by their fine qualities: their sober nature, cleverness and their ability to endure any injuries very well."[126] All this is the opinion of a veterinary surgeon, a very valuable opinion concerning military horses, not so much with respect to the horse's appearance but to its nature and efficiency.

For the later centuries of the Migration Period, we have the additional evidence of bone samples. This refers particularly to Germanic, Avar and Hungarian horses, for it was a widespread custom with these people to place his horse in the grave of the dead warrior. The Avars and Germanic peoples generally buried the whole horse, but sometimes only the skull and the feet in the grave; this latter custom was most usual with the Hungarians. (In the case of the Hungarians the horse had evidently been flayed and the fleshless head, along with the feet from the carpals and tarsals downwards — sometimes the lower end of the radius and tibia being cut off with them — were left in the hide.) Unfortunately, we do not always possess exact data concerning the Germanic burials of horses or those of the Avars and Hungarians outside the territory of Hungary. In Hungary so far the bone samples of 107 Avar graves with horses and 76 Hungarian ones from the Period of the Magyar Conquest have been studied. The proportion according to age and sex of the buried Avar and Hungarian horses is the following:

		juvenile	subadult	adult	mature	senile
Avar	specimen	2	21	75	7	2
	%	1.9	19.6	70.1	6.5	1.9
Hungarian	specimen	—	39	35	1	1
	%	—	51.3	46.1	1.3	1.3

		stallion	mare	undefinable
Avar	specimen	49	—	58
	%	45.8	—	54.2
Hungarian	specimen	50	2	24
	%	65.8	2.6	31.6

As is evident from the above tables mares were buried in only two graves from the Period of the Magyar Conquest. In all other graves with horses whether Avar or Hungarian of the Period of the Conquest, there were always

[126] P. Vegetius Renatus, III. p. 6

stallions or geldings whenever it was possible to ascertain the sex of the horses, at all. (Similarly, it was mostly stallions or geldings that had been found in Germanic graves with horses.) These examinations of ours have the advantage that it is easier to compare the horses of the three ethnic groups, and, moreover, the investigations are not disturbed by differences in sexual-dimorphism. The majority of the horses buried were animals between 3 and 10 years of age; that is the horses were killed in their prime to be given to the warriors as companions in the other world. The Germanic horses were buried at about the same age. Nevertheless, there is a rather greater number of subadult animals among the Hungarian horses, and this has influenced the picture which has been formed about their size (see below).

The fact that the Hungarians of the Period of the Conquest buried only the skulls and feet of their horses excludes the possibility of comparing body proportions of these animals with those of Avar and Germanic horses. We have compared the horses of the two latter peoples but have not found any differences between them.

On the basis of the proportions of extremity bones, Duerst made a distinction between running ("*warm blooded*") horses and trotting ("*cold blooded*") ones. According to him the former have relatively shorter upper forelegs.[127] Müller considered it strange that this did not hold good for the Grossörner-Molmeck horses which he had described and considered to have been "*ancient cold blooded*" horses.[128] In Nobis' opinion the two abovementioned types of horses cannot be distinguished on account of the very wide variation range of Duerst's values.[129] The examination of the Avar horses of Bóly revealed that, although they had been of eastern origin, only one among them approximated the values which Duerst had set for running horses.[130] The Bavarian horses of Linz-Zizlau also showed very wide variation and did not differ at all from the horses of the Avar cemetery of Bóly.[131] Müller's examination of the Avar horses of Nové Zámky showed the same results.[132] Exploring the question on the basis of the large amount of material which we have examined we can only observe that Avar and Germanic horses cannot be distinguished from one another by Duerst's criterion.

But our examinations in this direction led to another result, that is the distinction of stallions from geldings on the basis of the proportions of extremity bones. On horses' skeletons the os sacrum and the pelvis are mostly incomplete and therefore of no use in the determination of the sexes so that this mostly has to be performed by ascertaining whether or not the animal had well-developed canines. In the case of well-developed canines the animal is usually considered a stallion, and otherwise a mare. But since recent examinations have shown that 22 per cent of pony mares have ca-

[127] Duerst, U. J., 1908, pp. 410 ff.
[128] Müller, H. H., 1955, p. 671
[129] Nobis, G., 1962, p. 140
[130] Bökönyi, S., 1963a, pp. 97—98
[131] Bökönyi, S., 1965, p. 10
[132] Müller, H. H., 1966, p. 208

nines,[133] this method does not seem to be expedient. On the other hand, an examination of the proportion of extremity bones indicates the presence of a group among the horses with canines and with long metapodials. Moreover, the metapodials of these horses were not only long but also very slender and it is these horses which may have been geldings. Unfortunately, their separation from the stallions was not extremely clear (which may have been due to the fact that some of the stallions were gelded only when they were adults and by then they had grown to the proportions characteristic of stallions); on the other hand when the length of the metacarpals of an Avar or Germanic horse amounts to at least 23 per cent of the total length of the fore limbs, that is, when the length of the metatarsal is at least 26.7 per cent of the total length of the hind-extremities and their slenderness index is below 14.5 and 11.5 respectively, we may suspect a castrated animal.

The size of the three groups of horses mentioned above — Germanic, Avar, and Hungarian of the Period of the Conquest — was also very similar: 136—137 cm on the average. (See Table 3 for the average withers height of Hungarian horses of the Period of the Conquest and of Avar horses.) The average withers height of Germanic horses on the basis of the metacarpals (81 specimens) was 136.47 cm, and on the basis of the metatarsals (78 specimens) 137.67 cm. The withers height of most of these horses was between 130 and 145 cm, although there also occurred smaller and bigger individuals with 122—124 and 150—160 cm withers height respectively. Pigmy horses with withers height of about 100 cm, which occurred not infrequently with Celtic peoples, did not occur in the Migration Period.

Thus, as far as withers height is concerned, the size of the horses of the Migration Period reached that of the eastern group of Iron Age horses. No doubt, the effect which the Roman horses exerted in improving the stock of primitive horses over the whole territory of the Empire and even in neighbouring regions musthave been considerable. But in our opinion the influence of the mass of ea stern horses which spread to Europe with the various successive waves of the Migration of Peoples must have been even more significant. These horses which were larger and better from the breeder's point of view than the western ones, with the exception of Roman horses, exerted a stronger effect just by their very mass — particularly in regions beyond the boundaries of the Roman Empire — than the Roman horses which had been introduced into the territories in question in smaller numbers. Thus the former were easily able to shape the whole population of horses of Central and Eastern Europe to their own likeness and render it homogeneous.

This homogeneity is reflected in the slenderness ratios of horse metapodials in the Migration Period. As is shown in Table 4 the slenderness index of the metacarpals of Avar horses (115 specimens) is 15.12, for Hungarian horses of the Conquest Period (84 specimens) is 14.76 and it is 14.90 for Germanic horses (81 specimens). The same indexes of the metatarsals are 11.70 (117 specimens), 11.45 (92 specimens) and 11.60 (78 specimens) respectively.

[133] Habermehl, K. H., 1961, p. 54

From this point of view, therefore, Germanic horses stood between the Avar horses and the Hungarian horses of the Period of the Magyar Conquest. (Since there were many horses aged between two and a half and five and a half years among the Hungarian horses, whose metapodials had perhaps not reached their full breadth, their slenderness index should really be somewhat higher, almost equalling that of Germanic horses.)

All the above-mentioned facts prove that in Migration Period Europe it is impossible to distinguish the eastern and western group of horses on the basis of their extremity bones. In spite of all expectations, the Germanic horses have not proved to be the "*ancient cold blood*" type because their stature and proportions were identical to those of Avar and Hungarian horses, whose eastern origin leaves no doubt. To be more precise, in the Migration Period a homogeneous horse population, though with a wide range of variation, existed in Central and Eastern Europe (Figs 109–110). This is a somewhat painful admission, especially if one considers the great number of attempts made by different authors, which were aimed at finding the characteristic type of horses belonging to different peoples and at exploring the origin of these horses, respectively. On the other hand, we are forced to this conclusion if we take into consideration the conditions prevailing in the horse keeping of Europe in the Migration Period.

As we have seen in the examples of other species, conscious animal breeding disappeared for a long time from Europe after the fall of the Roman Empire. Its rudiments did, in fact, survive in the breeding of horses and dogs, but this did not go as far as breeding within segregated breeds. No doubt, every horse keeper would have liked to acquire the better quality eastern horses, but he would not have gone to such length as to breed from these alone and exclude his own smaller horses. In addition, the Migration Period, as is suggested by its name, was a real "golden age" of the movements of peoples, of incursions and marauding campaigns. Consequently, the horses became widely distributed and were used for breeding in each region. Indisputably, whether it was the Magyars or the Avars who captured Germanic horses, or the other way round, there is no doubt that the horses were not killed but added to and interbred with the local stock. Thus it is not surprising that a uniform population of horses emerged.

Towards the end of the Migration Period, breeding selection and conscious horse breeding began to reappear. It was in this period that the first large, heavy "*cold blood*" horses that is to say "*western horses*" in the modern meaning of the term, appeared.[134] They are apparent also on our diagrams in particular among the Germanic horses, and perhaps among the Avar horses as well. They were thick-legged horses, though their legs were no thicker relatively than those of some of the small individuals.

Heavy "*cold blood*" horses were bred for war purposes, for in this period heavy knightly armour appeared and large horses were needed for carrying riders in armour. It is interesting to note that the first horseshoes appeared in Central Europe in the 9th–10th century, more or less at the time when

[134] Nobis, G., 1955, p. 208; 1957, p. 45; Herre, W., 1958, p. 35; Boessneck, J., 1958a, p. 293

heavy horses were first bred. Since their weak hoofs need shoeing more than those of the eastern horses it is not impossible that there was a connexion between the emergence of heavy horses and the introduction of shoeing.[135]

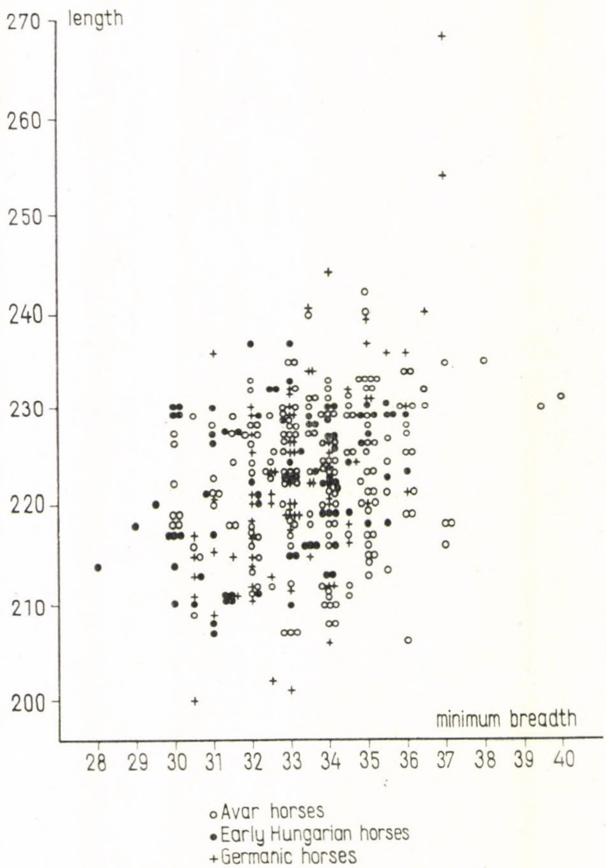


Fig. 109. Variation of horse metacarpals in the Migration Period

The only difference between Germanic horses and eastern horses of the Avars and Hungarians of the Period of the Magyar Conquest is to be seen in the structure of the skull. Unfortunately there is not the same ample material to investigate this as for the study of previous aspects. Only 15 skulls of Avar horses and 34 Hungarian ones of the Period of the Magyar Conquest are available for comparison with the measurements of 19 skulls of Germanic horses. (Only complete skulls can be used for these examina-

[135] Kasparek, M. U., 1958, p. 42

tions, for the basal length has to be measured and compared with other measurements, but we also included a much greater number of incomplete skulls within the scope of our comparisons.) No results have been achieved in most cases by comparing different parts of skulls and skull proportions, for example, the comparison of the length of sets of teeth, of the proportion

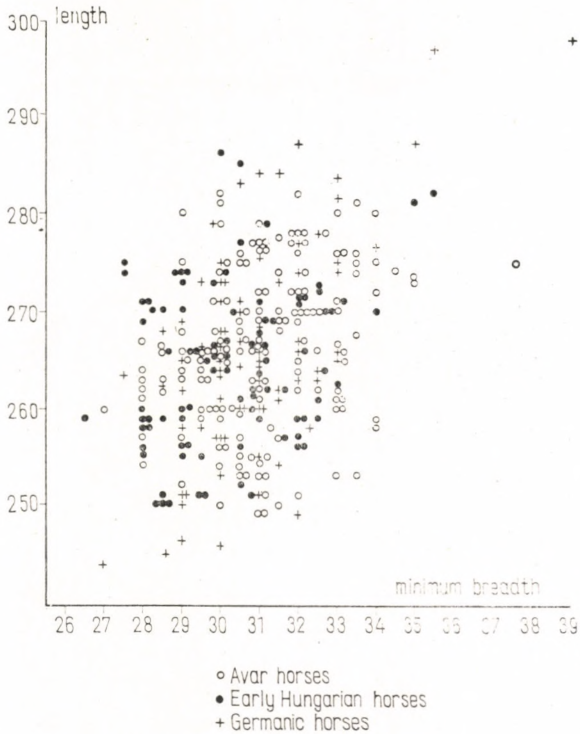


Fig. 110. Variation of horse metatarsals in the Migration Period

between the facial part of the skull and the brain case of the pattern of the molars, of the form of orbits, etc. However, there does seem to be a difference in the relationship between frontal breadth and basal length, which is expressed by the frontal index (frontal breadth/basal length × 100) between Germanic horses on the one hand and Avar horses and Hungarian ones of the time of the Conquest on the other.[136] Figures 111—112 show that most of the horses belonging to the latter group have broader foreheads than the Germanic horses. Most of the Germanic horses are in one group, whereas four of them (three of the skulls originating from the Alamann

[136] We suspected this before (1960c, pp. 93—94; 1963a, pp. 93—94)

graves of the 6th century at Niederstotzingen and the fourth from Iceland from a period synchronous with the Magyar Conquest) are absolutely different with their markedly narrow foreheads. On the other hand, the frontal index of some Avar and Hungarian horses is to be found among those of the

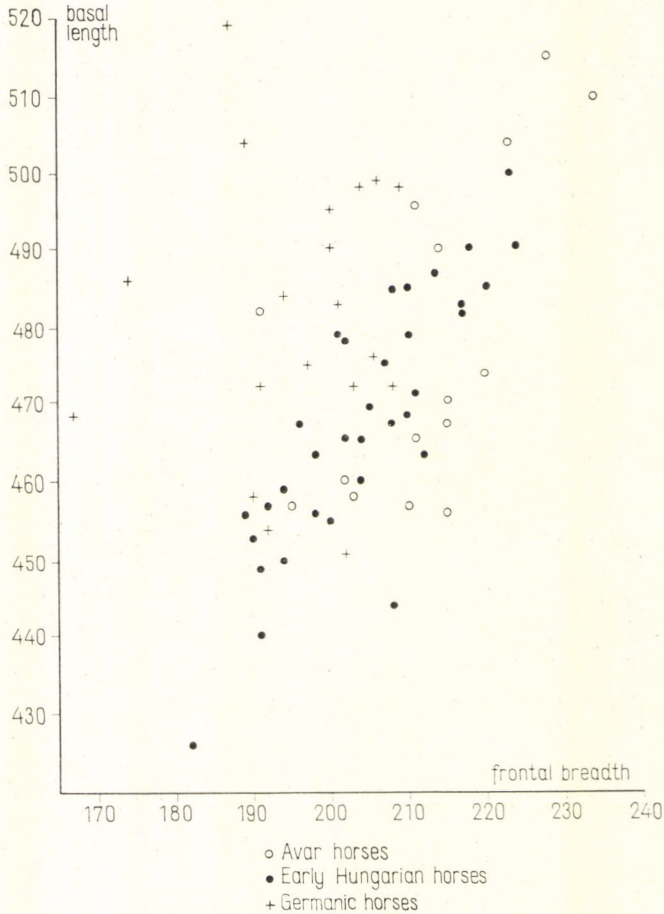


Fig. 111. Variation of horse skulls (basal length/frontal breadth) in the Migration Period

Germanic horses, but still far away from the above-mentioned four Germanic skulls. (The two surviving *tarpan* skulls fall in the centre of the range of variation of Avar and Hungarian horses and reveal clearly the links of origin.) The measurements and indices of the skulls are shown in Table 5.

No doubt a great many Germanic horses differ from the Avar and Hungarian horses of eastern origin, by having narrower forehead. However, since — with the exception of the four skulls of Germanic horses mentioned above — they do not differ sharply from the eastern group and since several of their skulls fall within the range of variation of the eastern group, so that there is an actual overlapping of the two groups, it seemed necessary use statistical methods to determine whether or not the two groups are in fact distinct. The statistical analysis indicated that the difference between the two groups is a significant one.

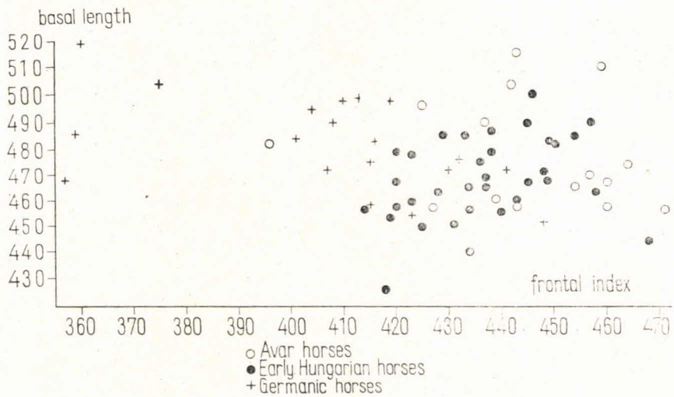


Fig. 112. Variation of horse skulls (basal length/frontal index) in the Migration Period

Craniologically there is a difference, though not a general one, between Hungarian horses of the Period of the Magyar Conquest and Avar horses. Both of them have broad foreheads, but whereas the forehead of Avar horses is convex (Figs 113—118) and the orbits are rather narrow (oval lengthwise), most Hungarian horses have straight or indented foreheads with wide orbits extending to the forehead. In fact their dorsal edges often rise above the plane of the forehead (Figs 119—124), as seen very clearly in the Hungarian horse skulls found at Szentes–Borbásföld, which represent more or less the general type of Hungarian horses of the Period of the Magyar Conquest.

This skull form of Hungarian horses of the time of the Conquest throws some light on the origin of these animals. The question of the origin of Hungarian horses has been hotly debated since its first discussion. The first author to write about Hungarian horses of the Period of the Conquest was Brummel, in whose opinion the Hungarian type of horse corresponded to the Mongolian type.[137] A similar view was set forth by Besskó[138] and D. Nagy.[139] Hankó, on the other hand, traced back the horse of the conquering Magyars to the *tarpan*.[140] By the analogy of ancient breeds of Hungarian

[137] Brummel, Gy., 1900, p. 32
[138] Besskó, J., 1906, p. 149
[139] Nagy, D., 1936, pp. 991 ff.
[140] Hankó, B., 1936a, p. 21

TABLE 5

Germanic horses

site	basal length	frontal breadth	frontal index
Iceland	468	167	35.7
Stotzingen	486	174	35.8
Stotzingen	519	187	36.0
Stotzingen	504	189	37.5
Oseberg	484	194	40.1
Oseberg	495	200	40.1
Barsbek	472	192	40.7
Oseberg	490	200	40.8
Rasbokil	498	204	41.0
Oseberg	499	206*	41.3
Nydam	475	197	41.5
Barsbek	458	190	41.5
Grossörner – Molmeck	483	201	41.6
Grossörner – Molmeck	498	209	41.9
Barsbek	454	192	42.3
Quedlinburg	472	203	43.0
Valsgärda	476	205.5	43.2
Wurten	472	208	44.1
Gokstad	451	202	44.8

Avar horses

site	basal length	frontal breadth	frontal index
Óbuda	482	191	39.6
Nové Zámky	496	211	42.5
Deszk G	457	195	42.7
Bóly	490*	214	43.7
Unknown site	460	202	43.9
Óbuda	504	223	44.2
Bóly	458	203	44.3
Keszthely	515	228	44.3
Orosháza	465	211	45.4
Pókaszepetk	470	215	45.7
Szeged – Makkoserdő	510	234	45.9
Pókaszepetk	457	210	46.0
Bóly	467	215	46.0
Keszthely	474	220	46.4
Szőreg – Téglagyár	456	215	47.1

* Approximate measurements.

dogs Anghi also recently suggested that the Hungarian horse originated from the Mongolian wild horse, but he added that *tarpan* blood had also been introduced later in these horses in the course of the migrations.[141] The above-mentioned features (the indented forehead and the wide orbits rising above the plane of the forehead) are certainly characteristic of the *tarpan*

[141] Anghi, Cs., 1959, p. 192

TABLE 5 (cont'd)

Hungarian horses of the time of the Magyar Conquest

site	basal length	frontal breadth	frontal index
Tiszaeszlár – Bashalom	456	189	41.4
Kecskemét	426	182	41.8
Orosháza	453	190	41.9
Kecskemét	457	192	42.0
Kecskemét	467	196	42.0
Öttevény	479	201	42.0
Szentes – Borbásföld	478	202	42.3
Szentes – Borbásföld	459	194	42.3
Koronczó	449	191	42.5
Pesterzsébet	463	198	42.8
Nagylók	485	208	42.9
Kőbánya	450	194	43.1
Szentes – Borbásföld	485	210	43.3
Kübekháza	465	202	43.4
Kübekháza	440	191	43.4
Szentes – Borbásföld	456	198	43.4
Városföld	475	207	43.6
Jánosszállás	469	205	43.7
Kenézlő	465	204	43.7
Szentes – Borbásföld	487	213.5	43.8
Komárom	479	210	43.8
Dormánd – Hanyi puszta	455	200	44.0
Tiszanána	460	204	44.3
Szabolcs megye	467	208	44.5
Rétközberencs	490	218	44.5
Jánosszállás	500	223	44.6
Nagykőrös	471	211	44.8
Tiszaeszlár – Bashalom	468*	210	44.9
Orosháza	483	217	44.9
Hékút	482	217	45.0
Biharkeresztes	485	220	45.4
Mohács	490	224	45.7
Szentes – Borbásföld	463	212	45.8
Csanytelek	444	208	46.8

Summary

site	n	min.	max.	M
Germanic horses	19	35.7	44.8	40.7
Avar horses	15	39.6	47.1	44.5
Hungarian horses of the time of the Magyar Conquest	34	41.4	46.8	43.7

but not of the Przevalsky horse. In the Institute of Zoology of the Soviet Academy of Sciences in Leningrad in 1962 we had the opportunity to study one of the preserved *tarpan* skulls. It shows exactly the same features as those indicated above and could, in fact, be mistaken for an average Hungarian horse skull of the Period of the Magyar Conquest.

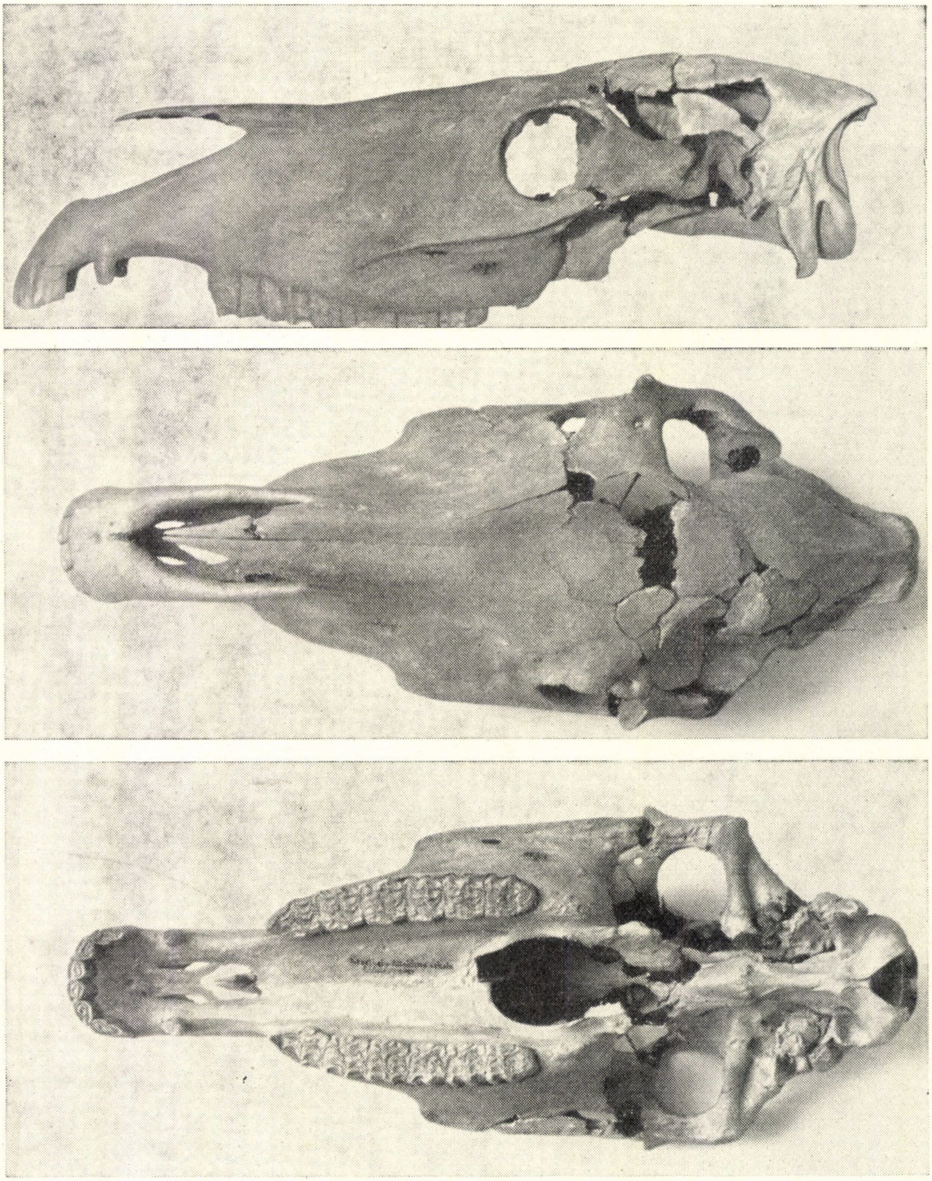


Fig. 113. Skull of a horse. Keszthely—Általános iskola (Primary School). Avar

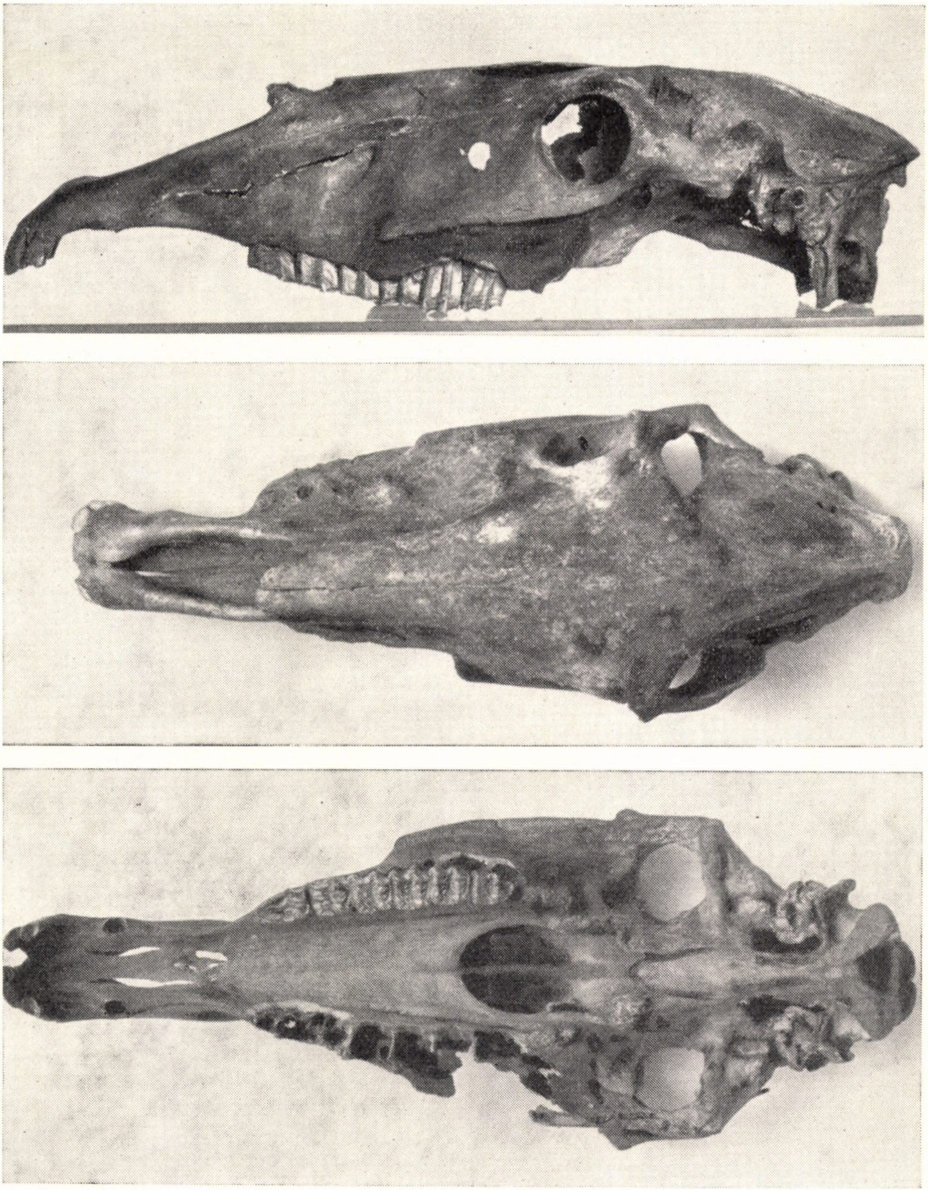


Fig. 114. Skull of a horse. Óbuda—Szőllő utca. Avar

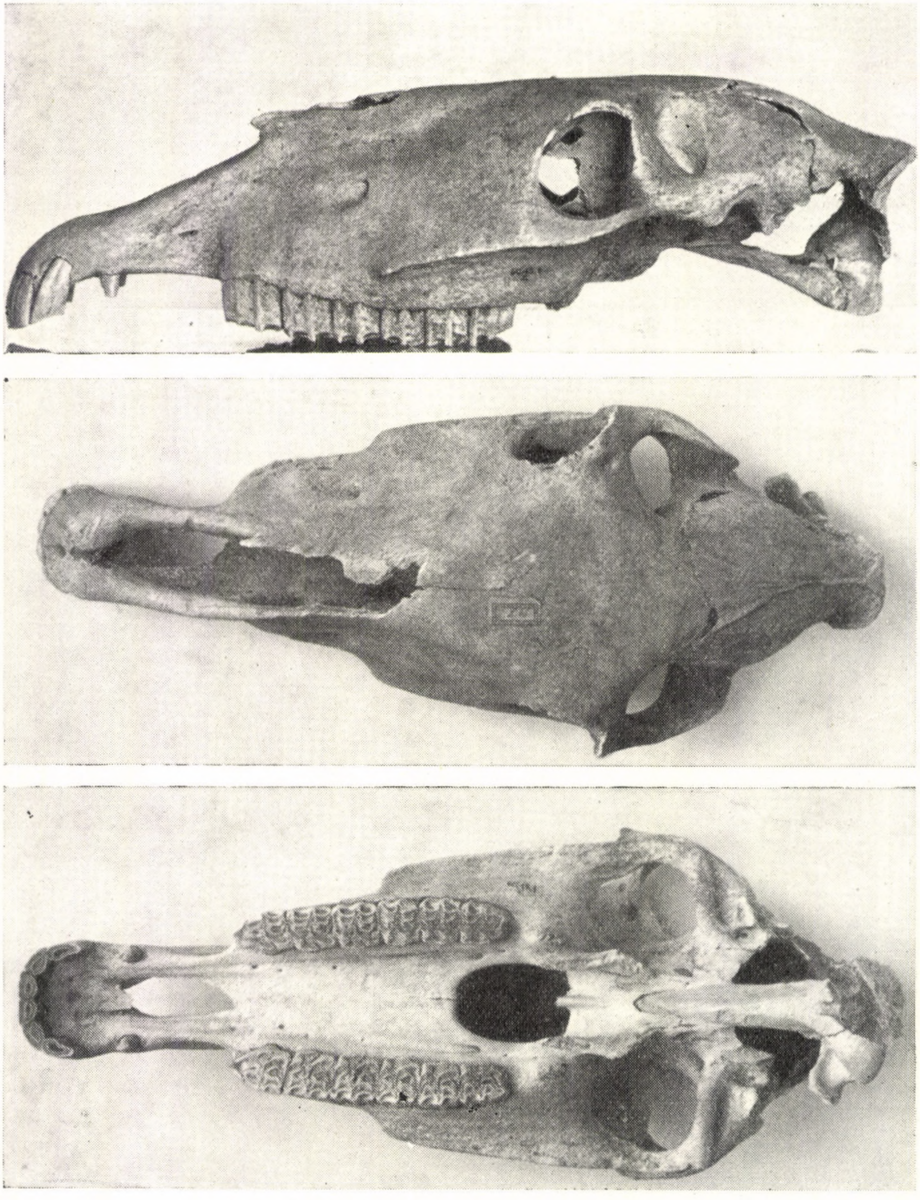


Fig. 115. Skull of a horse. Orosháza, Avar

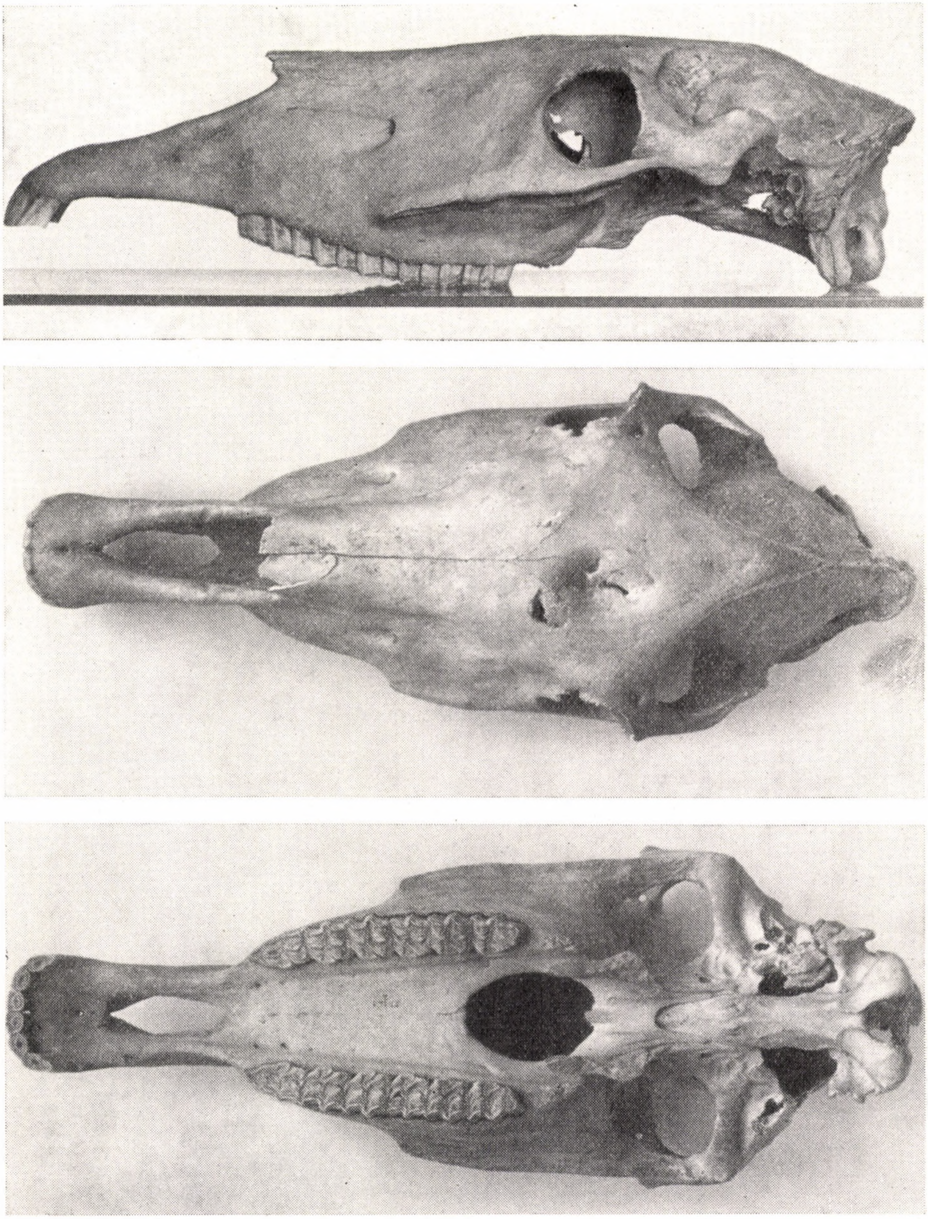


Fig. 116. Skull of a horse. Pókaszepetk, Avar

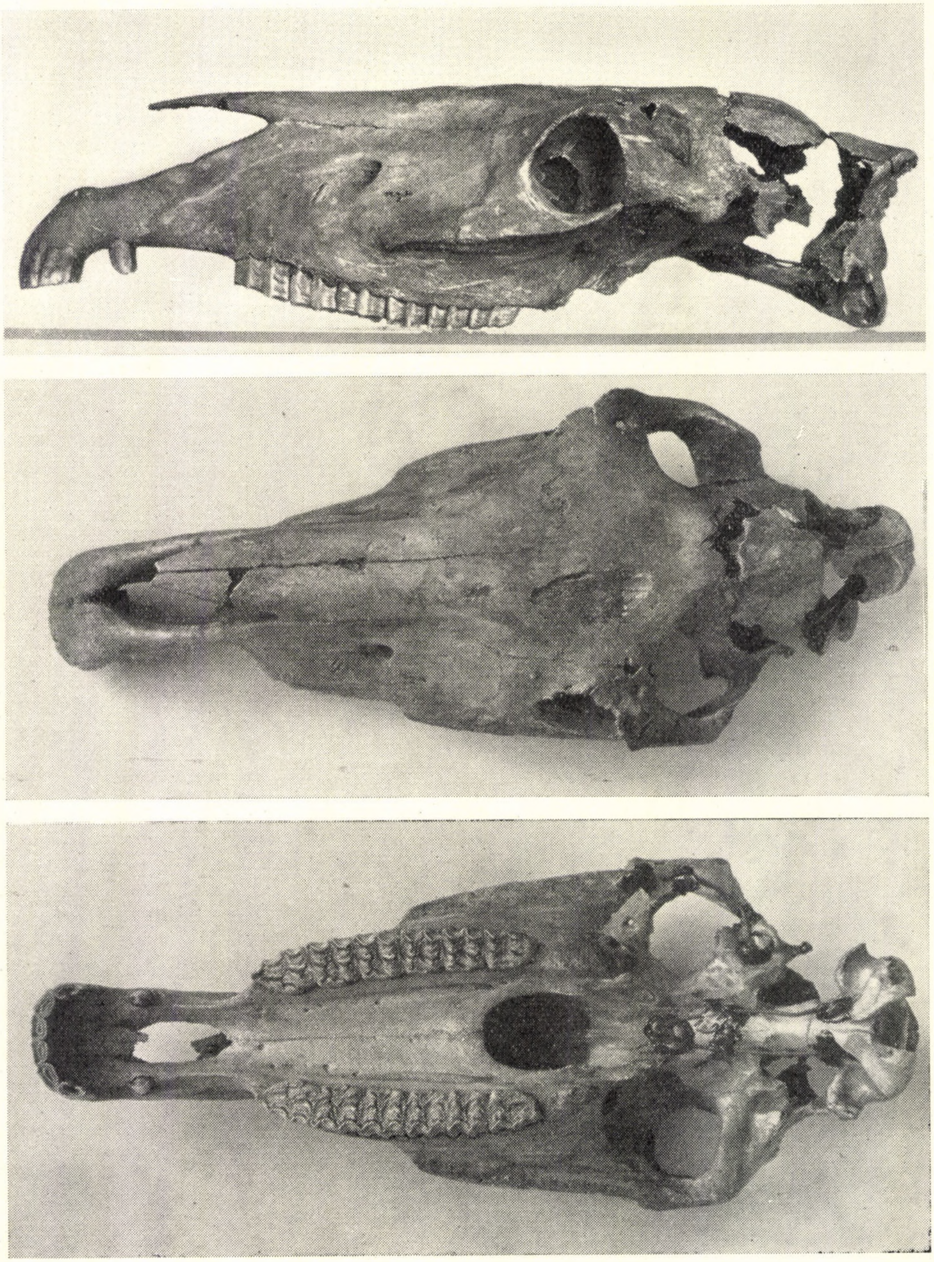


Fig. 117. Skull of a horse. Pókaszepetk, Avar

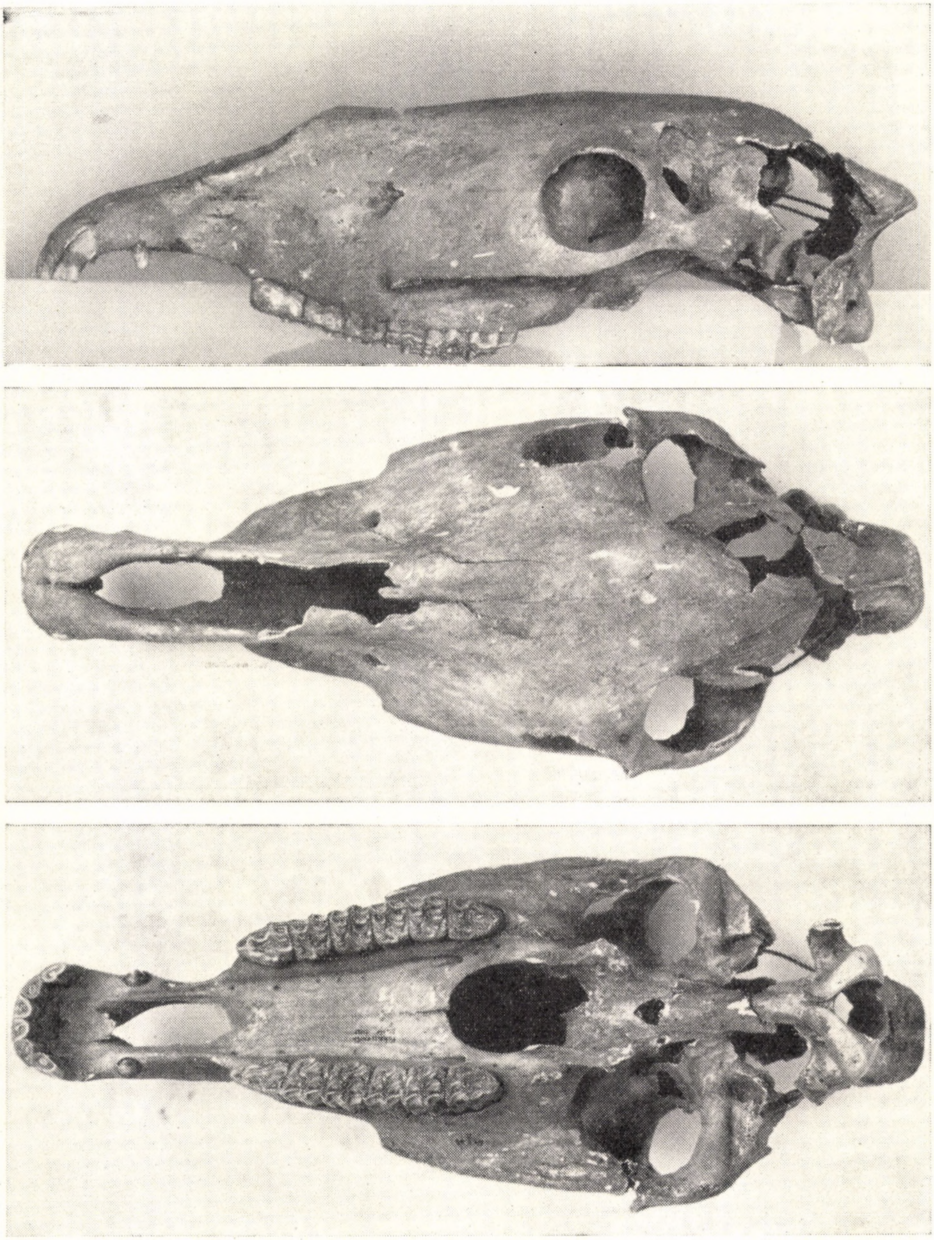


Fig. 118. Skull of a horse. Pókaszepetk, Avar

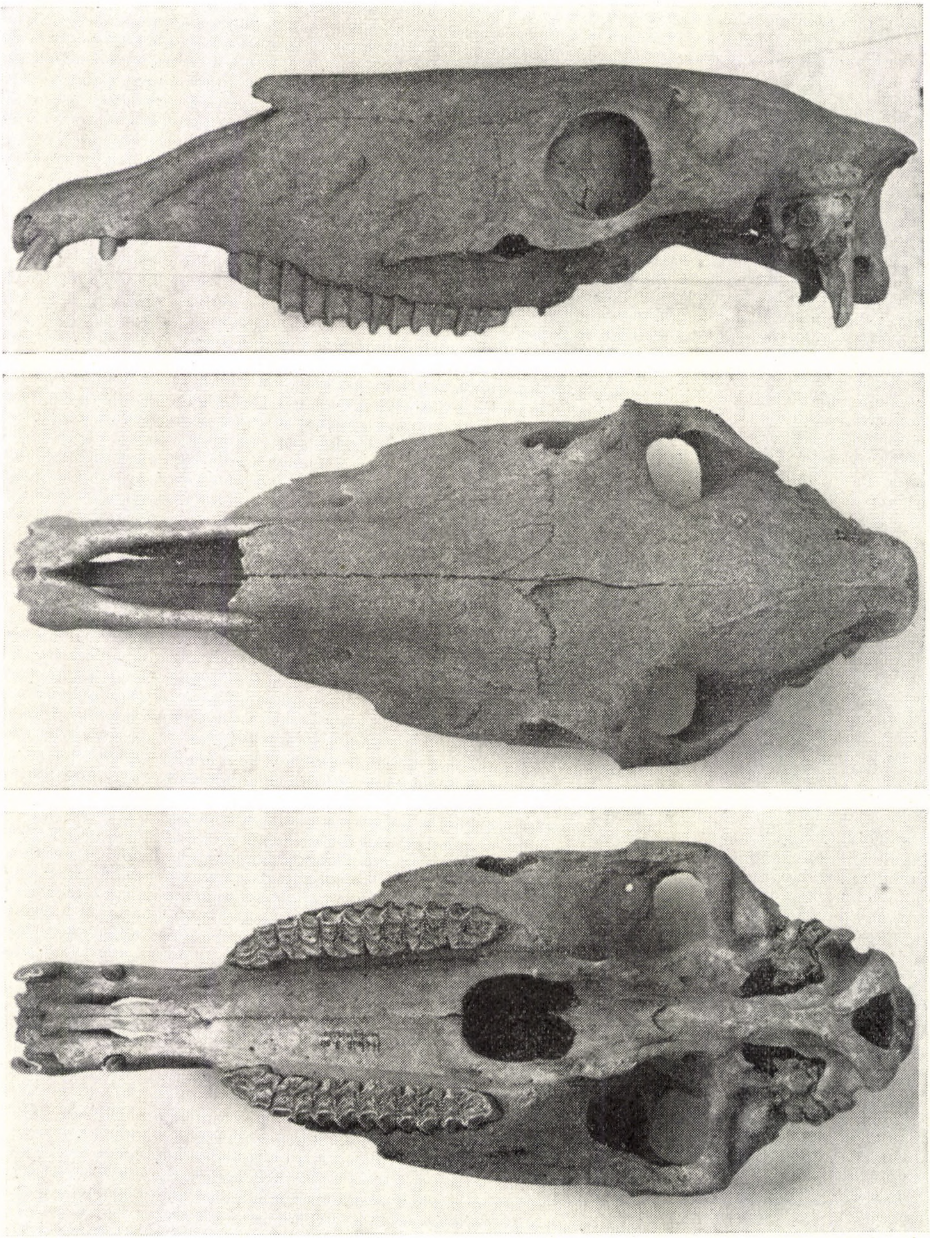


Fig. 119. Skull of a horse. Hékut, Period of the Magyar Conquest

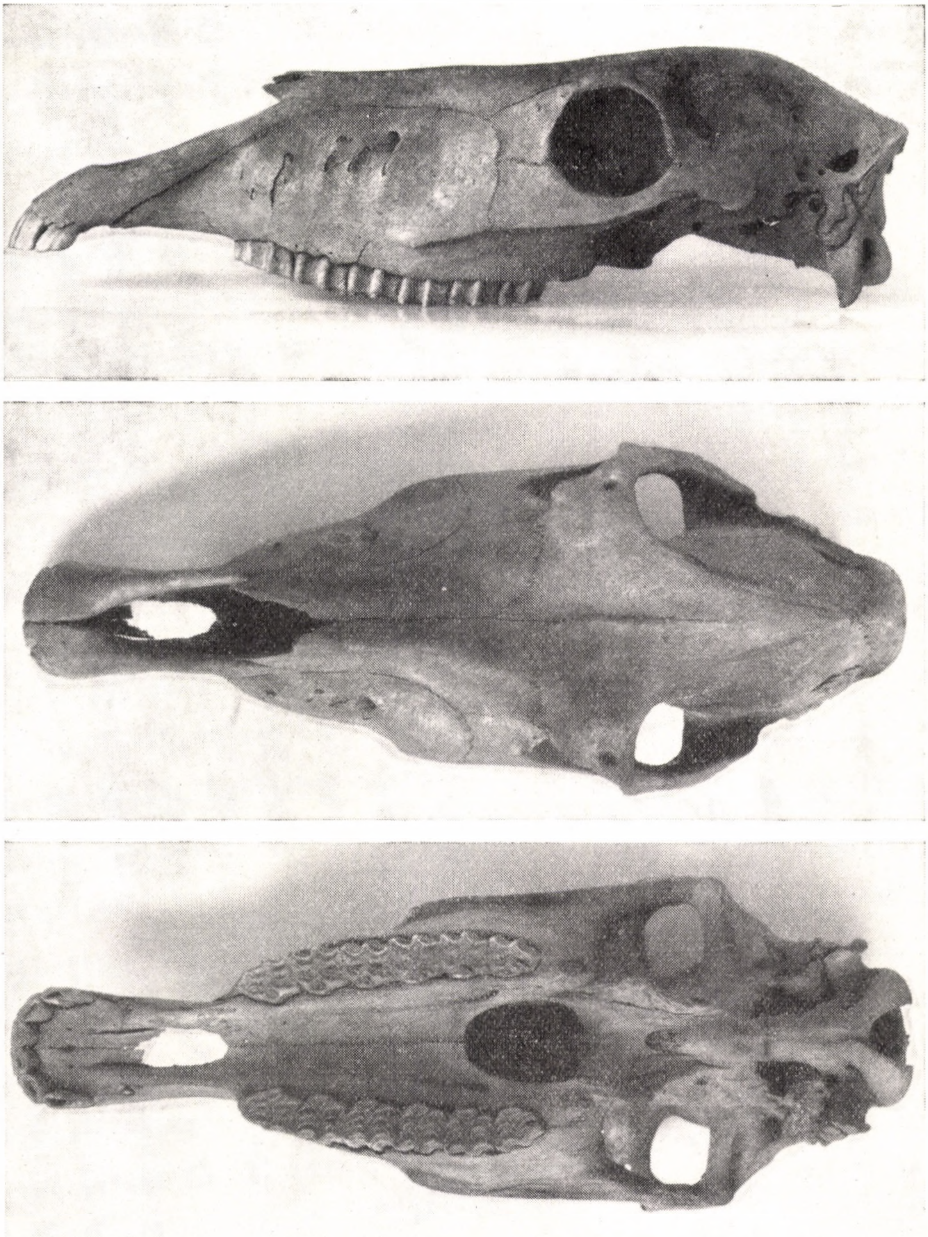


Fig. 120. Skull of a horse. Koroncó, Period of the Magyar Conquest

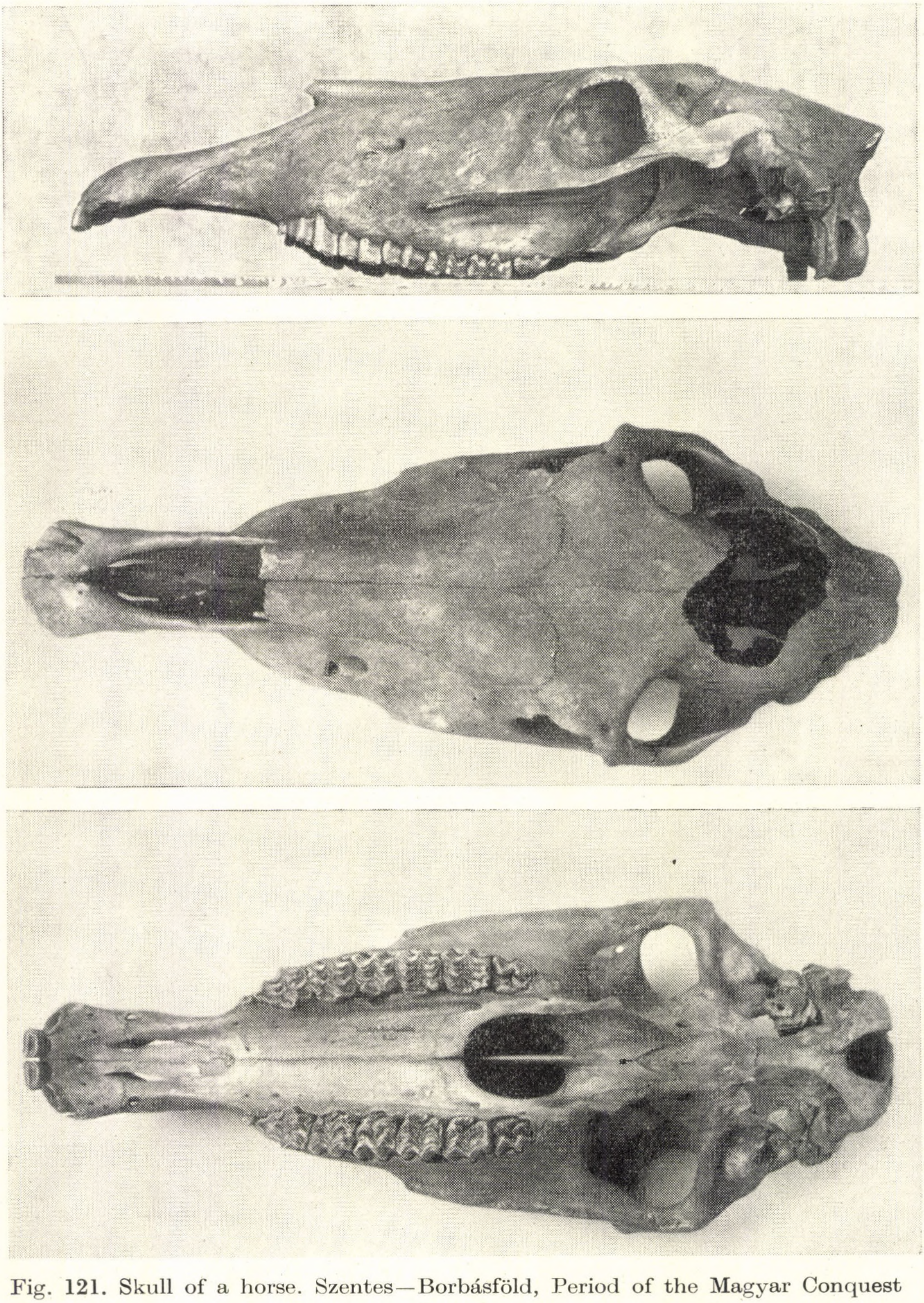


Fig. 121. Skull of a horse. Szentes—Borbásföld, Period of the Magyar Conquest

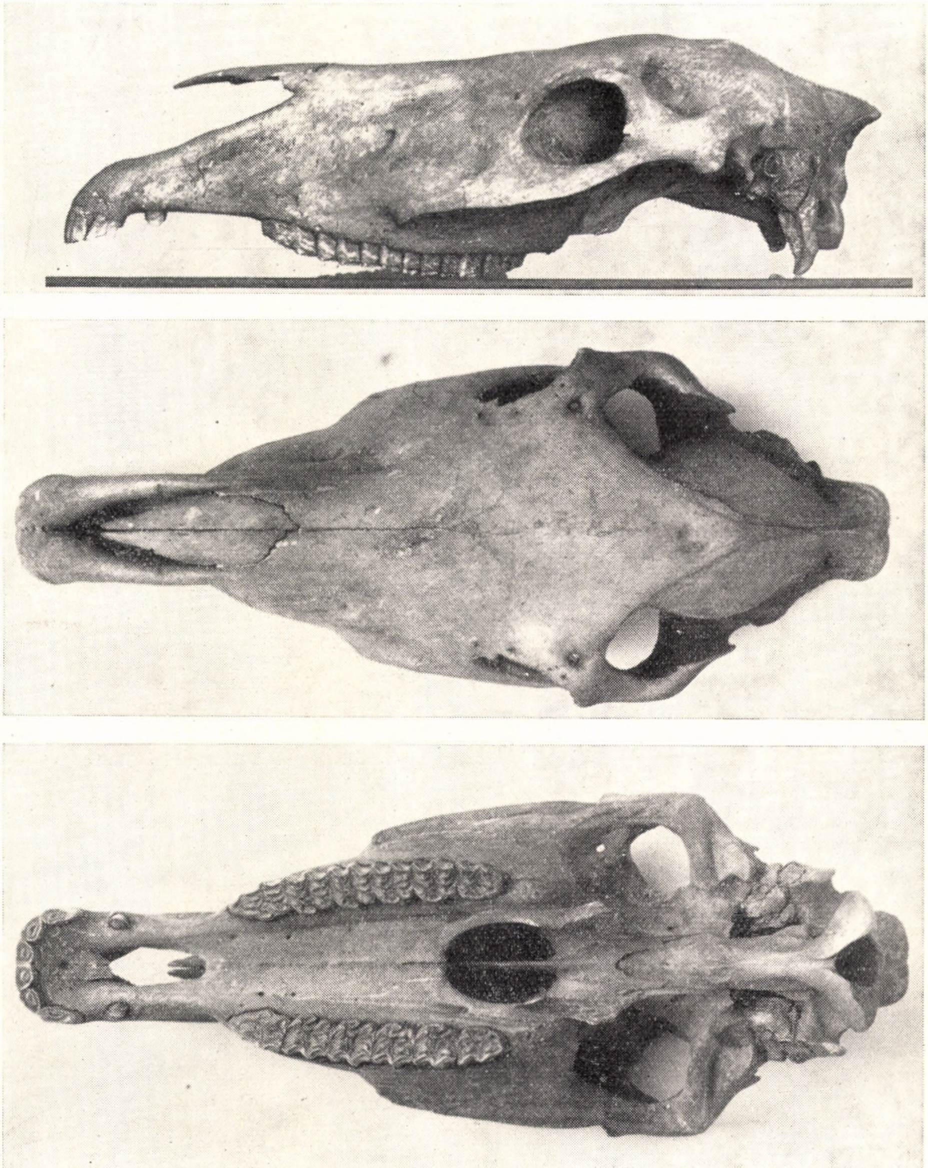


Fig. 122. Skull of a horse. Szentes—Borbásföld, Period of the Magyar Conquest

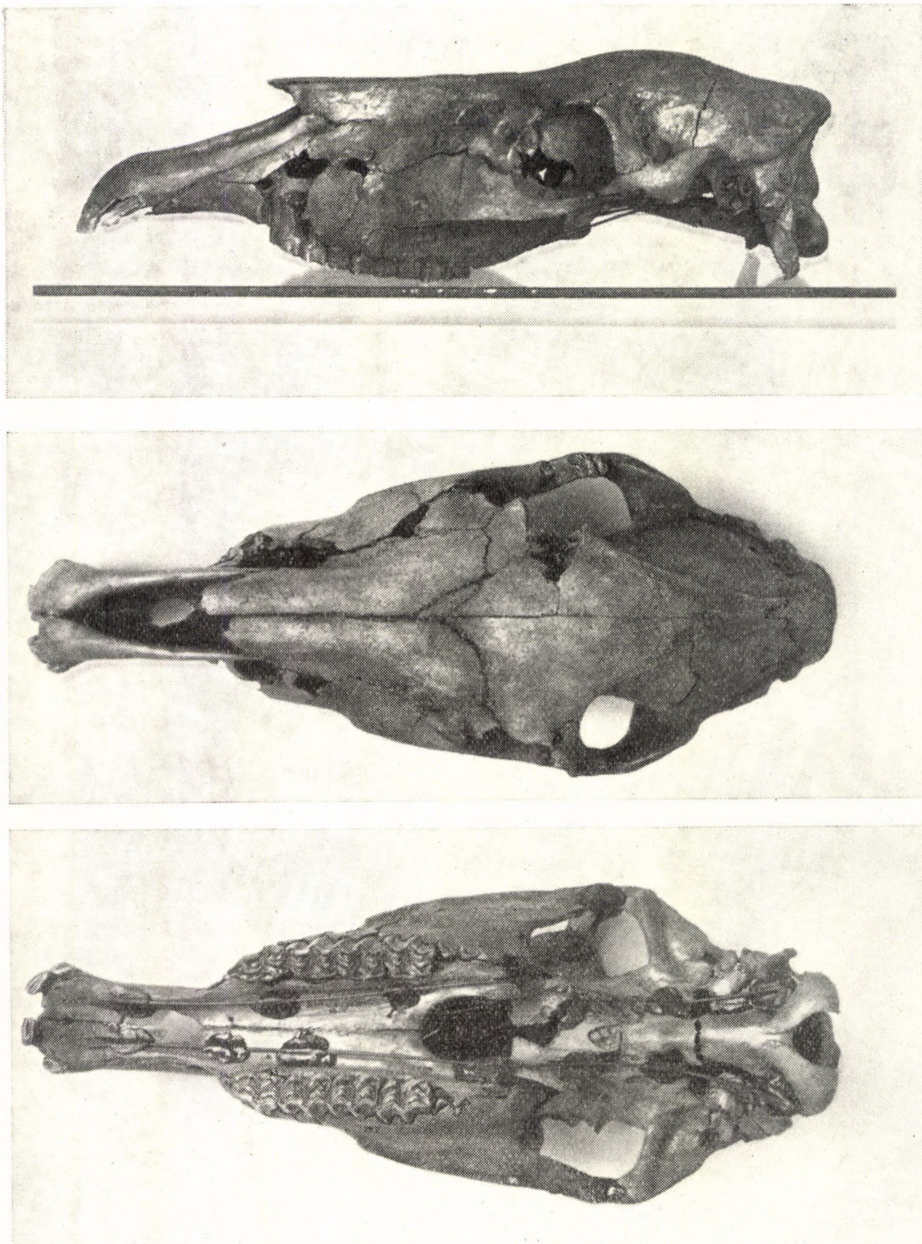


Fig. 123. Skull of a horse. Szentes—Borbásföld, Period of the Magyar Conquest

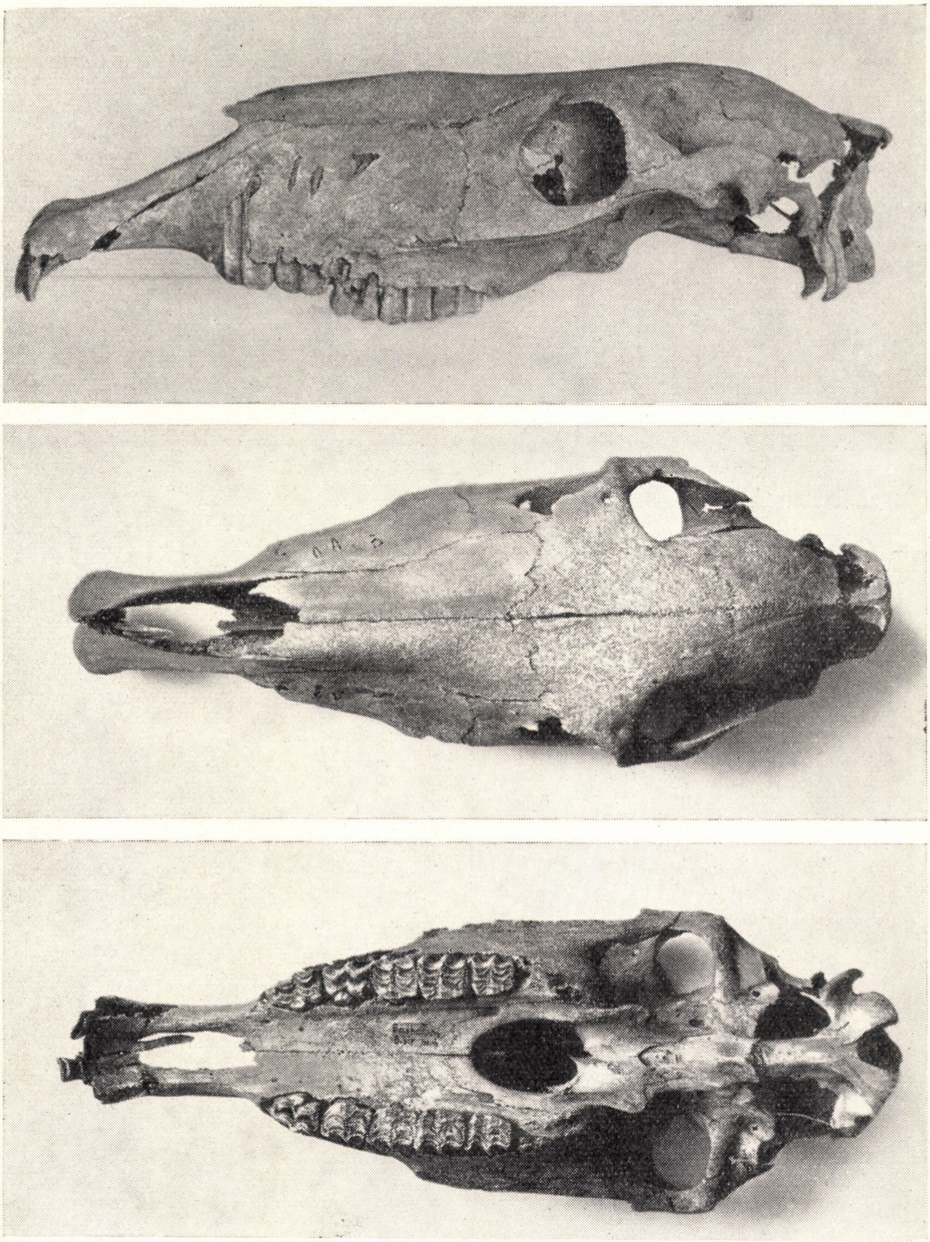


Fig. 124. Skull of a horse. Tiszaeszlár—Bashalom, Period of the Magyar Conquest

A number of interesting problems arose in connexion with the horses buried in graves of the Migration Period. In 1952 Zalkin[142] and ourselves[143] found many lame horses in Scythian graves. We later found lame horses among those buried in the Avar cemetery of Bóly[144] and the Bavarian cemetery of Linz-Zizlau.[145]

We formerly explained the placing of lame and sick horses in graves by the fact that at the time of burial, the funeral rites had become obsolete and survived only in their form, but had lost their content so that there was a trend towards killing useless animals for the deceased. It was also suggested that those animals which revealed pathological symptoms must have been the favourite horses, the companions-at-arms of the buried warriors, horses which were kept even when they were diseased so that they could be buried together with their masters.

However, recently in an Avar cemetery excavated by I. Kovrig in the town of Keszthely, the skeleton of a horse was discovered, which suggests another explanation. It was the skeleton of an adult stallion, on which the following deformations were to be seen: 17 dorsal and lumbar vertebrae of the spine showed adhesions (Fig. 125); the tarsus of the left hind foot was rigid due to arthritis chronica deformans, so that the animal was lame; and finally on the incisor section of the mandibula, in front of the left I_3 there was a superfluous incisor which must have been conspicuous from the outside (Fig. 126). This latter feature particularly attracted our attention, since shamans also had superfluous teeth. We then looked up the folklore about shaman horses.

It is very interesting to note that folk tales mention that magic horses not only had one superfluous tooth, but also in every case had been poor, often lame animals — before they were turned by magic into shaman horses.

Thus, for example, in one variant of the tale about the three horses of a witch, the lad in her service chose the worst of the horses because he had been told that it was a magic horse. In another variant the lad — following the advice of the magic mare — asked only for a poor horse in return for his services. In a third variant the magic horse was definitely lame.

In a variant of the tale about the tree reaching the sky, the lad asked the old woman for a horse that could hardly stand on its legs — and this animal turned into a magic horse. In yet another variant, the young swine herd tended three foals and a fourth, poor one, which could hardly totter, moreover it had five legs. This turned out to be the magic horse.

According to a folk tale of Kalotaszeg in Transylvania, Vitéz Palkó (Valiant Paul) chooses an old, feeble, six-legged horse, because it is a magic horse. In another tale the youngest prince chooses the worst horse; in another, Borsszem Jankó (Peppercorn John), the king's youngest son, chooses three times a very worthless horse, which then turns into a magic one.

[142] Zalkin, V. I., 1952, p. 154
[143] Bökönyi, S., 1952b, p. 109
[144] Bökönyi, S., 1963a, pp. 98—99
[145] Bökönyi, S., 1965, pp. 9—10

Thus, the magic horses of all the folk tales have two essential qualities: superfluous teeth and lameness. The same two qualities can be seen on some of the horse skeletons found in graves of the Migration Period, in particular in those of the Avars. Although the superfluous teeth are not always in such conspicuous places as that of the horse found in the Keszthely grave, most of these horses have them. In most cases they are rudimentary so-

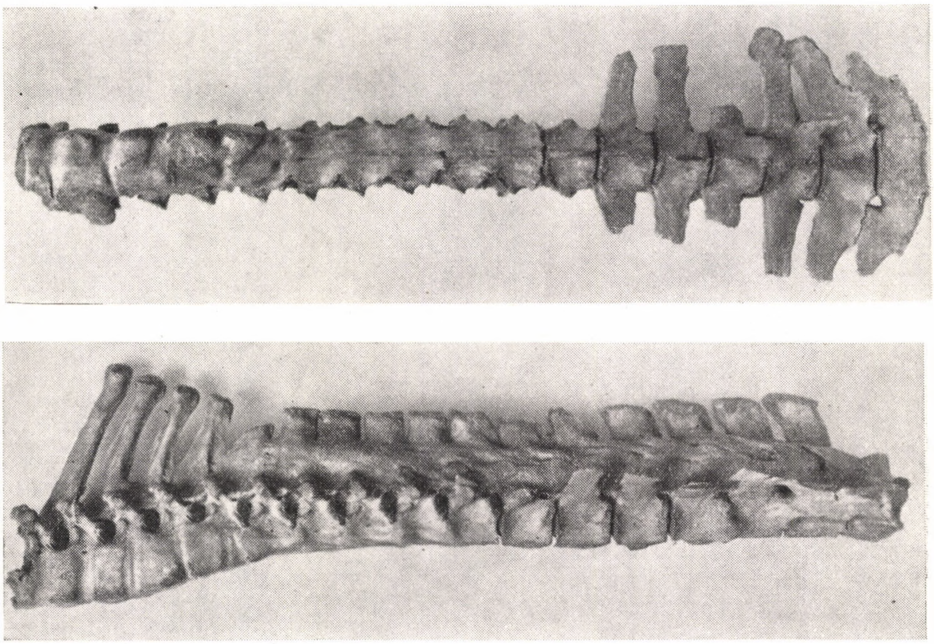


Fig. 125. Dorsal and lumber vertebrae showing adhesions of the horse in grave No. 1 of Keszthely. Avar

called "wolf-teeth", in front of the first premolar. These are the origina first premolars of the horse species, but in the course of evolution they disappeared and are to be found with domestic horses only very rarely as a kind of atavism. The same teeth often occur in horses found in Hungarian graves of the Period of the Conquest. The other quality of shaman horses is their poor state of health and lameness, which can often be found in horses of Avar graves. On the bones of these animals, chronic pathological deformations frequently occur. (The deformations of the vertebrae of the horse excavated at Keszthely must have taken several years to get to such a state, so that the animal could not have been used for any work for many years.)

The motif of the magic horse — as demonstrated by Solymossy — occurs, in general, in folklore of an oriental type, conceived in the spirit of shaman-

Fig. 126. Superfluous incisor on the external side of left I_3 of the horse in grave No. 1 of Keszthely. Avar

ism.[146] This tallies with the fact that so far it has been possible to find lame diseased animals only in the graves of peoples of eastern origin, or in cemeteries in which marked eastern elements were evident in their material. There must have been some mark on the horses placed in the graves which distinguished them as magic horses, so that they were not killed, even though they were of no use, but kept to be placed beside the dead. Evidently, this distinguishing mark must have been, above all, the superfluous tooth, although possibly some other external characteristics were also prescribed, or perhaps the origin of the horse was the decisive point. It is not impossible that these horses were the shamans' horses, animals to which extraordinary, magic powers were attributed, and that after the death of their masters they were put into the grave together.

HORSES OF THE MIDDLE AGES

In the first centuries of the Middle Ages the horse population did not undergo great changes from the situation in the Migration Period. Horses more or less like those of the previous period, continued to exist everywhere, except that in Central Europe "*cold blood*" horses became more frequent. In addition, breeds began to emerge among the "*warm blood*" horses, although this process did not become fully developed until the Late Middle Ages.

In Mediaeval Russia, the average withers height of horses was 132.56 cm, with horses of withers height between 120 and 140 cm in the majority. Individuals of 152—160 cm withers height also occurred but only rarely. The population of horses in Mediaeval Russia was fairly homogeneous, for

[146] Solymossy, S., 1929, pp. 133 ff.

there was only a difference of 2.24 cm at most between the average withers height of horses in the six largest cities (Novgorod, Pskov, Staraya Ladoga, Moscow, Staraya Razany and Grodno).[147] Written sources indicate that several breeds existed among the horses. The valuable horses belonging to the Princes were brandmarked.[148] Castration must have been quite frequent, for kits of equipment for gelding have often been excavated. In Staraya Ladoga a "*pipe*" used for curbing horses was also found.[149] In the southern, steppe part of the country, horse breeding was much more developed than in the north.[150]

Horses in Mediaeval Latvia were smaller than in Russia, their average withers height being 122.4 cm.[151] In the Lielupe Basin the horses were particularly small, whereas the horses of Daugave Valley approached more the size of Russian horses. Similarly small horses seem to have lived in Byelorussia too and it is not impossible that the horses of both territories can be traced back to Vetulani's *forest tarpan.*

Polish horses were also smaller in the Early Middle Ages,[152] with large individuals occurring only rarely among them.[153] These latter were often "*cold blood*" horses. The withers height of the mediaeval horses of Pomerania was 121—146 cm, the majority falling within Vitt's size group of 126—138 m[154].

At Budmerice in Slovakia (14th—15th centuries), Ambros found horses which were smaller than those of the Avars. Their withers height was 131 and 133 cm.[155]

A medium-sized horse was discovered at Burg Grenchen (11th—13th century) in Switzerland.[156] In Germany, Herre found a variable horse population in Hamburg with fine bones and withers height of 120—150 cm,[157] whereas at Burgheim (7th—9th century the horses were of 135—140 cm withers height, somewhat stockier than those of the Period of the Roman Empire.[158] The majority of the horses from Hannover (chiefly 11th—15th century) were of 130—140 cm withers height, though heavy "*cold-bloods*" of 150 cm withers height also occurred.[159] In Berlin–Köpenick (9th—14th century) there was evidence of a highly variable local heavy (?) breed. At this site no difference in the form of growth between the horses of the Slav and then of the German period was observable.[160]

[147] Zalkin, V. I., 1956, pp. 92—93
[148] Lebasheva, V. P., 1956, p. 119
[149] Lebasheva, V. P., 1956, pp. 122—123
[150] Lebasheva, V. P., 1956, p. 121
[151] Zalkin, V. I., 1961a, pp. 209—210
[152] Krysiak, K., 1950, p. 233; 1956b, p. 10; Kubasiewicz, M., 1957b, p. 195; 1963, p. 233; Sobocinski, M., 1964, p. 191
[153] Reich, H., 1938, p. 6; Kubasiewicz, M., 1959, pp. 149—150; Kubasiewicz, M., Gawlikowski, J., 1965, pp. 103—104; Sobocinski, M., 1963, p. 80
[154] Kubasiewicz, M., 1962, pp. 92—93
[155] Ambros, C., 1959a, p. 568; 1962b, p. 302
[156] Stampfli, H. R., 1962a, p. 169
[157] Herre, W., 1950a, p. 12; 1950b, p. 118
[158] Boessneck, J., 1958b, p. 115
[159] Müller, H. H., 1959, p. 231
[160] Müller, H. H., 1962b, p. 106

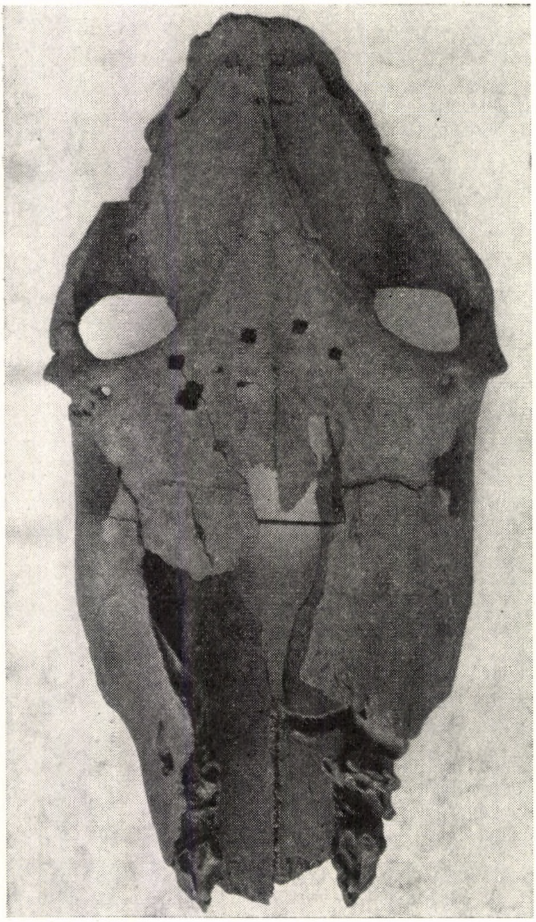


Fig. 127. Skull of a horse with traces of pole-axe blows on the front. Tiszalök – Rázom, Period of the Árpád Dynasty

Ivanov described horses of 129 – 147 cm withers height which were excavated at Popina in Bulgaria, dating to the 4th – 7th and the 9th – 12th century.[161]

On the basis of the scanty material formerly at our disposal we thought that the withers height of horses in the Period of the Árpád Dynasty had increased by approx. 10 cm from that of the Period of the Conquest.[162] But the ample material studied since seems to show that this increase in size did not take place until the 14th – 15th century. The majority of Hungarian horses in the Early Middle Ages were light, "*warm blood*" animals with withers height of approx. 135 cm, which rose to over 140 cm only at the end of the Middle Ages. The earliest evidence of heavy, "*cold blood*" horses has been dated to the Period of the Árpád Dynasty (Tiszalök, 11th – 13th century, Fig. 127;[163] Buda Castle 13th century;[164] Szeghalom, 13th – 14th century). Heavy horses were used more by knights coming from the west and by the aristocracy. A horse of this kind is depicted in the Illuminated Chronicle (c. 1370) as having been sent to the Magyar Chieftain Árpád from the Slav Prince Svatopluk; the majority of the conquering Magyars are riding on such horses in the pictures of the Illuminated Chronicle, and in the same codex King St. László (Ladislas) is also mounted on a western horse at his joust with a Cumanian warrior. On one of the ornamental

[161] Ivanov, S., 1956, p. 95
[162] Bökönyi, S., 1961b, p. 106; 1962b, p. 12; 1963b, p. 410
[163] Bökönyi, S., 1961b, p. 106; 1962b, p. 12
[164] Bökönyi, S., 1963b, p. 410

saddles of the Order of the Dragon founded by King Sigismund one of the riders is also represented mounted on a heavy, "*cold blood*" horse.

Evidence of horse breeding in Mediaeval Hungary is provided by not only bone samples but also written sources. The description given by Bertrandon de la Brocquière, who travelled through Hungary in 1433, is characteristic of the extent of Hungarian horse breeding. According to him in Szeged ". . . if anyone wanted to obtain three to four thousand horses he could find that many in this city. The horses are so cheap that for ten Hungarian forints one could buy a fine Hungarian stallion". "Setting out from Szeged I arrived at a town. My journey led me again across a beautiful plain, where the horses lived quite freely, like wild animals, and yet fine studs abound, that is why there are so many horses to be seen at the Szeged market." "In Pest there are a great many horse-dealers, so that, if one wanted to buy two thousand good horses, one would surely be able to get them here. They are sold by stables of ten horses, the price of each stable being 200 forints. I have seen horses, two or three of which would be well worth that price. Most of them come from the Transylvanian Mountains which form the boundaries of Hungary. I have bought an excellent runner. Nearly all of them are saddle horses. A fault is that they are a bit recalcitrant and they are particularly difficult to shoe."[165]

It was not only western horses but eastern ones as well that had found their way to Hungary during the Period of the Árpád Dynasty. As mentioned by Master Rogerius, numerous Mongolian horses came into Hungarian possession after the Mongolian invasion of Hungary in 1241—42.[166] The fact that these animals survived for a long time as independent breeds is proved by the record dated 1293 according to which Judge László adjudicated four oxen and a Mongolian horse to the serf Csud.[167] There is an interesting mediaeval record of horse diseases: In 1314 Bálint Szolniki and the Bárcais of Bárca's family were given in compensation for the assassination of Edus Bárcai, 70 M as blood money, as well as cloth, weapons and a broken-winded, lame horse (". . . equo flegmatico et claudo").[168]

From the Period of the Árpád Dynasty we know very few colours of horses. The name "Szeg" of King St. László's horse, known from his legend, originated from the animal's colour; in 1296 Péter Váradi returned a horse at Pécsvárad which had been stolen by the people of Konrád (of Óvár) (". . . equum alma hymu peeg coloris . . .").[169] In 1432 the colour "*tar*" and in 1557 the "*tarfakó*"[170] appeared in documents, but in the 17th—18th century minutes of the City of Debrecen more than two dozen colours of horses are mentioned.[171] Ottó Herman collected 321 expressions to indi-

[165] Szamota, I., 1891, pp. 92—93
[166] Belényesy, M., 1956, p. 24
[167] Ibid.
[168] Györffy, Gy., 1963, p. 149
[169] Györffy, Gy., 1963, p. 366
[170] Szamota, I., Zolnai, Gy., 1902—1906, p. 96
[171] Hankó, B., 1936a, p. 13

cate the colour of horses from Hungarian herdsmen of which twelve referred just to colour variants of bay horses.[172]

With the increase in conscious breeding, the numbers of different breeds began to multiply. The Turkish occupation, which introduced excellent oriental horses into Hungary, was also partly responsible for this, e.g. the skeleton of a horse buried with Arab gear was found in the layers dating to the Turkish occupation excavated in Buda Castle; with its exceptionally fine head it displayed the form of the best Arab thoroughbreds in South East and Central Europe. In contemporary Hungarian lists of animals, Turkish horses were always included, and it is to them that the Hungarian scrub horses owe their form which is reminiscent of those of Arab horses.

To summarize the evolution of domestic horses in Central and Eastern Europe, it can be stated that there were two populations of wild horses — one in Central Europe and the other in South Russia and the Southern Ukraine — which were probably different in size and in their skull form. From there, after the domestication in the late Neolithic – early Copper Age, two groups of domestic horses emerged as early as in the Bronze Age. The eastern group comprised bigger horses and the western group smaller horses; thus the size relations were quite the opposite of those of present types of horses. The same situation continued in the Iron Age. But during the Period of the Roman Empire, the types of horses became more mixed. In addition, as a result of deliberate breeding, large horses were evolved, although these had disappeared by the end of the period. The great mass of eastern horses that spread to Europe during the Migration Period shaped the whole Central European horse population to their own likeness, so that it is not possible to distinguish on the basis of stature the horses of the eastern from those of the western peoples of the Migration Period. Western heavy, "*cold blood*" horses, in the modern meaning of the term, emerged at the end of the Migration Period and the beginning of the Middle Ages.

[172] Herman, O., 1914, pp. 338 ff.

THE ASS

Asses (*Asinus*) belong to a single species (*Equus* [*Asinus*] *asinus* L.), which can be divided into three subspecies. The Nubian subspecies (*Equus* [*Asinus*] *asinus africanus* Fitz.) is reddish or bluish grey, the abdomen and the inner side of the legs being lighter; it has a sharply marked dark stripe along the back and a shorter one crosswise along the shoulders; on the legs, blurred horizontal stripes can be seen. This subspecies formerly lived in vast territories in the eastern part of Africa (it even occurred in Egypt, where it was hunted by Tutankhamen in the 14th century B.C. and by the Pharaoh Ramses III in the 12th century B.C.[1]). Later it withdrew to ever diminishing territories, by the beginning of the present century it existed only in the region between the Nile, the Red Sea and the Abyssinian Plateau. In the 'twenties, it became extinct in its wild form and is to be found today only in zoos.[2] The Somalian subspecies (*Equus* [*Asinus*] *asinus somaliensis* Noack) is much bigger than the former, with a stronger structure and more vividly coloured and marked. The basic colour is more intensely reddish or bluish grey than that of the Nubian ass, the whiteness of the belly and legs being strongly contrasting with the ground colour; the stripe along the back is narrow, or even missing along with the horizontal stripe along the shoulders; on the other hand the stripes on the legs are always vivid. At present, this subspecies lives only in the territory of Somaliland, although its distribution used to be much larger.[3] We know very little about the third subspecies (*Equus* [*Asinus*] *asinus atlanticus* Thom.). On the basis of its representations and bone samples, which have not been examined thoroughly, we know only that a subspecies of wild asses also used to live in North West Africa, in the Atlas Mountains.[4] This ass was often represented on the Roman mosaics but it seems to have become extinct after the Period of the Roman Empire.[5] The distribution areas of the three subspecies was at one time contiguous.

Formerly there existed another special form of wild ass, the *Equus (Asinus) hydruntinus* Reg.[6] This type holds a very special place among the *Equidae*, for its teeth resembled those of asses but its extremity

[1] Antonius, O., 1922, p. 248

[2] Zeuner, F. E., 1963, p. 374; Zeuner believes that the wild asses which occasionally appear in Nubia at present are, in all probability, feral ones

[3] Antonius, O., 1922, p. 248; Werth, E., 1929, p. 343

[4] Zeuner, F. E., 1963, p. 374

[5] In Zeuner's view this animal may possibly be identical with the *Asinus hydruntinus*

[6] Stasi, P. E., Regalia, E., 1904, pp. 24 ff.

bones, particularly its metapodials were reminiscent of those of half-asses. *Equus (Asinus) hydruntinus* Reg. lived in the southern part of Europe, although it also occurred in South West Asia and in North East Africa. In the warm periods of the Pleistocene the distribution area of this wild ass stretched as far as the Carpathian Basin and the central part of Germany and its bones have been found in several Paleolithic sites.[7] In contrast to earlier theories, according to which it became extinct during the last glaciation of the Pleistocene, it has recently become clear that *Equus (Asinus) hydruntinus* Reg. survived, and, at the climatic optimum of the Holocene,[8] it spread northwards along with the wave of other warmth-loving animals, such as the water buffalo (see above) to the Carpathian Basin and became extinct only some time during the Middle Neolithic period.[9]

Half-asses also reached Europe in the course of the Pleistocene, spreading with the steppe fauna of Central Asia as far as West Europe;[10] in the Holocene, they occurred until the Middle Ages in the steppes of South Russia and the southern Ukraine.[11] The eastern boundary of *Hemionus* and *Hydruntinus* during the Holocene seems to have been the eastern chain of the Carpathians and the lower reaches of the Danube river.

There are marked differences between asses and half-asses, in their colouring, the size of their ears, their skull form, their dentition and their metapodials. Their common characteristics distinguishing them from horses are their long ears, the fact that their tails are not covered with long hairs but have only a tuft at the end of the tail and that they have "chestnuts" only on their fore-legs. The ears of half-asses are much shorter than those of asses. Their colour is a deeper or duller chestnut and not the grey tint which is characteristic of asses. The facial part of the skulls of half-asses is longer, the frontal part is narrower and the whole of the skull is rather like that of a horse. In the form of the orbits and the upper zone of the skulls half-asses also resemble horses. Another difference in the skull form is that whereas half-asses have several foramen supra-orbitals, asses have only one.[12] As far as dentition is concerned the incisors of half-asses are much more hipselodontic than those of asses. The intertubercular surfaces of half-asses' upper molars and premolars show a definite tendency towards concavity so that their lines toward the columns are graduated, whereas with asses they converge on the columns at right-angles without any transition. In addition, the trend towards a thickening or doubling of the columns — which, by the way, is always more marked on the premolars than on the molars — is much stronger with half-asses than with asses. (It should

[7] Stehlin, H. G., Graziosi, P., 1935, pp. 1 ff.; Blanc, G. A., 1933, pp. 4 ff.; 1936, pp. 827 ff.; 1956, p. 3 ff.; Gromova, V. I., 1949, pp. 197 ff.

[8] Bökönyi, S., 1954a, pp. 19 ff.: 1957a, pp. 66 ff.; 1959a, pp. 78–79

[9] Bökönyi, S., 1954a, pp. 12 ff.; Necrasov, O., 1964, pp. 141 ff.; Necrasov, O., Haimovici, S., 1965, pp. 239 ff.; Necrasov, O., Haimovici, S., Maximilian, C., Nicolaescu, D., 1959, pp. 110 ff.

[10] Dietrich, W. O., 1959, pp. 13 ff.

[11] Pidoplitchko, I. G., 1956, pp. 51 ff.; Bibikova, V. I., 1958a, pp. 145, 147

[12] Antonius, O., 1951, pp. 3 ff.

be pointed out, however, that in this respect there is a wide individual variability.) And finally — and this is the most essential point of difference — the protoconus is very short with asses whereas with half-asses it is almost as long as with horses. The metapodials of half-asses are much slenderer than those of asses.[13] In general, the metapodials of the *Hemioni* are the slenderest among the equids.

With respect to the above-mentioned characteristics, all domestic asses are like true asses. Only one author has ever tried to trace back certain breeds of domestic asses to the onager, thus supposing a diphyletic origin of domestic asses.[14] Modern authors have unanimously rejected the possible derivation of any breed of domestic asses from half-asses; moreover, onagers which have occasionally been described as domestic animals,[15] on the basis of their representations[16] are now thought to have never become real domestic animals.[17] The onagers in question must have been captured when young, and then tamed; however, since they did not breed in captivity, they never became real domestic animals. The opinion that practically all domestic asses originated from the Nubian wild ass has now been generally accepted. This view is supported by zoological and archaeological evidence alike. In particular, the stripe along the back, the cross-stripe on the shoulders and the pattern of stripes on the legs point to this origin, since with the majority of domestic asses these characteristics are like those of the Nubian wild ass. Further evidence is provided by the fact that the earliest domestic asses were found in the distribution area of the Nubian wild ass. Finally, the oldest Egyptian representations of domestic asses show animals reminiscent of the Nubian wild ass, with a strong stripe across the shoulders and with blurred horizontal stripes on the legs.[18] To what extent the other two subspecies of wild asses contributed to the evolution of the domestic ass has not yet been clarified, but there is substantial evidence to indicate that an important role may have been played at least by the North West African subspecies (see below).

THE EARLIEST DOMESTIC ASSES

The opinion formerly prevailed that the first domestication of asses must have taken place south of Egypt and from there asses spread to Egypt. However, it is now known that the original distribution area of the Nubian wild ass also included Egypt and thus it seems highly probable that its earliest domestication was carried out there — under the stimulus of the domestication of other animals. Unfortunately, no analysis has yet attempted to separate wild ass bones from those of domestic asses, so that it is not yet possible to decide whether the bones of asses unearthed with

[13] Stehlin, H. G., Graiziosi, P., 1935, pp. 4 ff.
[14] Keller, C., 1909, p. 61; 1923, p. 14
[15] Hilzheimer, M., 1930, p. 426
[16] Zervos, C., 1935, Table 75; Zeuner, F. E., 1963, 307, fig. 14: 4
[17] Zeuner, F. E., 1963, p. 369
[18] Antonius, O., 1922, pp. 269—270

other domestic animal bones of the middle of the 4th millennium B.C. (First Negada Period = Amrah culture) really belonged to domestic asses as was suggested by Boettger.[19] On the other hand, it is very probable that the asses represented on a slate slab of the second half of the 4th millennium B.C. (Second Negada Period = Gerzeh culture) were domestic, for they are depicted in the exclusive company of domestic animals.[20] In earlier rock paintings of North Africa, asses are always represented together with hunted animals, and were thus probably wild animals themselves. On the other hand, however, in the cave settlements of the territory in question their bones occurred together with the bones of domestic animals, which may point to their domestication.[21]

After their initial domestication, asses very quickly spread to other territories. They first reached the Near East. The fragment of pottery found at Tell Chagar Bazar (4th millennium B.C.) may not bear the representation of an ass[22] but ass bones were found at Tell Duweir in Palestine (Early Bronze Age = c. 3000–2500 B.C.), and the baked clay figure of an ass was discovered in a grave in Jericho (Early Bronze Age III).[23] From that time onwards it was often mentioned both in Palestine and in Syria; it was frequently mentioned in the Old Testament, and in cuneiform writing the name of Damascus was "the city of asses".[24]

Asses reached Asia Minor in the Hittite period (17th—14th century B.C.).[25] Evidently, it was from there that they spread to Europe, to South Russia and the southern Ukraine, where the earliest evidence of their existence dates to the 9th–8th century B.C.,[26] although according to Aristotle (Hist. an. VIII. 151 p. 605a, 162 p. 666b) and to Pliny (VIII, 167) there were no asses in the Pontus. But north of the Pontus, in the Scythian country, they really do seem not to have existed (Herodotus, IV. 27.192), which is also supported by the fact that in Darius' Scythian campaigns, the asses and mules of the Persians frightened the Scythian horses with their voices and their appearance, respectively (Herodotus, IV. 129). Asses were adopted by the Greeks in the last centuries B.C.[27] How well they were known there is demonstrated by the fact that Aristotle was able to describe in detail their change of teeth (Hist. an. VI. 159, p. 577a) and even "the strangles", their most dangerous disease (ibid. VIII. 151, p. 605a). In the works of Greek authors on the natural sciences, we can read detailed advice on the breeding of asses. Among asses in Greece those of Arcadia were particularly famous and in Italy the asses of the region of Reate (Varro II. 6, 1 ff.) were the most famous. In 54 B.C. a breeding ass of Reate fetched a price of 40,000 sestertii (Pliny, VIII. p. 167). In Illyria, Thracia and Epirus, on the other

[19] Boettger, C. R., 1958, p. 106
[20] Ibid.
[21] Ibid.
[22] Mallovan, M. E. L., 1936, fig. 27
[23] Zeuner, F. E., 1963, p. 376
[24] Brentjes, B., 1965, p. 47
[25] Herre, W., Röhrs, M., 1952, pp. 60 ff.; Vogel, R., 1952, p. 134
[26] Pidoplitchko, I. G., 1956, pp. 78, 156
[27] Boettger, C. R., 1958, p. 111

hand, small asses lived (Aristotle, Hist. an. VIII. 162, p. 606b) and thus it is well understandable that in the 2nd century B.C. an ass cost only 25–30 Drachmae in Macedonia (Lucan as. 35, 46).

The Greeks played an important part in spreading asses in Europe. Whereas in the Ukrainian settlements dating to the 1st mill. B.C. bones were discovered only sporadically, in the Greek city colonies on the Black Sea they were found in considerable numbers. For example in the layers of the 6th–1st centuries B.C. at Olbia, 16 ass bones were found along with 5490 others whose identification between horse or mule was uncertain.[28] But ass bones also occurred in the Graeco–Roman layers of Scythian Neapolis, Pantikapaion, Myrmekion, Tyritake and Ilurat.[29]

THE SPREAD OF DOMESTIC ASSES TO CENTRAL EUROPE

Simultaneously with the spread of domestic asses to Greece they spread to Rome and from there to all parts of Europe which were invaded by the Roman conquerors. Zeuner thought it strange that in the territory of the Roman Empire ass bones were found only in the Mediterranean region of France.[30] And yet, as early as in 1888, Schlosser identified an ass metacarpal from Cambodunum (Bavaria, 14–37A.D.–4th century A.D.),[31] and Vogel proved that the Romans had introduced asses to Württemberg.[32] Recently Poulain-Josien has found 21 bones belonging to three asses in the Romano–Gaulish layers of Paris.[33] Remains of asses have also been found in the vicinity of Heidelberg too (c. 100 A.D.)[34] and 17 bones of asses have been found in the Roman villa settlement at Tác–Fövenypuszta in Transdanubia in Hungary.

We know three fine representations of asses from Roman Pannonia. One was produced on the basis of a pattern book of foreign origin in a stone-carver's workshop in Aquincum and shows an ass loaded with amphoras which is attacked by a large beast of prey in a typical Nile landscape.[35] The second is the mould of a seal used for the decoration of a fairly large sized *terra sigillata* (Fig. 128) and represents an old Silenus mounted on a small ass (2nd century–beginning of 3rd century A.D.). It was discovered on the site of the gas works at Aquincum, where a big potter's workshop formerly operated; the famous Master Pacatus also worked there. The artists pursued local traditions and mostly used local motifs.[36] Thirdly, the tombstone of a blacksmith was also found at Aquincum. In his right hand the master is holding a hammer with which he is on the point of

[28] Pidoplitchko, I. G., 1956, p. 91
[29] Zalkin, V. I., 1960a, p. 49
[30] Zeuner, F. E., 1963, p. 382
[31] Schlosser, M., 1888, p. 19
[32] Vogel, R., 1940, p. 110
[33] Josien (Poulain), Th., 1962, p. 238 (Erroneously termed *Equus hydruntinus*)
[34] Lüttschwager, J., 1967, pp. 355 ff.
[35] Nagy, L., 1942, p. 664, CIV, table 3
[36] Nagy, L., 1942, pp. 631 ff.; CXVIII, table 3

Fig. 128. Mould of a *terra sigillata* seal representing an old Silenus riding an ass. Aquincum, Period of the Roman Empire (2nd century—beginning of 3rd century B.C.) Aquincum Museum, Budapest

striking the piece of iron which is held in his other hand. Underneath his figure are represented an ass-drawn cart and facing this a mule.[37]

In contrast to the situation described above we do not know of any find of ass bones from the Migration Period of Central and Eastern Europe, and this is clearly connected with the exploitation of the ass (see below).

So far we have examined the eastern Mediterranean route through which asses spread to Europe. But, according to the latest data, there must have been another, more western route through Gibraltar and the Iberian Peninsula. Da Cunha was the first to mention the bones of asses (identified by H. Breuil) excavated from the Aeneolithic settlement near Vila Nova de S. Pedro in Portugal.[38] He did not realize the significance of the find and rather emphasized the interesting finds of beavers' bones excavated at the same time, for they were the first finds of beavers' remains in the Iberian

[37] Nagy, L., 1942, p. 655, LXV, table 1
[38] Cunha, A. X., da, 1961, p. 5

Peninsula. Later Zeuner mentioned the representation of an ass found at Alacon, in the Teruel Province of Spain, which, in his opinion, could be considered a domestic ass. Its date is thought to be Neolithic, although its chronological position is uncertain.[39] These two finds suggest that a western route existed very probably through which asses spread into Europe, particularly, if we consider that in Africa, directly across from the Iberian Peninsula, there lived wild asses, which were very likely domesticated, and that a lively connexion existed between the two territories in prehistoric times. And here we have reached the contribution of the North West African subspecies of wild asses to the evolution of domestic asses. In the same way as certain characteristics of the Somalian subspecies of wild asses can be demonstrated on those domestic asses living near its original area of distribution — thus proving the domestication of the East African breed of wild asses — so the characteristic features of the wild asses of the Atlas Mountains can be found on the domestic asses of North West Africa and South West Europe. However, to be able to demonstrate this, we must first become much more familiar with the Atlas wild ass.

THE USE OF THE ASS

The ass is the most typical representative of the beasts of burden. Relative to its size it can carry stupendous weights. It is more suited to be a beast of burden than the horse, not only because so it needs less attention, but also because of its calmer nature. If, for example, a loaded ass stumbles and falls with its burden, it remains quiet, unlike the horse, which in a similar situation kicks about and thus makes its release more difficult; on narrow mountain paths the ass proceeds more carefully. On the other hand, it is not so good as a saddle animal, not only because of its smaller size, but also because it moves at a slower pace than the horse. Before horses spread to Egypt, asses were used as the saddle animals of great personnages,[40] but they never became widespread as saddle animals. Most often a litter was fastened between two asses for the traveller to take a seat. Asses can often be seen on Greek or Cyprian representations loaded with amphorae or big panniers (Fig. 129); and as a beast of burden the ass is very frequently used in the Balkans even today. Apart from this it was mostly used in threshing and in treading out grain. It was and is still used in small peasant farms and around the farmhouse in South and South East Europe. In the Roman army it was only used as a beast of burden. According to the edict issued by the Emperor Diocletian in 301 A.D. its burden was not to exceed 200 Roman pounds (65.49 kg). During the Period of the Roman Empire the Roman postal service used ass-drawn light carriages, chiefly for carrying supervising officials on their tours of inspection.[41] After the fall of the Roman Empire there must have been an extraordinary decline

[39] Zeuner, F. E., 1963, p. 377
[40] Boessneck, J., 1953, p. 19
[41] Hundemann, E., 1878, p. 34

in ass keeping in Central Europe, for not a single ass bone has been detected from that period. But later on it spread again from Italy. Religious houses had an important role in its spread in the Middle Ages.[42] From about the turn of the first millenium onwards, asses occurred again in the temperate belt of Europe.[43] In Hungary they appeared again during the Period of the Árpád Dynasty. Placenames formed from the ass'sname were first recorded in the 12th–13th century: for example 1171: In uilla Zamard; 1211: De hinc ad stagnum Somardy et per mediam Piscinam Somardy; 1269: Uenitur ad locum qui dicitur Zamarvth = szamárút (in Hungarian: asses' path); 129: Itur versus de Zamar var (asses' castle).[44] The association between asses and the miller's craft in Europe is very interesting indeed. They were used for carrying sacks and for turning tread-mills. In the same manner they were used for turning water-raising engines, particularly for the deep wells in castles.[45]

Fig. 129. Pack-ass with panniers. Terracotta statuette. Cyprus, 600–100 B.C. Metropolitan Museum of Art, New York, Cesnola Collection. Purchased by subscription, 1874–1876

In general, the flesh of the ass was not eaten. Its lower value must have been the reason why a separate market was appointed in Athens for its sale (Poll. IX. 48). In Rome, too, it was consumed only by the poorest people.[46] In other places, for example in North Hungary, up to quite recent times it was eaten mostly by herdsmen. In Hungary it is predominantly shepherds who keep asses, for an ass is a suitable mount for accompanying a flock of sheep which only proceeds slowly. The asses were often fattened on slightly unripe corncobs, after which they were killed and their meat salted and smoked like pork.[47]

[42] Boettger, C. R., 1958, p. 11
[43] Schatz, H., 1963, p. 7
[44] Szamota, I., Zolnai, Gy., 1902–06, pp. 882–883
[45] Zeuner, F. E., 1963, p. 381, fig. 15 : 6
[46] Zeuner, F. E., 1963, p. 380
[47] Györffy, I., 1925, p. 412

In contrast to their meat the milk of asses was highly valued. Poppea, Nero's wife, used asses' milk as a cosmetic to preserve the whiteness of her skin. For this purpose she kept 500 she-asses (Pliny, XI, 238, Cassius Dio, LXII, 28). Later asses' milk was used as a medicament for a large variety of illnesses from liver complaints to whooping cough. Even as late as just before the First World War, it was the fashion to feed babies on asses' milk, for its composition — particularly with respect to its sugar content — resembles that of mother's milk.

We have only very scanty evidence to provide information on the asses of Central and Eastern Europe in different periods. We have already mentioned the asses of Antiquity in the Balkans. As far as those of Central Europe are concerned, even the little evidence at our disposal makes it clear that their variability in size must have been very wide indeed. Asses in the Period of the Roman Empire were generally small, as indicated by the representation found at Aquincum of an ass carrying Silenus. They were much smaller than Osmankayashi's Hittite asses, although some larger individuals also occurred among them, as is indicated by the metacarpal fragment found at Tác—Fövenypuszta. In the Middle Ages, on the other hand, there is definitely evidence of large individuals like the one whose metatarsus of 227 mm was excavated at Garvan in Romania (Dinogetia, 9th—12th century).[48]

THE MULE

There seems to be no doubt that from very early on asses were crossbred with horses, and moreover, that both of these species were crossbred with onagers.[49] The earliest mules should be sought in West Asia, where the keeping of horses and asses first occurred together.[50] According to Boettger this may have happened in Mesopotamia, in the first half of the 2nd millennium B.C.[51] Brentjes mentions written evidence dating to the 3rd millennium B.C. and slightly later representation of mules in the Near East.[52] In any case the idea of crossbreeding horses with asses must have spread to Europe from South-West Asia, for Homer (Iliad, XXIV, 278) attributed the keeping of mules to the Mysians in Asia Minor.

It is interesting to note that Homer also mentions wild mules, but their existence is very improbable.[53] The first mules may have reached South-East Europe in the 8th—7th century B.C., for at the Olympic Games of 580 B.C. mule races were held. Lame Hephaistos was often represented by the Greeks seated on a mule (Fig. 130) as were women riding mules in an armchair-like side-saddle (Fig. 131). From Greece the keeping

[48] Gheorghiu, G., Haimovici, S., 1965, p. 180
[49] Antonius, O., 1955, p. 229
[50] Zeuner, F. E., 1963, p. 383; Ambros, C., 1962a, p. 260; Gheorghiu, G., Haimovici, S., 1965, p. 180; Müller, H. H., 1962, p. 83
[51] Boettger, C. R., 1958, p. 210
[52] Brentjes, B., 1965, p. 52
[53] Devereux, G., 1965, pp. 29 ff.

of mules spread, on the one hand, to Italy and on the other to Central Europe through South Russia and the Balkans. In the Greek city colonies of the north Black Sea coast (the South Ukraine) — as already mentioned — large numbers of mule bones, sometimes totalling several thousand, have been found.[54] These mules were quite big and it was often impossible to distinguish their bones from those of horses. Thus we have to think of mules with horse mares for their mother and he-asses for their father.

No mule bones have been found in Central Europe, but two fine representations of mules are known from Pannonia. One of them is on the tombstone of the Aquincum blacksmith already mentioned, the other is on a limestone slab from Szőny (Brigetio, 3rd century, Fig. 132).[55] On this latter, a mule-driver is represented dressed in a hooded cloak (a Celtic garment), standing in the middle; on each side of him is a loaded mule shown in profile. Although the mules resemble horses, their big ears easily identify them. In Aquincum the tombstone of a mule driver (mulio) has also been excavated,[56] on which in addition to the inscription, a wheel and a whip are represented. The loaded mules on the slab from Szőny and the wheel on

Fig. 130. Hephaistos riding a mule, represented on the fragment of a kantharos of Boeotia, 6th century B.C. Metropolitan Museum of Art, New York, donated by N. Koutoulakis, 1960

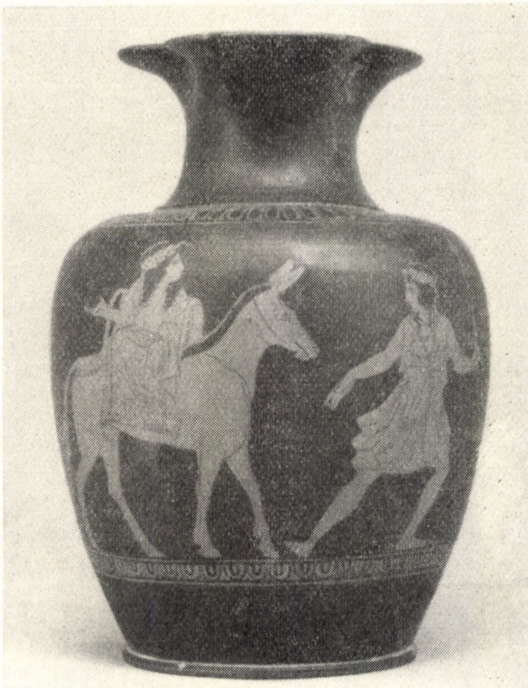


Fig. 131. Greek red figure vase with a woman riding a mule in a chair-like saddle 5th century B.C. (460—420). Metropolitan Museum of Art, New York, Rogers Fund, 1920

[54] Pidoplitchko, I. G., 1956, pp. 91 ff.
[55] Archeológiai Értesítő, 1910, p. 317, Fig. 3
[56] Nagy, L., 1942, p. 655

Fig. 132. Mule driver and two packed mules represented on a limestone slab of the Period of the Roman Empire. Szőny, 3rd century A.D. Hungarian National Museum, Budapest

the tombstone of the mule driver from Aquincum clearly show the twofold use of the mule: beast of burden and draught animal.

At all times, good mules have been highly valued. As mentioned above, they were used primarily as beasts of burden and draught animals, but sometimes also as saddle animals. Thus, mules were used in the postal courier service established by King Cyrus.[57] Roman people of rank would often harness mules to their carriages or use them as saddle animals. Nero had silver sandals made for his favourite mules (Suetonius, Nero, 30) and

[57] Hankó, B., 1954, p. 99

his wife Sabina had gold ones made (Pliny, XXXIII, 140; Cassius Dio, LCII, 28). It was a widespread custom to hitch mules to hearses. Thus, the hearse of Alexander the Great was drawn from Babylon to Alexandria by 64 decorated mules.[58]

[58] Zeuner, F. E., 1963, p. 383

THE CAT

The cat does not belong among those animals which were domesticated for their meat, so that economic factors played a very minor role in its initial domestication. Nor did it prove to be very profitable economically in its later history, in the Period of the Roman Empire and ever since the Middle Ages it has been considered more as a pet.

Its wild ancestors are to be found in the genus *Felis* s. str., which has three species; of these the European wild cat (*Felis silvestris* Schreb.) is distributed in most parts of the continent, as well as in the Caucasus and Asia Minor. It used to be much more frequent and its bones have been found in the fauna of every prehistoric site which has a large quantity of bone samples. The second species, the manul (*F. manul* Pall.) lives in the steppes of Central Asia and the third, the Nubian wild cat (*F. lybica* Forster) is distributed over a territory ranging from the Balearic Islands through Corsica and Sardinia, over the greater part of Africa and Arabia as far as India. On the basis of colour and hair, the three species can be easily distinguished from each other, but osteologically there are strongly overlapping features. The third of the above species, the Nubian wild cat, provided the original ancestor of the domesticated cat. It is not impossible — although there is no positive evidence yet — that European wild cats were also domesticated. If this latter is true, the domestication did not take place until the Middle Ages at the earliest.

Domestication brought about essential changes to the cat. Szunyoghy dealt in detail with the morphological differences between the skulls of domestic and wild cats.[1] According to him, the chief distinguishing features are the following: on account of the well-developed tuber frontale of the frontal bone the wild cat skull shows a more convex profile than that of the domestic cat. When viewed from above the zygomatic arch of the domestic cat appears to be parallel with the main axis of the skull, whereas with the wild cat it broadens more markedly caudolaterally. The zygomatic arch of the domestic cat measured at its narrowest point dorsoventrally is thicker than that of the wild cat. The hollow at the caudal end of the domestic cat's nasal bone is highly characteristic of its skull, for on the skulls of wild cats it is mostly missing or occurs only in traces. On young animals this difference is even more conspicuous. The processus zygomaticus of the frontal bone is rather broad with the domestic cat and narrower with the wild one. Finally, the dentition of wild cats is markedly stronger, particularly the

[1] Szunyoghy, J., 1952, pp. 177 ff.

canines and the carnassials. In association with this feature the diastema behind the canine on the domestic cat's jaw is strikingly large.

Zeuner thought it very probable that there was also a great difference between the size of wild and domestic cat skulls. In his opinion, skulls of 90 mm and below (he did not indicate what measurement he meant, but probably it was the overall length) belonged to domestic cats, and of 105 mm and above to wild ones.[2] Unfortunately, this is not supported by closer examination, for he omitted to take into consideration the fact that the castration of juvenile cats may result in veritable giant skulls. Szunyoghy published a skull originating from a castrated cat, and its size rivalled that of the sturdiest wild males.[3]

Domestication has also caused changes in the body proportions, particularly of the extremities. Another interesting domestication feature is the shortening or the disappearance of the tail, and this is the consequence of simple mutation.[4] The most significant changes appeared in the quality of the hair (on this basis, domestic cats are classified into longhaired and shorthaired groups) and its colouring. Whitening and spottedness emerged quite early as is indicated by numerous representations; on the other hand, domestic cats with the colouring of wild ones are quite frequent even today. The transformation of the digestive system indicates changes in nutrition concomitant with domestication: whereas the length of the intestinal canal of the wild cat is only three times as much as the length of its body, that of the domestic cat is five times as long.[5]

The first domestication of cats took place, in all likelihood, in Egypt, although Zeuner mentions a single tooth from the Pre-Pottery layers of Jericho (c. 6700 B.C.), which he indicated, with a question mark, as having belonged to a domestic cat;[6] later, however, he changed his mind.[7] Brentjes may have relied on Zeuner's find when he suggested that it was probable that domestic cats had been kept in Jericho at the end of the 6th and at the beginning of the 5th millennium B.C.[8] In his view, domestic cats were widespread in South Iraq at the beginning of the 3rd millennium B.C.; moreover, on the basis of a Haçilar statuette, he dated the domestication of cats as far back as the 6th millennium B.C.[9] Unfortunately, it is not certain that the animal represented on the cylinder seal from Ur, the sole piece of evidence from which he inferred a general spread of domestic cats in southern Iraq at the beginning of the 3rd millennium B.C. or the animal on the statuette of Haçilar, are cats at all (they may have been mongooses, which were kept as domestic animals in Egypt[10]). With the animal on the Haçilar statuette the clue to its domestication may be the

[2] Zeuner, F. E., 1963, p. 389
[3] Szunyoghy, J., 1952, p. 180
[4] Zeuner, F. E., 1963, p. 399
[5] Zimmermann, Á. G., 1914, p. 5
[6] Zeuner, F. E., 1956, p. 4
[7] Zeuner, F. E., 1963, p. 390
[8] Brentjes, B., 1962, p. 82
[9] Brentjes, B., 1965, p. 83
[10] Morrsion-Scott, T. C. S., 1952, p. 866

fact that it is held in the arms of a woman. But even this is not sufficient evidence, for the petting of young animals — including the young of wild beasts — has been customary in all periods. We do not know exactly when cats were first domesticated; although domestic cats occurred in the Ancient Empire of Egypt,[11] it is only from the New Empire onwards (16th century B.C.) that we can speak of genuine cat keeping.[12] On the basis of the examination of numerous mummies of Egyptian domestic cats, one can say that they represented a fairly homogeneous population and originated, as is shown both osteologically and by their representations, from the Nubian wild cat.[13]

From Egypt the domestic cat spread to Europe first through Greece and then, with the expansion of the Roman Empire to Africa, through Italy. The earliest representation of a cat in Europe is from Palaikastro on the island of Crete, dated to before 1100 B.C.[14] From the Greek mainland the first representations are known from the 5th century B.C. But it is probable that cats had spread there earlier, for it has been possible to prove their existence osteologically as early as the 6th—5th century B.C. in the Greek city colonies of the northern coastal region of the Black Sea and adjacent regions (they were kept as pets by Scythian persons of rank).[15] In all probability it was through Greece that they reached the Balkans, whereas they were introduced to Central Europe by the Romans. At sites in the Roman provinces, particularly villas and towns, bones of cats almost always occurred. Unfortunately, we do not know much about these cats since the different authors have tended only to emphasize their small size.

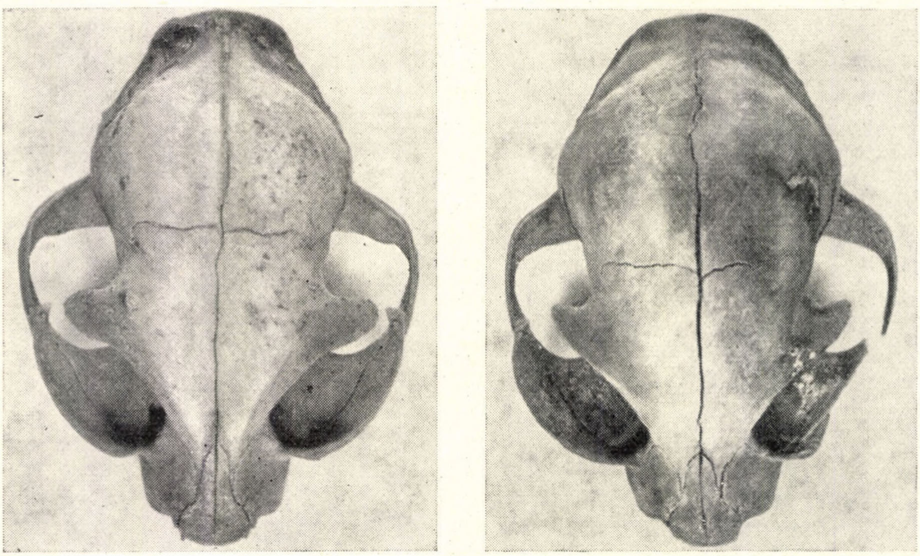
The earliest cat bones in Hungary were discovered at the Roman villa settlement of Tác and at the Albertfalva camp. There was an exceptionally large number excavated at Tác: 49 bones belonging to 14 individual cats. At Albertfalva a skull was also excavated; both this skull and the extremity bones indicate that they were small animals. The range of variation in size was narrow, but sexual dimorphism — as is the case, in general, with primitive domestic animals — was extensive.

With the disappearance of Roman animal keeping, cats became very rare during the Migration Period. A find dating to this period from Biebrach is of special importance: it consists of the skeletons of three cats found in an early Frankish grave.[16] O. Keller described a cat skeleton, which had been lying on the chest of the human skeleton, excavated in a Vandal grave in Hungary.[17] From a Roman or Migration Period well at Keszthely—Deák u. Sörkert (Beer Garden) the incomplete skeleton and skull fragments of an adult domestic cat have been excavated. It is interesting that in an Avar grave (Bóly—Sziebert puszta, grave No. 60) skull fragments and the incomplete skeleton of a wild cat were discovered.[18]

[11] Kuschel, P., 1911, p. 25
[12] Boessneck, J., 1953, p. 25
[13] Morrison-Scott, T. C. S., 1952, p. 866
[14] Zeuner, F. E., 1963, p. 392
[15] Zalkin, V. I., 1964a, p. 8
[16] Kutsch, F., 1921, p. 32
[17] Keller, O., 1909, p. 80
[18] Bökönyi, S., 1963a, pp. 93, 95

Cats only became really frequent in Central and Eastern Europe in the Middle Ages, although in the 14th–15th century they were distributed chiefly in religious houses and in towns. At this time also the cat was considered primarily as a pet, although there are early records of cats having been kept in granaries to kill rodents. The superstitions and misbeliefs about cats are also of mediaeval origin. In many places, cats were considered to be animals of the satan (see black cats); in other places they were said to breathe the plague, to poison the water, to be the permanent companions of witches and to turn into witches themselves on certain occasions, etc. Because of this cats were burned on certain holidays, in other places they were hurled out of towers or killed in other ways.

In the refuse pits of mediaeval towns and castles numerous skeletons of cats were found, often with undamaged skulls (Figs 133 and 134). Unfortunately, their measurements are generally not available so that they cannot be comprehensively evaluated. Generally, they were small, primitive animals, amongst whom different breeds cannot be distinguished. Nor is it likely that there was a conscious effort to produce different breeds. Conscious competitive breeding with purely aesthetic aims in mind was launched only in modern times.



Figs 133–134. Two skulls of cats. Visegrád–Alsóvár (Lower castle), 16th century

THE DOG

THE SIGNIFICANCE OF DOG

The origin of no other species of domestic animals has been dealt with so often and by so many people as that of the dog. This may have been due to the special rank among domestic animals which the dog has occupied throughout its history by which it has grown so close to modern man. The abundance of different forms of dogs in modern times — a feature that can be surpassed perhaps only by the domestic rabbit — may have aroused the researchers' interest, encouraging them to find the origin of this fact. Perhaps this interest springs from the fact that the dog is the species of domestic animals of which the richest collections of skulls and skeletons are accessible to researchers — both with respect to domestic breeds and to species that could be taken into consideration as wild ancestors. These, and other reasons may have collectively played a part, but the fact remains that there are a very large number of investigations into the origin of domestic dogs.

The dog did not belong among those domestic animals which were important from an economic point of view, nor does it belong among them today. There was such aim in its initial domestication — if man had any conscious purpose with it at all. There are authors who believe that the domestication of dogs was in fact a self-domestication in which man played no deliberate role.[1]

WILD FORMS

At the end of the Pleistocene the animals which can be taken into consideration as wild ancestors of the dog evolved and occupied the area in which they were distributed in the Holocene. Among them the wolf (*Canis lupus* L.) spread over the whole of Europe, in North and Central America, and in Asia, in Siberia, Japan and India, with numerous subspecies, of which the northern ones were bigger and the southern ones much smaller. But with the expansion of the forest clearance and the increase in the density of the population the distribution area of the wolf shrank considerably and today it is to be found in Europe only on the Iberian and the Apennine Peninsulas,

[1] Hahn, E., 1909, pp. 60 ff.; Reinhardt, L., 1912, p. 3; Stegmann, v. Pritzwald, F. P., 1924, pp. 6—7; Klatt, B., 1927, p. 5; 1938, p. 32; Szilády, Z., 1927, p. 43; Gandert, O. F., 1932, p. 374

and in North, East and South East Europe. The jackal (*Canis aureus* L.) lives south of the distribution area of the wolf, in an area stretching from Sumatra to India, the Caucasus, the Near East and Asia Minor to South-East Europe; occasionally individuals occur in the Carpathian Basin. In the early Holocene this species was also distributed over a much larger territory whose extent, however, has not yet been clarified. Finds of the wolf, sometimes complete skulls (Fig. 135) were more than once discovered in prehistoric sites of Central Europe. The distribution areas of the two species overlap in a broad zone. In nature, however, no interbreeding of the two occurs.

The wolf and the jackal were the two species that chiefly emerged in works discussing the origin of the domestic dog; at times they were mentioned together, at others either one or the other. In other instances a hypothetical wild dog was also suggested among the wild ancestors. There was an author as recently as 1951 who classified domestic dogs into two groups: one descending from the wolf and the other from the jackal.[2]

But today, on the basis of comparative analysis of morphology, physiology and interbreeding, there is almost an unanimous conclusion that the wolf was the wild ancestor of all domestic dogs.[3]

The taming of juvenile wolves is not difficult, particularly of the small, southern subspecies, the *Canis lupus pallipes* Sykes (distribution area Iraq and India) and the *C. l. arabs* Pocok (in Arabia). For this reason most modern authors consider them to have been the wild forms from which the earliest domestic dogs originated. The situation seems to have been the same as in the case of the domestication of cattle: since only juvenile animals were suitable for domestication the size of adult individuals was of no particular importance. In recent experiments it was also shown to be possible to tame the youngs of the large northern subspecies of wolf and certain of the earliest domestic dogs also point to such northern wolf ancestors.

CHANGES BROUGHT ABOUT BY DOMESTICATION

Outstanding among the changes caused by domestication is the decrease in the size of teeth and the shortening of the rows of teeth. (This is concomitant with the shortening of the facial part of the skull, a process that can develop into pugheadedness.) Certain teeth became crowded, a change that appeared quite early, already in the Neolithic. The role of certain teeth was changed and parallel with this their degree of development also underwent a change. Thus, for example, with wolves, which are purely carnivorous, the upper carnassial, the P_4, is generally longer than the total length of the two molars. With domestic dogs which are also kept on vegetal food this proportion is generally reversed.

[2] Lorenz, K., 1952, pp. 32 ff.

[3] Herre, W., 1958, p. 32; 1959, p. 90; Degerbøl, M., 1961, p. 46; Nobis, G., 1963, pp. 306 ff.

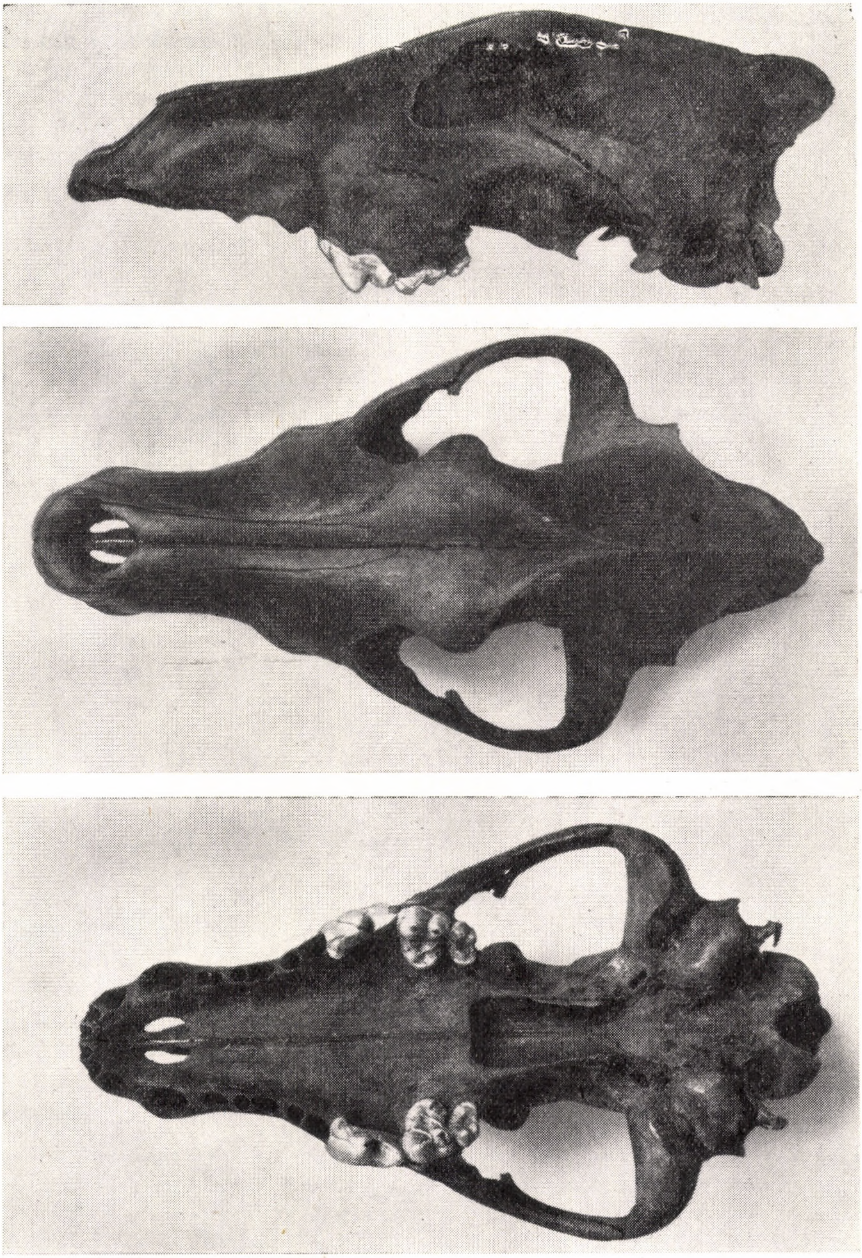


Fig. 135. Skull of a wolf. Zalaszentmihály, Bronze Age

There is also a marked decrease in the size of the brain with domestic dogs; this can be as much as 20–30 per cent. This decrease is particularly strong in the cerebrum, in which the areas that comprise the centres of smelling, seeing and hearing lose some of their volume. These are no longer as important with the domesticated dog as they are with the wild animal.

Domestication is associated with a decrease in body size, which in the initial stages of domestication was considerably marked. Early Neolithic dogs hardly equalled half the size of wolves. After the launching of conscious animal breeding, big breeds of dogs were evolved, although these never reached the size of wolves.

With domestication marked changes also appeared in the proportions of the body. In this connexion it is sufficient to point out the huge variation in body proportions and stature of the c. 400 breeds of dogs which live today. The proportions of the extremity bones also underwent a change. With some breeds these bones became longer (greyhound), with others they became shorter (Pomeranian dog), with yet others they became distorted and twisted around their longitudinal axis (dachshund). Some of these changes appeared quite early. The earliest greyhounds, for example, appeared in ancient Mesopotamia,[4] and during the Period of the Roman Empire they spread to Europe. The dachshund seems to have also emerged in the Roman Period, through a process of mutation.

The curling of the tail upwards onto the back is an interesting symptom of domestication. Since it never occurs with wolves, domesticated dogs can be identified fairly well in early representations. Flop-ears are also symptoms of domestication — as is the case with other domestic animals — but it is not known when they first appeared.

In the quality and colour of the hair domestication brought about substantial changes. The wild colours of wolves have been retained by some breeds of dogs, e.g. by the Alsatian, but alongside this, masses of colour variations and types of markings emerged. Similarly, the quality of the hair shows all kinds of variations, from baldness (bald dogs of China, America and Africa) to long, curly hair (*komondor*). However, there are great difficulties in investigating changes of the hair caused by domestication: there is no organic evidence available for such examinations, so that it is necessary to rely completely on representations: these, however, are rather poor in both quantity and quality.

THE EARLIEST DOMESTIC DOGS

There is no doubt that the earliest domestication of dogs took place in the Mesolithic, prior to the agricultural revolution. According to our present evidence the earliest remains of domestic dogs were found — against all expectations — in North America. The part of a right maxilla, a pair of mandibles and a left mandible were unearthed from the Jaguar Cave at Birch Creek Valley in Idaho. Radiocarbon dating has set their origin at

[4] Zeuner, F. E., 1963, p. 100

c. 8400 B.C.[5] They were small dogs with short, broad muzzles and in the lower row of teeth the crowded position of the premolars — proof of domestication — can be well observed. On the basis of the characteristics of their dentition, these dogs were definitely descendants of wolves, moreover, of the type found in the Old World; in all likelihood they had got to America from Eurasia, where there must have been an earlier domestication centre.

The earliest finds of the domestic dog in Europe were discovered in the Senckenberg morass in Germany,[6] and at Starr Carr in England.[7] The two finds are approximately synchronous; the latter is dated by radiocarbon analysis to 7538 ± 350 B.C. The dog of the Senckenberg morass was of a more primitive type and was closer to the wolf, whereas the Starr Carr dog — according to Degerből[8] — seems to have been a genuine domestic dog and not a first generation domesticated wolf; thus at Starr Carr domestication must have been started much earlier.

The earliest domestic dog of the Near East is of a much later date than the above: it dates to 7000 B.C., and was found at Cayönü in Anatolia.[9] In this region sheep and goats seem to have been domesticated earlier than dogs.

Different authors have described many types of dogs from European prehistory, in which they have attempted to identify the direct beginnings of certain present breeds, whose skull form resembles that of the prehistoric dogs. However, they were not really independent types but individuals within a highly variable population, the details of which are still not fully understood. Thus we use their denominations here only to give an indication of a certain size group or a type of skull form. On this basis we can distinguish certain types of dog.

The first type of this kind was Rütimeyer's *turbary dog (Canis familiaris palustris)*, the first to be found in Swiss Neolithic sites.[10] It was a small, spitz-like dog (also called *turbary spitz*), its skull having a spacious vaulted brain-case and a pointed nose. The *turbary spitz* was discovered in all Swiss Neolithic sites, and has been identified at other prehistoric sites in Europe. Thus Anutchin described a form, somewhat bigger than the Swiss dogs and with stronger bones, which was found at early Neolithic sites on the shores of Lake Ladoga. He called it *Canis familiaris ladogensis*.[11] He described another dog, *C. f. inostranzewi*, which was bigger than the *turbary dog*, also excavated at Lake Ladoga.[12] Another prehistoric dog of Russia, *C. poutiatini*, was described by Studer.[13] In its skull form and size it approximated the *dingo*. The other types that evolved are *C. f. intermedius*

[5] Lawrence, B., 1967, pp. 44 ff.
[6] Mertens, H., 1936, pp. 506 ff.
[7] Fraser, F. C., King, J. E., 1949, pp. 72—73; 1954, p. 118; Degerből, M., 1961, p. 53; 1962, p. 335
[8] Degerből, M., 1961, p. 53
[9] Lawrence, B., 1967, pp. 56—57
[10] Rütimeyer, L., 1861, pp. 116 ff.; Studer, Th., p. 26
[11] Anutchin, D. V., 1884, pp. 1 ff.
[12] Ibid.
[13] Studer, Th., 1906, pp. 24 ff.

Woldr.[14] and *C. f. matris-optimae* Jeitt.,[15] which were medium-sized sheep-dogs and hunters respectively.

We have named only those types of prehistoric dogs most often mentioned. In addition, there are great number of lesser known types. To enumerate them in detail would be superfluous since Hauck's monograph[16] offers a good survey with the original measurements and descriptions.

The earliest finds of domestic dogs in South East Europe date to the middle of the 7th millennium B.C. and were found at Argissa-Magula. As they were discovered in a domestic fauna of South West Asian origin, they had also very probably got to Europe from there. In their size they fall between *C. f. palustris* and *C. f. intermedius*.[17] Only the nondescript fragment of a radius was excavated at Nea Nikomedeia.[18]

The dogs of the pre-Starčevo phases of Lepenski Vir were small animals with crowded premolars in their mandibles as a typical mark of domestication. In the Starčevo phase of the site also medium-sized dogs appeared, however, the small ones still represented the overwhelming majority of the population.[18a]

The Neolithic dogs of Central Europe belonged, by and large, to the same size group. However, alongside them medium-sized dogs appeared quite early. Thus, whereas at the settlements of the Körös culture in Hungary and in Yugoslavia the greater part of the dog bones definitely belonged to small animals, extremity bones of bigger animals have also been discovered, and moreover the incomplete skull of such a dog has been brought to light at Röszke-Ludvár (Fig. 136). This is much larger than the usual *palustris* skulls, and its brain case is less vaulted, but the most marked difference is that the *crista sagittalis* and the *lineae semicirculares* are strongly protuberant.

The situation was more or less the same in the western part of Central Europe as well. Thus, besides the above mentioned small *turbary dogs*, some medium-sized individuals also occurred in Swiss Neolithic settlements,[19] and the dog found at the Senckenberg morass, classified by its describer as belonging to the *C. putiatini*,[20] was also a medium sized of this kind. A highly variable population of dogs is known from the Linear Pottery culture of Germany, a population in which all variants ranging in size from modern foxterriers to smaller Alsatians occurred.[21]

In the Bronze Age the size of dogs increased considerably, for in that period medium-sized dogs became very widespread. In Hungary they became quite frequent but the situation was more or less the same in the whole of Central and Eastern Europe. In addition in the course of the

[14] Woldrich, J. N., 1878, pp. 61 ff.
[15] Jeitteles, L. H., 1872, pp. 18 ff.
[16] Hauck, E., 1950, pp. 34 ff.
[17] Boessneck, J., 1962, p. 31
[18] Higgs, E. S., 1962, p. 272
[18a] Bökönyi, S., 1969, p. 159; 1970, p. 1704
[19] Hescheler, K., Kuhn, E., 1949, p. 289
[20] Baas, J., 1938, pp. 3 ff.
[21] Müller, H. H., 1964, p. 52

Fig. 136. Skull of a dog. Röszke—Ludvár, Neolithic (Körös culture)

Bronze Age an essential change may have taken place in the function of dogs. No doubt, from the very earliest domestication of dogs, they were used as hunting companions of man and later on helped to tend flocks and guard dwellings; in early prehistoric times they also played a part as meat animals. Crushed bones of dogs and their skulls with the brain cases opened found in settlements prove that man ate dogs. The brain seems to have been a favourite delicacy for prehistoric man, for Neolithic and Bronze Age dog skulls have often been found whose brain case was opened with a cut along the medial plane or, by cutting off the os occipitale; sometimes holes were made on the side of the skull so that the brain could be removed. Mention should be made of skulls whose brain case was simply crushed to get access to the brain.

Two dog skulls opened in this way have been found at the Bronze Age settlement of Tószeg[22] (Fig. 137) and a third at Füzesabony from the same period. Hescheler and Rüeger described two dog skulls with opened brain cases discovered at Egolzwil 2 and at Seematte—Gelfingen, but they declared that such skulls were found at other Swiss Neolithic sites too.[23] At Pestenacker (late Neolithic—Copper Age) a similar skull was brought to light by Boessneck.[24] This custom appears to have been widespread also in South West Asia; at least this is indicated by the skull excavated from the Early Iron Age layer of Hasanlu in North West Iran.

As a hunting companion the dog was often buried with its master. The earliest European graves in which domestic animal bones occurred (Hurbanovo and Iza in Slovakia) contained dog skeletons[25] and in the Neolithic—early Metal Ages of the Old World, dogs were the domestic animals most frequently placed in graves. In fact, 42.5 per cent of the total bone sample of domestic animals excavated from graves were of dogs.[26]

In Hungary the finest examples of dog burials were found at the Polgár—Basatanya cemetery.[27] Here five graves yielded skeletons of small dogs, which, with respect to their skull form, belonged to the *palustris* group (Fig. 138).

The essential change that had taken place by the end of the Bronze Age in the use of the dog is that by that period man in Europe had ceased eating dog meat. Moreover, in the late Iron Age deliberate breeding of dogs began: alongside the small- and medium-sized dogs, which made up the bulk of the dog population at the Celtic oppidum of Manching, dwarf dogs appeared as the first signs of breeding selection and the emergence of breeds.[28]

But deliberate breeding became fully developed in the Period of the Roman Empire. Although sporadic data on different breeds of dogs are known in the literature from Greece from somewhat earlier times, and on

[22] Reményi, K. A., 1952, pp. 117—118
[23] Hescheler, K., Rüeger, J., 1942, p. 386
[24] Boessneck, J., 1966c, p. 16
[25] Behrens, H., 1964, p. 18
[26] Behrens, H., 1964, p. 17
[27] Bognár-Kutzián, I., 1963, pp. 98, 111, 114, 129, 137
[28] Boessneck, J., 1961b, pp. 387 ff.

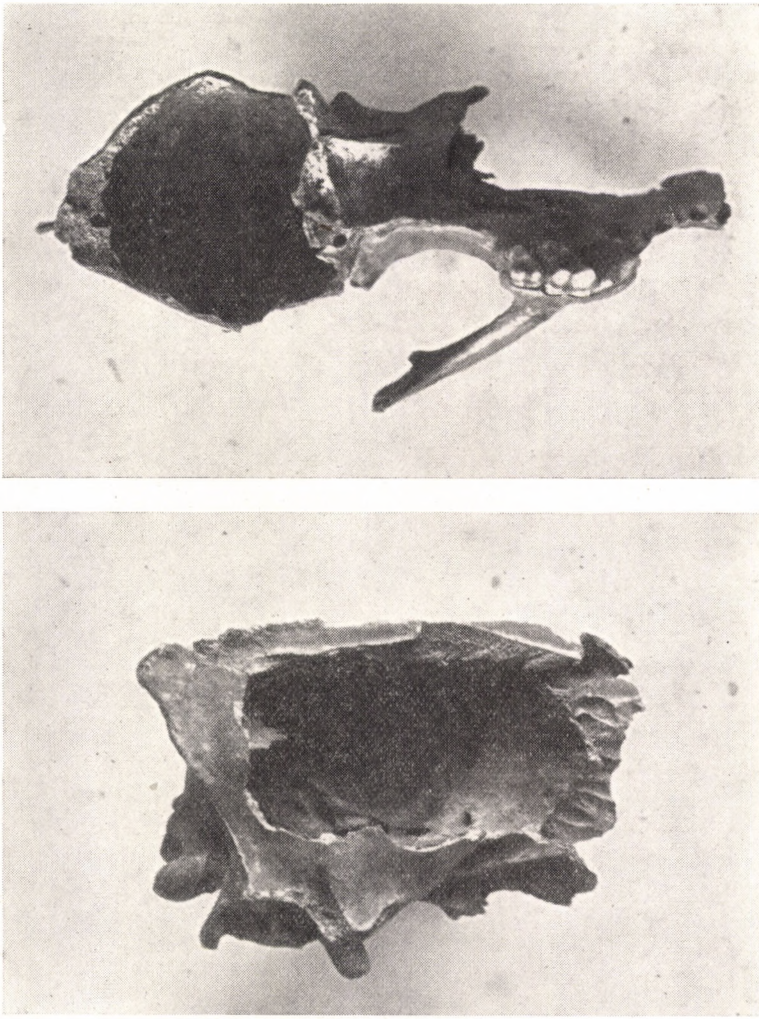


Fig. 137. Fragments of dog skulls with the brain-cases opened. Tószeg–Laposhalom, Bronze Age. After Reményi, 1952

tombstones of the 4th century B.C. several breeds, in particular greyhounds, were represented, but we do not know anything of them osteologically.

Studer,[29] Birkner[30] and Hilzheimer[31] have given good descriptions of the Roman dogs of Central Europe. They emphasized, above all, the occurrence

[29] Studer, Th., 1901, pp. 1 ff.
[30] Birkner, F., 1902, pp. 156 ff.
[31] Hilzheimer, M., 1920, pp. 293 ff.; 1924, pp. 140 ff.; 1927, pp. 47 ff.

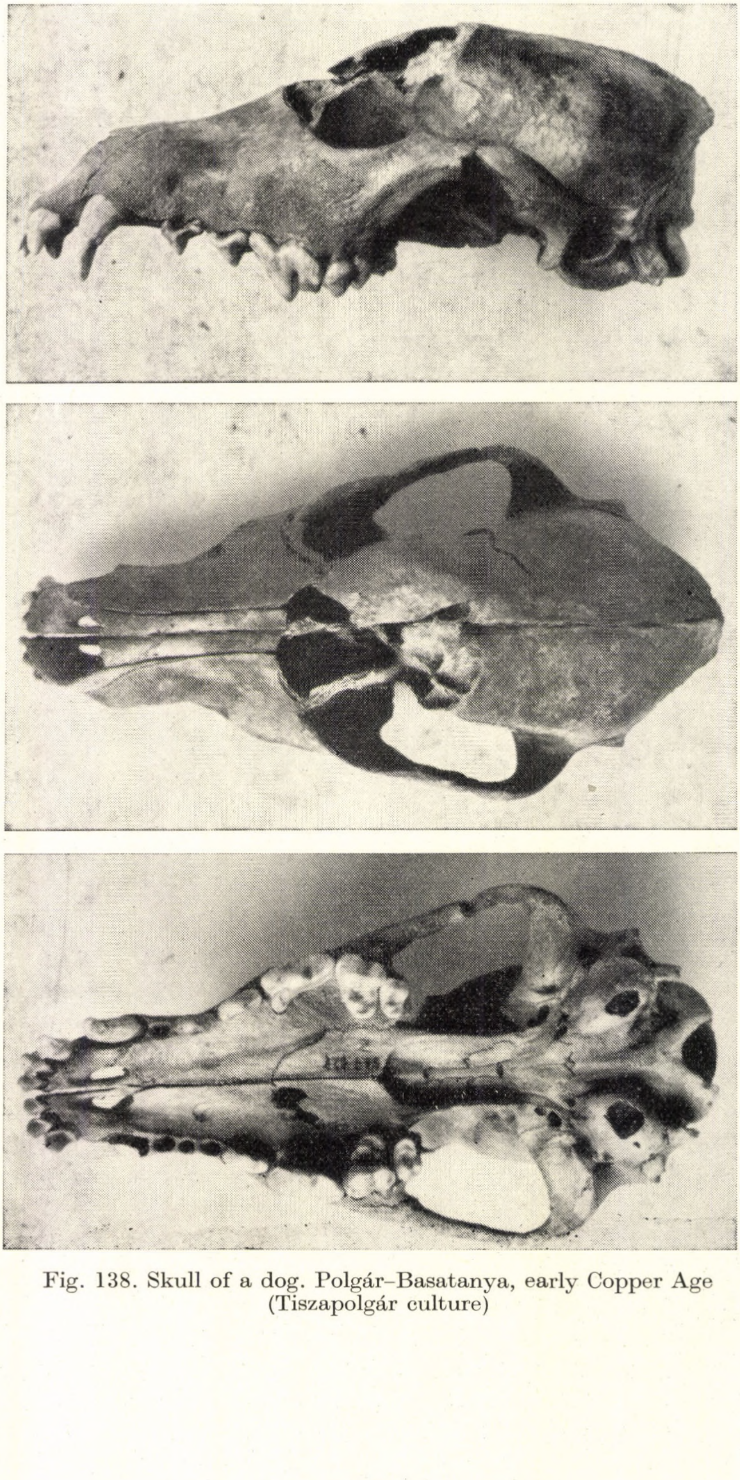


Fig. 138. Skull of a dog. Polgár–Basatanya, early Copper Age
(Tiszapolgár culture)

of small dogs, of dachshunds and greyhounds. The small dogs with thin legs were evidently used as lapdogs. The occurrence of dachshunds and greyhounds is more interesting. The former was evolved in numerous places at about the same time (brachymelia is a rather frequent phenomenon with domestic animals), whereas the latter probably emerged in two centres: a western one in Gaul and an eastern one in the Near East or perhaps in Central Asia. Both groups may have played a part in bringing about Roman greyhounds; on the other hand the greyhounds that reached Central Europe with the peoples of the Migration Period could have originated only from the eastern centre.

As was to be expected, the cities and towns of the Roman provinces as well as their villa settlements, places where people lived a real "Roman" life, were the chief centres to yield bone samples of the Roman breeds of dogs. The villa settlement of Tác in Pannonia is the best example of this. Owing to favourable circumstances the bone samples found there comprised numerous dog bones in very good condition. Among them there were large numbers of dog skeletons which had undamaged extremity bones and often complete skulls. Altogether 50 dog skulls have been excavated at the settlement; half of these skulls were in such good condition that their basal length could be measured.

The majority of the Roman dogs of Tác were thin-legged animals from small to medium size, ranging from the size of foxterriers to that of airdaleterriers with withers height between 45 and 60 cm (worked out with Koudelka's multipliers[32] on the basis of the length of the extremity bones). There were also two dwarf dogs with slightly twisted extremity bones and withers height of 23 – 25 cm. (The size and shape variations of the extremity bones of the Roman dogs of Tác are shown in Fig. 139.) The next size group was a dog of about 30 cm withers height and thin, straight legs (with untwisted extremity bones), then came the dachshunds of about the same size. They were much bigger than the modern dachshunds (and this refers to the dachshunds of all Roman sites[33]); the dwarf dogs of Tác were the size of modern dachshunds.

A very interesting breed among the dogs of Tác was represented by dogs which were somewhat bigger than the large dachshunds, their height being as much as 40 cm, with very thick but untwisted extremity bones. There also occurred some dogs which were bigger than the average, with thicker legs and withers height of 67 cm. They may have been mastiffs, but perhaps only especially big individuals of the average-sized breed. And finally the long and straight, very slender extremity bones of two greyhounds can be clearly distinguished from the rest.

Thus five or six breeds of dogs lived together at Tác. Their extremity bones are well differentiated on the diagrams too (Figs 140—143). This refers in particular to the radius, the femur and the tibia, but can also be discerned on the humerus. On all the diagrams of the long bones, three lines of evolution are conspicuously displayed: the first group included dogs

[32] Koudelka, F., 1884, pp. 1 ff.
[33] Ehret, R., 1964, p. 30

Fig. 139. Line of variation of the tibiae of dogs of Tác in the Period of the Roman Empire

with short, thick legs, with twisted and untwisted extremity bones alike. The second was represented by average dogs along with those that had short, thin legs and the mastiffs (?). Whereas the third line was that of long, thin-legged greyhounds.

The skulls of the Tác dogs can be classified into five groups:

1. Small skulls, with strongly developed, vaulted brain cases and with short, relatively pointed noses. The crista mediana is doubled and slightly protruding; the lineae semicirculares are also very flat. The foreheads are bulging. The skulls of dachshunds belong to this group and are represented by an undamaged skull and a brain case.

2. Skulls reminiscent of the *palustris* type in size and shape. The skull is well developed, and the brain case is strongly vaulted. The facial part is pointed or medium. The crista mediana and the lineae semicirculares are slightly protruding, the forehead is flat or somewhat convex. Eight complete skulls and eight large fragments of skulls belong to this group.

3. Skulls larger than the above, with narrower, and less vaulted brain cases. The crista mediana and the lineae semicirculares are strongly protruding, and the forehead which is flat, is sunk between the latter in a medial position. The nose is moderately broad to broad. 13 completely undamaged skulls and several large fragments of skulls belong to this group. The skulls of the average sized dogs of Tác also belong to this group. This type of skull form also occurs with other dogs of the Roman Period in Hungary (Fig. 144).

4. Skulls resembling the former in shape but larger, with broad noses and often with broad, flat foreheads. They are the skulls of the

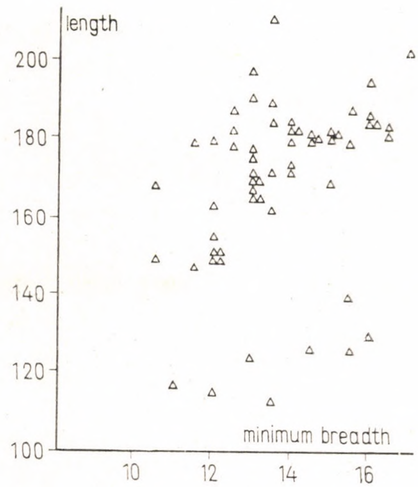


Fig. 140. Variation of the humeri of dogs of Tác in the Period of the Roman Empire

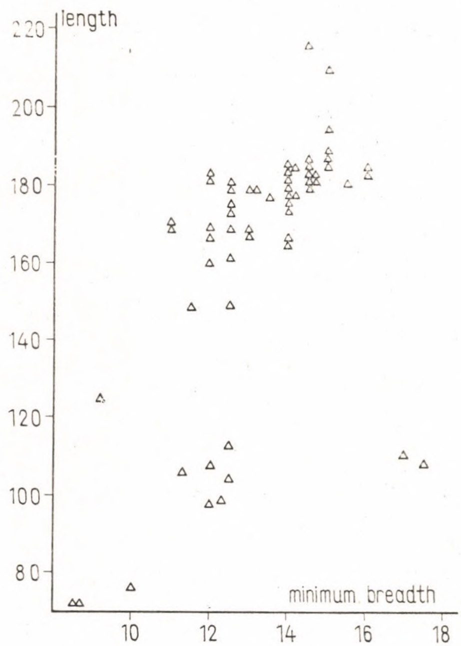


Fig. 141. Variation of the radii of dogs of Tác in the Period of the Roman Empire

biggest dogs (mastiffs?); and comprise three complete skulls and one brain case.

5. The elongated skull of greyhounds with a spacious brain case, a long, pointed nose and a rather flat forehead. One complete skull and an incomplete one.

The five groups of skulls described above can be correlated fairly well with the breeds identified on the basis of the extremity bone analysis.

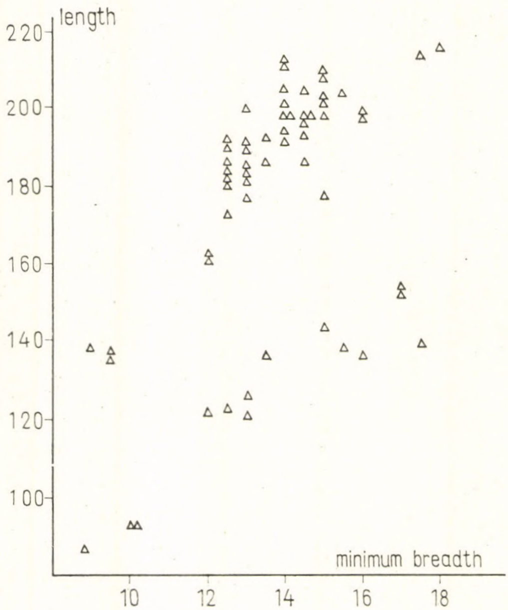


Fig. 142. Variation of the femora of dogs of Tác in the Period of the Roman Empire

No skulls or fragments of the dwarf dogs have been found except for a mandible; the dogs with thin, short legs had, in all likelihood, the same skull form as the dachshunds. At the same time it has turned out that the "average" type of dog, which appeared to be homogeneous on the basis of the extremity bones was not so homogeneous with respect to the skull form; the skulls of these dogs constitute the second and third group of skulls. At the same time, the skull forms reveal the close link by which the big dogs are connected with the former breed.

In the Migration Period the Roman breeds of dogs — as with other Roman breeds of domestic animals — mostly disappeared in Central Europe. This can be stated definitely only concerning the dachshunds, the dogs with thick, straight legs, the dwarf dogs and perhaps the greyhounds, but cannot be ascertained with respect to the "average" breed, since the peoples arriving from the east also brought with them small, medium-sized dogs. It cannot be ascertained whether such a dog was a remnant of the Roman stock or an individual that was introduced later. Skulls or complete skeletons of dogs from this period are not at all infrequent. A fine example of the latter was discovered in a Langobard grave at Hegykő, where two dog skeletons were excavated. They were so similar in size and skull form (Figs 145—146) that — being of the same age — they had evidently originated from dogs of the same litter.

No doubt, the people who spread to Europe from the east during the Migration Period brought along greyhounds from their emergence centre in the east. These latter can be demonstrated both by means of osteological finds and representations in Central and Eastern Europe. The rock drawings of Madara depicting the Bulgarian Khan Krum display the finest likenesses of greyhounds;[34] a greyhound skull was discovered at Zhurovka (Tchernayakov culture, 3rd–4th century)[35].

From the Middle Ages onwards the variations of dogs started to increase again. Although osteologically very little is known about mediaeval dogs, by comparing representations and contemporary descriptions it can be stated that in addition to the average dogs of small and medium sizes there also occurred dwarf dachshunds and Pomeranians (Wyrost demonstrated both breeds in Early Mediaeval Opole and Wroclaw[36]), as well as greyhounds and mastiffs. This proves that in addition to the horse, the dog was the domestic animal of which traces of breeding selection and deliberate breeding survived into the early Middle Ages.

As far as early Hungarian breeds of dogs are concerned, there can be no doubt that the conquering Magyars had greyhounds. This is shown not only by the greyhound's skull excavated at Zalavár (Fig. 147), but also by the numerous place names of Agárd (which is the derivation of the Hungarian name of the greyhound = *agár*). A document dated 1193 also contains the name of the greyhound (*agár*).[37] The name of the beagle (*kopó*), which served as a beater, has been preserved in a deed of 1237.[38] It is highly probable that the *puli*, the *kuvasz* and the *komondor* were also to be found among the dogs of the ancient Hungarians, since all three breeds were distributed from Mongolia to Central Europe. There is evidence of dogs of the *puli*-type in Hungary from the Bronze Age, and in Reményi's opinion Rütimeyer's *palustris* type was not identical with Pomeranians but with terriers, the *puli* being a representative of the latter.[39] Of course, osteological finds do not reveal the most important mark of identity of the *puli*, its hair, though this above all would decide the question whether this breed did live in the Carpathian

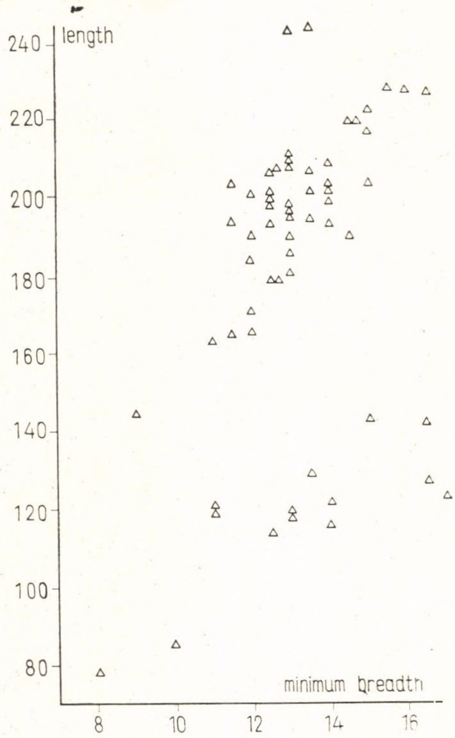


Fig. 143. Variation of the tibiae of dogs of Tác in the Period of the Roman Empire

[34] Fehér, G., 1931, p. 104, fig. 59
[35] Zalkin, V. I., 1966, pp. 54 ff.
[36] Wyrost, P., 1963, pp. 232–233
[37] Hankó, B., 1954, p. 15
[38] Hankó, B., 1940, p. 17
[39] Reményi, K. A., 1952, p, 123

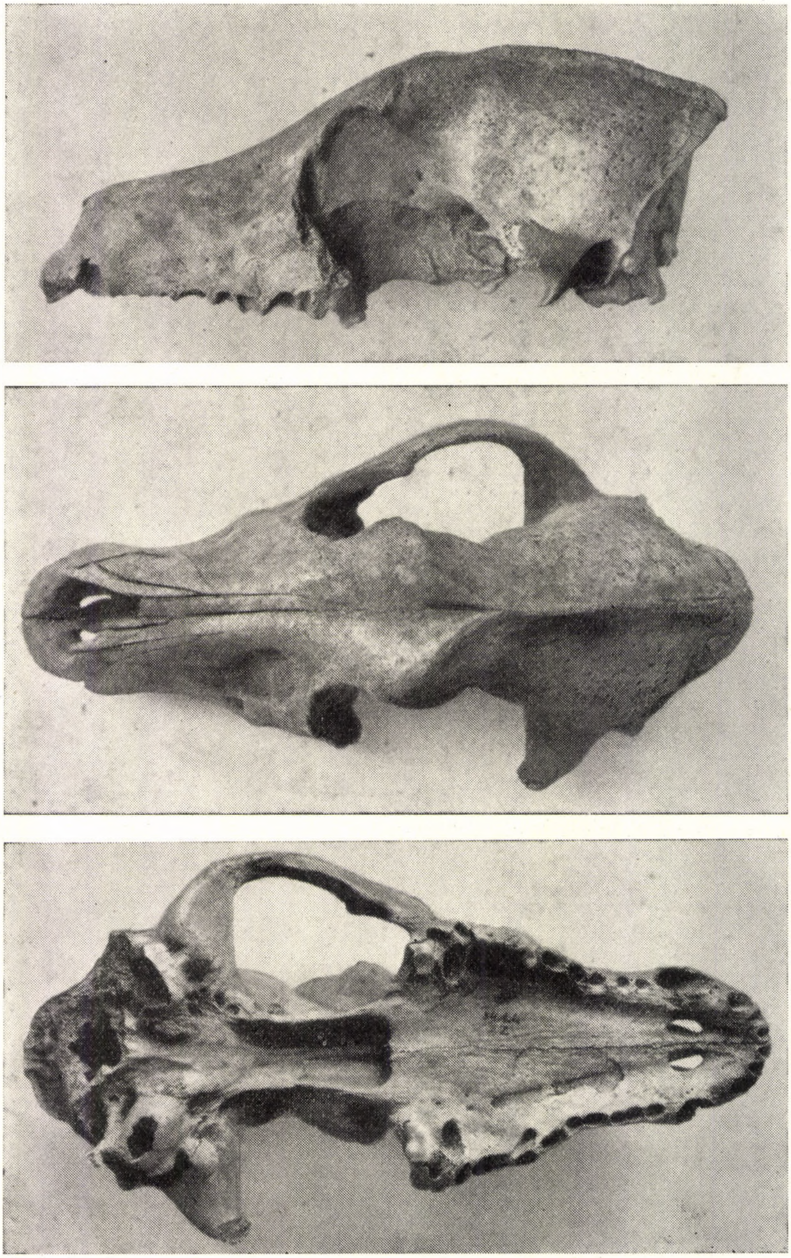


Fig. 144. Skull of a dog. Százhalombatta, Period of the Roman Empire

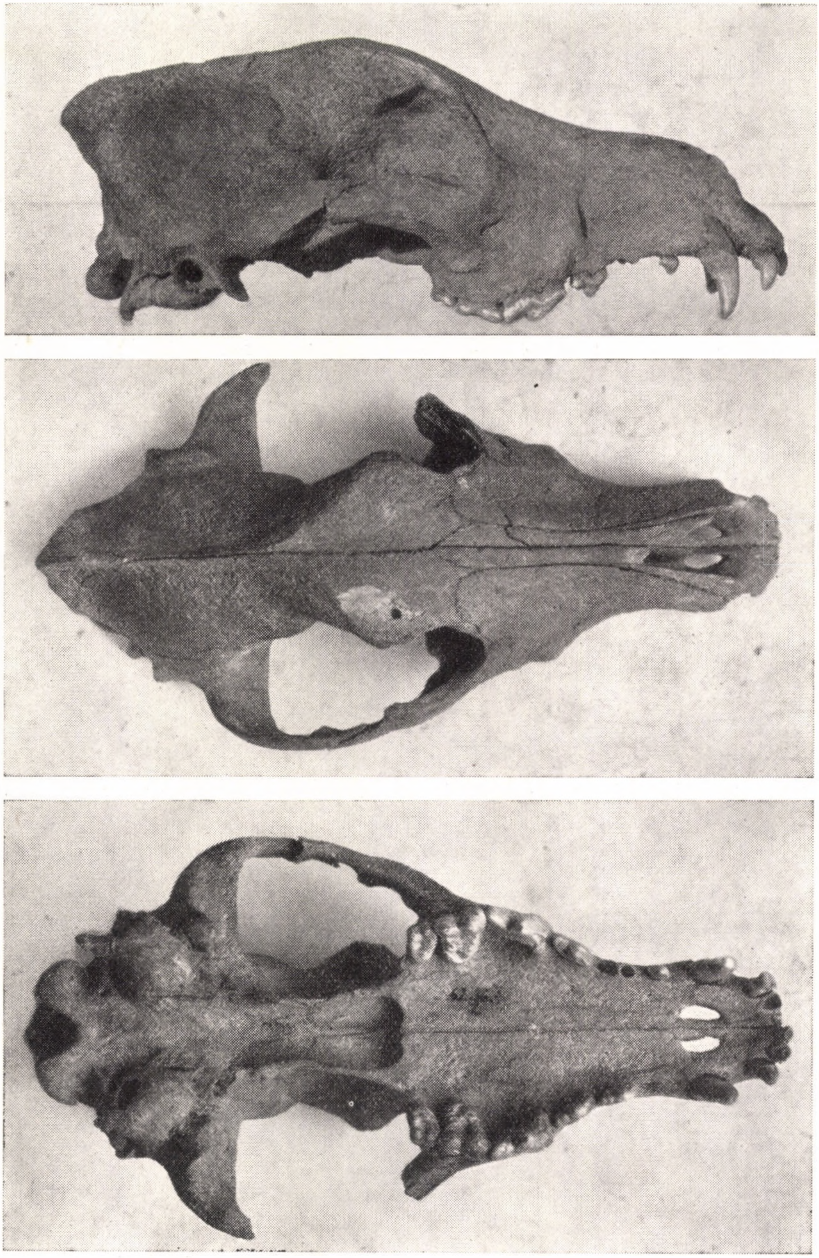


Fig. 145. Skull of a dog. Hegykő, Langobard

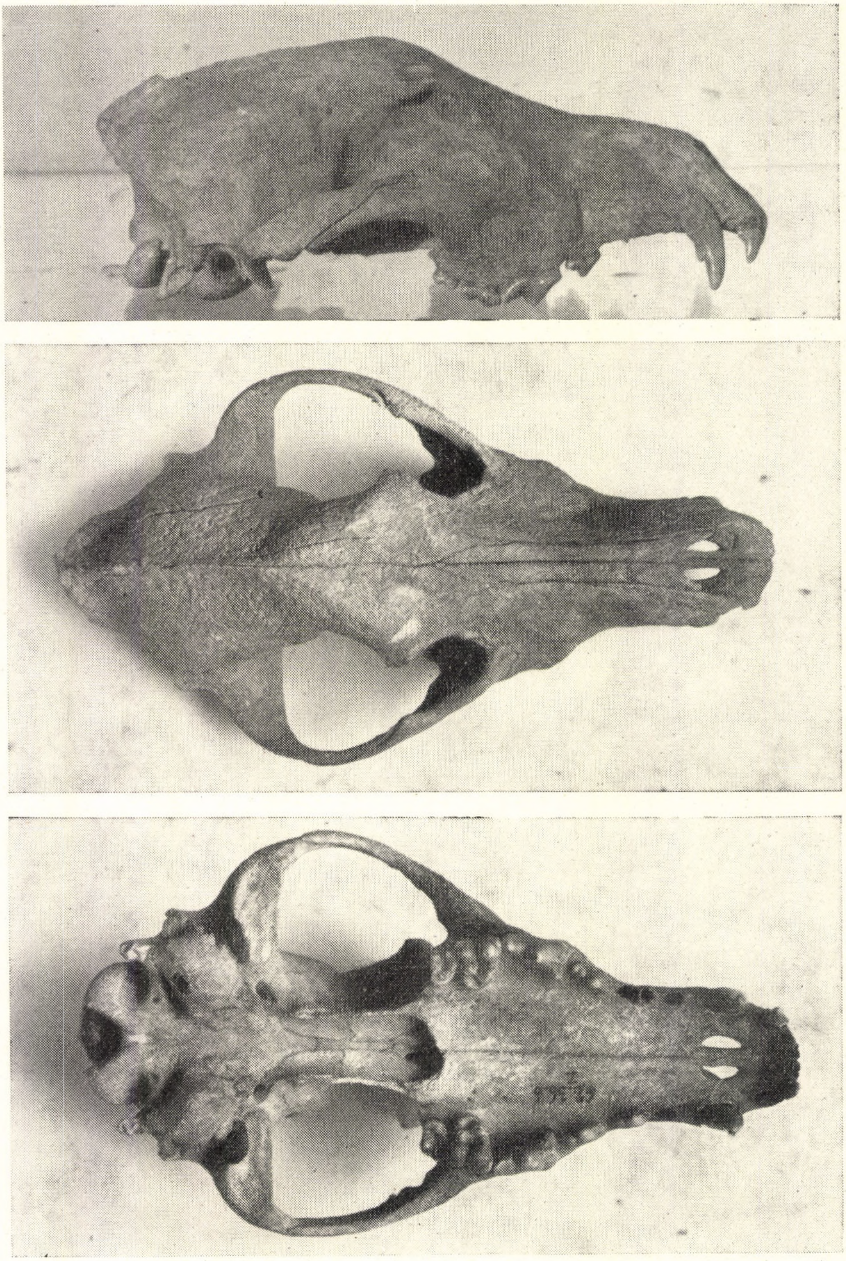


Fig. 146. Skull of a dog. Hegykő, Langobard

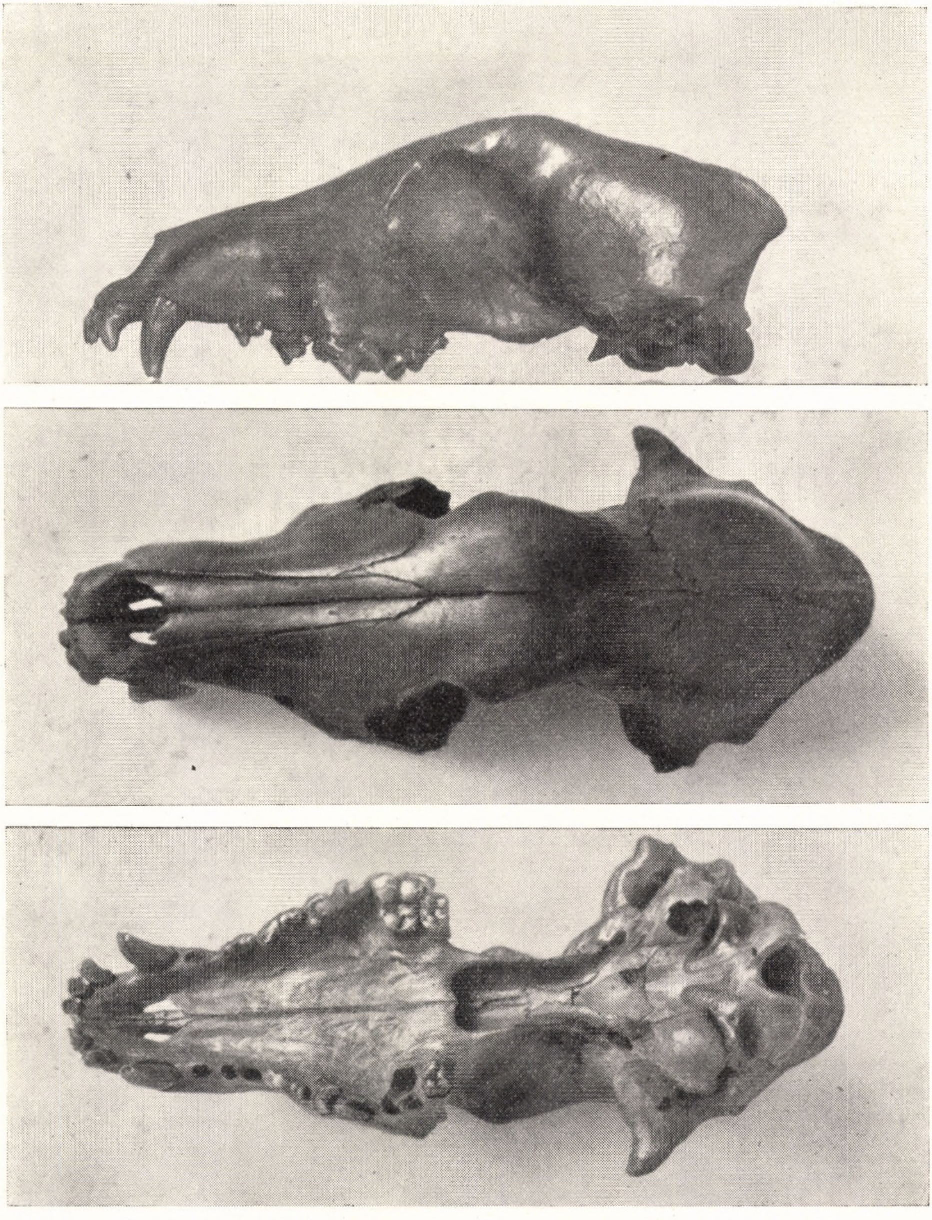


Fig. 147. Skull of a dog. Zalavár, Period of the Árpád Dynasty

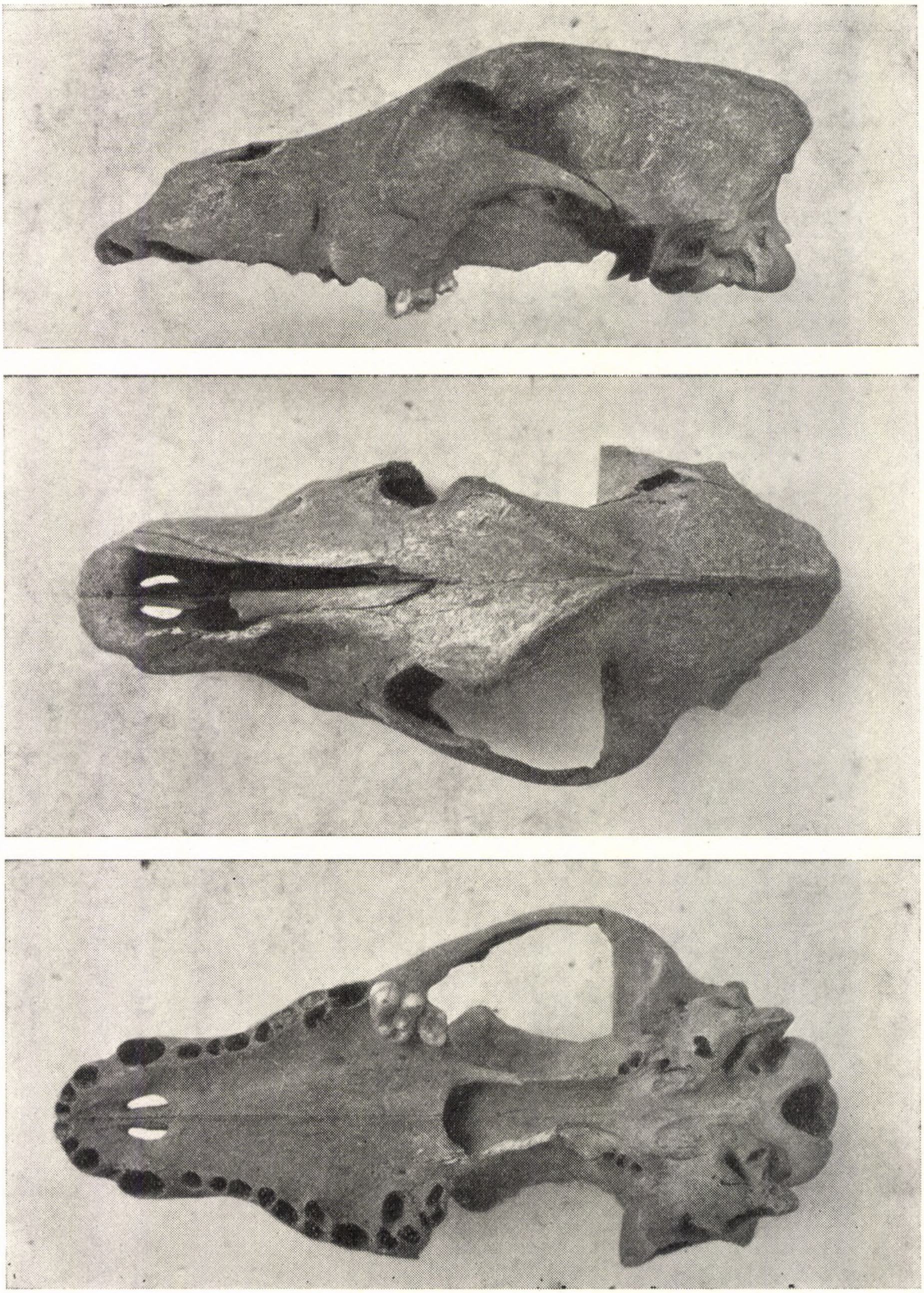


Fig. 148. Skull of a dog. Túrkeve—Móricz, 15th—16th centuries

Basin before the Magyar Conquest or not. The same refers to the *kuvasz*. Dogs of a similar skull form to this also occurred in Hungary before the Migration Period. The name "*komondor*" appeared in Hungary rather late, in 1544;[40] moreover, in the 15th–16th century village excavated at Túrkeve–Móricz a skull, reminiscent of today's *komondor's*, has been brought to light (Fig. 148). At Kardoskút, a village of the Period of the Árpád Dynasty the relatively strong extremity bones of a large dog have been found, unfortunately without its skull. It may also have been a *komondor* but to ascertain this without the skull is impossible.

[40] Hankó, B., 1954, p. 7

THE DOMESTIC RABBIT

The domestic rabbit is one of the latest domestic animals of Europe, for its domestication was commenced only some time at the beginning of the Middle Ages. During the last glaciation its wild form, the wild rabbit, withdrew to the Iberian Peninsula, where its domestication took place. It was from there that domestic rabbits spread first over Europe and then over the whole world.

The rabbit is the animal on which the changes brought about by domestication are perhaps the most marked. In the early stages of its domestication the size of this species also diminished, although we have no direct evidence of this. Today we have dwarf breeds, but most of them exceed the wild form in size, a phenomenon happening with very few domestic animals. (The average weight of the wild rabbit is 2–3 kg, of the dwarf ermine-rabbit 1 kg, but the breed of German giants weighs 8–9 kg.)

The proportions of the skull underwent great changes as a consequence of domestication. The brain case of the wild form is always longer than the facial part of the skull; with domesticated animals this proportion is approximately 1 : 1 or definitely shifted in favour of the facial part of the skull. The breadth of the domestic rabbit skulls is also smaller than that of wild ones. With the diminishing of the brain case the brain also loses some of its weight: the wild rabbit's brain weighs about 22 per cent more than that of the domestic one.[1] The skeleton of the domestic rabbit in general shows the lesser stress to which it is exposed; whereas the skeleton of the wild rabbit amounts to 5.3 per cent of the weight of the body, the domestic rabbit's comes up to only 4.3 per cent of the weight. In addition, the bones of the domestic rabbit contain less inorganic matter and their strength is also less.

The form of the ears has been transformed by domestication (lop-ears) and so has the proportion of certain viscera, of the heart, the lungs, etc. Domestication has also changed the sexual rhythm and prolification. But the changes in the hair and colouring are the most striking. Whereas natural selection eliminates (with the wild rabbit) all colour variations that reduce blending with the surroundings, under man's protection these colour variants have survived. Moreover, breeders have endeavoured to breed the greatest variety of colours or types of colours respectively. A number of mutations added to this and thus now we know of 500 different breeds of domestic rabbits at least, mostly based on their colouring.

[1] Nachtsheim, H., 1949, p. 69

In spite of the fact that rabbits were domesticated only in the early Middle Ages, the Romans kept rabbits in enclosures, the so-called leporaria. At first the leporaria were made for captured brown hares, but later wild rabbits brought from Hispania were also kept in them, although no breeding of either species was attempted. Roman authors (Varro, Pliny, Strabon, etc.) often mentioned the wild rabbits of Hispania and described in detail both the damage wrought by them and the way they had been captured.

The Roman keeping of wild rabbits cannot be considered as domestication, for they only captured the rabbits without endeavouring to breed them. Only in the early Middle Ages, on the Iberian Peninsula, did the first domestication take place. From there the domestic rabbits spread to France at about the turn of the first millennium A.D. In France, rabbits were at first bred in religious establishments, for there it was easy to keep them within stone walls underneath which the animals could not burrow themselves out. The meat of rabbits contributed a variety in the monks' and nuns' diet, especially since they were allowed to eat foetuses or new-born young rabbits while still blind even during fasts. This custom had originated in Antiquity; Pliny mentioned that such young animals were considered tit-bits on the Balearic Islands.[2]

In the 12th century A.D. domestic rabbits found their way from France to Germany, again through religious orders.[3] But from that time onwards they were taken up by princely courts and by the nobility, who were also able to keep their domestic rabbits among stone walls or on small islands, from which they could not escape. Margaret Island in Budapest, originally called "Rabbits' Island", must have been an island of this kind. At first, rabbits were perhaps kept in the convent there, but later the animals spread over the whole island. Such islands of rabbits were used for a long time; for example, the one at Schwerin-See was mentioned in 1407; Elizabeth I of England also had rabbit islands in the 16th century, and there was one as late as the 17th century near Berlin.[4]

It is not known when rabbits continued their way from Germany. But, in all probability, quite early they spread farther on. In Hungary they appeared already i n the Period of the Árpád Dynasty, although the earliest osteological evidence dates only to the 16th century (Visegrád—Salamon-torony).

In mediaeval leporaria, rabbits were treated half as domestic animals and half as wild ones. Aristocratic ladies, for example, would often hunt them and such hunting scenes are displayed in very fine mediaeval representations indeed. However, occasionally, particularly during times of war, rabbits escaped into nature where they soon became wild again, and, moreover, quickly regained their wild colouring. Possibly, as early as in the Middle Ages, domesticated rabbits were set free intentionally with a a view to obtaining highly prolific game supply. Such hunting scenes, too, have also often been represented, one of the best being on the 16th century Flemish tapestry preserved at the De Young Memorial Museum in San

[2] Nachtsheim, H., 1949, p. 52
[3] Nachtsheim, H., 1936, p. 245
[4] Zeuner, F. E. 1963, pp. 412—413

Francisco. On it peasants are capturing wild rabbits with the typical wild colouring, with ferrets and nets.

Later, in modern times, great numbers of wild rabbits were settled in most countries of Europe. However, in Hungary for example, this was done only in the 19th century. Although mention was made even earlier of the hunting of the wild rabbit, these cases must have referred to individuals which occasionally went wild — as can be inferred from the above. In the national shooting statistics greater numbers of rabbits (12,255 individuals) were first mentioned in 1884.[5] Since then wild rabbits have become very numerous in Hungary particularly in the hilly areas with a light, sandy soil.

[5] Szunyoghy, J., 1958 p. 358

REGISTER OF SITES AND FAUNAS

In this register all the Hungarian sites are included the bone samples of which were examined when we were preparing this monograph; the museums in which the samples are preserved have also been indicated here. The complete faunal lists of the sites first published here are also given below, together with the specimen and individual numbers of the species dealt with; those latter data have been omitted when the bone samples have already been published. In such cases we have only mentioned where the faunal lists were published. Among sites in foreign countries we have included the ones whose bone samples we ourselves have identified; these bone samples are published here for the first time.

Percentual data are included in the faunal lists only for sites where bone samples were found in a sufficient number to be able to evaluate the frequency of different species. For the numbers of individuals we have not indicated the so-called minimal number of individuals, but the values obtained by the method we use for determining the number of individuals. The essence of this method is the following: the bones discovered are classified into four groups according to the animals' age: juveniles, subadults, adults and mature-senile groups. Then, within each age group, we form three further groups according to size: small, medium-sized and large animals. Then we determine the minimal number of individuals within each group and summarize the values obtained in this manner.

For the geographical placing of Hungarian sites see Figs 149—150.

HUNGARIAN SITES

Aba–Báránd

Bronze Age (Vatya culture) earthwork. Excavated by É. Petres, 1960. István Király Museum, Székesfehérvár.

species	specimens	individuals
roe deer — *Capreolus capreolus* L.	2	2
red deer — *Cervus elaphus* L.	4	2
Wild animals	6	4
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	2	2
pig — *Sus scrofa dom.* L.	9	3
sheep — *Ovis aries* L. goat — *Capra hircus* L.	38	10
cattle — *Bos taurus* L.	41	12
Domestic animals	91	28
Total	97	32

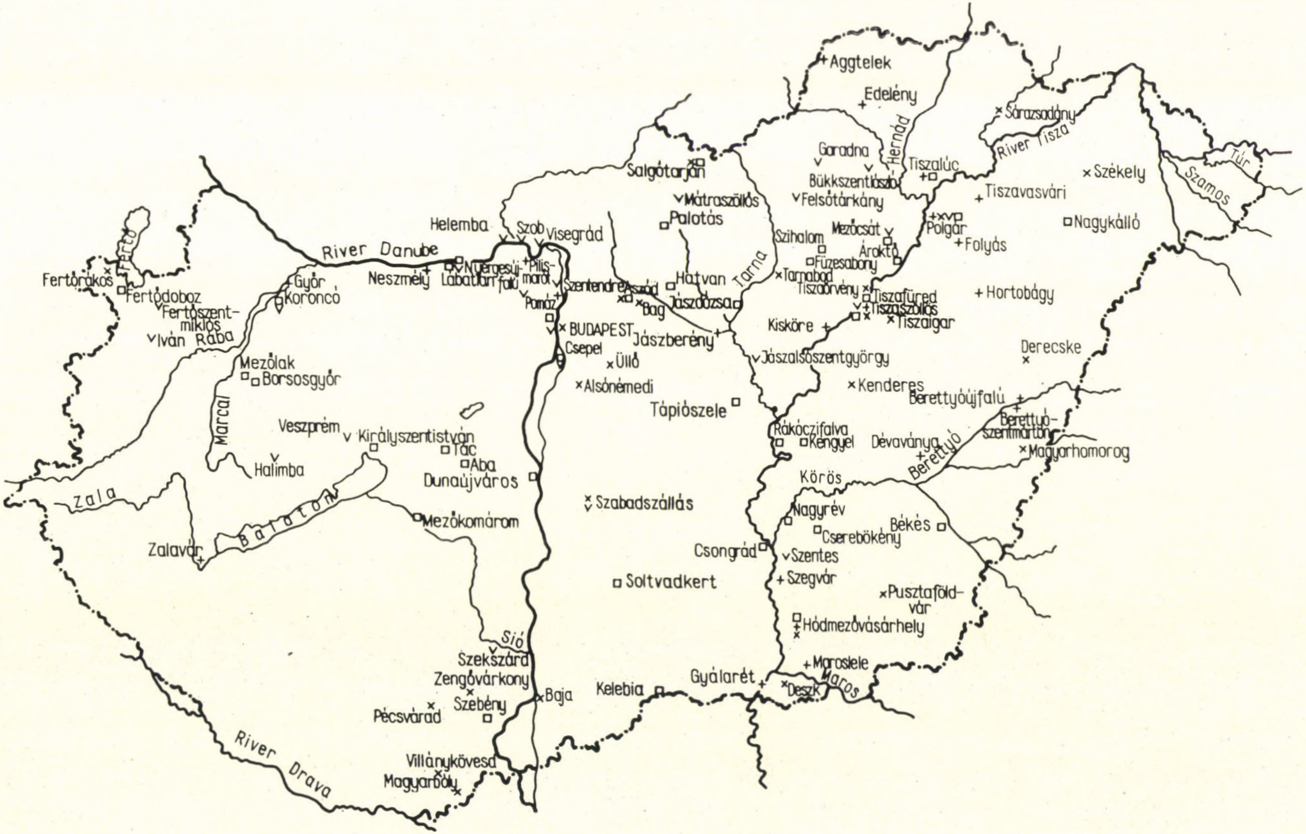


Fig. 149. The prehistoric sites in Hungary mentioned in the book (identical indications as in the measurement diagrams)

Fig. 150. Sites in Hungary mentioned in the book of the Period of the Roman Empire, of the Migration Period and of the Middle Ages (numerical indications as in the diagrams)

ÁCS-VASPUSZTA

Roman castrum. Excavated by L. Barkóczi and S. Mithay, 1948. Xantus János Museum, Győr.

species	specimens	individuals
hen — *Gallus domesticus* L.	2	2
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	5	3
pig — *Sus scrofa dom.* L.	23	10
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	7	5
cattle — *Bos taurus* L.	19	12
Domestic animals	55	31
Total	55	31

ADONY

Roman settlement. Excavated by L. Barkóczi, 1950. Hungarian National Museum, Budapest.

species	specimens	individuals
wolf — *Canis lupus* L.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	1	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	5	2
cattle — *Bos taurus* L.	12	4
Domestic animals	18	7
Total	19	8

Aggtelek–Baradla barlang (Cave)

Neolithic (Bükk culture) settlement. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 50).

Alattyán–Tulát

Avar cemetery. Excavated by N. Fettich. Hungarian National Museum, Budapest (*Arch. Hung.*, **XL** [1963] p. 189).

Albertirsa–Kostyelik P. udvara (Yard of P. Kostyelik)

Early Bronze Age settlement. Collected by F. Kőszegi, 1957. Hungarian National Museum, Budapest.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
horse — *Equus caballus* L.	6	2
pig — *Sus scrofa dom.* L.	2	2
cattle — *Bos taurus* L.	7	2
Domestic animals	15	6
Total	16	7

Alsónémedi

Copper Age (Pécel culture) cemetery. Excavated by J. Korek, 1948. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **1** [1951] pp. 72—79).

Apagy–Barucha J. telke (Plot of J. Barucha)

Sarmatian settlement. Collected by L. Kiss, 1936. Jósa András Museum, Nyíregyháza.

species	specimens	individuals
brown bear — *Ursus arctos* L.	2	1
wild swine — *Sus scrofa fer.* L.	6	3
roe deer — *Capreolus capreolus* L.	1	1
red deer — *Cervus elaphus* L.	10	3
aurochs — *Bos primigenius* Boj.	4	2
Wild animals	23	10
dog — *Canis familiaris* L.	5	2
horse — *Equus caballus* L.	10	6
pig — *Sus scrofa dom.* L.	62	17
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	52	22
cattle — *Bos taurus* L.	93	38
Domestic animals	222	85
Total	245	95

Apátfalva–Maros utca (Street)

Sarmatian grave. Excavated by O. Trogmayer, 1960. Hungarian National Museum, Budapest.

Skull of adult ♂ horse (*Equus caballus* L.).

Arka

2nd–4th century A.D. settlement. Excavated by Á. Salamon, 1960. Hungarian National Museum, Budapest.

species	specimens	individuals
dog – *Canis familiaris* L.	46	2
horse – *Equus caballus* L.	1	1
pig – *Sus scrofa dom.* L.	23	7
sheep – *Ovis aries* L. / goat – *Capra hircus* L.	12	5
cattle – *Bos taurus* L.	103	11
Domestic animals	185	26
Total	185	26

Árokttő–Dongóhalom

Bronze Age settlement. Excavated by A. Saád and G. Megay, 1930. Herman Ottó Museum, Miskolc.

species	specimens	individuals
catfish – *Silurus glanis* L.	1	1
carp – *Cyprinus carpio* L.	2	1
Wild animals	3	2
horse – *Equus caballus* L.	1	1
cattle – *Bos taurus* L.	1	1
Domestic animals	2	2
Total	5	4

Aszód–Gépállomás (Machine Station)

Early Bronze Age pits. Excavated by N. Kalicz, 1962. Hungarian National Museum, Budapest.

species	specimens	individuals
aurochs — *Bos primigenius* Boj.	2	2
Wild animals	2	2
dog — *Canis familiaris* L.	3	2
pig — *Sus scrofa dom.* L.	13	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	11	4
cattle — *Bos taurus* L.	27	6
Domestic animals	54	16
Total	56	18

Aszód–Papi földek

Early Copper Age (Lengyel culture) settlement. Excavated by N. Kalicz, 1961. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
bird — *Avis* sp. I.	1	0.04	1	0.32
bird — *Avis* sp. II.	1	0.04	1	0.32
brown hare — *Lepus europaeus* Pall.	1	0.04	1	0.32
brown bear — *Ursus arctos* L.	4	0.17	2	0.64
wolf — *Canis lupus* L.	4	0.17	3	0.96
wild swine — *Sus scrofa fer.* L.	233	9.89	28	9.00
roe deer — *Capreolus capreolus* L.	59	2.51	9	2.89
red deer — *Cervus elaphus* L.	419	17.79	50	16.08
aurochs — *Bos primigenius* Boj.	397	16.86	53	17.06
Wild animals	1119	47.51	148	47.61
dog — *Canis familiaris* L.	47	2.00	6	1.93
pig — *Sus scrofa dom.* L.	191	8.11	27	8.69
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	35	1.49	5	1.61
cattle — *Bos taurus* L.	963	40.89	125	40.16
Domestic animals	1236	52.49	163	52.39
man — *Homo sapiens* L.	26			
Total	2381		311	

Bag

Late Copper Age (Pécel culture) settlement. Hungarian National Museum, Budapest. Adult sheep or goat *(Ovis* s. *Capra)* — part of mandible.

Bágyog–Gyürhegy

Avar cemetery. Excavated by B. Szőke, Gy. László and J. Nemeskéri, 1952. Xantus János Museum, Győr.

The remains of 8 species of animals were excavated from the graves:

	No. of graves
hen — *Gallus domesticus* L.	19
goose — *Anser domesticus* L.	7
cattle — *Bos taurus* L.	6
pig — *Sus scrofa dom.* L.	6
sheep or goat — *Ovis* s. *Capra*	3
sheep — *Ovis aries* L.	2
brown hare — *Lepus europaeus* Pall.	2
horse — *Equus caballus* L.	1

Baja–Dózsa György út (Street) 233

Early Copper Age (Pécel culture) grave. Excavated by M. Kőhegyi, 1962. Türr István Museum, Baja.

Skull and incomplete skeleton of adult cattle (*Bos taurus* L.).

Bakonyszentlászló

Part of Roman settlement. Donated by J. Fillinger, 1955. Bakony Museum, Veszprém.

On phalangis III.a of adult horse (*Equus caballus* L.).

Balatonaliga

Roman settlement. Excavated by É. Bónis, 1951. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
bird — *Avis* sp.	2	0.38	2	1.60
brown hare — *Lepus europaeus* Pall.	1	0.19	1	0.80
wolf — *Canis lupus* L.	2	0.38	2	1.60
Wild animals	5	0.95	5	4.00
hen — *Gallus domesticus* L.	5	0.95	3	2.40
dog — *Canis familiaris* L.	95	18.09	6	4.80
horse — *Equus caballus* L.	96	18.28	23	18.40
pig — *Sus scrofa dom.* L.	61	11.62	24	19.20
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	87	16.58	27	21.60
cattle — *Bos taurus* L.	176	33.53	37	29.60
Domestic animals	520	99.05	120	96.00
Total	525		125	

Balatonfüred

Roman cemetery. Excavated by Á. Kiss, 1953. Bakony Museum, Veszprém.
Grave No. III: incomplete skeleton of adult hen (*Gallus domesticus* L.).

Balotapuszta

Cemetery of the Period of the Magyar Conquest. Excavated by I. Dienes, 1960. Hungarian National Museum, Budapest.
Grave No. 5: fragments of skull and feet of adult horse (*Equus caballus* L.).

Bana

Cemetery of the Period of the Magyar Conquest. Excavated by Á. Kiss and A. Bartha, 1956. Hungarian National Museum, Budapest:

	No. of graves
horse — *Equus caballus* L.	3
sheep — *Ovis aries* L.	1

Békásmegyer–Buváti

Late Copper Age (Pécel culture), Bronze Age (Zók and Early Nagyrév cultures) Bronze Age II—III and Celtic pits. Excavated by V. G. Csánk, 1962. Municipal Museum, Budapest.

species	Copper Age		Bronze Age		Celtic	
	specimens	individuals	specimens	individuals	specimens	individuals
fish — *Pisces* sp.	1	1	1	1	—	—
bird — *Avis* sp.	—	—	1	1	—	—
brown hare — *Lepus europaeus* Pall.	—	—	3	2	—	—
wild swine — *Sus scrofa fer.* L.	—	—	4	3	—	—
red deer — *Cervus elaphus* L.	7	3	12	5	1	1
aurochs — *Bos primigenius* Boj.	1	1	6	3	—	—
Wild animals	9	4	27	15	1	1
dog — *Canis familiaris* L.	63	2	59	4	—	—
horse — *Equus caballus* L.	25	6	17	5	1	1
pig — *Sus scrofa dom.* L.	10	4	23	7	—	—
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	12	5	25	9	1	1
cattle — *Bos taurus* L.	78	22	82	20	2	2
Domestic animals	188	39	206	45	4	4
Total	197	44	233	60	5	5

BÉKÁSMEGYER-VÖRÖS CSILLAG TSz (COOPERATIVE)

Neolithic (Linear Pottery culture, Zseliz group) settlement. Excavated by M. Gábori, 1962. Municipal Museum, Budapest.

species	specimens	individuals
fish — *Pisces* sp.	1	1
beaver — *Castor fiber* L.	1	1
wild swine — *Sus scrofa fer.* L.	5	3
red deer — *Cervus elaphus* L.	6	3
aurochs — *Bos primigenius* Boj.	22	6
Wild animals	35	14
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	11	4
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	35	8
cattle — *Bos taurus* L.	57	17
Domestic animals	104	30
Total	139	44

BÉKÁSMEGYER

Neolithic settlement. Excavated by F. Tompa. Hungarian National Museum, Budapest.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	3	3
red deer — *Cervus elaphus* L.	2	2
aurochs — *Bos primigenius* Boj.	4	2
Wild animals	9	7
cattle — *Bos taurus* L.	1	1
Domestic animals	1	1
Total	10	8

BÉKÉS–VÁROSERDŐ

Bronze Age (Gyulavarsánd—Ottomány culture) settlement. Excavated by J. Banner, 1950—60. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
catfish — *Silurus glanis* L.	3	0.055	3	0.29
pike — *Esox lucius* L.	2	0.03	2	0.19
carp — *Cyprinus carpio* L.	6	0.10	6	0.57
fish — *Pisces* sp. div.	25	0.40	18	1.72
European pond tortoise — *Emys orbicularis* L.	6	0.10	2	0.19
white pelican — *Pelecanus onoctrotalus* L.	1	0.015	1	0.09
black grouse — *Lyrurus tetrix* L.	1	0.015	1	0.09
crane — *Grus grus* L.	3	0.055	3	0.29
bird — *Avis* sp.	1	0.015	1	0.09
brown hare — *Lepus europaeus* Pall.	11	0.17	6	0.57
beaver — *Castor fiber* L.	20	0.32	13	1.24
fox — *Vulpes vulpes* L.	10	0.16	4	0.38
wolf — *Canis lupus* L.	6	0.10	2	0.19
brown bear — *Ursus arctos* L.	2	0.03	2	0.19
otter — *Lutra lutra* L.	3	0.055	2	0.19
badger — *Meles meles* L.	8	0.13	4	0.39
pine marten or stone marten — *Martes* sp.	1	0.015	1	0.09
lynx — *Lynx lynx* L.	1	0.015	1	0.09
wild cat — *Felis silvestris* Schreb.	6	0.10	4	0.39
wild swine — *Sus scrofa fer.* L.	362	5.74	80	7.64
roe deer — *Capreolus capreolus* L.	37	0.59	18	1.72
red deer — *Cervus elaphus* L.	789	12.51	89	8.51
aurochs — *Bos primigenius* Boj.	313	4.95	49	4.69
Wild animals	1617	25.66	312	29.80
dog — *Canis familiaris* L.	137	2.17	43	4.11
horse — *Equus caballus* L.	164	2.60	60	5.74
pig — *Sus scrofa dom.* L.	1587	25.16	230	22.00
sheep — *Ovis aries* L. goat — *Capra hircus* L.	697	11 06	128	12.25
cattle — *Bos taurus* L.	2103	33.35	273	26.10
Domestic animals	4688	74.34	734	70.20
small ruminants	159			
man — *Homo sapiens* L.	1			
Total	6465		1046	

Békéscsaba–Erzsébethely–Báthory utca (Street) 82

Grave with horse of the Period of the Magyar Conquest. Collected by Gy. Tábori, 1963. Munkácsy Mihály Museum, Békéscsaba.

Skull and 3 extremity bones of a horse (*Equus caballus* L.) aged about $2^1/_2$ years.

Berettyószentmárton

Neolithic (Herpály culture) settlement. Excavated by N. Kalicz and I. Kutzián, 1954–55. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 55).

Biharkeresztes

Grave with horse of the Period of the Magyar Conquest. Collected by A. Horváth, 1960. Déri Museum, Debrecen.

Skull and feet of ♂ horse (*Equus caballus* L.) aged about 9 years.

Bodrogzsadány

Aeneolithic settlement. Excavated by J. Petróczy, 1941–43. Hungarian National Museum, Budapest.

species	specimens	individuals
pike – *Esox lucius* L.	2	2
wild swine – *Sus scrofa fer.* L.	2	2
roe deer – *Capreolus capreolus* L.	3	3
red deer – *Cervus elaphus* L.	3	1
Wild animals	10	8
dog – *Canis familiaris* L.	2	2
pig – *Sus scrofa dom.* L.	2	2
Domestic animals	4	4
Total	14	12

Bodrogzsadány–Soltész J. telke (Plot of J. Soltész)

Mediaeval (16th–17th century) refuse pit. Excavated by S. Gallus, 1943. Hungarian National Museum, Budapest.

species	specimens	individuals
pig – *Sus scrofa dom.* L.	2	2
sheep – *Ovis aries* L. / goat – *Capra hircus* L.	1	1
Domestic animals	3	3

BOGÁD

Roman cemetery (4th century). Excavated by A. Burger, 1959. Janus Pannonius Museum, Pécs.

Incomplete skeleton of hen (*Gallus domesticus* L.) in 3 graves.

BOKROS-FEHÉRKERESZT

Traces of Migration Period (Avar) settlement. Excavated by O. Trogmayer, 1961. Móra Ferenc Museum, Szeged.

species	specimens	individuals
horse — *Equus caballus* L.	5	3
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	3	2
cattle — *Bos taurus* L.	26	6
Domestic animals	34	11

BOLY-SZIEBERT PUSZTA (FARMSTEAD)

Avar cemetery. Excavated by L. Pap, 1960—63. Janus Pannonius Museum, Pécs (*Jan. Pann. Múz. Évk.* [1963] pp. 91 ff.).

BOLY

Oven of the Period of the Árpád Dynasty. Collected by S. Bökönyi, 1955. Hungarian National Museum, Budapest.

Skull and skeleton of an adult dog (*Canis familiaris* L.).

BORDÁNY

Grave with horse of the Period of the Magyar Conquest. Excavated by I. Dienes, 1955. Móra Ferenc Museum, Szeged.

Fragments of skull and feet of an old horse (*Equus caballus* L.).

BORSOD-DEREKEGYHÁZI DŰLŐ (BAULK)

Neolithic (Bükk culture) settlement. Excavated by J. Csalogh and J. Korek, 1948. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 50).

BORSOSGYŐR-TÉGLAGYÁRI AGYAGBÁNYA (CLAY-PIT OF THE BRICK FACTORY)

Traces of Bronze Age settlement. Collected by K. A. Reményi, 1955. Hungarian National Museum, Budapest.

species	specimens	individuals
red deer — *Cervus elaphus* L.	2	2
Wild animals	2	2
cattle — *Bos taurus* L.	2	2
Domestic animals	2	2
Total	4	4

Buda–Disz tér

Mediaeval (turn of the 13th – 14th centuries) well in a cellar. Excavated by I. Holl, 1954. Hungarian National Museum, Budapest (*Stud. Arch.*, **IV** [1966] pp. 71 ff.).

Buda–Vár (Castle)

Mediaeval castle and Early Modern palace Excavated by L. Gerevich. Municipal Museum, Budapest (*Budapest Régiségei*, **XVIII** [1958] pp. 455 ff.; **XX** [1963] pp. 395 ff.; **XXI** [1964] pp. 369 ff.).

Buda-Vár-Pasa palota (Castle — the Pasha's Palace)

Part of Palace from the time of the Turkish occupation. Excavated by Gy. Gerő, 1964. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
brown hare — *Lepus europaeus* Pall.	1	0.07	1	0.71
roe deer — *Capreolus capreolus* L.	5	0.34	3	2.13
red deer — *Cervus elaphus* L.	9	0.62	5	3.54
Wild animals	15	1.03	9	6.38
goose — *Anser domesticus* L.	8	0.55	4	2.84
hen — *Gallus domesticus* L.	27	1.85	8	5.67
dog — *Canis familiaris* L.	7	0.48	4	2.84
horse — *Equus caballus* L.	2	0.14	2	1.42
pig — *Sus scrofa dom.* L.	5	0.34	3	2.13
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1245	85.27	87	61.70
cattle — *Bos taurus* L.	151	10.34	24	17.02
Domestic animals	1445	98.97	132	93.62
Total	1460		141	

Budakalász

Sarmatian settlement. Excavated by S. Soproni, 1954. Hungarian National Museum, Budapest.

species	specimens	individuals
red deer — *Cervus elaphus* L.	11	3
aurochs — *Bos primigenius* Boj.	3	2
Wild animals	14	5
horse — *Equus caballus* L.	5	3
pig — *Sus scrofa dom.* L.	1	1
cattle — *Bos taurus* L.	4	3
Domestic animals	10	7
small ruminants	1	
Total	25	12

Budakalász-Pomázi Á. G. (State Farm)

Early Avar cemetery. Excavated by I. Erdélyi, 1954. Hungarian National Museum, Budapest.

Grave Nos. 4 – 5: skulls and parts of skeletons of two adult horses.

Budapest-Albertfalva

Roman castrum. Excavated by T. Nagy, 1951 – 54. Municipal Museum, Budapest.

species	specimens	%	individuals	%
fish – *Pisces* sp. div.	4	0.21	4	1.30
European pond tortoise – *Emys orbicularis* L.	1	0.05	1	0.32
bird – *Avis* sp.	2	0.11	1	0.32
roe deer – *Capreolus capreolus* L.	6	0.32	4	1.30
red deer – *Cervus elaphus* L.	8	0.43	5	1.62
aurochs – *Bos primigenius* Boj.	28	1.48	10	3.25
Wild animals	49	2.60	25	8.11
goose – *Anser domesticus* L.	3	0.16	2	0.65
hen – *Gallus domesticus* L.	36	1.91	9	2.92
dog – *Canis familiaris* L.	39	2.06	8	2.59
domestic cat – *Felis domestica* Briss.	14	0.74	2	0.65
horse – *Equus caballus* L.	323	17.10	45	14.61
pig – *Sus scrofa dom.* L.	489	25.90	72	23.38
sheep – *Ovis aries* L. / goat – *Capra hircus* L.	267	14.13	53	17.21
cattle – *Bos taurus* L.	668	35.40	92	29.88
Domestic animals	1839	97.40	283	91.89
Total	1888		308	

Budapest-XI. Andor utca (Street)

Late Copper Age (Pécel culture) settlement. Excavated by T. Nagy. Municipal Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 61).

Budapest-Aquincum

Roman (2nd century) settlement. Excavated by Gy. Parragi, 1964. Municipal Museum, Budapest.

species	specimens	individuals
horse – *Equus caballus* L.	1	1
pig – *Sus scrofa dom.* L.	7	4
sheep – *Ovis aries* L. / goat – *Capra hircus* L.	1	1
cattle – *Bos taurus* L.	68	30
Domestic animals	77	36

BUDAPEST–GELLÉRTHEGY (HILL)

Celtic settlement (with Bronze Age and early Iron Age pits). Excavated by L. Nagy. Municipal Museum, Budapest (*Arch. Hung.*, **XLVII** [1969] pp. 242–243).

BUDAPEST–PESTERZSÉBET

Woman's grave with horse from the Period of the Magyar Conquest. Hungarian National Museum, Budapest.

Skull and mandible of ♀ horse aged about 3 years.

BUDAPEST–PESTLŐRINC

Grave of the Period of the Magyar Conquest. Hungarian National Museum, Budapest.

Skull and part of the mandible of an adult horse.

BUDAPEST–REMETEBARLANG (CAVE)

Bronze Age—Hallstatt Period settlement. Excavated by L. Vértes, 1949. Municipal Museum, Budapest (*Budapest Régiségei*, **XVIII** [1958] p. 15; *Acta Arch. Hung.*, **11** [1959] p. 69).

BUDAPEST–XI. SZTREGOVA UTCA (STREET)

Early Bronze Age (late Nagyrév culture) and Hallstatt A (Vál culture) settlement Excavated by T. Nagy and F. Kőszegi, 1964. Municipal Museum, Budapest.

species	Bronze Age		Hallstatt Period	
	specimens	individuals	specimens	individuals
wild swine — *Sus scrofa fer.* L.	—	—	1	1
roe deer — *Capreolus capreolus* L.	—	—	1	1
red deer — *Cervus elaphus* L.	34	2	8	5
aurochs — *Bos primigenius* Boj.	—	—	2	2
Wild animals	34	2	12	9
dog — *Canis familiaris* L.	—	—	2	1
horse — *Equus caballus* L.	9	5	20	5
pig — *Sus scrofa dom.* L.	5	3	8	5
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1	13	7
cattle — *Bos taurus* L.	16	6	43	15
Domestic animals	31	15	86	33
man — *Homo sapiens* L.	—	—	1	
Total	65	17	99	42

Budapest–Tabán

Celtic settlement (with early Iron Age pits). Excavated by L. Nagy. Municipal Museum, Budapest (*Arch. Hung.*, **XLVII** [1969] pp. 242–243).

Csanytelek–Sirôhegy

Cemetery of the Period of the Magyar Conquest. Excavated by G. Csallány, 1934. Hungarian National Museum, Budapest.

In grave No. 12 skull and feet of a ♂ horse (*Equus caballus* L.) of about 9 years.

Csátalja–Vágotthegy

Village of the Period of the Árpád Dynasty. Excavated by Gy. Szabó, 1952. Hungarian National Museum, Budapest.

species	specimens	individuals
roe deer – *Capreolus capreolus* L.	1	1
red deer – *Cervus elaphus* L.	1	1
Wild animals	2	2
dog – *Canis familiaris* L.	4	2
horse – *Equus caballus* L.	19	5
pig – *Sus scrofa dom.* L.	28	12
sheep – *Ovis aries* L. / goat – *Capra hircus* L.	27	13
cattle – *Bos taurus* L.	53	17
Domestic animals	131	59
Total	133	61

Csatár–TSz istálló (Stable of Collective Farm)

Part of settlement of the Period of the Árpád Dynasty. Excavated by I. Walter, 1965. Hungarian National Museum, Budapest.

species	specimens	individuals
hen – *Gallus domesticus* L.	1	1
horse – *Equus caballus* L.	17	1
pig – *Sus scrofa dom.* L.	31	8
sheep – *Ovis aries* L. / goat – *Capra hircus* L.	15	5
cattle – *Bos taurus* L.	18	6
Domestic animals	82	21

Csepel–Hajós utca (Street) 37

Bronze Age (Bell Beaker culture) dwelling pit. Excavated by R. Schreiber, 1960. Municipal Museum, Budapest.

species	specimens	individuals
horse — *Equus caballus* L.	15	5
pig — *Sus scrofa dom.* L.	3	2
cattle — *Bos taurus* L.	9	4
Domestic animals	27	11

Csepel–Háros

Bronze Age (Bell Beaker culture) settlement with Celtic pits. Excavated by R. Schreiber, 1960—61. Municipal Museum, Budapest.

species	Bronze Age			
	specimens	%	individuals	%
fish — *Pisces* sp. div.	12	0.44	3	1.87
European pond tortoise — *Emys orbicularis* L.	2	0.07	1	0.62
beaver — *Castor fiber* L.	1	0.035	1	0.62
brown bear — *Ursus arctos* L.	1	0.035	1	0.62
wild swine — *Sus scrofa fer.* L.	69	2.51	8	5.00
red deer — *Cervus elaphus* L.	83	3.02	12	7.50
aurochs — *Bos primigenius* Boj.	72	2.62	10	6.25
Wild animals	240	8.73	36	22.48
dog — *Canis familiaris* L.	125	4.54	7	4.38
horse — *Equus caballus* L.	1236	44.89	57	35.65
pig — *Sus scrofa dom.* L.	205	7.45	13	8.12
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	255	9.27	16	10.00
cattle — *Bos taurus* L.	691	25.12	31	19.37
Domestic animals	2512	91.27	124	77.52
Total	2752		160	

CSEPEL–HÁROS *(continued)*

species	Celtic	
	specimens	individuals
brown bear — *Ursus arctos* L.	1	1
wild swine — *Sus scrofa fer.* L.	2	1
red deer — *Cervus elaphus* L.	4	2
aurochs — *Bos primigenius* Boj.	8	3
Wild animals	15	7
horse — *Equus caballus* L.	14	5
pig — *Sus scrofa dom.* L.	7	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	2	2
cattle — *Bos taurus* L.	16	8
Domestic animals	39	19
Total	54	26

CSEREBÖKÉNY

Part of Bronze Age (?) settlement. Hungarian National Museum, Budapest. Part of a horse's (*Equus caballus* L.) brain case.

CSERSZEGTOMAJ

Hallstatt Period (C—D) settlement. Excavated by M. Párducz, 1946. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] pp. 69—70).

CSONGRÁD–FELGYŐ

Village of the Period of the Árpád Dynasty. Excavated by Gy. László, 1955. Hungarian National Museum, Budapest.

species	specimens	individuals
brown hare — *Lepus europaeus* Pall.	1	1
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	2	2
dog — *Canis familiaris* L.	24	2
horse — *Equus caballus* L.	13	5
pig — *Sus scrofa dom.* L.	7	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	21	8
cattle — *Bos taurus* L.	57	22
Domestic animals	122	41
Total	124	43

Congrád–Petőfi TSz homokgödre (Sandpit of the Petőfi Collective Farm)

Bronze Age (Zók culture) settlement. Excavated by Gy. Gazdapusztai, 1958. Hungarian National Museum, Budapest.

species	specimens	individuals
European pond tortoise — *Emys orbicularis* L.	1	1
wild swine — *Sus scrofa fer.* L.	3	2
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	3	2
Wild animals	8	6
dog — *Canis familiaris* L.	6	3
pig — *Sus scrofa dom.* L.	59	18
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	67	22
cattle — *Bos taurus* L.	140	38
Domestic animals	272	87
Total	280	93

Derecske–Téglagyár (Brick Factory)

Copper Age (Bodrogkeresztúr culture) settlement. Excavated by J. Makkay, 1957. Déri Museum, Debrecen (*Acta Arch. Hung.*, [1959] p. 60).

Derecske

Sarmatian settlement. Excavated by I. Dienes, 1960. Hungarian National Museum, Budapest.

species	specimens	individuals
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	21	6
cattle — *Bos taurus* L.	51	13
Domestic animals	73	20

Deszk B

Aeneolithic cemetery. Excavated by F. Móra. Móra Ferenc Museum, Szeged (*Acta Arch. Hung.*, **11** [1969] p. 56).

Deszk-Baráth András földje (Plot of András Baráth)

Avar cemetery. Excavated by D. Csallány, 1937. Hungarian National Museum, Budapest.

	No. of graves
horse — *Equus caballus* L.	2
sheep — *Ovis aries* L.	1

Deszk G

Avar cemetery, Móra Ferenc Museum, Szeged:

	No. of graves
hen — *Gallus domesticus* L.	1
horse — *Equus caballus* L.	1
sheep or goat — *Ovis* s. *Capra*	1
cattle — *Bos taurus* L.	1

Deszk-Ördögh telke (Ördögh's plot)

Avar cemetery. Excavated by D. Csallány, 1936. Hungarian National Museum, Budapest.

Grave No. 21: fragments of skull and skeleton of a ♂ horse (*Equus caballus* L.) aged about 7—8 years.

Deszk T

Avar cemetery. Excavated by D. Csallány, 1938. Móra F. Museum, Szeged:

	No. of graves
goose — *Anser domesticus* L.	1
horse — *Equus caballus* L.	1

Dévaványa-Sártó

Neolithic (Tisza culture) settlement. Collected by I. Berecki and excavated by J. Korek, 1959. Hungarian Museum of Agriculture, Budapest.

species	specimens	individuals
fish — *Pisces* sp.	2	1
wild swine — *Sus scrofa fer.* L.	4	3
roe deer — *Capreolus capreolus* L.	7	3
red deer — *Cervus elaphus* L.	34	10
aurochs — *Bos primigenius* Boj.	5	4
Wild animals	52	21
pig — *Sus scrofa dom.* L.	5	3
sheep — *Ovis aries* L.	3	2
goat — *Capra hircus* L.	1	1
cattle — *Bos taurus* L.	9	8
Domestic animals	18	14
Total	70	35

DÉVAVÁNYA-SIMASZIGET

Neolithic (Linear Pottery culture of the Great Hungarian Plain) settlement. Excavated by J. Korek, 1962. Hungarian National Museum, Budapest.

species	specimens	individuals
pig — *Sus scrofa dom.* L.	4	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	5	4
cattle — *Bos taurus* L.	2	2
Domestic animals	11	9

Part of an astragalus probably originating from a horse (*Equus caballus* L.) was also found at the site.

DIÓSGYŐR-VÁR (CASTLE)

From 14th—17th century layers. Excavated by I. Czeglédy, 1964. Hungarian National Museum, Budapest.

species	specimens	individuals
camel — *Camelus* sp.	1	1
Wild animals	1	1
dog — *Canis familiaris* L.	1	1
Domestic animals	1	1
Total	2	2

DOBOZ-HAJDÚIRTÁS

Village of the Period of the Árpád Dynasty (10th—11th century). Excavated by J. Kovalovszki, 1962. Hungarian National Museum, Budapest.

species	specimens	individuals
hen — *Gallus domesticus* L.	2	2
dog — *Canis familiaris* L.	10	3
horse — *Equus caballus* L.	34	8
pig — *Sus scrofa dom.* L.	87	10
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	71	11
cattle — *Bos taurus* L.	142	14
Domestic animals	346	48

Dóc–Balástyai bekötőút (Approach road of Balástya)

Avar grave. Excavated by A. Bálint, 1960. Hungarian National Museum, Budapest, Fragments of a skull and incomplete skeleton of a subadult cattle (*Bos taurus* L.).

Dormánd–Hanyi puszta (Farmstead)

Cemetery of the Period of the Magyar Conquest. Excavated by J. Szabó and I. Dienes, 1959—60. Hungarian National Museum, Budapest.

In grave Nos. 4, 6 and 15 skull and feet of horse (*Equus caballus* L.).

Dömös-II. őrtorony (2nd Watch-tower)

Roman (4th century) watch-tower. Excavated by F. Kőszegi and S. Soproni, 1959. Hungarian National Museum, Budapest.

species	specimens	individuals
cattle — *Bos taurus* L.	1	1
Domestic animals	1	1

Dunaújváros-(Dunapentele)-Koszider

Bronze Age (Nagyrév and Vatya cultures, with traces of Kisapostag culture) settlement. Excavated by A. Mozsolics, 1949. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 63).

Dunaújváros

Roman fortress. Excavated by A. Radnóti, 1949. Hungarian National Museum, Budapest.

Skull of an adult horse (*Equus caballus* L.).

Esztergom–Kovácsi

Village of the Period of the Árpád Dynasty. Excavated by Gy. Szabó, 1955. Hungarian National Museum, Budapest.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	11	5
cattle — *Bos taurus* L.	13	3
Domestic animals	26	10
Total	27	11

Felsőtárkány-Várhegy

Hallstatt Period settlement. Excavated by M. Párducz, 1964. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp.	1	0.20	1	1.06
bird — *Avis* sp.	1	0.20	1	1.06
wild swine — *Sus scrofa fer.* L.	72	13.58	10	10.63
roe deer — *Capreolus capreolus* L.	6	1.13	2	2.13
red deer — *Cervus elaphus* L.	150	28.31	25	26.60
aurochs — *Bos primigenius* Boj.	11	2.08	2	2.13
Wild animals	241	45.50	41	43.61
dog — *Canis familiaris* L.	5	0.94	2	2.13
horse — *Equus caballus* L.	7	1.32	3	3.19
pig — *Sus scrofa dom.* L.	89	16.78	16	17.02
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	46	8.68	8	8.51
cattle — *Bos taurus* L.	142	26.78	24	25.54
Domestic animals	289	54.50	53	56.39
Total	530		94	

Fertőboz-Gradinahegy

Early Bronze Age earthwork. Excavated by Gy. Nováki, 1963—64. Liszt Ferenc Museum, Sopron.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	1	1
red deer — *Cervus elaphus* L.	4	3
Wild animals	5	4
horse — *Equus caballus* L.	4	2
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	7	3
cattle — *Bos taurus* L.	24	4
Domestic animals	37	11
Total	42	15

Fertőrákos—Golgota

Late Copper Age (Pécel culture) settlement. Excavated by Gy. Nováki, 1964. Liszt Ferenc Museum, Sopron.

species	specimens	individuals
red deer — *Cervus elaphus* L.	5	3
aurochs — *Bos primigenius* Boj.	3	2
Wild animals	8	5
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	8	3
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	27	9
cattle — *Bos taurus* L.	110	20
Domestic animals	146	33
Total	154	38

Fertőszentmiklós

Celtic cemetery. Excavated by Gy. Nováki, 1959. Liszt Ferenc Museum, Sopron. Grave No. 8: right side of a subadult pig's (*Sus scrofa dom.* L.) skeleton; parts of an adult hen's (*Gallus domesticus* L.) skeleton.

Folyás—Szilmeg

Neolithic (Szilmeg culture) settlement. Excavated by I. Kutzián, 1950. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 49).

Fonyód

Settlement of the Period of the Turkish rule. Excavated by J. Fitz, 1959. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp.	1	0.18	1	0.83
brown hare — *Lepus europaeus* Pall.	1	0.18	1	0.83
wild swine — *Sus scrofa fer.* L.	14	2.58	4	3.31
roe deer — *Capreolus capreolus* L.	3	0.55	2	1.65
red deer — *Cervus elaphus* L.	3	0.55	2	1.65
Wild animals	22	4.04	10	8.27
domestic goose — *Anser domesticus* L.	5	0.92	2	1.65
hen — *Gallus domesticus* L.	13	2.39	5	4.13
dog — *Canis familiaris* L.	1	0.18	1	0.83
domestic cat — *Felis domestica* Briss.	3	0.55	1	0.83
horse — *Equus caballus* L.	8	1.47	3	2.49
pig — *Sus scrofa* dom. L.	119	21.83	32	26.44
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	17	3.12	6	4.96
cattle — *Bos taurus* L.	357	65.50	61	50.42
Domestic animals	523	95.66	111	91.73
Total	545		121	

Füzesabony

Bronze Age III (Füzesabony culture) settlement. Excavated by F. Tompa, 1930—36. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] pp. 65—66).

Gádoros

Cemetery of the Period of the Magyar Conquest. Excavated by D. Csallány, 1933. Hungarian National Museum, Budapest.

Horse (*Equus caballus* L.) bones from two graves.

Garadna

Traces of late La Tène settlement; settlements of the 1st—4th and of the 9th—13th centuries A.D. Excavated by Gy. Török, 1960. Hungarian National Museum, Budapest.

species	La Tène Period	
	specimens	individuals
horse — *Equus caballus* L.	1	1
Domestic animals	1	1

species	1st—4th century	
	specimens	individuals
roe deer — *Capreolus capreolus* L.	2	1
red deer — *Cervus elaphus* L.	2	2
Wild animals	4	3
hen — *Gallus domesticus* L.	2	1
dog — *Canis familiaris* L.	5	2
horse — *Equus caballus* L.	7	3
pig — *Sus scrofa dom.* L.	54	7
sheep — *Ovis aries* L. goat — *Capra hircus* L.	43	6
cattle — *Bos taurus* L.	113	12
Domestic animals	224	31
Total	228	34

GARADNA *(continued)*

species	9th—13th century	
	specimens	individuals
beaver — *Castor fiber* L.	1	1
Wild animals	1	1
hen — *Gallus domesticus* L.	1	1
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	12	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	8	4
cattle — *Bos taurus* L.	29	7
Domestic animals	72	18
Total	73	19

GERENDÁS—PETŐFI TSZ HOMOKBÁNYÁJA (SANDPIT OF THE PETŐFI COOPERATIVE)

Grave with a horse from the Period of the Magyar Conquest. Excavated by I. Dienes, 1963. Hungarian National Museum, Budapest.

Fragment of a skull, and feet cut off from the carpus and the tarsus, respectively of a subadult horse (*Equus caballus* L.); part of right humerus of an adult sheep or goat (*Ovis* s. *Capra*).

GESZTERÉD—KECSKELÁTÓ DÜLŐ (BAULK)

Grave with a horse of the Period of the Magyar Conquest. Excavated by L. Kiss, 1927. Jósa András Museum, Nyíregyháza.

Teeth, and feet from the carpus and the tarsus, respectively of a horse (*Equus caballus* L.) of 8—9 years.

GÖDÖLLŐ—DOMONYVÖLGY

Sarmatian (2nd century A. D.) settlement. Excavated by Á. Salamon, 1956. Hungarian National Museum, Budapest.

species	specimens	individuals
horse — *Equus caballus* L.	2	1
cattle — *Bos taurus* L.	1	1
Domestic animals	3	2

GÖDÖLLŐ—MÁRIABESNYŐI CSEMETEKERT (NURSERY GARDEN)

Settlement of the time of the Árpád Dynasty. Excavated by Gy. Török, 1959. Hungarian National Museum, Budapest.

species	specimens	individuals
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	9	6
pig — *Sus scrofa dom.* L.	9	5
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	5	3
cattle — *Bos taurus* L.	19	10
Domestic animals	43	25

GYÁLARÉT

Neolithic (Körös culture) settlement. Excavated by O. Trogmayer, 1964. Móra Ferenc Museum, Szeged.

species	specimens	%	individuals	%
catfish — *Silurus glanis* L.	1	0.25	1	0.81
pike — *Esox lucius* L.	1	0.25	1	0.81
fish — *Pisces* sp. div.	55	14.00	12	9.76
European pond tortoise — *Emys orbicularis* L.	13	3.31	6	4.86
birds — *Aves* sp. div.	30	7.63	17	13.83
brown hare — *Lepus europaeus* Pall.	4	1.02	2	1.62
wild ass — *Asinus hydruntinus* Reg.	1	0.25	1	0.81
wild swine — *Sus scrofa fer.* L.	37	9.41	10	8.13
roe deer — *Capreolus capreolus* L.	13	3.31	6	7.86
red deer — *Cervus elaphus* L.	11	2.80	5	4.07
aurochs — *Bos primigenius* Boj.	13	3.31	5	4.07
Wild animals	179	45.54	66	53.63
dog — *Canis familiaris* L.	3	0.76	1	0.81
pig — *Sus scrofa dom.* L.	10	2.55	5	4.07
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	136	34.61	35	28.47
cattle — *Bos taurus* L.	65	16.54	16	13.02
Domestic animals	214	54.46	57	46.37
Total	393		123	

Győr—Pándzsa dülő (Baulk)

Neolithic (Linear Pottery culture, Zseliz group) settlement. Excavated by S. Mithay, 1952. Xantus János Museum, Győr.

species	specimens	individuals
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1
cattle — *Bos taurus* L.	9	3
Domestic animals	10	4

Győr—Pápai vám (Tollbooth of Pápa)

Neolithic (Linear Pottery culture, Zseliz group) settlement. Excavated by S. Mithay, 1952—53. Xantus János Museum, Győr (*Acta Arch. Hung.*, **11** [1959] p. 51).

Győr—Széchenyi tér (Square)

Roman (2nd century) settlement. Excavated by S. Mithay. 1950. Xantus János Museum, Győr.

species	specimens	individuals
horse — *Equus caballus* L.	7	3
pig — *Sus scrofa dom.* L.	4	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	4	2
cattle — *Bos taurus* L.	11	5
Domestic animals	26	13

GYULA—VÁR (CASTLE)

From layers of a Late Mediaeval, and Early Modern (15th—17th century) castle. Excavated by N. Parádi, 1960. Hungarian National Museum, Budapest; Erkel Ferenc Museum, Gyula.

species	specimens	individuals
great crested grebe — *Podiceps cristatus* L.	2	2
buzzard — *Buteo buteo* L.	1	1
white-tailed eagle — *Haliaetos albicilla* L.	2	1
crane — *Grus grus* L.	4	1
birds — *Aves* sp. div.	3	3
wild swine — *Sus scrofa fer.* L.	1	1
roe deer — *Capreolus capreolus* L.	4	2
red deer — *Cervus elaphus* L.	2	2
Wild animals	19	13
hen — *Gallus domesticus* L.	1	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	5	5
sheep — *Ovis aries* L.	14	14
goat — *Capra hircus* L.	7	7
cattle — *Bos taurus* L.	11	11
Domestic animals	39	39
Total	58	52

Selected bone samples were collected so that sheep and goat bones could all be distinguished from each other and the number of individuals is very high.

HALIMBA—CSERES

Hallstatt Period cemetery. Excavated by Gy. Török, 1952. Hungarian National Museum, Budapest:

	No. of graves
horse — *Equus caballus* L.	1
sheep — *Ovis aries* L.	1

HALIMBA

Avar cemetery. Excavated by Gy. Török, 1961. Hungarian National Museum, Budapest.

Animal remains were found in 49 graves:

	No. of graves
cattle — *Bos taurus* L.	37
sheep or goat — *Ovis* s. *Capra*	13
hen — *Gallus domesticus* L.	9
pig — *Sus scrofa dom.* L.	3
horse — *Equus caballus* L.	2

HALIMBA

Cemetery of the Period of the Árpád Dynasty (10th–11th centuries). Excavated by Gy. Török, 1954. Hungarian National Museum, Budapest.

Grave No. 427: part of upper molar tooth of an adult cattle (*Bos taurus* L.).

HATVAN

Bronze Age II settlement. Excavated by F. Tompa, 1935. Hungarian National Museum, Budapest.

Right horn core of an adult cattle (*Bos taurus* L.).

HEGYKŐ

Langobard cemetery. Excavated by I. Bóna, 1958. Hungarian National Museum, Budapest.

Grave No. 70: skulls and skeletons of two adult dogs (*Canis familiaris* L.).

HÉKUT

Cemetery of the Period of the Magyar Conquest. Excavated by I. Dienes, 1960. Hungarian National Museum, Budapest.

Animal remains were found in three graves:

	No. of graves
horse — *Equus caballus* L.	3
cattle — *Bos taurus* L.	1

HELEMBA—SZIGET (ISLAND)

Hallstatt A–B (Vál culture) settlement. Excavated by O. Trogmayer, 1959. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp.	1	0.07	1	0.59
brown hare — *Lepus europaeus* Pall.	2	0.14	2	1.18
beaver — *Castor fiber* L.	3	0.21	2	1.18
wild swine — *Sus scrofa fer.* L.	11	0.78	5	2.94
roe deer — *Capreolus capreolus* L.	1	0.07	1	0.59
red deer — *Cervus elaphus* L.	30	2.12	12	7.06
aurochs — *Bos primigenius* Boj.	8	0.56	5	2.94
Wild animals	56	3.95	28	16.48
dog — *Canis familiaris* L.	58	4.09	10	5.88
horse — *Equus caballus* L.	92	6.49	13	7.64
pig — *Sus scrofa dom.* L.	433	30.56	42	24.70
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	243	17.15	28	16.47
cattle — *Bos taurus* L.	535	37.76	49	28.83
Domestic animals	1361	96.05	142	83.52
man — *Homo sapiens* L.	27			
Total	1444		170	

HÓDMEZŐVÁSÁRHELY—BODZÁSPART

Neolithic (Körös culture) pit. Excavated by J. Banner and J. Korek, 1948. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **4** [1954] pp. 9 ff; **11** [1959] pp. 46—47).

HÓDMEZŐVÁSÁRHELY—GORZSA—CUKORTANYA (CUKOR FARMSTEAD)

Neolithic settlement. Excavated by Gy. Gazdapusztai, 1956. Tornyai János Museum, Hódmezővásárhely (*Acta Arch. Hung.*, **11** [1959] pp. 52—53).

HÓDMEZŐVÁSÁRHELY—GORZSA—KOVÁCSTANYA (KOVÁCS FARMSTEAD)

Neolithic (Körös culture), Bronze Age A–B, Mediaeval settlement, Excavated by Gy. Gazdapusztai, 1955. Tornyai János Museum, Hódmezővásárhely.

Age	Neolithic		Bronze Age		Mediaeval	
species	specimens	individuals	specimens	individuals	specimens	individuals
red deer — *Cervus elaphus* L.	—	—	1	1	—	—
aurochs — *Bos primigenius* Boj.	—	—	2	1	—	—
Wild animals	—	—	3	2	—	—
horse — *Equus caballus* L.	—	—	—	—	1	1
pig — *Sus scrofa dom.* L.	1	1	3	2	—	—
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	—	—	4	2	—	—
cattle — *Bos taurus* L.	6	3	10	3	5	2
Domestic animals	7	4	17	7	6	3
Total	7	4	20	9	6	3

HÓDMEZŐVÁSÁRHELY—TATÁRSÁNC—ZALAY TÉGLAGYÁR (ZALAY BRICK FACTORY)

Aeneolithic settlement. Excavated by P. Patay, 1955. Tornyai János Museum, Hódmezővásárhely (*Acta Arch. Hung.*, **11** [1959] p. 57).

HORTOBÁGY—ÁRKUSI ÁG (ÁRKUS STATE FARM)

Avar cemetery. Excavated by E. H. Tóth, 1959. Déri Museum, Debrecen.
Horse (*Equus caballus* L.) skeletons in 12 graves.

ISASZEG—KATONAPALLAG

Sarmatian kurgans. Excavated by É. Garam, 1962. Hungarian National Museum, Budapest.
Animal remains from two kurgans:

	No. of graves
horse — *Equus caballus* L.	1
pig — *Sus scrofa dom.* L.	1
cattle — *Bos taurus* L.	1

IVÁN

Celtic settlement. Excavated by Gy. Nováki, 1960. Liszt Ferenc Museum, Sopron.

species	specimens	individuals
dog — *Canis familiaris* L.	3	1
horse — *Equus caballus* L.	3	2
pig — *Sus scrofa dom.* L.	7	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	11	5
cattle — *Bos taurus* L.	25	10
Domestic animals	49	20

JÁNOSHIDA

Avar cemetery. Excavated by N. Fettich, 1934. Hungarian National Museum, Budapest.

Animal bones were transferred from five graves to the collections of the Hungarian National Museum:

	No. of graves
hen — *Gallus domesticus* L.	4
sheep or goat — *Ovis* s. *Capra* L.	1

JÁSZBERÉNY—CSERŐHALOM

Neolithic (Linear Pottery culture) settlement, Hallstatt Period and Celtic graves. Excavated by Gy. Kaposvári, 1957—59. Damjanich János Museum, Szolnok.

species	Neolithic	
	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	2	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	3	2
cattle — *Bos taurus* L.	10	6
Domestic animals	13	8
Total	15	10

JÁSZBERÉNY *(continued)*

Animal bones were found in 12 graves: 3 from the Hallstatt and 9 from the Celtic Period.

species	Hallstatt	Celtic
	No. of graves	
pig — *Sus scrofa dom.* L.	2	6
European pond tortoise — *Emys orbicularis* L.	2	1
sheep or goat — *Ovis* s. *Capra* L.	—	2
horse — *Equus caballus* L.	1	—
cattle — *Bos taurus* L.	1	—
bird — *Avis* sp.	—	1

JÁSZDÓZSA

Bronze Age (Hatvan culture) part of a settlement. Excavated by S. Gallus, 1943. Hungarian National Museum, Budapest.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	3	2
roe deer — *Capreolus capreolus* L.	1	1
red deer — *Cervus elaphus* L.	6	3
aurochs — *Bos primigenius* Boj.	3	2
Wild animals	13	8
dog — *Canis familiaris* L.	14	3
pig — *Sus scrofa dom.* L.	7	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	6	3
cattle — *Bos taurus* L.	22	7
Domestic animals	49	17
Total	62	25

JÁSZFELSŐSZENTGYÖRGY—TÚRÓCZI TANYA (FARMSTEAD)

Part of Scythian settlement. Excavated by Zs. Csalogh, 1961. Damjanich János Museum, Szolnok.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	1	1
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	3	3
hen — *Gallus domesticus* L.	1	1
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	23	8
pig — *Sus scrofa dom.* L.	5	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	17	6
cattle — *Bos taurus* L.	58	15
Domestic animals	105	34
Total	108	37

KÁDÁRTA

Roman villa. Excavated by M. Kanozsay, 1963. Bakony Museum, Veszprém.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	2	2
Domestic animals	2	2
Total	3	3

KAKASSZÉK

Sarmatian cemetery. Hungarian National Museum, Budapest.

Grave No. 2: part of skull, right metacarpus and right astragalus of an adult horse (*Equus caballus* L.).

KARDOSKÚT—HATABLAK

Village of the Period of the Árpád Dynasty. Excavated by I. Méri, 1955, 1957. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
bird — *Aves* sp. div.	2	0.24	2	0.65
brown hare — *Lepus europaeus* Pall.	14	1.56	2	0.65
wild swine — *Sus scrofa fer.* L.	3	0.34	2	0.65
red deer — *Cervus elaphus* L.	1	0.12	1	0.32
Wild animals	20	2.26	7	2.27
domestic goose — *Anser domesticus* L.	9	1.02	4	1.30
hen — *Gallus domesticus* L.	93	10.50	13	4.21
dog — *Canis familiaris* L.	132	14.89	10	3.25
horse — *Equus caballus* L.	209	23.59	83	26.95
pig — *Sus scrofa dom.* L.	66	7.45	46	14.94
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	80	9.03	49	15.91
cattle — *Bos taurus* L.	277	31.26	96	31.17
Domestic animals	866	97.74	301	97.75
Total	886		308	

KECSKEMÉT—BOCSKAI UTCA (STREET)

17th—19th century pits. Collected by A. Horváth, 1963. Katona József Museum, Kecskemét.

species	specimens	individuals
sheep — *Ovis aries* L.	3	2
cattle — *Bos taurus* L.	3	3
Domestic animals	6	5

Kelebia

Bronze Age cemetery. Excavated by E. Zalotay, 1954. Türr István Museum, Baja.
Grave No. 71/a: bones of dog (*Canis familiaris* L.), of horse (*Equus caballus* L.), of pig (*Sus scrofa dom.* L.) and of cattle (*Bos taurus* L.).

Kenderes—Kulis

Early Copper Age (Tiszapolgár culture) settlement, mixed with Neolithic material. Excavated by Zs. Csalogh, 1962. Damjanich János Museum, Szolnok.

species	specimens	individuals
bird — *Aves* sp.	1	1
brown hare — *Lepus europaeus* Pall.	1	1
wild swine — *Sus scrofa fer.* L.	4	2
red deer — *Cervus elaphus* L.	4	2
aurochs — *Bos primigenius* Boj.	10	4
Wild animals	20	10
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	68	16
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	96	25
cattle — *Bos taurus* L.	82	20
Domestic animals	248	63
Total	268	73

Kenderes—Telekhalom

Early Copper Age (Tiszapolgár culture) settlement, mixed with Neolithic material. Excavated by Zs. Csalogh, 1952. Damjanich János Museum, Szolnok.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	1	1
red deer — *Cervus elaphus* L.	2	1
aurochs — *Bos primigenius* Boj.	10	4
Wild animals	13	6
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	17	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	9	3
cattle — *Bos taurus* L.	26	7
Domestic animals	54	16
man — *Homo sapiens* L.	1	
Total	68	22

KENÉZLŐ

Cemetery of the Period of the Magyar Conquest. Excavated by N. Fettich, 1927. Jósa András Museum, Nyíregyháza.

Grave No. 14: skull and feet of a ♂ horse (*Equus caballus* L.) aged 3—3½ years.

KENGYEL

Bronze Age settlement. Excavated by A. Mozsolics, 1957. Hungarian National Museum, Budapest.

species	specimens	individuals
aurochs — *Bos primigenius* Boj.	3	2
Wild animals	3	2
horse — *Equus caballus* L.	3	2
pig — *Sus scrofa dom.* L.	4	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	10	3
cattle — *Bos taurus* L.	16	5
Domestic animals	33	12
Total	36	14

KESZTHELY—ÁLTALÁNOS ISKOLA (PRIMARY SCHOOL)

Avar cemetery. Excavated by I. L. Kovrig, 1961. Hungarian National Museum, Budapest.

The skeletons of a horse (*Equus caballus* L.) and a dog (*Canis familiaris* L.) were found in each of three graves.

KESZTHELY—DEÁK UTCA (STREET)—SÖRKERT (BEER GARDEN)

Well from the Period of the Roman Empire or of the Migration Period. Excavated by I. L. Kovrig, 1957. Hungarian National Museum, Budapest.

Skulls and skeletons of an adult and of a subadult dog (*Canis familiaris* L.), fragments of the skull and skeleton of an adult domestic cat (*Felis domestica* Briss.).

KIRÁLYSÁG—UJJ SÁNDOR FÖLDJE (PLOT OF SÁNDOR UJJ)

Grave of the Migration Period. Hungarian National Museum, Budapest.

Skull and mandible of a ♂ horse (*Equus caballus* L.) aged 5½—6 years.

KIRÁLYSZENTISTVÁN

Bronze Age II settlement. Excavated by Gy. Rhé. Bakony Museum, Veszprém.

species	specimens	individuals
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	2	2
cattle — *Bos taurus* L.	1	1
Domestic animals	4	4

Kisköre

Neolithic (Tisza culture) settlement. Excavated by J. Korek, 1963. Hungarian National Museum, Budapest.

species	specimens	individuals
brown bear — *Ursus arctos* L.	1	1
fox — *Vulpes vulpes* L.	1	1
wild swine — *Sus scrofa fer.* L.	10	5
roe deer — *Capreolus capreolus* L.	6	3
aurochs — *Bos primigenius* Boj.	7	4
Wild animals	25	14
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	8	4
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	8	4
cattle — *Bos taurus* L.	34	6
Domestic animals	51	15
Total	76	29

Kiskőrös

Avar cemetery. Excavated by N. Fettich, 1933. Hungarian National Museum, Budapest.

Animal bones were transferred from three graves to the Hungarian National Museum:

	No. of graves
hen — *Gallus domesticus* L.	2
cattle — *Bos taurus* L.	2

Kiskundorozsma—Vöröshomok-dűlő (Baulk)

Grave with horse from the time of the Magyar Conquest. Excavated by A. Bálint, 1959. Móra Ferenc Museum, Szeged.

Fragments of skull, and feet cut off from the carpus and the tarsus, respectively of a mature ♂ horse (*Equus caballus* L.).

Kiskunfélegyháza

Grave of the Period of the Magyar Conquest. Hungarian National Museum, Budapest.

Skull, and feet from the carpus and tarsus of a ♂ horse (*Equus caballus* L.) aged about 4 years.

Kiskunmajsa—Kőkút

Avar grave. Excavated by B. Bálint, 1958. Katona József Museum, Kecskemét

Skull and skeleton of an adult cattle (*Bos taurus* L.).

KISVARSÁNY

Settlement of the 5th—6th century A.D. Excavated by J. Korek, 1963. Hungarian National Museum, Budapest.

species	specimens	individuals
bird — *Avis* sp.	1	1
Wild animals	1	1
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	11	2
pig — *Sus scrofa dom.* L.	12	5
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	22	4
cattle — *Bos taurus* L.	31	8
Domestic animals	78	20
Total	79	21

KÓKA—VÁRHEGY

Bronze Age (Hatvan culture) settlement. Hungarian National Museum, Budapest.

species	specimens	individuals
pig — *Sus scrofa dom.* L.	1	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1
cattle — *Bos taurus* L.	3	3
Domestic animals	5	5

Korlát

Bronze Age settlement. Hungarian National Museum, Budapest.
Fragment of an adult horse's (*Equus caballus* L.) skull.

Koronczó—Bábota

Late Bronze Age—Hallstatt Period settlement. Excavated by S. Gallus, 1941. Xantus János Museum, Győr.

species	specimens	individuals
bird — *Avis* sp.	1	1
red deer — *Cervus elaphus* L.	2	2
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	4	4
pig — *Sus scrofa dom.* L.	5	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	9	5
cattle — *Bos taurus* L.	18	7
Domestic animals	32	15
Total	36	19

Koronczó—Tószer-dűlő (baulk)

Late Bronze Age—Hallstatt Period settlement. Excavated by S. Mithay, 1952. Xantus János Museum, Győr.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
dog — *Canis familiaris* L.	2	2
horse — *Equus caballus* L.	14	5
pig — *Sus scrofa dom.* L.	12	6
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	22	12
cattle — *Bos taurus* L.	76	25
Domestic animals	126	50
Total	127	51

Koronczó—Tószer-dülő (Baulk)—Domán S. kertje (Garden of S. Domán)

Grave of the Period of the Magyar Conquest. Excavated by S. Mithay and J. Nemeskéri, 1952. Xantus János Museum, Győr.

Skull and feet of a ♀ horse (*Equus caballus* L.) about 5 years of age; fragment of a rib and femur of sheep or goat (*Ovis* s. *Capra*).

Környe

Avar cemetery. Excavated by I. Erdélyi, 1955. Hungarian National Museum Budapest.

Animal remains in 22 graves:

	No. of graves
horse — *Equus caballus* L.	22
cattle — *Bos taurus* L.	1

Kőszeg—Vár (Castle)

From Late Mediaeval (13th—17th century) layers. Excavated by I. Holl, 1960—62. Hungarian National Museum, Budapest.

age	13th—14th century		c. 1300		15th—17th century	
species	speci-mens	individ-uals	speci-mens	individ-uals	speci-mens	individ-uals
fish — *Pisces* sp.	—	—	1	1	—	—
wild swine — *Sus scrofa fer.* L.	—	—	12	4	1	1
roe deer — *Capreolus capreolus* L.	—	—	—	—	4	2
red deer — *Cervus elaphus* L.	2	1	15	4	4	2
Wild animals	2	1	28	9	9	5
domestic goose — *Anser domesticus* L.	—	—	1	1	2	1
hen — *Gallus domesticus* L.	—	—	6	2	56	12
dog — *Canis familiaris* L.	—	—	—	—	1	1
domestic cat — *Felis domestica* Briss.	—	—	—	—	2	1
horse — *Equus caballus* L.	—	—	—	—	11	2
pig — *Sus scrofa dom.* L.	1	1	81	10	11	3
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	1	1	32	8	3	2
cattle — *Bos taurus* L.	8	2	79	15	25	5
Domestic animals	10	4	199	36	111	27
Total	12	5	227	45	120	32

Kunhegyes—Jajhalom

11th—12th century settlement. Collected by J. Bereczki, 1962. Hungarian Museum of Agriculture, Budapest.

species	specimens	individuals
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	12	2
pig — *Sus scrofa dom.* L.	2	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	2	2
cattle — *Bos taurus* L.	10	3
Domestic animals	27	9

Kübekháza—Újtelep

Cemetery of the Period of the Magyar Conquest. Excavated by A. Bálint, 1961. Hungarian National Museum, Budapest.

Horse (*Equus caballus* L.) skulls and feet in two graves; horse toebones in a third grave.

Lábatlan

From a Celtic vessel. Excavated by A. Mócsy, 1953. Hungarian National Museum, Budapest.

Part of pig's (*Sus scrofa dom.* L.) femur and tibia.

Lebő

Neolithic (Tisza and Great Plain Linear Pottery culture with traces of Körös culture) settlement. Excavated by J. Korek and O. Trogmayer respectively in 1950 and in 1956. Hungarian National Museum, Budapest, Móra Ferenc Museum, Szeged (*Móra F. Múz. Évk.* [1957]; *Acta Arch. Hung.*, **11** [1959] pp. 47—48).

Lengyel

Bronze Age—Halstatt Period settlement. Excavated by F. Tompa, 1928. Hungarian National Museum, Budapest.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	4	2
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	6	4
dog — *Canis familiaris* L.	2	1
pig — *Sus scrofa dom.* L.	1	1
cattle — *Bos taurus* L.	1	1
Domestic animals	4	3
Total	10	7

MAGYARBÓLY—TÉGLAGYÁR (BRICK FACTORY)

Early Copper Age (Lengyel culture) settlement. Collected by J. Dombay, 1959. Janus Pannonius Museum, Pécs (*Jan. Pann. Múz. Évk.* [1961] pp. 97, 99).

MAGYARHOMOROG

Middle Copper Age (Bodrogkeresztúr culture), Celtic graves, graves of the Period of the Magyar Conquest. Excavated by P. Patay, 1961; by I. Dienes—P. Patay, 1962. Hungarian National Museum, Budapest.

Animal bones were found in one grave of the early Copper Age and one of the Celtic Period and in five of the Period of the Magyar Conquest:

	No. of graves	
pig — *Sus scrofa dom.* L.	1	Early Copper Age
	1	Celtic Period
wolf — *Canis lupus* L.	1	Period of the Magyar Conquest
horse — *Equus caballus* L.	4	,,

MÁNFA

Avar grave of a horse. Excavated by A. Kiss, 1962. Hungarian Museum of Agriculture, Budapest.

Skull and skeleton of a horse (*Equus caballus* L.) aged about 2 years.

MAROSLELE—PANA

Early Neolithic (Körös culture) settlement. Excavated by O. Trogmayer, 1963. Móra Ferenc Museum, Szeged (*Arch. Ért.*, **91** [1964] p. 87).

MÁTRASZÖLLŐS

Celtic cemetery. Excavated by P. Patay, 1959. Hungarian National Museum, Budapest.

Animal bones were found in 49 graves:

	No. of graves
pig — *Sus scrofa dom.* L.	49
hen — *Gallus domesticus* L.	15

MEZŐCSÁT—HÖRCSÖGÖS

Late Copper Age (Pécel culture) grave, late Bronze Age (early phase of Tumulus Grave culture) graves, Hallstatt B-C cemetery. Hallstatt A and B settlement, Mediaeval houses. Excavated by E. Patek, 1958—60. Hungarian National Museum, Budapest.

Bones of cattle (*Bos taurus* L.) in a late Bronze Age grave, animal remains in 29 Hallstatt Period graves:

	No. of graves
cattle — *Bos taurus* L.	22
sheep or goat — *Ovis* s. *Capra*	9
sheep — *Ovis aries* L.	5
pig — *Sus scrofa dom.* L.	3
dog — *Canis familiaris* L.	1

MEZŐCSÁT—PÁSTIDOMB

Bronze Age settlement. Excavated by A. Leszih and G. Megay, 1930. Hermann Ottó Museum, Miskolc.

species	specimens	individuals
sturgeon — *Apcienser* sp.	1	1
roe deer — *Capreolus capreolus* L.	3	1
red deer — *Cervus elaphus* L.	1	1
Wild animals	5	3
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	2	2
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	2	2
cattle — *Bos taurus* L.	2	2
Domestic animals	9	9
Total	14	12

MEZŐKOMÁROM—ALSÓHEGY

Bronze Age settlement. Excavated by L. Nagy. Bakony Museum, Veszprém.

species	specimens	%	individuals	%
fish — *Pisces* sp.	1	0.18	1	0.94
mute swan — *Cygnus olor* L.	1	0.18	1	0.94
brown bear — *Ursus arctos* L.	1	0.18	1	0.94
wild swine — *Sus scrofa fer.* L.	11	1.98	5	4.72
red deer — *Cervus elaphus* L.	122	21.98	8	7.55
aurochs — *Bos primigenius* Boj.	14	2.52	5	4.72
Wild animals	150	27.02	21	19.81
dog — *Canis familiaris* L.	3	0.54	2	1.89
horse — *Equus caballus* L.	17	3.06	6	5.66
pig — *Sus scrofa dom.* L.	41	7.39	11	10.38
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	121	21.80	28	26.41
cattle — *Bos taurus* L.	223	40.19	38	35.85
Domestic animals	405	72.98	85	80.19
Total	555		106	

MEZŐKÖVESD

Sarmatian settlement. Excavated by P. Patay, 1959. Hungarian National Museum, Budapest.

species	specimens	individuals
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	25	10
cattle — *Bos taurus* L.	3	2
Domestic animals	28	12

MEZŐKÖVESD—CSÖRSZÁROK

Sarmatian settlement. Excavated by P. Patay, 1964. Hungarian National Museum, Budapest.

species	specimens	individuals
horse — *Equus caballus* L.	6	3
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	5	3
cattle — *Bos taurus* L.	17	7
Domestic animals	30	15

MEZŐLAK

Part of Bronze Age (Zók culture) settlement. Collected by P. Galló, 1939. Hungarian National Museum, Budapest.

species	specimens	individuals
red deer — *Cervus elaphus* L.	3	2
aurochs — *Bos primigenius* Boj.	6	1
Wild animals	9	3
horse — *Equus caballus* L.	5	3
pig — *Sus scrofa dom.* L.	2	1
cattle — *Bos taurus* L.	3	2
Domestic animals	10	6
Total	19	9

MOHÁCS—TÉGLAGYÁR (BRICK YARD)

Avar grave of cattle, and graves of the Period of the Magyar Conquest. Excavated by G. Fehér, 1949. Hungarian National Museum, Budapest.

Each of the 2 graves of the Period of the Magyar Conquest contained the skull and feet of an adult ♂ horse (*Equus caballus* L.).

MÓR—AKASZTÓDOMB

Avar cemetery. Excavated by Gy. Török, 1953. István Király Museum, Székesfehérvár.

In grave No. 2: skull, and feet distal from the carpus and tarsus, respectively of subadult ♀ cattle (*Bos taurus* L.).

NAGYKÁLLÓ

Bronze Age (Gáva culture) settlement. Excavated by A. Mozsolics, 1960. Hungarian National Museum, Budapest.

species	specimens	individuals
wolf — *Canis lupus* L.	1	1
wild swine — *Sus scrofa fer.* L.	2	1
aurochs — *Bos primigenius* Boj.	7	4
Wild animals	10	6
dog — *Canis familiaris* L.	110	5
horse — *Equus caballus* L.	20	9
pig — *Sus scrofa dom.* L.	19	10
sheep — *Ovis aries* L. goat — *Capra hircus* L.	57	10
cattle — *Bos taurus* L.	93	24
Domestic animals	299	58
Total	309	64

NAGYKANIZSA—VÁR (CASTLE)

15th—17th century castle. Excavated by I. Méri, 1953—57. Thury György Museum, Nagykanizsa.

species	specimens	%	individuals	%
catfish — *Silurus glanis* L.	1	0.05	1	0.40
fish — *Pisces* sp.	1	0.05	1	0.40
birds — *Aves* sp. div.	3	0.15	2	0.80
brown hare — *Lepus europaeus* Pall.	5	0.24	2	0.80
fox — *Vulpes vulpes* L.	1	0.05	1	0.40
wild swine — *Sus scrofa fer.* L.	9	0.44	4	1.60
roe deer — *Capreolus capreolus* L.	17	0.83	4	1.60
red deer — *Cervus elaphus* L.	5	0.24	3	1.20
bison — *Bison bonasus* L.	3	0.15	1	0.40
Wild animals	45	2.20	19	7.60
domestic duck — *Anas domestica* L.	1	0.05	1	0.40
domestic goose — *Anser domesticus* L.	7	0.34	2	0.80
hen — *Gallus domesticus* L.	65	3.17	7	2.78
dog — *Canis familiaris* L.	42	2.05	5	1.99
domestic cat — *Felis domestica* Briss.	9	0.44	2	0.80
horse — *Equus caballus* L.	73	3.56	12	4.77
pig — *Sus scrofa dom.* L.	234	11.42	30	11.96
sheep — *Ovis aries* L. goat — *Capra hircus* L.	305	14.89	51	20.33
water buffalo — *Bos bubalis* L.	1	0.05	1	0.40
cattle — *Bos taurus* L.	1267	61.83	121	48.17
Domestic animals	2004	97.80	232	92.40
Total	2049		251	

NAGYKŐRÖS—FEKETE-DŰLŐ (BAULK)

Graves with horses from the Period of the Magyar Conquest. Excavated by I. Kovrig, 1950. Hungarian National Museum, Budapest.

One grave contained the skull and feet of a horse (*Equus caballus* L.), another the feet of a horse.

NAGYMÁGOCS—ÓTOMPA

Avar cemetery. Excavated by G. Csallány. Hungarian National Museum, Budapest. Grave No. 40: parts of skull and left metacarpus of an adult cattle (*Bos taurus* L.).

NAGYRÉV

Early Bronze Age (Bronze Age I) settlement. Excavated by F. Tompa, 1929. Hungarian National Museum, Budapest

species	specimens	individuals
wild cat — *Felis silvestris* Schreb.	1	1
roe deer — *Capreolus capreolus* L.	1	1
reed deer — *Cervus elaphus* L.	5	2
Wild animals	7	4
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	1	1
cattle — *Bos taurus* L.	2	2
Domestic animals	5	5
small ruminant	1	
Total	13	9

NAGYTÉTÉNY

Roman camp. Excavated by F. Fülep, 1949—55. Hungarian National Museum, Budapest.

species	specimens	individuals
roe deer — *Capreolus capreolus* L.	1	1
red deer — *Cervus elaphus* L.	13	4
aurochs — *Bos primigenius* Boj.	4	1
Wild animals	18	6
dog — *Canis familiaris* L.	25	4
horse — *Equus caballus* L.	31	11
pig — *Sus scrofa dom.* L.	23	10
sheep — *Ovis aries* L. goat — *Capra hircus* L.	17	10
cattle — *Bos taurus* L.	93	25
Domestic animals	189	60
Total	207	66

NAGYVÁZSONY—CSEPELY

Mediaeval (14th—16th century) village. Excavated by I. Méri, 1958. Hungarian National Museum, Budapest.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	1	1
roe deer — *Capreolus capreolus* L.	5	3
red deer — *Cervus elaphus* L.	28	5
Wild animals	34	9
dog — *Canis familiaris* L.	9	4
horse — *Equus caballus* L.	17	6
pig — *Sus scrofa dom.* L.	109	19
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	26	9
cattle — *Bos taurus* L.	217	38
Domestic animals	378	76
Total	412	85

NESZMÉLY—TEKERES PATAK (BROOK)

Neolithic (Linear Pottery culture, Zseliz group) settlement. Excavated by J. Makkay, 1959. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp div.	21	3.94	6	3.92
goose — *Anser* sp.	1	0.19	1	0.65
bird — *Avis* sp.	1	0.19	1	0.65
brown hare — *Lepus europaeus* Pall.	5	0.94	2	1.31
beaver — *Castor fiber* L.	1	0.19	1	0.65
wild swine — *Sus scrofa fer.* L.	8	1.50	3	1.96
roe deer — *Capreolus capreolus* L.	1	0.19	1	0.65
red deer — *Cervus elaphus* L.	12	2.25	5	3.27
aurochs — *Bos primigenius* Boj.	21	3.94	13	8.50
Wild animals	71	13.33	33	21.56
pig — *Sus scrofa dom.* L.	68	12.76	18	11.77
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	135	25.33	32	20.92
cattle — *Bos taurus* L.	259	48.48	70	45.75
Domestic animals	462	86.67	120	78.44
Total	533		153	

NÓGRÁD—VÁR (CASTLE)

Castle of the early Modern Period (16th—17th century). Excavated by M. Héjj, 1949. Hungarian National Museum, Budapest.

species	specimens	individuals
roe deer — *Capreolus capreolus* L.	1	1
red deer — *Cervus elaphus* L.	3	1
Wild animals	4	2
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	6	5
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	4	3
cattle — *Bos taurus* L.	11	8
Domestic animals	22	17
Total	26	19

NYÁRSAPÁT

Late Mediaeval (second half of the 15th century) village. Excavated by A. Bálint, 1952—53. Hungarian National Museum, Budapest; Móra Ferenc Museum, Szeged.

species	specimens	individuals
birds — *Aves* sp. div.	2	2
brown hare — *Lepus europaeus* Pall.	1	1
roe deer — *Capreolus capreolus* L.	1	1
red deer — *Cervus elaphus* L.	1	1
Wild animals	5	5
dog — *Canis familiaris* L.	7	3
domestic cat — *Felis domestica* Briss.	3	1
horse — *Equus caballus* L.	44	14
pig — *Sus scrofa dom.* L.	56	24
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	83	26
cattle — *Bos taurus* L.	222	44
Domestic animals	419	115
Total	424	120

NYERGESÚJFALU—TÉGLAGYÁR (BRICK YARD)

Bronze Age settlement. Excavated by N. Kalicz, 1959. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	12	1.10	3	1.44
wolf — *Canis lupus* L.	1	0.09	1	0.48
wild swine — *Sus scrofa fer.* L.	11	1.01	3	1.44
roe deer — *Capreolus capreolus* L.	2	0.18	2	0.96
red deer — *Cervus elaphus* L.	37	3.40	9	4.33
aurochs — *Bos primigenius* Boj.	7	0.64	3	1.44
Wild animals	70	6.42	21	10.09
dog — *Canis familiaris* L.	34	3.13	7	3.37
horse — *Equus caballus* L.	20	1.84	5	2.40
pig — *Sus scrofa dom.* L.	153	14.08	38	18.27
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	253	23.27	49	23.57
cattle — *Bos taurus* L.	557	51.26	88	42.30
Domestic animals	1017	93.58	187	89.91
man — *Homo sapiens* L.	2			
Total	1089		201	

ÓBUDA—SZŐLŐ UTCA (STREET)

Avar cemetery. Excavated by T. Nagy, 1949. Hungarian National Museum, Budapest.

Horse (*Equus caballus* L.) skull and skeleton from one grave; a horse skull from each of two graves.

ÓCSA—ÓMÉRT-DÜLŐ (BAULK)

Sarmatian settlement. Excavated by Gy. Török, 1957. Hungarian National Museum, Budapest.

species	specimens	individuals
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	1	1
cattle — *Bos taurus* L.	11	5
Domestic animals	13	7

ÓHUTA—NAGYSÁNC

Hallstatt Period settlement with traces of the La Tène Period. Excavated by M. Párducz, 1958. Hungarian National Museum, Budapest.

species	specimens	individuals
fish — *Pisces* sp.	1	1
wild cat — *Felis silvestris* Schreb.	1	1
Wild animals	2	2
horse — *Equus caballus* L.	5	3
pig — *Sus scrofa dom.* L.	27	8
sheep — *Ovis aries* L. } goat — *Capra hircus* L.	11	6
cattle — *Bos taurus* L.	42	10
Domestic animals	85	27
man — *Homo sapiens* L.	1	
Total	88	29

OROSHÁZA—GÖRBICS-TANYA (FARMSTEAD)

Cemetery of the Period of the Magyar Conquest. Excavated by I. Dienes, 1961. Hungarian National Museum, Budapest.

Animal bones from two graves:

	No. of graves
horse — *Equus caballus* L.	2
sheep or goat — *Ovis* s. *Capra*	1

OROSHÁZA—NAGY ALBERT TANYÁJA (ALBERT NAGY'S FARM)

Cemetery of the Period of the Magyar Conquest. Excavated by I. Dienes, 1961. Hungarian National Museum, Budapest.

Sheep or goat (*Ovis* s. *Capra*) bones in four graves.

OROSHÁZA

Cemetery of the Period of the Magyar Conquest. Excavated by I. Dienes, 1961. Hungarian National Museum, Budapest.

Horse (*Equus caballus* L.) skulls and feet in three graves.

OROSHÁZA

Avar grave. Hungarian National Museum, Budapest.

Skull and mandible of a ♂ horse (*Equus caballus* L.) aged 8—9 years.

OROSZLÁNY

Avar cemetery. Excavated by Á. Sós, 1957. Hungarian National Museum, Budapest.

Skull and feet of a sheep (*Ovis aries* L.) in grave No. 1.

Örvény

Aeneolithic settlement. Excavated by S. Gallus, 1938. Hungarian National Museum, Budapest.

species	specimens	individuals
fish — *Pisces* sp.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	7	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	50	7
cattle — *Bos taurus* L.	3	2
Domestic animals	60	13
Total	61	14

Örvényes—Hosszúrétek-dülő (Baulk)

Roman settlement. Excavated by T. Szentléleky, 1958—59. Bakony Museum, Veszprém.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
dog — *Canis familiaris* L.	8	3
domestic cat — *Felis domestica* Briss.	1	1
pig — *Sus scrofa dom.* L.	7	4
horse — *Equus caballus* L.	11	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	3	3
cattle — *Bos taurus* L.	18	9
Domestic animals	48	24
Total	49	25

Öskü

Avar cemetery. Excavated by Gy. Rhé. Bakony Museum, Veszprém.
Animal bones from two graves:

	No. of graves
hen — *Gallus domesticus* L.	1
sheep or goat — *Ovis* s. *Capra*	1

PALOTÁS—HOMOKOS

Bronze Age (Bronze Age IV) settlement. Collected by A. Horváth and F. Gábor, 1958. Hungarian National Museum, Budapest.

species	specimens	individuals
fox — *Vulpes vulpes* L.	1	1
Wild animals	1	1
dog — *Canis familiaris* L.	1	1
cattle — *Bos taurus* L.	2	2
Domestic animals	3	3
Total	4	4

PÉCEL

Avar cemetery. Excavated by Gy. Török, 1958—59. Hungarian National Museum, Budapest.

Animals bones from 4 graves:

	No. of graves
pig — *Sus scrofa dom.* L.	3
hen — *Gallus domesticus* L.	3

PÉCS—BUZSÁKI ÚT (STREET)

Avar cemetery. Excavated by F. Fülep—A. Burger, 1961. Janus Pannonius Museum, Pécs.

Grave No. 4: skull and skeleton of an adult horse (*Equus caballus* L.); skull of a subadult sheep (*Ovis aries* L.).

PÉCSVÁRAD—ARANYHEGY

Early Copper Age (Lengyel culture) settlement and cemetery. Excavated by J. Dombay, 1941—59. Janus Pannonius Museum, Pécs (*Acta Arch. Hung.*, **11** [1951] pp. 58—59; *Jan. Pann. Múz. Évk.*, 1960, pp. 116 ff.; 1961, pp. 91 ff.).

PELYPUSZTA

Avar cemetery. Excavated by G. Megay, 1932. Herman Ottó Museum, Miskolc.

In two graves, the incomplete skeletons of horses (*Equus caballus* L.) were found.

PILISCSABA

Hallstatt Period (B) cemetery. Excavated by F. Kőszegi, 1957. Hungarian National Museum, Budapest.

Grave No. 3: radius with part of the ulna of a subadult cattle (*Bos taurus* L.).

PILISMARÓT—I. ŐRTORONY (WATCH-TOWER I)

Roman (second half of 4th century) watch-tower. Excavated by S. Soproni, 1959. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	22	2.23	4	2.15
birds — *Aves* sp. div.	9	0.91	3	1.61
brown hare — *Lepus europaeus* Pall.	3	0.30	2	1.08
beaver — *Castor fiber* L.	1	0.10	1	0.54
badger — *Meles meles* L.	3	0.30	1	0.54
fox — *Vulpes vulpes* L.	1	0.10	1	0.54
wild swine — *Sus scrofa fer.* L.	78	7.92	10	5.38
roe deer — *Capreolus capreolus* L.	3	0.30	2	1.08
red deer — *Cervus elaphus* L.	84	8.53	12	6.45
aurochs — *Bos primigenius* Boj.	7	0.71	3	1.61
Wild animals	211	21.40	39	20.98
dog — *Canis familiaris* L.	17	1.73	5	2.68
horse — *Equus caballus* L.	121	12.29	18	9.68
pig — *Sus scrofa dom.* L.	221	22.43	42	22.58
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	170	17.27	36	19.35
cattle — *Bos taurus* L.	245	24.88	46	24.73
Domestic animals	774	78.60	147	79.02
man — *Homo sapiens* L.	20			
Total	1005		186	

PILISMARÓT—ÖREGEK DÜLŐ (BAULK)

Avar cemetery. Excavated by A. J. Horváth, 1942. Hungarian National Museum, Budapest.

Animal bones from three graves:

	No. of graves
hen — *Gallus domesticus* L.	2
pig — *Sus scrofa dom.* L.	1

PILISMARÓT—SZOBI RÉV (SZOB FERRY)

Neolithic (Linear Pottery culture, Zseliz group) settlement. Excavated by J. Makkay, 1959. Hungarian National Museum, Budapest.

species	specimens	individuals
brown hare — *Lepus europaeus* Pall.	1	1
wild swine — *Sus scrofa fer.* L.	1	1
red deer — *Cervus elaphus* L.	3	1
aurochs — *Bos primigenius* Boj.	4	2
Wild animals	9	5
dog — *Canis familiaris* L.	2	1
pig — *Sus scrofa dom.* L.	9	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	20	4
cattle — *Bos taurus* L.	53	7
Domestic animals	84	15
man — *Homo sapiens* L.	3	
Total	96	20

PÓHALOM

Sarmatian settlement. Hungarian National Museum, Budapest.

species	specimens	individuals
horse — *Equus caballus* L.	2	1
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1
cattle — *Bos taurus* L.	2	2
Domestic animals	7	6

PÓKASZEPETK

Avar cemetery. Excavated by R. Pusztai, A. Radnóti and Á. Sós, 1956; by Á. Sós, 1963. Hungarian National Museum, Budapest.

Animal bones from 9 graves:

	No, of graves
horse — *Equus caballus* L.	8
sheep or goat — *Ovis* s. *Capra*	2
pig — *Sus scrofa dom.* L.	1

POLGÁR—BASATANYA

Early Copper Age (Tiszapolgár culture) and middle Copper Age (Bodrogkeresztúr culture) cemetery; Neolithic (Szilmeg culture), late Copper Age (Pécel culture), Bronze Age (Nagyrév and Füzesabony cultures), Hallstatt Period and Sarmatian settlements. Excavated by I. B. Kutzián, 1950—54. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] pp. 41—42, 64; Bökönyi S., 1964. pp. 1 ff.).

POLGÁR—CSŐSZHALOM

Late Neolithic settlement. Excavated by I. B. Kutzián, 1957. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	14	0.58	9	1.20
European pond tortoise — *Emys orbicularis* L.	9	0.38	7	0.94
purple heron — *Ardea* cf. *purpurea* L.	1	0.04	1	0.13
eagle owl — *Bubo bubo* L.	1	0.04	1	0.13
bird — *Avis* sp.	1	0.04	1	0.13
fox — *Vulpes vulpes* L.	4	0.17	3	0.41
wolf — *Canis lupus* L.	1	0.04	1	0.13
badger — *Meles meles* L.	2	0.08	1	0.13
brown bear — *Ursus arctos* L.	1	0.04	1	0.13
wild cat — *Felis silvestris* Schreb.	1	0.04	1	0.13
wild swine — *Sus scrofa fer.* L.	298	12.42	105	14.02
roe deer — *Capreolus capreolus* L.	95	3.96	48	6.41
red deer — *Cervus elaphus* L.	403	16.79	124	16.56
aurochs — *Bos primigenius* Boj.	839	34.96	176	23.50
Wild animals	1670	69.58	479	63.95
dog — *Canis familiaris* L.	28	1.17	18	2.40
pig — *Sus scrofa dom.* L.	157	6.42	74	9.88
sheep — *Ovis aries* L. goat — *Capra hircus* L.	47	1.96	27	3.61
cattle — *Bos taurus* L.	501	20.87	151	20.16
Domestic animals	730	30.42	270	36.05
Total	2400		749	

Pomáz—Zdravlyák

Neolithic (Linear Pottery culture, Zseliz group) settlement. Excavated by I. B. Kutzián and S. Sashegyi, 1956. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] pp. 51—52).

Pusztaföldvár—Bakihalom

Part of Aeneolithic settlement. Excavated by P. Patay, 1955. Tornyai János Museum, Hódmezővásárhely (*Acta Arch. Hung.*, **11** [1959] p. 57).

Rákóczifalva

Bronze Age (Bronze Age III) settlement. Excavated by S. Gallus, 1939. Hungarian National Museum, Budapest.

species	specimens	individuals
pig — *Sus scrofa dom.* L.	3	3
cattle — *Bos taurus* L.	2	2
Domestic animals	5	5

Rétközberencs—Paromdomb

Cemetery of the Period of the Magyar Conquest. Excavated by D. Csallány, 1958. Jósa András Museum, Nyíregyháza (*Jósa A. Múz. Évk.*, 1958 [1960] pp. 88 ff.).

Rozvágy

Celtic cemetery. Excavated by S. Gallus, 1935. Hungarian National Museum, Budapest.

Animal bones were found in two graves:

	No. of graves
pig — *Sus scrofa dom.* L.	2
goose — *Anser* sp.	1

Röszke—Ladányi dűlő (Baulk)

Cemetery of the Period of the Magyar Conquest. Excavated by O. Trogmayer, 1959. Hungarian National Museum, Budapest.

Grave No. 1: parts of skull and feet of a subadult horse (*Equus caballus* L.).

RÖSZKE—LÚDVÁR

Early Neolithic (Körös culture) settlement. Excavated by O. Trogmayer, 1963–65. Móra Ferenc Museum, Szeged.

species	specimens	%	individuals	%
catfish — *Silurus glanis* L.	1	0.05	1	0.435
pike — *Esox lucius* L.	1	0.05	1	0.435
fish — *Pisces* sp. div.	400	19.16	26	11.30
European pond tortoise — *Emys orbicularis* L.	123	5.89	11	4.78
cormorant — *Phalacrocorax carbo* L.	2	0.10	1	0.435
grey heron — *Ardea cinerea* L.	2	0.10	2	0.87
purple heron — *Ardea purpurea* L.	2	0.10	2	0.87
grey leg goose — *Anser anser* L.	1	0.05	1	0.435
wild goose — *Anser* sp.	3	0.14	1	0.435
mallard — *Anas platyrhynchos* L.	12	0.57	2	0.87
tufted duck — *Aythya fuligula* L.	1	0.05	1	0.435
short-toed eagle — *Circaetus gallicus* Gm.	1	0.05	1	0.435
black grouse — *Lyrurus tetrix* L.	1	0.05	1	0.435
demoiselle crane — *Anthropoides virgo* L.	1	0.05	1	0.435
great bustard — *Otis tarda* L.	2	0.10	1	0.435
curlew — *Numedius arquata* L.	1	0.05	1	0.435
wood pigeon — *Columba palumbus* L.	1	0.05	1	0.435
birds — *Aves* sp. div.	106	5.08	4	1.74
brown hare — *Lepus europaeus* Pall.	7	0.33	2	0.87
beaver — *Castor fiber* L.	8	0.38	3	1.30
fox — *Vulpes vulpes* L.	15	0.72	7	3.05
wolf — *Canis lupus* L.	7	0.33	2	0.87
badger — *Meles meles* L.	1	0.05	1	0.435
mustelid — *Mustela* sp.	10	0.49	2	0.87
wild cat — *Felis silvestris* Schreb.	2	0.10	1	0.435
wild ass — *Asinus hydruntinus* Reg.	17	0.81	5	2.17
wild swine — *Sus scrofa fer.* L.	75	3.59	14	6.09
roe deer — *Capreolus capreolus* L.	54	2.59	10	4.35
red deer — *Cervus elaphus* L.	307	14.70	24	10.43
aurochs — *Bos primigenius* L.	72	3.45	12	5.22
Wild animals	1236	59.22	142	61.74
dog — *Canis familiaris* L.	34	1.63	5	2.17
pig — *Sus scrofa dom.* L.	14	0.67	4	1.74
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	631	31.16	64	27.83
cattle — *Bos taurus* L.	153	7.32	15	6.52
Domestic animals	852	40.78	88	38.26
Total	2088		230	

RÖSZKE—NAGYSZÉKSÓS

10th—11th century cemetery. Excavated by O. Trogmayer, 1959. Hungarian National Museum, Budapest.

Grave No. 3: parts of skull and left metacarpus of an adult horse (*Equus caballus* L.).

SÁGHEGY

Hallstatt Period settlement. Collected by J. Lázár. Hungarian National Museum, Budapest.

species	specimens	individuals
badger — *Meles meles* L.	2	1
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	2	2
Wild animals	5	4
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	1	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	2	2
cattle — *Bos taurus* L.	2	2
Domestic animals	6	6
Total	11	10

SALGÓTARJÁN—KENYÉRGYÁR (BAKERY)

Part of Bronze Age settlement. Collected by P. Kiss, 1962. Museum, Salgótarján.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	2	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1
cattle — *Bos taurus* L.	22	6
Domestic animals	25	8
Total	26	9

SALGÓTARJÁN—PÉCSKŐ

Late Copper Age (Pécel culture) and early Bronze Age (Zók culture) settlement. Excavated by J. Korek and P. Patay, 1960. Museum, Salgótarján (*Acta Arch. Hung.*, **20** [1968] pp. 60 ff.).

SÁROSPATAK—VÁR (CASTLE)

From 17th—18th century layers. Excavated by J. Kovalovszki, 1963. Hungarian National Museum, Budapest.

species	specimens	individuals
sheep — *Ovis aries* L.	2	2
cattle — *Bos taurus* L.	2	2
Domestic animals	4	4

SÁROSPATAK

Grave with horse (*Equus caballus* L.) bones of the Period of the Magyar Conquest. Excavated by A. Bartha, 1956. Hungarian National Museum, Budapest.

Fragments of a skull and left hind foot of a horse aged about 5 years.

SOLTVADKERT

Bronze Age (Bronze Age IV) foundry. Excavated by Gy. Gazdapusztai, 1954. Hungarian National Museum, Budapest.

Part of a horse's (*Equus caballus* L.) splint bone.

SOPRON—SZENTGYÖRGY TÉR (SQUARE) 18

Mediaeval (12th—15th century) layers. Excavated by Gy. Nováki, 1961. Liszt Ferenc Museum, Sopron.

species	specimens	individuals
horse — *Equus caballus* L.	2	1
pig — *Sus scrofa dom.* L.	1	1
cattle — *Bos taurus* L.	4	2
Domestic animals	7	4

SOPRONKŐHIDA

Late Avar cemetery. Excavated by Gy. Török, 1956—60. Hungarian National Museum, Budapest.

Animal bones were excavated from 49 graves:

	No. of graves
hen — *Gallus domesticus* L.	40
cattle — *Bos taurus* L.	20
pig — *Sus scrofa dom.* L.	7
sheep or goat — *Ovis* s. *Capra*	6
sheep — *Ovis aries* L.	1

SURJÁN

Scythian cemetery. Excavated by Zs. Csalogh, 1961. Damjanich János Museum, Szolnok.

Animal bones were excavated from 3 graves:

	No. of graves
sheep or goat — *Ovis* s. *Capra*	2
cattle — *Bos taurus* L.	1

SÜTTŐ—HOSSZÚVÖLGY

Bronze Age (Magyarád culture) settlement. Excavated by A. Mozsolics, 1959. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	4	0.41	2	1.12
brown hare — *Lepus europaeus* Pall.	1	0.10	1	0.56
fox — *Vulpes vulpes* L.	1	0.10	1	0.56
wild cat — *Felis silvestris* Schreb.	1	0.10	1	0.56
wild swine — *Sus scrofa fer.* L.	27	2.78	7	3.93
roe deer — *Capreolus capreolus* L.	5	0.51	2	1.12
red deer — *Cervus elaphus* L.	52	5.36	10	5.62
aurochs — *Bos primigenius* Boj.	8	0.82	3	1.69
Wild animals	99	10.18	27	15.16
dog — *Canis familiaris* L.	39	4.02	8	4.50
horse — *Equus caballus* L.	25	2.57	6	3.37
pig — *Sus scrofa dom.* L.	158	16.27	34	19.09
sheep — *Ovis aries* L. goat — *Capra hircus* L.	204	21.02	43	24.16
cattle — *Bos taurus* L.	446	45.94	60	33.72
Domestic animals	872	89.82	151	84.84
man — *Homo sapiens* L.	1			
Total	972		178	

Szabadszállás—Ágostonhalmi dülő (Baulk)

Late Copper Age (Pécel culture) pit. Excavated by E. H. Tóth, 1962. Katona József Museum, Kecskemét.

Fragments of a skull and skeleton of an adult cattle (*Bos taurus* L.).

Szabadszállás—Józan

Scythian cemetery, Sarmatian settlement. Excavated by E. H. Tóth, 1961. Katona József Museum, Kecskemét.

In Scythian grave: left mandible of a mature horse (*Equus caballus* L.).

Sarmatian pit: fragments of a skull and skeleton of adult and juvenile cattle (*Bos taurus* L.), metacarpus of adult sheep (*Ovis aries* L.), part of radius of an adult pig (*Sus scrofa dom.* L.).

Szakony

Cemetery of the Period of the Magyar Conquest. Excavated by I. Dienes and Gy. Nováki, 1961. Hungarian National Museum, Budapest.

Animal bones were excavated from 3 graves:

	No. of graves
horse — *Equus caballus* L.	3
sheep or goat — *Ovis* s. *Capra*	2

Szarvas—Rózsás

Village of the Period of the Árpád Dynasty (10—12th century). Excavated by J. Kovalovszki, 1956. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
silver bream — *Blicca björkna* L.	8	1.47	1	1.00
pike — *Esox lucius* L.	18	3.32	3	3.00
crucian — *Carassius carassius* L.	8	1.47	1	1.00
carp — *Cyprinus carpio* L.	142	26.15	8	8.00
catfish — *Silurus glanis* L.	1	0.18	1	1.00
fish — *Pisces* sp.	3	0.56	1	1.00
black-tailed godwit — *Limosa limosa* L.	5	0.92	1	1.00
birds — *Aves* sp. div.	2	0.37	2	2.00
Wild animals	187	34.44	18	18.00
domestic goose — *Anser domesticus* L.	24	4.42	3	3.00
hen — *Gallus domesticus* L.	1	0.18	1	1.00
dog — *Canis familiaris* L.	73	13.44	11	11.00
domestic cat — *Felis domestica* Briss.	3	0.56	1	1.00
horse — *Equus caballus* L.	12	2.21	9	9.00
pig — *Sus scrofa dom.* L.	117	21.55	18	18.00
sheep — *Ovis aries* L. goat — *Capra hircus* L.	44	8.10	15	15.00
cattle — *Bos taurus* L.	82	15.10	24	24.00
Domestic animals	356	65.56	82	82.00
Total	543		100	

SZÁZHALOMBATTA—DUNAFÜRED

Roman camp, excavated by A. Mócsy, 1953. Hungarian National Museum, Budapest.

species	specimens	individuals
beaver — *Castor fiber* L.	1	1
roe deer — *Capreolus capreolus* L.	1	1
Wild animals	2	2
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	3	2
cattle — *Bos taurus* L.	1	1
Domestic animals	5	4
Total	7	6

SZEBÉNY—PAPERDŐ

Bronze Age (southern group of Transdanubian lime inlay pottery) settlement. Excavated by G. Bándi, 1963—64. Janus Pannonius Museum, Pécs.

species	specimens	%	individuals	%
fish — *Pisces* sp.	1	0.14	1	0.56
brown hare — *Lepus europaeus* Pall.	4	0.54	2	1.12
wild swine — *Sus scrofa fer.* L.	12	1.64	7	3.93
roe deer — *Capreolus capreolus* L.	9	1.23	5	2.81
red deer — *Cervus elaphus* L.	22	3.00	8	4.50
aurochs — *Bos primigenius* Boj.	2	0.27	1	0.56
Wild animals	50	6.82	24	13.48
dog — *Canis familiaris* L.	6	0.82	3	1.69
horse — *Equus caballus* L.	34	4.64	12	6.74
pig — *Sus scrofa dom.* L.	120	16.37	34	19.10
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	63	8.59	25	14.05
cattle — *Bos taurus* L.	460	62.67	80	44.94
Domestic animals	683	93.18	154	86.52
Total	733		178	

SZEGED—KUNDOMB

Avar cemetery, excavated by Ferenc Móra, 1929. Móra Ferenc Museum, Szeged. Animal bones were excavated from 2 graves:

	No. of graves
dog — *Canis familiaris* L.	1
cattle — *Bos taurus* L.	1

SZEGED—MAKKOSERDŐ

Avar cemetery. Excavated by D. Csallány, 1942. Hungarian National Museum, Budapest.

Animal bones were excavated from 9 graves:

	No. of graves
cattle — *Bos taurus* L.	5
horse — *Equus caballus* L.	3
hen — *Gallus domesticus* L.	2
sheep — *Ovis aries* L.	1
sheep or goat — *Ovis* s. *Capra*	1

SZEGED—SZENTGYÖRGY TÉR (SQUARE)

Mediaeval pit. Hungarian National Museum, Budapest. Incomplete skull of adult cattle (*Bos taurus* L.).

SZEGHALOM—KÁROLY—PAKACPART

Settlement of the Middle Ages (13th—14th century). Collected by I. Bereczki, 1961. Hungarian Museum of Agriculture, Budapest.

species	specimens	individuals
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	1	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1
cattle — *Bos taurus* L.	6	4
Domestic animals	10	8

SZEGVÁR—TŰZKÖVES

Neolithic (Tisza culture, with traces of the Linear Pottery culture of the Great Hungarian Plain) settlement. Excavated by J. Csalog, 1955—56. Koszta József Museum, Szentes (*Acta Arch. Hung.*, **11** [1959] pp. 48 ff.).

SZÉKELY—ZÖLDTELEK

Part of Copper Age (Bodrogkeresztur and Pécel cultures) settlement. Excavated by N. Kalicz, 1955. Jósa András Museum, Nyíregyháza (*Acta Arch. Hung.*, **11** [1959] pp. 59 ff.).

SZEKSZÁRD—PALÁNK

Avar cemetery. Excavated by Gy. Kiss and Á. Salamon, 1957. Hungarian National Museum, Budapest.

Animal bones were excavated from 23 graves:

	No. of graves
horse — *Equus caballus* L.	23
cattle — *Bos taurus* L.	1

SZENTENDRE—CEMENTGYÁR (CEMENT-PLANT)

Celtic settlement. Excavated by A. Radnóti, 1953. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 70).

Szentes — Berekhát

Avar cemetery. Excavated by G. Csallány, 1940—41. Hungarian National Museum, Budapest.

Grave No. 22: fragments of mandible and skeleton of adult cattle (*Bos taurus* L.).

Szentes — Borbásföld

Cemetery of the Period of the Magyar Conquest. Excavated by J. Szabó, 1954—55. Hungarian National Museum, Budapest.

Animal bones were excavated from 9 graves:

	No. of graves
horse — *Equus caballus* L.	9
sheep — *Ovis aries* L.	1

Szentes — Kaján

Avar cemetery. Excavated by G. Csallány, 1937. Hungarian National Museum, Budapest. Animal bones were transferred from 5 graves to the Hungarian National Museum:

	No. of graves
cattle — *Bos taurus* L.	4
horse — *Equus caballus* L.	2
pig — *Sus scrofa dom.* L.	1
sheep — *Ovis aries* L.	1

Szentes — Nagyhegy

Avar and Gepid cemetery. Excavated by G. Csallány, 1927—28, 1939; excavated by D. Csallány, 1941. Hungarian National Museum, Budapest; Móra Ferenc Museum, Szeged.

From Avar graves, 3 skeletons of horses (*Equus caballus* L.) and 1 skull of sheep (*Ovis aries* L.) were transformed to the collections.

Szentes — Nagyhegy — Orosz Imre földje (Plot of Imre Orosz)

Avar cemetery. Excavated by G. Csallány, 1927—32. Hungarian National Museum, Budapest.

The skull of a pig (*Sus scrofa dom.* L.) aged approximately 2 years was transferred to the National Museum without the number of the grave being indicated.

Szentes — Vekerzug

Scythian cemetery. Excavated by G. Csallány, 1941 and M. Párcuz 1950, 1952, 1954—55. (*Acta Arch. Hung.*, **2** [1952] pp. 173 ff.; **4** [1954] pp. 93 ff.; **6** [1955] pp. 23 ff.).

Szentkirályszabadja

Roman settlement. Excavated by L. Márton, 1934. Bakony Museum, Veszprém.

Part of the horn core of adult cattle (*Bos taurus* L.).

Szihalom

Bronze Age settlement. Excavated by A. Ipolyi, 1870. Hungarian National Museum, Budapest.

species	specimens	individuals
roe deer — *Capreolus capreolus* L.	15	12
red deer — *Cervus elaphus* L.	29	20
Wild animals	44	32
cattle — *Bos taurus* L.	4	4
Domestic animals	4	4
Total	48	36

Szilvásvárad—Töröksánc

Earthwork of the Hallstatt Period. Excavated by Á. Salamon, 1962. Hungarian National Museum, Budapest.

species	specimens	individuals
wild swine — *Sus scrofa fer.* L.	2	2
Wild animals	2	2
dog — *Canis familiaris* L.	2	1
horse — *Equus caballus* L.	6	3
pig — *Sus scrofa dom.* L.	9	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	32	7
cattle — *Bos taurus* L.	42	10
Domestic animals	92	25
Total	93	27

Szilvásvárad

Settlement of the 2nd—5th century A.D. Excavated by Á. Salamon, 1959, 1962. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
brown hare — *Lepus europaeus* Pall.	2	0.34	1	0.61
wild swine — *Sus scrofa fer.* L.	2	0.34	2	1.22
roe deer — *Capreolus capreolus* L.	3	0.51	2	1.22
red deer — *Cervus elaphus* L.	7	1.18	4	2.44
Wild animals	14	2.37	9	5.49
hen — *Gallus domesticus* L.	1	0.17	1	0.61
dog — *Canis familiaris* L.	28	4.73	6	3.66
horse — *Equus caballus* L.	41	6.92	12	7.32
pig — *Sus scrofa dom.* L.	167	28.22	46	28.04
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	83	14.02	29	17.67
cattle — *Bos taurus* L.	258	43.57	61	37.21
Domestic animals	578	97.63	155	94.51
Total	592		164	

Szob—Öregfalu

Settlement of the Hallstatt Period (HC), excavated by A. J. Horváth, 1927. Hungarian National Museum, Budapest.

species	specimens	individuals
horse — *Equus caballus* L.	3	1
cattle — *Bos taurus* L.	2	1
Domestic animals	5	2

Szolnok—Szanda

Sarmatian settlement, Gepid cemetery, excavated by I. Kovrig, 1952. Damjanich János Museum, Szolnok.

"A" / Gepid, pit: skull and skeleton of adult dog.

Sarmatian settlement: fragment of skull of subadult sheep (*Ovis aries* L.), skull of juvenile sheep.

Szolnok—Vár (Castle)

Castle of the Period of Turkish occupation. Collected by S. Bökönyi, 1962. Hungarian National Museum, Budapest. Damjanich János Museum, Szolnok.

species	specimens	individuals
horse — *Equus caballus* L.	9	6
goat — *Capra hircus* L.	1	1
sheep — *Ovis aries* L.	121	100
cattle — *Bos taurus* L.	16	16
Domestic animals	147	123

The material was selected before being collected.

Szőreg—Téglagyár (Brick Works)

Avar cemetery. Excavated by D. Csallány, 1942—43. Hungarian National Museum, Budapest.

From each of 6 graves a horse skeleton (*Equus caballus* L.) was excavated.

Táborfalva—Postadülő (Post-Office Baulk)

Sarmatian settlement. Excavated by Gy. Török and Á. Salamon, 1956. Hungarian National Museum, Budapest.

species	specimens	individuals
dog — *Canis familiaris* L.	2	2
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. goat — *Capra hircus* L.	4	3
cattle — *Bos taurus* L.	18	8
Domestic animals	26	15

Tác—Fövenypuszta

Roman villa settlement with traces of settlement from the Bronze Age, Migration Period and Middle Ages with Avar graves. Excavated by J. Horváth, A. Marosi, A. Radnóti and J. Fitz. István Király Museum, Székesfehérvár.

Bronze Age

species	specimens	individuals
sheep — *Ovis aries* L. goat — *Capra hircus* L.	3	2
cattle — *Bos taurus* L.	2	2
Domestic animals	5	4

TÁC *(continued)*
Period of the Roman Empire

species	specimens	%	individuals	%
pike — *Esox lucius* L.	2	0.01	1	0.07
fish — *Pisces* sp. div.	15	0.08	5	0.34
European pond tortoise — *Emys orbicularis* L.	8	0.04	3	0.20
white stork — *Ciconia ciconia* L.	3	0.15	2	0.14
mallard — *Anas platyrhynchos* L.	2	0.01	1	0.07
garganey — *Anas querquedula* L.	1	0.005	1	0.07
teal — *Anas crecca* L.	1	0.005	1	0.07
pochard — *Aythya ferina* L.	3	0.015	2	0.14
tufted duck — *Aythya* cf. *fuliga* L.	1	0.005	1	0.07
goshawk — *Accipiter gentilis* L.	1	0.005	1	0.07
white-tailed eagle — *Haliaetus albicilla* L.	6	0.03	2	0.14
marsh harrier — *Circus aeruginosus* L.	1	0.005	1	0.07
crane — *Grus grus* L.	5	0.025	2	0.14
little bustard — *Otis tetrax* L.	1	0.005	1	0.07
wood pigeon — *Columba palumbus* L.	1	0.005	1	0.07
rook — *Corvus* cf. *frugilegus* L.	2	0.01	2	0.14
crow — *Corvus* sp.	3	0.015	2	0.14
jackdaw — *Colaeus monedula* L.	1	0.005	1	0.07
birds — *Aves* sp. div.	14	0.07	4	0.27
brown hare — *Lepus europaeus* Pall.	45	0.22	10	0.68
badger — *Meles meles* L.	2	0.01	1	0.07
fox — *Vulpes vulpes* L.	3	0.015	2	0.14
wolf — *Canis lupus* L.	1	0.005	1	0.07
wild swine — *Sus scrofa fer.* L.	30	0.15	8	0.54
roe deer — *Capreolus capreolus* L.	5	0.02	3	0.20
red deer — *Cervus elaphus* L.	37	0.19	9	0.61
aurochs — *Bos primigenius* Boj.	49	0.24	10	0.68
Wild animals	243	1.22	78	4.38
pigeon — *Columba domestica* L.	3	0.015	2	0.14
goose — *Anser domesticus* L.	133	0.66	21	1.42
hen — *Gallus domesticus* L.	665	3.33	98	6.63
dog — *Canis familiaris* L.	3132	15.68	95	6.43
cat — *Felis domestica* Briss.	49	0.24	19	1.28
ass — *Asinus asinus* L.	17	0.085	7	0.47
horse — *Equus caballus* L.	1499	7.52	110	7.45
pig — *Sus scrofa dom.* L.	3172	15.88	257	17.39
sheep — *Ovis aries* L. goat — *Capra hircus* L.	4274	21.41	332	22.45
cattle — *Bos taurus* L.	6781	33.96	458	31.00
Domestic animals	19725	98.78	1399	94.65
Total	19968		1477	

TÁC *(continued)*

Migration Period

species	specimens	individuals
horse — *Equus caballus* L.	3	1
pig — *Sus scrofa dom.* L.	1	1
cattle — *Bos taurus* L.	4	2
Domestic animals	8	4

Middle Ages

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
goose — *Anser domesticus* L.	1	1
dog — *Canis familiaris* L.	10	3
cat — *Felis domestica* Briss.	1	1
ass — *Asinus asinus* L.	1	1
horse — *Equus caballus* L.	29	6
pig — *Sus scrofa dom.* L.	36	7
sheep — *Ovis aries* L. goat — *Capra hircus* L.	38	9
cattle — *Bos taurus* L.	108	19
Domestic animals	224	47
Total	228	48

In those Roman layers which were mixed with those of the Middle Ages part of a camel's (*Camelus* sp.) mandible was found, which has not been included in the statistics.

In Avar graves skeletons of 5 horses (*Equus caballus* L.) were found.

TÁPIÓSZELE—HEGYESDOMB

Grave from the Period of the Hungarian Conquest (9th—10th century). Excavated by Gy. Blaskovich, 1956. Hungarian National Museum, Budapest.

Hoof bone of an adult horse (*Equus caballus* L.).

TÁPIÓSZELE—TŰZKÖVES

Bronze Age settlement. Excavated by J. Banner, 1951. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959], pp. 64, 65).

TAR

3rd—4th century A.D. settlement. Excavated by J. Korek, 1958. Hungarian National Museum, Budapest.

species	specimens	individuals
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	1	1
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	2	2
cattle — *Bos taurus* L.	14	10
Domestic animals	17	13
Total	18	14

TARNABOD

Middle Copper Age (Bodrogkeresztúr culture) settlement. Excavated by N. Kalicz, 1955. Dobó István Museum, Eger (*Acta Arch. Hung.*, **11** [1959] p. 60).

TARNAZSADÁNY—SÁNDORRÉSZE

Part of Bronze Age settlement. Excavated by N. Kalicz, 1963. Hungarian National Museum, Budapest.

species	specimens	individuals
brown hare — *Lepus europaeus* Pall.	1	1
roe deer — *Capreolus capreolus* L.	2	2
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	1	1
Wild animals	5	5
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	29	6
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	29	7
cattle — *Bos taurus* L.	129	15
Domestic animals	188	29
Total	193	34

TÁRNOK

Roman settlement. Excavated by A. Mócsy, 1957. Hungarian National Museum, Budapest.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
horse — *Equus caballus* L.	1	1
Domestic animals	1	1
Total	2	2

TISZABERCEL—RÁCTEMETŐ (SERB CEMETERY)

Cemetery of the Period of the Hungarian Conquest (9th—10th century). Excavated by N. Kalicz, 1957. Hungarian National Museum, Budapest.

Grave No. 10: parts of skull and feet of a 5 and a $5\frac{1}{2}$-year-old ♂ horse (*Equus caballus* L.).

TISZAESZLÁR—BASHALOM

Cemetery of the Period of the Hungarian Conquest (9th—10th century). Excavated by I. Dienes, 1958—65. Hungarian National Museum, Budapest.

In each of 7 graves, the skull and feet of a horse (*Equus caballus* L.) were found.

TISZAESZLÁR—BASHALOM

Sarmatian settlement and settlement of the Period of the Árpád Dynasty (11th—13th century). Excavated by J. Kovalovszki, 1962—63. Hungarian National Museum, Budapest.

Age	Sarmatian		Period of Árpád Dynasty	
species	specimens	individuals	specimens	individuals
wild swine — *Sus scrofa fer.* L.	—	—	1	1
Wild animals	—	—	1	1
dog — *Canis familiaris* L.	1	1	—	—
horse — *Equus caballus* L.	16	2	9	6
pig — *Sus scrofa dom.* L.	7	4	7	5
sheep — *Ovis aries* L. goat — *Capra hircus* L.	3	3	13	6
cattle — *Bos taurus* L.	10	5	29	12
Domestic animals	37	15	58	29
Total	37	15	59	30

TISZAESZLÁR—VÖRÖSMARTY UTCA (STREET) 37

Avar grave of a horseman. Excavated by D. Csallány, 1961. Jósa András Museum, Nyíregyháza.

Fragments of the skull and feet of a horse (*Equus caballus* L.) about 5 years old.

TISZAFÜRED—ÁSOTTHALOM

Bronze Age settlement. Excavated by E. Tariczky and B. Milesz. Museum, Tiszafüred.

species	specimens	individuals
bird — *Aves* sp.	1	1
brown hare — *Lepus europaeus* Pall.	1	1
wild swine — *Sus scrofa fer.* L.	2	2
roe deer — *Capreolus capreolus* L.	13	8
red deer — *Cervus elaphus* L.	34	20
Wild animals	51	32
dog — *Canis familiaris* L.	5	4
pig — *Sus scrofa dom.* L.	3	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	4	4
cattle — *Bos taurus* L.	15	13
Domestic animals	27	24
Total	78	56

TISZAIGAR—CSIKÓSTANYA

Part of a Neolithic and early Bronze Age settlement. Excavated by J. Szabó, 1954. Damjanich János Museum, Szolnok (*Acta Arch. Hung.*, **11** [1959] p. 56).

TISZALÖK—RÁZOM

Village from the Period of the Árpád Dynasty (11th—13th century). Excavated by I. Méri, 1950. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
carp — *Cyprinus carpio* L.	23	1.99	2	0.50
fish — *Pisces* sp.	57	4.92	5	1.25
birds — *Aves* sp. div.	15	1.30	2	0.50
wild swine — *Sus scrofa fer.* L.	2	0.19	1	0.25
roe deer — *Capreolus capreolus* L.	8	0.67	5	1.25
red deer — *Cervus elaphus* L.	38	3.28	12	3.00
Wild animals	143	12.35	27	6.75
hen — *Gallus domesticus* L.	32	2.76	6	1.50
dog — *Canis familiaris* L.	60	5.18	13	3.25
cat — *Felis domesticus* Briss.	1	0.09	1	0.25
horse — *Equus caballus* L.	261	22.54	96	24.00
pig — *Sus scrofa dom.* L.	240	20.73	86	21.50
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	60	5.18	34	8.50
cattle — *Bos taurus* L.	361	31.17	137	34.25
Domestic animals	1015	87.65	373	93.25
Total	1158		400	

TISZALUC—DANKADOMB

Bronze Age (Hatvan culture) settlement. Excavated by N. Kalicz, 1957, 1960. Herman Ottó Museum, Miskolc; Hungarian National Museum, Budapest. Material of the excavation of 1957 (*Herman O. Múz. Évk.* [1958] II, pp. 19 ff.).

Bone samples of the excavation of 1962.

species	specimens	%	individuals	%
catfish — *Silurus glanis* L.	6	0.15	2	0.24
pike — *Esox lucius* L.	4	0.10	2	0.24
fish — *Pisces* sp. div.	46	1.14	5	0.60
European pond tortoise — *Emys orbicularis* L.	2	0.05	2	0.24
cormorant — *Phalacrocorax carbo* L.	1	0.02	1	0.12
black stork — *Ciconia* cf. *nigra* L.	1	0.02	1	0.12
goose — *Anser* sp.	2	0.05	1	0.12
crane — *Grus grus* L.	2	0.05	1	0.12
bird — *Avis* sp.	2	0.05	1	0.12
brown hare — *Lepus europaeus* Pall.	5	0.12	2	0.24
beaver — *Castor fiber* L.	8	0.20	3	0.36
fox — *Vulpes vulpes* L.	3	0.07	2	0.24
wolf — *Canis lupus* L.	4	0.10	2	0.24
brown bear — *Ursus arctos* L.	1	0.02	1	0.12
lynx — *Lynx lynx* L.	1	0.02	1	0.12
wild cat — *Felis silvestris* Schreb.	1	0.02	1	0.12
wild swine — *Sus scrofa fer.* L.	56	1.38	28	3.37
roe deer — *Capreolus capreolus* L.	39	0.96	15	1.81
red deer — *Cervus elaphus* L.	279	6.89	88	10.61
aurochs — *Bos primigenius* Boj.	51	1.26	27	3.25
Wild animals	514	12.67	186	22.40
dog — *Canis familiaris* L.	63	1.56	20	2.41
horse — *Equus caballus* L.	118	2.93	38	4.58
pig — *Sus scrofa dom.* L.	852	21.03	165	19.88
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1054	26.02	183	22.05
cattle — *Bos taurus* L.	1449	35.79	238	28.68
Domestic animals	3536	87.33	644	77.60
Total	4050		830	

TISZALUC—VÁLYOGOS

Neolithic (Tisza culture) settlement. Excavated by N. Kalicz, 1960. Hungarian National Museum, Budapest.

species	specimens	individuals
fish — *Pisces* sp.	2	1
wild swine — *Sus scrofa fer.* L.	2	1
roe deer — *Capreolus capreolus* L.	1	1
red deer — *Cervus elaphus* L.	2	2
aurochs — *Bos primigenius* Boj.	4	2
Wild animals	11	7
pig — *Sus scrofa dom.* L.	8	4
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	3	2
cattle — *Bos taurus* L.	63	18
Domestic animals	74	24
Total	85	31

TISZANÁNA—CSEH TANYA (FARMSTEAD)

Cemetery of the Period of the Hungarian Conquest (9th—10th century). Excavated by J. Szabó, 1958. Hungarian National Museum, Budapest.

Animal remains were found in 9 graves:

	No. of graves
sheep or goat — *Ovis* s. *Capra*	4
horse — *Equus caballus* L.	3
pig — *Sus scrofa dom.* L.	2

Tiszaszöllős—Csákányszeg

Neolithic (Bükk culture), late Copper Age (Pécel culture), Bronze Age and Scythian settlement. Excavated by Zs. Csalog, 1960. Damjanich János Museum, Szolnok.

species	Copper Age			
	specimens	%	individuals	%
fish — *Pisces* sp. div.	42	7.47	4	4.26
wild swine — *Sus scrofa fer.* L.	5	0.89	3	3.19
red deer — *Cervus elaphus* L.	4	0.71	2	2.13
aurochs — *Bos primigenius* Boj.	5	0.89	3	3.19
Wild animals	56	9.96	12	12.77
dog — *Canis familiaris* L.	11	1.96	5	5.32
pig — *Sus scrofa dom.* L.	42	7.47	14	14.89
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	375	66.73	43	45.74
cattle — *Bos taurus* L.	78	13.88	20	21.28
Domestic animals	506	90.04	82	87.23
Total	562		94	

Age	Neolithic		Bronze Age		Scythian	
species	speci-mens	individ-uals	speci-mens	individ-uals	speci-mens	individ-uals
bird — *Avis* sp.	1	1	—	—	—	—
roe deer — *Capreolus capreolus* L.	1	1	1	1	—	—
Wild animals	2	2	1	1	—	—
pig — *Sus scrofa dom.* L.	—	—	1	1	—	—
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	2	2	2	2	5	3
cattle — *Bos taurus* L.	1	1	11	4	11	6
Domestic animals	3	3	14	7	16	9
Total	5	5	15	8	16	9

Tiszaszöllős—Csákányszeg—Gyep

Scythian cemetery, and part of Mediaeval settlement. Excavated by Zs. Csalog, 1960. Damjanich János Museum, Szolnok.

In the 17th grave of the Scythian age cemetery part of left humerus of adult sheep or goat (*Ovis* s. *Capra*).

Bone sample of the part of Mediaeval settlement.

species	specimens	individuals
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	4	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	11	6
cattle — *Bos taurus* L.	10	6
Domestic animals	26	16

Tiszaszöllős—Csákányszeg—Temető (Cemetery)

Late Copper Age (Pécel culture) pit. Excavated by Zs. Csalog, 1960. Damjanich János Museum, Szolnok.

species	specimens	individuals
fish — *Pisces* sp.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	1	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	4	3
cattle — *Bos taurus* L.	1	1
Domestic animals	6	5
Total	7	6

TISZAVASVÁRI — KERESZTFAL

Neolithic settlement. Excavated by J. Makkay, 1962. Jósa András Museum, Nyíregyháza.

species	specimens	individuals
fish — *Pisces* sp.	2	1
brown hare — *Lepus europaeus* Pall.	1	1
red deer — *Cervus elaphus* L.	1	1
aurochs — *Bos primigenius* Boj.	2	1
Wild animals	6	4
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	12	2
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	20	4
cattle — *Bos taurus* L.	32	7
Domestic animals	65	14
man — *Homo sapiens* L.	6	
Total	77	18

TISZAVASVÁRI—KOLDUSDOMB

Early Avar cemetery. Excavated by D. Csallány, 1956. Jósa András Museum, Nyíregyháza.

Animal remains were found in 6 graves:

	No. of graves
cattle — *Bos taurus* L.	5
horse — *Equus caballus*	3
sheep — *Ovis aries* L.	2
sheep or goat — *Ovis* s. *Capra*	1

TISZAVASVÁRI—PAPTELEKHÁT

Sarmatian settlement, disturbed by diggings from the Period of the Árpád Dynasty (11th—13th century). Excavated by N. Kalicz and J. Makay, 1960. Jósa András Museum, Nyíregyháza.

Age	Sarmatian		Period of Árpád Dynasty	
species	specimens	individuals	specimens	individuals
red deer — *Cervus elaphus* L.	2	2	—	—
Wild animals	2	2	—	—
dog — *Canis familiaris* L.	11	4	1	1
horse — *Equus caballus* L.	35	15	15	5
pig — *Sus scrofa dom.* L.	6	4	1	1
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	6	3	—	—
cattle — *Bos taurus* L.	59	20	27	8
Domestic animals	117	46	44	15
Total	119	48	44	15

TISZAVASVÁRI—TÉGLÁS

Sarmatian settlement. Excavated by N. Kalicz and J. Makkay, 1960. Jósa András Museum, Nyíregyháza.

Part of horn core of adult cattle (*Bos taurus* L.).

TISZAVASVÁRI—VÖRÖSHADSEREG UTCA (STREET) 8

Avar grave of a horseman. Excavated by D. Csallány, 1961. Jósa András Museum, Nyíregyháza.

Skull of a 6—7-year-old horse (*Equus caballus* L.).

TOKOD—ERZSÉBETAKNA (SHAFT)

Roman (2th—4th century A.D.) settlement and fort. Excavated by A. Mócsy, 1956, 1960. Hungarian National Museum, Budapest.

site	settlement		fort	
species	specimens	individuals	specimens	individuals
crane — *Grus grus* L.	—	—	10	1
brown hare — *Lepus europaeus* Pall.	—	—	1	1
badger — *Meles meles* L.	—	—	1	1
wild swine — *Sus scrofa fer.* L.	—	—	2	2
red deer — *Cervus elaphus* L.	—	—	6	3
aurochs — *Bos primigenius* Boj.	—	—	2	1
Wild animals			22	9
hen — *Gallus domesticus* L.	—	—	2	2
dog — *Canis familiaris* L.	—	—	3	2
horse — *Equus caballus* L.	2	2	26	4
pig — *Sus scrofa dom.* L.	3	3	41	8
sheep — *Ovis aries* L. } goat — *Capra hircus* L.	7	6	50	10
cattle — *Bos taurus* L.	1	1	98	15
Domestic animals	13	12	220	41
Total	13	12	242	50

Tószeg—Laposhalom

Bronze Age settlement. Excavated by J. Csalog and A. Mozsolics, 1948. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **2** [1952] pp. 71 ff.).

Túrkeve—Móricz

Late Mediaeval (15th—16th century) village. Excavated by I. Méri, 1948. Hungarian National Museum, Budapest.

species	specimens	%	individuals	%
European pond tortoise — *Emys orbicularis* L.	1	0.07	1	0.54
white stork — *Ciconia ciconia* L.	1	0.07	1	0.54
great bustard — *Otis tarda* L.	1	0.07	1	0.54
bird — *Avis* sp.	41	2.66	1	0.54
brown hare — *Lepus europaeus* Pall.	1	0.07	1	0.54
Wild animals	45	2.94	5	2.70
dog — *Canis familiaris* L.	30	1.95	4	2.18
cat — *Felis domestica* Briss.	200	13.02	2	1.09
horse — *Equus caballus* L.	209	13.60	40	21.74
pig — *Sus scrofa dom.* L.	221	14.39	21	11.41
sheep — *Ovis aries* . / goat — *Capra hircus* L.	320	20.83	48	26.10
cattle — *Bos taurus* L.	441	28.71	56	30.43
Domestic animals	1491	97.06	179	97.29
Total	1536		184	

Turony—Hosszúföldek—Kosaras

Bronze Age (South-Pannonian lime-inlay pottery) settlement. Excavated by G. Bándi, 1962. Janus Pannnonius Museum, Pécs.

species	specimens	individuals
red deer — *Cervus elaphus* L.	1	1
Wild animals	1	1
dog — *Canis familiaris* L.	5	2
pig — *Sus scrofa dom.* L.	3	1
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	2	1
cattle — *Bos taurus* L.	33	6
Domestic animals	43	10
Total	44	11

Uzd

Avar graves. Excavated by Gy. Mészáros, 1959. Balogh Ádám Museum, Szekszárd. Animal remains were found in 2 graves:

	No. of graves
goose — *Anser* sp.	1
hen — *Gallus domesticus* L.	1
horse — *Equus caballus* L.	1

Üllő—Tehénjárás

Late Copper Age (Pécel culture) settlement. Collected by K. Kiss, 1936. Hungarian National Museum, Budapest.

species	specimens	individuals
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	2	2
cattle — *Bos taurus* L.	2	2
Domestic animals	4	4

Üllő

Avar cemetery. Excavated by I. Kovrig and Á. Soós, 1950. Hungarian National Museum, Budapest.

Animal remains were found in 39 graves:

	No. of graves
hen — *Gallus domesticus* L.	23
sheep — *Ovis aries* L.	12
pig — *Sus scrofa dom.* L.	6
sheep or goat — *Ovis* s. *Capra*	4

Vác—Kavicsbánya (Gravel-pit)

Avar cemetery. Excavated by A. Kralovánszky, 1959. Hungarian National Museum, Budapest.

In two graves, the skull and skeleton of horse (*Equus caballus* L.) were found.

Valkó—Erdőgazdaság (Forestry)

Bronze Age settlement. Excavated by K. Mikes, 1953. Hungarian National Museum, Budapest (*Acta Arch. Hung.*, **11** [1959] p. 68).

Városföld—Aranykalász TSz (Cooperative)

Horseman's grave of the Period of the Hungarian Conquest (9th—10th century). Excavated by A. Horváth, 1960. Katona József Museum, Kecskemét.

Skull of a $5\frac{1}{2}$-year-old ♂ horse (*Equus caballus* L.).

VELEMSZENTVID

Iron Age settlement. Excavated by K. Miske. Savaria Museum, Szombathely.

species	specimens	individuals
beaver — *Castor fiber* L.	1	1
brown bear — *Ursus arctos* L.	1	1
wild swine — *Sus scrofa fer.* L.	19	6
roe deer — *Capreolus capreolus* L.	8	3
red deer — *Cervus elaphus* L.	10	4
aurochs — *Bos primigenius* Boj.	3	3
Wild animals	42	18
dog — *Canis familiaris* L.	6	4
horse — *Equus caballus* L.	30	5
pig — *Sus scrofa dom.* L.	92	18
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	49	19
cattle — *Bos taurus* L.	68	40
Domestic animals	245	86
Total	287	104

VESZPRÉM—JÓZSEF ATTILA UTCA (STREET) 70

Hallstatt Period settlement. Collected by T. Szentléleky, 1959. Bakony Museum, Veszprém.

species	specimens	individuals
roe deer — *Capreolus capreolus* L.	2	1
red deer — *Cervus elaphus* L.	1	1
Wild animals	3	2
dog — *Canis familiaris* L.	3	2
horse — *Equus caballus* L.	2	2
pig — *Sus scrofa dom.* L.	8	5
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	6	3
cattle — *Bos taurus* L.	17	8
Domestic animals	36	20
Total	39	22

VILLÁNYKÖVESD

Early Copper Age (Lengyel culture) settlement. Collected, 1956; excavated, 1957, by J. Dombay. Janus Pannonius Museum, Pécs (*Jan. Pann. Múz. Évk.*, [1961] p. 94 ff.).

VISEGRÁD—FELLEGVÁR (CITADEL)

Hallstatt Period settlement, 15th—18th century castle. Excavated by M. Héjj, 1957. Mátyás Király Museum, Visegrád.

Age	Hallstatt Period		15th—18th century	
species	specimens	individuals	specimens	individuals
fish — *Pisces* sp. div.	—	—	3	2
birds — *Aves* sp. div.	—	—	2	2
brown hare — *Lepus europaeus* Pall.	—	—	8	3
red deer — *Cervus elaphus*	4	2	4	2
Wild animals	4	2	17	9
goose — *Anser domesticus* L.	—	—	6	3
hen — *Gallus domesticus* L.	—	—	121	21
dog — *Canis familiaris* L.	1	1	—	—
horse — *Equus caballus* L.	—	—	1	1
pig — *Sus scrofa dom.* L.	1	1	106	24
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	1	1	41	11
cattle — *Bos taurus* L.	13	4	75	15
Domestic animals	16	7	350	75
Total	20	9	367	84

VISEGRÁD—FŐ UTCA (STREET) 73

Late Mediaeval (14th—15th century) houses. Excavated by M. Héjj, 1958. Mátyás Király Museum, Visegrád.

species	specimens	individuals
fish — *Pisces* sp. div.	10	3
brown hare — *Lepus europaeus* Pall.	2	1
roe deer — *Capreolus capreolus* L.	2	1
Wild animals	14	5
hen — *Gallus domesticus* L.	12	2
cat — *Felis domestica* Briss.	7	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	166	14
cattle — *Bos taurus* L.	73	7
Domestic animals	260	27
Total	274	32

VISEGRÁD—KÁLVÁRIA (CALVARY)

Mediaeval (14th century) settlement. Excavated by M. Héjj, 1953—54. Mátyás Király Museum, Visegrád.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	4	0.20	2	0.69
black kite — *Milvus* cf. *migrans* L.	1	0.05	1	0.35
partridge — *Perdix perdix* L.	21	1.12	8	2.77
pheasant — *Phasianus colchicus* L.	3	0.15	2	0.69
thrush — *Turdus* sp.	1	0.05	1	0.35
brown hare — *Lepus europaeus* Pall.	75	4.00	8	2.77
red squirrel — *Sciurus vulgaris* L.	11	0.59	4	1.38
brown bear — *Ursus arctos* L.	1	0.05	1	0.35
wild swine — *Sus scrofa fer.* L.	14	0.75	5	1.73
roe deer — *Capreolus capreolus* L.	4	0.20	3	1.04
red deer — *Cervus elaphus* L.	11	0.59	5	1.73
Wild animals	146	7.75	40	13.85
duck — *Anas domestica* L.	2	0.10	1	0.35
goose — *Anser domesticus* L.	60	3.20	10	3.46
hen — *Gallus domesticus* L.	599	31.95	77	26.64
peacock — *Pavo cristatus* L.	1	0.05	1	0.35
dog — *Canis familiaris* L.	2	0.10	1	0.35
cat — *Felis domestica* Briss.	4	0.20	3	1.04
horse — *Equus caballus* L.	2	0.10	1	0.35
pig — *Sus scrofa dom.* L.	312	16.61	48	16.60
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	184	9.80	37	12.80
cattle — *Bos taurus* L.	566	30.14	70	24.25
Domestic animals	1732	92.25	249	86.15
Total	1878		289	

VISEGRÁD—KŐBÁNYA (QUARRY)

Roman watch-tower. Excavated by S. Soproni, 1955, 1957. Mátyás Király Musem, Visegrád.

species	specimens	individuals
fish — *Pisces* sp. div.	2	2
brown hare — *Lepus europaeus* Pall.	1	1
wild swine — *Sus scrofa fer.* L.	4	2
red deer — *Cervus elaphus* L.	5	3
Wild animals	12	8
goose — *Anser domesticus* L.	3	2
hen — *Gallus domesticus* L.	15	3
dog — *Canis familiaris* L.	2	2
horse — *Equus caballus* L.	11	5
pig — *Sus scrofa dom.* L.	53	16
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	18	9
cattle — *Bos taurus* L.	33	13
Domestic animals	135	50
Total	147	58

Visegrád — Palota (Palace)

Late Mediaeval and Early Modern Times (14th—17th century) royal palace, excavated by M. Héjj, 1952—1963. Mátyás Király Museum, Visegrád.

species	14th—15th century			
	specimens	%	individuals	%
pike-perch — *Lucioperca sandra* Cuv.	2	0.05	1	0.14
pike — *Esox lucius* L.	3	0.08	2	0.27
catfish — *Silurus* L.	5	0.13	3	0.41
carp — *Cyprinus carpio* L.	2	0.05	2	0.27
fish — *Pisces* sp. div.	91	2.35	23	3.11
coot — *Fulica atra* L.	1	0.03	1	0.14
tawny owl — *Stix aluco* L.	2	0.05	1	0.14
partridge — *Perdix perdix* L.	33	0.85	13	1.75
pheasant — *Phasianus colchicus* L.	1	0.03	1	0.14
rook — *Corvus frugilegus* L.	1	0.03	1	0.14
wood pigeon — *Columba palumbus* L.	1	0.03	1	0.14
fieldfare — *Turdus pilaris* L.	1	0.03	1	0.14
mistle thrush — *Turdus viscivorus* L.	2	0.05	1	0.14
birds — *Aves* sp. div.	38	0.97	13	1.74
brown hare — *Lepus europaeus* Pall.	77	1.99	28	3.78
red squirrel — *Sciurus vulgaris* L.	2	0.05	1	0.14
wolf — *Canis lupus* L.	21	0.54	2	0.27
brown bear — *Ursus arctos* L.	5	0.13	2	0.27
wild swine — *Sus scrofa fer.* L.	52	1.34	15	2.02
roe deer — *Capreolus capreolus* L.	9	0.23	5	0.68
red deer — *Cervus elaphus* L.	46	1.19	16	2.15
Wild animals	395	10.20	133	18.00
duck — *Anas domestica* L.	2	0.08	2	0.27
goose — *Anser domesticus* L.	32	0.83	11	1.49
pigeon — *Columba domestica* L.	1	0.03	1	0.14
guinea fowl (?) — *Numida meleagris* L. (?)	1	0.03	1	0.14
peacock — *Pavo cristatus* L.	1	0.03	1	0.14
hen — *Gallus domesticus* L.	1051	27.13	132	17.82
dog — *Canis familiaris* L.	7	0.18	4	0.54
cat — *Felis domestica* Briss.	33	0.85	8	1.08
horse — *Equus caballus* L.	10	0.26	5	0.68
pig — *Sus scrofa dom.* L.	778	20.11	146	19.72
sheep — *Ovis aries* L. goat — *Capra hircus* L.	617	15.94	128	17.28
cattle — *Bos taurus* L.	942	24.33	168	22.70
Domestic animals	3476	89.80	607	82.00
Total	3871		740	

species	16th—17th century			
	specimens	%	individuals	%
catfish — *Silurus glanis* L.	1	0.08	1	0.49
fish — *Pisces* sp. div.	69	5.78	16	7.84
garganey — *Anas querquedula* L.	1	0.08	1	0.49
tawny owl — *Stix aluco* L.	2	0.17	1	0.49
partridge — *Perdix perdix* L.	7	0.59	3	1.47
birds — *Aves* sp. div.	5	0.42	3	1.47
brown hare — *Lepus europaeus* Pall.	42	3.52	7	3.43
wild cat — *Felis silvestris* Schreb.	2	0.17	1	0.49
wild swine — *Sus scrofa fer.* L.	8	0 67	4	1.96
roe deer — *Capreolus capreolus* L.	7	0.59	3	1.47
red deer — *Cervus elaphus* L.	12	1.00	6	2.94
Wild animals	156	13.07	46	22.54
goose — *Anser domesticus* L.	37	3.10	11	5.39
hen — *Gallus domesticus* L.	414	34.66	48	23.53
dog — *Canis familiaris* L.	13	1.09	4	1.96
cat — *Felis domestica* Briss.	18	1.50	1	0.49
horse — *Equus caballus* L.	1	0.08	1	0.49
pig — *Sus scrofa dom.* L.	182	15.22	30	14.71
sheep — *Ovis aries* L. goat — *Capra hircus* L.	148	12.37	22	10.78
cattle — *Bos taurus* L.	226	18.91	41	20.11
Domestic animals	1039	86.93	158	77.46
Total	1195		204	

VISEGRÁD—RÉV UTCA (STREET)—BENEDA KERT (GARDEN)

14th—16th century monastery, excavated by M. Héjj, 1960. Mátyás Király Museum, Visegrád.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	5	0.37	3	1.73
birds — *Aves* sp. div.	4	0.29	3	1.73
brown hare — *Lepus europaeus* Pall.	3	0.22	2	1.16
wolf — *Canis lupus* L.	1	0.07	1	0.58
wild swine — *Sus scrofa fer.* L.	3	0.22	2	1.16
red deer — *Cervus elaphus* L.	15	1.10	9	5.20
Wild animals	31	2.27	20	11.56
hen — *Gallus domesticus* L.	63	4.62	16	9.25
dog — *Canis familiaris* L.	4	0.29	2	1.16
cat — *Felis domestica* Briss.	6	0.44	3	1.73
horse — *Equus caballus* L.	35	2.57	11	6.36
pig — *Sus scrofa dom.* L.	304	22.31	38	21.95
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	123	9.02	22	12.72
cattle — *Bos taurus* L.	797	58.48	61	35.27
Domestic animals	1332	97.73	153	88.44
Total	1363		173	

VISEGRÁD—SALAMON TORONY (TOWER)

13th—17th century castle, excavated by M. Héjj, 1952—1963. Mátyás Király Museum, Visegrád.

Age	13th—15th century		15th—17th century			
species	speci-mens	individ-uals	speci-mens	%	individ-uals	%
fish — *Pisces* sp. div.	—	—	89	1.05	21	2.50
black vulture — *Aegypius monachus* L.	—	—	1	0.01	1	0.12
black grouse — *Lyrurus tetrix* L.	—	—	1	0.01	1	0.12
partridge — *Perdix perdix* L.	—	—	1	0.01	1	0.12
wood pigeon — *Columba palumbus* L.	—	—	1	0.01	1	0.12
eagle owl — *Bubo bubo* L.	—	—	1	0.01	1	0.12
hoopoe — *Upupa epops* L.	—	—	1	0.01	1	0.12
birds — *Aves* sp. div.	3	2	105	1.25	30	3.57
brown hare — *Lepus europaeus* Pall.	—	—	41	0.49	18	2.14
fox — *Vulpes vulpes* L.	—	—	4	0.05	2	0.24
wild cat — *Felis silvestris* Schreb.	—	—	2	0.02	1	0.12
wild swine — *Sus scrofa fer.* L.	—	—	21	0.25	10	1.19
roe deer — *Capreolus capreolus* L.	—	—	29	0.34	13	1.55
red deer — *Cervus elaphus* L.	—	—	127	1.50	37	4.39
Wild animals	3	2	424	5.01	138	16.42
duck — *Anas domestica* L.	—	—	2	0.02	1	0.12
goose — *Anser domesticus* L.	—	—	59	0.70	21	2.50
hen — *Gallus domesticus* L.	12	4	2040	24.19	187	22.22
peacock — *Pavo cristatus* L.	—	—	1	0.01	1	0.12
domestic rabbit — *Oryctolagus cuniculus* L.	—	—	100	1.19	13	1.55
dog — *Canis familiaris* L.	—	—	79	0.94	11	1.31
cat — *Felis domestica* Briss.	—	—	84	1.00	16	1.90
ass — *Asinus asinus* L.	—	—	2	0.02	2	0.24
horse — *Equus caballus* L.	1	1	56	0.66	17	2.02
pig — *Sus scrofa dom.* L.	30	10	534	6.33	62	7.37
sheep — *Ovis aries* L. goat — *Capra hircus* L.	25	9	2005	23.76	168	19.97
cattle — *Bos taurus* L.	77	18	3053	36.17	204	24.26
Domestic animals	145	42	8015	94.99	703	83.58
Total	148	44	8439		841	

VISEGRÁD — SIBRIKDOMB

Roman camp. Excavated by S. Soproni,, 1951. Mátyás Király Museum, Visegrád.

species	specimens	individuals
bird — *Avis* sp.	1	1
Wild animals	1	1
pig — *Sus scrofa dom.* L.	2	2
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	6	3
cattle — *Bos taurus* L.	11	3
Domestic animals	19	8
Total	20	9

VISEGRÁD — SZÁLLODAUDVAR (HOTEL COURT)

14th century tower. Excavated by M. Héjj, 1962. Mátyás Király Museum, Visegrád.

species	specimens	individuals
fish — *Pisces* sp. div.	2	2
wild swine — *Sus scrofa fer.* L.	1	1
red deer — *Cervus elaphus* L.	6	4
Wild animals	9	7
hen — *Gallus domesticus* L.	1	1
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	3	2
pig — *Sus scrofa dom.* L.	53	14
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	16	5
cattle — *Bos taurus* L.	64	15
Domestic animals	138	38
Total	147	45

VISEGRÁD—VÁRKERT DŰLŐ (BAULK)

Roman and 10th—12th century settlement, excavated by M. Héjj, I. Méri, I. Kovalovszki and J. Soproni, 1955—62. Mátyás Király Museum, Visegrád.

Age	Roman		10th—12th century			
species	speci-mens	individ-uals	speci-mens	%	individ-uals	%
pike — *Esox lucius* L.	—	—	1	0.12	1	0.59
fish — *Pisces* sp. div.	1	1	7	0.85	4	2.36
brown hare — *Lepus europaeus* Pall.	—	—	2	0.24	2	1.18
wild swine — *Sus scrofa fer.* L.	—	—	4	0.48	2	1.18
roe deer — *Capreolus capreolus* L.	—	—	5	0.60	3	1.74
red deer — *Cervus elaphus* L.	7	3	15	1.83	6	3.53
Wild animals	8	4	34	4.12	18	10.58
goose — *Anser domesticus* L.	—	—	4	0.48	2	1.18
hen — *Gallus domesticus* L.	3	2	30	3.65	10	5.88
dog — *Canis familiaris* L.	—	—	3	0.36	3	1.74
horse — *Equus caballus* L.	5	3	49	5.96	17	10.00
pig — *Sus scrofa dom.* L.	55	13	255	31.03	36	21.17
sheep — *Ovis aries* L. } goat — *Capra hircus* L.	36	10	177	21.53	32	18.83
cattle — *Bos taurus* L.	19	5	270	32.87	52	30.62
Domestic animals	118	33	788	95.88	152	89.42
Total	126	37	822			170

VÖRS

Langobard cemetery. Excavated by K. Sági, 1959. Hungarian National Museum, Budapest.

Grave No. 1: right femur of subadult sheep or goat (*Ovis* s. *Capra*), skull of 9—12-month-old pig (*Sus scrofa dom.* L.), radius and ulna of adult hen (*Gallus domesticus* L.).

ZALASZENTMIHÁLY—TŐZEGTELEP (PEAT BOG)

Bronze Age settlement. Collected by Gy. Hontváry, 1956. Hungarian National Museum, Budapest.

species	specimens	individuals
wolf — *Canis lupus* L.	1	1
red deer — *Cervus elaphus* L.	8	6
Wild animals	9	7
dog — *Canis familiaris* L.	2	1
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	3	2
Domestic animals	6	4
Total	15	11

Zalavár

Neolithic and Mediaeval settlement. Excavated by B. Bálint, 1951. Hungarian National Museum, Budapest.

Age	Neolithic		Middle Ages	
species	specimens	individuals	specimens	individuals
catfish — *Silurus glanis* L.	—	—	1	1
bird — *Avis* sp.	—	—	1	1
wild swine — *Sus scrofa fer.* L.	4	2	8	3
roe deer — *Capreolus capreolus* L.	7	1	2	2
red deer — *Cervus elaphus* L.	3	2	4	3
aurochs — *Bos primigenius* Boj.	18	2	26	3
Wild animals	32	7	42	13
horse — *Equus caballus* L.	—	—	49	10
pig — *Sus scrofa dom.* L.	3	2	32	8
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	—	—	24	8
cattle — *Bos taurus* L.	20	4	89	20
Domestic animals	23	6	194	46
Total	55	13	236	59

Zalavár

Mediaeval settlement. Excavated by G. Fehér, 1951—54. Hungarian National Museum, Budapest (*Arch. Hung.*, **XLI** [1963] pp. 313 ff.).

Zengővárkony

Early Copper Age (Lengyel culture) settlement and cemetery. Excavated by J. Dombay, 1934 - 47. Janus Pannonius Museum, Pécs (Yearbook of the Janus Pannonius Museum.) (*Jan. Pann. Múz. Évk.*, 1960, pp. 80 ff.; 1962, p. 101).

BRÜCKLER—MAUER

Late Neolithic—early Bronze Age settlement. Niederösterreichisches Landesmuseum, Linz.

species	specimens	individuals
bird — *Avis* sp.	1	1
brown bear — *Ursus arctos* L.	2	1
wild swine — *Sus scrofa fer.* L.	2	1
roe deer — *Capreolus capreolus* L.	2	2
red deer — *Cervus elaphus* L.	1	1
Wild animals	8	6
dog — *Canis familiaris* L.	1	1
horse — *Equus caballus* L.	2	2
pig — *Sus scrofa dom.* L.	13	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	9	3
cattle — *Bos taurus* L.	21	4
Domestic animals	46	13
Total	54	19

LANGENSTEINER—MAUER

Late Neolithic—early Bronze Age settlement. Niederösterreichisches Landesmuseum, Linz.

species	specimens	individuals
amphibian — *Amphibia*	2	1
bird — *Avis* sp.	1	1
brown hare — *Lepus europaeus* Pall.	1	1
stone marten or pine marten — *Martes* sp.	2	2
roe deer — *Capreolus capreolus* L.	1	1
wild swine — *Sus scrofa fer.* L.	2	1
red deer — *Cervus elaphus* L.	7	3
Wild animals	16	10
dog — *Canis familiaris* L.	1	1
pig — *Sus scrofa dom.* L.	6	3
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	4	2
cattle — *Bos taurus* L.	1	1
Domestic animals	12	7
Total	28	17

NEUDORF A. LEITHA

Neolithic settlement. Hungarian National Museum, Budapest.

From the settlement, the skull of an adult cattle (*Bos taurus* L.) is now in the museum.

REBENSTEINER MAUER

Late Neolithic—early Bronze Age settlement. Niederösterreichisches Landesmuseum, Linz.

species	specimens	individuals
fish — *Pisces* sp. div.	3	2
birds — *Aves* sp. div.	9	4
hedgehog — *Erinaceus europaeus* L.	5	3
rodents — *Rodentia* sp.	3	2
red squirrel — *Sciurus vulgaris* L.	1	1
brown hare — *Lepus europaeus* L.	2	1
pine marten or stone marten — *Martes* sp.	16	5
badger — *Meles meles* L.	18	6
fox — *Vulpes vulpes* L.	12	3
wolf — *Canis lupus* L.	17	5
brown bear — *Ursus arctos* L.	11	4
wild swine — *Sus scrofa fer.* L.	16	5
roe deer — *Capreolus capreolus* L.	7	4
red deer — *Cervus elaphus* L.	270	18
aurochs — *Bos primigenius* Boj.	2	1
Wild animals	392	64
dog — *Canis familiaris* L.	6	3
horse — *Equus caballus* L.	1	1
pig — *Sus scrofa dom.* L.	8	3
sheep — *Ovis aries* L. } goat — *Capra hircus* L. }	22	7
cattle — *Bos taurus* L.	34	12
Domestic animals	71	26
Total	463	90

SONNBICHL

Neolithic (Linear Pottery culture; Notenkopf pottery) settlement. Excavated by Ä. Kloiber, Niederösterreichisches Landesmuseum, Linz.

species	specimens	individuals
badger — *Meles meles* L.	1	1
wild swine — *Sus scrofa fer.* L.	3	2
red deer — *Cervus elaphus* L.	19	5
Wild animals	23	8
cattle — *Bos taurus* L.	3	1
Domestic animals	3	1
Total	26	9

YUGOSLAVIAN SITES

NOSZA—GYÖNGYPART

Early Neolithic (Körös culture) settlement. Excavated by D. Garasanin, 1957. Municipal Museum, Subotica.

species	specimens	individuals
great bustard — *Otis tarda* L.	3	1
brown hare — *Lepus europaeus* Pall.	3	3
badger — *Meles meles* L.	1	1
wild ass — *Asinus hydruntinus* Reg.	11	3
wild swine — *Sus scrofa fer.* L.	3	2
roe deer — *Capreolus capreolus* L.	6	3
red deer — *Cervus elaphus* L.	4	2
aurochs — *Bos primigenius* Boj.	6	2
Wild animals	37	17
sheep — *Ovis aries* L. / goat — *Capra hircus* L.	13	4
cattle — *Bos taurus* L.	9	4
Domestic animals	22	8
Total	59	15

LUDAS—BUDZSÁK

Early Neolithic (Körös culture) settlement. Excavated by L. Szekeres, 1965. Municipal Museum, Subotica.

species	specimens	%	individuals	%
fish — *Pisces* sp. div.	47	1.72	6	3.83
catfish — *Silurus glanis* L.	3	0.11	1	0.38
carp — *Cyprinus carpio* L.	1	0.04	1	0.38
pike — *Esox lucius* L.	2	0.07	1	0.38
European pond tortoise — *Emys orbicularis* L.	36	1.31	5	1.92
birds — *Aves* sp. div.	196	7.17	29	11.11
brown hare — *Lepus europaeus* Pall.	44	1.61	8	3.83
beaver — *Castor fiber* L.	1	0.04	1	0.38
fox — *Vulpes vulpes* L.	5	0.18	2	0.77
wolf — *Canis lupus* L.	1	0.04	1	0.38
badger — *Meles meles* L.	3	0.11	1	0.38
wild cat — *Felis silvestris* Schreb.	3	0.11	2	0.77
wild ass — *Asinus hydruntinus* Reg.	137	5.01	16	6.13
wild swine — *Sus scrofa fer.* L.	7	0.26	3	1.15
roe deer — *Capreolus capreolus* L.	26	0.95	7	2.68
red deer — *Cervus elaphus* L.	28	1.02	8	3.07
aurochs — *Bos primigenius* Boj.	32	1.17	8	3.07
Wild animals	572	20.92	106	40.61
dog — *Canis familiaris* L.	8	0.29	3	1.15
pig — *Sus scrofa dom.* L.	8	0.29	3	1.15
sheep — *Ovis aries* L. goat — *Capra hircus* L.	1863	68.12	124	47.51
cattle — *Bos taurus* L.	284	10.38	25	9.58
Domestic animals	2163	79.08	155	59.39
Total	2735		261	

TABLES OF BONE MEASUREMENTS

Measurement data on Hungarian and foreign sites unpublished so far are given below. Among the bone samples analysed in the book, those mentioned hereunder are not included, as they have already been published or are in press (all of them have been studied by the author)

Alsónémedi Acta Arch. Hung. 1 (1951) pp. 75 ff.
Baja – Dózsa György út (Street) 233. Acta Arch. Hung. 29 (1968) pp. 95 ff.
Berettyószentmárton (measurements of cattle bones only). Bökönyi—Kubasiewicz 1961, pp. 74 ff.
Berettyóújfalu—Herpály (measurements of cattle bones only). Ibid.
Boly—Sziebert puszta (Farmstead) Yearbook of the Janus Pannonius Museum, Jan. Pann. Múz. Évk. (1963) pp. 99 ff.
Borsod—Derekegyházi dülő (Baulk) (measurements of cattle bones only). Bökönyi—Kubasiewicz 1961, pp. 78 ff.
Buda—Dísz tér (Square) Stud. Arch. IV (1966) pp. 76 ff.
Buda—Vár (Castle) Bud. Rég. XVIII (1958) pp. 460 ff.; XX (1963) pp. 398 ff.; XXI (1964) pp. 371—372.
Budapest – Gellérthegy (Hill) Acta Arch. Hung. (in press).
Budapest—Tabán Ibid.
Csongrád—Petőfi TSz (Cooperative) Acta Arch. Hung. 20 (1968) pp. 84 ff.
Derecske—Téglagyár (Brick-works) (measurements of cattle bones only). Bökönyi—Kubasiewicz 1961, pp. 75 ff.
Folyás—Szilmeg (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961, pp. 76 ff.
Győr—Pándzsa dülő (Baulk) (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961, pp. 74 ff.
Győr—Pápai vám (measurements of cattle bones only). Ibid.
Hódmezővásárhely—Bodzáspart Acta Arch. Hung. 4 (1954) pp. 10 ff.
Hódmezővásárhely—Gorzsa—Cukor tanya (Farmstead) (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961, pp. 74 ff.
Hódmezővásárhely—Tatársánc—Zalay (Brick-works) (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961, pp. 82 ff.
Lebő (measurements of bones sample of the 1956 excavation). Yearbook of the Móra Ferenc Museum, Móra F. Múz. Évk. (1957) pp. 75 ff. (measurements of cattle bones); Bökönyi—Kubasiewicz, 1961, pp. 74 ff.
Maroslele—Pana Arch. Ért. 91 (1964) pp. 89 ff.
Pécsvárad—Aranyhegy Yearbook of the Janus Pannonius Museum, Jan. Pann. Múz. Évk. (1960) pp. 121 ff.; 1961, pp. 98 ff.
Polgár—Basatanya (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1971, pp. 76 ff.
Polgár—Csőszhalom (measurements of cattle bones only). Ibid., pp. 74 ff.
Pomáz—Zdravlyák (measurements of cattle bones only). Ibid., pp. 81 ff.
Rétközberencs Yearbook of the Jósa András Museum, Jósa A. Múz. Évk. 1 (1958) pp. 95 ff.
Salgótarján—Pécskő Acta Arch. Hung. 20 (1968) pp. 84 ff.
Sopronkőhida Acta Arch. Hung. (1969) (in press).
Szebény—Paperdő Yearbook of the Janus Pannonius Museum, Jan. Pann. Múz. Évk. (in press).

Szegvár—Tűzköves (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961, pp. 74 ff.
Szentes—Vekerzug Acta Arch. Hung. 2 (1952) pp. 181—182; 4 (1954) pp. 110 ff.; 5 (1955) pp. 27 ff.
Tarnabod (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961, pp. 77 ff.
Tác Alba Regia (in press).
Tiszaigar—Csikóshalom (measurements of cattle bones only). Ibid. p. 88.
Tiszaluc—Dankadomb (measurements of bone sample of the 1957 excavation). Yearbook of the Herman Ottó Museum, Herman Ottó Múz. Évk. II (1958) pp. 22 ff.
Tószeg—Laposhalom Acta Arch. Hung. 2 (1952) pp. 109 ff.
Turony—Hosszúföldek—Kosaras Yearbook of the Janus Pannonius Museum, Jan. Pann. Múz. Évk. (in press).
Üllő—Tehénjárás (measurements of cattle bones only). Bökönyi—Kubasiewicz, 1961. p. 73.
Villánykövesd Yearbook of the Janus Pannonius Museum, Jan. Pann. Múz. Évk. 1961, pp. 98 ff.
Zalavár Arch. Hung. XLI (1963) pp. 339 ff.
Zengővárkony Yearbook of the Janus Pannonius Museum, Jan. Pann. Múz. Évk. 1960, pp. 121 ff.

The measurements of bone samples are published according to species and sites. The sites are grouped according to their archaeological or historical ages, and — for technical reasons — they are enumerated with the respective periods not in a narrower chronological but in an alphabetical order.

Cattle — Bos taurus L.

Horn core

Measurements: 1. length measured on the greatest curve
2. greatest diameter
3. smallest diameter
4. circumference of the basis

Age/Site	1	2	3	4
Neolithic				
Neszmély—Tekerespatak	—	60	47.5	174
Röszke—Ludvár	—	69	58.5	—
Copper Age				
Aszód–Papi földek	—	72	50	195
	—	66	54	188
	—	66	48	185
	—	68.5	47.5	189
	—	62	49	180
	380	64	48.5	180
	—	70*	54*	198*
	250*	63	52	185
Bronze Age				
Békásmegyer—BUVÁTI	—	59	40.5	160
Békés—Városerdő				
53.1.25	—	48	37	135
53.4.26	—	73	49.5	202
53.4.294	—	76.5	62	224

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Horn core (continued)

Age/Site	1	2	3	4
	—	59	41.5	170
	205*	52	43	156
53.4.295	—	49	42	146
	—	49	40	146
	—	71	52.5	205
	—	55	41	160
56.20.142	205	54	39	153
60.7.539	—	56	47	165
60.7.653	—	50	42	155
60.7.687	—	48	25	132
62.19.356	—	70.5	54	208
Csepel—Háros	240*	60	47.5	168
	—	75	49	203
	—	48	38.5	138
	255	55*	—	165*
Dunaújváros—Koszider				
920.a	—	45	41	142
923.a	160*	48	37.5	136
953.a	—	81	—	—
991.a	178	49	36	136
1005.a	—	58	48	166
1008.a	—	57	48	175
55.9.35	—	50	40	150
Füzesabony				
651.a	216	46	37	135
57.6.9	—	48	37	135
57.6.10	173	48	37.5	137
57.6.11	—	79	60	230
	—	88	66*	240*
57.6.13	195	46.5	—	—
57.6.14	—	53	47	168
57.6.15	—	66*	48*	195*
57.6.16	193	45.5	36	133
	224	54	45	167
57.6.17	—	53	44.5	153
57.6.18	—	59.5	46.5	170
	—	52	41.5	150
57.6.20	—	48	39.5	138
	—	41	35	121
58.17.1	—	49	39	139
58.17.2	170*	52	42	143
Hatvan 63.22.1	280	63	50	180
Mezőlak 659.c	—	72	59	212
Süttő—Hosszúvölgy				
62.44.152	—	54	44	157*
62.44.282	—	73.5	49	197
62.44.435	—	51	31.5	132
62.44.474	—	55.5	43	156
Tápiószele—Tűzköves				
242.b	—	59	—	160
258.a	—	54	—	148
274.a	—	68	—	195

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Horn core (continued)

Age/Site	1	2	3	4
60.11.1.	—	67	45	184
60.11.2.	—	70	54	203
Tiszaluc—Dankadomb	—	49.5	40	142
	210*	—	—	—
	—	57.5	45.5	166
	—	76	58	218
	—	65	46	172
	—	72*	55	212
	—	64*	47.5	180*
	—	54	43	152
	—	80.5	53*	222*
Iron Age				
Helemba—Sziget (Island)	—	73.5	52*	185*
	—	60	45*	166*
	—	63.5	41	149
	—	65	45*	180*
	—	77	45*	193*
	185	53	40	148
Jászfelsőszentgyörgy 62.1.57	—	71	56	205
Óhuta—Nagysánc	—	49	36.5	135
Sághegy				
63.15.1	370*	—	—	—
63.31.1	375	79	62	225
Velemszentvid	143*	53	36	140*
	125	40	32	116
	—	52.5	40.5	147
Veszprém—József A. utca (Street)				
59.9.78	210	58.5	44	170
Period of the Roman Empire				
Balatonaliga				
623.b	—	92	74	—
627.b	245	56	44	159
Budapest—Albertfalva	—	64	53	190
	—	53	38.5	143*
	—	38	33.5	116
	172	54	42	155
Budapest—Aquincum	130	45.5	34	128
	150*	45	32.5	123
	200*	—	43	—
	230	56	43	158
	—	44	38	132
	—	42	35	123
	—	50	35	123
	—	47	37.5	130
	—	54	38.5	148
	—	48	41	140
	—	43	35	124
	—	45.5	36	130
	—	59	42.5	157
	—	71	54.5	200
	—	42	36.6	128

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Horn core (continued)

Age/Site	1	2	3	4
	—	54.5	40	151
	—	47	39.5	134
	—	48	34	132
	—	64	49.5	185
	—	67.5	48	190
	—	65	54	194
Győr—Széchenyi tér (Square)	—	62	52	188
Neszmély—Tekeres	—	73*	57*	—
Szentkirályszabadja	190*	49	38.5	143
Migration Period				
Apagy—Barucha J. földje (J. Barucha's land)	230*	63	47	185*
	—	57	44	164
	—	61	45	170
	—	61	47	175
	—	63	46	174
	—	79	59	220
Mezőkövesd 64.14.1.Z.	—	49	44*	—
Tiszavasvári—Paptelekhát				
62.370.2	—	50*	38.5	140*
62.394.1	—	58	50	170
62.423.3	—	40.5	30.5	116
62.488.1	117	41	32	120*
62.518.2	160*	51	39.5	144
62.523.2	—	60.5	47	173
Tiszavasvári—Téglás 62.213.2	—	57	42.5	160
Avar period				
Bokros—Fehérkereszt	—	50	36.5	142
Kiskunmajsa—Kőkút	175*	57	41.5	158
10th—13th century				
Csátalja—Vágotthegy				
53.3.1	—	38	35	117
53.3.109	110	38	29	108
Csatár—TSz istálló (Cooperative stable)	105*	41.5	31	115*
Doboz—Hajdúirtás				
64.8.14.Z.	—	36*	30*	108*
64.8.45.Z	—	39.5	31	113*
Szarvas—Rózsás 59.8.68	—	52	42	156
Tiszaeszlár—Bashalom—Fenyvesdomb 64.12.59.Z	210*	47.5	38	138
Tiszalök—Rázom				
409.b	68	33	—	—
418.a	92	39	—	110*
837.b	—	37	31	108
14th—17th century				
Buda—Vár — Pasa palota (Castle, Pasha's Palace)	118	46	32	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Horn core (continued)

Age/Site	1	2	3	4
Fonyód 63.3.7	—	39	35*	120*
Gyula – Vár (Castle)				
63.1.15	—	60	52	180
63.1.16	—	65	52	192
63.1.18	195*	52.5	44	164
63.1.19	164*	46	39	130
63.1.32	215*	56	42	162
	165*	45	38	130
	—	59	50	176
	—	64	52.5	188
	130	45	32	128
	132	46	34.5	126
	235*	55	40	152
	188	50	41	144
	—	54	43	157
	—	55	49	164
	—	40.5	39	127
	—	68	54	205
Kecskemét – Bocskai utca (Street)	280*	98	91	305*
	290*	57.5	48	167
	320	66	62.5	205
	330	64	47	176
	427	94	74	266
	—	58	45.5	160
	—	62	51	180
	—	45	42	142
Kőszeg – Vár (Castle)				
63.6.1	—	50.5	47	157
63.6.2	—	41	32	118
63.6.14	100	50	43	145
63.6.57	93	36	30.5	104
Nagyvázsony – Csepely				
61.21.69	—	57	43	170
61.21.80	—	58	44	168
	—	62	49	184
61.21.116	—	55.5	43	160
61.21.116	—	56.5	47	166
Sárospatak – Vár (Castle)				
64.10.1.Z	150*	45	41	133
64.10.2.Z	300	65	51	186
Szolnok – Vár (Castle)	155*	46*	36	133*
Túrkeve – Móricz				
54.3.139	—	40	35.5	118
63.5.1	180*	51.5	41	150
63.5.223	155	44.5	35.5	130
63.5.224	120*	41	34	115
63.5.226	—	52	42	154
63.5.227	—	37	33.5	110
63.5.228	—	50	38.5	143
64.1.1012	185*	68	58*	215*
65.2.136	—	42	36	123
65.2.137	—	65	43	173

* In the tables, the approximate measurements are marked by an asterisk.

Cattle – Horn core (continued)

Age/Site	1	2	3	4
66.1.252	120	39	29.5	108
66.1.562	—	58	46	—
66.1.563	90*	35.5	30.5	100
66.1.711	100	42	32.5	117*
58.3.1	170	53	45.5	163
58.3.80	—	55	53	185
59.2.1	—	60.5	45	168
59.2.1	125	46	53	130
59.6.1	95	37.5	31.5	112
59.62.2	—	54	48	163
60.18.39	—	38.5	28	—
61.1.1	—	66	47	180
61.1.330	142	—	—	—
61.1.1486	—	48.5	46	155*
62.1.2	—	47	39	—
62.1.3	—	49	42.5	—
52.1.219	—	38.5	33	—
68.2.121	—	56	50	165
68.2.175	139	49	39.5	138
68.2.261	—	70	50.5	191

Mandible

Measurements: 1. height at P_1 4. M_1-M_3
2. height at M_1 5. M_3 h
3. P_1-P_3

Age/Site	1	2	3	4	5
Copper Age					
Aszód – Papi földek	34.5	48	50.5	95	38.5

Atlas

Measurements: 1. length of body 4. breadth of caudal articular surface
2. length of arch 5. greatest breadth
3. breadth of cranial articular surface 6. greatest height

Age/Site	1	2	3	4	5	6
Neolithic						
Röszke – Ludvár	54.5	—	81	84	—	—
Copper Age						
Aszód – Papi földek	53*	—	91	82	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6
Bronze Age						
Mezőkomárom – Alsóhegy	41	31	98	91.5	—	71
Avar period						
Kiskunmajsa – Kőkút	49	—	94	83.5	131	—
14th – 17th century						
Gyula – Vár (Castle)	39	44.5	93	88	148	77
Visegrád 64.1.1311	36	44	83	78	133	—

Epistropheus

Measurements:
1. length of body
2. length of arch
3. length of dens
4. breadth of dens
5. breadth of caput craniale
6. breadth of fossa caudalis
7. greatest breadth
8. height of caput craniale
9. height of fossa caudalis
10. greatest height

Age/Site	1	2	3	4	5	6	7	8	9	10
Neolithic										
Neszmély – Tekerespatak	—	—	20.5	43	93	—	—	51	—	—
Copper Age										
Aszód – Papi földek	—	—	36	45	106	—	—	61	—	—
	—	—	19	45	96*	—	—	56*	—	—
Kenderes – Kulis 62.22.158	—	—	19	42	93	—	—	55	—	—
Bronze Age										
Csepel – Háros	—	—	16	42.5	85*	—	—	—	—	—
	—	—	20	38.5	87*	—	—	47.5	—	—
Mezőkomárom – Alsóhegy	—	—	22	40	88	—	—	53	—	—
Nyergesújfalu – Téglagyár (Brick-yard)	—	43	22	41	88	—	—	50.5	—	—
	—	41	18	38.5	80	—	—	44.5	—	—
	—	50.5	24	43	91	—	—	55.5	—	—
	—	53.5	23	41	93	—	—	56	—	—
Tiszaluc – Dankadomb	—	—	35	45.5	98	—	—	55*	—	—
Period of the Roman Empire										
Pilismarót – I. őrtorony (Watch tower)	—	—	19	35	80	—	—	47	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Epistropheus (continued)

Age/Site	1	2	3	4	5	6	7	8	9	10
Avar period										
Kiskunmajsa—Kőkút	—	49	22	37	84	—	—	—	—	—
14th—17th century										
Gyula—Vár (Castle)	—	57	18	41.5	88.5	—	—	57	—	—

Scapula

Measurements: 1. greatest length
2. greatest breadth
3. smallest breadth of collum scapulae
4. breadth of angulus articularis
5. diameter of facies articularis

Age/Site	1	2	3	4	5
Neolithic					
Jászberény—Cserőhalom 62.11.3	—	—	—	71.5	52*
Neszmély—Tekerespatak	—	—	51.5	72	52*
	—	—	55	68	54
	—	—	—	64.5	47
	—	—	—	70	51*
Röszke—Ludvár	—	—	—	77	53
Copper Age					
Aszód—Papi földek	—	—	49	71	54
	—	—	50	73*	51*
	—	—	51.5	70	—
Békásmegyer—BUVÁTI	—	—	44	—	44*
Fertőrákos—Golgota	—	—	48	64*	—
	—	—	—	70.5	52*
	—	—	—	61	46.5
Kenderes—Telekhalom 62.21.17	—	—	—	68	52*
Bronze Age					
Aszód—Gépállomás (Machine station)	—	—	—	56	41.5
Békés—Városerdő					
53.1.64	—	—	54	65	—
	—	—	41.5	61	47
	—	—	42	—	48.5
	—	—	43.5	69	49
	—	—	41	68	—
53.1.65	—	—	—	65	46
	—	—	—	59	40
53.4.350	—	—	34	—	40
	—	—	38	60	42
	—	—	—	62.5	42.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5
	—	—	—	69.5	47*
56.20.415	—	—	51.5	64.5	48
60.7.130	—	—	46.5	60	44.5
60.7.343	—	—	43.5	63	49
Dunaújváros—Koszider					
858.c	—	—	50	70	50
869.d	—	—	44.5	56	41
893.a	—	—	50	—	48
895.a	—	—	—	76	55
902.a	—	—	54.5	72	53.5
924.a	—	—	37	56	40
924.a	—	—	50	—	47
957.a	—	—	—	64	45.5
973.c	—	—	47	62.5	—
973.e	—	—	51	64	47
1040.a	—	—	42	56	43
1043.b	—	—	—	69	51
1054.a	—	—	53	73	—
1065.a	—	—	50	—	51
Füzesabony					
644.d	—	—	59	—	57
651.b	321	—	47	64	46
651.d	—	—	43	56	39
651.e.	—	—	44	60	41
Jászdózsa 60.24.11	—	—	44	58.5	41.5
Nyergesújfalu—Téglagyár (Brick-yard)	—	—	46.5	60.5	43*
	—	—	45	63*	43.5
	—	—	—	69	50
	—	—	45.5	—	43
	—	—	53	69	52*
	—	—	—	70*	50*
Süttő—Hosszúvölgy					
62.44.14	—	—	43	60*	39.5
62.44.26	—	—	42	59	38
62.44.35	—	—	51	63.5	—
62.44.40	—	—	44	59	45
62.44.95	—	—	48	56*	38.5
62.44.125	—	—	47.5	65	50*
62.44.285	—	—	54	70	53*
62.44.452	—	—	56	72*	—
62.44.681	—	—	40.5	57	45*
	—	—	56	72	—
62.44.940	—	—	46	62.5	48.5
Tápiószele—Tűzköves					
239.d	—	—	61	74	57
271.d	—	—	54	69	50
274.b	—	—	—	80	57
1142.d	—	—	45	63	—
1142.c	—	—	—	62.5	45.5
Tiszaluc—Dankadomb	—	—	48.5	70*	—
	—	—	—	66	50*
	—	—	50	67.5	45

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5
	—	—	55.5	67	53
	—	—	42	60*	42
	—	—	—	62.5	47
	—	—	—	71	50*
	—	—	—	78	56*
	—	—	47.5	59.5	46
Iron Age					
Budapest—Remete barlang (Cave)	—	—	56	—	—
	—	—	53	71	50
	—	—	74	—	—
Helemba—Sziget (Island)	—	—	—	60.5	47
	—	—	55.5	72*	51*
Jászberény—Cserőhalom 62.13.23	—	—	51	65*	49*
Mezőcsát—Hörcsögös 65.4.39.Z	—	—	46.5	62*	43*
Velemszentvid	—	—	56.5	80	50
Period of the Roman Empire					
Balatonaliga 579.d	—	—	61	76	56
Budapest—Albertfalva	—	—	—	71	52
	—	—	—	72	—
	—	—	—	79	—
Pilismarót—I. őrtorony (Watch tower)	—	—	47	62*	44*
Tokod—Erzsébet akna (Shaft)	—	—	—	71*	53*
	—	—	—	63*	46*
Migration Period					
Apagy—Barucha J. földje (J. Barucha's land)	—	—	52	70*	50*
	—	—	57.5	71	51
	—	—	—	65	48
	—	—	—	75	54
Arka					
62.34.47	—	—	43.5	60.5	43
62.34.65	—	—	45	—	44*
Garadna 60.12.6	—	—	—	59	42
Szabadszállás—Józan	—	—	46	63.5	—
Tiszavasvári—Paptelekhát					
62.370.2	—	—	47.5	66.5	43*
62.503.3	—	—	—	72*	48*
Avar period					
Dócz—Balástyai bekötőút (Balástya approach road) 62.7.10	—	—	53.5	65*	51*
	—	—	54.5	65*	50*
Kiskunmajsa—Kőkút	—	—	49	61	46.5
	—	—	48.5	61.5	45.5
Mohács—Téglagyár (Brick-yard)	—	—	49	64	46
10th—13th century					
Csátalja—Vágotthegy					
53.3.97	—	—	44.5	60*	—
53.3.112	—	—	36	54	41

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Scapula (continued)

Age/Site	1	2	3	4	5
Csongrád – Felgyő 56.10.4	—	—	48	66	—
Tiszalök – Rázom					
280.b	—	—	—	66	45
314.d	—	—	41	54	40
14th – 17th century					
Budavár – Pasa palota (Castle, Pasha's Palace)	—	—	53.5	67*	48
Fonyód					
63.3.79	—	—	—	66	47*
63.3.261	—	—	57.5	72.5	57
	—	—	—	61	44
	—	—	—	72.5	—
63.3.262	—	—	41	60*	—
63.3.413	—	—	47	60	42.5
Gyula – Vár (Castle)	—	—	50	67	46
Kőszeg – Vár (Castle)					
63.6.234	—	—	53	68	49*
63.6.84	—	—	—	56*	40
Nagyvázsony – Csepely					
61.21.72	—	—	54	71	51*
61.21.125	—	—	54	73	—
Tiszaszőlős – Csákányszeg 62.9.3	—	—	—	69	51.5
Túrkeve – Móricz					
54.3.508	—	—	—	66	47
54.3.918	—	—	46	—	43
	—	—	53.5	68	—
55.20.3	—	—	46.5	62	43
Visegrád					
63.5.32	—	—	—	65	46*
	—	—	—	59*	42*
	—	—	—	64*	47
	—	—	—	57	—
63.5.272	—	—	—	58*	40
	—	—	—	60*	44
	—	—	—	72*	56
	—	—	49	70	46
64.1.1105	—	—	44	56.5	40.5
	—	—	45.5	64	42
64.1.1106	—	—	—	57*	42.5
64.1.1315	—	—	50.5	65.5	—
65.1.21	—	—	45.5	—	43.5
65.1.22	—	—	—	63.5	43.5
	—	—	—	73	48*
66.1.495	—	—	—	77*	60*
58.3.88	—	—	—	60.5	40.5
59.1.6	—	—	54.5	—	50
	—	—	55	70	50
	—	—	—	57	41
60.1.23	—	—	48	62	46
	—	—	44.5	—	45
60.8.25	—	—	58.5	78	54

* In the tables, the approximate measurements are marked by an asterisk.

Cattle – Scapula (continued)

Age/Site	1	2	3	4	5
60.21.147	—	—	—	55	41
61.1.117	—	—	44.5	60	—
61.1.246	—	—	—	77	54
61.1.341	—	—	54	61	—
61.1.866	—	—	46.5	62.5	42.5
	—	—	—	65	45
61.1.990	—	—	47.5	58.5	42
61.1.1583	—	—	—	72	—
61.1.1809	—	—	—	—	47.5
	—	—	—	—	53
61.2.25	—	—	44	—	45*
	—	—	—	65*	51*
	—	—	44	—	40*
	—	—	—	61*	50*
62.1.20	—	—	—	73	52
63.1.6	—	—	43	60*	40
63.3.43	—	—	58.5	—	50*
	—	—	—	71	50.5
	—	—	57	72	58
	—	—	47	62.5	44
	—	—	46	62	—
	—	—	—	71	47
	—	—	—	75	57.5
63.3.46	—	—	—	70.5	56*
68.2.4	—	—	48	67	45.5
68.2.266	—	—	—	75	56.5

Humerus

Measurements:
1. length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Neolithic							
Neszmély – Tekerespatak	—	—	—	79	—	—	81
	—	—	—	77	—	—	77
Copper Age							
Aszód – Papi földek	—	—	—	85	—	—	83
	—	—	35.5	86*	—	45	—
	—	—	—	82	—	—	80.5
	—	—	38	80	—	46	82
	—	109	—	—	116	—	—
	—	—	38	—	—	49	79
	—	—	—	80	—	46	82

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Fertőrákos – Golgota	—	—	35	77	—	42.5	78
Szabadszállás – Ágostonhalmi dűlő (Baulk)	—	—	37	85	—	47	80
	—	—	37	85	—	45	—
Tiszaszőlős – Csákányszeg 62.6.186	—	—	—	78	—	—	76
Bronze Age							
Békés – Városerdő							
53.1.68	—	—	—	63	—	—	62
	—	—	—	81	—	—	78
53.4.353	—	—	34.5	72	—	43	72
	—	—	31	68	—	40.5	69
	—	—	—	68	—	37.5	70
	—	—	—	65	—	44	64
53.4.355	—	—	29	—	—	36.5	—
	—	—	28	—	—	35	—
	—	—	31	—	—	35	—
	—	—	34.5	—	—	42	—
56.20.309	—	—	32	74	—	39	73.5
58.18.36	—	—	—	72	—	—	79
	—	—	—	82	—	—	84
60.7.250	—	—	32.5	69	—	40	67
62.19.220	—	—	37	84	—	43	75*
Csepel – Háros	—	—	—	82	—	—	82
Dunaújváros – Koszider							
847.c	—	—	31.5	70	—	39.5	—
860.b	—	—	—	67	—	—	64
938.b	—	—	—	72.5	—	—	76
939.d	—	—	31	—	—	40.5	—
954.a	—	—	—	66	—	—	66.5
956.a	—	—	—	62	—	—	61.5
956.b	—	—	—	80	—	—	78
968.a	—	—	29	67.5	—	38	70
969.c	—	—	31	—	—	39	—
969.e	—	—	—	83	—	—	85
969.f	—	—	—	84	—	—	81
991.b	—	—	34	77	—	—	83
1005.d	—	—	—	85	—	—	80
1023.a	—	—	33	73.5	—	39	70
1038.c	—	—	28	66	—	34	62
1040.c	—	—	33.5	68.5	—	49	—
1043.e	—	—	31	—	—	38	—
55.9.9	—	—	—	78	—	46	82
Jászdózsa 60.24.12	—	—	—	81	—	41	74
Mezőkomárom – Alsóhegy	—	—	32	65	—	38	63
	—	—	—	77	—	—	76.5
	—	—	—	74	—	40	72
Nyergesújfalu – Téglagyár (Brick-yard)	—	—	30	74	—	37.5	—
	—	—	36	80	—	43	—
	—	—	39	85	—	42	—
	—	—	32	76	—	—	—
Süttő – Hosszúvölgy							
62.44.317	—	—	40	85	—	46	—

Cattle — Humerus (continued)

Age/Site	1	2	3	4	5	6	7
62.44.390	—	—	33	69	—	42	71
62.44.453	—	—	—	86	—	—	82*
Tápiószele – Tűzköves							
256.b	—	—	31	66	—	—	—
256.b	—	—	—	69	—	—	—
1138.d	—	94	—	—	96	—	—
1142.a	—	—	36	—	—	44	—
1162.e	—	—	28	69	—	35	68
1220.a	—	—	36	77	—	45	77
Tiszaluc – Dankadomb	—	—	—	81	—	—	79
	—	—	—	79	—	—	78
	—	—	—	70	—	—	68
	—	—	32	68	—	38	70
	—	—	—	79	—	—	77
	—	—	31	72	—	40	70
	—	—	32	77	—	38	—
	—	—	—	85	—	48	80
	—	—	—	88	—	—	85
	—	—	—	75*	—	39	71
Valkó – Erdőgazdaság (Forestry) 55.6.11	—	—	—	68	—	—	61
Iron Age							
Felsőtárkány – Várhegy	—	—	—	70	—	—	69
Helemba – Sziget (Island)	—	—	—	85	—	—	79*
	—	—	—	82	—	—	79
	—	—	—	82	—	40	75
	—	—	—	70	—	—	—
Jászfelsőszentgyörgy – Turóczi-tanya (Farmstead) 62.1.33	—	—	—	75	—	42	—
Mezőcsát – Hörcsögös							
59.10.4	—	—	25	—	—	28	—
59.10.11	291	95	35	79	101	39	75
59.10.19	253	—	29.5	—	—	35	65
62.26.5	281	94	32	76	99	38	69
62.26.21	261	80*	29.5	67	93	34	65
62.26.56	253	78	28.5	69	87	33	65
62.26.68	267	83	31	68	95	38.5	71
62.26.91	270*	—	34	85	—	47	78
62.26.201	—	—	32	73*	—	40	78
65.4.40	259	83	31	69	90	33.5	67
Period of the Roman Empire							
Budapest – Albertfalva	—	—	—	78	—	—	86
	—	—	—	69	—	—	—
	—	—	28	—	—	—	—
Pilismarót – I. őrtorony (Watch tower)	—	—	26	—	—	30	—
	—	—	29.5	—	—	39	—
Migration Period							
Szabadszállás – Józan	260*	—	32	—	—	37	—
	260*	—	31	—	—	38	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Avar period							
Dóc—Balástyai bekötőút							
(Balástya approach road)							
62.7.11	—	—	36	81	—	44	72
62.7.11	—	—	36	79	—	45	73
Halimba							
62.45.1	—	—	29*	68*	—	35	66
62.45.10	255*	74	30	—	84	36	65*
62.45.17	—	—	28.5	65	—	33	58
65.10.25	262*	85.5	28.5	69	97	34	67.5
65.10.118	—	—	30	67.5	—	36	66*
65.10.149	285*	—	34	84	105*	40	76
65.10.172	—	—	28	65	—	37	65
65.10.173	293*	76*	28	66	77	33	60
65.10.189	285	90	30	69	91	39	71
65.10.190	—	—	29	70*	—	39	73
Kiskunmajsa—Kőkút	277	89	35	71	98	38	71
	—	—	35	74	99	37.5	71
Mohács—Téglagyár (Brick-yard)							
8.	258	—	26	—	—	36	—
9.	283	—	30	—	—	39	—
Szentes—Berekhát 62.3.6	—	—	39	87	—	47	79
	—	—	38	87	—	48	79
Szentes—Kaján 61.36.1	235	76	28.5	62.5	—	33	55
10th—13th century							
Csátalja—Vágotthegy 53.3.122	—	—	—		—	39	69
Csongrád—Felgyő				67			
56.10.24	—	—	26	—	—	32	—
56.10.81	—	—	37	70	—	39	68.5
Kardoskút—Hatablak							
56.1.285	—	—	—	64	—	41	62
58.4.21	—	—	—	62	—	—	65
Szarvas—Rózsás 59.8.107	—	—	—	67	—	38	67
Tiszalök—Rázom							
418.d	238	70	27	63	84	32	64
829.b	—	—	27	—	—	36	—
Tiszavasvári—Paptelekhát 62.395.1	—	—	—	78	—	—	74
14th—17th century							
Fonyód 63.3.264	—	87	—	—	88	—	—
Nagyvázsony—Csepel 61.21.73	—	—	34	82	—	37	68
	—	—	34	80	—	38	67
Túrkeve—Móricz							
54.3.511	—	—	30	—	—	35.5	—
54.3.744	—	—	—	69	—	—	68
Visegrád							
58.3.31	—	—	—	81	—	—	77
59.6.21	—	—	35	—	—	43	—
61.1.868	—	—	—	62	—	—	67
61.1.1810	—	—	—	67*	—	—	—
62.1.23	—	—	34	—	—	42	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
62.1.395	—	—	27	62	—	32	61
63.1.8	—	—	—	64.5	—	—	61
63.3.50	—	—	29	68	—	38.5	70
	—	—	—	66	—	37	65
	—	—	36	77	—	45	—
	—	—	—	87	—	—	90
	—	—	32	74	—	40	70
	—	—	—	87	—	42	—
	—	—	—	80	—	—	79
	—	—	27	67	—	34	63
63.5.36	—	—	—	86*	—	—	82*
63.5.278	—	—	—	79	—	43	70
63.5.78	—	—	—	81	—	—	73
Buda—vár—Pasa palota (Castle, Pasha's Palace)	—	—	—	83	—	—	78

Radius

Measurements: the same as those of the humerus.

Age/Site	1	2	3	4	5	6	7
Neolithic							
Békásmegyer—Vöröscsillag TSz (Cooperative)	—	—	—	78	—	—	57.5
Jászberény—Cserőhalom 62.11.4	—	—	—	71	—	—	47*
Neszmély—Tekerespatak	—	97.5	—	—	50	—	—
	—	—	—	71	—	—	43
	—	—	—	75	—	—	48
	—	—	—	71	—	—	48
	—	85	42.5	—	42	22.5	—
	—	—	—	66.5	—	—	43
	—	—	—	83	—	—	57
	—	64.5	39	—	34.5	—	—
	—	79	—	—	40	—	—
	—	—	—	72	—	—	47
Röszke—Ludvár	—	89	—	—	44	—	—
Copper Age							
Aszód—Papi földek	—	—	—	75	—	—	45
	—	—	—	75.5	—	—	45
	—	91.5	—	—	47	—	—
	—	95	—	—	50	—	—
	—	—	—	80	—	—	51.5
	—	88	—	—	44*	—	—
	—	95	—	—	46	—	—
	—	—	—	75.5	—	—	46
	—	87*	—	—	45.5	—	—
	—	87	—	—	43*	25	—
	—	94	—	—	45.5	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	—	—	81	—	—	51
	—	—	—	69	—	—	45
	—	89	—	—	48.5	—	—
	—	71	—	—	39*	—	—
	—	—	—	80	—	—	47
	—	—	—	78	—	—	48
	—	—	—	70*	—	—	44
Békásmegyer—BUVÁTI	—	88	—	—	45	—	—
Fertőrákos—Golgota	—	85*	—	—	—	—	—
Kenderes—Telekhalom 62.21.10	—	86	—	—	42.5	—	—
Szabadszállás—Ágostonhalmi dűlő (Baulk)	315*	87	45.5	79	50	26	49
Tiszaszőlős—Csákányszeg							
62.6.188	—	78*	—	—	37	—	—
62.6.195	—	75.5	—	—	39	—	—
62.6.262	—	—	—	71	—	—	44
Bronze Age							
Békásmegyer—BUVÁTI	—	86.5	—	—	43	—	—
	—	—	—	55.5	—	—	35
	—	—	—	75	—	—	53*
Békés—Városerdő							
53.4.359	—	—	—	76	—	—	47
	—	—	—	65	—	—	48
	—	—	—	62	—	—	38
53.4.360	—	—	—	73	—	—	42
	—	—	—	62	—	—	38
	—	—	—	68.5	—	—	44
	—	—	—	62	—	—	42
56.20.83	—	81	—	—	40	—	—
56.20.97	—	75	—	—	38	—	—
56.20.311	—	73	—	—	41	—	—
	—	70.5	—	—	37.5	—	—
56.20.312	—	—	—	75.5	—	—	44
56.20.416	—	74.5	—	—	38	—	—
56.20.584	—	74	—	—	39	—	—
56.20.642	—	66*	—	—	33.5	—	—
58.18.40	—	72	37	—	37	18	—
	—	77	—	—	42	—	—
	—	80	—	—	41	—	—
58.18.41	—	—	—	80	—	—	48
58.18.42	—	—	—	77	—	—	51
60.7.133	—	83	—	—	43.5	—	—
60.7.398	—	67	—	—	34	—	—
62.19.12	—	72.5	—	—	35*	—	—
62.19.359	—	84*	—	—	45*	—	—
Csepel—Háros	—	77.5	—	—	40.5	—	—
	—	79	—	—	41.5	—	—
	—	—	—	72	—	—	44
	—	—	—	73	—	—	42.5
	—	—	—	80	—	—	47
	—	88*	—	—	45*	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	73*	40*	—	37*	—	—
	—	—	—	64	—	—	38
	—	—	—	67	—	—	43
	302	87	42	79	44.5	23	49
	—	87	—	—	44*	—	—
	—	—	—	84	—	—	54
	—	78.5	—	—	40.5	—	—
	—	79	—	—	40	—	—
	—	—	—	74.5	—	—	48.5
	—	79	—	—	40*	—	—
	—	79.5	—	—	41*	—	—
Dunaújváros – Koszider							
847.d	—	70	35	—	38	19	—
847.e	—	—	—	72	—	—	39
863.b	—	—	—	74	—	—	43
880.d	—	—	—	71	—	—	39
894.d	—	—	40	72	—	—	46
902.b	301	82.5	43	78	—	23	44
904.b	—	71	40	—	—	—	—
906.b	290	81	43	74	43.5	26	44
913.a	275	76.5	40	70	—	21	40
913.b	253	68	34	56	—	17	36
917.d	—	—	—	75	—	—	48
921.c	302	88	45.5	—	44	25.5	—
924.b	241	—	32	59	34	17	35
924.d	—	—	—	77	—	—	49
930.b	281	82	39	68	44	23	41
932.c	—	—	—	76.5	—	—	51
938.c	241	75	35.5	61	38	19	40
946.e	288	83	45.5	72	42.5	25.5	44
949.c	—	89	—	—	43	—	—
949.d	—	—	—	65	—	—	36
953.b	287	—	36	69	—	22	43.5
956.c	—	—	—	69	—	—	46
975.a	—	—	—	78	—	—	45
986.d	—	—	—	64	—	—	42
987.b	—	—	—	64	—	—	42
994.d	—	—	—	75	—	—	45
996.e	—	—	—	69	—	—	41
998.b	—	—	—	76	—	—	50.5
1011.b	—	—	—	75	—	—	50
1105.e	—	75	—	—	38	—	—
1008.d	—	69	35	—	—	18	—
1016.d	—	—	—	76	—	—	43
1023.b	—	79	—	—	42.5	—	—
1023.d	—	—	—	74.5	—	—	41.5
1049.c	—	—	—	79	—	—	50
1054.b	283	84	43.5	73.5	—	24	45
1060.b	—	84.5	—	—	46.5	—	—
1062.c	—	87	—	—	44	—	—
1062.d	—	80	—	—	40.5	—	—
1067.c	—	87	—	—	41.5	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
55.9.19	—	80	37	—	40.5	21	—
Füzesabony							
652.c	285	80	42	70	41	21	40
652.d	253	70	37	58	—	18	40
Mezőkomárom – Alsóhegy	—	75.5	—	—	40*	—	—
	—	—	—	68*	—	—	46*
	—	—	—	68	—	—	46
	—	73*	—	—	38	—	—
	—	—	—	78	—	—	47
	—	92	—	—	48	—	—
	—	—	—	75	—	—	46
	—	84	—	—	45	—	—
Mezőlak 60.25.5	—	78	—	—	45	—	—
Nyergesújfalu – Téglagyár (Brick-yard)	—	83	—	—	42.5	—	—
	253	74.5	36.5	63.5	37	21	41
	—	75*	—	—	38	—	—
	—	87	—	—	47.5	—	—
	308	86*	42	77*	45.5	25	—
	—	—	—	72	—	—	46
	—	—	—	68.5	—	—	42.5
	—	72	—	—	36*	—	—
	—	73	38	—	37	19.5	—
	—	—	37.5	—	39	20.5	—
	—	—	—	75	—	—	50
	—	68.5	—	—	37.5	—	—
Süttő – Hosszúvölgy							
62.44.41	—	—	—	60	—	—	37.5
62.44.100	—	—	—	70	—	—	45
62.4.253	—	83*	—	—	43	—	—
62.44.254	—	—	—	63*	—	—	42
62.44.340	—	81	—	—	43	—	—
62.44.391	—	80	—	—	41	—	—
62.44.442	—	—	—	76	—	—	46
62.44.455	—	—	—	70	—	—	44
62.44.456	—	—	—	76	—	—	50
62.44.739	—	—	—	66	—	—	43
62.44.924	—	—	—	81	—	—	51
62.44.937	—	90	—	—	46	—	—
62.44.994	—	75	—	—	40.5	—	—
Tápiószele – Tűzköves							
258.c	—	79	43	—	40	—	—
1115.d	—	78	—	—	39	—	—
1115.e	—	—	—	70	—	—	43
1126.c	—	—	—	73	—	—	43
1129.d	—	—	—	84	—	—	57
1142.b	—	76	—	—	38	—	—
1142.d	—	—	—	69	—	—	45
1142.e	—	—	—	79	—	—	51
	—	—	—	81	—	—	52.5
1163.a	—	69	35	—	37	20	—
1175.c	—	—	—	74	—	—	47
1188.c	—	88	—	—	45	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
1188.d	—	—	—	83	—	—	55
1190.a	—	—	—	75.5	—	—	50
1195.c	—	—	—	70.5	—	—	47
1220.d	287	79	42	73	39	25	41
1220.e	—	90	46.5	—	—	28	—
1220.f	—	91	—	—	48	—	—
1221.a	—	—	—	76	—	—	49
	—	—	—	81	—	—	51
Tiszafüred – Ásotthalom	273	—	37.5	—	—	—	—
Iron Age							
Felsőtárkány – Várhegy	—	82	—	—	—	—	—
	—	75	—	—	39	—	—
	—	83	—	72.5	43	—	52
	—	67	—	—	—	—	—
Helemba – Sziget (Island)	264	76	37.5	66.5	40	21.5	43
	313	87	43	72	44	24.5	47
	—	82	—	—	42	—	—
	—	—	—	65	—	—	40
	—	78	—	—	38.5	—	—
	—	—	—	67	—	—	40
	—	—	—	76	—	—	46
	—	76*	—	—	39	—	—
	—	—	—	72	—	—	50*
Koroncó – Tószer dűlő (Baulk)	242	67	33	57.5	32	17.5	38
Mezőcsát – Hörcsögös							
59.10.5	221	72	31	60	36	18	—
59.10.12	278	81	39	70	42	21	44
59.10.20	248	—	36	60	36	18.5	41
62.26.6	273*	76	36.5	67.5	39.5	21.5	42
62.26.22	—	—	—	65.5	—	—	43
62.26.57	244	69.5	33	59	36	19	36
62.26.69	257	72	36	62	37.5	21	37
62.26.92	274	82*	45	—	43	25	—
62.26.233	—	—	—	67*	—	—	42*
65.4.41	247	72	34	62	38	20.5	43
Óhuta – Nagysánc	—	68*	—	—	32	—	—
	—	—	—	56.5	—	—	32
	—	70*	—	—	36*	—	—
	258*	75*	37.5	—	37.5	19.5	40*
	262	73.5	38	64	37	21	44
Tápiószele							
55.23.24	—	—	50	—	—	33	—
55.23.25	—	—	—	73	—	—	51
55.23.45	—	—	—	73	—	—	53
Veszprém – József Attila utca (Street)							
59.9.92	268	81	38.5	69.5	40	22	43
Period of the Roman Empire							
Balatonaliga							
578.c	—	77	—	—	42	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
608.b	—	84	42	—	42	22	—
55.21.24	—	81	—	—	44	—	—
Budapest—Albertfalva	—	94	—	—	50	—	—
	307*	—	41	—	—	23	—
	—	—	34.5	—	—	18.5	—
	—	—	—	70	—	—	42
	306	81	42	75	41.5	23	49
	—	—	—	76*	—	—	—
	267	—	37	—	—	22	37
	—	83	—	—	41.5	—	—
	—	—	—	87	—	—	58
	—	—	—	68	—	—	49
Pilismarót—I. őrtorony (Watch tower)	—	90*	—	—	45.5	—	—
Tokod—Erzsébet akna (Shaft)	—	—	—	80	—	—	51
	—	82	—	—	40.5	—	—
	—	—	—	67	—	—	43.5
Migration Period							
Arka 62.34.66	—	74	—	—	40*	—	—
Garadna 60.12.19	250*	72	36	63	38	20	40
Mezőkövesd 60.29.12	—	72*	35	—	38	17	—
Szilvásvárad							
63.7.211	—	67.5	—	—	36	—	—
63.7.300	—	62.5	—	—	36	—	—
63.6.439	—	77.5	—	—	40.5	—	—
Avar period							
Bokros—Fehérkereszt	—	—	—	62*	—	—	44
Kiskunmajsa—Kőkút	269	75	39.5	66	40.5	22	43
	268	76.5	39.5	66.5	40.5	22	44
Szeged—Makkoserdő							
62.2.17	285*	82	40.5	70	41	22	44
62.2.74	278*	—	39	—	—	—	—
	285*	82	40	70	42	22	44
	278*	—	38	—	—	—	—
Tiszavasvári—Koldusdomb							
grave 8	—	—	—	66	—	—	41
grave 19	—	—	—	69	—	—	50
grave 23	—	—	—	64	—	—	41
10th—13th century							
Csátalja—Vágotthegy							
53.3.13	—	—	34	—	36	19.5	—
53.3.14	—	67	—	—	34	—	—
Kardoskút—Hatablak							
56.1.68	—	—	—	56.5	—	—	36
56.1.248	—	—	—	60.5	—	—	41
56.1.286	—	72	—	—	38	—	—
Kardoskút							
58.4.49	—	—	—	65	—	—	44
58.4.186	—	78	37.5	—	40	—	—
Szarvas—Rózsás							
59.8.17	—	77	—	—	40	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
59.8.108	—	—	—	73	—	—	43
59.8.185	—	67	—	—	35	—	—
Tiszalök – Rázom							
285.a	—	65	—	—	36	—	—
417.a	286	—	39	65	40	21	45
417.b	—	78	38	—	—	—	—
418.e	—	66	31	—	35	19	—
14th – 17th century							
Budavár – Pasa palota (Castle, Pasha's Palace)	—	68	33.5	—	35*	16.5	—
	—	68.5	—	—	35*	—	—
	—	72.5	36.5	—	38	21	—
	—	76.5	—	—	41.5	—	—
	—	83	—	—	44*	—	—
	—	—	—	71	—	—	42.5
Fonyód							
63.3.80	—	78	—	—	38	—	—
63.3.143	—	76.5	—	—	38.5	—	—
63.3.269	—	76.5	—	—	35	—	—
Gyula – Vár (Castle)	—	80	—	—	40	—	—
Nagyvázsony – Csepely							
61.21.74	294	78	38	69	41	21	47
	294	77	38	69	40.5	21	47
61.21.177	285*	83	38	74	43.5	22	48
61.21.127	—	—	—	72.5	—	—	45
61.21.215	—	81	42	—	42	24	—
61.21.301	—	69	33.5	—	36	19.5	—
Visegrád							
58.3.7	—	—	—	71	—	—	48
58.3.32	—	66	—	—	43	—	—
58.3.67	—	72	—	—	—	—	—
59.1.9	287	—	40	72	40	21	42.5
59.4.8	—	—	—	59	—	—	44
59.6.26	—	81	—	—	38	—	—
59.6.372	239	66	22	60	34	18	41
59.6.373	—	73.5	—	—	40.5	—	—
59.8.10	—	74	—	—	37	—	—
60.1.28	—	78	—	—	—	—	—
60.2.22	—	—	—	63	—	—	42
60.2.57	—	87	—	—	—	—	—
60.6.26	—	80	—	—	—	—	—
60.7.7	—	69	—	—	35	—	—
60.9.11	—	69	—	—	36.5	—	—
60.9.221	270	—	38	—	—	21	42
60.13.118	—	—	—	64	—	—	70
60.13.19	—	—	38.5	—	38	21.5	—
60.13.20	—	—	—	84	—	—	50
60.15.42	325	—	36	83	—	27	53
61.1.122	—	72	—	—	39.5	—	—
61.1.251	—	65.5	31	—	39	—	—
61.1.347	—	—	—	61	—	—	38

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
61.1.405	—	87	—	—	41	—	—
61.1.459	—	70	—	—	34	—	—
	—	77.5	—	—	41	—	—
	—	69.5	—	—	36.5	—	—
61.1.657	—	—	—	64	—	—	46
61.1.658	—	69	36	—	—	18.5	—
61.1.659	—	—	—	67	—	—	52
61.1.872	—	70.5	—	—	35*	—	—
61.1.1062	—	72.5	—	—	37.5	—	—
61.1.1104	—	91	—	—	48.5	—	—
61.1.1147	—	—	—	72	—	—	45
61.1.1329	—	—	—	74	—	—	42
61.1.1331	—	85	46.5	—	44.5	26	—
61.1.1440	241	67.5	34	56	35*	20	36
61.1.1430	241	65.5	34	56	35*	20	36
61.1.1642	—	—	—	74	—	—	41
61.1.1841	—	75	40	—	42.5	—	—
61.2.36	—	—	—	62.5	—	—	40.5
62.1.28	—	83	—	—	45.5	—	—
62.1.399	—	64	32	—	35.5	20.5	—
62.1.400	—	88.5	—	—	41*	—	—
63.3.54	—	—	—	60.5	—	—	38
	—	—	—	61	—	—	37
	—	—	—	67	—	—	43
	—	—	—	77	—	—	—
	—	—	—	61	—	—	40
63.3.55	—	—	—	75	—	—	45
63.3.59	—	78	—	—	42*	—	—
	—	67	—	—	35	—	—
	—	70.5	—	—	36	—	—
	—	85.5	—	—	44	—	—
	—	73	—	—	37	—	—
	—	71*	38	—	37	20	—
	—	83	—	—	39	—	—
	—	77	42	—	43	22	—
	—	88	—	—	41.5	—	—
	—	—	34	—	—	21	—
	—	83	—	—	43	—	—
	—	70	—	—	37	—	—
	—	83*	43	—	45	23.5	—
	—	90	45.5	—	47*	26	—
	—	83	—	—	—	—	—
	—	85	—	—	44.5	—	—
63.3.59	—	73*	—	—	38*	—	—
68.2.269	—	—	—	73	—	—	44
68.2.270	—	82	42	—	—	22.5	—
68.2.317	—	79.5	—	—	41.5	—	—
68.2.670	—	68	—	—	35.5	—	—
68.2.918	—	76	—	—	40*	—	—
Túrkeve—Móricz							
54.3.64	—	71	—	—	37*	—	—
54.3.170	—	67	34	—	—	18.5	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	74	—	—	38	—	—
54.3.258	—	67	32	—	34	16	—
54.3.325	—	—	—	64	—	—	38
54.3.429	—	72.5	—	—	39.5	—	—
54.3.430	—	—	—	64	—	—	42.5
54.3.512	—	97	48	—	43	—	—
54.3.516	—	—	—	65	—	—	44
54.3.640	—	—	—	77	—	—	50
54.3.848	265*	74	37	60	36.5	20	43
54.3.849	—	—	—	66	—	—	43
54.3.920	—	87	—	—	—	—	—

Metacarpus

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Békásmegyer—Vörös Csillag TSz (Cooperative)	—	62*	31.5	—	38	—	—
	—	71	—	—	41	—	—
Békásmegyer 63.28.1	—	53	—	—	34	—	—
Dévaványa—Sártó 61.16.1	—	—	—	65	—	—	36
	—	70	—	—	47	—	—
Jászberény—Cserőhalom 62.11.6	—	54*	27	—	34*	—	—
Neszmély—Tekerespatak	—	—	—	62	—	23.5	34.5
	—	—	—	64	—	—	35
	—	—	—	67	—	24	35.5
	—	59	33	—	42	—	—
	—	—	—	67	—	—	36
	—	—	—	58.5	—	23.5	33
	—	—	—	63.5	—	24.5	33
	—	58.5	—	—	38.5	—	—
	—	—	—	71	—	24.5	37
	—	66	—	—	44.5	—	—
	—	—	—	66.5	—	24.5	35*
Tiszaluc—Vályogos	—	—	—	60.5	—	25	35.5
Tiszaszőlős—Csákányszeg 62.5.15	—	56.5	—	—	42	—	—
Tiszavasvári—Keresztfal							
63.5.1	—	56*	—	—	35.5	—	—
63.7.1	—	55	28.5	—	33.5	—	—
Copper Age							
Aszód—Papi földek	—	—	—	63.5	—	23	35
	—	58.5	36	—	44	—	—
	—	59	34	—	39	—	—
	—	—	—	59.5	—	24.5	35
	—	—	—	64	—	—	34.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	—	—	63.5	—	—	35
	—	67.5	40	—	46.5	—	—
	—	65	—	—	40*	—	—
	—	60	—	—	36.5	—	—
	—	—	—	57.5	—	—	34*
	—	67	—	—	41	—	—
	—	67	—	—	43	—	—
	—	58	—	—	38.5	—	—
	—	—	—	70.5	—	26.5	36
	—	65.5	—	—	42	—	—
	—	—	—	69.5	—	28.5	33
	—	—	—	60*	—	24.5	35*
Békásmegyer – BUVÁTI	—	—	—	62.5	—	—	33*
	—	51.5	—	—	32	—	—
	—	—	—	70	—	24	37
	—	64	—	—	37.5	—	—
	—	—	—	56	—	—	30*
	—	—	—	57*	—	23	32*
Fertőrákos – Golgota	—	52.5	—	—	34	—	—
	—	—	—	57*	—	20.5	30*
	—	—	—	59	—	—	—
Szabadszállás – Ágostonhalmi dűlő (Baulk)	206	61	35	68	42	24.5	36.5
	206	62.5	35	68	42	24.5	36.5
Tiszaszőlős – Csákányszeg							
62.6.50	—	—	—	68*	—	24	37*
62.6.171	—	55	—	—	34.5	—	—
62.7.10	177*	—	—	—	—	—	—
Bronze Age							
Ároktő – Dongóhalom	189	55.5	32	57	33.5	18	30
Békásmegyer – BUVÁTI	179	48.5	27	52.5	34	20	29.5
	201	58	31.5	60.5	38.5	22	32.5
	167*	—	—	52*	—	—	27*
	—	—	—	54.5	—	—	30
	190*	58	37	65	40*	23	34*
Békés – Városerdő							
53.1.80	—	59	—	—	38.5	—	—
	—	60	32	—	42	—	—
53.1.80	—	59	36	—	38	—	—
	—	48.5	25	—	30.5	—	—
	—	55	28.5	—	35	—	—
	—	52	—	—	32	—	—
53.1.81	—	—	—	60	—	21	—
	—	—	—	58.5	—	18	26.5
	—	—	—	61.5	—	21	31.5
	—	—	—	64.5	—	21	32
53.4.365	—	53	28	—	33	—	—
	—	55	—	—	33	—	—
	—	52	—	—	35	—	—
	—	57	—	—	38	—	—
	—	58	—	—	38.5	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	—	53	29	—	33	—	—
	—	52	—	—	36	—	—
	—	57.5	—	—	38	—	—
	—	49	—	—	34	—	—
	—	52	29	—	31.5	—	—
53.4.366	—	—	—	60	—	20.5	29.5
	—	—	—	69	—	29.5	38
	—	—	—	66	—	29	—
	—	—	—	53.5	—	—	27.5
	—	—	—	52	—	19	—
	—	—	—	65	—	26	36
	—	—	—	57	—	18	—
56.20.9	—	—	—	53	—	19	28.5
56.20.314	162*	—	30	61.5	—	20.5	42
56.20.315	—	54	—	—	33.5	—	—
56.20.316	—	—	—	51	—	19	27.5
56.20.426	200	51.5	27	54	33	20	30
58.18.48	190*	60	—	—	39	—	32*
59.18.49	—	63	36	—	38	—	—
	—	49	26	—	30	—	—
	—	49	26	—	32	—	—
58.18.51	—	—	—	53	—	20	27.5
60.7.50	180	50	29.5	54	33	19.5	28.5
60.7.94	193	51	30	56	—	—	—
60.7.135	172	50	25	51	32.5	18.5	26.5
60.7.198	—	67	40	—	45*	—	—
60.7.695	172	47	29	53	35	19	28
62.19.13	—	—	—	62	—	23	33
62.19.55	—	51	29	—	33	—	—
62.19.135	—	—	30.5	—	—	20.5	—
62.19.261	—	52.5	27.5	—	31	20.5	—
Csepel—Háros	214	63	37	70*	40	24	35
	—	58	35	—	34	—	—
	—	—	—	53	—	20.5	29.5
	—	—	—	55.5	—	21	32
	—	—	—	60	—	24.5	—
	—	—	—	71	—	22.5	37.5
	—	—	—	71	—	—	39
	—	60	—	—	39	—	—
	—	65	38	—	43	—	—
	—	50	29	—	36*	—	—
	—	—	—	68.5	—	23	35*
	—	68.5	—	—	40	—	—
	—	—	—	62	—	21.5	32*
	—	—	—	72*	—	26	37*
	—	66	—	—	41	—	—
	—	68.5	—	—	46	—	—
	—	68.5	—	—	43	—	—
	—	—	—	68	—	—	37.5
	202*	60.5	35	—	40	25	35*
	—	—	—	70*	—	26.5	35*

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	—	62	35	—	43	23.5	—
	—	—	—	61	—	22	32
Dunaújváros–Koszider							
848.a	176	57	30.5	55	35	20	30
	197	52	31	56	34.5	21	31
	196.5	52	29	51	36	20	30
	181	56.5	33.5	62	36	20	32
	174	49	27	50	31	18	—
863.c	197	59	36	63	39	22	—
	189	60	34	62	38	22.5	33
863.d	—	61	35	—	37	21	—
867.e	—	—	—	58	—	23.5	33
869.f	186	51	29	52	31	20	28
888.b	180	54	36	59	37	21	30
895.c	—	—	—	56	—	20.5	30.5
900.d	—	—	28	—	—	18	—
902.c	198	61	34.5	66	42	22	34
906.c	—	—	—	49	—	20.5	—
909.d	—	—	—	63	—	24	33
911.c	199	59.5	34.5	63.5	37	23	—
915.e	—	—	—	65.5	—	24	—
917.f	199	60.5	32	62	40	23	33
924.e	—	61.5	35	—	41	21	—
925.a	194	52	30	56.5	32	20	31
	174	46	25	49.5	31	17	28
938.e	179	46.5	27	50	33	19	28
	170	46	27	50.5	34.5	19	27
947.c	—	47	—	—	33	—	—
950.a	164	49	28	51	30	16	—
950.b	—	67.5	—	—	42.5	—	—
953.c	—	—	—	53.5	—	—	30
954.c	183	47.5	28	51	33	20	27
957.b	202	58	32	60	36.5	21.5	31
959.a	—	—	—	51	—	18.5	—
968.b	176	56	34.5	62	36	20	30.5
970.b	182	—	29	63	41.5	20.5	31
970.c	—	49	25	—	34.5	18	—
974.b	178	48	28	50	33	19	27
975.c	—	52.5	30	—	—	20.5	—
987.c	—	—	—	56	—	—	32
988.b	—	49	—	—	36	—	—
988.c	—	71	—	—	45.5	—	—
995.a	—	50.5	—	—	39	—	—
995.b	—	—	—	63.5	—	—	34
998.c	—	—	—	62	—	—	32
1002.c	190	—	27.5	53	—	21	30
1012.d	195	54.5	26.5	54.5	35	19.5	32.5
1012.e	—	—	—	62.5	—	22	33
1016.e	—	—	—	67	—	26	36
1024.b	187	52	28	55	34	20.5	30
1036.c	—	—	27	—	—	19.5	—
1062.e	174.5	51	30	54	35	19	29

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
1067.b	174	47	28	51.5	29.5	18	27
1076.e	190	—	32	55	33.5	20.5	27.5
55.9.26	195*	—	29	59	—	19	—
Fertőboz – Gradinahegy	185	53	30	59.5	33	20.5	31.5
Füzesabony							
652.e	—	60	—	—	36	—	—
655.f	187	55	31	60	33	19	31
Kelebia, grave 71.a	186	57	32	—	—	20.5	—
Mezőkomárom – Alsóhegy	—	—	31	—	—	22.5	—
	—	55.5	30.5	—	33.5	—	—
	—	60	—	—	42	—	—
	—	55	—	—	36	—	—
	—	63	35.5	—	39.5	—	—
Nagykálló							
61.25.42	—	59	35	—	40*	—	—
61.25.108	182*	58	35	64	37.5	22	—
61.25.200	—	53	—	—	33.5	—	—
Nyergesújfalu – Téglagyár (Brick-yard)	—	—	—	63.5	—	21	33
	—	59	33.5	—	41	—	—
	195	62*	36	67.5	37.5	22	36
	193*	60.5	—	—	38.5	—	—
	188*	—	—	64.5	—	21	34.5
	209	59.5	35.5	66	42	23	35
	—	—	—	68	—	23.5	37
	—	52.5	29	—	33	19	—
	—	—	—	68*	—	25	36*
	—	53.5	—	—	36	—	—
	195*	57	34	—	38	21.5	—
	—	—	—	63.5	—	23	37
	—	—	—	63	—	22	35.5
	203	55.5	32	60	35	23	34*
	—	50.5	—	—	33	—	—
	—	50*	27	—	32*	20	—
	—	62	—	—	42	—	—
	—	58	—	—	40*	—	—
	—	—	—	55	—	20.5	31*
Süttő – Hosszúvölgy							
62.44.43	—	—	—	65	—	—	33
62.44.96	—	—	—	62*	—	21	33*
62.44.101	171	—	27	50	—	18.5	—
62.44.155	181	48*	26	50	31	18.5	28*
62.44.157	—	—	—	35	—	22	32.5
62.44.281	190*	—	—	—	—	—	—
62.44.269	—	—	—	52	—	19.5	29
62.44.318	—	62	36	—	40	—	—
62.44.341	173	53	31	56	35	19.5	29
62.44.369	—	65	38	—	39	—	—
62.44.427	—	—	—	55*	—	19.5	28*
62.44.458	—	—	—	73*	—	24	37
62.44.480	—	—	—	51*	—	19	28*
62.44.531	—	—	—	56	—	21.5	30*
62.44.582	—	59	—	—	40	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	61	—	—	37	—	—
62.44.869	—	51.5	—	—	32	—	—
62.44.943	—	—	—	55*	—	21.5	31*
Tápiószele—Tűzköves							
1145.a	—	—	21	—	—	15.5	—
1145.c	—	64.5	—	—	41	—	—
1145.d	—	—	—	66.5	—	22	33
	—	—	—	55	—	22	31
1163.b	—	—	—	58	—	23	31
1175.d	—	55	—	—	40	—	—
1190.c	203	60	34.5	65	39	22	34.5
1190.d	—	56	34	—	38	—	—
	—	58	—	—	39	—	—
1190.e	—	—	—	69	—	21	33
1192.c	—	55	—	—	35	—	—
1192.d	—	53	27	—	35	—	—
1192.f	203.5	53	32	56.5	37	22	31
249.d	—	59	30	—	36	23	—
249.e	—	—	—	67	—	26	35
261.c	—	59	—	—	36	—	—
Tiszafüred—Ásotthalom	193	55	35	—	—	—	—
	198	56	38	—	—	—	—
Tiszaluc—Dankadomb	191	53	30.5	55	33.5	21	29
	—	—	—	62	—	22	33.5
	—	—	—	54.5	—	18.5	27.5
	—	69.5	—	—	45	—	—
	193	—	31.5	57	—	20.5	30.5
	—	—	—	56	—	20.5	30.5
	—	53.5	31.5	—	33.5	—	—
	—	—	—	52	—	20.5	30.5
	—	—	—	65	—	—	35
	198	54*	32	56	36*	22.5	31
	—	58	—	—	34	—	—
	—	53.5	—	—	33	—	—
	—	—	—	63	—	21	32
	—	—	—	63	—	—	34.5
	—	53	—	—	36	—	—
	185	52	29.5	58	33	20	28.5
	—	56*	—	—	35	—	—
	—	—	—	64.5	—	25	33.5
	—	—	—	67*	—	—	36*
	198	57	36	63	40	23	32.5
	—	—	—	60.5	—	—	33
	201	54*	30	56	33	22	32
	—	68	—	—	44	—	—
	196	55.5	33	58	37	22	31.5
	199	54.5	32.5	60.5	36	23	31.5
	—	52.5	32	—	35	—	—
	—	54.5	33	—	37	—	—
	—	64	—	—	42	—	—
	—	—	—	62*	—	23	34.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Iron Age							
Felsőtárkány — Várhegy	—	—	—	53*	—	20	28*
	—	51	31.5	—	33	—	—
	—	59	—	—	38	—	—
	167	42	25	46	28.5	—	25
	—	—	—	62	—	22	33
	172*	48	26	—	30	19	—
	—	—	—	49.5	—	—	28
Helemba — Sziget (Island)	182*	—	28.5	55	—	19.5	30
	197	65	36	—	46	23.5	—
	—	67.5	—	—	46.5	—	—
	—	—	—	67	—	23	35
	—	51*	26.5	—	31	—	—
	—	56*	—	—	34.5	—	—
	—	—	—	59.5	—	—	33.5
	—	57	31	—	36.5	—	—
	—	58*	31.5	—	36	—	—
	—	46.5	26	—	29	—	—
	—	—	—	45.5	—	20	31.5
	—	—	—	58.5	—	20.5	32.5
	—	—	—	59*	—	20.5	31*
	—	—	—	71	—	—	45
	—	59.5	—	—	38	—	—
	—	61	—	—	40.5	—	—
	—	62	—	—	39.5	—	—
	—	—	—	66	—	—	34.5
	—	69	38	—	42	—	—
	—	68.5	—	—	44.5	—	—
Koroncó — Bábota 63.330.2	—	60.5	—	—	38	—	—
Koroncó — Tószerdűlő (Baulk)	—	—	28	—	—	20	—
	—	—	—	55*	—	18.5	—
Mezőcsát — Hörcsögös							
62.26.177	—	—	27	—	—	20.5	—
62.26.216	—	—	31	—	—	22	—
Óhuta — Nagysánc	—	—	—	65*	—	21.5	34*
	—	—	—	61*	—	21.5	33*
	—	56*	32	—	34*	—	—
	—	47*	26.5	—	30	18.5	—
Velemszentvid	190*	50*	27	54*	32*	19.5	—
	183	50	26	52	32	19	—
	182*	60	34	63	45.5	20.5	34*
	—	58	35.5	—	—	22.5	—
Budapest — Remete barlang (Cave)	—	—	30	—	35	—	—
	—	59	—	—	42	—	—
	—	—	—	66	—	22	34
Period of the Roman Empire							
Ács — Vaspuszta-castrum	199	—	32	59	40	21	31.5
	203	58	35	61	40	22.5	32.5
Adony 497.b	—	—	—	52	—	—	26
Balatonaliga 576.b	—	—	—	70	—	—	35

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
598.b	207	55	31	57	36	23	32
626.b	216	—	37	71	—	26	39
Budapest—Albertfalva	200	64	37.5	70.5	—	21	36
	—	48.5	—	—	35	—	—
	193	52	28.5	52	34	19	29
	—	—	—	53	—	—	30
	202	—	31	57	—	20	28
	206	60	33	64	47	22	33.5
	—	—	—	64	—	25	35
	214	64	36	67	41	24	35
	204	58	33	61	41	22	32
	—	—	31	—	—	21	—
	—	—	32	—	—	22	—
	—	55	33	—	35	—	—
	213	65	34	69.5	44	22	36
Budapest—Aquincum	—	55	31	—	37	—	—
	—	62	—	—	42*	—	—
	—	—	—	52	—	—	28
	—	—	—	61	—	21.5	33
Pilismarót—I. őrtorony (Watch tower)	192*	61	35	65	38.5	21.5	35
	—	54.5	—	—	36.5	—	—
Százhalombatta—Dunafüred	205	52	32	58	35	21	30
Tokod—Erzsébet akna (Shaft)	185	49	26	53	35	19	29.5
	—	—	—	61	—	21	31
	209	65*	37.5	63*	—	21.5	35*
Migration Period							
Apagy—Barucha J. földje (J. Barucha's land)	—	58	30.5	—	40	—	—
	—	68	—	—	42	—	—
	—	68	—	—	43	—	—
	—	—	—	52	—	18.5	—
	—	—	—	66	—	24	34
	—	—	—	67	—	24	34.5
Arka							
62.25.9	—	55	32.5	—	35.5	20.5	—
62.34.1	—	47	25	—	32	—	—
62.34.25	—	50.5	—	—	34	—	—
62.34.38	175	46.5	26	47.5	31	18.5	27
62.34.55	—	45.5	27.5	—	33	18.5	—
62.34.56	—	—	24	—	—	17	—
Derecske 62.43.8	177*	49*	28	51*	—	18.5	—
Szilvásvárad							
63.7.407	—	—	33	68.5	—	21	32.5
63.7.466	—	48	—	52	32	—	28*
Tiszavasvári—Paptelekhát							
62.327.7	180	49	27	49	31	20	28*
62.374.2	178	48	30	52.5	33	19.5	27
62.397.2	182	56	32	59	38.5	20	31*
62.423.3	—	59.5	33.5	—	36*	23.5	—
	—	—	30	—	—	—	—
	—	58*	30	—	35*	—	—
62.529.3	197	59	35	66	43*	21	34

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Avar period							
Dóc—Balástyai bekötőút							
(Balástya approach road) 62.7.14	—	—	30	59	—	21.5	32*
	196	55	30	59	39	22	32*
Kiskunmajsa—Kőkút	186	50.5	29.5	55	36	20.5	30.5
	187	51	30	55.5	39	20.5	30.5
Mohács—Téglagyár (Brick-yard) 28	—	56	31	58	33	21	31
29	204	56	31	57	33	21	33
Nagymágócs—Ótompa 62.9.10	180	46	26	48*	32.5	19.5	29*
Szeged—Makkoserdő							
62.2.7	204	58.5	31	60.5	40	23	33.5
	204	59	30.5	61	39	22.5	32.5
62.2.18	195	55	30	59.5	38.5	23	33
	195	55	30	59.5	40	23	33
62.2.26	203*	60.5	30.5	67*	40	22	34
62.2.31	188	55	30	58*	38	20	31
	190	57*	30	58*	36*	20.5	31
62.2.76	188	54.5	31	58*	33	21	31*
	188	54.5	31.5	58*	34	21	31*
62.2.122	205*	60	32	64	41	22.5	35
Szentes—Berekhát 62.3.8	199	63	35.5	62.5	40	23.5	34.5
Szentes—Kaján							
61.36	185	—	25	50	34	19	28*
61.36.12	—	—	30	58.5	—	21.5	32*
Tiszavasvári—Koldusdomb	—	51	28.5	—	34	—	—
grave 1	185	54	30	60	36	19.5	30.5
grave 8	190	50	30	54	—	19.5	29.5
	191	53	30.5	—	31.5	—	—
grave 19	197	57	31	60	38	21	31
grave 23	196	51	28	53	34	19	27*
	197	52	27	54	33	19.5	28
10th—13th century							
Csátalja—Vágotthegy 53.3.58	—	48	—	—	32	—	—
Csatár—TSz istálló (Cooperative stable)	191*	—	29.5	58	38	18.5	30.5
Csongrád—Felgyő							
56.10.5	196	56.5	33	61	38	22	31
56.10.72	—	60.5	—	—	39	—	—
Doboz—Hajdúirtás							
64.8.96 Z	—	46	—	—	29	—	—
64.8.166 Z	—	56*	—	—	37*	—	—
Garadna 61.18.52	—	—	—	58.5	—	21.5	32.5
Kardoskút—Hatablak							
56.1.71	158	41.5	21.5	43.5	28	16	23
56.1.178	170	43	24	46	29	16	23.5
56.1.297	174	47	27	49	35	18	25.5
58.4.131	—	47	35	—	—	16	—
58.4.202	176*	—	27	49	—	18	—
Tiszalök—Rázom							
194.c	—	—	—	48	—	24	38
230.a	—	—	—	48	—	25	—
286.d	—	54	30	—	31	21	—
288.a	—	—	—	56	—	21	29

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
290.b	—	42	19	—	26	13	—
291.a	188	54	30	56	35	21	31
	—	56	29	—	33	22	—
	—	56	29	—	33	22	—
	—	60	34	—	—	25	—
341.d	154	52	31	54	32	20	29
352.b	—	—	32	—	—	21	—
818.c	—	52	—	—	34	—	—
832.d	—	60.5	—	—	37.5	—	—
834.b	—	—	—	52	—	20	—
844.c	—	—	—	59	—	—	31
14th–17th century							
Buda—Vár—Pasa palota							
(Castle, Pasha's Palace)	187*	57	30.5	60	37*	21	33
	189.5	49.5	26.5	51	34	19.5	28
	—	55	—	—	35	—	—
	—	—	—	51.5	—	19.5	28
Fonyód							
63.3.274	—	48*	—	—	34*	—	—
63.3.275	—	—	—	50*	—	19	28
63.34.17	—	53.5	—	—	35	—	—
Gyula—Vár (Castle)							
63.1.1	—	66	38	—	43.5	23.5	—
63.1.13	200*	—	32	63*	—	22.5	—
63.1.28	189.5	54	30	54.5	35.5	21.5	30
63.1.29	182*	—	—	51.5	—	21.5	28
63.1.33	183	54.5	31	54*	35	22	30.5
63.1.35	216	55	31	58.5	35	22	32
63.1.36	208	55	29	58	38	22	33*
63.1.37	197*	59	34	62	38	23.5	—
63.1.38	191	49	28.5	54	32	19.5	28
63.1.39	198	—	28.5	57.5	36	21	31
63.1.69	176	46.5	28	52.5	32	18	28*
	177	45	27	52	32	16.5	26.5
	200*	59	33	61	35	23	32
	202*	—	31	62	—	22.5	30
	191	48	27	53	33	18.5	27
	214	55	31	56	38	23	32
	201	56	32	56	38	20	30
	198*	54	30.5	58	—	20	30
	192	53	30	54	34	20.5	29
	188	49	24	49	32	17.5	27
	198	53	25.5	54.5	37	20.5	30
	188	51.5	27	55	32	20	30*
Kőszeg—Vár (Castle)							
63.6.50	189	58	34	60	40	22	31.5
63.6.96	—	47.5	27.5	—	28	—	—
	—	48	26.5	—	33.5	—	—
63.6.98	—	—	—	52	—	—	27.5
	—	—	—	63	—	22.5	33.5
63.6.42	180	57	32.5	58.5	37	21	31*

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Nagyvázsony – Csepel							
61.21.10	—	57.5	—	—	37	—	—
61.21.75	182	56	31	62.5	37.5	20.5	32
61.21.284	—	—	—	60.5	—	20.5	31
Sopron – Szent György tér (Square) 18	—	47	—	—	30	—	—
	—	—	27.5	—	—	—	—
Szolnok – Vár (Castle)							
64.7.3	216	57	32	59	36.5	23	32
64.7.4	200	50	28	53	34.5	21.5	30.5
64.7.5	199	51	29.5	54	33.5	21.5	29.5
64.7.6	199	51.5	27	52	35	21.5	29
64.7.7	191	48.5	25.5	49	32	19	29*
64.7.8	211	52*	29	54	32.5	20	29
64.7.10	217	—	29	56.5	—	21.5	30
64.7.9	208	55.5	29	56	34	21.5	31.5
Tiszaszőlős – Csákányszeg 62.9.7	201	56.5	35	63	40	22.5	33.5
Túrkeve – Móricz							
54.3.174	199	52	26.5	55	36	20	—
54.3.281	197	51	29.5	55	35.5	22	28
	193	53	27	—	—	19	—
54.3.282	—	48	27	—	32	—	—
54.3.283	—	—	—	55	—	21	—
54.3.308	177	47	27.5	50.5	33	18	—
54.3.432	—	62	36	—	41	—	—
	—	48	27	—	33	—	—
	—	45	25.5	—	33	—	—
54.3.433	—	—	29	55	—	19	30
54.3.517	191	45	25.5	49	32	18	27
54.3.518	—	57	31	—	39	—	—
54.3.519	—	—	—	55.5	—	20	28.5
54.3.668	192	—	59	61	37	21	31
54.3.747	200	53	28	55	37	20	—
54.3.867	190	55	35	—	37	22	—
54.3.882	179	48	26	—	—	18	—
	—	49	25.5	—	30	20	—
54.3.883	—	—	32.5	—	—	22	—
54.3.923	—	54.5	—	—	36	—	—
	—	54.5	—	—	37	—	—
	—	51	—	—	34	—	—
	—	46	—	—	30.5	—	—
55.20.33	187	50	28	53	35	18.5	28
55.20.34	—	45	—	—	31	—	—
55.20.35	—	—	—	49	—	16	—
Visegrád							
59.9.1	189	—	26.5	52	—	19	30
60.1.34	—	46.5	28	—	29	—	—
60.1.35	—	—	—	61.5	21.5	—	—
60.13.24	—	57.5	33	—	40	—	—
60.15.22	212	60	37	62	35	24	30
60.17.249	—	51	26.5	—	—	21	—
61.1.22	—	51.5	30.5	—	40	—	—
	—	51.5	—	—	36	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	—	58	—	—	33	—	—
	—	59.5	32.5	—	36.5	—	—
	—	54.5	—	—	35	—	—
61.1.23	—	—	—	48.5	—	18.5	27.5
	—	—	—	57	—	22.5	33.5
61.1.464	—	54	—	—	34.5	—	—
	—	64.5	—	—	38	—	—
61.1.465	—	—	—	56.5	—	21	30
61.1.834	209	52	29	56	40	21.5	30
61.1.835	—	49	28	—	29.5	—	—
61.1.877	195	56	34.5	61	37	23	30
61.1.878	—	56	32	—	41.5	—	—
61.1.1028	—	—	—	59	—	23.5	—
61.1.1127	—	53	—	—	33.5	—	—
61.1.1221	—	57	—	—	36	—	—
61.1.1291	—	—	—	55	—	—	31.5
61.1.1334	—	54*	34	—	36.5	—	—
61.1.1335	—	—	—	54	—	20	29*
61.1.1644	—	53	28	—	37	—	—
61.1.1814	—	—	—	62	—	22	32
61.1.2125	—	—	—	47	—	17.5	27
61.1.2184	—	—	—	49.5	—	20	28
61.2.41	—	48.5	26.5	—	30.5	—	—
	—	49	26.5	—	30.5	—	—
	—	47	27	—	31.5	—	—
	—	53	30.5	—	34	—	—
	—	51	29.5	—	35.5	—	—
61.2.42	—	—	—	53	—	20	29.5
	—	—	—	60.5	—	—	33
	—	—	—	65	—	21	32.5
61.2.43	—	—	—	63*	—	—	31*
62.1.33	186	49.5	26.5	52.5	32.5	19	27.5
62.1.34	—	52.5	30.5	—	34.5	—	—
	—	55	—	—	39.5	—	—
	—	57.5	—	—	33	—	—
62.1.158	184.5	55	30.5	59.5	41	21	30.5
62.1.159	—	46*	26	—	29	—	—
	—	49	27	—	29	—	—
	—	50.5	30	—	32	—	—
	—	57	33.5	—	36.5	—	—
62.1.160	—	—	—	48.5	—	19	28
	—	—	—	52	—	22.5	30.5
	—	—	—	61*	—	21.5	31*
	—	—	—	61.5	—	—	33
62.1.406	—	52	—	—	35	—	—
	—	57	—	—	41	—	—
	—	63	—	—	41	—	—
62.1.407	—	—	—	49	—	19	27
	—	—	—	54	—	21	30*
62.3.28	—	58	34	—	35.5	—	—
62.3.29	—	56	—	—	38	—	—
	—	46	25	—	29	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	—	25	—	—	19	—
62.3.30	—	—	—	61.5	—	24	**34***
	—	—	—	58.5	—	20.5	**42**
62.7.61	190	52.5	28	54	39	20.5	**29**
62.7.62	—	49.5	28	—	35	—	—
62.8.186	—	54	30.5	—	37.5	—	—
63.1.18	—	—	—	49	—	19	29
63.2.6	—	59	32.5	—	37	—	—
63.2.29	—	—	—	46*	—	20.5	27*
	—	—	—	52*	—	22	29
63.3.69	174.5	46.5	25	49.5	32.5	19	27.5
	181	50.5	29	53	35	20	29
	184	49	28	52.5	32.5	19.5	28
	184*	57	24.5	63	39	21.5	32.5
	194	54	—	60	41	—	31
	206	63.5	38	68	41	23.5	35*
	187	52*	31.5	52*	32	21	—
	194	58	33	63	38	21	32
	194*	—	32.5	—	—	23	—
	198	60	35	61	39	22	33
	205	59	34	62.5	39.5	23	32.5
63.3.72	197*	—	—	—	—	—	—
	207*	—	—	—	—	—	—
63.373	—	46	23.5	—	30	—	—
	—	48.5	26	—	31	—	—
	—	62.5	34.5	—	40	—	—
	—	57.5	—	—	39	—	—
	—	50.5	—	—	34	—	—
	—	58	—	—	42	—	—
	—	51	32	—	32	—	—
	—	52	—	—	34*	—	—
	—	58.5	34.5	—	37.5*	—	—
	—	50	29.5	—	33	—	—
	—	61	—	—	41	—	—
	—	57	—	—	36	—	—
63.5.48	—	64	36.5	—	41.5	—	—
	—	58	—	—	40	—	—
	—	58	31.5	—	38.5	—	—
	—	46.5	26	—	31	—	—
63.5.49	—	—	—	54*	—	—	29*
63.5.298	189	54	31	57	35	20.5	30.5
	180.5	47	25.5	51.5	31	18	27
63.5.299	189	56.5	33	61	40	22.5	33*
63.5.300	—	65	35	—	42	24	—
63.5.302	—	47	28	—	33	—	—
	—	54	—	—	36	—	—
	—	55.5	—	—	37.5	—	—
	—	60.5	36	—	39	—	—
	—	47.5	27.5	—	32.5	—	—
	—	50.5	30.5	—	35.5	—	—
	—	49	29	—	32	—	—
	—	47.5	—	—	32	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	—	57	—	—	39.5	—	—
63.5.302	—	46	—	—	32.5	—	—
	—	55.5	—	—	37.5	—	—
	—	56*	—	—	36	—	—
	—	48.5	—	—	32	—	—
63.5.304	—	—	—	50*	—	18	26.5
	—	—	—	50.5	—	19	29
	—	—	—	62	—	21	31
	—	—	—	55.5	—	20.5	30.5
	—	—	—	51	—	20	26
	—	—	—	55*	—	21.5	31.5
	—	—	—	48.5	—	19	27
	—	—	—	66	—	22.5	33
	—	—	—	54.5	—	21.5	30
	—	—	—	51	—	19	28
64.1.408	—	—	—	53.5	—	20	29.5
64.1.583	—	58	33.5	—	37.5	—	—
	—	53	27.5	—	33.5	—	—
	—	53	—	—	34	—	—
	—	59	—	—	38*	—	—
64.1.584	—	—	—	51.5	—	20.5	28
	—	—	—	57	—	19	28*
	—	—	—	62	—	—	32
	—	—	—	70*	—	—	32
64.1.795	174	49.5	26.5	54	33.5	20	28.5
64.1.834	—	—	—	63	—	—	33.5
64.1.861	—	57.5	34	—	38*	—	—
64.1.862	—	—	—	50	—	20	27
64.1.876	—	57.5	31	—	38.5	—	—
64.1.942	—	53	30	—	37	21	—
	—	53*	29	—	34*	22	—
64.1.1122	—	53.5	—	—	37.5	—	—
	—	51.5	27	—	32.5	—	—
	—	47	26.5	—	33	—	—
	—	51	—	—	34.5	—	—
	—	49.5	—	—	33.5	—	—
	—	55.5	—	—	36.5	—	—
64.1.1123	—	—	—	51	—	20	28.5
	—	—	—	61	—	22	31
64.1.1338	—	52	—	—	33	—	—
65.1.36	176.5	56	32	59.5	38.5	19.5	31.5
65.1.38	—	49.5	27.5	—	33.5	—	—
	—	58*	32.5	—	—	—	—
65.1.39	—	56	—	—	34	—	—
65.1.40	—	—	—	53*	—	19	28
	—	—	—	60	—	22	32
	—	—	—	65	—	23	34
65.1.41	—	—	—	51	—	—	27*
65.1.328	—	49.5	—	—	34	—	—
66.1.13	—	56.5	—	—	36.5	—	—
66.1.147	—	47	25	—	32	—	—
	—	46.5	—	—	31.5	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	—	50	—	—	31	—	—
66.1.148	—	—	—	67	—	22	32
66.1.233	—	50	—	—	30	—	—
	—	56	32	—	34	—	—
66.1.234	—	—	—	52.5	—	21	24
66.1.282	—	57	—	—	33	—	—
66.1.431	—	—	—	52	—	—	28.5
	—	—	—	53	—	—	29.5
	—	—	—	54.5	—	—	29
	—	—	—	55	—	—	30
	—	—	—	55	—	—	31
	—	—	—	52.5	—	—	30.5
	—	—	—	55	—	—	30
	—	—	—	59	—	—	29
	—	—	—	61	—	—	31
	—	—	—	63	—	—	30.5
	—	—	—	53	—	—	30
	—	—	—	60.5	—	—	31*
	—	—	—	65	—	—	32.5
	—	—	—	58*	—	—	31.5
	—	—	—	59.5	—	—	30.5
	—	—	—	64.5	—	—	31
	—	—	—	65	—	—	33
	—	—	—	58	—	—	31
	—	—	—	66	—	—	33*
66.1.497	185	54	30.5	57.5	37.5	20.5	31
66.1.498	—	54	—	—	34	—	—
66.1.541	—	52	29	—	35	19.5	—
66.1.542	—	—	—	49.5	—	—	27
66.1.601	—	—	—	52.5	—	—	28.5
	—	—	—	51	—	—	28.5
	—	—	—	64	—	—	33
66.1.1112	—	64.5	39.5	—	38	—	—
66.1.1113	—	—	—	63	—	20.5	32.5
66.1.1114	—	—	—	52.5	—	—	28
58.3.69	—	59.5	30	—	37	—	—
59.9.2	—	—	—	60.5	—	23	32.5
59.6.31	—	52	31.5	—	33.5	—	—
	—	61	34	—	36.5	—	—
59.6.271	—	57	—	—	41	—	—
59.8.13	221	61	33	63	40	23	33.5
63.3.73	—	58	33	—	36	—	—
	—	58	33	—	36.5	—	—
	—	54	—	—	36	—	—
63.3.75	—	—	—	47	—	18	26
	—	—	—	56	—	20.5	31
	—	—	—	62.5	—	23	33
	—	—	—	50	—	19.5	28
	—	—	—	57.5	—	21	31
	—	—	—	63	—	—	33
	—	—	—	62.5	—	22	32.5
	—	—	—	53.5	—	19	28

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	—	—	—	66	—	—	33.5
	—	—	—	60*	—	—	31*
	—	—	—	55*	—	21	30
68.1.22	—	68*	—	—	40*	—	—
68.2.9	—	58	—	—	35	—	—
68.2.95	207	60*	32	63*	37	23.5	36
68.2.273	—	62*	—	—	38	—	—
68.2.349	—	65	—	—	41.5	—	—

Femur

Measurements: 1. length to the trochanter major
2. length to the caput
3. breadth of proximal epiphysis
4. smallest breadth of diaphysis
5. breadth of distal epiphysis
6. diameter of proximal epiphysis
7. smallest diameter of diaphysis
8. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7	8
Iron Age								
Mezőcsát—Hörcsögös								
64.13.3.Z	327	315	103.5	32.5	86.5	50.5	32.5	103*
64.13.8.Z	307	292	101	29	76.5	—	29	103
Avar period								
Halimba								
65.10.34.Z	—	380	—	38	—	—	40.5	—
65.10.36.Z	313*	303	100*	32	82	73	34	104
65.10.62.Z	—	301	—	30	76	—	32	102
62.45.2	365	343	118	34	—	70*	35.5	112
62.45.7	—	—	—	26	66	—	29	92
62.45.12	—	346	—	32.5	92*	—	36	—
62.45.13	358	344	119	33	92	70	34.5	119
62.45.16	—	295	—	30	—	—	33	—
62.45.27	361	339	111	32	89	90	35	—
62.45.50.a	—	292	—	31	—	—	34	—
62.45.71	—	318	—	31	—	—	33	—
65.10.68.Z	363	341	115	31	90	72	32	123
65.10.79.Z	355*	—	—	35.5	92	—	36	120*
65.10.82.Z	340*	—	—	32	—	—	32.5	—
65.10.81.Z	—	293	—	31	—	—	32	—
65.10.43.Z	—	284	91	28	78	53	31	103
65.10.88.Z	330*	312	104	30	81	—	33	—
65.10.85.Z	340*	323*	—	32	—	—	34	—
65.10.115.Z	315*	291	105*	32	80*	61	31	104
65.10.116.Z	—	318	—	34	87*	—	35	114*
65.10.147.Z	355*	336	120*	34	—	—	34	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Femur (continued)

Age/Site	1	2	3	4	5	6	7	8
65.10.169.Z	345*	328	106	30	83*	62	31	—
65.10.171.Z	—	330	—	39	—	—	38.5	—
65.10.175.Z	310	293	99	29.5	85	63	31	108
65.10.181.Z	375*	360*	125*	36	—	63	40	—
Kiskunmajsa—Kőkút	337	319	112*	32	84	69	33	119
	—	321	—	32	86	66	33	120
Szentes—Kaján								
61.36.2	300*	284	93*	30	—	—	30.5	—
61.36.7	327	—	—	29	—	—	34	107
10th—13th century								
Csongrád—Felgyő	—	322	—	34	—	—	34.5	—

Tibia

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Békásmegyer—Vöröscsillag TSz (Cooperative)	—	—	—	75	—	—	54
	—	—	—	65	—	—	47.5
Neszmély—Tekerespatak	—	—	—	62	—	—	47
	—	—	—	65.5	—	—	49
	—	100	—	—	90	—	—
	—	—	—	60	—	—	47.5
	—	—	—	64	—	—	48
	—	—	—	61	—	—	45
	—	105	—	—	98	—	—
Röszke—Ludvár	—	—	—	58	—	—	46*
	—	—	—	67	—	—	48*
Tiszaluc—Vályogos	—	—	—	62	—	—	46.5
Copper Age							
Aszód—Papi földek	—	—	—	66.5	—	—	48*
	—	—	40	65.5	—	27	49
	—	—	—	66	—	—	50
	—	—	35.5	61.5	—	29.5	—
	—	—	—	60.5	—	—	46
	—	—	—	66	—	—	49.5
	—	—	—	62	—	—	48
	—	—	—	57*	—	—	45
	—	—	—	66	—	—	45.5
	—	—	—	67	—	—	49.5
	—	—	—	65	—	—	47
	—	—	—	63	—	—	48
	—	—	—	64	—	—	49
	—	—	34	57.5	—	28.5	41.5
	—	—	—	62.5	—	—	46.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	—	—	61.5	—	—	47.5
	—	—	—	58.5	—	—	46
	—	—	—	66.5	—	—	48
Békásmegyer—BUVÁTI	—	—	—	61	—	—	43.5
Kenderes—Kulis 62.22.97	—	—	—	63.5	—	—	49
Szabadszállás—Ágostonhalmi dűlő (Baulk)	370*	—	40.5	64.5	—	27.5	49.5
	370	—	41	65	—	27	50.5
Bronze Age							
Békés—Városerdő 53.1.4	—	—	35	47.5	—	24	42
	—	—	32	51	—	—	36
	—	—	—	60	—	—	41
	—	—	—	54	—	—	39
	—	—	—	63	—	—	46
	—	—	—	52.5	—	—	38
	—	—	—	49	—	—	37
	—	—	—	63	—	—	45
	—	—	—	53	—	—	38.5
	—	—	33	53	—	—	42
	—	—	—	53.5	—	—	41
53.4.6	—	—	34	53	—	23	38.5
	—	—	—	54	—	—	43
53.4.373	—	83*	—	—	89	—	—
	—	—	—	—	90	—	—
53.4.374	—	—	38	62.5	—	25	44
	—	—	32	52	—	23	34.5
	—	—	35	54.5	—	24	40.5
	—	—	—	57.5	—	23	41
	—	—	31	56	—	22	41
	—	—	36	—	—	24	42
	—	—	—	58	—	—	43
	—	—	—	54.5	—	—	41
	—	—	—	65	—	—	50
	—	—	—	57	—	—	41
53.4.375	—	—	—	67	—	—	47
53.4.376	—	—	—	64	—	—	48
56.20.114	—	—	—	62	—	—	44
56.20.269	—	—	29	51.5	—	24	40.5
56.20.318	—	—	—	63	—	—	45.5
	—	—	—	51	—	—	36.5
	—	—	—	50.5	—	—	36.5
56.20.427	—	—	—	56.5	—	—	—
56.20.677	—	—	—	56.5	—	—	43
56.20.689	—	—	—	53	—	—	39
	—	—	—	54	—	—	42*
	—	—	—	53	—	—	42.5
60.7.7	—	—	—	63.5	—	—	45
60.7.139	—	—	34	54	—	24.5	39
	—	—	—	57	—	—	42.5
60.7.298	—	—	—	52.5	—	—	37.5
60.7.435	—	—	—	61	—	—	46

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
62.19.263	—	—	—	60.5	—	—	46
62.19.381	—	—	—	63.5	—	—	47
Csepel—Háros	—	—	—	72.5	—	—	53
	—	—	—	61.5	—	—	45.5
	—	—	—	55	—	—	41*
	—	—	—	59.5	—	—	43
	—	—	—	56*	—	—	42*
	—	—	—	65	—	—	48
	—	—	—	65	—	—	47
	—	—	—	68	—	—	50
	—	—	—	57.5	—	—	40*
	—	—	—	68.5	—	—	49.5
	—	—	—	56.5	—	—	45
	—	—	—	64	—	—	50
	—	—	—	71	—	—	52
	—	—	41.5	65	—	27	46.5
Dunaújváros—Koszider							
505.d	—	—	—	56	—	—	40
848.c	—	—	—	63	—	—	48
862.c	—	—	40	63	—	27.5	46.5
873.b	—	—	34	55	—	24	39
888.e	—	—	32.5	56	—	—	40
893.d	—	—	37	59	—	24	43
904.d	—	—	—	74	—	—	51
913.d	—	—	42.5	66	—	29	47.5
932.e	—	—	—	50	—	—	39
954.d	—	—	34.5	59.5	—	—	41
	—	—	—	62	—	—	43
959.c	—	—	—	66	—	—	48
974.c	—	—	38	60	—	25	40
980.a	—	—	—	62.5	—	—	48
987.d	—	—	—	58	—	—	42
992.d	—	—	—	68	—	—	49
995.c	—	77	—	—	72	—	—
1005.f	—	—	39	61	—	27	47
1009.d	—	—	—	63.5	—	—	47.5
1017.c	—	—	34	58	—	26	41
1024.d	—	—	—	65	—	29	49
1056	—	—	—	64.5	—	—	46
55.9.10	—	—	—	47	—	21	33
55.9.24	—	—	—	53.5	—	—	42.5
Nyergesújfalu—Téglagyár (Brick-yard)	—	—	—	57	—	—	45
	—	—	39	65	—	29	47.5
	—	—	—	64	—	—	47.5
	—	—	—	60	—	—	43.5
	—	—	—	64	—	—	43
	—	—	—	57.5	—	—	41
	—	—	37	56.5	—	25	40
	—	—	—	62	—	—	48
	—	—	—	58	—	—	43
Tápiószele—Tűzköves							
242.a	—	85	34	—	77	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
244.b	—	—	—	66	—	—	48
253.e	—	—	34	62	—	25	46
254.d	—	—	38	60	—	26	44
1116.b	—	—	—	72.5	—	—	51.5
1143.c	—	—	—	66.5	—	—	47
	—	—	—	62.5	—	—	46
1143.e	—	—	—	67	—	—	47.5
1163.f	—	—	—	56	—	—	42
1187.d	—	—	—	61	—	—	44
1189.a	—	—	32	52	—	22	37.5
1189.b	—	—	35	—	—	22	—
1189.c	—	—	33	57	—	24	42
1193.b	—	—	33	52	—	23.5	39
1217.c	—	—	—	62	—	—	46
Tarnazsadány – Sándorrésze	—	—	—	63.5	—	—	48.5
Tiszaluc – Dankadomb	—	—	40.5	63.5	—	27	47.5
	—	—	—	62*	—	—	47
	—	—	41	67	—	30	51
	—	—	—	68	—	—	48.5
	—	—	—	55	—	—	42.5
	—	—	—	62.5	—	—	45*
	—	—	—	61	—	—	46
	—	89*	—	—	80*	—	—
	—	—	—	57	—	—	45.5
	—	—	37.5	60	—	25.5	44.5
	—	—	—	63	—	—	46.5
	—	—	—	55.5	—	—	42
	—	—	—	69	—	—	50.5
	—	—	—	64	—	—	48
	—	—	43	65.5	—	28.5	51.5
	—	—	—	68	—	—	52
	—	—	—	58.5	—	—	45
	—	—	—	65	—	—	47
	—	—	—	65*	—	—	48
Iron Age							
Helemba-Sziget (Island)	—	—	—	61.5	—	—	47
	—	—	—	63.5	—	—	45
	—	—	—	55	—	—	41
	—	—	—	62	—	—	47
	—	—	—	62	—	—	46.5
	—	—	—	51*	—	—	40*
	—	—	36.5	59	—	25.5	42*
	—	—	—	55.5	—	—	41
	—	—	—	60.5	—	—	44.5
	—	—	36.5	62.5	—	26	46
	—	—	—	62	—	—	44*
	—	—	—	57.5	—	—	43
Szilvásvárad – Töröksánc	343	—	38	62*	—	25.5	47*
Period of the Roman Empire							
Budapest – Albertfalva	369	—	39	61	—	25.5	49
	390	—	43	67	—	29	51

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Tibia (continued)

Age/Site	1	2	3	4	5	6	7
Pilismarót – I. őrtorony (Watch tower)	—	—	—	64	—	—	48
	302	—	31.5	53.5	—	22	41
	—	—	38.5	62.5	—	26	45.5
	—	—	—	72*	—	—	54*
Tokod – Erzsébet akna (Shaft)	—	—	—	52	—	—	37.5
	—	—	—	61	—	—	45.5
	—	—	—	70	—	—	51
Migration Period							
Apagy – Barucha J. földje (J. Barucha's land)	—	—	—	62.5	—	—	45
	—	—	—	64	—	—	47.5
	—	—	—	65.5	—	—	48
Tiszavasvári – Paptelekhát							
62.389.4	—	—	32	53*	—	22.5	41*
62.395.1	—	—	33	54	—	25.5	40
62.488.1	—	—	—	53	—	—	39
62.538.2	—	—	36	57	—	24.5	42.5
Avar period							
Halimba							
65.10.26.Z	303	—	32	—	—	21	39
65.10.101.Z	292	80	28.5	51	—	20	36
65.10.102.Z	303	83	31	53	75	22	40
Kiskunmajsa – Kőkút	319	86	36	58	84	24	42.5
	321	87	36	57	84	24.5	43.5
14th – 17th century							
Visegrád 59.1.14	354	—	35.5	57	—	24	48.5

Astragalus

Measurements: 1. greatest length
2. greatest breadth
3. greatest height

Age/Site	1	2	3
Neolithic			
Gyálarét	57*	36	32
	62*	42	35
	76	53.5	46
Hortobágy – Árkusi Á.G. (State Farm) 61.24.4	66	46.5	38
Jászberény – Cserőhalom 62.11.7	66	46*	39.5
Kisköre 63.10.27	72	48	43
Neszmély – Tekerespatak	74	50	41
	70	47.5	41
Tiszaluc – Vályogos	69	46	37
	67.5	44	40
	70	48.5	40.5

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Astragalus (continued)

Age/Site	1	2	3
Copper Age			
Aszód—Papi földek	77	50.5	45
	62.5	42.5	36
	65.5	44	38.5
	72	49	43
	69	43.5	40
	66.5	44	38
	68.5	47.5	38.5
	74	50	44
Békásmegyer—BUVÁTI	64	42	37.5
	64.5	43	35.5
	71	52	40
	72	53	41
	72*	49	42
Fertőrákos—Golgota	68.5	47.5	41.5
	68.5	—	—
	73.5	50.5	43
Kenderes—Kulis 62.22.77	76	51	43
Szabadszállás—Ágostonhalmi dűlő (Baulk)	71.5	50.5	40
	71.5	50	40.5
Bronze Age			
Aszód—Gépállomás (Machine station)	58.5	40.5	34.5
Békés—Városerdő 53.4.15	58.5	38	30
	—	45	35
	62	—	—
	—	39	·31
	67	47	38
	61.5	40	33
	66.5	46	35
	71	50.5	39
	67	43	37
	59	37	32.5
53.4.379	66.5	46	36
	58.5	38.5	31.5
	59	42	32.5
	58.5	39	30
	60	39	22
	64	44	33
	64	44	34
	63	42.5	34
	72	50	40.5
	68	40	37
	64.5	43	38
	70	43	40
	72	48	40
53.4.379	65	44	36
	69	47.5	37.5
	62	42.5	34.5
	—	—	37
53.4.380	63	—	35.5
56.20.36	57	42	33

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
56.20.319	58	39	35
	62	—	35
	63	—	—
56.20.419	62.5	43	37
	66	44.5	38
56.20.523	65.5	43	39
56.20.607	64	41.5	38
	64.5	46	36.5
56.20.690	60	—	—
58.18.67	64	44	38
	63	43	37
	57	39	33
	63	43	38
	62*	42	36
	57	36	32.5
	68	47.5	39
	66	52	41
	69	49	40
	69	47	39
	63*	45	—
	60*	41	32
	—	45	37
	—	43	37.5
60.7.9	59	—	—
60.7.178	67	48	37.5
60.7.279	59.5	41	37
60.7.562	61	40	34.5
60.7.662	65	48	39
60.7.697	57.5	39.5	34.5
62.19.15	70.5	51	39
	57	39	35
	57	—	—
62.19.139	60.5	42	35
62.19.264	60.5	41	35.5
	64	45	37
62.19.334	67	46	38
Budapest—XI. Sztregova utca (Street)	67*	45.5	40*
	59	38	34.5
	60	39	—
	60	43	34.5
	67.5	46.5	39.5
	74*	48*	—
Csepel—Hajós utca (Street) 37	64.5	43	36.5
Csepel—Háros	78	52.5	47.5
	72*	48	39
	71	49	42
	68	45	38.5
	72	50*	—
	63.5	44	38
	68*	46	39
	78*	56.5	—
	70	44.5	42.5

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Astragalus (continued)

Age/Site	1	2	3
	65.5	45.5	38.5
	71	53	40.5
	58	40.5	35
	61	41.5	25.5
	66	45.5	39
	68	45.5	37
	63	41.5	37.5
Dunaújváros — Koszider			
502.b	71	47	39
864.d	73	50	41
	63	46	36.5
	66	45.5	36
870.e	62	41	37
880.3	63	43	36
906.d	65	47	38.5
925.b	66.5	43	37
950.e	—	43	32
953.d	59	42	33.5
	59	40	33.5
	54	36	31
959.d	62	43	34
970.d	70	47	39
980.b	67.5	47.5	36
	64	45	36.5
991.d	61	—	35
992.e	66	48	36.5
1017.d	69	49	39
1024.e	75.5	51.5	41
1025.b	61.5	42	34
1067.f	55	39	31
Füzesabony			
643.c	62	44	36
58.17.15	59	40	36
Hódmezővásárhely — Kovács tanya (Farm)			
55.52.19/a	62	43	37
Mezőkomárom — Alsóhegy	65.5	44	38
	63.5	40.5	37
Nyergesújfalu — Téglagyár (Brick-yard)	63	41.5	37
	69.5	50	40
	62	41	37.5
	70.5	47	40.5
	62	39.5	36
	64*	47	38.5
	72	49	43.5
	61	39.5	33.5
	60.5	42.5	36
	64	48	40.5
	68.5	47	38.5
	61.5	38.5	35
	60.5	40	35
	68.5	48	42
	58	38.5	32.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
	60	41.5	34.5
	70	49.5	38.5
Süttő – Hosszúvölgy			
62.44.19	64*	46	38
62.44.92	62	41*	34
	63.5	43	38.5
	64	44	39
62.44.112	61	40	35
	59	39	33
62.44.162	64	43	37
62.44.228	62	43	36
62.44.310	66	45.5	39
62.44.506	62	38	34.5
	65	46.5	39
	60*	40*	—
	60*	—	33*
	62*	40	—
	61.5	—	—
62.44.513	62.5	40.5	36.5
62.44.572	65	42	39
62.44.687	63*	42	36
62.44.741	67	45.5	39.5
62.44.872	56	38	32
62.44.904	61	43	34
62.44.931	72	51	39.5
62.44.999	71	53.5	42
Tápiószele – Tűzköves			
241.d	66	45	38
251.d	71	48	41
254.e	70	47	39
1116.d	67	47.5	38.5
1129.e	67	45.5	38
1144.b	71	49	41
	67.5	43	37
1164.a	68	47.5	38
	68	50	38
	74	51.5	—
1189.d	75	52.5	42
	60	41.5	34
	57.5	41	34
	65.5	42.5	37
Tarnazsadány – Sándorrésze	62	42.5	37
	69.5	50.5	39
	67*	46.5	40
Tiszaluc – Dankadomb	71.5	48.5	43
	71	49.5	41.5
	73*	49	40.5
	65	43.5	36
	68.5	48.5	40.5
	66.5	47	40
	76	54.5	—
	70.5	48	39.5

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Astragalus (continued)

Age/Site	1	2	3
	72.5	49	41
	70	46.5	40.5
	60	39.5	36
	64.5	44.5	38
	71.5	46	38.5
	70	50*	40.5
	68	47.5	40
	66.5	44.5	38
	68	47.5	41.5
	70.5	49	40
	70	49.5	39.5
	70.5	45.5	39.5
	64	43	36
	66.5	46	39.5
	68.5	50	40.5
	71.5	51	42
Iron Age			
Budapest—Remete barlang (Cave)	64	47	37
Felsőtárkány—Várhegy	60.5	40	33
	56	36	31.5
	63.5	43	36
	58	38.5	33
	62	43	38
	58.5	41	32.5
Helemba—Sziget (Island)			
	56	38.5	31.5
	58.5	39.5	37
	64	43.5	37
	71.5	48	42
Koroncó—Tószer dűlő (Baulk)	61.5	43	35
Mezőcsát—Hörcsögös 64.13.5.Z	61.5	39.5	34
Óhuta—Nagysánc			
	59*	39	—
	68	45	39
	55	38.5	32
	63	42.5	35.5
Szilvásvárad—Töröksánc 63.8.18	68	47*	42*
Velemszentvid	63	42.5	37
	72	48.5	—
	71	49	42.5
	75.5	51.5	45
Period of the Roman Empire			
Balatonaliga			
716.c	62	39	36
622.f	65	46	38
Budapest—Albertfalva	65	45	39
	73	50	43
	75	52.5	44
	60	44	34
	64	44	36.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
	70	50.5	42
	72	50	43
Dömös – II. őrtorony (Watch tower)	59	43.5	34.5
Pilismarót – I. őrtorony (Watch tower)	62.5	40	38
	55.5	37.5	32
	62	42.5	37
	75.5	51	44
Tokod – Erzsébet akna (Shaft)	54.5	36.5	32
	64	44	37
	60.5	40	33
	71	50.5	43
	72.5	50.5	43.5
	71*	48.5	41.5
Migration Period			
Apagy – Barucha J. földje (J. Barucha's land)	68.5	49	41
	70	47	40
	76	52	43.5
	77.5	55	—
Garadna 60.12.7	56	39	33.5
Szilvásvárad			
63.7.53	55	35	32
63.7.262	62*	—	—
63.7.442	60.5	41	34
	67	48	40
	67	47.5	39
63.7.498	61.5	41	36
Tar 60.6.6	57.5	38.5	—
Avar period			
Halimba			
65.10.27.Z	55	39	32
65.10.63.Z	57	37.5	33.5
65.10.103.Z	58	40	33.5
Tiszavasvári – Koldusdomb			
grave 19	66	47	41
grave 21	60	44	36
grave 19	68	59	40
10th – 13th century			
Doboz – Hajdúirtás			
64.8.97.Z	54	35.5	32.5
64.8.123.Z	56	38.5	33
Kardoskút – Hatablak			
56.1.137	62	43	36
56.1.224	56.5	40	—
58.4.288	63	44	36
Tiszalök – Rázom			
280.c	69	44	38
287.d	64	43	34
309.d	62	45	35
373.e	61	46	35

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Astragalus (continued)

Age/Site	1	2	3
414.e	—	38	35
416.e	58	40	36
426.e	58	40	34
818.e	56	37	22
14th—17th century			
Buda—Vár—Pasa palota (Castle, Pasha's Palace)			
	55.5	37.5	31.5
	60	—	—
	62	40	35.5
Fonyód			
63.3.14	63.5	43	—
63.3.283	57.5	39.5	32
	66	45*	—
	67	—	—
Kőszeg—Vár (Castle) 63.6.106	57.5	37.5	35
Nagyvázsony—Csepely			
61.21.146	62	45	36
61.21.244	62.5	42.5	36
Túrkeve—Móricz			
54.3.10	60	43	34
54.3.119	63	—	—
54.3.146	62.5	44	36
54.3.286	55	37	30.5
	65	44	35
54.3.804	55.5	35	31
54.3.850	60	39	33
54.3.868	58	40	33
54.3.888	—	43	35
55.20.39	56	39	33
Visegrád			
58.3.41	66	44	37
58.3.213	55	36.5	32
60.8.108	56	—	—
60.9.19	54.5	37	31
60.16.7	58	37	33
60.21.153	61	—	—
60.21.172	64	44.5	37.5
61.1.139	60	41.5	35.5
61.1.415	65	47	40
61.1.673	59	39	33.5
	59	42.5	35.5
	61.5	41	35.5
	61.5	41.5	34.5
61.1.841	65.5	44.5	36
61.1.882	59.5	40.5	34
	69	46	36.5
61.1.1038	60	39	33.5
61.1.1817	67*	—	—
61.1.1920	56	37.5	32
61.1.2128	69.5	49.5	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
61.1.2227	68	43.5	38
61.2.54	60	41	35
	62	40.5	34.5
62.1.175	68	45	39
	64	—	35
	65	45	—
62.9.10	70	49	42
	62.5	—	—
63.3.92	65	44.5	38
	65.5	45.5	38.5
	64.5	44.5	36.5
	64*	44.5	35
	63	42	37.5
	67	45.5	37.5
	55	39	—
	58	39.5	33.5
	65.5	45	35.5
	59	40.5	34.5
	67*	—	—
	63.5	44	38
	65.5	42	37
	64	45.5	37
63.5.62	65	42	37
	57	39	34
	57.5	40	33
63.5.329	59	40	33.5
	57.5	40	34.5
	56.5	40.5	35
	66.5	48	38.5
	59	38	31
	59.5	—	33.5
	59	37	32
	58.5	41	33.5
	60	41.5	34
	59	43	35.5
	54	37	32.5
	60	—	35.5
68.2.186	69	45.5	—
68.2.278	63	44	35
68.2.352	64	42	34.5
	70*	49	—
	72*	47	—
68.2.675	60	39	33
68.2.969	62	41	36
	64	45.5	37

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Calcaneus

Measurements: the same as those of the astragalus.

Age/Site	1	2	3
Neolithic			
Dévaványa—Sártó	150	51	56
Gyálarét	145.5	50.5	54.5
Neszmély—Tekerespatak	133*	45	57
	145	43.5	58
Copper Age			
Aszód—Papi földek	144	46	62
	150	49	58
	141	—	—
	143	48	—
	145	49	47
	136	43	52
	141	47	52
Fertőrákos—Golgota	118*	—	—
Szabadszállás—Ágostonhalmi dűlő (Baulk)	142	50	60
	142	48	59
Tiszaszőlős—Csákányszeg 62.6.176	115*	41	51
Bronze Age			
Békés—Városerdő	115	34	41
53.4.16	124	36.5	39
	139	—	49
	116	35.5	36
	125	39	47
	138	45	44
	121	36	41
	123	39	45.5
	132.5	39	46
53.4.17	—	36	44
	—	—	48
	—	45	37.5
	—	44	53
	—	38	40
53.4.382	120	38	37
	—	39	46.5
	118	—	—
	—	46	47
	115	37	46
	—	53	60
	—	53	53
56.20.151	—	46	49
	—	40	40
56.20.202	—	38	46
56.20.320	112	37.5	46
56.20.420	125.5	41.5	48.5
56.20.421	—	49	58
	—	48	56
56.18.68	116	36	42
	111	33	42
	—	36	42
	—	—	38

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
62.19.265	—	36*	45
	—	38	46
	—	41	46.5
	—	43	48*
Csepel — Háros	137	43	55
	142*	50	—
	138	47	49
	140	49	58
	142	46	61
	151	51	62*
Dunaújváros — Koszider			
850.e	—	42	47
878.b	—	48.5	54
893.e	128	37	53
902.d	137.5	47	—
911.d	122	44	—
	128	42	50
959.e	113	41	48
980.c	128	40	—
1065.d	—	48	47
Füzesabony 643.d	—	45	51
	—	40	47
Mezőkomárom — Alsóhegy	142	—	—
	132	46	58
	—	48	56
Süttő — Hosszúvölgy	117.5		
62.44.44	131	37	51
62.44.198	—	46	51
62.44.443	126	39	43
62.44.534	117	40	—
62.44.587	133	—	—
62.34.755	132*	43	54
62.44.873	148	43*	—
62.44.1012		46	53
Tápiószele — Tűzköves			
238.c	—	42	49
239.c	—	51	60
265.e	—	41	52
1116.e	—	47.5	51
1129.f	—	41	48
1144.c	—	49.5	49
1167.c	133	45	49.5
Tiszaluc — Dankadomb			
	143	51.5	62
	128	44	53.5
	138	45	55
Valkó — Erdőgazdaság (Forestry) 55.6.19	116	40	44
	120	39	42

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
Iron Age			
Budapest—Remetebarlang (Cave)			
	—	39	40
	131	43	44
Helemba—Sziget (Island)	153*	—	—
Jászfelsőszentgyörgy—Turóczi tanya (Farm)			
62.1.37	116*	39	41*
Mezőcsát—Hörcsögös 64.13.6.Z	122	39	51
Óhuta—Nagysánc	124*	42.5	48.5
Period of the Roman Empire			
Balatonaliga			
599.2	—	53	58
599.b	—	34	42
608.e	141	46	50
608.f	132	41	—
Budapest—Albertfalva			
	151*	48	55
	115	35	49
	116	35	49
	117	38	43
	141	44	52
	141	46	54
	117	40	45
	139	49	54
Pilismarót—I. őrtorony (Watch tower)	120	35	—
Tokod—Erzsébet akna (Shaft) 56.19.3	112*	37.5	47
	155	54	54
Migration Period			
Apagy—Barucha J. földje			
(J. Barucha's land)	134	48	53
	145	49	54
Arka 62.34.59	123	42	47
Tiszavasvári—Paptelekhát 62.423.3	117	40	49
Avar period			
Bokros—Fehérkereszt	—	37	41
Dóc—Balástyai bekötőút			
(Balástya approach road) 62.7.18	135	42	55
Halimba			
62.45.57	114	38	47
62.45.59	126	40.5	49.5
62.45.80	117.5	41	49
65.10.22.Z	113	—	—
Mohács—Téglagyár (Brick-yard) 26	110	30	48
Tiszavasvári—Koldusdomb			
grave 1	125	40	38
grave 21	117	40	—
10th—13th century			
Csongrád—Felgyő 56.10.85	—	46	59

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3
Kardoskút – Hatablak 58.4.84	115	36	42
Tiszalök – Rázom			
290.d	—	38	42
312.r.	—	—	51
362.c	—	40	50
407.c	120	40	44
435.e	—	39	43
826.f	—	41	45.5
14th – 17th century			
Fonyód			
63.3.284	122	41	—
63.3.361	143	44	58
Kőszeg – Vár (Castle) 63.6.108	104	34.5	44
Túrkeve – Móricz 54.3.748	137	43	54
Visegrád			
58.2.2	132	42	51
58.3.13	119	39	47
58.3.342	133	—	—
58.3.214	109	36	33
59.6.42	114	38	43
	128	37	49
59.6.43	—	45	53
59.6.44	—	42	53
59.9.11	133	42	54
59.10.18	113	—	58.5
	115	39	46
59.11.26	116	37.5	43
60.1.39	124	48	57.5
60.3.9	140	—	52
60.17.350	147	—	—
60.21.35	115	—	—
60.21.162	115	40	38
61.1.141	125	41	52
61.1.257	129	44	48
61.1.353	113	39	47
61.1.418	132	—	—
61.1.479	125	40	51
	131	40	50
	138	—	—
61.1.842	121	38	47
61.1.113	129	47	49
	130.5	43	51
61.1.1586	127	42	51
61.1.22 28	125	40	49
61.2.56	123	—	—
62.1.45	155	—	—
62.1.414	122*	—	—
	125*	—	—
62.9.12	124.5	—	—
63.1.28	113*	—	—
	116*	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Calcaneus (continued)

Age/Site	1	2	3
63.1.29	119	40	50
63.3.96	124.5	38	—
	135	44	43
	123.5	40	47
	130	45	—
	138	48	53
	136	43	53
	134	43	—
	118	—	—
	126	42	47
	135	42	—
	119	—	—
63.4.78	116	41	—
63.5.64	123	41	51
63.5.331	124	37.5	48
	139	43	—
	135	46	50
	122	—	48
	139	43	—
	119	36	44
	119.5	39	49
	118	36	41
	125	41	50
	123	39	43
	120	40	40
64.1.418	113.5	39.5	47
64.1.598	128	43.5	54
64.1.1030	129	—	—
64.1.1133	108.5	34.5	44.5
65.1.50	111	39.5	48
	108	35	44
	121	37	47
	128	40	—
66.1.436	113.5	—	—
	115.5	—	—
	116*	—	—
66.1.1070	130*	—	—
68.2.19	130	42	45
68.2.280	113.5	38	47
68.2.319	140	47	–
68.2.67	116	37	45

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metatarsus

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Békásmegyer—Vöröscsillag TSz							
(Cooperative)	220*	—	26	55	—	24	31
Dévaványa—Sártó							
61.16.2	—	—	—	57	—	—	35
Röszke—Ludvár	—	55	—	—	51.5	—	—
	—	48.5	—	—	43	—	—
Copper Age							
Békásmegyer—BUVÁTI	233	53.5	31	59.5	53	27.5	32
	212	—	26.5	52.5	—	24	30
Szabadszállás—Ágostonhalmi dűlő							
(Baulk)	239	52.5	27	56.5	50	27	35
	239	53	27.5	—	50	26.5	34.5
Bronze Age							
Békásmegyer—BUVÁTI	202*	—	—	—	—	—	—
Békés—Városerdő							
53.4.9	197	—	22	51	—	20.5	28.5
53.4.10	—	47.5	27	—	47	25.5	—
53.4.11	—	40	20	—	35	—	—
	—	48.5	25.5	—	45	—	—
	—	48	—	—	45	—	—
	—	47.5	24	—	47	—	—
	—	47	26	—	49	—	—
	—	48	—	—	45	—	—
53.4.12	—	—	—	49	—	23	28
	—	—	—	57	—	23	29
	—	—	—	50.5	—	22.5	27
	—	—	—	58	—	25	28.5
53.4.386	210	41	23	50	40	21.5	28
	—	—	22	46	—	20.5	26
	—	42	22.5	—	41	22	—
53.4.387	—	—	25	—	—	24	—
53.4.388	—	—	19.5	—	—	17	—
53.4.390	—	45	—	—	43	—	—
	—	49	29.5	—	47	—	—
	—	51	—	—	48	—	—
	—	46	—	—	45	—	—
53.4.391	—	—	—	58	—	—	29.5
	—	—	—	65	—	31	38
	—	—	—	—	—	27	36
	—	—	—	47	—	21	26
	—	—	—	58.5	—	—	31
53.4.392	—	—	—	46	—	—	26
53.4.393	—	—	—	60.5	—	—	36
	—	—	—	58	—	—	32
56.20.115	—	—	—	57	—	—	28.5
56.20.201	—	45.5	—	—	44	—	—
56.20.287	—	—	—	65	—	—	39.5
56.20.322	225*	47	26	—	—	24.5	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
56.20.323	—	—	—	61	—	26	32.5
56.20.422	—	—	—	62	—	—	33
56.20.632	—	44.5	24	—	43	23.5	—
Csepel—Háros	—	51.5	27	—	50.5	—	—
	—	—	—	53*	—	—	32*
	—	—	—	64*	—	27	34*
	—	—	—	53*	—	26	32*
	—	—	—	64	—	30.5	38
	—	—	—	63*	—	—	38*
	—	—	—	63.5	—	28.5	35
	—	—	—	54	—	—	32*
	—	45.5	—	—	42.5	—	—
	—	—	—	52	—	22.5	29
	—	52.5	—	—	50	—	—
	—	51	—	—	48	—	—
	—	51	—	—	51*	—	—
	208	44	23	51	41.5	21.5	29.5
	—	46.5	25.5	—	45	25	—
	—	—	—	60*	—	24.5	28*
	—	—	—	47.5	—	22	28
	—	—	—	—	—	24	32*
	—	53	—	—	49	—	—
	—	—	—	65	—	29	35*
	—	—	—	63*	—	—	34*
Dunaújváros—Koszider							
503.d	214	48	28	58	45	21	35
503.e	—	—	19	—	—	21	—
848.c	—	—	—	54	—	26.5	32
858.e	—	—	—	50	—	—	28
873.c	231	47.5	26	54	44	24	29.5
873.d	—	41	22	—	41	—	—
878.c	—	57	—	—	59	—	—
882.d	—	—	—	52.5	—	27	30.5
895.d	—	—	—	51.5	—	23	29.5
906.e	197	41.5	23.5	49	40	22	27.5
	208	41	23.5	48	—	21	28
913.e	188	39.5	21	45	37	18	25
918.c	—	—	—	47	—	—	28
921.d	—	—	22	54	—	23	29
928.c	225	47.5	25	52	44	24.5	31
925.d	—	—	—	47.5	—	20.5	28.5
930.d	—	—	—	51	—	21	29.5
930.e	—	—	22	—	—	—	—
947.e	—	—	—	61	—	25.5	33
950.f	216	46	23.5	53	46	23	30
950.g	—	45	—	—	42	—	—
956.e	—	—	—	48	42	21.5	28
957.c	—	41.5	23	—	42	21	—
957.e	—	44	25	—	41.5	—	—
968.d	214	43.5	24	50	43	24	29.5
968.d	214	45	25.5	50	43	24.5	28
975.d	217	45	24	53	—	22	29.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
991.e	—	—	—	52	—	—	28
995.d	213	46.5	24	52	42.5	24	30.5
1001.e	—	46.5	—	—	42	—	—
1013.d	—	44.5	23	—	41	—	—
1013.e	—	—	—	50	—	22.5	28.5
1018.e	—	—	—	65	—	30	36
1044.e	225	53	—	61.5	44	26	33.5
1049.d	—	—	—	60	—	27	31.5
106.d	—	—	27	58.5	—	26.5	33
55.9.38	204	41	21	48.5	40.5	—	26.5
Füzesabony							
645.c	—	40	22	—	38	—	—
654.d	205	43	21	47	41	20	27
655.g	203	42	22	48	41.5	21	28
57.6.61	209	46	26	59	44	23.5	30.5
Mezőkomárom – Alsóhegy	224*	47	24	—	46	22.5	—
Nyergesújfalu – Téglagyár (Brick-yard)	230	49	25	64	47	26	33.5
	228	42.5	23*	50	40	22.5	30
Süttő – Hosszúvölgy							
62.44.165	213	43	23	48.5	41.5	23	28
62.44.166	213*	41	20.5	—	39	20	—
62.44.167	220*	48.5	28.5	57.5	46	27	32*
62.44.230	218*	44	22.5	50	41.5	23	29
62.44.250	—	—	—	66.5	—	28	35*
62.44.256	208	47	25	54*	44	22.5	30
62.44.271	—	—	—	56	—	24.5	30
62.44.320	—	41	—	—	39.5	—	—
62.44.359	—	48.5	25	—	47	—	—
62.44.497	—	—	—	48.5	—	23	28
62.44.688	—	40*	—	—	40*	—	—
62.44.761	—	—	—	61	—	25.5	33*
62.44.970	—	46.5	—	—	47	—	—
Tápiószele – Tűzköves							
1194.a	248	51	28.5	60	48	28	33
1194.b	230	53	28	61	49	27	33
1194.c	199	40	22	48	39	22	28
Tiszaluc – Dankadomb	226	46	26.5	55	45.5	24	31
Iron Age							
Helemba – Sziget (Island)							
	187*	38*	21	45.5	40	19	26.5
	203.5	44.5	22	48	40.5	21.5	28.5
	—	—	—	55	—	25.5	33
	—	—	—	53.5	—	26	31.5
	—	45.5	—	—	45.5	—	—
	—	—	—	49	—	—	27*
	—	48.5	27.5	—	47	—	—
	—	—	—	56.5	—	27	31.5
	—	46.5	—	—	46.5	—	—
	—	—	—	58*	—	24	30
	—	50.5	—	—	51	—	—
	—	—	—	54	—	25	32

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	49.5	—	—	48	—	—
Lengyel 60.27.1	207	46.5	25	—	42	22	29.5
Velemszentvid	218	50	28	56.5	48*	24.5	31*
Period of the Roman Empire							
Balatonaliga 576.e	251	53	28	61	50	27	34
Budapest—Albertfalva	229	48	27	—	47	27	—
	235*	54.5	30	63	54.5	27.5	33
	250	57.5	34.5	—	55.5	30	37
	206*	43	22.5	—	—	21.5	27.5
	228	48	24.5	54	—	25	—
	253	54.5	30.5	63	55	27	35.5
	234	56	30	—	53	29.5	—
	178	46	25	46	32	17	26
	235	—	26.5	—	51	26	34
	235*	49	26	57	49	23.5	32
Budapest—Aquincum	214	44	23	50	41	22.5	28
	216*	42.5	23.5	46.5	42.5	22	28.5
	225	50	26.5	54.5	44.5	25.5	31
Pilismarót—I. őrtorony	225	—	24	—	44.5	24	—
(Watch tower)	203*	—	23.5	49	—	23.5	27.5
Tokod—Erzsébet akna (Shaft)							
	216*	47.5	25.5	53	50	25	30*
	219	48	26.5	53*	44.5	24.5	30
Migration Period							
Arka							
62.34.28	215*	45.5	24	54.5	43.5	22.5	29*
62.34.40	205*	—	24.5	—	—	—	—
Derecske 62.43.10	242*	55	31.5	—	57	28.5	35*
Tar 60.6.7	—	47	24	—	44	22	—
Tiszavasvári—Paptelekhát 62.423.3	210*	44.5	23.5	49	43.5	22.5	29
	233*	47.5	26.5	57.5	46	25.5	31.5
	—	45.5	23	—	41	22.5	—
	—	—	23.5	—	—	22	—
Avar period							
Dóc—Balástyai bekötőút							
(Balástya approach road) 62.7.20	224*	48.5	25	55	46	25	31*
	224*	49	25	55	47	25	30
Kiskunmajsa—Kőkút	212	45	24.5	50.5	41.5	23	30
	213	45	24.5	50.5	43	23.5	30
Mohács—Téglagyár (Brick-yard)							
23.b	194	39	21	44	40	21	25
25.a	194	40	20	44	38	21	25
Szeged—Makkoserdő							
62.2.9	237*	48	25	56*	45	25.5	32*
	236	50	25	55	44.5	25	32*
62.2.19	222*	46	25	56	46.5	26	32
	222	46	25	56	46.5	26	32
62.2.27	237	53	26	61	53	26.5	34
	235	51	25	61	53	25.5	34*

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
62.2.32	216	47	24	51.5	44	23.5	28.5
	216	48	23.5	52	46	23	30
62.2.82	225*	47.4	26	55	43.5	24	31
	225	48	26	54	42	24	31
62.2.123	234*	—	26.5	58*	—	27	33.5
	234	51.5	26.5	59	48	26	33*
Szentes—Berekhát							
62.3.11	232	51	30.5	57	52.5	27	32.5
62.3.12	—	51	30.5	—	51	26.5	—
Szentes—Kaján							
61.36.3	186	40	22.5	49	37	20	26.5
Tiszavasvári—Koldusdomb							
grave 8	217	46	23.5	50.5	41	22	—
	216*	45	24	—	44	21	—
	217	46	23	50*	42	22	29
grave 19	223	49	25	55	46	24	29
	226	49	25	56	48	24	30
grave 21	215*	41*	21.5	48	39*	21	27
	214	42	24	47.5	40	21	27
grave 23	223*	41	23	49	41	22	27
	224*	—	23	49	—	22	27*
10th—13th century							
Garadna 61.18.63	222	51	25	54	—	25.5	31
Kardoskút—Hatablak							
56.1.78	—	—	—	55	—	26	30
56.1.79	—	40	21	—	38	—	—
56.1.225	—	—	20	—	—	19	—
56.1.251	202	39	22	42	—	20.5	25.5
56.1.298	—	—	—	46	—	18	24.5
58.4.148	—	—	—	47.5	—	23	27
Tiszalök—Rázom							
278.a	201	40	22	46	40	20	26
290.c	—	36	16	—	35	15	—
291.b	215	48	25	52	47	24	30
	—	—	25	—	—	25	—
295.c	—	45	23	—	42	—	—
313.d	—	—	—	47	—	—	30
345.b	—	—	—	50	—	23	28
346.c	—	42	24	—	40	—	—
407.b	—	39	21	—	35	—	—
418.b	—	40	22	—	38	22	—
420.c	—	35	16	—	33	16	—
422.d	—	—	—	47	—	20	27
829.d	223	46	25	50.5	45.5	21	28
14th—17th century							
Buda—Vár—Pasa palota (Castle, Pasha's Palace)							
	212	45*	22.5	50.5	43.5	23	31.5
	228	45	24.5	55	47.5	24.5	31
	233*	52	28.5	57	52.5	26	32

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Gyula–Vár (Castle)	221	**48.5**	27	57.5	47	24	30
	224	**45**	20	49	43	22	28
	232	**41**	24	51	41	22	30.5
	—	**47**	24	—	45.5	23	—
	—	—	24.5	—	—	25	—
	—	—	24.5	52	—	23	29
	238	46.5	24	50	46.5	22.5	28
	257	53	26	59	51	27	32.5
	—	45	27.5	—	46	23.5	—
	233	44	21.5	50.5	44	22.5	30
	212	41	21.5	48	40	19	27
	212	42	24	51	41	21.5	27
	225	—	27	—	—	25	—
	220	40.5	20	45	40	20	27.5
	227*	50	26	55.5	46	22.5	29
	240	42	25.5	—	42	21.5	—
63.1.2	230	50	27	56.5	53.5	26	31.5
63.1.14	220	42	21	46	41	21.5	29
63.1.40	227*	51	27	55.5	47.5	24	30
63.1.41	211	43	25	51.5	41.5	23	28*
63.1.42	226*	—	27.5	—	—	27	—
63.1.43	234.5	46	—	51.5	45.5	24	31.5
63.1.44	211	41.5	—	50	41	19.5	28
63.1.45	242*	42.5	26.5	—	42.5	23	—
63.1.64	218*	42	20.5	—	41.5	22.5	28*
63.1.70	232	44	22.5	52	44.5	23.5	31.5
Kecskemét–Bocskai utca (Street)	252*	51	26	57.8	48	27	32
Kőszeg–Vár (Castle)							
63.6.61	207	49.5	25	54.5	47	23	50.5
63.6.76	209	42.5	22.5	47	40	21.5	27.5
	220*	49	27	54.5	48.5	24.5	31.5
Nagyvázsony–Csepely							
61.21.13	211*	41	21	46*	39.5	20	—
61.21.149	230	49	25.5	55	49.5	24	30.5
Szolnok–Vár (Castle)							
64.7.11	237	43	23	29.5	43	23.5	30.5
64.7.12	217	43	24	26.5	40	21.5	27.5
64.7.13	227*	43.5	23.5	48.5	42	22	30
64.7.14	218	46	25	51.5	46.5	24	31
64.7.15	212*	44	24	49	41.5	23	28
64.7.16	224*	44.5	24.5	50*	41	24	30
Túrkeve–Móricz							
64.3.289	—	42	22	—	42	—	—
54.3.290	—	—	—	45	—	20.5	26
53.3.439	215	45	27	—	43	23	—
	222	42	22	—	41	21	28
54.3.440	—	45	22	—	43	—	—
54.3.441	—	—	—	49	—	24	28.5
54.3.528	217	43	24.5	49	—	22.5	—
	222	43	22.5	52	42	20	27.5
	216	43	22	48	41	20	28
	—	36	21	—	36	19.5	—

* In the tables, the approximate measurements are marked by an asterisk.

Cattle — Metatarsus (continued)

Age/Site	1	2	3	4	5	6	7
54.3.529	—	37	19	—	—	19	—
54.3.530	—	44	—	—	44	—	—
	—	37	20	—	37	—	—
54.3.531	—	—	—	47.5	—	19.5	26
54.3.646	—	39	21	—	38	19	—
54.3.670	242	53	27.5	—	50	26.5	33
	206	41	22	49	33	20	26.5
54.3.671	—	42	—	—	40	—	—
54.3.750	—	—	—	52	—	26	30.5
54.3.851	—	42	21	—	36	—	—
54.3.890	245	50.5	25	56	48	24	33
55.20.40	210*	—	25	—	—	22	—
55.20.41	—	41	19	—	38	—	—
55.20.69	218	41	22.5	—	39	20	—
Visegrád							
61.1.31	215	42	25	48	41.5	21	27
61.1.849	212*	41	22	47	39	19.5	26
61.1.1175	181	40	19	50	39	20	33.5
	212*	43*	19	44	39	19	26*
61.1.1464	214*	—	20.5	43	35	19.5	26.5
62.1.49	215*	42	22	47.5	43	22	26.5
63.1.33	200*	—	21	43	—	20	—
63.2.54	226*	47	26	56.5	44	—	32
63.5.69	217	43.5	24	47	41	22	27.5
	204	42.5	25.5	50	42.5	21	28
63.3.105	207	48.5	28.5	53	46	24.5	30.5
	224*	53	31	59.5	49	27	33.5
	222*	43.5	23.5	48.5	43	22	29
63.5.340	234*	—	—	—	—	—	—
64.1.1140	196	54.5	26.5	57	45.5	24	30
64.1.1357	224.5	45	24.5	52	41	24	29.5
60.6.34	217	41	21.5	47	40	21.5	—
66.1.287	216*	48	28	55.5	49*	23.5	30*
68.2.20	204*	44	24.5	51	43	24	28.5
68.2.159	213*	49	26.5	55*	45	23.5	30
68.2.972	206	44.5	26	50	42.5	22.5	—

Sheep — Ovis aries L.

Horn core

Measurements: 1. greatest length measured on the great curve
2. greatest diameter
3. smallest diameter
4. circumference of the basis

Age/Site	1	2	3	4
Neolithic				
Dévaványa—Sártó 55.1.1295	—	60	39	158
Győr—Pápai vám 63.10.15	—	73	53	205

* In the tables, the approximate measurements are marked by an asterisk

Sheep — Horn core (continued)

Age/Site	1	2	3	4
Kisköre	—	45	32	120
Neszmély—Tekerespatak	—	64	45	175
Röszke—Lúdvár	—	31	21	—
Copper Age				
Kenderes—Kulis 62.22.62	—	35.5	23*	95*
Székely—Zöldtelek	84	32	17	82
Tiszaszőlős—Csákányszeg				
62.6.52	106	39.5	22.5	103
62.6.54	—	40*	22	103*
62.6.293	—	41	26	111
62.6.294	—	43.5	25	114
Bronze Age				
Békés—Városerdő				
53.4.49	—	33	18	92
53.4.50	100*	—	—	—
53.4.405	—	45	44	163
53.4.406	107*	—	—	—
Csepel—Háros	—	57.5	46.5	170
	45	16.2	13.2	50
Dunaújváros—Koszider				
854.a	—	40	27	—
868.a	—	30	23.5	88
915.b	100	30	18	80
942.b	—	56	46	168
997.a	—	53	39	—
1028.a	123	44	27.5	122
1028.b	121	44	28	120
1061.a	—	48	32	133
1064.a	86	24	14	67
Füzesabony 646.a	77	42	25	109
Mezőkomárom—Alsóhegy	63	24	16.5	64
Tápiószele—Tűzköves				
269	105	37	—	93
1133.a	—	42	27	115
1150.a	57	22	17	64
1150.c	91	—	18	—
1150.d	67*	32	—	—
1165.b	—	41	29	114
1222.b	—	49	32	139
Tiszaluc—Dankadomb	100	28	20	78
Iron Age				
Helemba—Sziget (Island)	45	17.5	16	55
Velemszentvid	92*	32	20	83
	—	43.5	31	123
	80*	22	18	66
	80*	22	18	66
	—	52	45	158*
	56	28	19	78
	—	26	21	75

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4
Veszprém—József Attila utca (Street) 59.9.26	—	58*	42	165*
Period of the Roman Empire				
Budapest—Albertfalva	88*	19	14	53
	—	61*	46*	—
Nagytétény 55.3.25	90	28	—	75*
Migration Period				
Szolnok—Szanda	118	25	20	80
14th—17th century				
Gyula—Vár (Castle)	—	41	26	109
	252*	52	37	141
	140*	34	21.5	88
	—	36.5	22	92
	—	44.5	30	120
	—	49.5	35	134
	—	70	48	187
	148*	39.5	24	103
	170*	—	—	—
	148*	36	23	94
	—	42	27.5	112
	—	37	19.5	96
	—	39	26	104
	210*	46.5	30	125
61.22.1	273*	60	40	160
63.1.25	—	55	36.5	147*
63.1.34	210*	48*	34.5	140*
63.1.71	255*	50	35	140
Sárospatak—Vár (Castle) 64.10.4	—	42	29	115
Szolnok—Vár (Castle)				
64.7.17	133*	31	23	85
64.7.18	110	35	21.5	91
64.7.19	135*	32	20	88
64.7.20	135*	37.5	23	95
64.7.21	—	38	23.5	98
	175*	38	25.5	104
	—	56	41	156
	—	57	36	154
Túrkeve—Móricz 53.4.830	—	29	20	—
Visegrád				
58.3.95	127	32.5	22	92
58.3.96	118	—	—	—
59.6.390	60	—	18.5	—
60.1.60	70	22.5	21	67
61.1.680	135*	—	—	—
61.1.894	135*	—	26	105*
61.1.1350	138*	46	27	115
63.5.85	260*	—	37*	—
	270*	47	34*	133*
63.5.86	160	—	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Horn core (continued)

Age/Site	1	2	3	4
	150	—	23	—
	150*	—	23*	—
64.1.615	207	36*	25*	100*
64.1.1360	—	36.5	24	100

Scapula

Measurements: 1. greatest length
2. greatest breadth
3. smallest breadth of collum scapulae
4. breadth of angulus articularis
5. diameter of facies articularis

Age/Site	1	2	3	4	5
Neolithic					
Gyálarét	—	—	17	31	19
Röszke—Lúdvár	—	—	19	30	19*
Iron Age					
Helemba—Sziget (Island)	—	—	20.5	33	22
	—	—	21	31.5	24
Mezőcsát—Hörcsögös 65.4.26.Z	—	—	21	34	22
Avar period					
Halimba 65.10.184.Z	—	—	22	33	23
14th—17th century					
Buda—Vár—Pasa palota (Castle, Pasha's Palace)	168*	—	22.5	39	23.5
	178*	—	23.5	42	26

Humerus

Measurements: 1. greatest length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Neolithic							
Gyálarét	—	—	13.8	27	—	15.3	23.5
	—	—	—	28	—	14.5	23.8
Iron Age							
Mezőcsát—Hörcsögös 65.4.27.Z	141	42	16.5	32	42	18.5	25

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Humerus (continued)

Age/Site	1	2	3	4	5	6	7
Avar period							
Bágyog—Gyűrhegy							
grave 80.a	145	38	16	32	38	17.5	24.5
grave 80.b	—	40	14	33.5	45.5	16	29.5
Halimba 65.10.156.Z	174	—	17	32	45	17.5	27
14th—17th century							
Buda—Vár—Pasa palota							
(Castle, Pasha's Palace)	152	—	15.5	32	42.5	16.5	27
	156	42	16.5	34	48	18	29

Radius

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Gyálarét	—	29	—	—	15	—	—
	—	29	15.2	—	16	8	—
	—	31*	—	—	16	—	—
	—	35	17.7	—	17	10.2	—
	—	27	—	—	16	9.2	—
Röszke—Ludvár	—	—	—	27	—	—	18
	150	30	16	28	18	9	19.5
Iron Age							
Helemba—Sziget (Island)	139	30	16	28.5	16.5	8	—
	148	28	14.2	26.7	17	7.5	17.5
	151	31.5	18	30.5	19	9	21
	159.5	30*	16.2	30	16*	8.2	20
	170.5	34.5	21.5	33	21	11	22.5
	—	31	17	—	17.5	9	—
	—	—	—	28.5	—	—	19
Mezőcsát—Hörcsögös							
65.4.28.Z	147*	31	19.5	—	19	10	21
65.4.33.Z	—	29.5	16	—	17.5	8.5	—
Avar period							
Bágyog—Gyűrhegy							
grave 80.a	162	32	16.5	30.5	21	8	21
grave 80.a	163	33	16	30	19.5	7.5	22
grave 80.b	151	33	17	33	21	9	23
grave 80.b	150	33.5	17.5	33	20	9	23
14th—17th century							
Buda—Vár—Pasa palota							
(Castle, Pasha's Palace)	156	32	17.4	30	18.5	8.8	20
	162	32.5	16.5	32	19	8.5	21.5
	167	34.8	18	31	20	9.8	20

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Radius (continued)

Age/Site	1	2	3	4	5	6	7
	167*	33.5	17.5	34.5	21	9	22*
	172	34	16.5	33.5	21.5	9.25	24
	177	35	18.5	33.5	18.5	10.5	20.5
	191.5	37	20.5	36	21	10.5	25.5
Visegrád							
65.1.78	160	34.5	17	33.5	19	9	21
	164	36	17	32	18	10	23
68.2.23	138	30.5	16	28	17.5	8.5	19

Metacarpus

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Berettyószentmárton 56.11.297	—	20	11.6	—	—	8.4	—
Borsod—Derekegyházi dűlő (Baulk) 171	110	18	13	23	16	9	15
Dévaványa—Sártó	121.5	20	12	22.5	15	9	—
Gyálarét	—	20.8	—	—	15.7	—	—
Győr—Pápai vám 55.1.891	—	—	—	22.5	—	7.6	14.6
Röszke—Ludvár	123	22	13	24.8	16.5	9	16
	123	20	13	22.8	15.5	8.5	15.8
	—	22	13.8	—	16.3	—	—
	—	21	12	—	15.5	—	—
	—	21.5	—	—	15.5	—	—
	—	19.5	—	—	14.8	—	—
	—	23.5	—	—	17	—	—
	—	21	13	—	15.5	—	—
	—	—	—	24	—	8.5	15.5
	—	—	—	23	—	9	15.5
Copper Age							
Kenderes—Telekhalom 62.21.27	—	—	—	21.5	—	—	14.5
Kenderes—Kulis							
62.22.19	—	19.7	—	—	14.3	—	—
62.22.36	110.7	20	10.3	21	14	7.8	14
62.22.50	109	20	12.5	22.5	15.2	8	15*
62.22.105	110.8	19	12.5	22.5	14.3	7.8	14
	107*	18.5	11.4	22*	14.3	8.3	13.4
62.22.189	118.5	22.5	13	24	16	8.7	14.8
Székely—Zöldtelek	—	21.5	12.3	—	15.5	9	—
Tiszaszőlős—Csákányszeg							
62.5.19	132	22*	13.5	—	17*	9.3	16
62.5.20	—	20*	11.8	—	15*	—	—
62.7.11	120	20.2	12	22	15	8.5	15
62.6.57	117.2	22.2	12.2	24	16.3	8	16.5
	117.6	22.4	12	24	—	8	15.3
62.6.58	120	20.4	12	22	14.3	8.5	15
62.6.59	116.5	22.5	12.2	24	15.5	8	16

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
62.6.60	114*	—	12.3	23.4	—	8.5	16
62.6.61	—	22	13.6	—	16	8	—
62.6.196	—	21.5	12.5	—	15.8	9	—
Bronze Age							
Aszód—Gépállomás (Machine station)	121*	21	11.7	24*	16	7.5	14.8
Békés—Városerdő							
53.4.54	138	24.5	13	25	17.5	9.7	16.5
53.4.85	—	—	—	24.5	—	9	14
56.20.238	—	—	—	24	—	9.5	16.5
56.20.330	—	27	—	—	19.5	—	—
56.20.331	—	—	13.5	—	—	9.2	—
60.7.201	—	24.5	15	—	14.5	—	—
62.19.18	—	—	—	24	—	—	16.5
62.19.144	—	23.5	14	—	18.5	—	—
62.19.145	—	—	13	—	—	9	—
62.19.270	—	24	13.5	—	18	—	—
Csepel—Háros	133	22.3	13.2	24	16.5	9.7	16
	—	23*	14	—	16*	—	—
	—	—	—	25*	—	9	16*
	—	23*	12.7	—	16*	—	—
	—	22.5	—	—	17*	—	—
Dunaújváros—Koszider							
504.b	140	23	13	25	16	9	17
849.d	135	24	15	26.5	18	10	17
899.b	—	23	12.5	—	16	9	—
917.g	—	—	14.5	—	—	9	—
978.a	—	—	14.5	—	—	10.5	—
992.b	139	23	14.5	27	18	8.5	17
1000.e	128	23	12	24	18	9	17
1031.b	138	28	15	29.5	20	10.5	19
1031.c	—	—	14	—	—	9.5	—
1031.d	—	—	13.5	—	—	10	—
1045.e	133.5	23.5	14	26	17	9.5	16.5
Mezőkomárom—Alsóhegy							
	—	—	—	26.5	—	—	18
	—	—	15	27*	—	10	17*
	133	23.5	13.5	26.5	17.5	9	18*
Süttő—Hosszúvölgy							
62.44.170	—	22.5	13	—	16.5	—	—
	—	24	13	—	17	—	—
62.44.464	—	—	—	26.5	—	8.5	17.5
62.44.485	135	23	13	24.5	17	9	17*
62.44.536	131	23.5	14.5	26.5	16.5	8.5	16.5
62.44.757	126	22.5	12	24.5	17	8.5	15*
Tápiószele—Tűzköves							
247.e	—	24	14	—	16	10	—
250.c	—	—	15	—	18	11	—
250.e	—	24	13	—	17	10	—
250.d	—	—	—	27	—	10	18
259.d	—	21	12	—	15	8	—
1123.c	—	—	—	24	—	10.5	16.5

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
1166.f	141	24	13.5	26	17	9.5	16.5
1181.a	147	26	14.5	28.5	20	11	19.5
1181.b	—	22	13	—	17.5	10.5	—
1181.c	—	—	—	30	—	11	19.5
1207.e	—	25	14	—	19.5	—	—
1218.d	—	23	13	—	17	—	—
Tiszaluc – Dankadomb	146	25.3	14.8	28	18.5	10.7	17.8
Iron Age							
Helemba – Sziget (Island)	112*	—	12.1	—	—	—	—
	119.8	22	11.9	24	16.2	8.4	15.6
Period of the Roman Empire							
Budapest – Albertfalva	—	—	—	25	—	10.5	16.5
	—	28	15.5	—	20	11.5	—
	—	25.5	—	—	19	—	—
	—	29.5	16	—	22.5	—	—
	—	27	—	—	21	—	—
	147	27.5	16	28.5	20	12	18.5
Migration Period							
Szabadszállás – Józan	—	21.5	12.5	—	15	9.5	—
Avar period							
Bágyog – Gyűrhegy,							
grave 60	123	25.5	14.5	27	18	10	17
grave 80.a	128	25	13	25	19.5	10	16
	128	25	13	25	19	10	16
grave 80.b	132	25	14	28.5	19	10.5	17
	132.5	25	14	29	18	10	17
Oroszlány 62.31.1	124.5	24	13.5	25.5	19	9	—
	124.5	24	14	25.5	18.5	9.5	17
Szeged – Makkoserdő 62.2.33	129	23	14	27	18	16	16
	127	23	13.5	26	18	10.5	16
Szentes – Kaján 61.36.8	127.5	23	13	25*	17.5	9.5	15.5
14th – 17th century							
Buda – Vár – Pasa palota (Castle, Pasha's Palace)	144.5	25	13.2	26.2	19.5	11	18
	146.5	25.5	15	27.2	18.4	10	18.5
	—	25.5	14.1	—	19.2	—	—
	—	27	14.8	—	20	—	—
	—	27	16	—	20.2	—	—
	139	25	13.5	25	18	9.6	17
	139*	—	14.4	27.8	—	9.8	18
	139.5	25	14	26.5	19	10	18.3
	150	29.5	15.5	29.8	20	17.7	19.6
	151	29	15.7	29.8	20.5	11.7	19.6
	—	27	13.5	—	19	—	—
	—	26*	14.7	—	—	—	—
	—	27*	15	—	—	—	—
	—	26.2	—	—	20.3	—	—
	—	—	—	25.7	—	8.8	16.2

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
	137*	24.2	15.2	26.8	18	11.1	18
	140*	25	14.3	26	18.2	9	17.2
	143*	—	15	27	—	10.2	18.3
	142	26.8	15.3	29	19.2	11.5	18.2
	151*	27*	15.3	28.8	—	11.1	19.8
	—	26.2	14.3	—	18.5	—	—
	—	27	16.5	—	20.5	—	—
	—	27*	15.6	—	20*	—	—
	129.5	25	15.4	27	18	9.5	17.5
	132.5	26	15.2	29	18.5	11.8	18
	135	25.8	14.1	27.5	19.5	10	18.3
	144	25	13.8	27.7	19	11.3	17.8
	144	27	15.2	29	18.8	11.1	19
	161	29.6	17.3	31.8	22.1	11.8	19.5
	—	25.5	15.5	—	18	—	—
	—	25.5	14.8	—	18*	—	—
	—	27	15	—	20	—	—
	—	—	—	30.3	—	11.7	20.1
Fonyód 63.3.148	137	25.5	14.5	28	18	10	17.5
Gyula—Vár (Castle)							
63.1.20	146	27	14.5	28	20.5	11.5	19
63.1.21	137	25	14	27.5	17.5	10	17
63.1.30	139	25	13.8	25.5	19	9.5	18
63.1.46	147	25	14	27	18	11	18
63.1.47	149	25.5	14	27	19	—	—
63.1.62	132	24.5	13	26.5	17.5	9.5	17.5
63.1.72	148	27	16	28	20	12	18.5
63.1.73	144	—	15	28.5	18.5	9.5	—
63.1.74	124	23	14	24.5	17.5	10	16.5
	146*	27	15	28.5	19.5	12	18
	138	25	14	27.5	18	10	17
	146	27.5	15	28	20	12	19
	126	23	14.5	25	17.5	10.5	16.5
	144	25	15	29	19.5	10	—
	148	25.5	14	27.5	18	11	18
	124.5	24	15	26	19	9.5	17
	129	24	14.5	27.5	18.5	9	17
Szolnok—Vár (Castle)							
64.7.23	151	27	13.5	28	19.7	11	19
64.7.24	137	25.7	14.5	26.2	18.5	10.7	18
64.7.25	160	28.8	15.5	28.7	20.5	11.3	19
64.7.26	143	26.4	14.3	27	19	11	18.2
64.7.27	150	26	15.3	28	18.2	11	17.5
64.7.28	139	28.8	15.5	30	20	11.2	19
64.7.29	153	27.3	16.2	29.5	20	11.7	19
64.7.30	145	25.2	13.7	25.7	18.7	10	17.5
64.7.31	140	26	14.2	26.8	19	9.8	18
64.7.32	148	26.2	16	27.3	20*	11.2	18
64.7.33	136	27*	13.5	28	—	10	19
64.7.34	138	26	14.5	27	17.5	11.3	18.5
64.7.35	156*	25.5	14.5	27.2	19*	11	18.3
64.7.36	141	24.5	14	26	17.8	11.3	17.7

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
64.7.37	145	27	15.2	28	20.3	10.7	19
64.7.38	146*	27	13.2	27.7	19.8	11	19
64.7.39	155	29	15.3	31	22	13.2	21
64.7.40	143*	25.2	14.2	27	19	10.2	18.8
64.7.41	154*	—	15	28	—	10.4	18.3
64.7.42	140	24.7	14.5	25.5	18	9.7	16.2
64.7.43	140*	29*	15	28.5	20*	11	19.3
64.7.44	149	25.7	14.5	25.7	19	11.3	18.7
64.7.45	135*	24*	14.6	27	—	10	18
64.7.46	137*	—	—	28.7	—	—	17.8
64.7.47	138*	27	14.7	29	21	10.7	18.2
64.7.48	145	26.5	14	—	20	11	18
64.7.49	145	25	12.8	26	18.8	10	17.5
64.7.50	145	25	14	26.5	18	9.2	16.7
64.7.51	154	28.5	16	30.2	20.8	12	19.5
64.7.52	140	25	15	—	18.7	10.7	17.7
64.7.53	134*	—	13	26.5	—	10.3	17
64.7.54	147*	26	14.7	28.5	19	10.2	18.3
64.7.55	141*	25*	14	25.5	18*	10	17
64.7.56	151	26	14.3	28	19*	11	18
64.7.57	153	26.8	17	29.2	19	11	18*
64.7.58	143	—	14.2	27.5	—	10.5	18
64.7.59	151	25.8	14.8	26.2	19	11.2	17.7
64.7.60	140	—	14.5	27	—	11.7	17*
64.7.61	140*	—	13.5	25	—	9.7	17
64.7.62	147*	25	14.7	28	18.2	10.3	18
64.7.63	134*	—	14	25	—	10.2	16.7
64.7.64	144	24.5	13.6	27.2	19	8.5	17.2
64.7.65	145	27*	15	27	20*	11	18
64.7.66	146*	—	13.7	26.5	—	11	18
64.7.67	144*	24.3	15	25.5	18	9.7	17
64.7.68	130	24.5	14	26.5	17.5	10.3	17.8
64.7.69	150	27.5	16.5	30*	20	11.5	19*
64.7.70	155	28	17	30.5	21	11.5	20.5
64.7.71	146*	27.2	14.3	27.7	20	11.7	19*
64.7.72	157	28	17	29.8	20*	11.3	18.5
64.7.73	146*	—	13	26	—	10.7	17.5
64.7.74	134	24	14	26*	17	10.8	16*
64.7.75	150	26	15	27	18.5	—	—
64.7.76	145	26.8	14.8	28.5	19	10.5	18
64.7.77	146	26	15	27.8	20*	10.8	19
64.7.78	153	29.8	15.8	31*	23	11.3	20*
64.7.79	148	25.5	15.5	27.2	19	11	17.8
64.7.80	137	25.7	13.8	26.2	18.5	10.5	17
64.7.81	145	25.7	14.2	27.8	18.7	10.5	17.5
64.7.82	142	26	14	27*	19	10.2	18
64.7.83	146*	25	13.5	26	18	11	17.8
64.7.84	157	28.7	18.5	—	21	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Tibia

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
14th—17th century							
Buda—Vár—Pasa palota (Castle, Pasha's Palace)	228	—	16.2	29.5	46	13.3	23.5

Astragalus

Measurements: 1. greatest length 2. greatest breadth 3. greatest height

Age/Site	1	2	3
Neolithic			
Gyálarét	26.5	19	—

Calcaneus

Measurements: the same as those of the astralagus

Age/Site	1	2	3
Neolithic			
Gyálarét	63	21.5	25.5
Iron Age			
Helemba—Sziget (Island)	54	20	24

Metatarsus

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Berettyószentmárton 56.11.709	—	—	—	24.3	—	—	16.4
Győr—Pápai vám 55.1.844	130	19.5	11.5	23	19.5	9	14.8
	121	18.5	11.5	22	19.2	9	14.6
Röszke—Ludvár							
	141	20.5	11.2	24	20.3	9.2	17
	128	—	11	22.3	—	9	15.7
	—	18	10.2	—	19	—	—
	—	18.3	—	—	18.7	—	—
	—	18.5	—	—	18.3	—	—
	—	19	—	—	19.8	—	—
	—	19	—	—	20	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	20	–	—	20	—	—
	—	19	—	—	20	—	—
	—	18.5	—	—	19	—	—
	—	18.8	12	—	20.2	9	—
	—	19	—	—	19.5	—	—
	—	19	10.3	—	19.2	—	—
	—	18.2	—	—	20	—	—
	—	18	—	—	18.2	—	—
	—	19.5	11.3	—	20	—	—
	—	20.2	—	—	19.8	—	—
	—	—	—	20.5	—	—	13
Copper Age							
Kenderes – Kulis							
62.22.1	—	—	—	21	—	8.7	14.5
62.22.106	120	17.5	10.3	21	17.8	8	14
62.22.64	—	16.7	9.6	—	17*	—	—
62.22.201	117.5	16.7	10.7	20.7	16.4	8.2	13
62.22.208	—	17.4	9.9	—	18.4	—	—
Székely – Zöldtelek	132	18.7	11.5	23	19	9.6	15.5
	—	—	—	23.5	—	9.2	16
Tiszaszőlős – Csákányszeg							
62.6.62	128.5	18.3	10.2	20.7	18	8.2	15
	129*	—	10.4	21.8	—	8.2	15
62.6.63	140*	—	11	—	20.2	9.4	—
	140*	—	11	22.8	—	9.2	16
62.6.64	127*	18.7	10.8	22.3	19.2	8.8	15.5
62.6.65	126*	19	10.2	22.2	18.8	8.7	15.8
62.6.66	125.2	19	10.2	22.4	18.8	8.8	15.7
62.6.67	129*	20.3	10.6	23*	19.2	8.8	15*
62.6.68	123*	18.5	10.2	—	18	8	—
62.6.69	—	—	10.6	23	—	8.3	15.7
Bronze Age							
Békés – Városerdő							
53.4.90	—	20	12	—	20.5	—	—
53.4.91	—	—	—	24.5	—	11	17.5
53.4.418	135*	—	11.5	24	—	10	16.5
	—	—	12	—	—	9.5	—
53.4.419	—	—	—	25.5	—	11	17.5
	—	–	—	23.5	—	10	15
	—	—	—	27	—	11.5	17
	—	—	—	—	—	12	18
53.4.420	—	22	13	—	23.5	—	—
56.20.40	—	—	—	24.5	—	11	17
56.20.156	—	20	11	—	20.5	—	—
56.20.242	—	20	11.5	—	21	—	—
58.18.128	—	20.5	12	—	21.5	10.5	—
58.18.129	—	23	14	—	23	—	—
62.19.271	—	—	—	28	—	11.5	18.5
62.19.272	—	—	11	—	—	10.5	—
Csepel – Háros	—	22*	—	—	22*	—	—
	—	21.2	—	—	20.8	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metatarsus (continued)

Age/Site	1	2	3	4	5	6	7
	—	21.7	—	—	22	—	—
	—	—	—	26.5	—	11.3	17.8
	—	—	—	27.5	—	11	18.5
	—	21.5	13	—	21.5	—	—
Dunaújváros — Koszider							
504.f	—	—	12	24	—	10	16
851.d	—	—	—	25	—	10	18
889.d	149	20.5	12	24.5	21	9.5	17
	147.5	21	12	25	21	10.5	17.5
899.c	148	22	13	24.5	21	11	17
899.d	—	20	11	—	20	10.5	—
927.e	—	23.5	—	—	24	—	—
967.c	—	20	—	—	20	—	—
1015.d	143	20	11	23	20.5	10	16.5
1015.e	—	21	11.5	—	20	10	—
1041.d	—	23	14	—	23	12	—
Süttő — Hosszúvölgy							
62.44.361	132*	21	11.5	24.5	21	9.5	16.5
62.44.372	—	—	—	25	—	9.5	17*
62.44.639	—	19	—	—	18.5	—	—
62.44.851	137*	20*	11	—	—	9.5	—
Tiszaluc — Dankadomb	—	21.3	13	—	21.3	—	—
	—	21.2	—	—	22.5	—	—
	—	—	—	25.2	—	11	17.5
	—	—	—	24.7	—	10.5	16.8
	—	—	11	22.8	—	9	15.5
	—	23.3	12.2	—	22.7	11.8	—
	—	20.2	—	—	20.2	—	—
	—	19.8	10.8	—	20	—	—
	—	—	—	25.5	—	11	18
	—	—	—	23	—	10.7	16
Valkó — Erdőgazdaság (Forestry) 55.6.24	137	19	12	24	19.5	9.5	16
Iron Age							
Helemba — Sziget (Island)	121.2	19	11	22.2	18.8	8.8	14.7
	121	18.9	10.7	22.5	18.8	9.5	14.8
	32.5	20	11.3	24	20	9.3	16
	134*	19.9	11.2	23.5	20	9.2	16
	137	21	11.8	23.5	20.5	10	16.5
	—	18	11	—	19*	—	—
	—	—	—	25	—	—	16.8
	—	19.2	10.5	—	19*	—	—
	—	20	—	—	19*	—	—
Óhuta — Nagysánc	123.5	19.5	11.8	23.3	18.8	8.9	14.8
Velemszentvid	130*	21	12	—	21	10	—
	—	—	—	24	—	9.5	16
	151	22.5	13	25.5	22	11	17.5
Veszprém — József A. utca (Street)							
59.9.36	122	18	10	22	19	8.5	14.5
Period of the Roman Empire							
Budapest — Albertfalva	—	23.5	14	—	23	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metatarsus (continued)

Age/Site	1	2	3	4	5	6	7
	—	—	14	—	—	12	—
	—	20.5	12	—	20	11	—
	160*	26	16.5	33	—	14	—
Tokod—Erzsébet akna (Shaft)	138*	21.6	12.7	25.6	21.2	11	17
	138	22.2	12	—	23	10.3	17*
	—	—	—	24	—	10.2	16.3
	—	19.7	11.7	—	19.8	10	—
Migration period							
Arka 62.34.68	130*	19.5	12	23	20	9.5	16
Mezőkövesd 60.29.17	143	21.5	13	25.5	22	11.5	17.5
Avar period							
Bágyog—Gyűrhegy							
grave 80.a	135	21.5	12	25	20.5	10.5	16
	135	21.5	12	24.5	21	10	16
grave 80.b	142	23	12.5	27	23.5	11	17
	142	22.5	12.5	27	24	12	17.5
Deszk—Baráth A. földje (A. Baráth's land)							
61.35.16	130	21	12	—	21	11	—
61.35.17	—	21	12	—	21.5	—	—
Oroszlány 62.31.2	135*	21	12	25	—	10	17
	135	21.5	12	25.5	22	10	17
Szeged—Makkoserdő 62.2.34	135*	21	12	25	20	11.5	—
	135	21	12	24	20	10.5	16
Tiszavasvári—Koldusdomb							
grave 1	—	—	11.5	23	—	10	15.5
grave 19	139	21	11	25	21	10	17
	—	22	11	—	21	10.5	—
10th—13th century							
Felsőtárkány—Várhegy	—	—	—	22.2	—	7.3	14*
	122*	19.5	11.2	24	19.8	9.5	15.5
14th—17th century							
Buda—Vár—Pasa palota (Castle, Pasha's Palace)	143*	22	12.7	26.7	22	11	17.7
	144*	—	14	27	—	11.2	18
	156	23	13	26.6	23	12	18.2
	165	26.7	13.4	29	24.5	12.6	19
	154.5	22	12.8	26	22	11.3	18
	—	21.8	13.6	—	21.7	—	—
	129*	21.2	11.1	25	21.5	9.8	16.2
	138*	21*	12.1	25	21	10	16
	146.6	23	13	26	22.3	11.6	17.2
	145	21.3	12.5	25	22.5	10.8	17.2
	152	22.8	12.3	26.7	23	11	18.5
	155	23.4	13.5	26	23	12.8	17.6
	—	22.5	12.7	—	23	—	—
	—	23.5	13.1	—	23.5	—	—
	—	24	15.2	—	24	—	—
	—	20.3	—	—	20.1	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metatarsus (continued)

Age/Site	1	2	3	4	5	6	7
	—	23	—	—	22	—	—
	—	—	—	26.7	—	10.5	18.4
	146.5	22.2	12.9	26.3	22.7	10.8	18.5
	149.5	22.3	12.9	25.5	22.2	11.3	17.8
	151.5	24	14	27.7	24.8	12.8	18.5
	—	22.8	13.4	—	23	—	—
	—	23.2	—	—	23.7	—	—
	—	—	—	29	—	12.2	20.2
	158	22	12.2	26*	22.2	11.5	17
	—	21.8	12	—	21.2	—	—
	—	21.3	—	—	21.8	—	—
Gyula–Vár (Castle)							
	162	24.5	14.5	29	24.5	13.5	19.5
63.1.3	170	26	14.5	30	26	13	20
63.1.22	161	24	14	28.5	24.5	12.5	19
Szolnok–Vár (Castle)							
64.7.85	138	21	12	24.4	21	10.5	16.8
64.7.86	145	22.5	12	26.2	22.8	11	17.4
64.7.87	146	21	12.3	24	21.4	10.8	17
64.7.88	151	23	12.7	27	23.5	11	18
64.7.89	152	21.2	12.5	23.5	21.3	11	16.7
64.7.90	155	22.8	12	26	22.8	12	17.7
64.7.91	154	22.5	13.2	27.2	23.5	11	18.3
64.7.92	161	24.5	14.5	28.7	25	13	19.2
64.7.93	164	24.8	15	28.2	24.2	12	19
64.7.94	161	22.5	13	26.5	23	11.5	18.5
64.7.95	149	22	13.6	25.3	22.5	11.5	18
64.7.96	151	22	12.8	26	21.5	11.2	17.3
64.7.97	144.5	23	12.5	27	22.2	10.3	17.2
64.7.98	142.5	21	12	26.5	21.5	10.7	17.5
64.7.99	154	22.7	14	26.3	22.4	11.5	17.5
64.7.100	160	22.3	14	—	22.8	11.2	18.7
64.7.101	146*	22	—	25.2	23	11	17.5
64.7.102	152*	24	13.2	27	22	11.2	17.5
64.7.103	156*	22	—	26	21	11.5	18
64.7.104	175	26	14	30	25.5	13	21
64.7.105	143	22.5	12.2	26.8	22	11	17.2
64.7.106	150*	23*	—	26.3	23*	11	19
64.7.107	163*	23.5	13.5	27.5	22.2	12	19.3
64.7.108	158	22.5	13	26.5	22	11.2	17.5
64.7.109	145*	—	12	25	—	11	18
64.7.110	156	23.5	13	27	23	11.5	18.5
64.7.111	167	23	14	27*	23.5	12.2	18
64.7.112	150.5	21.7	13	26	21.2	11	16.5
64.7.113	153	22	12.3	25.8	22	11	18
64.7.114	164*	—	13.5	28	—	12	19
64.7.115	158*	—	14	26.8	—	12	—
64.7.116	150.5	22.3	13	26.5	22.2	11	18
64.7.117	150*	23.3	—	26.4	22.5	11	18.8
64.7.118	163	23	13.5	26.8	22.5	12	19.5
64.7.119	160*	26	14	28.5	25*	12.5	19*
64.7.120	152	22	12	26.3	22.5	10.5	17

* In the tables, the approximate measurements are marked by an asterisk.

Sheep — Metatarsus (continued)

Age/Site	1	2	3	4	5	6	7
64.7.121	146	22.5	13	26.8	22	11	17
64.7.122	147	21	13	25.5	21.8	11	17
64.7.123	163	23.8	13.5	27	24	12	18
64.7.124	156*	22.3	12	26.5	—	10.5	18
64.7.125	153	22.5	13	26	22	11.5	18
64.7.126	151	22	11.8	25*	23	11	18*
64.7.127	134*	—	12	—	—	10.5	17*
64.7.128	152	23.5	12	27	23	11.5	17.5
64.7.129	146	23	12	26.2	22.5	11	18
64.7.130	154	22.5	12.5	26*	21.5	10.7	17.5
64.7.131	157*	—	13	28*	—	12	19*
64.7.132	155	23	12.5	26.5	23.5	11	19
64.7.133	161	24	13	28	24	—	19*
64.7.134	157*	23	—	27.5	—	12	18.3
64.7.135	153*	22.8	—	26	22	12	17
64.7.136	160	23.5	13.5	27.7	24*	12	19.2
64.7.137	147*	23.5	—	27	23*	11.5	18

Goat — Capra hircus L.

Horn core

Measurements: 1. greatest length measured on the great curve
2. greatest diameter
3. smallest diameter
4. circumference of the basis

Age/Site	1	2	3	4
Neolithic				
Berettyószentmárton				
55.4.60	210*	34.5	26	92
55.4.61	—	—	22	—
55.4.359	—	46.5	31.5	122
	—	50	35.5	132
56.11.161	—	33	22.5	88
Berettyóújfalu — Herpály	147	28.5	19.5	78
	—	39.5	28	110
Győr — Pápai vám				
55.1.163	—	67	40*	170*
55.1.400	—	40	29.5	113
55.1.592	—	38	27	108
55.1.757	—	33	23	92
Hódmezővásárhely — Gorzsa — Cukortanya				
57.1.662.b	—	31.5	23.5	90
Neszmély — Tekeres patak	—	65*	38*	180*
	—	39	28	106
	—	35	26.5	100
Copper Age				
Aszód — Papi földek	—	31*	24	90*
	—	66	41.5	172
	—	36	25	100

* In the tables, the approximate measurements are marked by an asterisk.

Goat — Horn core (continued)

Age/Site	1	2	3	4
Bronze Age				
Békés—Városerdő				
53.4.422	—	32	23.5	89
60.7.701	—	34	22	87
Dunaújváros—Koszider				
502.a	255	39	27	102*
897.a	154	35	—	—
910.a	106	28	17	75
942.a	—	28.5	17	77
990.a	—	33	25	97
1000.c	—	32	20	83
1048.b	—	35	18	88
Nyergesújfalu—Téglagyár (Brick-yard)	—	34	21	86
Süttő—Hosszúvölgy 66.44.421	—	30	22	80
Tápiószele—Tűzköves				
1122.a	110*	32	23	90
1137.a	—	23.5	17	68
1138.a	—	32	23	—
1150.b	120*	32	17.5	78*
Iron Age				
Felsőtárkány—Várhegy	—	35	23	92
Helemba—Sziget (Island)	145*	46.5	31	125
	—	33	23*	98*
	—	33.5	21.5	90
Szentendre—Cementgyár (Cement works)				
61.8.1	—	73	43	182
Period of the Roman Empire				
Balatonaliga 581.b	—	35	27	—
Budapest—Albertfalva	—	37	26	102
	—	30.5	—	88
	—	—	24	—
	—	31	22	85
Nagytétény				
55.3.13	—	43	28	114
55.3.42	225*	35*	—	—
Migration Period				
Apagy—Barucha J. földje (J. Barucha's land)	200*	36	22.5	99
	—	36	23	99
	—	29	21	82
10th—13th century				
Csátalja—Vágotthegy 53.1.103	—	55	35	142
14th—17th century				
Gyula—Vár (Castle)				
63.1.17	182*	37	25.5	102
	—	37.5	25.5	104
63.1.48	133	53*	30*	130*
63.1.49	—	56*	39	150*
63.1.50	—	30.5	22	87

* In the tables, the approximate measurements are marked by an asterisk.

Goat — Horn core (continued)

Age/Site	1	2	3	4
	172*	39	26	103
	183*	38.5	25	102
	—	37*	25	100*
	—	31.5	22.5	85
	—	56	38*	—
	165*	30	20.5	85
	155*	31	20.5	83
	—	33	20	83

Metacarpus

Measurements:
1. greatest length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Neolithic							
Berettyószentmárton							
55.4.43	92	22	14.5	25.5	17	8	15
55.4.544	—	23	15	—	17	10	—
Berettyóújfalu—Herpály	115	28.5	19	31.3	20	11.8	18.5
Borsod—Derekegyházi dűlő (Baulk) 171	110	18	13	23	15	9	15
Győr—Pápai vám 12/2/1952	106.5	—	15.5	27	17	10.5	—
55.1.12	—	—	—	23.2	—	8.6	14.5
Neszmély—Tekeres patak	—	27*	17	—	18*	—	—
Bronze Age							
Békés—Városerdő							
58.18.131	113	25	15.5	28	18	10	17
58.18.132	—	25	15.5	—	17.5	—	—
60.7.17	—	24	—	—	16	—	—
60.7.448	—	27.5	17	—	18.5	—	—
62.19.273	—	25.5	—	—	19.5	—	—
Dunaújváros—Koszider 1064.d	104	22	13	24.5	15	8	14
Tiszaluc—Dankadomb	—	28.3	—	—	21.5	—	—
	—	29	—	—	19	—	—
Iron Age							
Felsőtárkány—Várhegy	—	—	16	39.8	—	11.2	17.5
Helemba—Sziget (Island)	117*	—	16.5	29	—	11.2	—
	—	21.3	14	—	16.5	—	—
Óhuta—Nagysánc	—	23.5	17	—	17*	11.2	—
Period of the Roman Empire							
Balatonaliga							
583.a	—	28	16	—	20	12	—
583.b	—	27	16	—	21	12	—

* In the tables, the approximate measurements are marked by an asterisk.

Goat — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
585.e	128	26	16	30	18	11	18
589.d	—	—	18	—	—	12	—
Tokod – Erzsébet akna (Shaft) 56.19.4	126	27	17	30	20	11	18.5
	—	25	14	—	18.2	9.5	—
	113*	25*	15.5	27	—	9.8	—
14th – 17th century							
Gyula – Vár (Castle)							
63.1.23	120.5	27.5	16.5	32*	19	11	17.5
63.1.24	110	25.5	17.8	28*	17.5	10	17
63.1.31	114*	25*	15	29	18	9.5	16.5
63.1.51	111	24.5	16.3	28	17	10.5	16
	118*	24.5	17	28	—	10	16.5
	111	26	18	—	17.5	10	17.5
	111.5	24.5	17	28.5	17.5	10.5	16.5
	116	26	18	30.5	18	10	17.5

Metatarsus

Measurements: the same as those of the metacarpus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Berettyóújfalu – Herpály	112	21	14	25.5	17	10.5	16
Bronze Age							
Tápiószele – Tűzköves 1182.c	—	—	—	29	—	12	19
Iron Age							
Helemba – Sziget (Island)	118*	—	14	26*	—	10	—
	—	21*	12.8	—	—	—	—
14th – 17th century							
Szolnok – Vár (Castle) 64.7.138	121	21	12.3	26	19.5	10.2	16.3

Pig — Sus scrofa dom. L.

Skull	Berettyó-szentmárton, Neolithic	Tiszaluc-Dankadomb, Bronze Age		Kardoskút-Hatablak, 10th—13th C.
basal length	307*	—	—	—
overall length	341	—	—	—
I_1 — M_1	140	—	—	—
M_1 — basion	168	183	—	147
I_1 — aboral end of palate	223	—	—	—
aboral end of palate — basion	87	92	—	77
I_1 — aboral end of nasal bones	202	—	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Pig (continued)

Skull	Berettyó-szentmárton, Neolithic	Tiszaluc-Dankadomb, Bronze Age		Kardoskút-Hatablak, 10th–13th C.
from the latter point — opisthion	138	157.5	—	—
I_1 — to middle of straight line connecting foramina supraorbitalia	228	—	—	—
from that point — opisthion	76	79	—	—
length of row of teeth (I_1 — M_1)	196	—	—	—
length of incisor row	48	—	—	—
length of diastema	48	—	—	—
P_1 — P_4	44	46	48	40
M_1 — M_3	59	66.5	68	58
length of M_3	27	34	31	27
ventral length of os lacrymale	35	35	32	25
extreme frontal breadth	106	103	104	92
breadth at the medial canthus	82	72	70	66
breadth at the foramina supraorbitalia	34	29	—	33
breadth of incisor row	44	—	—	—
breadth at canines	72	74	68	51
P_1 — P_1	58	53	46.5	44
M_1 — M_1	72	68	64	59
breadth at condyli occipitales	58	59	58.5	54
extreme breadth of os lacrymale	24	23	23	23
length of foramen magnum	—	28	28	25
breadth of foramen magnum	25	25	23	24
occipital height	112 ♀	115 ♀	—	— ♀

Mandible

Measurements: 1. length of row of teeth
2. length of row of incisors
3. length of diastema
3. $P_1 - P_4$
5. $M_1 - M_3$
6. length of M_3
7. breadth of row of incisors
8. breadth at C-s

Age/Site	1	2	3	4	5	6	7	8
Bronze Age								
Dunaújváros – Koszider	178	20.5	23.5	—	70	33	38	—
Nyergesújfalu – Téglagyár (Brick-yard)	—	29	28	—	—	—	44	—
	—	30	25	—	—	—	42	49
	185*	23*	26	62	73	42	42	49
	—	—	—	—	69	37.5	—	—
Tiszaluc – Dankadomb	—	26.5	23.5	58.5	—	—	43	48
Iron Age								
Felsőtárkány – Várhegy	—	26	27.5	54.5	—	—	—	—
Period of the Roman Empire								
Pilismarót – I. őrtorony (Watch tower)	—	—	—	42	68	32	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Pig — Mandible (continued)

Age/Site	1	2	3	4	5	6	7	8
10th—13th century								
Csátalja—Vágotthegy	165	23	30	53	60	30	41	52
Kardoskút—Hatablak	151	20	23	47	62.5	30	—	—
14th—17th century								
Túrkeve—Móricz	162	25	28	47	63	31	39	—

Scapula

Measurements: 1. greatest length
2. greatest breadth
3. smallest breadth of collum scapulae
4. breadth of angulus articularis
5. diameter of facies articularis

Age/Site	1	2	3	4	5
Neolithic					
Borsod—Derekegyházi dűlő (Baulk) 176.b			28	44	31
Győr—Pápai vám					
55.1.428	—	—	22.5	35	—
55.1.609	—	—	26	41	27
Copper Age					
Kenderes—Kulis 62.22.195	—	—	19	32*	22
Tarnabod	—	—	21	33.5	22.5
	—	—	20	33	—
	—	—	25	—	24
Tiszaszőlős—Csákányszeg					
62.6.29	—	—	—	38*	27*
62.6.215	—	—	21.5	34*	24*
Bronze Age					
Békés—Városerdő					
53.4.200	—	—	32.5	48	33.5
	—	—	31	—	31
	—	—	34.5	46	33
53.4.657	—	—	25	39	27.5
	—	—	24	40	28
	—	—	28	40.5	28
	—	—	—	48	35
	—	—	27	37	27
	—	—	27	44	32
	—	—	—	48	34
	—	—	24	36	24.5
	—	—	31.5	—	32
	—	—	31	—	36
53.4.658	—	—	23.5	36	—
56.20.88	—	—	27	39	27
56.20.176	—	—	24.5	37.5	25.5
	—	—	26	38	27

* In the tables, the approximate measurements are marked by an asterisk.

Pig — Scapula (continued)

Age/Site	1	2	3	4	5
62.19.30	—	—	24.5	37*	26*
	—	—	25	—	—
62.19.295	—	—	24.5	36.5	25.5
Dunaújváros — Koszider					
869.e	—	—	21	31	21
871.c	—	—	23	35	26
1018.a	172	—	—	38	24.5
Süttő — Hosszúvölgy 62.44.702	221	—	26	40	27
Tiszaluc — Dankadomb	—	—	23.5	38.5	24.5
	—	—	24	39.5	27.5
	—	—	24.5	39*	27
	—	—	26.5	38.5	25*
	—	—	26*	39.5	28.5
	—	—	26	37*	26*
	—	—	26	—	27*
Iron Age					
Fertőszentmiklós, grave 8	176*	108	22	35	23.5
Mátraszőlős 64.1.2	—	—	23	34*	23*
14th — 17th century					
Fonyód					
63.3.20	—	—	24.5	37*	—
63.3.21	—	—	21	33*	22.5
63.3.43	—	—	23	32.5	24
63.3.88	—	—	22.5	31	22.5
63.3.130	—	—	22.5	34	24.5
63.3.154	—	—	23	34.5	—
63.3.202	—	—	21	38*	—
63.3.299	—	—	22.5	33.5	23.5
63.3.350	202	116	24.5	35.5	25.5
Túrkeve — Móricz 54.3.200	—	—	22	35	23

Humerus

Measurements: 1. greatest length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Neolithic							
Berettyószentmárton							
55.4.389	—	—	—	33.5	—	—	34
55.4.569	—	—	—	38.5	—	—	37.5
56.11.486	—	—	—	35.3	—	—	34.8
56.11.867	—	—	—	36	—	23	38.5
56.11.1309	—	—	13.5	36.5	—	21	36

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Győr — Pápai vám							
22.1952	—	—	—	38	—	—	38.5
55.1.1295	—	—	14.5	37.5	—	25	39
Neszmély — Tekerespatak	—	—	—	39	—	—	41
Copper Age							
Kenderes — Kulis							
62.22.119	—	—	13	—	—	18	36
62.22.121	—	—	—	39	—	—	40
62.22.170	—	—	—	36	—	22	36.5
62.22.196	—	—	—	37*	—	—	39
Bronze Age							
Békés — Városerdő							
53.4.663	—	—	—	41	—	27.5	41
	—	—	—	42	—	—	43.5
	—	—	—	43.5	—	31.5	41.5
	—	—	—	—	—	23	39
53.4.664	—	—	—	44.5	—	—	44
56.20.58	—	—	—	44	—	26.5	44.5
56.20.450	—	—	—	44.5	—	—	44
58.18.203	—	—	—	41	—	23	—
60.7.324	—	—	16.5	40.5	—	29	—
60.7.379	—	—	—	40.5	—	—	41
60.7.678	—	—	—	41.5	—	—	46
60.7.709	—	—	—	43	—	28	42
62.19.78	—	—	—	38	—	—	38
62.19.399	—	55	—	—	73	—	—
Dunaújváros — Koszider							
876.b	—	—	15.5	41.5	—	23.5	43
915.c	—	—	16	38.5	—	23	38
983.d	—	—	—	42.5	—	—	45.5
983.e	—	—	13	—	—	18.5	—
Süttő — Hosszúvölgy							
62.44.187	—	—	—	41	—	24	39
62.44.213	—	—	—	44	—	—	44.5
62.44.243	—	—	—	38*	—	25.5	39*
62.44.275	—	—	—	40.5	—	25	40
62.66.704	—	54	—	—	71	—	—
62.44.705	—	—	—	43.5	—	26	44
Tiszaluc — Dankadomb	—	—	19	44	—	28	42
	—		18	45	—	28.5	43.5
	—	—	—	39.5	—	22.5	39
	—	—	—	40.5	—	28	40
	—	—	18	44.5	—	25	47
	—	—	20	45	—	26	42.5
	—	—	19	46	—	32	44.5
	—	—	16.5	40	—	29.5	41
	—	—	—	42	—	—	—
Iron Age							
Fertőszentmiklós, grave 8	190*	—	15	37.5	60	23.5	38.5

* In the tables, the approximate measurements are marked by an asterisk.

Pig — Humerus (continued)

Age/Site	1	2	3	4	5	6	7
Helemba—Sziget (Island)	—	—	—	42.5	—	26.5	42.5
	—	—	19	42.5	—	28.5	43.5
	—	—	15	40.5	—	23.5	40*
	—	—	—	43	—	28	42.5
	—	—	—	39.5	—	—	40.5
	—	—	—	37.5	—	23	35.5
	—	—	—	42	—	—	44
	—	—	17	41.5	—	27	40.5
	—	—	—	41.5	—	—	41
	—	—	17	40	—	26.5	38
	—	—	17	41.5	—	25.5	42
	—	—	—	40*	—	—	42
	—	—	—	39.5	—	—	40.5
	—	—	—	42	—	26.5	42.5
10th—13th century							
Szarvas—Rózsás 59.8.227	184	48	16.5	39	61	23	37.5

Radius

Measurements: the same as those of the humerus.

Age/Site	1	2	3	4	5	6	7
Bronze Age							
Tiszaluc—Dankadomb	—	34	—	—	23.5	—	—
	—	33	18.5	—	22	13.5	—
	—	31	20	—	24	13	—
	—	31.5	21	—	25.5	14	—
	—	30	—	—	—	—	—
	—	29.5	19.5	—	23*	—	—
	—	—	—	38.5	—	—	30
	—	31	19	—	25.5	13	—
	—	31.5	19	—	25	14	—
	—	31.5	19.5	—	24.5	12	—
	—	32.5	—	—	24	—	—
Iron Age							
Fertőszentmiklós, grave 8	143	28	16	32.5	23	10.5	25.5
Helemba—Sziget (Island)	—	29.5	17	—	22.5	11	—
	—	29	—	—	23	—	—
	—	29	—	—	23	—	—
	—	32	21.5	—	24	14	—

* In the tables, the approximate measurements are marked by an asterisk.

Pig — Tibia

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Bronze Age							
Békés — Városerdő 53.4.683	—	—	—	32.5	—	—	28
	—	—	21.5	32	—	16.5	27.5
	—	—	23	35	—	18	32
	—	—	25.5	36	—	20	33
	—	—	—	36	—	—	32.5
56.20.180	—	—	—	31.5	—	—	29
56.20.393	—	—	20.5	32	—	14.8	27.2
	—	—	—	32.5	—	—	27.3
56.20.544	—	—	—	32	—	—	—
58.18.217	—	—	19	30.5	—	15	26
58.18.218	—	—	21	33	—	17	28
	—	—	—	31	—	—	28
	—	—	—	33	—	—	28*
	—	—	20.5	31	—	16	27
	—	—	19	29.5	—	14.5	25
	—	—	—	33	—	—	28.5
58.18.219	—	—	18	30	—	14	—
	—	—	—	31	—	—	27.5
	—	—	—	31.5	—	—	28
60.7.78	—	50.5	—	—	—	—	—
60.7.218	—	—	20.5	30	—	14	27
	—	—	—	30	—	—	27.5
Iron Age							
Helemba — Sziget (Island)	—	—	21.5	33	—	16	28.5
	—	—	—	31.5	—	—	27
	—	—	—	32.5	—	—	28.5
	—	—	18.5	30	—	15	28
	—	—	—	32	—	13.5	26
	—	46	—	—	—	—	—
	—	—	—	34	—	—	28
	—	—	—	31.5	—	—	26.5
	—	—	20	31*	—	14.5	26
Rozvágy							
63.32.19	194	44	17.5	27.5	—	13	25
63.32.20	—	—	17	26.5	—	13	24.5
Period of the Roman Empire							
Budapest — Aquincum	195	—	19	32	—	15	27
14th — 17th century							
Túrkeve — Móricz							
54.3.343	182	42	18	32	41	13	28
54.3.352	182	40.5	18	31	—	13	27.5
54.3.584	—	—	21	30	—	15	28
54.3.216	—	—	—	27	—	—	24

* In the tables, the approximate measurements are marked by an asterisk.

Pig — Astragalus

Measurements: 1. greatest length 2. greatest breadth 3. greatest height

Age/Site	1	2	3
Neolithic			
Győr—Pápai vám			
55.1.260	52	—	—
55.1.453	42.5	25	24
55.1.510	45.5	27	28
Hódmezővásárhely—Gorzsa—Cukor tanya (Farm)	47	29	27
	51	31	29
Polgár—Csőszhalom			
60.9.879	51	32.5	30.5
60.9.381	50.5	30	29.5
Bronze Age			
Békés—Városerdő			
53.4.227	43	26	25.5
56.20.73	—	23	21
56.20.261	41	—	24.5
58.18.228	46	26	26
60.7.183	50	32	30
60.7.610	46	—	—
Tápiószele—Tűzköves			
248.d	44	29	27
270.d	49	31	30
1160.e	43	27	26
Iron Age			
Rozvágy 63.32.21	37.5	24.5	22.5
	40.5	25	24.5
10th—13th century			
Tiszalök—Rázom	38	24	22
280.d	34	21.5	21
823.e	35.5	22	20
845.d			

Horse — Equus caballus L.

Skull

Measurements:

1. basal length
2. overall length
3. basion — M_1,
4. $M_1 - I_1$
5. basion — aboral end of palate
6. this latter point — I_1 (length of palate)
7. prosthion — middle of the straight line connecting the caudal points of nasal bones
8. this latter point — opisthion
9. prosthion — middle of the straight line connecting the most lateral points of frontal bones
10. this latter point — opisthion
11. prosthion — middle of the straight line connecting the foramina supraorbitalia
12. this latter point — opisthion
13. length of row of teeth ($I_1 - M_3$)
14. length of row of incisors
15. length of diastema
16. length of row of premolars.
17. length of row of molars
18. length of foramen magnum
19. extreme frontal breadth
20. distance between medial canthuses
21. distance between foramina supraorbitalia
22. distance between oral ends of the cristae faciales
23. distance between points of the cristae faciales where the sutura zygomaxillares cross them
24. distance between the foramina infraorbitalia

Horse — Skull (continued)

25. breadth of the row of incisors
26. $P_1 - P_1$
27. $M_1 - M_1$
28. extreme breadth of the brain case
29. distance between the mandibular joints
30. distance between the meati acustici externi
31. distance between the processus jugulares
32. distance between the condyli occipitales
33. breadth of foramen magnum
34. height of the occiput
35. horizontal diameter of orbitae
36. vertical diameter of orbitae

Measurements	Dunaújváros-Koszider, Bronze Age	BudapestA - lbertfalva, Period of the Roman Empire	Királyság, Migration Period	Keszthely – Primary school, Avar	Óbuda - Szőlő utca, Avar	ditto	Orosháza, Avar	Pókaszepetk, Avar	ditto	Szeged - Makkoserdő, Avar
1.	483	505	460	474	504	482	465	470	457	510
2.	532	553	407	524	567	519	521	518	518	569
3.	—	285	249	277	277	268	258	266	252	284
4.	—	218	212	197	227	205	—	205	203	226
5.	225	228	212	225	238	226	220	219	214	236
6.	—	277	247	248	268	252	245	252	242	274
7.	—	351	317	313	344	332	328	327	321	—
8.	—	219	203	214	232	220	206	205	213	—
9.	—	387	367	362	398	378	371	360	360	398
10.	—	185	155	168	183	175	165	170	177	186
11.	—	382	357	352	394	371	367	357	356	394
12.	—	189	164	180	192	183	171	175	181	191
13.	300	295	291	276	305	290	272	283	274	295
14.	—	—	31	24	—	—	25	23	25	27
15.	89	100	84	82	117	84	87	92	97	99
16.	92	83	94	88	84	91	87	91	83	87
17.	79	74	79	76	74	82	74	73	74	77
18.	36	38	35	37	35	36	—	35	41	41
19.	206	223	198	220	223	191	211	215	210	234
20.	—	144	133	155	159	131	141	148	151	163
21.	142	134	137	149	154	131	139	144	144	158
22.	—	161	157	170	162	144	150	147	148	164
23.	—	182	173	190	178	161	—	170	—	196
24.	86	82	82	88	84	77	80	75	—	—
25.	74	73	67	71	67	66	69	68	68	73
26.	107	103	101	103	98	100	100	99	100	104
27.	122	126	120	124	122	114	116	118	121	125
28.	103	111	102	108	108	109	109	112	109	111
29.	—	201	191	202	200	188	186	200	194	210
30.	118	112	112	115	120	107	110	—	—	119
31.	100	117	102	99	110	110	113	—	103	116
32.	78	89	82	83	84	88	84	83	79	85
33.	35	33	32	32	35	38	—	35	32	38
34.	—	91	91	95	97	88	97	100	99	94
35.	—	59	67	60	58	62	60	61	64	61
36.	—	50	55	58	51	54	59	57	56	52

Measurements	Szőreg – Téglagyár (Brick-yard), Avar	Unknown site, Avar	Biharkeresztes, Period of Magyar Conquest	Csanytelek, Period of Magyar Conquest	Dormánd – Hanyi puszta, Period of Magyar Conquest	Hékút, period of Magyar Conquest	Koroncó, Period of Magyar Conquest	Kübekháza – Újtelep, Period of Magyar Conquest	ditto	Mohács – Téglagyár (Brick-yard), Period of Magyar Conquest
1.	456*	460	485	444	455	482	449	465	440	490
2.	510*	506	549	504	—	533	488	521	497	547
3.	260	255	264	245	—	271	—	250	228	284
4.	193*	207	221	199	206	—	—	212	210	—
5.	227	216	216	208	—	222	210	211	204	236
6.	228*	246	267	237	244	261	237	253	235	—
7.	312	319	—	320	332	335	—	336	299	—
8.	—	202	—	210	—	213	—	212	212	222
9.	350*	349	382	358	370	376	—	377	352	—
10.	178	172	183	172	—	174	—	164	160	181
11.	347	352	380	353	365	371	—	373	345	—
12.	180	169	186	177	—	178	—	168	166	185
13.	260*	275	286	274	280	287	283	288	281	—
14.	38	22	25	27	27	30	—	26	32	27
15.	91	100	92	85	87	97	80	91	83	111
16.	88	89	91	91	89	89	91	96	94	82
17.	77	68	75	82	78	80	75	74*	72	75
18.	37	42	35	40	35	39	34	38	40	43
19.	215*	202	220	208	200	217	191	202	190	224
20.	138	137	—	140	126	153	122	127	128	160
21.	152	140	144	142	134	157	135	130	140	167
22.	153	148	153	158	146	158	149	151	143	168
23.	173	166	181	180	164	185	—	178	162	191
24.	88	68	72	84	73	81	79	73	84	93
25.	76	67	74	68	68	69	67	66	65	—
26.	102	98	97	104	104	110	97	101	99	107
27.	121	115	119	122	116	133	117	126	120	121
28.	109	109	115	107	108	115	103	105	104	103
29.	201	192	192	188	180	202	—	198	178	210
30.	118	111	123	112	—	121	110	116	109	116
31.	112	103	106	106	—	109	102	107	102	108
32.	84	82	84	79	78	85	76	82	82	85
33.	31	35	33	34	31	35	35	33	33	35
34.	100	95	90	95	—	—	87	97	98	104
35.	68	60	64	59	62	62	—	68	64	61
36.	68	54	58	55	55	59	—	58	56	54

* In the tables, the approximate measurements are marked by an asterisk.

Measurements	Orosháza, Period of Magyar Conquest	ditto	Pesterzsébet, Period of Magyar Conquest	Pestlőrinc, Period of Magyar Conquest	Szentes - Borbásföld, Period of Magyar Conquest grave 2	ditto grave 5	ditto grave 7	ditto grave 8	ditto grave 10	ditto grave 20
1.	453	483	463	—	487	485	456	478	463	459
2.	500	537	520	—	536	532	517	522	525	495
3.	241	262	248	—	262	261	237	256	256	—
4.	208	223	214	—	223	—	—	—	—	—
5.	211	213	217	—	225	223	212	220	221	—
6.	241	268	243	—	260	258	244	256	242	232
7.	309	339	317	—	327	335	328	331	318	—
8.	203	223	217	—	216	210	208	200	221	200
9.	342	383	357	—	378	367	356	357	361	—
10.	162	180	176	—	167	177	180	177	167	157
11.	339	377	351	—	362	365	355	361	318	—
12.	165	184	180	—	183	179	181	174	192	165
13.	285	298	—	—	—	—	—	296	279	—
14.	23	38	21	—	25	27	—	23	28	26
15.	100	96	93	—	99	104	94	98	84	89
16.	87	94	92	—	89	90	94	87	90	91
17.	72	79	—	—	—	—	—	78	75	—
18.	38	36	39	—	38	34	39	38	39	39
19.	190	217	198	198	213.5	210	198	202	212	194
20.	123	156	130	141	136	138	139	138	144	—
21.	132	148	138	140	144	141	140	147	141	—
22.	145	165	146	155	157	150	145	151	153	136
23.	161	191	167	175	178	172	167	170	178	158
24.	81	85	87	84	84	82	89	78	81	—
25.	68	74	67	—	71	68	64	70	67	60
26.	100	109	100	98	108	105	105	105	99	—
27.	117	127	117	—	125	123	117	119	120	—
28.	101	110	106	108	111	106	106	114	108	115
29.	186	216	190	190	194	205	191	196	202	185
30.	112	114	—	—	117	123	114	112	118	112
31.	102	114	108	—	96	113	111	105	110	105
32.	80	82	82	—	82	86	86	82	82	84
33.	32	33	36	—	34	32	33	33	33	38
34.	94	—	95	—	98	95	99	93	96	98
35.	66	62	66	59	69	62	60	59	63	—
36.	58	59	56	52	56	56	55	53	53	—

Measurements	Tiszaeszlár - Bashalom, Period of Magyar Conquest	ditto	Tiszanána, Period of Magyar Conquest	ditto	Városföld, Period of Magyar Conquest	Tiszalök - Rázom, Age of Árpád dynasty	Túrkeve - Móricz, 14th–17th century	Zalavár, Middle Ages
1.	468*	456	—	460	475	—	500*	480*
2.	510*	500*	—	513	—	—	560*	—
3.	269	252	271	246	278	—	—	—
4.	205*	199	—	214	—	—	—	210
5.	215	224	241	215	225	235	—	—
6.	250*	231	—	246	249	—	—	—
7.	322*	308*	—	318	322	—	—	—
8.	200	203	208	210	—	—	—	—
9.	360*	347*	—	361	375	—	—	364
10.	164	165	—	169	—	—	—	—
11.	353*	342	—	356	362	—	—	361
12.	171	169	170	173	—	—	—	—
13.	283*	285	—	250*	287	—	—	286
14.	30*	25*	—	23	28	—	—	28
15.	78	80*	—	98	91	—	—	88
16.	91	91	90	91	90	93	—	93
17.	74	—	73	75*	80	80	—	75
18.	38	39	36	39	—	—	37	—
19.	210	189	—	204	207	202	210*	197
20.	148	147	134	133	132	—	142	134
21.	138	129	139	142	139	141	130	137
22.	152	147	154	151	149	—	—	148
23.	176	162	174	175	171	—	—	171
24.	82	79	82	94	75	—	90	—
25.	67	65*	—	68	68	—	72	68
26.	98	96	111	101	104	—	106	101
27.	124	116	123	123	121	—	—	113
28.	114	102	108	110	108	109	116	—
29.	194	179	—	200	193	202	193	181
30.	—	—	—	118	118	107	123	—
31.	106	97	106	102	108	—	113	108
32.	82	76	87	84	84	—	89	—
33.	37	34	36	34	—	—	40	—
34.	92	90	99	94	—	—	—	—
35.	67	60	—	64	66	—	—	—
36.	55	53	—	56	58	—	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Scapula

Measurements: 1. greatest length
2. greatest breadth
3. smallest breadth of collum scapulae
4. breadth of angulus articularis
5. diameter of facies articularis

Age/Site	1	2	3	4	5
Copper Age					
Békásmegyer – BUVÁTI	—	—	65	95*	49
Bronze Age					
Csepel – Háros	—	—	—	92.5	45
	—	—	—	94	50.5
	—	—	—	95*	48*
	—	—	—	95	50
	—	—	—	86	50*
Dunaújváros – Koszider					
875.d	—	—	59	88	—
892.b	—	—	63	95	49
892.c	—	—	62	88	46
922.c	—	—	—	87	46.5
941.c	—	—	65	—	46.5
944.b	—	—	—	88	42.5
960.d	—	—	—	94	47
999.a	—	—	59.5	—	43.5
1026.b	—	—	58	88	42.5
Avar period					
Hortobágy – Árkus					
grave 13	347	175	68	101	—
grave 23	318	—	59	87	44
grave 24	—	—	63	88	46
grave 27	328	—	61	96	46
grave 30	355	171	66	91	—
grave 32	—	—	62	91	—
grave 36	—	—	61	89	45
grave 39	332	—	61	93	48
Keszthely – Általános iskola (Primary school)					
65.3.41.Z	370	—	66.5	95	52*
	—	—	68	95.5	51
65.3.105.Z	387	180	67.5	96	51.5
	390*	—	68	95	52
Pókaszepetk					
64.9.39.Z	335*	—	59	94	49
64.9.100.Z	350*	—	62.5	89	50*
Szekszárd – Palánk					
58.3.37.Z	—	—	52.5	87*	—
58.3.82.Z	—	—	65	99	51.5
58.3.149.Z	—	—	59	88.5	—

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Humerus

Measurements: 1. greatest length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Bronze Age							
Csepel – Háros	—	—	—	79	—	—	81
	—	—	—	75	—	—	78*
	—	—	34	85	—	44	—
	—	—	—	77	—	—	81
	—	—	—	72	—	—	78
	—	96	—	—	102	—	—
	—	—	—	76	—	—	84
	-	—	—	78	—	—	78
Avar period							
Deszk – Ördögh földje (Ördögh's land) 61.34.12	278	90	35	76	94	40	82
Hortobágy – Árkus							
grave 13	300	102	37	82	106	46	90
grave 23	277	88	31.5	75	92	41	78
grave 24	281	89	34	74	95	41.5	77
grave 27	288	95	35	77	98	44	83
grave 30	292	91	35	79	98	43	78
grave 36.d	293	90	33	72	92	42	81
grave 39	290	96	35	74	93	43	81
Keszthely – Általános iskola (Primary school)							
65.3.12.Z	291	101.5	39.5	80.5	99	46	79
65.3.42.Z	297	90	34.5	76	100	43	80
65.3.106.Z	311	94	39	81	98	43	80
Környe							
58.19.15	268	83	30.5	71	92	38	75
58.19.48	285	88	32.5	79	93	41	82
58.19.66	289	88	33	77	95	44	81
59.11.12	286	93	35	86	98	44	87
59.11.39	281	—	37	76	—	44	83
59.11.95	283	93	34	74	93	40	85
61.14.13	279	91	33.5	73	98	41	80
61.14.31	294	92	35	76	100	41	83
Óbuda – Szőlő utca (Street) 60.16.13	261	78	27	70	88	36	79
Pókaszepetk							
64.9.13.Z	275*	—	35	73	—	40	80*
64.9.40.Z	294	88	32	73	95	42	79
64.9.101.Z	285*	83	33	75	91	39	79
	288*	85*	33	75*	94	39	79
Szeged – Makkoserdő							
62.2.48	280*	—	36.5	73.5	—	42	83
62.2.101	280	92	35	76	93	42.5	81
Szekszárd – Palánk							
58.3.261	289	—	34	75	—	42.5	—
58.3.281	285*	—	35	76	—	42	—

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Humerus (continued)

Age/Site	1	2	3	4	5	6	7
58.3.308	297	91	34	76	97	43	81
58.3.325	293*	90	33	79	99	41	80
58.3.353	298	—	36	78	—	42.5	83
58.3.369	285	94	37	77	93	42	76
Szentes — Nagyhegy							
61.38.7	278*	—	34	—	100	40	—
61.38.10	282*	—	35	74	98	42	75
Szőreg — Téglagyár (Brick-yard)							
61.33.6	—	—	35	78	—	43	84
61.33.50	284	86	34	72	98	42	74
61.33.82	277	86	31	68	90	41	73
61.33.114	290*	93	35	76	101	41	79

Radius

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Bronze Age							
Csepel — Háros	—	87	—	—	47.5	—	—
	—	84	—	—	44	—	—
	—	—	—	77	—	—	47
		—	—	74	—	—	43
	—	—	—	82	—	—	47
	—	82	—	—	46.5	—	—
	—	80	—	—	—	—	—
	—	80*	—	—	45.5	—	—
	—	83.5	—	—	45	—	—
	—	85	—	—	48.5	—	—
	—	—	—	73	—	—	42*
	—	—	—	74*	—	—	42
	—	—	—	77	—	—	42
	—	—	—	74.5	—	—	45.5
	—	—	—	78	—	—	45
	—	83	—	—	43.5	—	—
	—	—	—	77.5	—	—	45.5
	—	—	—	79.5	—	—	44
	—	—	—	80	—	—	44
	—	—	—	81.5	—	—	42
	—	86	—	—	47	—	—
	—	—	—	74.5	—	—	47
	—	88.5	—	—	46	—	—
	—	84	—	—	44.5	—	—
	—	81.5	—	—	45*	—	—
	—	—	—	80	—	—	48*
	—	—	—	81.5	—	—	50
	—	—	—	75*	—	—	45
	—	82	—	—	44	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	83*	—	—	44	—	—
	—	—	—	75.5	—	—	45.5
Dunaújváros – Koszider							
941.b	322	79.5	38	74	44	26.5	44
1063.a	324	—	37	—	40.5	24.5	42
1065.b	—	76	35	—	44	23	—
1068.b	—	81	—	—	42	—	—
Tiszaluc – Dankadomb	333	84.5	—	75.5	47	—	44
Iron Age							
Jászfelsőszentgyörgy							
62.1.24	—	75*	—	—	43	—	—
62.1.25	—	—	—	71	—	—	43
62.1.81	355*	88*	41	83	50	36	51
Period of the Roman Empire							
Balatonaliga 574.b	317	75	36	70	43	25	42
Pilismarót – I. őrtorony (Watch tower)	338*	81.5	40.5	78.5	49	29	47.5
Százhalombatta 54.1.2	313	74	35	68	43	23	40.5
Avar period							
Deszk – Ördögh földje (Ördögh's land)							
61.34.13	312*	—	36.5	71.5	—	26.5	41.5
	312	79	37.5	72.5	49	27	40
Hortobágy – Árkus,							
grave 13	350*	90	40	82	51	28.5	50
grave 23	322	79	35	71	43	25	41
grave 24	330	79	37.5	—	44	26	—
grave 27	335	82.5	35.5	75	46.5	26	46
grave 30.d	340*	82	40	77	45	27	43
grave 32.d	337	81	38	73	43	25	45
grave 36	343	77	36.5	72	47.5	27	41
grave 39	335	79	40	73	47	26	44.5
Keszthely – Általános iskola (Primary school)							
65.3.13.Z	342	80.5	40	79	46	31.5	43.5
63.3.44.Z	346*	80.5	39	73.5	48.5	28	46
63.3.107.Z	350*	85	42.5	80	50	32	46
Környe							
58.19.16	316	75	33	70	37	24	42
58.19.67	335*	82	35	74	46	25.5	45
59.11.13	330*	86	38	78	47	26	48
59.11.40	326	—	39.5	77.5	50	28	45
59.11.96	331	79	34.5	73	47	24	43
61.14.14	317*	79	35.5	70	42	26	43
61.14.32	343	82	37	74	47	29	45
Óbuda – Szőlő utca (Street) 60.16.14	315*	75	32	67	42	20	41
Pókaszepetk							
64.9.14.Z	327*	79	36	72	45	28	47.5
64.9.41.Z	350*	79.5	38	74	46	26	41
	350*	80	37.5	—	46	26	41
64.9.102.Z	326	82	34	72.5	45	26	42.5

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Radius (continued)

Age/Site	1	2	3	4	5	6	7
Szeged – Makkoserdő							
62.2.49	330*	82	38.5	73	47	28.5	48
62.2.102	337*	82	41	77.5	47	28	41
Szekszárd – Palánk 58.3.85.Z	350*	84	38.5	80	50	27.5	46
	351	85	38.5	80	49.5	27.5	46*
Szentes – Nagyhegy 61.38.8	330*	—	37.5	74	48.5	29	46
Szőreg – Téglagyár (Brick-yard)							
61.33.7	—	—	—	77	—	—	48
61.33.51	328*	79	37	74	45	27	44*
61.33.83	318*	72	37	70	40	26	43
61.33.115	333*	81	37.5	75	43	25	42
Szekszárd – Palánk							
58.3.262	335*	81	37.5	75	47	26	47
58.3.282	327	85	38	75	44	27	41
58.3.309	345*	82	36	75	46	25	46.5
58.3.326	343*	83	35.5	76	45.5	27	48
58.3.354	358*	81	40	74	45	28	43
58.3.370	—	80	39.5	73	44	27	43
Vác – Kavicsbánya (Gravel pit)							
63.2.14	343*	83	37	76.5	47	29	46
63.2.44	337*	79	37*	75	45.5	27	47
10th – 13th century							
Kardoskút – Hatablak							
58.4.19	340*	86	38.5	79	53	31	47
58.4.190	340*	—	43	—	48.5	30	45
Tiszalök – Rázom							
275.a	327	—	39	71	47	26	44
285.b	—	—	39	73	—	—	45
299.f	—	—	—	65	—	—	40
14th – 17th century							
Fonyód 63.3.399	380*	—	41	84	42*	30	51
Kőszeg – Vár (Castle) 63.6.69	313	74.5	—	73.5	43.5	—	42.5
Szolnok – Vár (Castle) 64.7.140	380	88*	39	79	50	30	44

Metacarpus

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Bronze Age							
Békés – Városerdő							
53.1.10	214.5	50	35	49	36	22	37
53.1.12	—	—	—	54	—	—	38
53.1.20	—	—	—	47.5	—	18.5	35
53.4.740	221	48	34	49	36	21	37
	216	50.5	33	50	34	20.5	35

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
53.4.741	—	—	30.5	—	—	22	—
53.4.742	—	53	—	—	36	—	—
53.4.743	—	—	—	54	—	21.5	38
	—	—	—	48	—	20.5	—
60.7.122	—	46.5	—	—	31.5	—	—
Csepel—Háros	—	48	—	—	33.5	—	—
	—	—	—	47.5	—	22	35
	—	—	—	51.5	—	23	37
	—	47	34	—	33	—	—
	—	—	—	52	—	23	37
	—	50.5	—	—	35	—	—
	206	44	35	48.5	35	25	36
	—	—	—	50*	—	23.5	36*
	—	52	—	—	35	—	—
	—	51.5	35.5	—	35	—	—
	—	47*	—	—	33*	—	—
	—	51.5	35	—	35.5	—	—
	—	—	—	52	—	22	37
	—	—	—	52	—	20.5	36
	—	51.5	—	—	35.5	—	—
	—	49.5	33.5	—	34	—	—
	—	50	—	—	34	—	—
	204	48	33	50*	35.5	24	36
	206	48	33	49.5	34.5	24	36
	—	50.5	—	—	35	—	—
	—	—	—	49	—	—	35
	—	—	—	50*	—	23.5	35.5
	—	48*	—	—	33*	—	—
	—	—	—	48.5	—	21	34
	—	—	—	50	—	—	34.5
	—	46*	30.5	—	32*	—	—
Dunaújváros—Koszider							
881.a	—	51	29	—	—	21	—
934.c	221	53	35	51	36	23	36.5
944.c	216	53	33	50.5	35	22	35
960.e	219	50	36	52	35	24	37
971.d	213	47.5	34	48	34	21	36.5
993.b	—	—	—	53	—	—	36.5
1019.c	226	50	33	50.5	36	23	36
1040.d	—	—	—	52.5	—	26	38
1054.f	—	—	—	48.5	—	24	38
Jászdózsa 60.24.30	204	46.5	32	50	34	20	34
Nagykálló 61.25.61	226	51	36	54*	36	23	36
Iron Age							
Helemba—Sziget (Island)	197*	45.5	29	46*	32	19.5	32*
Period of the Roman Empire							
Ács—Vas puszta, castrum	227	48	33	48.5	32.5	24	37.5
Balatonaliga							
574.c	207	45	32	47	31	22	35
607.c	218	48	33	46	32	21	35

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
610.d	219	—	35	—	—	22	36
620.b	—	—	—	47	—	20	—
Budapest—Albertfalva	—	—	—	47	—	18.5	34
	216	46	32	46.5	36	22	36
	—	—	—	48.5	—	21.5	36.5
	—	50	—	—	34	—	—
	—	48	—	—	33.5	—	—
	245*	49	30.5	—	31.5	22	—
	240	53	33.5	—	37	24	37
	245	53	36.5	52.5	39	23	38
	240	55	36	50.5	37.5	23.5	39
	—	—	—	52	—	24	38
	—	—	—	52.5	—	24	—
	237	48.5	34	47	37	24	35
	227	47.5	33	—	34.5	22	33.5
	223	51	34	—	34.5	21	—
	242	53	33	48	38.5	24	36
	—	—	—	48.5	—	25	37
	220	45	32	46	31	19	34
	233	51	36	—	34	22.5	—
Migration Period							
Apagy—Barucha J. földje							
(J. Barucha's land)	215	48	34.5	47	35	21.5	34*
	218*	49	31	48.5	33	21	36.5
	219	51	35	49	35.5	23	36*
Kakasszék 62.12.3	226	48.5	34	47.5	35	23	35.5
Tiszavasvári—Paptelekhát	208	46	29.5	46*	32	19	33.5
	216*	—	33	47	—	22	35.5
	220*	—	34.5	—	—	20	—
Avar period							
Bágyog—Gyűrhegy, grave B	226	46	34	47	29	22	33.5
Deszk—Baráth A. földje							
(A. Baráth's land) 61.35.3	223	50	33.5	49*	33.5	20.5	36
Deszk—Ördögh földje							
(Ördögh's land) 61.34.15	208*	—	34	48	34	21	35
Hortobágy—Árkus,							
grave 13	240	53	35	54	38	23	40*
grave 23	216*	43	32	45*	33	19	32*
grave 24	219	46	30	48	33	20	35
grave 27	235	48	33	50	37	21	38
grave 29	211	45	32	48	30	21	34
grave 30	223	48	34	49	34	19	34
grave 32	232	52	32	48	35	21.5	37
grave 36	—	—	—	48	—	22	36.5
grave 39	221	48	34	48	34	22	35
grave 50	218	49	37	51	34	22	35
	233	53	35	53	36	22	37
Keszthely—Általános iskola							
(Primary school)							
65.3.15.Z	214.5	51.5	35	50	35	20.5	36
65.3.45.Z	230	47.5	36	50.5	36.5	22.5	37

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
65.3.110.Z	230*	52	39.5	53.5	38	23.5	36
Környe							
58.19.17	209	45	30.5	45	33	18	32
58.19.68	229	49	33	50	35	19	35.5
59.11.15	227	52	33.5	50.5	34	24	36
59.11.42	227	49	36	51	—	23	37
59.11.98	220	47	31	48	34.5	21	35
61.14.17	228	48	32	48	34	21	36
61.14.34	232	50	34	50	35	22.5	37
Óbuda – Szőlő utca (Street) 60.16.16	218	44	30	45	32	20.5	34.5
Pelypuszta	230	49.5	33	47	35	22	33.5
	232	49	33	47	34	22.5	36
Pókaszepetk							
64.9.15	210*	48*	34	47*	34*	22.5	34*
64.9.15.Z	211	48	34	47.5	34	22.5	34*
64.9.43	223	48.5	32.5	48*	36.5	20	34.5
64.9.75.Z	221	47*	31	46.5	34	21.5	35.5
64.9.104.Z	218	49	31.5	48.5	36.5	21.5	36
64.9.125.Z	206*	48*	36	—	—	22.5	35
Szeged – Makkoserdő							
62.2.51	211	48	34.5	47.5	35	22	35
62.2.104	219	52	36	50.5	36	23	38
Szekszárd – Palánk							
58.3.9.Z	—	—	—	50*	—	21.5	37
58.3.42.Z	216	47	30.5	46.5	33.5	22	36*
58.3.62.Z	229	51.5	34.5	53*	—	24	38*
58.3.88.Z	229	50	34.5	51	36.5	24.5	38
58.3.117.Z	227	47	33.5	49.5	33	22.5	36*
58.3.264	223	48	33	49	34	23	36
58.3.311	230	51	33	50	33	20.5	33.5
58.3.336	226	—	32	47.5	35	22	36
58.3.355	240	51.5	33.5	50	36	21	36.5
58.3.373	217	48	34	50	—	22	—
Szentes – Kaján							
61.36.19	226*	52.5	34	52	35	22.5	—
61.36.24	226.5	50	35.5	51.5	35.5	23	37
Szentes – Nagyhegy 61.38.9	221	50	35.5	49	36	23	35.5
Szőreg – Téglagyár (Brick-yard)							
61.33.8	221	50.5	35	49.5	36	22.5	38
61.33.53	218*	—	34	49.5	—	21.5	36
61.33.85	212	47	34	46	34.5	20.5	34
61.33.119	227	49	31.5	49	35	21	36
Vác – Kavicsbánya (Gravel pit)							
63.2.15	228	53.5	33	51.5	37	24.5	40.5
63.2.46	222.5	47.5	31	47.5	35.5	20.5	36.5
Period of the Magyar Conquesi							
Balotapuszta 61.20.6	230	53.5	34	52	37	23.5	40
Bana							
56.18.7	222*	49	—	—	35	20	—
56.18.15	218	52	35.5	—	36	23	35
Biharkeresztes, grave 1	222	47.5	34	47	35	20.5	34

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Bordány	229	51	33	51.5	33	25*	—
Csanytelek—Síróhegy 62.4.4	216	48.5	33.5	50.5	35	22	35
Dormánd—Hanyi puszta							
61.30.2	237	53	32	50	35.5	25	38*
62.29.5	227	46	31.5	49	34.5	22	35
Gádoros 62.6.4	232	55	36.5	51	37.5	22	39
Gerendás—Petőfi Tsz homokbányája (Sand pit of Petőfi Cooperative)							
64.16.9.Z	227	53	35	50	35	22.5	37
Kiskúndorozsma	223*	51	33	49.5	35	23	35.5
	223*	51	33	49.5	35	23	35.5
Hékút 62.33.5	219	47.5	34.5	47	33	20.5	34.5
Kiskúnfélegyháza 60.20.4	230*	49	31	—	34	22	—
Koroncó—Tószer dűlő (Baulk)	210	44	30	45	33.5	20	32
	210	45	30.5	44	33	21	32
Kübekháza—Újtelep 61.39.10	216	48	33.5	47	33	20.5	35
Magyarhomorog							
61.31.9	217	49	30	48	34	21	35
63.12.12	229	52	35	50	35	23	38.5
63.12.29	224	48	34	50	33	22	36
63.12.52	223	51	33	48	35	22.5	37
Mohács—Téglagyár (Brick-yard)							
61.28.6	222	47	32	46	34	21	34
60.14.10	230*	50	34	48	38	22	36
Orosháza—Görbics tanya (Farm)							
62.21.9	232	47.5	32.5	48*	33	21	36*
62.21.28	226	52.5	31	49*	35.5	23	37
Orosháza							
61.26.5	213	48	30.5	45.5	33.5	19	34
61.26.25	222	50	34	52	37	22	34
61.26.38	223	49	36	48.5	34.5	21	35.5
Röszke—Ladányi dűlő (Baulk) 62.10.5	211	45.5	31.5	46	32	21.5	33*
Szakony							
61.29.10	229	50	35.5	50.5	36.5	22	37.5
61.29.31	229	49	33.5	47	34	20.5	36
61.29.51	226	50	34	48	34	23	36.5
Szentes—Borbásföld							
59.18.3	221*	48	31	48	32.5	23	36
59.18.15	211	47	32	48	33.5	21	33.5
59.18.32	214	44	28	44.5	33.5	19	32
59.18.59	223	49	34	50	37	21	37
59.18.73	229	51	30	49.5	35.5	20	36
59.18.92	229	49	30	48.5	34	21.5	36
60.8.1	207	48	31	44	33	21	32.5
Tiszaeszlár—Bashalom							
61.19.5	219	47	34	45	31	22.5	33
61.19.19	218*	45	29	43*	31.5	20	—
61.19.34	217	46.5	30	—	33.5	19	32.5
61.19.46	219	48	34	50	35	22	35
61.19.58	220	48	32	—	33	20	34
61.19.67	229	49.5	36	—	34.5	21.5	37.5
Tiszanána 61.5.7	211	43	31.5	43.5	—	19	34.5

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Metacarpus (continued)

Age/Site	1	2	3	4	5	6	7
10th—13th century							
Csátalja—Vágotthegy 53.3.121	209.5	47	27	47	31.5	21	—
Kardoskút—Hatablak							
56.1.27	226	48	32	—	—	21	—
58.4.301	219	52	34	53.5	—	26.5	38
Röszke—Nagyszéksós 62.13.2	220	48	35.5	49.5	36	23	36
Szarvas—Rózsás 59.8.48	220	45	30	44	31	20	33
Tiszalök—Rázom							
194.c	—	—	—	48	—	24	38
230.a	—	—	—	48	—	25	—
275.b	221	50	34	50	33	23	38
341.c	241	54	38	53	35	27	39
361.b	—	49	30	—	—	—	—
381.b	220	48	34	50	33	23	36
381.c	—	—	—	49	—	—	37
412.e	211	50	32	49	35	21	36
413.d	—	—	—	51	—	22	38
426.c	220	50	36	—	35	22	37
428	227	53	39	52	—	24	—
14th—17th century							
Kőszeg—Vár (Castle) 63.6.70	204	46	33	—	32	21	32.5
Nagyvázsony—Csepely 61.21.109	195	43	28.5	44	31	20.5	—
Szolnok—Vár (Castle)							
64.7.141	208	46.5	33.5	45.5	33.5	22	34*
64.7.142	217	44.5	30	44	31.5	20.5	31
64.7.143	239	54	40	56	40	24.5	40*
64.7.144	238	54	39.5	55	39	24	39
Túrkeve—Móricz							
54.3.158	230	45	28.5	46	32.5	19.5	—
54.3.481	217	48	31	47	33	20	33
54.3.897	234	51	32.5	—	35.5	22	36

Femur

Measurements:
1. length to trochanter major
2. length to caput
3. breadth of proximal epiphysis
4. smallest breadth of diaphysis
5. breadth of distal epiphysis
6. diameter of proximal epiphysis
7. smallest diameter of diaphysis
8. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7	8
Avar period								
Deszk—Ördögh földje								
(Ördögh's land) 61.34.21	372	332	110	37.5	90*	85	44	112*
Halimba 62.45.37	367*	340	107	40	—	—	45	—
Hortobágy—Árkus,								
grave 13	410	370	118	44	98	97	49	127

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Femur (continued)

Age/Site	1	2	3	4	5	6	7	8
grave 23	380	350	109	38	87	76	41	110
grave 24	385	348	114	39	86	78	44	114
grave 30	398	358	120	42	94	83	49	115
grave 32	413	380	124	41	97	94	53	125
Keszthely – Általános iskola (Primary school)								
65.3.19.Z	397	356	—	45	91	—	50	114
65.3.50.Z	407	365	123	43	95	83.5	51	116
65.3.114.Z	408	372	120	44	95	99	50	119
Környe								
58.19.2	410	370	125	43	96	92	51	123
58.19.50	382	352	111	41	91	90	47	116
58.19.71	391	356	116	49	93	92	47	117
58.19.80	375	343	117	40	93	—	43.5	—
59.11.18	400	361	115	42	93.5	90	47	120
59.11.100	397	359	113	38	—	79	44	115
61.14.37	400	361	—	39	94	—	44	118
Pelypuszta, grave 12	390	352	111	38	89.5	—	48	118
Pókaszepetk								*
64.9.20	368	336	109	38	86	77	44	112
64.9.48.Z	397	364	120	38	—	85	49	113
64.9.109.Z	385	358	111	37	89	91	46	119
Szeged – Makkoserdő 62.2.126	392	355	118	41	86	81	47	116
Szekszárd – Palánk								*
58.3.26.Z	395*	357*	114	44	90*	87	49	122
58.3.128.Z	400	365	123	40	95	90	48	118
58.3.140.Z	382*	352*	120	42	96	93	49	119
58.3.177.Z	398	364	114	39.5	92	90	47	112
58.3.226	393	—	—	40	89	—	48	117
58.3.313	413	373	119	41	90	79	46	124
Szőreg – Téglagyár (Brick-yard)								
61.33.57	383*	350	—	37	89	—	45	113*
	383	350	113	38	89	80	45	112
61.33.90	380	343	110	36.5	87	76	43	111
61.33.122	388*	353*	113	40	—	80	47	118

Tibia

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Copper Age							
Békásmegyer – BUVÁTI	—	—	—	72.5	—	—	46
Bronze Age							
Csepel – Háros	—	—	—	71	—	—	45.5
	—	—	—	72	—	—	45*
	—	—	—	69	—	—	43.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	—	—	72*	—	—	42*
	—	—	—	75.5	—	—	47.5
	—	—	—	70*	—	—	45*
	—	—	—	74	—	—	47*
	—	—	—	72	—	—	45
	—	—	—	77	—	—	49.5
	—	97*	—	—	85*	—	—
	—	—	—	67	—	—	42
	—	—	—	74	—	—	45.5
	—	—	—	75	—	—	46*
	—	—	—	73	—	—	48
	—	—	—	74	—	—	47.5
	—	—	—	80	—	—	50
	—	—	—	74.5	—	—	46
Dunaújváros—Koszider							
881.b	331	—	45	72	—	33	47
1063.c	340	—	43	—	—	32	47
Tápiószele—Tűzköves							
246.a	326	88	39	70	76	30	46
260.e	—	—	36	—	—	27	—
Period of the Roman Empire							
Balatonaliga 621.a	363	98	42	—	85	31	—
Győr—Széchenyi-tér (Square)	385	—	48	73	—	31	49
Avar period							
Deszk—Ördögh földje (Ördögh's land)							
61.34.22	330	—	38	71	87	29.5	43
Hortobágy—Árkus,							
grave 27	357	—	39*	71	—	29	45
grave 30	356	99	40	73	95	29	44
grave 32	347	88*	37	68	80	30	34
Keszthely—Általános iskola (Primary school)							
65.3.21.Z	360	95	41	73	—	31	45
65.3.52.Z	373	100	41	70	99.5	31	45
65.3.116.Z	374	101.5	44	77	99	31.5	48
Környe							
58.19.3	362*	—	44	73	—	31	47
59.19.9	347	—	37	67	—	29	44
58.19.19	334	—	36	65	93	27	39
58.19.29	353*	—	40*	68*	—	30*	45*
58.19.52	342	—	40	75	—	29	48
58.19.71	357	96	38.5	70	94	31	47
59.11.20	353	—	40	75	—	31	47
59.11.43	342	—	40	73	—	30.5	47
59.11.76	322	90	35	65.5	88	26	43
59.11.103	343*	—	37	71	—	27	45
Óbuda—Szőlő utca (Street) 60.16.19	328	—	34	66	—	25	42
Pelypuszta, grave 12	344	—	41.5	71.5	91	31	45.5
Pókaszepetk							
64.9.22.Z	342	—	38	68.5	—	—	44

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Tibia (continued)

Age/Site	1	2	3	4	5	6	7
64.9.50.Z	363	96	39	70	95*	30	47*
64.9.111.Z	341	94	37.5	73.5	92	28.5	44.5
Szeged – Makkoserdő							
62.6.56	345*	—	40.5	68	—	30	42.5
62.2.110	358	98	40.5	73.5	88	31	47
Szekszárd – Palánk							
58.3.12.Z	346*	—	40.5	70	—	29.5	45
58.3.28.Z	345	—	41	69	—	30	45
58.3.90.Z	355*	—	40	71	—	31	47.5
58.3.130.Z	355*	—	39.5	71	—	29.5	46
58.3.141.Z	346	97	41	72	99	30	47.5
58.3.178.Z	357*	94	39	67	91	30	43
Szőreg – Téglagyár (Brick-yard)							
61.33.13	—	—	40	—	—	31	45
61.33.24	346	95	39	72	—	30	46.5
61.33.59	350	—	40.5	71	—	29	44
61.33.92	333	92	40.5	68.5	92	28	44
61.33.124	347	95	37.5	71	94	29	43
Vác – Kavicsbánya (Gravel pit) 63.2.50	345*	—	40	69	—	26.5	42.5
Period of the Magyar Conquest							
Szentes – Borbásföld 59.18.36	—	—	—	65	—	—	40.5
14th – 17th century							
Gyula – Vár (Castle)	361	93	37	72	97	26	43
	348	—	35.5	67	—	28	42

Astragalus

Measurements: 1. greatest length
2. greatest breadth
3. greatest height

Age/Site	1	2	3
Bronze Age			
Csepel – Háros	67	67	66
	65	67	60
	58	62	55
	59	64	62
	61	64	62
	65	63	57
	59	55	53
	59	—	—
	61	59	57
	62	63	—
	65	60	62
	65	—	—
	68	67	63

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Astragalus (continued)

Age/Site	1	2	3
	61	—	62
	65	68	60
	61	66	58
	58	63	60
	60	66	58
	60	66	58
	61	58	60
	61	62	59
	61	60	—
	62	60	60
	61	60	56
	68	—	64
Iron Age			
Helemba—Sziget (Island)	56.5	57	55
	59*	60	—
Avar period			
Hortobágy—Árkus			
grave 13	67	67	61
grave 17	60	62	54
grave 23	58	57	56
grave 24	56	58	52
grave 50	61	60	53
Szeged—Makkoserdő			
62.2.57	61	58	53
62.2.129	62	60	62
Szőreg—Téglagyár (Brick-yard)			
61.33.25	59	61	60
61.33.60	58	—	—
61.33.93	58	59	52
61.33.125	63	60	58
Period of the Magyar Conquest			
Biharkeresztes, grave 1	58	64	60
	58	64	60
Bordány	62	62	59
	61.5	62	58
Hékút 62.33.19	64	64	60
	63	62	61
Magyarhomorog			
61.31.13	58	57	57
	58.5	—	—
63.12.56	61	60	55
	61	61	55
Orosháza 61.26.44	60	63	50
Röszke—Ladányi dűlő (Baulk) 62.10.8	59	60	52
	59	60	52
Szakony			
61.29.14	62	63	57
61.29.35	62	62	59
61.29.55	62	61	58
Szentes—Borbásföld			
59.18.5	58	58	47

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Astragalus (continued)

Age/Site	1	2	3
59.18.17	61	60	54
	60	60	54
59.18.37	53	55	50
59.18.61	64	65	63
	64	64	63
59.18.75	60	64	59
60.8.5	56	55	52
	57	54	51
Tiszanána – Cseh tanya (Farm) 62.30.10	58	63	55.5
	59	63	56
10th – 13th century			
Tiszalök – Rázom			
278.d	52	53	48
315.c	61	60	59
343.c	52	58	56
354.a	61	68	60
	56	59	—
368.b	61	63	60
378.e	54	55	51
406.a	60	54	50
14th – 17th century			
Visegrád			
61.2.158	60.5	31.5	60
62.1.472	61	56	58
63.4.621	60	61	60
63.4.668	55	50	54

Calcaneus

Measurements: the same as those of the astragalus

Age/Site	1	2	3
Copper Age			
Békásmegyer – BUVÁTI	104	50	46
Bronze Age			
Békés – Városerdő			
53.4.751	109	51	54
	111	51	56
	107	49	51
	106	50.5	53
56.20.504	104	57	61
Csepel – Háros	110	56.5	51
	105	49	51
	106	48	47
	107	49	52
	114	54	56
	119	58	55
	114	53	54

Age/Site	1	2	3
	110	54	53
	110	50	55
	111	53	—
	112	53	—
	104	53	51
	111	51.5	54
	107	50	49
Nagyrév 640.d	108	50	51
Avar period			
Hortobágy — Árkus			
grave 13	115	52	55
grave 17	110	50	50
grave 23	106	48	50
grave 24	106	52	50
grave 27	108	48	47
grave 29	104	48	51
grave 30	108	50	49
grave 50	107	49	50
Keszthely — Általános iskola (Primary school)			
65.3.23	116	54	51
65.3.54	110.5	52	57
65.3.119	112.5	53	58
Period of the Magyar Conquest			
Biharkeresztes	110	54	51
Gerendás — Petőfi Tsz (Cooperative) 64.16.13	112	56	—
Hékút 62.33.20	114.5	53	52
Koroncó — Tószer dűlő (Baulk)	97	44	48
Magyarhomorog			
63.12.34	110*	50*	44
63.12.57	106	51	—
Mohács — Téglagyár (Brick-yard) 61.28.9	111	51	47
Orosháza 61.26.45	112	51	49
Szakony			
61.29.15	109	48	51
61.29.36	109	53	48
61.29.56	113	51	51
Tiszaeszlár — Bashalom			
61.19.7	108	52	48
61.19.49	108	52	48
Tiszanána — Cseh tanya (Farm) 62.30.11	106	52	50
10th — 13th century			
Kardoskút — Hatablak			
56.1.31	—	50	55
56.1.243	119	50	55
Tiszalök — Rázom			
416.d	—	51	56
816.d	104	48	49
834.d	103	50	—

Horse — Metatarsus

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Copper Age							
Békásmegyer – BUVÁTI	—	47	31.5	—	43	—	—
	—	—	—	52	—	24	36.5
	—	—	—	53	—	27	39.5
	—	—	—	53.5	—	26	38.5
Kenderes – Kulis 62.22.83	—	—	—	53	—	26	39.5
Bronze Age							
Békés – Városerdő							
53.1.19	265	49.5	33	49.5	46	25	38
54.4.753	256	51	32	51	47	26	39
56.20.480	—	51.5	—	—	43.5	—	—
62.19.402	—	51	—	—	44	—	—
Csepel – Háros	249	48	27.5	49*	45.5	25.5	38
	—	50*	—	—	44	—	—
	—	—	—	46.5	—	24.5	35*
	—	—	—	47	—	26.5	35*
	—	47	—	—	43.5	—	—
	—	—	—	52.5	—	27	39.5
	—	—	—	49*	—	26.5	37
	—	49.5	—	—	42.5	—	—
	—	—	—	53.5	—	28	39.5
	—	—	—	50.5	—	—	37*
	—	52*	—	—	55*	—	—
	—	—	—	47	—	23	36*
	—	—	—	50	—	26.5	36
	—	—	—	52	—	—	35.5
	—	52	—	—	47	—	—
	—	—	—	51.5	—	23.5	37.5
	—	—	—	54.5	—	27	40.5
	—	—	—	52	—	—	39
	—	—	—	53.5	—	27.5	42
	—	—	—	46.5	—	24	35.5
	—	51.5	—	—	47.5	—	—
	—	—	—	47.5	—	23.5	—
	—	—	—	51.5	—	—	36.5
	—	50	—	—	44.5	—	—
	—	51	—	—	44*	—	—
	—	52	31.5	—	48	—	—
	—	52*	32.5	—	45	—	—
	—	53	—	—	48	—	—
	—	53.5	—	—	48	—	—
	—	54	—	—	46.5	—	—
	—	—	—	48	—	25.5	38*
	—	—	—	48.5	—	—	36.5
	—	—	—	49.5	—	27	36.5
	—	—	—	50	—	27	38.5
	—	—	—	50.5	—	—	37
	—	—	—	51	—	—	39
	—	—	—	52.5	—	28	40.5
	—	—	—	53	—	25	38.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
	—	—	—	52	—	28	40
	—	—	—	56	—	28.5	39.5
	—	48.5	—	—	44	—	—
	—	53	32	—	50	—	—
	—	—	—	53*	—	27.5	39*
	—	—	—	55	—	24.5	39
	—	—	—	55*	—	—	39
	—	48	—	—	41.5	—	—
	—	—	—	49	—	23.5	35.5
	—	52.5	35	—	48	—	—
	—	54.5	—	—	50	—	—
	—	—	—	50*	—	26	38*
Dunaújváros – Koszider							
935.d	275.5	54.5	34	54	50	26	38
940.e	267	52	—	50	44	—	38
945.d	—	49.5	—	—	43	—	—
1020.c	—	54	—	—	47	—	—
1063.f	261	49	29	50	47	25.5	37
Kelebia, grave 71/a	259	—	28	—	—	—	—
Iron Age							
Helemba – Sziget (Island)	231	44	28.5	47	41	23.5	34
	253.5	46.5	28	48	43.5	22.5	37.5
	254	45.5	28	47.5	43.5	22	37.5
Period of the Roman Empire							
Pilismarót – I. őrtorony (Watch tower)	245	43.5	26	45.5	39	22.5	34
	245	43.5	26.5	45.5	39.5	22.5	34
	243	49	35	52	44.5	26.5	37.5
Balatonaliga							
575.a	265	48	29	—	43	25	—
590.b	—	51	31	—	42	—	—
597.e	—	49	27	—	43	—	—
620.c	264	51	35	50	45	25	36
Győr – Széchenyi tér (Square)	282	51	33.5	53.5	48	27	36
Migration Period							
Tiszavasvári – Paptelekhát							
62.217.1	263*	46	29	—	42*	24	—
62.219.1	242*	—	28	44	—	22	35
	254	48	31.5	49	44	24.5	38
62.389.4	255	47	30	44.5	—	24.5	37
Avar period							
Deszk – Baráth A. földje (A. Baráth's land)							
61.35.4	267	48.5	31	49	44	24.5	37.4
61.35.25	270	50*	32.5	50	51	27	38
Deszk – Ördögh földje (Ördögh's land)							
61.34.26	250	47	31.5	46.5	44.5	25.5	—
Hortobágy – Árkus							
grave 13	280	51	33	53	50.5	26.5	40
grave 17	—	49	—	—	45	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
grave 23	263	45	28	48	45	23	37
grave 24	265	47	29	48	45	23	37
grave 27	282	48	30*	49	45	25	38.5
grave 29	255	46	31	46	42	25	35.5
grave 30	261	50	31	47.5	43	25	36
grave 32	280	47	29	47	45	25	37
grave 36	269	50	31.5	49	46	27	37.5
grave 50	258	47	34	50	45	25	34.5
Keszthely—Általános iskola (Primary school)							
65.3.25	262	52.5	32.5	47	46	26	36.5
65.3.56	272	46.5	32	50.5	47.5	25.5	32
65.3.121	273.5	50	35	51.5	50	26	37
Környe							
58.19.5	275	—	34	—	47	26	36
58.19.10	—	47	32	—	43	—	—
58.19.20	252	44.5	29	45	40	21	34.5
58.19.32	265*	—	33	—	—	24	33*
58.19.74	275	47.5	30	—	48	—	—
59.11.24	266	51	31	51	48	26	36
59.11.45	270	50	32	50.5	45	25	38.5
59.11.79	254	46	28	46	44	21	35.5
59.11.107	267	47	28	47	42	23	35
61.14.21	271	47.5	30	46	44	24	37
61.14.42	279	48	31	48	48	26	38
Óbuda—Szőlő utca (Street) 60.16.22	262	44	28	45	44.5	23	37
Pelypuszta, grave 12	277	49	31	47	48	26	36.5
Pókaszepetk							
64.9.26	253	47	30.5	48*	44.5	24.5	—
64.9.54	265	49.5	29.5	48	46	24	36
64.9.75	262	46	28.5	47*	46.5	24	37
64.9.115	263	46	29.5	46	48	24.5	38*
64.9.131	253*	48*	33	49.5	—	25	—
Szeged—Makkoserdő							
62.2.61	251	47	32	48	45	25.5	36
62.2.132	262	51.5	33	—	49	26	—
Szekszárd—Palánk							
58.3.14	266	46	29.5	—	44.5	25	36.5
58.3.29	256	46.5	30	48	45.5	24	38
58.3.66	270*	—	32.5	52	—	26	39
58.3.93	271	48.5	33	50*	47	26	—
58.3.102	274*	—	31.5	47.5	—	27	—
58.3.132	277	51*	31	51	47.5	26.5	38
58.3.142	257	51.5	30.5	50	48.5	25.5	38.5
58.3.179	270	46	31	48	44.5	24	36
58.3.271	266	49	33	47	45	24	36.5
58.3.284	259	45	30	—	47	22	—
58.3.318	278	52.5	32	50	48	25.5	38.5
58.3.378	266	50	32.5	49.5	45	26	37
58.3.392	282	51	32	49	48	26	—
Szentes—Kaján 61.36.20	272	50	32	52	47	26	40.5
Szentes—Nagyhegy 61.38.13	260*	49*	—	—	—	—	—

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
Szőreg—Téglagyár (Brick-yard)							
61.33.14	259	—	—	—	—	—	—
61.33.27	268	49.5	30.5	48.5	47.5	25.5	39
61.33.62	266	46	31	—	47	25	37.5
61.33.96	253	48	30.5	46	—	22.5	36*
51.33.128	274	50	30	48	44	25	37
Vác—Kavicsbánya (Gravel pit)							
63.2.24	269	53	30.5	51*	47.5	25.5	40.5
63.2.55	265	47	30	47	45.5	—	—
Period of the Magyar Conquest							
Bana							
56.18.10	262*	48	31.5	—	—	25	37
56.18.21	259	50	32	50	45	25	35
56.18.32	262*	50.5	31	—	—	25	—
Biharkeresztes	259	46	32.5	48	45	25	34
Bordány	274	50	30	—	45.5	25	—
Csanytelek 62.4.8	256	49.5	30.5	49	47.5	24.5	36.5
Gádoros 62.6.6	272	49	32.5	49	49	25	38.5
Dormánd—Hanyi puszta							
61.30.9	285	51	30.5	49	48	27.5	39
62.29.12	274	48.5	29	48.5	43.5	25	37
Gerendás—Petőfi Tsz (Cooperative)							
64.16.14	269	52	31.5	49	47.5	25	38
Geszteréd	281	48.5	35	52	49	28	38
Hékút							
62.33.1	267	48.5	30	47.5	—	24	38
62.33.6	264	47	32.5	47	44.5	24.5	36
62.33.23	261	48	30.5	48	46	23.5	39
Kiskúndorozsma—Vöröshomok dülő	263	50	31	49	48	26	37
Kiskúnfélegyháza 60.20.5	277	49	30.5	49	46	25.5	38
Koroncó—Tószer dülő (Baulk)	250	42	28.5	44	39.5	22.5	33
Kübekháza—Újtelep							
61.39.14	259	46	31	45.5	46	24	35
61.39.30	255	49.5	29.5	48	48	24	38.5
Magyarhomorog							
63.12.36	266	46.5	30	49	46	26	37
63.12.59	269	48	28	47.5	46	24.5	38
Mohács—Téglagyár (Brick-yard)							
60.14.13	279	49	30	50	49	26	37
Nagykőrös—Fekete dűlő (Baulk)							
grave II	276	48	33	49	44	25	36
Orosháza—Görbics tanya (Farm)							
62.21.16	273	47	29	47.5	42	25	—
62.21.32	270	51	29	49	45	26	38
Orosháza							
61.26.11	255	47	28	45	42	21.5	34
61.26.30	264	47	30	52	47	25	—
61.26.46	261	50	32.5	49	44.5	25	36
Röszke—Ladányi dűlő (Baulk) 62.10.10	259	45	28	45	43.5	24.5	34.5
Szakony							
61.29.17	271	49.5	33	51	46.5	25	39

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6	7
61.29.38	272	47	32	48	43	24.5	38.5
61.29.58	271	51	32	49.5	46.5	26	37.5
Szentes – Borbásföld							
59.18.8	270	48	30.5	—	46	26	37.5
59.18.20	251	45	31	47	45	24	35
59.18.40	259	44	26.5	46	42	22.5	35
59.18.64	266	52	31	50	49	25	40
59.18.78	271	48	28	48	47	25	37
59.18.94	274	50	27.5	48	44.5	23.5	37
60.8.8	250	43	28.5	43.5	41	22	34
Tiszaeszlár – Bashalom							
61.19.8	266	48	32	47	43	26	34
61.19.13	256	44	29	43.5	42	23	34.5
61.19.22	259	44	28	43*	41	23.5	—
61.19.37	266	46	29	47	44.5	22	—
61.19.51	260	47	30	48	48	25	37
61.19.62	265	46	30	46.5	44.5	23	34.5
61.19.70	270	50	32.5	49	45.5	25	38
Tiszaeszlár – Vörösmarty utca (Street) 37 grave 1	257	50	32	46	46	25	35
Tiszanána – Cseh tanya 61.5.8	251	45.5	29.5	44	42.5	21	35
10th – 13th century							
Csátalja – Vágotthegy 53.3.99	267	47	27	47	41	23	36.5
Doboz – Hajdúirtás 64.8.62	277	48.5	30	46	45	24	36
Kardoskút – Hatablak							
56.1.133	265	—	30	48	—	23.5	—
56.1.245	265	49	—	—	47	—	37
56.1.271	273	47	32	48	44	24	36
56.1.276	262	47	29	46	44	23	37.5
56.1.296	256	44	27	—	42	23	34
56.1.245	—	49	—	—	44	—	—
58.4.273	—	—	—	47	—	25	36
Kúhegyes – Jajhalom	267	51.5	35	49	48	26.5	39.5
Tiszalök – Rázom							
211.d	—	—	—	47	—	25	37
298.c	—	50	—	—	43	—	—
378.a	250	—	—	46	—	24	—
381.d	—	—	34	—	—	—	—
486.b	238	45	29	45	39	23	34
512.d	259	48	32	47	45	24	37
816.e	263	49.5	32.5	50	44.5	26	38
	252.5	46	34	48	43	25.5	37
820.e	259	49	32	—	—	25	—
14th – 17th century							
Gyula – Vár (Castle)	285	53.5	33	53	49	27	40
Kecskemét – Bocskay utca (Street)	286	57.5	32.5	53	51	27.5	41
Szolnok – Vár (Castle)							
64.7.147	267	46	30	47.5	46.5	25.5	40
64.7.148	290	53	33.5	52*	50	29.5	40

* In the tables, the approximate measurements are marked by an asterisk.

Horse — Metatarsus (continued)

Age/Site	1	2	3	4	5	6	7
Túrkeve—Móricz							
54.3.7	257	46.5	29	44	40	24	34
54.3.489	283	52	30.5	52	50.5	23	38
54.3.792	—	56	—	—	50	—	—
54.2.902	—	48	—	—	43	—	—
55.20.7	280	45	29.5	—	46	23.5	—
55.20.62	280	48	32	48	47	24.5	38

Cat — Felis domestica Briss.

Mandible

	length up to angulus	length up to processus coronoideus	length of row of teeth	height up to processus coronoideus
14th—17th century				
Visegrád 61.1.1597	59	59	31	25.5

Scapula

Measurements: 1. greatest length
2. greatest breadth
3. smallest breadth of collum scapulae
4. breadth of angulus articularis
5. diameter of facies articularis

Age/Site	1	2	3	4	5
14th—17th century					
Visegrád					
58.2.6	—	—	11.5	13	9
59.3.33	—	—	14	17	10.5
59.8.93	—	—	10.4	11.4	7.6
	—	—	10.5	11.6	7.6
61.1.567	43	32	10	12	7
61.1.1601	63	53	11.5	13	9
64.1.285	56	—	10.3	11.5	7.8
64.1.748	60	46.5	11.1	12.2	7.9

Cat — Humerus

Measurements: 1. greatest length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Period of the Roman Empire							
Budapest—Albertfalva	115	18	8	20	23.5	8.5	14
14th—17th century							
Visegrád							
58.2.7	95	17	7	18	20.5	12.5	7.5
59.8.85	83.6	13.8	5.6	16	17.5	6.5	10
59.10.99	—	—	5.8	15.6	—	6.2	9.2
61.1.226	83	14.5	5.8	16	18.2	6.5	9.5
61.1.319	89	16	7	17	20.3	7.3	10
	96	18.8	7	18	12	6.8	16
61.1.568	71.5	12	5	14.5	13.5	6	8.5
	71.5	12	5	15	13.5	6	8.5
61.1.1602	92.2	16	6.5	17.5	20.5	7	10.5
61.1.1679	83.5	14	6	16.8	17.5	6.5	10
61.1.1782	83.8	13.8	5.6	15.4	14.2	6.5	10
64.1.286	82.5	14	5.5	16	17.8	6.4	9.2
64.1.749	—	—	6	16.8	—	7.8	9.7

Radius

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Period of the Roman Empire							
Budapest—Albertfalva	113	8.5	5.8	13.8	8	4	9
14th—17th century							
Visegrád							
58.2.8	93	8	5	12.5	6	3.5	8
59.8.96	79	6.6	4	10.5	6	3.3	6.6
59.8.97	—	—	—	10.5	—	3.3	—
59.10.100	111.5	10.2	5	11	6.9	4	6.8
61.1.569	78	6.5	3.3	9.4	5.5	3	6
61.1.1603	87	6.5	5	12.2	6.5	4	8
61.1.1783	87	7	5	12	6.5	4	7.3

Cat — Femur

Measurements:
1. length to the trochanter major
2. length to the caput
3. breadth of proximal epiphysis
4. smallest breadth of diaphysis
5. breadth of distal epiphysis
6. diameter of proximal epiphysis
7. smallest diameter of diaphysis
8. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7	8
Period of the Roman Empire								
Budapest—Albertfalva	126.5	125	23	9.5	21	11.5	9	20
14th—17th century								
Visegrád								
58.2.13	104	102.5	19	7	18	17	8	14.5
59.8.100	—	91	17.5	7	16.2	11	6.6	15.6
	—	90	17.5	7	16	—	6.4	—
59.10.187	—	89.5	18	7	18	11	7	21
61.1.572	—	80	16	5.5	15	9	5.5	13
61.1.1607	100	101	20.5	8.2	18	12	7.5	17
61.1.1739	88	89	17	6.8	16.5	9	7	15.5
64.1.289	88.5	88.3	16.7	6.5	16.5	10.2	6.7	15.5
64.1.751	95.4	95.3	19.2	7.3	16.5	10	7.4	16

Tibia

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Period of the Roman Empire							
Budapest—Albertfalva	129	22	8	16	21.5	8	11
14th—17th century							
Visegrád							
58.2.15	112.5	19	7	15	18	7	9.5
59.8.101	97.5	—	6	12.5	—	5.3	—
61.1.227	91	16	4.8	12.8	15.7	5	8
	96	16.3	6.2	13.7	14.8	5.8	9
61.1.573	88.5	15	5	11.5	12.5	5	7.5
61.1.1608	107	18.5	6.5	15	19.5	6.5	9.5
61.1.1740	97	17.5	6.5	12.5	16.5	6	8.5
64.1.290	90	16.2	6.2	12.8	16.2	6.3	9.1
	94	16	6	12.8	17	5.8	8.4
	102	18	6.5	13	17	6.2	9.3
	105.2	18	6.6	14.2	19	6.6	9.6

Dog — Canis familiaris L.

Skull

Measurements:

1. basal length
2. overall length
3. $I_1 - M_1$
4. M_1 — basion
5. I_1 — aboral end of palate (length of palate)
6. aboral end of palate — basion
7. length of row of teeth ($I_1 - M_3$)
8. length of row of incisors
9. length of diastema
10. $P_1 - P_4$
11. $M_1 - M_2$
12. length of foramen magnum
13. I_1 — aboral end of ossa nasalia
14. aboral end of ossa nasalia — opisthion
15. I_1 — to the middle of the straight line connecting the extreme breadth of frontal bones
16. this latter point — opisthion
17. extreme breadth of skull
18. extreme breadth of front
19. extreme breadth of brain case
20. distance between medial canthuses
21. breadth at the foramina infraorbitalia
22. breadth of row of incisors
23. breadth at the canines
24. $P_1 - P_1$
25. $M_1 - M_1$
26. breadth at the processus jugulares
27. breadth at the mandibular joints
28. breadth at the external auditory meatuses
29. breadth at the condylus occipitales
30. breadth of the foramen magnum
31. height of occiput (basion — opisthion)

Measurement	Polgár - Basatanya, Neolithic	Röszke - Lúdvár, Neolithic	Polgár - Basatanya, Early Copper Age	Dunaújváros - Koszider, Bronze Age	Füzesabony, Bronze Age	Tiszaluc - Dankadomb, Bronze Age	Zalaszentmihály, Bronze Age	Sághegy, Hallstatt period	Százhalombatta - Dunafüred, Period of the Roman Empire	Keszthely - Deák u. (Street), Roman or Migration Period
1.	—	—	138	152*	—	165.5	—	159	187*	155
2.	—	—	154	178*	190	187.5	—	178	218	179
3.	68	—	63	70*	74	69	—	72	84	71
4.	—	85*	75	83*	—	97.5	88.5	88	104*	84
5.	81	—	—	—	93	92	—	89.5	106.5	98
6.	—	—	—	—	—	—	71.5	71	79*	67.5
7.	84	—	81	88*	92.5	92	—	88	101	89
8.	10	—	10	9*	9.5	10	—	10	11	9
9.	15.5	—	16.5	16.0	18.5	18	—	16.5	20	17.5
10.	45	46.5	43.5	45	50	47	47	45	57.5	47
11.	18	18.5	16	18	18.5	19	18	20	20.5	18
12.	—	—	14.5	17*	—	17	16	16*	—	16
13.	85	—	—	87*	94	89.5	—	87	103	88.5
14.	—	97	—	98.5	101	104	92	100	114	98.5
15.	94	—	—	102*	105.5	106.5	—	104	125.5	104.5
16.	—	88*	—	87	93	90	80.5	94	104	88.5
17.	95	—	81	—	—	—	96.5	—	118	96
18.	41.5	45	40*	49.5	47	45.5	49.5	54.5	54.5	50
19.	53	60	55	60	62	62	59.5	62	69	59
20.	30	—	28	34	34	34.5	33.5	36.5	39	34.5
21.	—	—	32.5	34	39	39	33.5	38	47	36.5
22.	26	—	20.5	24	25	27	—	25.5	30	24.5
23.	34	—	32	34*	37	38	—	36	45*	34.5
24.	32	—	29	32	33.5	34	30.5	34	41	31.5
25.	56	—	54	61	61.5	61	59	59	75*	60.5

* In the tables, the approximate measurements are marked by an asterisk.

Dog — Skull (continued)

Measurement	Polgár - Basatanya, Neolithic	Röszke - Ludvár, Neolithic	Polgár - Basatanya, Early Copper Age	Dunaújváros - Koszider, Bronze Age	Füzesabony, Bronze Age	Tiszaluc - Dankadomb, Bronze Age	Zalaszentmihály, Bronze Age	Sághegy, Hallstatt period	Százhalombatta - Dunafüred, Period of the Roman Empire	Keszthely Deák u. (Street), Roman or Migration Period
26.	—	—	40.5	49	—	51	—	48.5	60	46.5
27.	84	—	74	—	—	—	86	—	104	87
28.	—	60	50	61	60	61.5	55	59.5	66	58.5
29.	—	39	31	36	—	39	34.5	34	45	36
30.	—	21.5	15.5	18	—	19.5	18	17	—	18
31.	—	47*	38	48*	—	46	41	44.5	—	47.5

Measurement	Keszthely - Deák u. (Street), Roman or Migration Period	Hegykő, Langobard	ditto	Tiszaeszlár - Bashalom, Period of Árpád Dynasty	Bóly, Period of Árpád Dynasty	Doboz - Hajduirtás, Period of Árpád Dynasty	Kardoskút - Hatablak, Period of Árpád Dynasty	Zalavár, Period of Árpád Dynasty	Túrkeve - Móricz, 15th 16th century
1.	—	189	188	188	—	—	174*	183	197
2.	—	213	212	214	—	—	198*	206	223
3.	75.5	81	83	86	—	—	74*	82	88
4.	—	110	106	102	—	—	100	102	109.5
5.	—	103	—	—	—	—	95*	104	105.5
6.	—	87	—	—	—	—	80	80	99*
7.	98.5	100	102	103	—	—	98*	99	105.5
8.	12	10	10	11	—	—	10*	8	10.5
9.	18	21	22	20.5	—	—	20	21.5	21.5
10.	51	54	54	57.5	55	—	51	54	57
11.	20	20.5	20	19	20.5	—	19	20	21
12.	19.5	17	18	18	185	17	17	17	19.5
13.	91	113	112	107	—	—	102	105.5	116
14.	—	110.5	110	117.5	—	104	106	113	114
15.	—	125	123	124.5	—	—	113*	120	128
16.	—	100	101	103	101	87.5	96	100.5	106
17.	—	115	115.5	116*	—	—	103	—	123
18.	—	55.5	56.5	58	60	47.5	48	51.5	62.5
19.	65	67	68	67.5	65.5	60	64.5	66.5	67
20.	37	43	41	42.5	—	36	—	39	42.5
21.	42.5	42	43	44.5	41*	—	—	40.5	47
22.	27.5	27	28	28	—	—	25	26.5	30.5
23.	41	39.5	40	40	37*	—	38*	40	45
24.	38.5	35	37.5	37.5	34*	—	35.5	35.5	44
25.	68	71.5	69	69	64*	—	64.5	65	71

* In the tables, the approximate measurements are marked by an asterisk.

Dog — Skull (continued)

Measurement	Keszthely Deák u. (Street), Roman or Migration Period	Hegykő, Langobard	ditto	Tiszaeszlár - Bashalom, Period of Árpád Dynasty	Bóly, Period of Árpád Dynasty	Doboz - Hajduirtás, Period of Árpád Dynasty	Kardoskút Hatablak, Period of Árpád Dynasty	Zalavár, Period of Árpád Dynasty	Túrkeve - Móricz, 15th - 16th century
26.	53.5	55	54	53	55.5	51	53.5	—	59
27.	92	107	107	95	—	—	97	—	110
28.	63	67.5	66	65.5	65	61	62	62	66
29.	39.5	40	41	38.5	42	37	40.5	42	42
30.	20	20.5	21	20	20.5	19	19	20.5	—
31.	48.5	53	52	48	48.5	46	45	49	55

Mandible

Measurements:
1. length to the angulus
2. length to the processus coronoideus
3. height at P_1
4. height at M_1
5. length of row of teeth
6. length of incisor row
7. length of diastema
8. $P_1 - P_4$
9. $M_1 - M_3$
10. length of M_1

Age/Site	1	2	3	4	5	6	7	8	9	10
Neolithic										
Lebő										
451	—	—	17	18	83	3	13	36	33	20
465	—	—	16	19	82	4	14	33	31	19
	—	117	17	20	88	4	13	38	33	19
469	—	—	16	18	83	3	14	32	32	20
Polgár – Csősz-halom	—	130	30	24	90	3	13	40	33	19
Röszke – Lúdvár	—	—	—	18	—	—	—	30	30	18
	—	—	—	—	—	—	—	38	35	22
	—	—	18	20	—	—	—	32	34	20.5
	—	—	—	19.5	—	—	—	—	32.5	20
Szilmeg	—	—	—	22.5	—	—	—	—	32	20.5
Copper Age										
Polgár – Basa-tanya 53.7.128	—	—	16	16.5	81	5	14	33	30	19
Bronze Age										
Békés – Városerdő										
53.4.763	150	—	21	24.5	101	3	20.5	42.5	38	24
53.4.765	119	110	16	18.5	83	2.5	14	33	33.5	19
53.4.766	—	—	17	20.5	94	4	14.5	40	38	22
53.4.769	—	—	16	20	—	2.5	12	40	—	19
53.4.770	—	—	18	23.5	—	—	16.5	38	36	21.5
53.4.771	—	—	15	19	88	4	14.5	36	32.5	20.5

Age/Site	1	2	3	4	5	6	7	8	9	10
53.4.772	132	128	17	21	93	4.5	18	38	35	21
53.4.773	143	—	18	23	95	5	16.5	40	37.5	22
56.20.398	—	—	—	21.5	—	—	—	36	36.5	22
56.20.473	—	—	—	19	—	—	—	34.5	31.5	18
60.7.36	—	—	15	20.5	—	—	—	41	33	20
60.7.107	108*	—	16	18	83*	—	13	35	33.5	19.5
60.7.496	134*	—	18	22.5	94*	3*	18	39	35	19
62.19.91	136	136	18	21.5	94.5	5	17	38.5	35	21.5
Dunaújváros — Koszider 900	119	117	16	18	85	3.5	13	34	35	21
Füzesabony										
57.6.106	—	—	20	22.5	—	—	—	40.5	35.5	21
57.18.66	—	—	—	22.5	—	—	—	—	33.5	19
57.18.233	—	—	—	22	—	—	—	36	35.5	21
58.18.234	141	135	20	22.5	97	5	17	40.5	35	21
58.18.235	—	—	—	18.5	—	—	—	35.5	33.5	20
58.18.235	135	—	17	20	95	3.5	16	42	35	20.5
58.18.236	—	—	18	24	—	—	—	41.5	—	20
Nagykálló 62.20.3	144	143	20	23.5	101	5	16	41.5	38.5	22
Süttő 62.44.277	—	—	15.5	20	—	—	13	38	33.5	18
10th — 13th century										
Boly 59.7.3	—	—	19	23.5	—	—	—	42.5	40	22.5
Kardoskút — Hatablak										
56.1.195	—	158	21	24.5	110	6	21	43	43.5	25.5
56.1.257	—	—	19	19	—	—	—	36.5	38	22
Szarvas — Rózsás 59.8.90	143*	—	23	29	93*	—	—	42	37*	21.5
14th — 17th century										
Túrkeve — Móricz 54.3.591	—	—	22	25	—	—	—	43	39.5	22.5
Nagyvázsony — Csepely										
61.21.33	—	—	—	19.5	—	—	—	36	37	21
61.21.67	146	—	17	22.5	104*	4	15	46	39	23

Atlas

Measurements:
1. length of body
2. length of arch
3. breadth of cranial articular surface
4. breadth of caudal articular surface
5. greatest breadth
6. greatest height

Age/Site	1	2	3	4	5	6
Bronze Age						
Békés — Városerdő 53.4.779	10	18.5	40	33	—	28.5

* In the tables, the approximate measurements are marked by an asterisk.

Age/Site	1	2	3	4	5	6
60.7.329	9	17	38.5	30	83	28
60.7.497	8	17	38	32.5	—	27.5
Nagykálló 62.20.4	8	15	41.5	33.5	78	28.5
14th—17th century						
Túrkeve—Móricz 54.3.780	9	16	38	32	77	26.5

Epistropheus

Measurements: 1. length of body
2. length of arch
3. length of dens
4. breadth of dens
5. breadth of caput craniale
6. breadth of fossa caudalis
7. greatest breadth
8. greatest height

Age/Site	1	2	3	4	5	6	7	8
Bronze Age								
Süttő 62.44.790	44.5	19	10	6	25	16	32	36

Scapula

Measurements: 1. greatest length
2. greatest breadth
3. smallest breadth of collum scapulae
4. breadth of angulus articularis
5. diameter of facies articularis

Age/Site	1	2	3	4	5
Neolithic					
Aszód—Papi földek	—	—	24.5	28.5	14.8
Bronze Age					
Békés—Városerdő 53.4.827	—	—	21.5	26.5	16
	—	—	26	33	20
Dunaújváros—Koszider 907	116	—	23	27.5	16.5
Süttő 62.44.104	118	—	24	29	19
Period of the Roman Empire					
Nagytétény 57.2.24	—	—	23	29	18
Pilismarót—I. őrtorony (Watch tower)	—	—	25.7	31	17*
10th—13th century					
Kardoskút—Hatablak 56.1.181	177.5	107	31	38.5	24
Szarvas—Rózsás 59.8.234	125	69	23	27	16.5
14th—17th century					
Túrkeve—Móricz 54.3.782	126.5	—	24.5	29.5	17.5

* In the tables, the approximate measurements are marked by an asterisk.

Dog — Humerus

Measurements: 1. greatest length
2. breadth of proximal epiphysis
3. smallest breadth of diaphysis
4. breadth of distal epiphysis
5. diameter of proximal epiphysis
6. smallest diameter of diaphysis
7. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7
Copper Age							
Aszód—Papi földek	133	30	13.5	31	39	14	27
	—	—	—	27.5	—	14	21
Period of the Roman Empire							
Nagytétény							
57.2.34	168*	29	14	32.5	42	15.5	27
57.2.42	—	31	14.5	32.5	—	14	28
Tokod—Erzsébet akna (Shaft)	182	32	15	33.5	43.5	17.5	27.5
10th—13th century							
Bóly 59.7.14	198	—	14	34	47.5	15	31
Kardoskút—Hatablak 56.1.202	227	—	14	41.5	54	15	38
Szarvas—Rózsás 59.8.235	—	28	12	—	36.5	—	—
14th—17th century							
Túrkeve—Móricz 54.3.783	—	—	29	—	—	12.2	27

Radius

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Röszke—Lúdvár	—	—	—	21.3	—	—	13
Bronze Age							
Békés—Városerdő							
54.3.952	212	26.5	17.5	34.5	20.5	10	20
58.18.247	—	—	12	23.5	—	—	13.5
Süttő 62.44.552	—	—	11.5	21	—	—	12.5
Period of the Roman Empire							
Balatonaliga 606	169	18	12.5	23	12.5	7	13.5
10th—13th century							
Kardoskút—Hatablak 56.1.148	217	24	16	32	16	8	17.5
Szarvas—Rózsás 59.8.236	160.5	17	12	23	11	6	12.5
14th—17th century							
Túrkeve—Móricz 54.3.952	—	26	18.5	—	18.5	9.5	—

* In the tables, the approximate measurements are marked by an asterisk.

Dog — Femur

Measurements: 1. length to the trochanter major
2. length to the caput
3. breadth of proximal epiphysis
4. smallest breadth of diaphysis
5. breadth of distal epiphysis
6. diameter of proximal epiphysis
7. smallest diameter of diaphysis
8. diameter of distal epiphysis

Age/Site	1	2	3	4	5	6	7	8
Neolithic								
Röszke—Lúdvár	153	152.5	34.5	12.5	29	21	11.5	30.5
Bronze Age								
Dunaújváros—Koszider 891	167*	170	35	13	28.5	—	11.5	28
Nagykálló 62.20.18	—	183	—	13.5	33	—	14	37
Palotás—Homokos 59.4.4	187.5	188	38	14	33.5	23	14.5	35
Period of the Roman Empire								
Nagytétény								
57.2.27	—	—	41	14.5	—	20.5	—	—
57.2.43	—	—	40	12	—	26.5	13.5	—
10th—13th century								
Bóly 59.7.22	215	218	44	14	35	26	17.5	39
Kardoskút—Hatablak 56.1.181	239	242	48.5	13.5	38.5	30.0	16.5	47
14th—17th century								
Túrkeve—Móricz 54.3.786	147	146	37.5	14	30.5	19.5	14	35.5

Tibia

Measurements: the same as those of the humerus

Age/Site	1	2	3	4	5	6	7
Neolithic							
Polgár—Csőszhalom 60.9.910	151	29.5	11	20	32	10	13.5
Röszke—Lúdvár	—	—	12.5	21.5	—	11.5	16.5
Szilmeg 544	152	—	9	19	—	9.5	13
Copper Age							
Aszód—Papi földek	140.5	28	10.5	18	30	9.8	13
Bronze Age							
Békés—Városerdő 53.4.787	—	—	11.5	22	—	11.5	16
Nyergesújfalu—Téglagyár (Brick-works)	—	—	10.7	19	—	9.2	13.3
Period of the Roman Empire							
Nagytétény 57.2.38	185	34	13	23.5	37	12.5	17.5
10th—13th century							
Bóly 59.7.23	—	—	15	26	—	13.5	19.5
Kardoskút—Hatablak 56.1.205	243	41.5	13.5	28	49.5	14.5	20.5

* In the tables, the approximate measurements are marked by an asterisk.

Dog — Tibia (continued)

Age/Site	1	2	3	4	5	6	7
14th–17th century							
Túrkeve–Móric							
54.3.787	142	32.5	13.5	23	36.5	12.5	16.5
54.3.813	190	40	15	25	41.5	16.5	19

LITERATURE

ACSÁDY, I., 1944, *A magyar jobbágyság története* (The history of serfdom in Hungary), Budapest

ADAM, K. D., 1954, Die mittelpleistozänen Faunen von Steinheim a. d. Murr (Württemberg), *Quaternaria*, **1**, 131—144

ADAMETZ, L., 1898, Studien über Bos brachyceros, die wilde Stammform der Brachycerosrassen in Europa, *Journ. f. Landwirtsch.*, **46**, 17—31

— 1915, Untersuchungen über Capra prisca, einer ausgestorbenen neuen Stammform unserer Hausziegen, *Mitt. d. landw. Lehrkanz. d. k. k. Hochsch. f. Bodenkult. in Wien*, **III**, **1**, 1—21

— 1925, Kraniologische Untersuchungen des Wildrindes von Pamiatkowo, *Arb. d. Lehrkanz. f. Tierz. a. d. Hochsch. f. Bodenkult. in Wien*, **3**, 1—25

— 1928, Über neolithische Ziegen des östlichen Mitteleuropas, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **12**, 63—83

ADLERBERG, G. P. — Адлерберг, Г. П., 1933, К вопросу домашних свиней. *Пробл. происхождения дом. животн*, Ленинград, 185—209

ALIKHOVA, A. E. — Алихова, А. Е., 1955, Курганы эпохи бронзы у с. Комаровки, КСИИМК, Л, 91—99

AMBROS, C., 1958a, Zvieracie kosti z doby bronzovej a Dvorov nad Žitavou (Tierknochen aus der Bronzezeit von Dvory nad Žitavou), *Slov. Arch.*, **VI-1**, 66—81

— 1958b, Zvieracie zvysky z Bešeňova a Nitrianskeho Hrádku (Tierreste aus Bešeňov und Nitriansky Hrádok, Bez. Surany), *Slov. Arch.*, **VI-2**, 414—418

— 1959a, Chov domácich zvierat v stredrovekej osade Budmerice (Mittelalterliche Haustierzucht in Budmerice), *Slov. Narodop.*, **VII-4**, 560—568

— 1959b, Zvieracie zvysky z doby bronzovej z Gánoviec, okr. Poprad (Tierreste aus der Bronzezeit in Gánovce, Bez. Poprad), *Slov. Arch.*, **VII-1**, 47—70

— 1961, Zvierace kosti neolitickych objektov z Lužianok a Mlynáriec okr. Nitra (Neolithic animal bones from Lužianky and Mlynárce, district Nitra), *Musaica, Sborn. Filozof. Fak. Univ. Komensk.*, **XII**, 81—93

— 1962a, Zvieracie kosty zo slovanskych objektov v Devinskom Jazere a Kutoch (Tierknochenreste aus den slawischen Objekten in Devinske Jazero und Kuty), *Stud. Zvest. AUSAV Nitra*, **9**, 251—262

— 1962b, Zvieracie kosti zo stredovekych jám v Budmericiach (Tierknochenreste aus mittelalterlichen Gruben in Budmerice), *Acta Fac. Rer. Nat. Univ. Comen. Anthrop.*, **VII**, Bratislava, 267—316

— 1963, Zvieraci inventár zo slovansko-avarského pohrebiska v Bernolákove (Tierknocheninventar des slawisch—avarischen Gräberfeldes in Bernolákovo), *Slov. Arch.*, **XI-1**, 247—253

AMSCHLER, J. W., 1929, Zur Revision der Rassen- und Abstammungsfrage der Hausziege, *Züchtgskde*, **4**, 465—468

— 1931, Beitrag zur Rassen- und Abstammungsfrage der Hausziege sowie zur Erforschung der Urzentren der Haustierwerdung, *Biol. Gen.*, **VII**, 445—468

— 1933, Über den neuesten Stand der Abstammungfrage der Hausziege, *Fortschr. d. Landwirtsch.*, **8**, 1—11

— 1937a, Die vorgeschichtlichen Haustiere der Kelchalpe bei Kitzbühel in Tirol (1000 v. Chr.), *Forsch. u. Fortschr.*, **13**, 347

— 1937b, Vorgeschichtliche Tierreste aus den Grabungen von Bludenz, *Mitt. d. Prähist. Komm. d. Akad. d. Wiss.*, **3**, 217—242

— 1939a, Die Knochenfunde aus dem "Königshügel", Shah Tepé in Nordiran, *Forsch. u. Fortschr.*, **15, 9,** 115—116
— 1939b, Tierreste der Ausgrabungen von dem "Grossen Königshügel" Shah Tepé, Nord-Iran, *Reports from the Scient. Exped. to the NW Prov. of China under the Leadership of Dr. Sven Hedin, Publ.*, **9,** 35—129
— 1939c, Uranfänge der Tierzucht im Vorarlberg, *Forsch. u. Fortschr.*, **15,** 222—223
— 1949, Ur- und frühgeschichtliche Haustierfunde aus Österreich, *Arch. Austr.*, **3,** Wien
— 1950, Die Tierfunde (vom Magdalensberg), vorläufige Mitteilung, *Carinthia*, **140,** 483—485
Anderson, J. K., 1961, *Ancient Greek Horsemanship*. Berkeley—Los Angeles
Andreeva, V. G. — Андреева, В. Г., 1940, Фауна Кондаковского городища. *Пробл. и происх. эвол. и пододообр. дом. животн. Изд. АН СССУ*, I
Anghi, Cs. G., 1936, *A magyar pásztorkutyák és a külföldi rokonfajták* (Hungarian shepherd dogs and related foreign breeds), Budapest
— 1959, Die Taki-Tarpan-Abstammung des ungarischen Pferdes (A magyar ló taki-tarpán származásának kérdése), *Vertebr. Hung.*, **I,** 187—193
Antonius, O., 1918, Die Abstammung des Hauspferdes und Hausesels, *Die Naturwiss.*, **6,** 13—18, 32—34
— 1920a, Bermerkungen über einige Säugetierschädel von Sardinien. *Koninkl. Akad. v. Vetensch. te Amsterdam*, 1—7
— 1920b, Haustierkundliche Beobachtungen im Orient. *Jahrb. f. wiss. u. prakt. Tierzucht*, **14,** 45—57
— 1922, *Grundzüge einer Stammesgeschichte der Haustiere*, Jena
— 1936, Zur Abstammung des Hauspferdes. *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **34,** 359—398
— 1951, Die Tigerpferde (Die Zebras), *Monogr. d. Wildsäugetiere*, **XI,** Frankfurt a. M.
— 1955, Das Alter unserer Haustiere, *Naturwiss. Rundsch.*, 225—230
Anuchin, D. V. — Анучин, Д. В., 1886, К древнейшей истории домашних животных в России, *Труды* VI *Арх. Съезда, Одесса 1885*, 1—3
Arcikhovski, A. V. — Арциховский, А. В., 1947, *Введение в археологию*, Москва
Arenander, E. O., 1896, Studien über das ungehörnte Rindvieh im nördlichen Europa. *Inaug.-Diss.* Halle
— 1910, Den sista urens horn i Livrustkammaren, *Nya Dagligt Allehanda*, **310,** 325—326
Aristophanes, *Lysistraté*
Auerbach, M., 1907, Auerochs und Wisent in Deutschland, *Verh. d. naturw. Ver. in Karlsruhe*, **20,** 3—32
Baas, J., 1938, Zur Geschichte der Pflanzenwelt und der Haustiere im unteren Maintal, *Abh. d. Senckenberg. Naturf. Ges.*, **440,** Frankfurt a. M.
Bader, O. N. — Бадер, О. Н., 1937, Лихавевский могильник, *СА* II, 19—38
— 1939, К истории первобытного хозяйства на Оке и в Верхнем Поволжье в эпоху металла, *ВДИ, 3*, 110—123
Balogh, I., 1958, Pusztai legeltetési rend Debrecenben a XVIII—XIX. században (Die Weidegerechtigkeit auf den Pussten bei Debrecen im XVIII—XIX. Jahrhundert), *Ethnogr.*, **LXIX,** 537—566
Banner, J., 1939, Angaben zur Frage des Domestizierens der Pferde in der Urzeit, *Dolg. Szeged*, **XV,** 165—166
— 1956, Die Péceler Kultur, *Arch. Hung.*, **XXXV,** Budapest
Bannikov, A., G., 1958, Distribution géographique et biologie du cheval sauvage et chameau du Mongolia, *Mammalia*, **22,** 152—160
Bannikov, A. G. — Банников, А. Г., 1961, Особенности мест обитания и некоторые черты биологии дикой лошади Пржевальского (Special natural conditions of the biotope of the Przewalski wild horse and some biological features of this species), *Equus*, **I,** Praha, 13—21
Behrens, H., 1962, Quellenkritische Bemerkungen zu einigen neolithisch-frühmetallzeitlichen Pferdeskelettfunden in Europa, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76,** 186—189
— 1964, *Die neolithisch-frühmetallzeitlichen Tierskelettfunde der Alten Welt*, Berlin

BELÉNYESY, M., 1956, Az állattartás a XIV. században Magyarországon (Animal keeping in Hungary in the 14th century), *Népr. Ért.*, **XXXVIII**, 23—59
— 1961, Viehzucht und Hirtenwesen in Ungarn im 14. und 15. Jahrhundert, In: *Viehzucht und Hirtenleben in Ostmitteleuropa*, Budapest, 13—82
BERCKHEMER, F., 1927, Buffelus murrensis n. sp. Ein diluvialer Büffelschädel von Steinheim a. d. Murr, *Mitt. a. d. Württ. Naturalienslg. in Stuttgart*, **122**, 146—158
BERGER, M.—THENIUS, E., 1951, Über römerzeitliche Kamelfunde im Stadtgebiet von Wien, *Veröff. d. Hist. Mus. d. Stadt Wien*, 20—22
BESSKÓ, J., 1906, A honfoglaló magyar nemzet lovairól (On the horses of the conquering Magyars), *Dissertation*, Budapest
BIBIKOV, S. N. — Бибиков, С. Н., 1953, Поселение Лука—Врублевецкая, *МИА* **38**, Москва—Ленинград
BIBIKOVA, V. I. — Бибикова, В. И., 1950, Домашние и дикие животные из поселения Лука—Врублевецкая, *КСИИМК*, **XXXII**, 57—61
— 1958a, Фауна Ольвii та ii переферii за матерiалами разкопок 1935—1948 рр., *Арх. Пам. УРСР*, **VII**, 143—155
— 1958b, О некоторых отличительных чертах в костях конечностей зубра и тура (Some distinguishing features in the bones of the genera *Bison* and *Bos*), *Бюлл. Моск. Общ. Испыт. Природы. Отдел Биол.*, **LXIII**, 23—35
— 1967, К изучению древнейших домашних лошадей Восточной Европы (Studies of ancient domestic horses in Eastern Europe), *Бюлл. Моск. Общ. Исп. Природы. Отдел биол.*, **LXXII**, 106—118
BIBIKOVA, V. I. — SHEVTCHENKO, A. I. — Бибикова, В. И.—Шевченко, А. И., 1962, Фауна Михайливського поселения, Лагодовська, О. Ф.—Шапошникова, О. Г.—Макаревич, М. Л., *Михайливське поселенняя*, Киев, 206—246
BILEK, F., 1918, Zur Geschichte der ursprünglichen Ziegenrassen in Böhmen, *Jahrb. f. wiss. u. prakt. Tierzucht*, **XII**, 17—32
BIRKNER, F., 1902, Über die Hunde der Römer in Deutschland. *Corr.-Bl. d. Deutsch. Ges. f. Anthrop., Ethnol. u. Urgesch.*, **33**, 156—162
BLANC, G. A., 1933, Resti di equidi pleistocenici di una cavernetta di Corchiano (Remains of Pleistocene equids in a cave of Corchiano), *Riv. di Antr.*, **XXX**, 4—14
— 1936, Sulla presenza di "*Equus hydruntinus*" nelle ghiaie quaternarie dell'Aniene (On the occurrence of "*Equus hydruntinus*" in the Quaternary gravel-beds of the Aniene), *Rend. d. R. Acad. Naz. d. Lincei*, **XIII**, 827—830
— 1956, Sulla esistenza di "*Equus (Asinus) hydruntinus*" Regalia nel Pleistocene del Nord Africa (On the presence of "*Equus [Asinus] hydruntinus*" Regalia in the Pleistocene of North Africa), *Boll. d. Soc. Geol. Ital.*, **LXXV**, 3—14
BLANC, G. A.—BLANC, A. C., 1958—59, Il Bove della Stipe votiva del Niger Lapis nel Foro Romano (The cattle of the "Stipe votiva" of Niger Lapis in the Forum Romanum), *Bull. di Paletn. Ital.*, N. S. **XII**, **67—68**, 7—57
BODENHEIMER, F. S., 1960, *Animal and man in Bible lands*, Leiden
BOESSNECK, J., 1953, Die Haustiere in Altägypten, *Veröff. d. Zool. Staastssamml. München*, **3**, München
— 1956a, Die Tierknochenfunde aus dem Kastell Boiodurum, *Saalburgjahrb.*, **XV**, 79—80
— 1956b, Ein Beitrag zur Errechnung der Widerristhöhe nach Metapodienmassen bei Rindern, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **68**, 75—90
— 1956c, Tierknochen aus spätneolithischen Siedlungen Bayerns, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **I**, München
— 1956d, Zu den Tierknochen aus neolithischen Siedlungen Thessaliens, **36**. *Ber. d. Röm.-Germ. Komm.*, 1—51
— 1957a, Die Tierknochen. In: *Krämer, W.*, Cambodunumforschungen, 1953-I, *Materialhefte z. Bayer. Vorgesch.*, **9**, 103—116
— 1957b, Funde des Ures, Bos primigenius Bojanus, 1827, aus alluvialen Schichten Bayerns, *Säugetierkundl. Mitt.*, **5**, 55—69
— 1958a, Herkunft und Frühgeschichte unserer mitteleuropäischen landwirtschaftlichen Nutztiere, *Züchtgskde*, **30**, 289—296
— 1958b, Zur Entwicklung vor- und frühgeschichtlicher Haus- und Wildtiere Bayerns im Rahmen der gleichzeitigen Tierwelt Mitteleuropas, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **II**, München

— 1959, Tierknochen (von Regensburg—Kumpfmühler-Str. 47), *Bayer. Vorgeschichtsbl.*, **24**, 13—15
— 1961a, Haustierfunde präkeramisch-neolithischer Zeit aus Thessalien, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 39—42
— 1961b, Zu den Tierknochenfunden aus dem Oppidum von Manching, *Germania*, **30**, 368—383
— 1962, Die Tierreste aus der Argissa-Magula vom präkeramischen Neolithikum bis zur mittleren Bronzezeit, *Die deutschen Ausgrabungen auf der Argissa-Magula in Thessalien*, **I**, Bonn, 27—99
— 1964, Die Tierknochenfunde aus den Grabungen 1954—57 auf dem Lorenzberg bei Epfach. In: *Werner, J.*, *Studien zu Abodiacum-Epfach*, München, 213—261
BOESSNECK, J.—JÉQUIER, J. P.—STAMPFLI, H. R., 1963, Seeberg, Burgäschisee-Süd; Die Tierreste, *Acta Bern.*, **II**, **3**, Bern
BOETTGER, C., 1937, Herkunft und Ausbreitung der Haustiere und die Frage ihrer zweckmässigen Auswahl durch den Menschen, *Compt.-Rend. du XIIe Congr. Internat. de Zool.*, *Lisbonne* 1935, Lisboa, 2341—2356
BOETTGER, C. R., 1958, *Die Haustiere Afrikas*, Jena
BOGNÁR-KUTZIÁN, I., 1963, The Copper Age cemetery of Tiszapolgár—Basatanya, *Arch. Hung.*, **XLII**, Budapest
BOGOLYUBSKIJ, S. N. — Боголюбский, С. Н., 1929, Палеофауна сельскохозяйственных животных Старой Рязани, *Сб. Городцова*, Москва—Ленинград, 75—89
— 1959, *Происхождение и преобразование домашних животных*, Москва
BOHLKEN, H., 1962, Probleme der Merkmalsbewertung am Säugetierschädel, dargestellt am Beispiel des Bos primigenius Bojanus, 1827, *Morphol. Jahrb.*, **103**, 509—661
— 1964, Vergleichende Untersuchungen an den Schädeln wilder und domestizierter Rinder, *Zeitschr. f. wiss. Zool.*, **170**, 323—418
BOHM, J., 1878, *Die Schafzucht nach ihrem jetzigen rationellen Standpunkt*, Berlin
BOLOMEY, A., 1965, Studiul osteologic al calului din mormintul de calaret de le Tirgsor, *Stud. si cercet. de antrop.*, **2**, 63—68
BÖKÖNYI, S., 1951, Untersuchung der Haustierfunde aus dem Gräberfeld von Alsónémedi, *Acta Arch. Hung.*, **1**, 72—79
— 1952a, Die Wirbeltierfauna der Ausgrabungen in Tószeg vom Jahre 1948, *Acta Arch. Hung.*, **2**, 71—111
— 1952b, Les chevaux scythiques du cemetière de Szentes-Vekerzug, *Acta Arch. Hung.*, **2.**, 173—183
— 1954a, Eine Pleistozäne Eselart im Neolithikum der Ungarischen Tiefebene, *Acta Arch. Hung.*, **4**, 9—24
— 1954b, Les chevaux scythiques de Szentes-Vekerzug, II, *Acta Arch. Hung.*, **4**, 93—114
— 1954c, Rapport préliminaire sur l'examen des ossements d'animaux recueillis au course des fouilles de Zalavár, *Acta Arch. Hung.*, **4**, 281—286
— 1955a, Les chevaux scythiques de Szentes-Vekerzug, III, *Acta Arch. Hung.*, **6**, 23—31
— 1955b, Untersuchung der in der römischen Villa von Tác—Fövenypuszta gefundenen Tierknochen, *Acta Arch. Hung.*, **6**, 153—161
— 1956, Trinkbecher aus Urhörnern in Ungarn, *Säugetierkundl. Mitt.*, **4**, 145—150
— 1957a, A lebői 1956-os ásatás gerinces faunája (Die Wirbeltierfaune der Ausgrabungen von Lebő im Jahre 1956), *Móra F. Múz. Évk.*, Szeged, 61—78
— 1957b, Mitteleuropäische vorgeschichtliche Büffelfunde, *Fol. Arch.*, **IX**, 39—45
— 1958a, A budai várpalota ásatásának állatcsontanyaga (Die Tierknochenfunde der Ausgrabungen im Burgpalast von Buda), *Bud. Rég.*, **18**, 455—486
— 1958b, Zur Urgeschichte der Haustiere und der Faune der archäologischen Urzeit in Ungarn, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **72**, 239—249
— 1959a, Die frühalluviale Wirbetierfaune Ungarns (Vom Neolithikum bis zur La Tène-Zeit), *Acta Arch. Hung.*, **11**, 39—102
— 1959b, Mittelalterlicher Büffelfund im Burgpalast von Buda, *Fol. Arch.*, **11**, 151—155
— 1960a, A lengyeli kultúra gerinces faunája, I (Die Vertebratenfauna der Fundorte der Lengyeler Kultur, I), *Jan. Pann. Múz. Évk.*, Pécs, 85—133

— 1960b, A tiszaluc—dankadombi bronzkori telep gerinces faunája (Die Wirbeltierfauna der bronzezeitlichen Siedlung von Tiszaluc—Dankadomb), *Herman O. Múz. Évk.*, **II**, 1958, Budapest, 19—39
— 1960c, Honfoglaláskori lókoponyák a nyíregyházi múzeumban (Horses' skulls from the time of the Magyar Conquest at the Nyíregyháza Museum), *Jósa A. Múz. Évk.*, **1**, 1958, Budapest, 88—97
— 1961a, A lengyeli kultúra lelőhelyeinek gerinces faunája, II (Die Wirbeltierfauna der Fundorte der Lengyeler Kultur, II), *Jan. Pann. Múz. Évk.*, Pécs, 91—104
— 1961b, Die Haustiere in Ungarn im Mittelalter auf Grund der Knochenfunde, In: *Viehzucht und Hirtenleben in Ostmitteleuropa*, Budapest, 83—111
— 1962a, A lengyeli kultúra lelőhelyeinek gerinces faunája, III (Die Wirbeltierfauna der Fundorte der Lengyeler Kultur, III), *Jan. Pann. Múz. Évk.*, Pécs, 73—101
— 1962b, Die Entwicklung der mittelalterlichen Haustierfauna Ungarns, *Zeitschr. f. Tierzüchtg., u. Züchtgsbiol.*, **77**, pp. 1—15
— 1962c, Zur Naturgeschichte des Ures in Ungarn und das Problem der Domestikation des Hausrindes, *Acta Arch. Hung.*, **14**, 175—214
— 1963a, A bólyi avarkori temető állatmaradványai (Untersuchung der Tierknochenfunde des Gräberfeldes von Boly—Sziebert-puszta), *Jan. Pann. Múz. Évk.*, Pécs, 91—112
— 1963b, A budai várpalota ásatásának állatcsontanyaga, II (Die Tierknochenfunde der Ausgrabungen im Burgpalast von Buda, II), *Bud. Rég.*, **20**, 395—425
— 1963c, Die Wirbeltierfauna der Ausgrabungen in Zalavár, In: *Sós, A.—Bökönyi, S.*, Zalavár, *Arch. Hung.*, **XLVI**, Budapest, 313—371
— 1964a, A budai várpalota ásatásának állatcsontanyaga, III (Die Tierknochenfunde der Ausgrabungen im Burgpalast von Buda, III), *Bud. Rég.*, **21**, 369—373
— 1964b, A maroslele—panai neolithikus telep gerinces faunája (The vertebrate fauna of the Neolithic settlement at Maroslele—Pana), *Arch. Ért.*, **91**, 87—93
— 1964c, Adatok az Alföld korarézkorának gerinces faunájához (Data on the vertebrate fauna of the Great Plain in the Early Bronze Age), *Manuscript*
— 1964d, Angaben zur Kenntnis der eisenzeitlichen Pferde in Mittel- und Osteuropa, *Acta Arch. Hung.*, **16**, 227—239
— 1964e, M. S. mester állatábrázolásai (Animals represented by Master M. S.) *Művészet*, **V**, **7**, 45—46
— 1965, Untersuchung der Pferdeskelette des bayerischen Gräberfeldes von Linz—Zizlau I, *Naturkundl. Jahrb. d. Stadt Linz*, 7—20
— 1966, Untersuchung des Tierknochenmaterials des Kellerbrunnens, In: *Holl, I.*, Mittelalterliche Funde aus einem Brunnen von Buda, *Stud. Arch.*, **IV**, Budapest, 71—84
— 1968a, Data on Iron Age horses of Central and Eastern Europe, *Bull. of the Amer. School of Prehist. Res.*, **25**, Cambridge (Mass.)
— 1968b, Die Wirbeltierfauna der Siedlung von Salgótarján—Pécskő, *Acta Arch. Hung.*, **20**, 59—100
— 1969, A Lepenski Vir-i őskori telep gerinces faunája (The vertebrate fauna of the prehistoric settlement at Lepenski Vir), *Arch. Ért.*, **96**, 157—160.
— 1970, Animal remains from Lepenski Vir, *Science*, **167**, **3926**, 1702—1704.
Bökönyi, S.—Kállai, L.—Matolcsi, J.—Tarján, R., 1964, Összehasonlító vizsgálatok az őstulok és a szarvasmarha elülső lábközépcsontján (Vergleichende Untersuchungen der vorderen Mittelfussknochen des Ures und des Hausrindes), *Magy. Mezőgazd. Múz. Közl.*, 3—24
— 1965, Vergleichende Untersuchungen am Metacarpus des Ures und des Hausrindes, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **81**, 330—347
Bökönyi, S.—Kubasiewicz, M., 1961, Neolithische Tiere Polens und Ungarns in Ausgrabungen. I. Das Hausrind, *Wydz. Nauk. Przyrod.-Roln.*, **VIII**, **1**, Budapest—Szczecin
Bóna, I., 1960, Clay models of Bronze Age wagons and wheels in the Middle Danube Basin, *Acta Arch. Hung.*, **12**, 83—111
Bónis, É., 1969, Spätlatènezeitliche Siedlung am Gellérthegy—Tabán in Budapest, *Arch. Hung.*, **XLVII**, Budapest
Boule, M.—Breuil, H.—Licent, E.—Teilhard, P., 1928, Le paléolithique de la Chine, *Arch. d. l'Inst. de Paléont. Hum.*, Paris

BRENTJES, B., 1962, Wildtier und Haustier im Alten Orient, *Lebend. Altertum*, **11**, Berlin
— 1965, Die Haustierwerdung im Orient, *Die Neue Brehm-Bücherei*, **344**, Wittenberg
BRINKMANN, A., 1921, Equidenstudien I—III, *Bergens Mus. Aarbok* 1919—20, *Naturvidensk. Raekke*, **5**, Bergen
BRUMMEL, GY., 1900, A honfoglaló magyarok állattenyésztése (Animal breeding of the Conquering Magyars), *Erdélyi Gazda*, 1—42
BUNTE, C., 1964, Hällkistan son blev en alabod, *Hist. tidskr. f. Skaneland*, **3**, 18—24
BURCHAK-ABRAMOVITCH, N. I. — Бурчак-Абрамович, Н. И., 1957, Ископаемые быки старого света, I. Труд. Естеств.-ист. муз. Г. Сардаби, XI, Баку
CHILDE, V. G., 1929, The Danube in prehistory, Oxford
— 1957, The dawn of European civilisation, London
CLARK, G., 1941, Horses and battle-axes, *Antiquity*, **XV**, 50—70
— 1946, From savagery to civilisation, London
— 1952, Prehistoric Europe. The economic basis, London
CLUTTON-BROCK, J., 1962, Near Easterns canids and the affinities of the Natufian dogs, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 326—333
COON, C. S., 1951, Cave explorations in Iran 1949, *Pennsylv. Univ. Mus. Monogr.*, Philadelphia
CUNHA, A. X. DA, 1961, Sobre a cccorrencia do castor (*Castor fiber* L.) na fauna mamológica do castro de Vila Nova de S. Pedro (On the occurrence of the beaver [*Castor fiber* L.] in the mammalian fauna of the Aeneolithic castle of Vila Nova de S. Pedro), *Mem. e Estud. do Mus. Zool. da Univ. de Coimbra*, **270**, 5—7
DANEGGER, E. A., 1959, Osteologische Untersuchung der Tierknochenreste aus der Grabung 1952 im Pfahlbau Burgäschisee-Süd, Inaug.-Diss., Bern, *Mitt. d. Naturf. Ges. in Bern*, N. F. **18**, 1—34
DANNHEIMER, F., 1964, Die Rinderknochen der römischen Zivilsiedlung in Hüfingen (Ldkrs. Donaueschingen), *Baden. Fundber.*, **6**, Freiburg
DARWIN, CH., 1868, *The variation of animals and plants under domestication*, I—II, London
DAVID, A., 1897, Beiträge zur Kenntnis der Abstammung der Hausrindes, gegründet auf die Untersuchungen der Knochenfragmente aus den Pfahlbauten des Bielersees, *Diss.* (Zürich), Bern
DÉCHELETTE, J., 1927, *Manuel d'archéologie* **IV**, *Second age du fer ou époque de La Tène*, Paris
DEGERBÖL, N., 1935, *Danmarks Pattedyr i Fortiden*, Köbenhavn
DEGERBÖL, M., 1942, Et Knoglemateriale fra Dyrholm-Bopladsen, en aeldre Stenalder-Kökkenmödding, *Det. Kong. Dansk. Vidensk. selskab. arkaeol.-kunsthist. skr.*, **I, 1**, Köbenhavn, 79—135
— 1961, On a find of a Praeboreal domestic dog (*Canis familiaris* L.) from Star Carr, Yorkshire, with remarks on other Mesolithic dogs, *Proc. of the Prehist. Soc.*, **XXVII**, 33—55
— 1962, Der Hund, das älteste Haustier Dänemarks, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 334—341
DETEV, P., 1954, Szeliscsnata mogila pri sz. Bikovo (Tell prés du village de Bikovo), *Godisn. na Muz. v Plovdiv. Okr.*, 151—193.
DEVEREUX, G., 1965. Homer's wild she-mules, *Journ. of Hellen. Stud.*, **LXXXV**, 29—32
DIETRICH, W. O., 1959, Hemionus Pallas im Pleistozän von Berlin, *Vertebr. Palasiat.*, **III**, 13—22
DOBROWOLSKI, K., 1961, Die Haupttypen der Hirtenwanderungen in den Nordkarpaten vom 14. bis zum 20. Jahrhundert. In: *Viehzucht und Hirtenleben in Ostmitteleuropa*, Budapest, 113—146
DOBCHIN, N. — Добчин, Н., 1961, Лошадь Пржевальского существовала и существует в Монголии (The Przewalski horse in Mongolia), *Equus*, **I**, Praque, 22—27
DOWNS, J. F., 1960, Domestication: an examination of the changing social relationship between man and animals, *Kroeber Anthrop. Soc.*, Berkeley, 18—68
DUERST, U. J., 1900, Notes sur quelques Bovidés préhistoriques, *L'Anthrop.*, **11**, 129—158
— 1904a, Die Tierwelt der Ansiedlungen am Schlossberge zu Burg an der Spree, *Arch. f. Anthrop.*, N. F., **2**, 233—294

— 1904b, Über ein neues prähistorisches Hausschaf *(Ovis aries studeri)* und dessen Herkunft, *Vierteljahresschr. d. Naturf. Ges. in Zürich*, **49**, 17—34
— 1908, Animal remains from the excavations at Anau and the horse of Anau in its relation to the races of domestic horses. In: *Pumpelly, R., Explorations in Turkestan*, **2**, Washington, 339—442
— 1926, Vergleichende Untersuchungsmethoden am Skelett bei Säugern. In: *Abderhalden, O., Handbuch der biologischen Arbeitsmethoden*, **7**, **2**, Berlin—Wien, 125—530
Dürr, G., 1961, Neue Funde des Rindes aus dem keltischen Oppidum von Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **XII**, München
Dyson, R. H., 1953, Archaeology and the domestication of animals in the Old World, *Amer. Anthrop.*, **55**, 661—673
Éber, E., 1961, *A magyar állattenyésztés fejlődése* (The development of Hungarian animal breeding), Budapest
Ebhardt, H., 1962, Ponies und Pferde im Röntgenbild nebst einigen stammesgeschichtlichen Bemerkungen dazu, *Säugetierkundl. Mitt.*, **10**, 145—168
Efimenko, P. P. — Ефименко, П. П., 1934, Жилище эпохи бронзы, открытое на пойме Дона в окрестностях Костенок, *Пробл. ГАИМК*, **5**, 46—53
Ehret, R., 1964, Tierknochenfunde aus der Stadt auf dem Magdalensberg bei Klagenfurt in Kärnten, II. Carnivora, Lagomorpha, Rodentia und Equidae, *Kärntn. Museumsschr.*, **XXXIV**, Klagenfurt
Enderlein, H., 1930, Die Fauna der wendischen Burg "Poztupimi", *Zeitschr. f. Säugetierkde*, **5**, 241—303
Eugster, E., 1921, Beiträge zur Monographie des Bündner-Oberländerschafes, *Diss.* (Bern), Zürich
Evans, A., 1921, *The palace of Minos*, I, London
Ewart, J. C., 1909, The possible ancestors of the horses living under domestication, *Science*, N. S., **30**, 219—223
— 1913, Primitive and improved breeds of sheep, *Trans. Highland. Agric. Soc. Scotland*, **25**, 160—168
Falz-Fein, F., 1919, Über das letzte Aufreten des Wildpferdes in Südrussland, Taurisches Gouvernement, *Sitz.-Ber. d. Ges. Naturf. Freunde zu Berlin*, 196—205
Fehér, G., 1931, A bolgár—török műveltség emlékei és magyar őstörténeti vonatkozásaik (Les monuments de la culture protobulgare et leurs relations hongroises, *Arch. Hung.*, **VII**, Budapest
Fekete, L., 1944, Budapest a törökkorban (Budapest at the time of the Turkish occupation), *Budapest Tört.*, **III**
Fekete, L.—Káldy-Nagy, Gy., 1962, *Budai török számadáskönyvek*, 1550—1580 (Account books of the Turks in Buda, 1550—1580), Budapest
Fest, A., 1914, Halászat és állattenyésztés a középkori Fiuméban (Fishing and animal breeding in Mediaeval Fiume), *Századok*, **48**, 357—373
Filiptchenko, Yu. A. — Филипченко, Ю. А., 1933. Краниологическое исследование диких видов свиньи (Craniological investigations of the wild swine), *Пробл. происх. дом. животн.*, Ленинград 157—184
Foltiny, S., 1965, Zur frühesten Pferdezucht in Österreich, *Mitt. d. Öst. Arbeitsgemeinsch. f. Ur- u. Frühgesch.*, **16**, 48—53
Forsyth-Major, C. J., 1880, Beiträge zur Geschichte der fossilen Pferde, *Abh. d. Schweiz. Paläont. Ges.*, **7**
Förster, U., 1960, Die Pferdephalangen aus dem keltischen Oppidum von Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **VIII**, München
Franck, L., 1875, Beiträge zur Rassenkunde unserer Pferde, *Landwirtsch. Jahrb.*
Frank, K. G., 1962, Neue Funde des Pferdes aus dem keltischen Oppidum von Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **XIII**, München
Frantzius, A., 1877, Die Urheimat des Hausrindes, *Arch. f. Anthrop.*, **10**, 129—137
Fraser, F. C.—King, J. E., 1949, Preliminary report on the bone remains from Star Carr, Seamer, *Proc. of the Prehist. Soc.*, **6**, 67—69
— 1950, Second interim report on the animal remains from Star Carr, Seamer, *Proc. of the Prehist. Soc.*, **9**, 124—129
— 1954, The faunal remains. In: Clark, J. G. D., *Excavations at Star Carr, an Early Mesolithic site at Seamer, near Scarborough, Yorkshire*, Cambridge

Gaál, L., 1966, *A Magyar Állattenyésztés Múltja* (The past of Hungarian animal breeding), Budapest
Gandert, O.-F., 1930, Beitrag zur Kenntnis der Wirtschaft im kammkeramischen Kulturkreise, *Congr. Secund. Arch. Balt. Rigae*, 19–23. *VIII.* 1930, 65–66
— 1932, Haustierfragen, *Mannus*, **24**, 372–383
— 1937–38, Vorläufige Bemerkungen über die Tierreste aus der Siedlung bei Nauen-Bärhorst, *Prähist. Zeitschr.*, **28–29**, 335–337
— 1939, Das Pferd in der jüngeren Steinzeit Mittel- und Nordeuropas, *Congr. Internat. d. Sci. Anthrop. et Ethnol. Copenhague 1938*, Köbenhavn
— 1950, Neolithische Gräber mit Rinderbeigaben und Rinderbestattungen in Mitteleuropa, *Congr. Internat. d. Sci. Préhist. et Protohist.*, Zürich, 201
Gans, H., 1915, Banteng und Zebu und ihr gegenseitiges Verhältnis, *Diss.*, Halle
Garrutt, E. W.—Sokolov, I. I.—Saleszkaja, T. N., 1966, Erforschung und Zucht des Przewalski-Pferdes (*Equus przewalskii* Poljakoff) in der Sowjetunion, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **82**, 4, 377–426
Gaul, J. H., 1948, The Neolithic period in Bulgaria, *Bull. of the Amer. Sch. of Prehist. Res.*, **16**, Cambridge (Mass.)
Geijer, A.—Ljungh, H., 1937, Die Kleider der dänischen Bronzezeit, *Acta Arch.*, **VIII**, 266–275
Gerber, E., 1938, Die Säugetierreste aus dem Pfahlbau Port bei Nidau, *Mitt. d. Naturf. Ges. in Bern, 1938*, XI–XII
Gheorghiu, G.—Haimovici, S., 1965, Caracteristicile mamiferelor domestice descoperite in asezarea feodala timpurie de la Garvan (Dinogetia), *Anal. Stiint. ale Univ. "Al. I. Cuza" d. Jasi*, **XI**, 175–184
Giffen, A. E. V., 1913, Die Fauna der Wurten, *Onderzoek. verr. inhat. Zoöl. Labor, d. Rijksuniv. Groningen*, **3**, Leiden
Glur, G., 1894, Beiträge zur Fauna der Pfahlbauten, *Diss.*, Bern
Gromova, V. — Громова, В., 1933, Об ископаемых остатках козы и других домашних животных в СССР (Beiträge zur Geschichte der Hausziege und der ältesten Haustiere in der USSR), *Пробл. происх. эвол. и породообр. дом. животн.*, **I**, Ленинпад, 13–120
— 1948, Остатки млекопитающих из раннеславянских городищ вблизи г. Воронежа, *МИА*, **8**, Москва—Ленинград, 113–123
— 1949, История лошадей (рода *Equus*) в старом свете, I–II, *Труды Палеонт. Инст.*, **XVII**, *1–2*, Москва—Ленинград
— 1953, Остеологические отличия родов Capra (козлы) и Ovis (бараны), *Труды Комм. по изуч. четв. периода*, **X**, **1**, Москва
— 1959, О скелете тарпана (*Equus caballus gmelini* Ant.) и других современных диких лошадей (On the skeleton of the tarpan (*Equus caballus gmelini* Ant.) and of other present day wild horses), *Бюлл. Моск. Общ. Испыт. Природы. Отдел биол.*, **LXIV**, 99–124
Grüss, J., 1933, Über Milchreste aus der Hallstattzeit und andere Funde, *Forsch. u. Fortschr.*, **9**, 105–106
Györffy, Gy., 1963, *Az Árpád-kori Magyarország történeti földrajza* (Historical geography of Hungary in the period of the Árpád Dynasty), Budapest
Györffy, I., 1925, *A magyarság néprajza* (Ethnography of the Hungarian People), Budapest
Habermehl, K. H., 1957, Die Tierknochenfunde im römischen Lagerdorf Butzbach, *Saalburgjahrb.*, **XVI**, 67–108
— 1961, *Altersbestimmung bei Haustieren, Pelztieren und beim jagdbaren Wild*, Berlin–Hamburg
Hagberg, U. E., 1963, Blotare i Skedemosse, Tor, 71–75
Hahn, E., 1909, *Entstehung der Pflugkultur*, Heidelberg
Haimovici, S., 1960, L'étude de la faune néolithique de Trusesti, *Anal. Stiint. ale Univ. "Al. I. Cuza" d. Jasi, S. N., Sect. II*, **VII**, 387–396
Haimovici, S. — Хаймовици, С., 1962, Сравнительное изучение фаунистических остатков эпох неолита и бронзы, найденных в поселении у Валя Лупулуй (L'étude comparative des restes fauniques néolithiques et de l'époque du bronze trouvés dans la station de Valea Lupului), *Anal. Stiint. al. Univ. "Al. I Cuza" d. Jasi. Sect. II, Stiint. Nat.*, **VIII**, 291–326

— 1964, Studiu asupra resturilor de fauna descoperite in asezarile apartinind culturii Noua de la Birlad si Piatra Neamt (Étude sur les restes fauniques découverts dans les stations de Birlad et de Piatra Neamt apparenant à la civilization de Noua), *Arh. Moldov.*, **II-III**, 217—236

HAIMOVICI, S.—ONOFREI, M., 1967, Caracteristicile mamiferelor descoperite in statiunea feodala timpurie de le Bucov (Les caractéristiques des mammifères découverts dans le station du commencement de l'époque féodale de Bucov), *Anal. Stiint. al. Univ. "Al. I. Cuza" d. Jasi*, **XIII**, 181—188

HAMPE, R., 1956, Die homerische Welt im Lichte der neuesten Ausgrabungen, *Gymnasium*, **63**, 1—57

HANČAR, F., 1956, Das Pferd in prähistorischer und früher historischer Zeit, *Wiener Beitr. u. Kulturgesch. u. Linguist.*, **XI** (1955), Wien—München

— 1958, Erkenntnisbeitrag zum Tierzuchtanfang. Vielschichtige Höhlenstation als Entwicklungspegel, *Der Schlern*, **32**, 139—141

HANKÓ, B., 1935, *A magyar szarvasmarha egykori gazdasági jelentősége* (The former economic importance of Hungarian cattle), Debrecen

— 1936a, A magyar ló eredete (The origin of the Hungarian horse) *Debreceni Szemle*, 1—24

— 1936b, A magyar szarvasmarha eredete (The origin of Hungarian cattle), *Tisia*, Debrecen, 45—65

— 1936c, Hogy került az első arabs vér magyar parlagi lovainkba (How did Arab blood first get into Hungarian primitive horses), *Búvár*, 180—184

— 1937a, A magyar juh (Hungarian sheep), *Természettud. Közl.*, 1—9

— 1937b, A magyar juh eredete, múltja és jelene (The origin, past and presence of Hungarian sheep), *Tisia*, **2**, Debrecen, 45—115

— 1938a, A kihalt ősi szalontai sertés (The extinct, ancient pig of Szalonta), *Természettud. Közl.* 1—8

— 1938b, Az Alföldön élt avarok házisertése (The domestic pig of the Avars living on the Great Plain), *Pap Károly Emlékkönyv*, Debrecen

— 1939, Ősi magyar sertéseink (Ancient species of Hungarian pigs), *Tisia*, **3**, Debrecen, 1—69

— 1940, *Ősi magyar kutyák* (Ancient Hungarian dogs), Debrecen

— 1941, *Az ősmagyar fekete juhnyáj* (The flock of ancient Hungarian black sheep), Debrecen

— 1943, *Magyar háziállataink* (Hungarian domestic animals), Budapest

— 1954, *A magyar háziállatok története* (The history of Hungarian domestic animals), Budapest

HARTMANN-FRICK, H., 1957, Die Knochenfunde (der Burg Heitnau), *Thurg. Beitr. z. Vaterl. Gesch. d. Hist. Ver. d. Kt. Thurgau*, **93**, 53—73

— 1960, Die Tierwelt des prähistorischen Siedlungsplatzes auf dem Eschner Lutzengüetle, Fürstentum Liechtenstein, *Jahrb. d. Hist. Ver. f. d. Fürst. Liechtenst.*, **59**, 1—223

HARMATTA, J., 1968, Früheisenzeitliche Beziehungen zwischen dem Karpatenbecken, Oberitalien und Griechenland, *Acta Arch. Hung.* **20**, 153—157

HAUCK, E., 1950, *Abstammung, Ur- und Frühgeschichte des Haushundes*, Horn—Wien

HECK, H., 1936, Bemerkungen über die Mähne der Urwildpferde, *D. Zool. Gart. N. F.*, **8**, 179—189

— 1949, Die Rückzüchtung ausgestorbener Tiere, *Orion*, **4**, 401—410

— 1952, Über den Auerochsen und seine Rückzüchtung, *Jahrb. d. Nass. Ver. f. Naturkde.*, **90**, 107—124

HERMAN, O., 1914, *A magyar pásztorok szókincse* (The word-stock of Hungarian herdsmen), Budapest

HERMES, G., 1935, Das gezähmte Pferd im neolithischen und frühbronzezeitlichen Europa, *Antropos*, **30**, 803—823

HERODOTOS, *Historical Books in Greek and in Hungarian* (Translated by J. Geréb), Budapest, 1893

HERRE, W., 1939, Beiträge zur Kenntnis der Wildpferde, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **44**, 342—363

— 1943, Beiträge zur Kenntnis der Zwergziegen, *Der Zool. Gart. N. F.*, **15**, 26—45

— 1949, Zur Abstammung und Entwicklung der Haustiere, II. Betrachtungen über

vorgeschichtliche Wildschweine Mitteleuropas, *Verh. d. Dtsch. Zool. in Kiel, 1948, Leipzig,* 324–333
— 1950a, Haustiere im mittelalterlichen Hamburg. Untersuchungen über die Tierknochenfunde in der Kleinen Bäckerstrasse, *Hammaburg,* **2,** 7–19
— 1950b, Zur Abstammung und Entwicklung der Haustiere, III. Die Haustierreste mittelalterlicher Siedlungen der Hamburger Altstadt, *Zool. Gart. N. F.,* **17,** 103–121
— 1953, Wie sah der Auerochse aus? *Kosmos,* **49,** 72–75
— 1955, Domestikation und Stammesgeschichte. In: HEBERER, G., *Die Evolution der Organismen,* Stuttgart, 801–856
— 1958, Die geschichtliche Entwicklung der Haustierzüchtung. In: ZORN, W., *Tierzüchtungslehre,* Stuttgart, 17–43
— 1959, Der heutige Stand der Domestikationsforschung, *Naturwiss. Rundschau,* 87–94
— 1961, Grundsätzliches zur Systematik des Pferdes, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.,* **75,** 57–78
— 1962, Ist *Sus (Porcula) salvanius* Hodgson 1847 eine Stammart von Hausschweinen. *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.,* **76,** 265–281
HERRE, W.–KESPER, K. D., 1953, Zur Verbreitungsgeschichte von Ovis ammon in Europa, *Zool. Anzeig.,* **151,** 204–209
HERRE, W.–NOBIS, G.–REQUATE, H.–SIEWING, G., 1960, *Die Haustiere von Haithabu,* Neumünster
HERRE, W.–RÖHRS, M., 1958, Tierreste aus den Hethitergräbern von Osmankayashi. (Nach den Grabungen des Jahres 1952), **71,** *Mitt. d. Dtsch. Orient.-Ges.,* 60–80
HESCHELER, K., 1920, Beiträge zur Kenntnis der Pfahlbautenfauna des Neolithikums. (Die Fauna der Pfahlbauten im Wauvilersee), *Vierteljahresschr. d. Naturf. Ges. in Zürich,* **65,** 248–322
— 1929–30, Aus der Vorgeschichte der Säugetiere der Schweiz, *Jahrb. d. St. Gall. Naturw. Ges.,* **65,** 17–46
— 1933, Die Fauna der neolithischen Pfahlbauten der Schweiz und des deutschen Bodenseegebietes nach neueren Forschungen, *Vierteljahresschr. d. Naturf. Ges. in Zürich,* **78,** 198–231
HESCHELER, K.–KUHN, E., 1949, Die Tierwelt der prähistorischen Siedlungen der Schweiz. In: *Tschumi, O., Urgeschichte der Schweiz,* I, Frauenfeld, 121–368.
HESCHELER, K.–RÜEGER, J., 1939, Die Wirbeltierreste aus dem neolithischen Pfahlbaudorf Egolzwil 2 (Wauvilersee) nach den Grabungen von 1932–34, *Vierteljahresschr. d. Naturf. Ges. in Zürich,* **84,** 307–330
— — 1940, Die Wirbeltierreste aus den Pfahlbauten des Baldeggersees nach den Grabungen von 1938 und 1939, *Vierteljahresschr. d. Naturf. Ges. in Zürich,* **85,** 59–70
— — 1942, Die Reste der Haustiere aus den neolithischen Pfahlbaudörfern Egolzwil 2 (Wauvilersee, Kt. Luzern) und Seematte-Gelfingen (Baldeggersee, Kt. Luzern), *Vierteljahresschr. d. Naturf. Ges. in Zürich,* **87,** 383–486
HIGGS, E. S., 1962, The fauna of the Early Neolithic site at Nea Nikomedeia, (Greek Macedonia), *Proc. of the Prehist. Soc.,* **XXVIII,** 271–274
HILZHEIMER, M., 1910, Wie hat der Ur ausgesehen? *Jahrb. f. wiss. u. prakt. Tierzucht,* **5,** 42–93
— 1912–13, Überblick über die Geschichte der Haustierforschung, besonders der letzten 30 Jahre, *Zool. Ann.,* **5,** 233–254
— 1917, Der Ur in Ägypten, *Festschr. f. Eduard Hahn,* Stuttgart
— 1920, Die Tierreste aus dem römischen Kastell Cannstatt bei Stuttgart und anderen römischen Niederlassungen in Württemberg, *Landw. Jahrb.,* **55,** 293–336
— 1924, Die im Saalburgmuseum aufbewahrten Tierreste aus römischer Zeit, *Saalburgjahrb.,* 5, 105–158
— 1925, Der Zwergur, *Brandenburgia,* **XXXIV,** 100–108
— 1926, Säugetierkunde und Archäologie, *Zeitschr. f. Säugetierkde,* **1,** 140–169
— 1927, Unser Wissen von der Entwicklung der Haustierwelt Mitteleuropas, **16.** *Ber. d. Röm.-Germ. Komm.,* 47–85
— 1930, Austausch an Haustieren zwischen Asien und Afrika vor dem 2. Jahrtausend v. Chr., *Zeitschr. f. Völkerpsych. u. Soziol.,* **6,** 414–427

— 1933a, Die Tierreste. In: FREMERSDORF, F., Der römische Gutshof Köln-Müngersdorf, *Röm.-Germ. Forschgen.*, **6**, Berlin—Leipzig, 122—130
— 1933b, Untersuchungen über die Ziegen (Gattung *Capra* s. str.) und deren Kreuzungen, *Arch. f. Tierernährg. u. Tierzucht*, **8**, 323—371
— 1935, The evolution of the domestic horse, *Antiquity*, **9**, 133—139
— 1936, Sheep, *Antiquity*, **10**, 195—206
— 1937, Die Geschichte eines Wissenthorns und ein neuentdecktes Horn vom Ur *(Bos primigenius)*, *Zeitschr. f. wiss. Zool.*, **150**, **1**, 97—106
— 1939, Bison iselini Stehlin für Bubalus iselini Stehlin, *Zeitschr. f. Säugetierkde*, **13**, 254—256
HOLDEFLEISS, F., 1905, Prähistorische Haustiere in Schlesien, *Verh. d. Ges. Dtsch. Naturf. u. Ärzte Jb.*, Breslau, 269—272
HOLE, FR.—FLANNERY, K. V., 1967, The prehistory of Southwestern Iran: a preliminary report, *Proc. of the Prehist. Soc.*, **XXXIII**, 147—206
HOPKINS, J., 1966, Identification of the domestication of animals without morphological change, *Manuscript*, Chicago
HOYER, H., 1923, Ein hornloser und ein gehörnter Rinderschädel aus der jüngeren Steinzeit, *Bull. Internat. de l'Acad. Pol. d. Sci. et d. Lettr. Cl. Math. Sér. B.*
HUNDEMANN, E., 1878, *Geschichte des römischen Postwesens während der Kaiserzeit*
HUPPERTZ, J., 1961, Untersuchungen über die Anfänge der Haustierzucht unter besonderer Berücksichtigung der Pferdezucht, *Anthropos*, **56**, 14—30
— 1962, Die frühe Pferdezucht in Ostasien, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.* **76**, 190—208
HUSZTI, D., 1941, Olasz—magyar kereskedelmi kapcsolatok a középkorban (Italian—Hungarian commercial connexions in the Middle Ages), *A Római Magy. Tört. Int. Kiadv.*, Budapest
HÜBNER, F., 1938, Das Schwarzwild. In: *Waidwerk der Welt. Erinnerungswerk an die internationale Jagdausstellung, Berlin 1937*, Berlin, 234—238
IMHOF, U., 1964, Osteometrische Untersuchungen an Rinderknochen aus Pfahlbauten des Bielersees, *Mitt. d. Natuf. Ges. in Bern*, **21**, 135—237
INGEBRIGTSEN, O., 1922, Hjortens utbredelse i Norge, *Bergens Mus. Aarb. Naturw. Raekke*, **6**, 1—20
IVANOV, P.—SACHARIEV, S. J., 1960, Biologische Eigenschaften und Wirtschaftlichkeit der Büffel in Bulgarien, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **74**, 340—360
IVANOV, St. — Иванов, Ст., 1954, Някои данни за конете от тракийского могилно погребение при Брезово (Quelques données sur les chevaux de l'enterrement thrace tumulaire pres de Bresovo), *Год. на муз. в Пловдив. окр.*, 229—239
— 1956, Домашните и дивите животни от градището край с. Полина, Силистренско (Les animaux domestiques et les animaux sauvages de la cite pres du village de Popina, region Silistra). In: Вожарова, Ж., Славяно-българското селище край село Попина, Силистренско, София, 69—95
— 1958, Животински костни остатъци от некропола до Нови пазар (Tierknochenreste aus der Nekropole bei Novi Pazar). In: STANCHEV, S.—IVANOV, S., Nekropolite de Novi Pazar. София, 163—229
— 1959, Домашните и дивите животни в бита на населението от Ясатепе в Пловдив (Les animaux sauvages et domestiques dans la vie quotidienne de la population des Yassatepé à Plovdiv), Год. на Нар. арх. муз. Пловдив, III, 81—86
— 1965, Животински костни остатъци от селището в местността Джеджови лозя при с. Понина (Reste tierischer Knochen aus der Siedlung in Dzedzovi lozja bei Popina, Kreis Silistra), In: Вожарова, Ж. Н., Славянски и славяно-български селища в българските земи VI—XI век, София, 207—225
JAWORSKI, Z., 1927, Studja nad pochodzeniem pierwotnych swin domowych z obszarów lesnych i bagiennych Pinska (Studien über die Abstammung der primitiven Hausschweine aus dem Wald- und Sumpfgebiet von Pinsk), *Bull. de l'Acad. Pol. de Sci. et d. Lettr. Sér. B.*, 327—329
JEITTELES, L. H., 1872, Die vorgeschichtlichen Altertümer der Stadt Olmütz und ihrer Umgebung, *Mitth. d. Anthrop. Ges. in Wien*, **2**, 18—32, 55—62, 86—91
JOSIEN, TH., 1955, Station lacustre d'Auvernier (Lac de Neuchâtel). Étude de la faune de la station, *Bull. de la Soc. Préhist. Franç.*, **LII**, 57—75

— 1956, Étude de la faune de gisements néolithiques (niveau de Cortaillod) du canton de Berne (Suisse), *Arch. Suiss. d'Anthrop. Gén.*, **XXI**, 28–62
JOSIEN (POULAIN), T., 1962, Les chevaux galloromains découverts a Paris rue Henri-Barbusse (IIIè–IVè siècles), *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 238–242
KACZKOWSKI, B., 1929, Contribution to the studies of the origin of European sheep, *Proc. of the Royal Soc. of Edinburgh*, **48**, 10–14
KARAGEORGHIS, V., 1965, Horse burials on the island of Cyprus, *Archaeology*, **18**, **4**, 282–290
KASPAREK, M. U., 1958, Stand der Forschung über den Hufbeschlag des Pferdes, *Zeitschr. f. Agrargesch. u. Agrarsoziol.*, **6**, 38–43
KASZAB, Z., 1967, A Przewalski-ló (*Equus przewalskii* Poljakoff) újabb előfordulása Mongóliában (Recent occurrence of the Przewalski horse [*Equus przewalskii* Poljakoff] in Mongolia), *Állatt. Közl.*, **LIV**, 63–65
KELLER, C., 1909, *Die Stammesgeschichte unserer Haustiere*, Leipzig
— 1913, Über die Haustierfunde von La Tène, *Mitt. d. Thurg. Naturf. Ges.*, **20**, 140–153
— 1919, *Geschichte der Schweizerischen Haustierwelt*, Frauenfeld
— 1923, Kritische Gänge auf dem Gebiet der Haustierforschung, *Vierteljahresschr. d. Naturf. Ges. in Zürich*, **LXVIII**, 1–15
KELLER, O., 1909, *Die antike Tierwelt*, *I*, Leipzig
KELM, H., 1938, Die postembryonale Schädelentwicklung des Wild- und Berkhireschweins, *Zeitschr. f. Anat. u. Entwgesch.*, **108**, 499–559
— 1939, Zur Systematik der Wildschweine, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **43**, 362–369
KIESEWALTER, L., 1888, Skelettmessungen am Pferde, *Diss.*, Leipzig
KING, J., 1953, Mammal bones from Khirokitia and Erimi. In: DIKAIOS, P., *Khirokitia*, London–New York–Toronto, 1953, 431–437
KLATT, B., 1927, Entstehung der Haustiere, *Handb. d. Vererbungswiss.*, **3**, Berlin
— 1948, *Haustier und Mensch*, Hamburg
KLEINSCHMIDT, A., 1967, Die Tierreste. In: PAULSEN, P., Alamannische Adelsgräber von Niederstotzingen, *Veröff. d. Staatl. Amt f. Denkmpflege, Stuttgart, Reihe A*, **12/II**, 33–45
KNECHT, G., 1966, Mittelalterlich-frühneuzeitliche Tierknochenfunde aus Oberösterreich (Linz und Enns), *Naturkundl. Jahrb. d. Stadt Linz*, 11–72
KOCH, A., 1902, Új adat a muflon korábbi elterjedéséhez (New data on the earlier distribution of the moufflon), *Földt. Közl.*, **XXXII**, 403–408
KOCH, W., 1927, Über angebliche Anzeichen von Domestikation am Skelett von Rindern, *Zeitschr. f. Morph. u. Ökol. d. Tiere*, **7**, **3**, 444–471
KOMÁROMY, A., 1897, Ugocsa vármegye keletkezése (The development of Ugocsa County), *Ért. Tört. Tud. Kör.*, **16**, 24–26
KOROTKEVICH, O. L. — Коротkевич, О. Л., 1956, Фауна низнитрипильского поселения Сандраки, *Збирн. пр. Зоол. Муз.*, **27**, 130–143
KOTHE, H., 1953, Verbreitung und Alter der Stangenschleife, *Ethnogr.-archäol. Forsch.* **1**, 74–94
KOUDELKA, F., 1884, Das Verhältnis der Ossa longa zur Skelethöhe bei den Säugetieren, *Verh. d. Naturf. Ver. in Brünn*, **24**
KOVRIG, I., 1963, Das awarenzeitliche Gräberfeld on Alattyán, *Arch. Hung.*, **XL**, Budapest
KOEHLER, O., 1952, Heck, L.: Über den Auerochsen und seine Rückzüchtung. Jahrb. d. Nass. Ver. f. Naturkde, 90 (1952), 107–124. Review, *Zeitschr. f. Tierpsych.*, **9**, 498–499
KRAUS, F. R., Staatliche Viehhaltung im altbabylonischen Lande Larsa, *Med. d. Koninkl. Nederl. Akad. v Wetensch. AFD Leterkd.*, **29**, **5**, Amsterdam
KRÄMER, H., 1899, Die Haustierfunde von Vindonissa, *Rev. Suisse de Zool.* **7**, 143–272
KRETZOI, M., 1942, Capra im ungarischen Diluvium, *Földt. Közl.*, **72**, 353–356
KRICHEVSKIJ, E. O. — Кричевский, Е. О., 1933, Индогерманский вопрос — археологически разрешенный, *Извест. Инст. Мат. Култ.*, **100**, 158–202
— 1941, О процессе исчезновения трипольской культуры, *МИА*, **2**, 245–253
KRUMBIEGEL, I., 1952, Kamele, *Die Neue Brehm-Bücherei*, **50**, Wittenberg

KRYSIAK, K., 1937, Fragment czaszki owcy czterorogiej z neolitu (Der Schädelrest eines vierhörnigen Schafes aus dem Neolithikum), *Wiad. Weteryn.*, **201**, 129—133

— 1950, Charakterystyka materiału zwierzecęgo ze stanowiska wczesnośredniowiecznego w Jeziorku, pow. Gizycko (The material of animal derivation from the Jezierko excavation site of the Early Middle Ages — Gizycko adm. district), *Nat. wczesnośredniow.*, **II**, 227—233

— 1950—51, Szczątki zwierzęce z osady neolitycznej w Cmiełowie (Animal remains from Cmiełów Neolithic settlement), *Wiad. Arch.*, **XVII**, 165—228

— 1952, Szczątki zwierzęce z osady neolitycznej w Cmielowie (Animal remains from the Neolithic settlement at Cmiełów), *Wiad. Arch.*, **XVIII**, 251—290

— 1954, Szczątki zwierzęce z wczesnej epoki brązu w Biskupinie, pow. Znin (Animal remains from the Early Bronze Age, found at Biskupin, Znin admin. district), *Wiad. Arch.*, **XX**, 260—262

— 1955, Szczątki zwierzęce z wykopalisk w Gdańsku w latach 1950—51 (Animal remains from the Gdansk excavation in 1950—51), Stud. Wczesnośred. III. pp. 238—251.

— 1956a, Materiał zwierzęcy z osady neolitycznej w Gródku Nadbuznym, pow. Hrubieszów (Material originating from the Neolithic settlement at Grodek Nadbuzni, distr. Hubieszów), *Wiad. Arch.* **XIII**, pp. 49—60.

— 1956b, Wyniki badań nad materiałem zwierzęcym z wykopalisk w Gdańsku (Investigation data on animal finds from the Gdansk excavation), Prace Wrocław. Tow. Nauk. Ser. B. 78.

KUBASIEWICZ, M., 1956, Szczątki kostne zwierzęce z osady wczesnośredniowiecznej Szczecin—Msiecino (Animal bone remains from the Early Mediaeval settlement of Szczecin—Msiecino), *Mat. Zachod.-Pomorsk.* **I**, 73—79.

— 1957a, Dotychczasowe badania nad materiałem kostnym z wczesnośredniowiecznego podgrodzia w Szczecinie (Die bisherigen Untersuchungen des Knochenmaterials aus der frühmittelalterlichen Vorburg in Szczecin), *Mat. Zachod.-Pomorsk.*, **III**, 189—198

— 1957b, Zwierzęce szczątki kostne z wykopalisk w Miliczu (Die Tierknochenreste aus den Ausgrabungen in Milicz), *Zeszyty Nauk, Wyzsz. Szkoły Roln. w Wrocław.*, **10**, 179—195

— 1958a, Szczątki kostne bydła z wczesnośredniowiecznego Wolina (Hausrindknochenreste aus dem frühmittelalterlichen Wolin), *Zeszyty Nauk, Wyzsz. Szkoły Roln. w Szczecin.*, **1**, 123—133

— 1958b, Szczątki zwierzęce z badań sondasowych w Kamieniu Pomorskim (Überreste von Tieren aus Sondage-Gruben im Kamień Pomorski), *Mat. Zachod.-Pomorsk.*, **IV**, 241—250

— 1958c, Szczątki zwierzęce ze stanowiska neolitycznego w Ustowie, pow. Szczecin (Tierüberreste aus der neolithischen Siedlung in Ustowo, Kr. Szczecin), *Mat. Zachod.-Pomorsk.*, **IV**, 41—48

— 1959, Szczątki zwierząt wczesnośredniowiecznych z Wolina (Überreste der frühmittelalterlichen Tiere aus Wolin), *Wydz. Nauk. Przyrod.-Roln.*, **II**, Szczecin

— 1960, Przyczynek do znajomości bydła (*Bos taurus* L.) kultury amfor kulistych na ziemiach Polski (Beitrag zur Kenntnis des Rindes [*Bos taurus* L.] der Kugelamphorenkultur auf polnischem Boden), *Arch. Polsk.*, **V**, 255—271

— 1962, Zur Geschichte der Haustiere Pommerns, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **77**, 87—99

— 1963, Szczątki zwierzęce wczesnośredniowiecznego grodziska w Sieradzu (Restes fauniques de l'anciente fortifiée de Sieradz), *Prace i Mat. Muz. Arch. i Etnogr. w. Lodz.*, **9**, 195—233

KUBASIEWICZ, M.—GAWLIKOWSKI, J., 1965, Szczątki zwierzęce z wczesnośredniowiecznego grodu w Kolebrzegu (Frühmittelalterliche Tierüberreste aus Kołobrzeg), *Wydz. Nauk. Przyrod.-Roln.*, **XXIV**, Szczeczin

KUHN, E., 1932, Beiträge zur Kenntnis der Säugetierfauna der Schweiz seit dem Neolithikum, *Rev. Suisse de Zool.*, **39**, 531—768

— 1933, Beiträge zur Kenntnis der Säugetierfauna der Schweiz seit dem Neolithikum, *Vierteljahresschr. d. Naturf. Ges. in Zürich*, **87**, 15—26

— 1935, Die Fauna des Pfahlbaues Obermeilen, *Vierteljahresschr. d. Naturf. Ges. in Zürich*, **80**, 241—330

— 1937, Die Fauna der Wallsiedlung im Borscht (Endneolithikum — La Tène), *Jahrb. d. Hist. Ver. f. d. Fürstent. Liechtenst.*, 4—42
— 1938, Zur quantitativen Analyse der Haustierwelt der Pfahlbauten in der Schweiz, *Vierteljahresschr. d. Naturf. Ges. in Zürich*, **83**, 253—263
— 1942, Die Säugetier-Reste (von Grüthalde bei Herblingen), *Zeitschr. f. Schweiz. Arch. u. Kunstgesch.*, **4**, 78—80
— 1946, Die Tierreste der La Tène-Siedlung Bonaduz (Kt. Grbd.), *Bündn. Monatsbl. Zeitschr. f. Bündn. Gesch., Land- u. Volkskde*, 163—176
— 1951, Die Tierreste der prähistorischen Siedlungen von Schneller (Ältere Urnenfelderkultur und La Tène), *Jahrb. d. Hist. Ver. f. d. Fürst. Liechtenst.*, **51**, 249—254
KUHN, E.—GÜLLER, A., 1946, Die Tierreste des bronzezeitlichen Pfahlbaues in der Bleiche von Arbon (Kt. Thurgau), *Ber. d. Schweiz. Paläont. Ges. (Ecl. geol. Helv.)*, **39**, 364—366
KULCSÁR, ZS., 1964, *A középkori élet* (Mediaeval life), Budapest
KUSCHEL, P., 1911, Die Haustiere Ägyptens im Altertum, *Diss.* (Leipzig), Görlitz
KUTSCH, F., 1921, Frühfränkisches Grab aus Biebrich, *Germania*, **5**, 27—35
KÜENZI, W., 1939, Tierreste aus Grabungen des Historischen Museums Bern 1935—38, *Mitt. d. Naturf. Ges. in Bern*, 76—88
LA BAUME, W., 1909, Beitrag zur Kenntnis der fossilen und subfossilen Boviden, mit besonderer Berücksichtigung der im Westpreussischen Provinzialmuseum befindlichen Reste, *Schr. d. Naturf. Ges. in Danzig*, N. F. **XII**, **3**, 45—80
— 1947, Hat es ein wildlebendes Kurzhornrind gegeben? (Ein Beitrag zur Frage nach der Abstammung des Brachyceros-Hausrindes), *Ecl. geol. Helv.*, **40**, **2**, 308—318
— 1949, Die ältesten europäischen Haustiere, *Verh. d. Dtsch. Zool. in Kiel 1948*, Leipzig, 74—90
— 1953, Herkunft und älteste Kulturgeschichte der Haussäugetiere, *Wiss. Abh. d. Dtsch. Akad. d. Landw. zu Berlin*, **6/I**, 53—67
LADENBAUER-OREL, H., 1963, *Linz—Zizlau. Das bayerische Gräberfeld an der Traunmündung*, Wien—München
LÁSZLÓ, GY., 1955, Études archéologiques sur l'histoire de la société des avars, *Arch. Hung.*, **XXXIV**, Budapest
LAWRENCE, B., 1967, Early domestic dogs, *Zeitschr. f. Säugetierkde*, **32**, 44—59
LEBASHEVA, V. P. — Левашева, В. П., 1956, *Очерки по истории русской деревни* **X—XIII** *вв.*, Москва
LEHMAN, U. VON, 1949, Der Ur im Diluvium Deutschlands und seine Verbreitung, *Neues Jahrb. f. Miner., Geol. u. Palaeont., Abt. B.*, **90**, 163—266
LEITHNER, O. VON, 1927, Der Ur, *Ber. d. Internat. Ges. z. Erhaltg. d. Wisents*, **2**, 1—140
LENGERKEN, H. VON, 1955, Ur, Hausrind und Mensch, *Wiss. Abh. d. Deutsch. Akad. d. Landwirtsch. zu Berlin*, **14**, Berlin
LEUTHARDT, F., 1930, Über eisenzeitliche Knochenreste (Küchenabfälle) von der Sissacherfluh (Baselland), *Ecl. geol. Helv.*, **23**, 588—593
LIBEROV, P. D. — Либеров, П. Д., 1960, К истории скотоводства на территории Северного Причерноморья в эпоху раннего железа, *МИА, 53*, Москва, 110—154
LIEPE, H.-U., 1958, Die Pferde des Latène-Oppidums Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **IV**, München
LORENZ, K., 1951, *So kam der Mensch auf den Hund*, Wien
LUNDHOLM, B., 1947, Abstammung und Domestikation des Hauspferdes, *Zool. Bidr. fr. Uppsala*, **27**, Uppsala, 1—288
LÜTTSCHWAGER, J., 1967, Zum Vorkommen von Hauseseln zur Römerzeit nördlich der Alpen, *Zeitschr. f. Säugetierkde*, **32**, 355—361
LYDEKKER, R., 1880, Crania of Ruminants, *Mem. of Geol. Surv. of India., Palaeont. Ind., Ser. X.* Indian Tertiary and Post-Tertiary vertebrata. I. (1878) Calcutta
— 1885, *Catalogue of the fossil Mammals in the British Museum, II*, London
MAKKAI, L., 1954, *Rákóczi György birtokainak gazdasági iratai* (Economic papers of the estates of György Rákóczi), Budapest
MALLOVÁN, M. E. L., 1936, *The excavations at Tell Chagar Bazar, Iraq, III*, London
MAREK, J., 1898, Das helvetisch—gallische Pferd, *Abh. d. Schweiz. Paläont. Ges.*, **XXV**, 1—62

MARKOV, G., 1958, Prinoc kum izuchavane istoriata na bozainitzite v Bulgaria (Beitrag zur Geschichte der Haustiere in Bulgarien), *Izv. Zool. Int. (Bull. de l'Inst. Zool. de l'Acad. d. Sci. de Bulg.)*, **VII**, 133–161
MATESA, G., 1946, *Frumusica*, Bukarest
MATOLCSI, J., 1968, A szarvasmarha testnagyságának változása a történelmi korszakokban Magyarország területén (Die Veränderung der Körpergrösse des Rindes in den geschichtlichen Epochen auf dem Gebiete Ungarns), *Agrártört. Szemle*, 3–38
MELLER, P., 1912, Über den europäischen gemeinen Hausbüffel *(Bubalus indicus vulgaris)*. Ein Beitrag zu Siebenbürgens Tierzucht, *Diss.*, Halle–Wittenberg
MÉRI, I., 1964a, Árpád-kori népi építkezésünk feltárt emlékei Orosháza határában (Bericht über die Ausgrabungen in Karodskút), *Rég. Füz.*, **12**, Budapest
— 1964b, Kiaggatott lókoponyák árpádkori falvainkban (Ausgesteckte Pferdeschädel in arpadenzeitlichen ungarischen Dörfern), *Arch. Ért.*, **91**, 111–115
MERTENS, H., 1936, Der Hund aus dem Senckenberg–Moor, ein Begleiter des Urs, *Nat. u. Volk*, **66**, 506–510
MIKOV, G., 1959, Selishchna mogila ot bronzovata epokha do s. Veselinovo (Un tell de l'époque de bronze près du village de Veselinovo), *Bull. de l'Inst. Archéol. Bulg.*, **13**, 195–227
MINCHEN, M. CHOW–HSU YU-HSIAN, 1957, A new species of fossil Bubalus from Menghsien, Honan, *Acta Palaeont. Sin.*, **V**, 457–466
MOHR, E., 1959, Das Urwildpferd, *Neue Brehm-Bücherei*, **249**, Wittenberg
— 1960, Wilde Schweine, *Die Neue Brehm-Bücherei*, **247**, Wittenberg
MORRISON-SCOTT, T. C. S., 1952, The mummified cats of ancient Egypt, *Proc. of the Zool. Soc. of London*, **121**, 861–867
MOZSOLICS, A., 1953, Mors en bois de cerf sur le territoire du bassin des Carpathes, *Acta Arch. Hung.*, **3**, 69–111
— 1960, Die Herkunftsfrage der ältesten Hirschgeweihtrensen, *Acta Arch. Hung.*, **12**, 125–135
— 1968, Goldfunde des Depotfundhorizontes von Hajdúsámson, **46/47**. *Ber. d. Röm.-Germ. Komm.* 1965/66, 1–76
MUSIL, R., 1956, Osteologicky materiál z pohrebiska v Žitavskej Tôňi (Das osteologische Material vom Gräberfeld in Žitavska Tôň), *Slov. Arch.*, **IV-1**, 155–161
MÜLLER, H. H., 1955, Osteologische Untersuchung der Pferde von Grossörner-Molmeck vom Ende des 5. Jh. n. Chr., *Wiss. Zeitschr. d. Martin-Luther-Univ. Halle–Wittenberg*, **4**, 661–696
— 1959, Die Tierreste von Alt-Hannover, *Hannoversch. Geschichtsbl.*, *N. F.* **12**, 181–259
— 1962a, Die Säugetierreste aus der Burg Berlin–Köpenick nach den Grabungen von 1955 bis 1958. In: HERRMANN, J., Köpenick. Ein Beitrag zur Frühgeschichte Gross-Berlins, *Schr. d. Sekt. f. Vor- u. Frühgesch. d. Dtsch. Akad. d. Wiss. zu Berlin*, **12**, Berlin, 81–97
— 1962b, Die Tierreste der slawischen Burg Berlin–Köpenick, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **77**, 100–114
— 1963, Hornlose Rinder aus der Saalmünder Höhensiedlung von Halle-Mötzlich, *Jahresschr. mitteldeutsch. Vorgesch.*, **47**, 149–155
— 1964, Die Haustiere der mitteldeutschen Bandkeramiker, *Naturwiss. Beitr. z. Vor- u. Frühgesch.*, **1**, Berlin
— 1966, Die Pferdeskelettfunde des slawisch–awarischen Gräberfeldes von Nové Zámky, *Slov. Arch.*, **XIV-1**, 205–225
MYCZKOWSKI, K., 1934, Kości zwierząt ssących z osad epoki cesarstwa rzymskiego Południowo-wschodniej Polski (Matériaux ostéologiques récolté dans les stations de l'époque romaine au sud-est de la Pologne). In: *Śmiszko, M.–Sulimirski, T.–wschodniej Polski Przyczynki do poznania epoki cesarstwa rzymskiego Południowo-Myczkowski, K.*, (Contribution to the southeastern part of Poland during the Roman Imperial period), Lwów, 49–58
— 1960, Ogólne wyniki badan szczatków kostnych i skorup zwierzecych z wczesnogo sredniowiecza na Ostrowie Tumskim we Wroclawiu w latach 1950–1957 (Les

résultats de l'examen des restes ostéologiques etc. par la station Ostrów Tumski in Wroclaw), *Przegl. Arch.*, **XII**, 150–171

NACHTSHEIM, H., 1936, Haustierwerdung und Rassenbildung beim Kaninchen, *Forsch. u. Fortschr.*, **12**, 245–246

— 1949, *Vom Wildtier zum Haustier*, Berlin–Hamburg

NAGY, D., 1936, Kraniometriai vizsgálatok a honfoglaló magyarok lovain (Craniometrical examinations of the horses of the conquering Magyars), *Mat. és Természettud. Ért.*, **LIV**, 991–1003

NAGY, L., 1942, *Budapest története* (The history of Budapest) **I-2**, Budapest

NANNINGA, O., 1963, Neue Funde des Schweines aus dem keltischen Oppidum von Manching, *Stud. an vor- u. Frühgesch. Tierrest. Bayerns*, **XV**, München

NATHUSIUS, H. V., 1864, *Vorstudien für Geschichte und Zucht der Haustiere zunächst am Schweineschädel*, Berlin

NECRASOV, O. — Некрасов, О., 1961, К изучению домашних и диких живоытных ранненеологитической культуры Криш, *Anal. Stiint. ale Univ. "Al. I. Cuza" d. Jasi*, **VII**, 265–272

— 1964a, Sur la signification de certains caractères morphologiques de *Equus (Asinus) hydruntinus* Reg., *Rev. Roum. de Biol. Sér. Zool.*, **9**, 141–149

— 1964b, Sur les restes des faunes subfossiles datant de la culture Starčevo-Cris et le problème de la domestication, *Anal. Stiint. ale Univ "Al. I. Cuza". d. Jasi*, **X**, 167–181

NECRASOV, O.–HAAS, N.–HAIMOVICI, S.–MAXIMILIAN, C.–NICOLAESCU-PLOBSOR, D., 1959, Date asupra faunei descoperite in 1956. In: Bereiu, D.–Morintz, S., Sapaturile de la Cernavoda, *Mat. si cercet. arh.*, **V**, 110–112

NECRASOV, O.–HAIMOVICI, S., 1959a, Étude de la faune de la station néolithique de Tangiru, *Dacia, N. S.*, **III**, 561–570

— 1959b, Resturile de fauna exhumate in cursul sapaturilor din campania 1957 la santierul Trajan) Restes de faune exhumés à Traian), *Mat. si cercet. arh.*, **VI**, 179–185

— 1959c, Sur la présence de la dorade (*Aurata aurata* L.) dans les eaux du littoral roumain de la Mer Noire, pendant le néolithique, *Lucr. Sesiun. Stiint. a Stat. Zool. Mar. "Prof. Ioan Borcea" Agigea. Iasi*, 563–566

— 1962a, Studiul resturilor de fauna neolitica (cultura Hamangia) descoperite in corsul sapaturilor de la Techirghiol (Étude de la faune découverte dans la station néolithique de Techighiol), *Mat. si cercet. arh.*, **VIII**, 175–185

— 1962b, Studiul resturilor de fauna descoperite in 1959 la Traian (Dealul Viei si Dealul Fintinilor) (Étude des restes fauniques des stations néolithiques de Traian), *Mat. si cercet. arh.*, **VIII**, 261–266

— 1965, Mamiferele definitiv stinse san azi disparute din tara noastra identificate in fauna neolitica din R. P. R. (Definitely perished or disappeared mammalians in our country, identified in the Neolithic fauna of the R. P. R.), *Comunic. d. Geol.*, **III**, 239–245

NEHRING, A., 1884, Fossile Pferde aus deutschen Diluvial-Ablagerungen und ihre Beziehungen zu den lebenden Pferden. Ein Beitrag zur Geschichte des Hauspferdes, *Landw. Jahrb.*, **13**, 81–160

— 1888a, Bos primigenius, insbesondere über seine Coexistenz mit dem Menschen, *Zeitschr. f. Ethn.*, **XX**, 222–231

— 1888b, Die Fauna eines masurischen Pfahlbaues, *Naturw. Wochenschr.*, **III**, 9–13

— 1888c, Über das sogenannte Torfschwein (*Sus palustris* Rütimeyer), *Zeitschr. f. Ethn.*, **20**, 181–187

— 1888d, Über die Form der unteren Eckzähne bei den Wildschweinen, sowie über das sogenannte Torfschwein (*Sus palustris* Rütimeyer), *Sitz.-Ber. d. Ges. Naturf. Fr. zu Berlin*, 9–16

— 1890, *Über Tundren und Steppen*, Berlin

— 1891, Diluviale Reste von Cuon, Ovis, Saiga, Ibex und Rupicapra aus Mähren, *Neu. Jahrb. f. Miner.*, 107–155

— 1898, Das Augsburger Urstierbild, *Globus*, **74**, 79–81

NÉMETHY, L., 1899, Zsigmond király és a német lovagrend (King Sigismund and the Order of the Teutonic Knights), *Századok*, **XXXIII**, 134–144

NEUMANN, A., 1951, Ausgrabungen und Funde im Wiener Stadtgebiet 1948/49, *Veröff. d. Hist. Mus. d. Stadt Wien*
NOACK, TH., 1903, Zur Entwicklung von Equus Przewalskii, *Zool. Anzeig.*, **XXVI,** 370—373
NOBIS, G., 1954, Ur- und frühgeschichtliche Rinder Nord- und Mitteldeutschlands, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **63,** 155—194
— 1955a, Beiträge zur Abstammung und Domestikation des Hauspferdes nach Studien an ur- und frühgeschichtlichen Funden Nordwest- und Mitteldeutschlands, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **64,** 201—246
— 1955b, Die Entwicklung der Haustierwelt Nordwest- und Mitteldeutschlands in ihrer Beziehung zu landschaftlichen Gegebenheiten, *Petermanns Geogr. Mitt.*, **99,** 1—7
— 1957, Werden und Frühentwicklung der Haustierwelt Nordwest- und Mitteldeutschlands, *Beitr. z. Frühgesch. d. Landwirtsch.*, **III,** *Wiss. Abh. d. Deutsch. Akad. d. Landwirtsch. zu Berlin*, 38—47
— 1962, Zur Frühgeschichte der Pferdezucht. Die Pferde der Wikingerzeit aus Deutschland, Norwegen und Island, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76,** 125—185
— 1963, Abstammung, Domestikation und Rassenbildung unserer Haushunde, *Naturwiss. Rundsch.*, **16,** 306—310
— 1965, Haustiere im mittelalterlichen Bremen, *Brem. Arch. Blätt.*, 39—48
NYÁRÁDY, M., 1959. Fajtaváltozás a kéki juhtenyésztésben (Changes in variety in the sheep-breeding of Kék), *Népr. Közl.*, **IV,** 163—202
OBERDORFER, F., 1959, Die Hunde des Latène-Oppidums Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **VII,** München
OLSEN, S. J., 1960, Postcranial skeletal characters of *Bison* and *Bos*, *Papers of the Peabody Mus. of Arch. and Ethn., Harvard Univ.*, **XXXV,** Cambridge (Mass.)
OPITZ, G., 1958, Die Schweine des Latène-Oppidums Manching, *Stud an vor- u. frühgesch. Tierrest. Bayerns*, **III,** München
OTTO, F., 1901, Osteologische Studien zur Geschichte des Torfschweines (*Sus scrofa palustris* Rütimeyer) und seiner Stellung innerhalb des Genus Sus, *Rev. Suisse de Zool.*, **9,** 43—130
OWEN, R., 1846, *British fossil mammals and birds*, London
PAAVER, K., 1961, O nahodkah szubfosszilnyh kosztej dikoj losadi v Vosztocsnoj Pribaltike (On subfossil finds of the wild horse in the East Baltic area), *Vopr. golocena*, Vilnius, 341—357
PALÁGYI-KOVÁCS, A., 1965, A keleti palócok pásztorkodása (La bergerie des paloczes orientaux), *Művelts. és Hagyom.*, **VII,** Debrecen
PAULYS-WISSOVA, 1921, *Real-Encyclopädie*, Stuttgart
PAOR, M. L., DE, 1960, *Alt-Irland*, Köln
PERKINS, D., 1964, Prehistoric fauna from Shanidar, Iraq, *Science*, **144,** 1565—1566
PETŐ, M., 1966, Lótartás Pannoniában az i. u. I—IV. században (Horse-keeping in Pannonia in the 1st—4th centuries A. D.), *Dissertation. Manuscript*, Budapest
PETRI, M., 1961, Neue Funde des Hundes aus dem keltischen Oppidum von Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **X,** München
PETZSH, H., 1957, Lebender ♀-Bastard aus *Ammotragus lervia* Pall. — ♂ X *Capra hircus* L. — ♀ im Berg-Zoo Halle—S. geboren, *Zool. Anzeig.*, **159,** 285—290
PFUND, D., 1961, Neue Funde von Schaf und Ziege aus dem keltischen Oppidum von Manching, *Stud an vor- u. frühgesch. Tierrest. Bayerns*, **XI,** München
PIDOPLITCHKO, I. G. — Підопличко, І. Г., 1938, 1956, *Матеріали до вивчення минулих фаун УРСР*, **I—II,** Киев
PIETREMENT, C. A., 1870, *Les origins du cheval domestique*, Paris
PIGGOTT, S., 1962, Heads and hoofs, *Antiquity*, **XXXVI,** 110—118
PIRA, A., 1909, Studien zur Geschichte der Schweinerassen, insbesondere derjenigen Schwedens, *Zool. Jahrb. Suppl.*, **X,** 233—426
PITARD, E.—REVERDIN, L., 1920—22, A propos de la domestication des animaux pendant le période néolithique, *Arch. suisse d'anthrop. gén.*, **IV,** 259—271
PITZL, H., 1959, Albertus Magnus, Tierforschung, Tierheilkundiges und Nutzanwendung der Haustiere, *Diss.*, München

POHLE, H., 1960, Ein bronzezeitlicher Pferdeschädel aus der Mark Brandenburg, *Ausgrab. u. Funde*, **5**, 132–138

POHLHAUSEN, H., 1953, Nachweisbare Ansätze zum Wanderhirtentum in der niederdeutschen Mittelsteinzeit, *Zeitschr. f. Ethn.*, **78**, **1**, 64–82

POPOV, R. – Попов, Р, 1908, Приносъ към неолитната млькопитающа фауна въ България **XXIV**, 1–22 (Contribution to the mammal fauna of Bulgaria), *Сборникъ за народ. умотвор.*, *Наука и книжн.*, XXIV, 1–22

— 1909, Коджа-дерменската могила (The tumulus of Kodzha-dermen), *Период. спис.*, **XXI**, 503–561

— 1912a, Beiträge zur Vorgeschichte Bulgariens, I. Der prähistorische Wohnplatz "Pod-Grada" bei dem Dorf Madara, unweit der Stadt Schumen (Nordost-Bulgarien), *Prähist. Zeitschr.*, **IV**, 88–103

— 1912b, Материали за проучване на селището «Под-града» при Мадара. Изв. (Material to the study of the settlement of "Pod-grada" near Madara), *Изв. на Бълг. арх. друж.*, **III**, 90–107

— 1913, Die Ausgrabungen in der Höhle "Malkata Podlisza" beim Dorfe Bjeljakovez, unweit der Stadt Tirnovo (Nordbulgarien), *Prähist. Zeitschr.*, **V**, 449–460

— 1914, Предисторическата Денева могила при с. Салманово (Le tumulus de Denew pres du village Salmanovo), *Извест. на Бьлг. арх. друж.*, **IV**, 148–225

— 1918, Коджа-дерменската могила пир градъ Шуменъ (Der Hügel Kodjadermen bei Schumen), *Извест. на Бълг. арх. друж.*, **VI**, 71–155

— 1920, Материалы за проучване лова, земеделието, лозарството, скотовъдството въ предисторическо и раноисторическо време у насъ (Beitrag zur Erforschung der Jagd, der Landwirtschaft, der Viehzucht und der Fischerei in prähistorischen und frühhistorischen Zeiten), *Спис. на Земед. изпит. инст. въ Бълг.*, **I**, 150–169

PÖLLOTH, K., 1959, Die Schafe und Ziegen des Latène-Oppidums Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **VI**, München

QUITTA, H., 1950–51, Siedlung und Wirtschaft der Tripoljekultur, *Arb.- und Forschgsber. z. Sächs. Bodenkmalpfl.*, 25–38

RADULESCO, C.–SAMSON, P., 1962, Sur un centre de domestication du mouton dans le Mésolithique de la grotte "La Adam" en Dobrogea, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 282–320

REED, C. A., 1959, Animal domestication in the prehistoric Near East, *Science*, **130**, 1629–1639

— 1960, A review on the archaeological evidence on animal domestication in the prehistoric Near East. In: BRAIDWOOD, R. J.–HOWE, B., Prehistoric investigations in Iraqi Kuzdistan, *Stud. in ancient orient. civiliz.*, **31**, Chicago, 119–145

— 1961, Osteological evidences for prehistoric domestication in Southwestern Asia, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 31–38

REICH, H., 1937, Die Säugetierfunde der Ausgrabung Wollin 1934 und ihre kulturgeschichtliche Bedeutung, *Nachrichtenbl. f. deutsche Vorzeit*, **13**, **1**, 1–6

REINHARDT, L., 1912, *Kulturgeschichte der Nutztiere*, München

REITSMA, G., 1932, *Zoologisch Onderzoek der Nederlandsche Terpem*, 1. *Het Schaap*, Wageningen

REITSMA, G. G., 1935, *Zoologisch Onderzoek der Nederlandsche Terpen*, 2. *Het Varken*, Wageningen

REMÉNYI, K. A., 1952, Canidenreste aus den Ausgrabungen bei Tószeg, *Acta Arch. Hung.*, **2**, 115–124

REQUATE, H., 1956, Die Jagdtiere unter den Nahrungsresten einiger frühgeschichtlicher Siedlungen in Schleswig–Holstein. Ein Beitrag zur Faunengeschichte des Landes, *Schr. d. Naturwiss. Ver. f. Schlesw.-Holst.*, **XXVIII**, 21–41

— 1957, Zur Naturgeschicte des Ures (Bos primigenius Bojanus 1827), nach Schädel- und Skelettfunden in Schleswig–Holstein, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **70**, 297–338

REVERDIN, L., 1920–22, La faune néolithique de la station de St.-Aubin (Port-Conty, lac de Neuchâtel), *Arch. suisse d'anthrop. gén.*, **IV**, 251–254

— 1921, La fauna néolithique de St.-Aubin, *Verh. d. Schweiz. Naturf. Ges.*, **102**, 188–189

REVILLIOD, P., 1926a, Habitation gauloise de l'Oppidum de Genève: Les animaux domestiques, *Geneva*, **4**, 111–118

— 1926b, Sur les animaux domestiques de la station de l'époque de le Tène de Genève et sur le boeuf brachycephale de l'époque romaine, *Arch. Sc. Phys. et. Nat. Geneve*, **8,** 65—74

RICKMANN, K., 1921, Das norddeutsche frühhistorische Schwein und sein Verhältnis zum Schweizer Torfschwein, *Diss.*, Berlin

RIEDEL, A., 1947—48, Resti di animali olocenici delle torbière di Brunndorf (Lubiana) (Remains of Holocene animals of the Brunndorf [Lubiana] peat bogs), *Atti dell'Ist. Venet. di Sci., Lett. ed Arti*, **CVI,** 189—195

RODDEN, R. J., 1965, An Early Neolithic village in Greece, *Scient. Amer.*, **212,** 83—92

RÜEGER, J., 1942, Die Tierreste aus der mittelbronzezeitlichen Siedlung Crestaulta (Kanton Graubünden) nach den Grabungen 1935—1938, *Rev. Suisse de Zool.*, **49,** 251—267

— 1944, Knochenfunde. In: DRACK, W., Das römische Ökonomiegebäude in Kirchdorf, *Argovia*, **56,** Aarau, 236—237

— 1945, Die tierischen Reste. In: *Bersu*, G., Das Wittnauer Horn im Kanton Aargau, *Monogr. z. Ur- und Frühgesch. d. Schweiz*, **IV,** 105—109

RÜTIMEYER, L., 1861, Die Fauna der Pfahlbauten der Schweiz, *Neue Denkschr. d. Allg. Schweiz. Ges. d. ges. Natwiss.*, **19**

— 1863, Beiträge zur Kenntnis der fossilen Pferde und zur vergleichenden Odontographie der Huftiere überhaupt, *Verh. d. Naturf. Ges. in Basel*, **3**

— 1865, Beiträge zu einer paläontologischen Geschichte der Wiederkäuer, *Verh. d. Naturf. Ges. in Basel*, **5**

— 1878, Die Rinder der Tertiär-Epoche, *Abh. d. Schweiz. Paläontolog. Ges.*, **V**

— 1888, Zu der Frage über das Torfschwein und Torfrind, *Zeitschr. f. Ethn.*, **XX,** 550—556

RYDER, M., 1961, A specimen of Asiatic skeep-skin from the 4th or 5th century B.C., *The Austral. Journ. of Sci.*, **24,** 246—248

SANSON, A., 1869, Nouvelles déterminations des espèces chevalines du genre *Equus*, *Compt.-rend. de l'Acad. d. Sci. Paris*, **69**

SCHATZ, H., 1963, Die Tierknochenfunde aus einer mittelalterlichen Siedlung Württembergs, *Diss.*, München

SCHAUENBURG, K., 1955—56, Die Cameliden im Altertum, *Bonn. Jahrb.*, **155/156,** 59—94

SCHERTZ, E., 1936, Zur Unterscheidung von *Bison priscus* Boj. und *Bos primigenius* Boj. an Metapodien und Astragalus, *Senckenbergiana*, **18,** 37—71

— 1937, Ein neuer Wasserbüffel aus dem Diluvium Mitteldeutschlands (*Buffelus wanckeli* nov. spec.), *Palaeont. Zeitschr.*, **XIX,** 57—51

SCHLOSSER, M., 1888, Ueber Säugethier- und Vogelreste aus den Ausgrabungen in Kempten stammend, *Correspondenzbl. d. Deutsch. Ges. f. Anthrop., Ethn. u. Urgesch.*, **XIX,** 17—22

SCHMIDT, W., 1935, *Das Muffelwild*, Berlin

SCHNEIDER, F., 1958, Die Rinder des Latène-Oppidums Manching, *Stud. an vor- u. frühgesch. Tierrest. Bayerns*, **V,** München

SCHRAMM, Z., 1965, Szcaztki kostne zwierzat z okresu halsztackiego wydobyte v Kotlinie pow. Jarocin (Animal bone remnants from the Hallstatt period, excavated at Kotlin, district Jarocin), *Roczn. Wyzsz. Szkol. Roln. w Poznan*, **XXV,** 175—184

SCHRAMM, Z.—GEDYMIN, T., 1965, Szczatki kostne zwierzat domowych z wczosnosredniowiecznego grodziska w Radaczu powiat Szczecinek (Bone remnants of domestic animals from the early mediaeval castle at Radacz, district Szczeczinek), *Roczn. Wyzsz. Szkoly Roln. w. Poznan*, **XXV,** 185—195

SCHRÖTER, H., 1923, Das Verhältnis der europäischen zu den asiatischen Wildschweinen auf Grund der postembryonalen Schädelentwicklung der europäischen Wildschweine, *Zool. Jahrb. Syst.*, **46,** 303—365

SCHÜLE, W., 1960, Eisenzeitliche Tierknochen von der Heuneburg bei Hundersingen (Donau), *Stuttgart. Beitr. z. Naturkde*, **33,** 1—36

SCHWARZ, E., 1922, Über europäische fossile Pferde und den Ursprung der Hauspferde, *Paläont. Zeitschr.*, **4**

— 1935, On ibex and wild goat, *Ann. and Magaz. Nat. Hist.*, **16,** 433—437

SCHWERZ, F., 1918, Tierreste aus La Tène, *Anat. Anzeig.*, **50,** 457—472

SEEBERG, A., 1965, Hephaistos rides again, *Journ. of Hellen. Stud.*, **LXXXV,** 102—109

SEITZ, W., 1941, Die Haustierwerdung der Ziege, *Arch. f. Kleintierzucht*, **1**, 14–21
SICKENBERG, O., 1930, *Eine Wildziege der Capra prisca Gruppe aus dem Pleistozän Niederösterreichs*, *Palaeobiologica*, **3**, 92–102
— 1938, Vor- und frühgeschichtliche Tierreste und ihre Bedeutung, *Rhein. Vorzeit in Wort u. Bild*, **1**, 148–152
— 1962, Über die Grösse der pleistozänen Pferde der Caballus-Gruppe in Europa und Nordasien, *Eiszeitalt. u. Gegenwart*, **12**, 99–124
SIMOONS, F. J., 1961, *Eat not this flesh. Food avoidances in the Old World*, Madison
SIMPSON, G. G., 1961a, *Horses*, New York
— 1961b, *The major features of evolution*, New York
SKORKOWSKI, E., 1938, *Badania nad systematyka konia* (Studien über die Systematik des Pferdes), Kraków
— 1946, Systematyka konia i zasady jego hodowli (Systematics of the horse and the principles of its breeding). In: *Badan nad Systematyka Konia*, Kraków, 1–24
— 1956, Systematik und Abstammung des Pferdes, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **68**, 42–74
SKUTIL, J.—STEHLIK, A., 1939, Moravské prispevky k otázce poznani pravekych domácych zvirat (Mährische Beiträge zur Frage des Studiums der uralten Haustiere), *Vestn. zemed. Mus.*, **12**, 67–84
SMIRNOV, A. N.—Смирнов, А. Н., 1951, *Волжские булгары*, Москва
SOBOCINSKI, M., 1963, Material kostny a wykopalisk wczesnosredniowiecznego grodziska w Bonikowie (Das tierische Knochenmaterial von Ausgrabungen des alten Burgwalls Bonikowo aus dem frühen Mittelalter), *Wydz. Hist. i Nauk Spoleczn. Prace Komis. Arch.*, **VI**, **2**, Poznan
— 1964, Szcatki kostne zwierzat domowych z wykopalisk w Kruszwicy (Osseosn material of domestic animals from excavations in Kruszwica), *Roczn. Wyzsz. Szkoly Roln. w Poznan*, **XXII**, 173–193
— n.d., Szczatki kostne zwierat z osady z II–III. W. N. E. w Slupie, pow. Sroda Slaska (Reste von Tierknochen in der Siedlung Slup bei Sroda Slaska aus dem II–III. Jahrhundert), *Silesia Antiq.*, **III**, 150–163
SOLECKI, R. S., 1963, Prehistory in Shanidar Valley, northern Iraq, *Science*, **139**, 179–193
SOLYMOSSY, S., 1929, Magyar ősvallási elemek népmeséinkben (Elements of prehistoric religion in Hungarian folk-tales), *Ethnogr.*, **40**, 133–152
STAMPFLI, H. R., 1959–60a, Die Tierwelt der kelto–römischen Siedlung "Engehalbinsel" bei Bern nach den Grabungen 1956, 1957 und 1959, *Jahrb. d. Bern. Hist. Mus. in Bern*, **XXXIX-XL**, 415–434
— 1959–60b, Die Knochenfunde auf dem Areal der römischen Villa auf dem Buchsi bei Köniz, *Jahrb. d. Bern. Hist. Mus. in Bern*, **XXXIX-LX**, 435–437
— 1962a, Die Tierknochenfunde der Burg Grenchen, *Jahrb. f. Solothurn. Gesch.*, **35**, 160–178
— 1962b, Die Tierreste der neolithischen Siedlung "Seeberg/Burgäschisee-Süd", *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **77**, 31–34
— 1962c, Die Tierreste der slawischen Siedlungen Oldenburg in Holstein und Scharstorf, *Offa-Bücher*, **17/18**, Neumünster, 109–124
— 1964, Vergleichende Betrachtungen an Tierresten aus zwei neolithischen Siedlungen am Burgäschisee, *Mitt. d. Naturf. Ges. in Bern*, **21**, 113–136
STASI, P. E.—REGALIA, E., 1904, Grotta Romanelli (Castro, Terra d'Otranto). Stazione con faune interglaziali calda e di steppa, *Arch. per l'Antr. e l'Ethn.*, **34**, 3–367
STEGMANN, F. P., 1912, Studien über das aufrechthörnige Rind (Bos ortheceros), *Jahrb. f. wiss. u. prakt. Tierzucht*, 37–65
STEGMANN v. PRITZWALD, F. P., 1924, *Die Rassengeschichte der Wirtschaftstiere*, Jena
— 1934, Die Gewinnung der Haustiere, *Forsch. u. Fortschr.*, **10**, 12–14
STEHLIN, H. G., 1899, Über die Geschichte des Suiden-Gebisses, *Abh. d. Schweiz. Paläont. Ges.*, **26**, 1–336
— 1930, Die Säugetierreste (des neolithischen Pfahlbaues Thun), *Mitt. d. Naturf. Ges. in Bern*, 1930, 20–23
— 1937, *Bubalus Iselini* n. spec. aus dem obern Pliocaen von Val d'Arno, *Ecl. geol. Helv.*, **XXVII**, 407–412

STEHLIN, H. G.—GRAZIOSI, P., 1935, Ricerche sugli asinidi fossili d'Europa, *Mem. de la Soc. Paléont. Suisse*, **LVI**, 1—68
STEHLIN, H. G.—REVILLIOD, P., 1914, Die prähistorische Ansiedlung bei der Gasfabrik in Basel, V. Die Tierknochen, *Anzeig. f. Schweiz. Altertumskde*, **16**, 1—2
STELLA, L. A., 1965, *La civiltà micenea nei documenti contemporanei*, Roma
STONE, P., 1961, Some famous drinking-horns in Britain, *Apollo*, 102—104, 143—145
STRABON, Geographika, VIII. 1—6. (translated by I. FOLY), *Antik Tan.*, **IV**, 1957, 335—362
STUDER, TH., 1883, Die Tierwelt der Pfahlbauten des Bielersees, *Mitt. d. Naturf. Ges. in Bern*, 1883, 1—99
— 1900, Entwicklung der Haustierzucht bei den Pfahlbauern, *Mitt. d. Anthrop. Ges. in Wien*, **XXX (N. F. XX)**, 106—108
— 1901, Die prähistorischen Hunde in ihrer Beziehung zu den gegenwärtig lebenden Rassen, *Abh. d. Schweiz. Paläont. Ges.*, **28**, 1—137
— 1906, Über einen Hund aus der paläolithischen Zeit Russlands, *Canis Poutiatini*, *Zool. Anzeig.*, **29**, 24—35
SZALAY, B., 1914a, Der Meerochs, *Zool. Ann.*, **VI**, 75—111
— 1914b, Der Wisent im Brehm, *Zool. Ann.*, **VI**, 47—47
— 1915a, A jó Gunthrammus őstulka (The aurochs of Gunthrammus), *Vadászlap*, 92
— 1915b, Der Wisent in Ortsnamen, *Zool. Ann.*, 1—80
— 1930, Polyphyletische Rinderabstammung (Eine historische Studie), *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **19**, 165—232
— 1938, *Hundert irrige Wisentbelege*, Neudamm—Berlin
— n.d., A magyar őstulok. Az őstulok (*Bos primigenius* Bojanus) magyarországi története (The Hungarian Aurochs. History of the aurochs [*Bos primigenius* Bojanus] in Hungary). *Manuscript*
SZAMOTA, I., 1891, *Régi utazások Magyarországon és a Balkán félszigeten* (Old journeys in Hungary and the Balkan Peninsula), Budapest
SZAMOTA, I.—ZOLNAI, GY., 1902—1906, *Magyar oklevél szótár* (Dictionary of Hungarian Documents), Budapest
SZENTKIRÁLYI, A., 1889, *Über den Büffel*, Magyaróvár
SZILÁDY, Z., 1927, A háziasítás útjai (Ways of domestication), *Természettud. Közl.*, 43—45
SZUNYOGHY, J., 1952, The effect of castration on the skull of the domestic cat, and the establishment of differentiating characters on the skulls of the domestic cat and the wild cat (Kasztrálás hatása a házimacska koponyájára, egyben elkülönítő bélyegek megállapítása házi- és vadmacska koponyákon), *Ann. Hist. Nat. Mus. Nat. Hung.*, S. N. **II**, 177—181
— 1958, The introduction and distribution of the rabbit in Hungary, *Ann. Hist.-Nat. Mus. Nat. Hung.*, S. N. **IX**, 349—358
TAKÁTS, S., 1915, *Rajzok a török világból, II* (Sketches from the Turkish Occupation, II), Budapest
— n.d. *Régi magyar jókedv* (Old Hungarian jollities), Budapest
— n.d. *Szegény magyarok* (Poor Hungarians), Budapest
TEICHERT, M., 1962, Die Rinder aus dem Opfermoor Oberdorla, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **77**, 74—86
— 1964, Die Tierreste aus der spätlatènezeitlichen Siedlung von Schönburg, Kreis Naumburg, *Wiss. Zeitschr. d. Martin-Luther-Univ. Halle—Wittenberg*, **XIII**, 845—864
THALHEIMER, H., 1945, Die Wirbeltierreste aus dem neolithischen Pfahlbau Greng. *Diss.*, Bern
THENIUS, E.—HOFER, F.—PREISINGER, A., 1962, Capra "prisca" Sickenberg und ihre Bedeutung für die Abstammung der Hausziegen, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **76**, 321—325
THÈVENIN, R., 1947, *L'origin des animaux domestiques*, Paris
THOLT, J., 1934, *A sárvári uradalom majorgazdálkodása a XVII. szd. első felében* (The husbandry of the Sárvár domain in the first half of the 17th century), Budapest
THOMSEN, T., 1900, Vaevede stoffer fra Jenalderen, *Aarbög*, 257—278

TÖRÖK, GY., 1954, Kora-avar sírok Móron (Early Avar graves at Mór), *Arch. Ért.*, **81**, 54–60
— 1962, Pogány kultusz emléke a sopronkőhidai temetőben (Trace of a pagan cult in the cemetery at Sopronkőhida), *Fol. Arch.*, **XIV**, 83–93
TRAININAS, D., 1933, Beiträge zur Kenntnis der Haustiere der römisch–keltischen Ansiedlung auf der Engehalbinsel bei Bern. *Diss.* (Bern), Kaunas
TRINGHAM, R., 1969, Animal domestication in the Neolithic cultures of the southwest part of European USSR. In: UCKO, P. J.–DIMBLEY, G. W., *The domestication and exploitation of plants and animals*, London, 381–392
TROGMAYER, O., 1964, Megjegyzések a Körös-csoport relatív időrendjéhez (Remarks to the relative chronology of the Körös group), *Arch. Ért.*, **91**, 67–86
TROUESSART, E. L., 1904–5, *Catalogus Mammalium, Suppl.*, Paris
TSCHERSKI, J. D., 1892, Wissenschaftliche Resultate der von der kaiserlichen Akademie der Wissenschaften zur Erforschung des Janalandes und der Neusibirischen Inseln in den Jahren 1884 und 1886 ausgesandten Expedition, *IV. Mem. de l'Acad. d. Sci. St. Pétersbourg*, **7, 41**
TSCHUMI, O., 1949, *Urgeschichte der Schweiz, I*, Frauenfeld
ULMANSKY, S., 1914, Untersuchungen über das Wild- und Hausschwein des Pfahlbaues im Laibacher Moor und über einige von diesen Schweinen abstammende rezente Rausen, *Mitt. d. Landw. Lehrkanz. d. Hochsch. f. Bodenkult. in Wien*, **2**, 17–74
VEGETIUS RENATUS, P., *Digestorum artis mulomedicinae libri*, translated by E. Lommatzsch.
VENTRIS, M.–CHADWICK, J., 1956, *Documents in Mycenaean Greek*, Cambridge
VETULANI, T., 1939, Über den Farbenwechsel winterweisser Pferde. Beobachtungen bei der Rückzüchtung des europäischen Waldtarpans im Urwald Bialowies, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **45**, 182–190
VITT, V. O.– Витт, В. О., Лошады пазырыкских курганов, *Сов. Арх.*, **16**, 163–205
VOGEL, R., 1929, Vor- und frühgeschichtliche Tierreste aus dem Federseemoor, *Monatschr. Württbg.*, 455–461
— 1933, Tierreste aus vor- und frühgeschichtlichen Siedlungen Schwabens. I. Die Tierreste aus den Pfahlbauten des Bodensees, *Zoologica*, **32, 1**, Stuttgart
— 1940, Die alluvialen Säugetiere Württembergs, *Jahresh. d. Ver. f. Vaterl. Naturkde in Württbg.*, **96**, 93–110
— 1952, Reste von Jagd- und Haustieren. In: BITTEL, K.–NAUMANN, R., Bogazköy–Hattusa, **63**, *Wiss. Veröff. d. Deutsch. Orient-Ges.* Stuttgart, 128–153
VOGT, E., 1937, *Geflechte und Gewebe der Steinzeit*, Basel
WEBER, M., 1904, *Die Säugetiere*, Jena
WERTH, E., 1929, Zur Abstammung des Hauseesels, *Sitz.-Ber. d. Ges. Naturf. Fr. zu Berlin*, 342–355
WETTSTEIN, E., 1924, Tierreste aus dem Pfahlbau am Alpenquai in Zürich, *Vierteljahresschr. d. Naturf. Ges. in Zürich*, **69**, 78–127
WILKENS, M., 1877, Über die Schädelknochen des Rindes aus dem Pfahlbau des Laibacher Moores, *Mitth. d. Anthrop. Ges. in Wien*, **VII**, 165–173
— 1888, Beitrag zur Kenntnis des Pferdegebisses, *Nova Acta Leopold. d. Deutsch. Akad.*, 52
WOLDŘICH, J. N., 1878, Über einen neuen Haushund der Bronzezeit *(Canis familiaris intermedius)* aus den Aschenlagen von Weikersdorf, Pulkau und Ploscha, *Mitth. d. Anthrop. Ges. in Wien*, **7**, 61–85
— 1897, Wirbeltierfauna des Pfahlbaues von Ripać, *Wiss. Mitt. Bosn. u. d. Herzeg.*, **V**, 79–113
WRZESNIOWSKI, A., 1878, Studien zur Geschichte des polnischen Tur, *Zeitschr. f. wiss. Zool.*, **30**, Suppl., **45**
WÜRGLER, F. E., 1956, Beitrag zur Kenntnis der mittelalterlichen Fauna der Schweiz, *Ber. (Jahrb.) d. St. Gall. Naturw. Ges.*, **75**, 1–89
— 1957, Die Knochenfunde. In: KNOLL-HEITZ, F., *6. Burgenforschungskurs auf der Alttoggenburg (Iddaburg)*, St. Gallen, pp. 20–25
— 1959, Die Knochenfunde aus dem spätrömischen Kastel Schaan (4. Jahrhundert n. Chr.), *Jahrb. d. Hist. Ver. f. d. Fürst. Liechtenst.*, **58**, 255–282

— 1961, Die Säugetierknochen. In: Knoll-Heitz, F., 3. Burgenforschungskurs vom 4.—9. April 1960 auf Gräpplang bei Flums, St. Gallen, 30—35
- 1962, Veränderungen des Haustierbestandes während der Bronze- und Eisenzeit in zwei schweizerischen "Melauner"-Stationen, Montlingerberg und Mottata-Ramosch, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **77**, 35—46
Wyrost, P., 1963, Badania nad typami psow wczesnosredniowiecznego Opola i Wroclawia (Researches on the types of the early medieval dogs in Opole and Wroclaw), *Silesia Antiq.*, **V**, 198—233
Yetts, W. P., 1934, The horse: a factor in early Chinese history, *Eur. Septemtr. Antiq.*, **IX**, 231—255
Young, C. C., 1936, New finds of fossil *Bubalus* in China, *Bull. of the Geol. Soc. of China*, 15
Young, J. H.—Young, S. H., 1955, Terracotta figurines from Kourion in Cyprus, *Mus. Monogr. Univ. Mus. of Pennsylvania*, Philadelphia
Zalkin, V. I. — Цалкин, В. И., 1951, *Горные бараны Европы и Азии*, Москва
— 1952, К изучению лошадей из курганов Алтая, *МИА*, **24**, Москва, 147—156
— 1954, Домашние и дикие животные из Неаполя Скифского, *СА*, **XX**, 253—287
— 1956, Материалы для истории скотоводства и охоты в Древней Руси, *МИА*, **51**, Москва
— 1958, Фауна из раскопок археологических памятников Среднего Поволжья, *МИА*, **61**, Москва, 221—281
— 1960a, Домашние и дикие животные Северного Причерноморья в эпоху раннего железа, *МИА*, **53**, Москва
— 1960b, Изменчивость метаподий и ее значение для изучения крупного рогатого скота древности (Metapodialia variation and its significance for the study of ancient horned cattle), *Бюлл. Моск. Общ. Испыт. Природы, Отдел биол.*, **LXV**, 109—126
— 1961a, Фауна из раскопок средневековых городищ на территории Латвии. *Шнорре, Е. Д.*, Асотовское городище, *МИА Латв.ССР*, **2**, 203—222
— 1961b, Изменчивость метаподий у овец (The variability of metapodials in sheep), *Бюлл. Моск. Общ. Испыт. Природы, Отдел биол.* **LXVI**, pp. 115—132
— 1962, К истории животноводства и охоты в Восточной Европе, *МИА*, **107**, Москва
— 1964, Некоторые итоги изучения костных остатков животных из раскопок археологических памятников позднего бронзового века, *КСИА*, **101**, 24—30
— 1966, Древнее животноводство племен Восточной Европы и Средней Азии, *МИА*, **135**, Москва
Zengel, W., 1910, Die prähistorischen Rinderschädel usw., *Arch. f. Anthrop.*, N. F. **9**, 159—178
Zervos, C., 1935, *L'art de Mesopotamie*, Leipzig
Zeuner, F. E., 1933, The colour of the wild cattle of Lascaux, *Man*, **LIII**, 68—69
— 1934, The goats of early Jericho, *Palest. Explor. Quart.*, **86**, 70—86
— 1955, Domestication of animals. In: *A history of technology*, Oxford, 327—352
— 1956, La domestication dex animaux, *Scientia*, **VI, 50**, 1—6
— 1963, *A history of domesticated animals*, London
Zimmermann, Á. & G., 1944, A házimacska (The domestic cat), Budapest
Zimmermann, H., 1920, Untersuchung der Haustierfunde von Zurzach, Wädenswil und Hallwil, *Diss.*, Zürich
Zimmermann, K., 1953, Bemerkungen über die Wildziegen Kretas, *Zeitschr. f. Säugetierkde.*, **17**, 66
Zittel, K., 1895, *Handbuch der Paläontologie*, München—Leipzig

ADDENDUM

ADDITIONAL REFERENCES

ALLEN, G. M., 1968, Mammalian bones from Homolka (1929–1931). In: EHRICH, R. W.—PLESLOVÁ-STIKOVÁ, E., *Homolka: an eneolithic site in Bohemia*, Prague, 434–439

AMBROS, C., 1968, Remains of fauna found in the eneolithic settlement of Homolka. In: EHRICH, R. V.—PLESLOVÁ-STIKOVÁ, E., *Homolka: an eneolithic site in Bohemia*, Prague, 440–469

— 1969, Bemerkungen zur Auswertung der Tierknochen aus Siedlungsausgrabungen. In: BOESSNECK, J. (ed.), *Archäologie und Biologie*, Wiesbaden, 76–87

— 1971, Die Fauna der bronzezeitlichen Siedlungen in der Slowakei. In: FILIP, J. (ed.), *Act. du VIIe Congr. Internat. d. Sci. Préhist. et Protohist., Prague 1966*, **2**, Prague, 1313–1316

AMMANN, H., 1971, *Osteologische und osteometrische Untersuchungen an Tierknochenfunden der römischen Militärbasis Vindonissa.* Diss., Zürich

BALEVSKA, P.—PETROV, A., 1972, *Ovtsata tsakel u nas i v Yugoiztočna Evropa — Das Zackelschaf in Bulgarien und in Südosteuropa.* Sofia

BALEVSKA, R. K.—PETROV, A., 1973, About the origin of the "Tsakel" and some other Bulgarian sheep breeds. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 341–348

BAUER, K., 1971, Haustierreste in Gräbern des 9. Jahrhunderts aus Niederösterreich, *Arch. Austr.*, **50**, 268–278

BAUER, K.—SPITZENBERGER, F., 1970, Die Tierknochen aus dem neolithischen Hornsteinbergwerk von Mauer bei Wien. *Mitt. d. Anthrop. Ges. in Wien*, **100**, 111–115

BEHRENS, H., 1973, Nahrungsgewinnung bzw. Nahrungsproduktion bei den neolithischen Bauern im mitteldeutschen Raum. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 171–175

BERRY, R. J., 1969, The genetical implications of domestication in animals. In: UCKO, P. J.—DIMBLEBY, G. W., (eds.), *The domestication and exploitation of plants and animals*, London, 207–217

BEYER, A. I., 1970, *Tierknochenfunde der Michelsberger Kultur von Hetzenberg bei Heilbronn- Neckargartach und aus seiner Umgebung.* Diss., München

BIBIKOVA, V. I.— Бибикова, В. И., 1970, К изучению древнейших домашних лошадей Восточной Европы 2, (Study of the ancient domestic horses of East Europe, 2), *Бюлл. Московских. Общ. Испыт. Природ ы Отд. Биол.*, **LXXV**, **5**, 118—125

— 1971, Древнейшие домашние лошади Юго-Восточной Европы (The earliest domestic horses in Southeast Europe). In: *IIIème Congr. Internat. d. Mus. d'Agricult., Budapest 1971, Résum. d. Communic. Présent.*, Budapest

— 1972a, Фауна из энеолитических поселений северо-досточной Белоруссии — (The fauna of eneolithic settlements in northwestern Bielorussia), *Природ. обст. и Фауны прошл.*, **6**, 51—70

— 1972b, Остатки субфоссильного тарпана на Украине (Remains of subfossil tarpans in the Ukraine), *Основ. проблемы териолог. Труды Московск. Обш. Испыт. Природы Отд. Биол.*, **48**, 97—114

BIBIKOVA, V. I.—TIMCHENKO, N. G.— Бибикова, В. И.—Тимченко, Н. Г., 1971, Рештки тура из середньовичнїх поселенії Украинї (Aurochs remains from medieval sites in the Ukraine), *Збирн. прац зоол. муз.*, **34**, *Киïв*

BISIG, V., 1971. *Osteometrische Untersuchungen an zwei fast vollständig erhaltenen Hundeskeletten der römischen Colonia Augusta rauriaca.* Diss., Zürich

BOESSNECK, J., 1973, *Die Tierknochenfunde aus dem Kabirenheiligtum bei Theben* (Böotien), München

BOESNECK, J.—v. d. DRIESCH, A.—MEYER-LEMPPENAU, U.—WECHSLER-VON OHLEN, E., 1971, *Die Tierknochenfunde aus dem Oppidum von Manching*, Wiesbaden

BOESSNECK, J.—v. d. DRIESCH-KARPF, A., 1968, Tierknochenfunde von der Burg Nürnberg, *Jahrb. f. fränk. Landesforschung*, **28**, 73—80

BOESSNECK, J.—STORK, M., 1972, Tierknochenfunde aus einer Siedlung des 9/8. Jahrhunderts v. Chr. in Bosnien-Herzegowina, *Wiss. Mitt. d. Bosn.-herzeg. Landesmus. Sarajevo*, **11**, *A*, 127—154

BOESSNECK, J.—WIEDEMANN, U., 1972, Die Tierknochenfunde von Werlaburgdorf/Liet, Kreis Goslar, *Neue Ausgrab. u. Forschg. in Niedersachs.*, **7**, 381—400

BÖKÖNYI, S., 1969, Archeological problems and methods of recognizing animal domestication. In: UCKO, P. J.—DIMBLEBY, G. W. (eds.), *The domestication and exploitation of plants and animals*, London, 219—229

— 1970, A new method for determination of the number of individuals in animal bone material, *Amer. Journ. of Archaeol.*, **74**, 291—292

— 1971, The development and history of domestic animals in Hungary, *Amer. Anthrop.*, **73**, **3**, 640—674

— 1972a, Animal remains from the graves of the Bronze Age cemetery at Mokrin (Životinjski ostaci iz grobova nekropole bronzanog doba u Mokrinu). In: *Mokrin — the Bronze Age necropolis, II*, Beograd, 91—96

— 1972b, Aurochs (*Bos primigenius* Boj.) remains from the Őrjeg peat-bogs between the Danube and Tisza rivers, *Cumania* (Kecskemét), **I**, 17—56

— 1972c, Once more on the osteological differences of the horse, the half-ass and the ass. In: FIROUZ, L., The Caspian miniature horse in Iran, *Field Research Projects*, **64**, Miami, 12—23

— 1972d, Zoological evidence for seasonal or permanent occupation of prehistoric settlements. In: UCKO, P. J.—TRINGHAM, R.—DIMBLEBY, G. W. (eds.), *Man, settlement and urbanism*, London, 121—126

— 1973a, A temető állatcsontanyagának vizsgálata (The study on the animal bone sample of the cemetery). In: TÖRÖK, GY., Sopronkőhida IX. századi temetője, *Fontes Archeol. Hung.*, Budapest, 117—130

— 1973b, Some problems of animal domestication in the Middle East. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 69—75

— 1973c, Stock breeding. In: *Theocharis, D. R., Neolithic Greece*, Athens, 165—178

BÖKÖNYI, S.—BRAIDWOOD, R. J.—REED, C. A., 1973, Earliest animal domestication dated? *Science*, **182**, 1161

BOLOMEY, A., 1966, Fauna neolithica din asezarea Boian A de la Varasti (Neolithic fauna of the Boian A site of Varasti), *Stud. si cercet. de anthrop.*, **3**, **1**, 27—34

— 1973, The present stage of knowledge of mammal exploitation during the Epipalaeolithic on the territory of Romania. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 197—203

BUTZER, K. W., 1971, The significance of agricultural dispersal into Europe and Northern Africa. In: *Struever, S., Prehistoric agriculture*, Garden City—New York, 313—334

CASTEEL, R. W., 1971, Differential bone destruction: some comments, *Amer. Antiq.*, **36**, 466—469

— 1972, Some biases in the recovery of archeological faunal remains, *Proc. of the Prehist. Soc.*, **38**, 382—388

CHAIX, L., Faune des vertébrés. In: SAUTER, M.-R.—GALLAY, A.—CHAIX, L., Le néolithique du niveau inférieur du Petit-Chasseur à Sion, Valais. *Jahrb. d. Schweiz. Ges. f. Ur- u. Frühgesch.*, **56**, 66—74

CHAPLIN, R. E., 1969, The use of non-morphological criteria in the study of animal domestication from bones found in archaeological sites. In: UCKO, P. J.—DIMBLEBY, G. W. (eds.). *The domestication and exploitation of plants and animals*, London, 231—245.

— 1971, *The study of animal bones of archeological sites*, London—New York.

CHENEVIX TRENCH, CH., 1970, *Ridkonstens historia (History of riding art)*. Stockholm
CLASON, A. T., 1967. The animal remains and implements of bone and antler from Niederwil, *Palaeohist.*, **12**, 581–585
– 1968, Die Tierreste aus der Motte bei Haus Meer, Gemeinde Büderich, *Rhein. Ausgr.*, **1**, 101–130
– 1969, Einige Bemerkungen über Viehzucht, Jagd und Knochenbearbeitung bei der mitteldeutschen Schnurkeramik. In: *Die Becherkulturen im Gebiet der DDR*, Berlin, 173–195
– 1970a, Die Beurteilung der Tierknochen aus dem schnurkeramischen Gräberfeld von Vikletice. In: BUCHWALDEK, M.–ROUTECKY, D., *Ein Schnurkeramisches Gräberfeld*, Prag, 284–285
– 1970b, The animal bones of the Bandceramic and Middle Age settlements near Bylany in Bohemia, *Palaeohistoria*, **XIV**, 1–17
– 1971, Die Jagd- und Haustiere der mitteldeutschen Schnurkeramik, *Jhschr. mitteldeutsch. Vorgesch.*, **55**, 105–106
– 1972, Some remarks on the use and presentation of archeo-zoological data, *Helinum*, **XII, 2**, 139–153
– 1973, Some aspects of stock breeding and hunting in the period after the Bandceramic culture north of the Alps. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 205–212
COY, J. P., 1973, Bronze Age domestic animals from Keos, Greece. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 239–243
DALY, P.–PERKINS, D.–DREW, I. M., 1973, The effects of domestication on the structure of animal bone. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 157–161
DENNEL, R. W., 1972, Stone age farming in Bulgaria, *The Ill. London News. Sept.*, 61–62,
DENT, A., 1973, *The horse. Fifty centuries of civilisation*, London
v. d. DRIESCH, A., 1970, Ein Pferdeskelett der römischen Kaiserzeit aus Gielde, Kreis Goslar, *Neue Ausgr. in Niedersachs.*, **4**, 187–192
– 1971, Zu den Tierknochenfunden aus dem hallstattzeitlichen Fürstengrabhügel "Magdalenenberg" bei Villingen im Schwarzwald. In: SPINDLER, K., *Magdalenenberg*, I, Villingen, 49–50
– 1973, Viehhaltung und Jagd auf der mittelalterlichen Burg Schiedberg bei Sagogn in Graubünden, *Schriftenreiche d. Rätisch. Mus. Chur*, **16**, Chur
v. d. DRIESCH KARPF, A., 1971, Die Tierknochenfunde der Gräber aus Wessling, Ldkr. Starnberg, Grabung 1965. In: KELLER, E., *Die spätrömischen Grabfunde in Südbayern*. München, 1961–192
DUCOS, P., 1967, Les Equides des tombes royales de Salamine. In: KARAGEORGHIS, V., *Excavatoins in the necropolis of Salamis, I*, Nicosia, 154–181
FORMOZOV, A. A.–Формозов, А. А., 1972, К истории древнейшего скотоводства на Юге СССР (On the hitory of earliest stock breeding in the southern part of USSR), *Основ. проблемы териол. Труды Московск. Общ. Испыт. Природы Отд. Биол.*, **48**, 19–25
FRUTH, M., 1966, Tierknochenfunde aus der Stadt auf dem Magdalensberg bei Klagenfurt in Kärnten. IV. Die Wiederkäuer ohne die Bovini; *Kärntn. Museumsschr.*, **XLI**, Klagenfurt
GANDERT, O.-F., 1973, Das früheste Auftreten der Haustaube nördlich der Alpen. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 119–123
GAWLIKOWSKI, J., 1969a, Szczatki zwierzęce z badań sondazowych na wczesnośredniowiecznym stanowisku nr IV w Szczecinie (Tierreste aus den Suchschnitten auf der frühmittelalterlichen Fundstelle Nr. 4 in Szczecin), *Mat. Zachodniopomor.*, **15**, 243–254
– 1969b, Szczatki zwierzęce z zamku w Płotach (Tierreste aus dem Schloss Płoty), *Mat. Zachodniopomor.*, **15**, 255–264
GEJVALL, N.-G., 1969, *Lerna, I. The fauna*, Princeton

— 1973, Automation och arkeo-osteologi (Automatization and archaeo-osteology), *Tor*, **15**, 257–262

GEJVALL, N.-G.–PERSSON, O., 1970, Osteological analysis of the human and animal cremated bones. In: HOLMQUIST, W., *Excavations at Helgö, III. Report for 1960–1964*, Stockholm, 227–233

GERINGER, J., 1967, Tierknochenfunde von der Heuneburg, einem frühkeltischen Herrensitz bei Hundersingen an der Donau. Die Paarhufer ohne Bovini, *Naturwiss. Untersuch. z. Vor- u. Frühgesch. in Württbg. u. Hohenzoll.*, **5**, Stuttgart

GHETIE, B.–MATEESCO, C. N., 1971a, Le chien du néolithique moyen de Vadastra (Roumanie), *L'Anthropologie*, **75**, 357–368

— 1971b, Utilisation des bovines à la traction dans la phase plus récente de la civilisation Vadastra (néolithique moyen). In: FILIP, J. (ed.), *Act. du VIIe Congr. Internat. d. Sci. Préhist. et Protohist., Prague 1966*, **2**, Prague, 1310–1313

GRAF, G., 1967, Tierknochenfunde von der Heuneburg, einem frühkeltischen Herrensitz bei Hundersingen an der Donau. Nichtpaarhufer, *Naturwiss. Untersuch. z. Vor- u. Frühgesch. in Württbg. u. Hohenzoll.*, **6**, Stuttgart

GRIGSON, C., 1969, The uses and limitations of differences in absolute size in the distinction between the bones of aurochs *(Bos primigenius)* and domestic cattle *(Bos taurus)*. In: UCKO, P. J.–DIMBLEBY, G. W. (eds.), *The domestication and exploitation of plants and animals*, London, 277–294

HAIMOVICI, S., 1965, Date pivitoare la metapodele de Ovicaprinae din asezarile epocii bronzului de pe teritorial R. S. Romania (Données concernant les métapodiales des Ovicaprinae des stations de l'époque du bronze en Roumanie), *Anal. Stiint. al. Univ. "Al. I. Cuza" d. Iasi*, **XI**, **2**, 371–378

— 1966a, Les caractéristiques de la pléofaune de l'époque du bronze trouvée sur le territoire de la Roumanie, *Anal. Stiint. al. Univ. "Al. I. Cuza" d. Iasi*, **XII**, **2**, 411–418

— 1966b, Studiul materialui faunistic descoperit in asezarea din epoca bronzului (cultura Monteoru) de la Bogdanesti [Étude sur les restes fauniques découverts dans l'établissement de l'âge du bronze (civilisation de Monteoru) de Bogdanesti], *Archaeol. Moldv.*, **IV**, 119–136

— 1967, Unele caracteristici morfologice ale taurinelor din asezárile traco-getice (Quelques caractéristiques des bovins des établissements Thraco-Gétes), *Anal. Stiint. al. Univ. "Al. I. Cuza" d. Iasi*, **XIII**, **2**, 321–329

— 1968a, Caracteristicile mamiferelor domestice descoperite in statiunile arheologice din epoca bronzului de pe teritoriul Romaniei (Les caractéristiques des mammifères domestiques découverts dans les stations de l'époque du bronze sur le territoire de la Roumanie), *Anal. Stiint. al Univ. "Al. I. Cuza" d.* **XIV**, **1**, 185–198

— 1968b, Observations concernant le matériel faunique découvert dans la station éponyme de la culture de Pecica (le bronze moyen), *Anal. Stiint. al Univ. "Al. I. Cuza" d. Iasi*, **XIV**, **2**, 401–408

— 1969, Date cu privire la fauna descoperita intr-o asezarea dacica (oppidum Ziridava?") [Quelques données concernant la fauna trouvé dans un établissement dace (oppidum Ziridava?]), *Anal. Stiint. Al. Univ. "Al. I.Cuza" d. Iasi*, **XV**, **2**, 403–409

— 1970, Studiul faunei subfosile descoperita in asezarea de la Erbiceni (perioda de trecere de la neolitic la epoca bronzului) [L'étude de la fauna découverte dans la station d'Erbiceni (la période de transition du néolithique à l'époque du bronze)], *Anal. Stiint. al. Univ."Al. I. Cuza" d. Iasi*, **XVI**, **1**, 169–179

— 1971, Les caractéristiques des chevaux découverts dans la nécropole Gète de Zimnicea, *Anal. Stiint. al Univ. "Al. I. Cuza" d. Iasi*, **XVII**, **1**, 169–185

— 1972a, Date privind resturile de animale descoperite in asezarea getica de la Zimnicea (Quelques données concernant les restes d'animaux trouvés dans l'établissement Gète de Zimnica), *Anal. Stiint. al. Univ. "Al. I. Cuza" d. Iasi* **XVIII**, **1**, 191–204

— 1972b, Studial resutilor faunistice proventite din asezarea apartinind perioadei de trecere de la neolitic la epoca bronzului de la Foltesti (Étude des restes fauniques provenant de l'établissement de Foltesti, appartenant à la periode de transition du néolithique à l'âge du bronze), *Arheol. Moldv.*, **VII**, 97–102

— 1973, L'élevage et la chasse chez les Gèto-Daces. In: MATOLCSI, J. (ed.), *Domesti-*

kationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971, Budapest, 257–262

HAIMOVICI, S.—GHIORGHIU, G., 1969, Sur quelques traits de la faune subfossile découverte par les fouilles exécutées dans la station de Luncavita, *Lucr. Stat. de Cercet. Marine "Prof. Ioan Borcea"*, **III**, 337–343

— 1971, L'élevage et la chasse durant la période de transition entre Hallstatt et la Tène chez les populations du Nord de la Moldavie (Roumanie). In: FILIP, J. (ed.), *Actes du VIIe Congrès International des Sciences Préhistoriques et Protohistoriques, Prague 1966*, **2**, Prague, 1317–1320

HAIMOVICI, S.—ONOFREI, M., 1967, Caracteristicile mamiferelor descoperite in statiunea feudala timpurie de la Bucov (Les caractéristiques des mammifères découverts dans la station du commencement de l'époque féodale de Bucov, *Anal. Stiint. al. Univ. "Al. I. Cuza" d. Iasi*, **XIII, 1**, 181–188

HAIMOVICI, S.—URECHE, R., 1968, Studiul resturilor de fauna descoperite in satiunea de la Cernavoda (Dealul Sofia) [(L'étude des restes fauniques découverts dans la station de Cernavoda (Dealul Sofia)], *Lucr. Sesiun. Stiint. a Stat. de Cercet. Marina "Prof. Ioan Borcea", Vol. Festiv.*, Iasi, 291–308

HANSCHKE, G., 1970. *Die Tierknochenfunde aus der Wüstung Wölfingen. II. Die Wiederkäuer.* Diss., München

HARTL, M., 1971, *Die Tierknochenfunde aus der Wüstung Wölfingen. I. Die Nichtwiederkäuer.* Diss., München

HARTMANN-FRICK, H., 1970, Die Tierwelt im neolithischen Siedlungsraum. In: *Ur- und frühgeschichtliche Archäologie der Schweiz. II*, Zürich, 17–32

HERRE, W., 1967, Zoologische Betrachtungen zu Aussagen über den Domestikationsbeginn, *Palaeohist.*, **12**, 283–285

— 1972, Zur haustierkundlichen Problematik der Analyse von Tierknochenfunden aus frühgeschichtlichen bis mittelalterlichen Siedlungen Mitteleuropas, *Die Kunde*, **23**, 184–195

HERRE, W.—RÖHRS, M., 1971, Domestikation und Stammesgeschichte. In: HEBERER, G. (ed.), *Die Evolution der Organismen*, **II/2**, 29–174

— 1973, *Haustiere—zoologisch gesehen*, Stuttgart

HIGGS, E. S.—CLEGG, I. M.—KINNES, I. A., 1968, Saliagos animal bones. In :RENFREW, C., *Excavations at Saliagos near Antiparos*, London, 114–117

HILLS, E. S.—JARMAN, M. R., 1969, The origins oj agriculture: a reconsideration, *Antiquity*, **XLIII**, 31–41

— 1972, The origins of animal and plant husbandry. In: HIGGS, E. S. (ed.), *Papers in economic prehistory*, Cambridge, 3–13

HIGHAM, C. F. W., 1967, Stock rearing as a cultural factor in prehistoric Europe, *Proceed. of the Prehist. Soc.*, **XXXIII**, 84–106

— 1968a, Faunal sampling and economic prehistory, *Zeitschr. f. Säugetierkde.*, **33, 5**, 297–305

— 1968b, Size trends in prehistoric European domestic fauna, and the problem of local domestication, *Acta Zool. Fenn.*, **120**, 3–21

— 1968c, Trends in prehistoric European caprovine husbandry, *Man*, **3, 1**, 64–75

— 1969, Towards an economic prehistory of Europe, *Curr. Anthrop.*, 139–150

HILDEBRANDT, K., 1966, Tierknochenfunde aus der Stadt auf dem Magdalensberg bei Klagenfurt in Kärnten. V, Die Rinderknochen, *Kärntn. Museumschr.* **XLII**, Klagenfurt

HORNBERGER, M., 1970, Gesamtbeurteilung der Tierknochenfunde aus der Stadt auf dem Magdalensberg in Kärnten (1948–1966), *Kärntn. Museumschr.*, **XLIX**, Klagenfurt

v. HOUWALD, G., 1971, *Römische Tierknochenfunde aus Pfaffenhofen am Inn, Ldkr. Rosenheim, und aus Wehringen, Ldkr. Schwabmünchen.* Diss., München

ISAAC, E., 1971, On the domestication of cattle. In: STRUEVER, S., *Prehistoric agriculture*, Garden City—New York, 451–470

IVANOV, S., 1972, Konete ot trakiyskata nadgrobna mogila III pri s. Yankovo, Shumenki okrig (Die Pferde im thrakischen Grabhügel III beim Dorf Jankovo, Kreis Šumen), *Izvest. na Arch. Inst. Sofia*, **33**, 121–126

JANKOVICH, M., 1967 Adatok a magyar szarvasmarha eredetének és hasznosításának kérdéséhez (Ursprung und Nutzbarmachung des ungarischen Steppenrindes), *Agrártört. Szemle*, 420–431

— 1971, A magyar ló (Das ungarische Pferd) *Agrártört. Szemle*, 253–267
JARMAN, M. R., 1969, The prehistory of Upper Pleistocene and recent cattle. Part I: East Mediterranean, with reference to North-west Europe, *Proceed. of the Prehist. Soc.*, **XXXV**, 236–266
JARMAN, M. R.–JARMAN, H. N., 1968, The fauna and economy of early neolithic Knossos, *Ann. of the Brit. School of Archaeol. at Athens*, **63**, 241–264
JARMAN, M. R.–WILKINSON, P. F., 1972, Criteria of animal domestication. In: HIGGS, E. S. (ed.), *Papers in economic prehistory*, Cambridge, 83–96
KARAIWANOW, R.–PETROW, A., 1973, Frühgeschichte und Ursprung des aboriginen primitiven Hauspferdes in Bulgarien. In: MATOLCSI, J. (ed.), *Domestikationforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 285–295
KLEINSCHMIDT, A., 1972, Die Pferdeknochenfunde aus dem Reihengräberfriedhof von Donzdorf (Kr. Göppingen). In: NEUFFER, E. M., Der Reihengräberfriedhof von Donzdorf, *Forschg. u. Ber. z. Vor- u. Frühgesch. in Baden-Württbg.*, **2**, 119–131
KOCH, W., 1969, Die Ernährung der Haustiere in der frühen Domestikation. In: BOESNSECK, J. (ed.), *Archäologie und Biologie*. Wiesbaden, 94–99
KRANZOWA, I., 1972, Zwierzęce szczątki kostne z osady póznolazenskiej w Lachmirowicach, pow. Inowroclaw (Tierknochenreste aus der spätlatènezeitlichen Siedlung von Lachmirowice, Kr. Inowrocław), *Zesztyty Nauk. Univ. Mikol. Kopernika w Toruń.*, *Nauki hum.–spol.*, **45**, 85–93
KRASNOV, YU. A.–Краснов, Ю. А., 1971, Раннее земледелие и животноводство в лесном полесье Восточной Европы (Earlier agriculture and stock breeding in the forest belt of East Europe), *МИА*, **174**, Москва
KRATOCHVIL, J.–KRATOCHVIL, Z., 1970, Die Unterscheidung von Individuen der Population *Felis s. silvestris* aus den Westkarpaten von *Felis s.* f. *catus. Zool. Listy*, **19**, **4**, 293–302
KRATOCHVIL, Z., 1969a, Die Tiere des Burgwalles Pohansko, *Acta Sci. Nat. Brno*, **III**, **1**, 1–39
— 1969b, Wildlebende Tiere und einige Haustiere der Burgstätte Pohansko, *Acta Sci. Nat. Brno*, **III**, **3**, 1–44
— 1971, Microscopic evaluation of the hairs of the mane and the tail of the wild horse *(Equus przewalskii)* in comparison with the modern and historical domestic horse, *Acta Vet. Brno*, **40**, 23–31
— 1972, Knochenüberreste von der neolithischen Siedlung "Jeleni louka" bei Mikulov (Bez. Breclav), *Prehlad vyzk.*, 24–27
— 1973a, Der Fund von *Equus (Hydruntinus) hydruntinus* (Regalia, 1907) und anderer Säuger aus dem südmährischen Neolithikum, *Slov. Arch.*, **XXI**, –**1** 195–210
— 1973b, Schädelkriterien der Wild- und Hauskatze (*Felis silvestris* Schreb. 1777 und *F. s.* f. *catus* L. 1958), *Acta Sci. Nat. Brno*, **7** (**10**), 1–50
KRATOCHVIL, Z.–STERBA, O., 1970, Osteologische Analyse der heimischen Knochenindustrie aus Mikulcice und Pohansko, *Archeol. Rozhl.*, **XXII**, 447–470
KRYSIAK, K.–LASOTA, A., 1971, Zwierzęce materiały kostne z osady Kamień Lukawski, pow. Sandomierz (Das Tierknochenmaterial aus einer Siedlung bei Kamień Lukawski, Kr. Sandomierz), *Wiad. Archeol.*, **36**, **2**, 187–202
KRYSIAK, K.–LASOTA, A.–KOWALCZYK, J., 1973, Contribution à l'étude des Bovides du néolithique polonais. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 317–324
KUBASIEWICZ, M.–GAWLIKOWSKI, J., 1969, Zwierzęcy materiał kostny z wczesnośredniowiecznego Rynku Warzywnego w Szczecinie, częśc II (Tierknochenmaterial aus dem frühmittelalterlichen Gemüsemarkt in Szczecin), II. Teil, *Mat. Zachodniopomor.*, **15**, 189–242
KÜHNHOLD, B., 1971, *Die Tierknochenfunde aus Unterregenbach, einer mittelalterlichen Siedlung Württembergs.* Diss., München
KÜPPER, W., 1972, *Die Tierknochenfunde von der Burg Schiedberg bei Sagogn in Graubünden. II. Die kleinen Wiederkäuer, die Wildtiere und das Geflügel.* Diss., München
LAWRENCE, B., 1973, Problems in the inter-site comparison of faunal remains. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 397–402

LAWRENCE, B.—BOSSERT, W. H., 1967, Multiple character analysis of *Canis lupus, latrans*, and *familiaris*, with a discussion of the relationships of *Canis niger*, *Amer. Zool.*, **7**, 223—232

LITTAUER, M. A., 1969, Bits and pieces, *Antiquity*, **XLIII**, 289—300

— 1972, The military use of the chariot in the Aegean in the Late Bronze Age, *Amer. Journ. of Archaeol.*, **76**, **2**, 145—157

LÜTTSCHWAGER, J., 1966, Über ein Hundeskelett aus einer Römesiedlung in Heilbronn am Neckar, *Säugetierkundl. Mitt.*, **14**, **2**, 85—91

MARKOW, G., 1973, Beitrag zur Geschichte einiger Haussäugetiere in Bulgarien. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 229—238

MATOLCSI, J., 1968a, A szarvasmarha testnagyságának változásai a történelmi korszakokban Magyarország területén (Die Veränderung der Körpergröße des Rindes in den geschichtlichen Epochen auf dem Gebiete Ungarns,) *Agrártört. Szemle*, 1—38

— 1968b, Avarkori háziállatok maradványai Gyenesdiáson (Überreste von Haustieren aus dem Zeitalter der Awaren in Gyenesdiás), *Magy. Mezőgazd. Múz. Közl.* 1967—68, 85—124

— 1968c, Untersuchung des Tierknochenmaterials des frühbronzezeitlichen Gräberfeldes bei Battonya, *Acta Antiq. et Archaeol.*, **XII**, 65—74

— 1969, Összefüggések a szarvasmarha élősúlya és lábközépcsontjainak súlya között (Zusammenhänge zwischen dem Lebendgewicht des Rindes und dem Gewicht seiner Metapodien), *Állatt. Közl.*, **LVI**, **1—4**, 99—106

— 1970, Historische Erforschung der Körpergröße des Rindes auf Grund von ungarischem Knochenmaterial, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.* **87**, **2**, 89—137

— 1972, Archeo-zoological problems of meat consumption in the early historical periods. In: *Advances in the biology of human populations*, Budapest, 503—508

— 1973, Schädelgestaltung des Pferdes in der Völkerwanderungszeit. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 297—307

MAY, E., 1969, Einige statistische Methoden zur Auswertung vor- und frühgeschichtlicher Tierknochenfunde. In: BOESSNECK, J. (ed.), *Archäologie und Biologie*. Wiesbaden, 141—147.

MOORA, H., 1971, Zur Viehhaltung und Jagd im Ostbaltikum in der zweiten Hälfte des 1. Jahrtausends und am Anfang des 2. Jahrtausends. In: FILIP, J., (ed.), *Act. du VIIe Congr. Internat. d. Sci. Préhist. et Protohist., Prague 1966*, **2**, Prague, 1183—1190

MÜLLER, H.-H., 1967, Die Tierreste aus der frühslawischen Siedlung von Dessau-Mosigkau. In: KRÜGER, B., Dessau-Mosigkau, *Deutsch. Akad. d. Wiss. zu Berlin, Schr. d. Sekt. f. Vor- u. Frühgesch.* **22**, 139—152

— 1969, Die Tierreste aus der Wallburg "Der Kessel" bei Kretzschau-Groitzschen, Kr. Zeitz. In: OTTO, K.-H.—HERRMANN, J., Siedlung, Burg und Stadt, *Dtsch. Akad. d. Wiss. zu Berlin, Schr. d. Sekt. f. Vor- u. Frühgesch.*, **25**, 361—370

— 1971a, Stand der Erforschung der neolithischen Haustiere. In: *Evolution und Revolution im Alten Orient und in Europa*. Berlin, 95—100

— 1971b, Viehzucht bei den westlichen Slawen. In: FILIP, J. (ed.), *Act. du VIIe Congr. Internat. d. Sci. Préhist. et Protohist, Prague, 1966*, **2**, 1190—1197

— 1973a, Das Tierknochenmaterial aus den frühgeschichtlichen Siedlungen von Tornow, Kr. Calau. In: HERRMANN, J., *Die germanischen und slawischen Siedlungen und das mittelalterliche Dorf von Tornow, Kr. Calau*. Berlin, 267—310

— 1973b, Widerspiegelung gesellschaftlicher Verhältnisse im archäologischen Tierknochenmaterial. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 187—194

MURRAY, J., 1970, The first European agriculture, Edinburgh

— 1973, Einige Gesichtspunkte über die Beziehung zwischen Viehzucht und archäologischen Kulturen im Spätneolithikum in Europa. In: MATOLCSI, J. (ed.), *Domestikations forschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 177—186

MUSIL, R., 1970, Domestication of the dog already in the Magdalenian? *Anthropologie (Brno)*, **8**, **1**, 87—88

NANDRIS, J., 1972, *Bos primigenius* and the bone spoon, *Bull. of the Inst. of Arch., Univ. of London*, **10**, 63–82

NECRASOV, O.—HAIMOVICI, S., 1966, Studiul resturilor de fauna neolitica, descoperite in statiunea Gumelnita (L'étude des restes de la faune néolithique découverts à Gumelnita), *Stud. si cercet. de ist. veche*, **17**, **1**, 101–118

NECRASOV, O.—BULAI, M., 1970, L'élevage, la chasse et la pêche durant le Néolithique roumain. In: *Act. du VIIe Congr. Internat. d. Sci. Anthrop. et Ethnol.*, **V**, Moscow, 544–556

NECRASOV, O.—STIRBU, M., 1971, L'élevage et la chasse chez le tribus de la culture de la céramique peinte Cucuteni-Ariusd. In: FILIP, J. (ed.), *Act. du VIIe Congr. Internat. d. Sci. Préhist. et Protohist., Prague 1966*, **2**, Prague, 1304–1310

NOBIS, G., 1968a, Das "Rind" aus dem Warnsdorfer Moor bei Ratekau, Kr. Eutin. In: CLAUS, M.—HAARNAGEL, W.—RADDATZ, K., *Studien zur europäischen Vor- und Frühgeschichte*. Neumünster, 28–36

— 1968b, Die Haustierreste aus Bergheim (Kr. Waldeck). *Fundber. aus Hessen*, **8**, 14–19

— 1969, Haben Haushunde mehrere wilde Stammformen? *Ber. mathemat. u. naturwiss. Unterricht*, **22**, **2**, 70–73

— 1971, Vom Wildpferd zum Hauspferd, *Fundamenta*, B, **6**, Köln

— 1973a, Die Pferde aus dem fränkischen Gräberfeld von Rübenach, *Germ. Denkm. d. Völkerwanderungszeit, Ser. B., Die Fränk. Altertüm. d. Rheinland.*, **7**, 275–282

— 1973b, Gedanken zum Domestikationsproblem, *Zeitschr. f. Agrargesch. u. Agrarsoziol.*, **21**, **2**, 161–172

— 1973c, Tierreste aus einer Siedlung der vorröm ischen Eisenzeit bei Sünninghausen, *Bodenaltertüm. Westfal.* **XIII**, 143–164

— 1973d, Welche Aussagen gestatten die Wildpferde von Feldkirchen-Gönnersdorf (Kr. Neuwied) auf die Frage nach dem Wildahn unserer Hauspferde? In: MATOLCSI J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 97–113

— 1973e, Zur Frage römerzeitlicher Hauspferde in Zentraleuropa, *Zeitschr. f. Säugetierkde.*, **38**, **4**, 224–252

NODDLE, B. A., 1973, Determination of the body weight of cattle from bone measurements. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 377–389

OWEN, C., 1973, Domestication of the ferret. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 115–117

PAAVER, K.—Паавер, К., 1972, Об остеонной организации костной ткани тура (*Bos primigenius* Boj.) и крупного рогатого скота [Osteon organization of bony tissue in the aurochs (*Bos primigenius* Boj.) and horned cattle], *Transact. of the Moscow Soc. of Natur.*, **XLVIII**, 126–134

— 1973, *Изменчивость остеонной организации млекопитающих* [*Variability of osteonic organization in mammals*], Tallin

PARAIN, CH., 1971, Zur Problematik der Geschichte der Viehzucht im römischen Reich, *Jahrb. f. Wirtschaftsgesch.* **2**, 165–173

PAYNE, S., 1968, The origins of domestic sheep and goats: a reconsideration in the light of the fossil evidence, *Proc. of the Prehist. Soc.*, **XXXIV**, 368–384

— 1972a, On the interpretation of bone samples from archeological sites. In: HIGGS, E. S. (ed.), *Papers in economic prehistory*, Cambridge, 65–81

— 1972b, Partial recovery and sample bias: the results of some sieving experiments. In: HIGGS, E. S. (ed.), *Papers in economic prehistory*, Cambridge, 49–64

— 1973, Animal bones (from the Franchthi Cave), *Hesperia*, **XLII**, **1**, 59–66

PERKINS, D., 1969, Fauna of Çatal Hüyük: evidence for early cattle domestication in Anatolia, *Science*, **164**, 177–179

— 1973, A critique on the methods of quantifying faunal remains from archaeological sites. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 367–369

PETRENKO, A. G.—Петренко, А. Г., 1967, Материалы к истории животноводства в эпоху поздней бронзы и раннего железа на территории Средней Волги и Нижней Камы (Materials to the history of stock breeding of the Late Bronze Age and

Early Iron Age from the Middle Volga and Lower Kama region), *Ученые записки*, Пермь, **148,** 187—196
PETROV, A., 1972, Issledovania na čerep ot glavanta na kon et kisnoeneolitnata i rannobronzovata epokna v Bulgaria (Untersuchungen des Schädels eines Pferdekopfes aus der spätneolithischen und der frühbronzenen Epoche in Bulgarien), *Životnovidni Nauki*, **IX, 3**, 109—118
PETZSCH, H., 1973, Zur Problematik der Primärdomestikation der Hauskatze *(Felis silvestris familiaris)*. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 109—113
PIDOPLICHKO, I. G. — Пидопличко, И. Г., 1969, *Позднепалеолитические жилища из костей мамонта на Украине (Late paleolithic dwelling place made of mammoth bones in the Ukraine)*, Киев
POHLHAUSEN, H., 1972, Standpunkte zur Diskussion über das Alter der Viehzucht. *Anthropos*, **67,** 176—195
PROTSCH, R. — BERGER, R., 1973, Earliest radiocarbon dates for domesticated animals, *Science*, **179,** 235—239
REICHSTEIN, H., 1971a, Pferde- und Menschenknochen aus dem fränkischen Grab Nr. 19 in Rheinhausen, *Rhein. Ausgrab.*, **9,** 166—173
— 1971b, Tierknochenfunde aus einem römischen Brunnen in Irrel, Kreis Bitburg-Prüm, *Trier. Zeitschr.*, **34,** 93—95
— 1971c, Tierknochenreste aus einer mittelalterlichen Burg bei Lürken, Kr. Jülich. I, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **88, 3**, 254—264
— 1972, Knochenreste von der urnenfelder- und späthallstattzeitlichen Ringwallanlage Dommelberg bei Koblenz, *Zeitschr. f. Tierzüchtg. u. Züchtgsbiol.*, **89, 3**, 256—263
— 1973, Untersuchungen zur Variabilität frühgeschichtlicher Rinder Mitteleuropas. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest 325—340
REISS, B., 1967, Tierknochenfunde von der Heuneburg, einem frühkeltischen Herrensitz bei Hundersingen an der Donau. Nichtwiederkäuer. *Naturwiss. Untersuch. z. Vor- u. Frühgesch. in Württbg. u. Hohenzoll.*, **4,** Stuttgart
RYDER, M. L., 1971, The status of non-domestic sheep, *Antiquity*, **45,** 220—221
RYDER, M. L.—HEDGES, J. W., 1973a, Ancient Scythian wool from the Crimea, *Nature*, **242, 5398**, 480—482
— 1973b, Römerzeitliche Wollreste aus Deutschland und Dänemark. *Archäol. Korrespondenzbl.*, **3,** 359—362
SAUER-NEUBERT, A., 1968, *Tierknochenfunde aus der römischen Zivilsiedlung in Hüfingen. II. Wild- und Haustierknochen mit Ausnahme der Rinder*. Diss., München
SCHAFFER, W. M.—REED, C., A., The co-evolution of special behavior and cranial morphology in sheep and goats, *Fieldiana, Zool.*, **61, 1**, Chicago
SCHMID, E., 1967, Tierreste aus einer Großküche von Augusta Raurica, *Basl. Stadtbuch*, 175—186
— 1969, Knochenfunde als archäologische Quellen. In: BOESSNECK, J. (ed.), *Archäologie und Biologie*. Wiesbaden, 100—111
SCHOLZ, E., 1972, *Die Tierknochenfunde von der Burg Schiedberg bei Sagogn in Graubünden. I. Die Haustiere mit Ausnahme der kleinen Wiederkäuer und des Geflügels*. Diss., München
SCHÜLE, W., 1969, Glockenbecher und Hauspferde. In: BOESSNECK, J. (ed.), *Archäologie und Biologie*. Wiesbaden, 88—93
SHCHEGLOVA, V. V. — Щеглова, В. В., 1967, К вопросу о фауне Минского замчища (The fauna of the castle of Minsk). In: *Белорусские древности*, Минск, 404—421
— 1969, К вопросу о животноводстве и охоте в Белоруссии в средние века (On the problem of stock breeding and hunting in the Middle Ages in Bielorussia). In: *Древности Белоруссии*, Минск, 406—426
SHCHEGLOVA, V. V. — ZVERYUGO, YA. G. — Щеглова, В. В. — Зверюго, Я. Г., 1967, Фауна древнего Волковыска (The fauna of the early Volkovysk). In: *Белорусские древности*, Минск, 342—389
SKORKOWSKI, E., 1971, Ewolucja gatunku konia (The evolution of the horse species), *Przgel. Zool.*, **15, 3**, 308—315
SOBOCINSKI, M., 1967, Szczątki kostne zwierzęce z wykopalisk w Wiślicy (Animal

skeletal material from the excavations at Wiślica), *Roczn. Wyzszej Szkoly Roln. w Poznan,* **XXXVI,** 175–213
– 1970, Materiał kostny zwierzęcy z wykopalisk w Kobylnikach i Aleksandrowie, pow. Busko-Zdrój (Tierknochenmaterial von den Ausgrabungen in Kobylniki und Aleksandrów, Kr. Busko Zdrój), *Rozpr. Zesp. Badan n. Pols. Sredniow. Univ. Warszaw. i. Politechn. Warszaw.*, **5,** 259–281

SOERGEL, E., 1969, Stratigraphische Untersuchungen am Tierknochenmaterial von Thayngen Weier. In: BOESSNECK, J. (ed.), *Archäologie und Biologie.* Wiesbaden, 157–171

STAMPFLI, H. R., 1968, Die Tierknochenfunde der Grabung Chur-Welschdörfli 1962/63. *Jahresber. d. Naturforsch. Ges. Graubünd.*, **XCII,** 1–8
– 1972, Die Tierknochenfunde der Burgstelle Rickenbach, *Jahrb. f. Solothurn. Gesch.*, **45,** 388–399

STECHER, R. M., 1967, The Przewalski horse: numerical variation of the vertebrae and chromosome counts compared to other Equidae, *Acta Zool. et Pathol. Antverp.*, **43,** 45–62

STREITFERDT, U. K., 1972, *Osteoarchäologische Untersuchungen an Tierknochenfunden aus vier römischen Stationen im süddeutschen Raum.* Diss., München

STÜBNER, L., 1971, *Osteologische und osteometrische Studien an Schweineknochen der latènezeitlichen Södersiedlung Bad Nauheim.* Diss., Gießen

SWIEZENSKI, K., – WYROST, P., 1973, Szczątki z grobów zwierzęcych jako przedmiot badań archeozoologicznych (Restes des animaux inhumés comme objet des recherches archéologiques), *Kwartaln. Hist. Kult. Mat.*, **XXI, 3,** 455–460

TEICHERT, M., 1968, Die Tierreste der germanischen Siedlung Wüste Kunersdorf, Kr. Seelow, *Veröff. d. Mus. f. Ur- u. Frühgesch. Potsdam,* **4,** 101–125
– 1969a, Osteometrische Untersuchungen zur Berechnung der Widderristhöhe bei vor- und frühgeschichtlichen Schweinen. *Kühn-Archiv,* **83, 3,** 237–292
– 1969b, Zur Bedeutung der Schweinehaltung in ur- und frühgeschichtlicher Zeit. *Ethnogr.–Archäol. Zeitg.* **10,** 543–546
– 1970a, Größenveränderungen der Schweine vom Neolithikum bis zum Mittelalter, *Arch. f. Tierzucht,* **13, 3,** 229–240
– 1970b, Abstammung und Morphogenese vor- und frühgeschichtlicher Hausschweine. *Arch. f. Tierzucht,* **13, 6,** 507–523
– 1970c, Vergleichende osteologische Untersuchungen der Tierreste von einem Fundplatz der Jastorfkultur bei Tangermünde, Kreis Steindal, *Ethnogr.–Archäol. Zeitschr.*, **11,** 499–514
– 1971a, Die Tierreste aus einer germanischen Siedlung bei Kablow, Kr. Königs Wusterhausen. *Veröff. d. f. Mus. f. Ur- u. Frühgesch. Potsdam,* **6,** 151–161
– 1971b, Tierreste aus einem Merowingergrab in Mühlhausen, *Ausgr. u. Funde,* **16, 5,** 262–264
– 1973, Haustierhaltung, Jagd und Fischfang in einigen germanischen Siedlungen zur La-Tène-Zeit und römischen Kaiserzeit. In: MATOLCSI, J., (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971,* Budapest, 263–274

THENIUS, E., 1971, Wirbeltier- und Molluskenreste aus den neolithischen und bronzezeitlichen Gruben in Schwechat, NÖ, *Arch. Austr.* **50,** 64–67

TELEGIN, D. J., 1973, Über einen der ältesten Pferdezuchtherde in Europa. In: *Act. du VIIIe Congr. Internat. d. Sci. Prehist. et Protohist.*, **II,** Beograd, 324–327

TIMCSENKO, N. G. – Тимченко, Н. Г., 1969, К характеристике быка домашнего тура (*Bos taurus* L.) из древнерусского города Воинья (Zur Charakterisierung der Hausrinder aus der altrussischen Stadt Voinja), *Вестн. Зоол.*, **6,** 71–78
– 1972, *Истории охоты и животноводства в Киевской Руси (Среднее Поднепровье) (To the history of hunting and stock breeding in the Kiev Russia–Middle Dniepr,* Киев

TRINGHAM, R., 1969, Animal domestication in the neolithic cultures of the south-west part of European U.S.S.R. In: UCKO, P. J. – DIMBLEY, G. W. (eds.), *The domestication and exploitation of plants and animals,* London, 381–392
– 1971, *Hunters, fishers and farmers of Eastern Europe,* London

UDRESCU, M. S., 1971, Nota asupra resturilor scheletice ale calului descoperit in mormintul de calaret de la Curcani-Ilfov (Skeletal remains of a horse from a rider's grave in Curcani-Ilfov), *Stud. i cercet, de ist. veche,* **22, 3,** 463–468

UERPMANN, H.-P., 1972, Zwei neolithische Funde von Wildrind und Hausrind aus dem südlichen Oberrheingebiet, *Arch. Nachricht. aus Baden*, **8**, 3–6

— 1973a, Animal bone finds and economic archaeology: a critical study of "osteo-archaeological", method, *World Archaeol.*, **4**, **3**, 307–322

— 1973b, Ein Beitrag zur Methodik der wirtschaftshistorischen Auswertung von Tierknochenfunden aus Siedlungen. In: MATOLCSI, J. (ed.), *Domestikationsforschung und Geschichte der Haustiere. Internationales Symposion in Budapest 1971*, Budapest, 391–395

WATERBOLK, H. T., 1971, Food production in prehistoric Europe. In: STRUEVER, S., *Prehistoric agriculture*, Garden City–New York, 335–358

WATSON, J. P. N., 1972, Fragmentation analysis of animal bone samples from archaeological sites, *Archaeometry*, **14**, **2**, 221–227

WENDT, W., 1969, Untersuchungen über die Tierwelt einer römerzeitlichen Siedlung aus Bonn. In: BOESSNECK, J. (ed.), *Archäologie und Biologie*. Wiesbaden, 172–179

WEYRAUCH, K. D., 1970, *Osteologische und osteometrische Studien an Knochenfunden von Schaf, Ziege, Hund und Fuchs aus der latènezeitlichen Södersiedlung Bad Nauheim*. Diss., Gießen

WYROST, P.–KUCHARCZYK, J., 1967, Versuch der Bestimmung der Widerristhöhe des Hundes mittels der inneren Hirnhöhlenlänge, *Acta Theriolog.*, **XII**, **9**, 105–110

— 1968, Über einige Eigenschaften gewisser Schädelmerkmale des osteuropäischen Wolfes. *Zool. Polon.*, **18**, **1**, 37–60

ZALKIN, V. I.–Цалкин, В. И., 1967, Домашние животные Золотой Орды [Domestic animals of the "Golden Horde" (Zolotaya Orda]), *Бюлл. Московск. Общ. Испыт. Природы Отд. Биол.*, **LXXII**, **1**, 114–130

— 1969, О некоторых корреляциях в строении костей млекопитающих (On some correlations in the structure of mammalian bones), *Бюлл. Московск. Общ. Испыт. Природы Отд. Биол.*, **LXXIV**, 2, 124–128

— 1970, Древнейшие домашние животные Восточной Европы (The earliest domestic animals of East Europe), *МИА*, **161**, Москва

— 1971a, Некоторые итоги изучения костных остатков животных из раскопок Москвы (Some results of the studies on the animal bone remains of the excavations in Moscow). In: *Древн. Москов. Кремля*, Москва, 164–185

— 1971b, Животноводство населения Северного Причерноморья в эпоху поздней бронзы и раннего железа (Stock breeding of the inhabitants of the northern Black Sea area in the Late Bronze Age and in the Early Iron Age), *МИА*, **177**, 13–15

— 1972a, Домашние животные Восточной Европы в эпоху поздней бронзы, 1–4 (The domestic animals of eastern Europe during the Late Bronze Age, 1–4), *Бюлл. Московск. Общ. Испыт. Природы Отд. Биол.*, **LXXVII**, **1**–4, 46–65, 42–50, 61–72, 60–74

— 1972b, Фауна из раскопок славянских памятников Молдавии (The subfossil fauna of Slavic sites in Moldavia), *Основ. проблемы териол. Труды Московск. Общ. Испыт. Природы Отд. Биол.*, **48**, 38–65

— 1972c, О времени и центрах происхождения домашних животных в свете данных современной археологии (On the time and centre of animal domestications in the light of the results of modern archaeology), *Известия Акад. Наук СССР, Сер. Геогр.*, **1/1972**, 12–24

ZOLLITSCH, H., 1969, Metrische Untersuchungen an Schädeln adulter Wildwölfe und Goldschakale, *Zool. Anzeig.*, **182**, 3/4, 153–182

AKADÉMIAI KIADÓ, BUDAPEST