Lasota-Moskalewska, Alicja / Kobryń, Henryk / Świeżyński, Krzysztof

The size of domestic sheep (ovis aries l.) in Europe and Asia from the neolithic to the middle ages

Światowit 41/Fasc.B, 323-348

1998

Alicja Lasota-Moskalewska*, Henryk Kobryń, Krzysztof Świeżyński****

THE SIZE OF DOMESTIC SHEEP (*OVIS ARIES L.*) IN EUROPE AND ASIA FROM THE NEOLITHIC TO THE MIDDLE AGES

Introduction

Archaeozoological studies demonstrate presence of two domestic sheep forms in prehistoric Europe. These two forms were distinguished in the literature already at the beginning of the 20th century (STEGMANN 1923; quoted after BOGOLUBSKI 1968), and additions are constantly being made to their descriptions (BÖKÖNYI 1983). Initially, the Neolithic Europe was inhabited by a small sheep with an average withers height of 60 cm. This sheep, designated *Ovis palustris,* was assumed by Adametz (1925) deriving from *Ovis orientalis,* and by Duerst (1926) as originating from *Ovis vignei.*

The other sheep form was approximately 10 cm taller than *Ovis palustris* and it appeared in Europe late in the Copper Age. Earlier authors mistakenly see it as a descendant of the mouflon *Ovis musimon,* believing it to have been domesticated in south - eastern France. In our day Bökönyi (1983) is of the opinion that the sheep reached Europe together with the south-eastern migration wave.

In this work we strove to distinguish the two sheep forms, and to describe their range of occurrence in various chronological periods together with their spread in Europe and Asia. We distinguished the sheep forms through macromorphometric analysis of withers heights of domestic sheep living in Europe and Asia from the Neolithic to the Middle Ages.

Macromorphometric analysis of abundant archaeozoological materials excellently describes the secular trend and geographical differentiation of animals. We have previously described these phenomena in the domestic pig (LASOTA-MOSKALEWSKA *et al.* 1987), aurochs (LASOTA-MOSKALEWSKA, KOBRYŃ 1990), and goat (LASOTA-MOSKALEWSKA *et al.* 1991).

Material and methods

Metacarpus III+IV, metatarsus III+IV, and radius lengths, as well as several dimensions of femur and humerus, were culled from archaeozoological literature (AMBERGER 1979; ANSCHÜTZ 1966; ARBINGER-VOGT 1978; BENEKE 1988; BERGQUIST, LEPIKSAAR 1957; BEYER 1970; BOESSNECK 1958, 1973; BOESSNECK,

* Institute of Archaeology, Warsaw University, Żwirki i Wigury 97/99, 02-089 Warsaw, Poland
** Department of Animal Anatomy, Warsaw Agricultural University, Nowoursynowska 166, 02-766 Warsaw, Poland

DRIESCH 1979, 1985, 1986, 1988; BOESSNECK, PETERS 1988; BOESSNECK, STORK 1973; BOESSNECK, WIEDEMANN 1972; BOESSNECK, ZIEGLER 1987; BÖKÖNYI 1976a, 1976b, 1981; BREU 1986; BUSCH 1985; CALKIN 1962; CHRZANOWSKA 1986; DONNERBAUER 1968; DRIESCH 1984; DRIESCH, KOKABI 1977; EKMAN 1973; FRIEDL 1984; GAUTIER 1970, 1972; GAUTIER, RUBBERECHTS 1976; GAWLIKOWSKI, STĘPIEŃ 1984; GODYNICKI 1973; GODYNICKI, SOBOCIŃSKI 1977; HAIMOVICI 1969; HANSCHKE 1970; HORNBERGER 1970; HOUWALD 1971; JANASZEK 1979; JERNIGAN, SOBOCIŃSKI 1979; JORDAN 1975; KARRER 1986; KNECHT 1966; KRATOCHVIL 1969; KRAUSS 1975; KRUPSKA 1977, 1978; KRYSIAK 1950, 1951/52, 1966; KUSSINGER 1988; KÜHNHOLD 1971; KÜPPER 1972; LASOTA-MOSKALEWSKA, SANEV 1985/86; LIPPER 1985; MAKOWIECKI 1989a, 1989b; MENNERICH 1968; MISSEL 1987; MÜLLER 1964; NEUBERT-SAUER 1968; NODDLE 1977; PIEHLER 1976; RAUH 1981; SACHENBACHER-PALAVESTRA 1986; SCHRAMM 1973, 1987; SCHRAMM, SPYCHAŁA-BAŁĘCZNA 1988; SCHWARTZ 1989; SOBOCIŃSKI 1964, 1967, 1969, 1971, 1973a, 1973b, 1976a, 1976b, 1976c, 1976d, 1977a, 1977b, 1978a, 1978b, 1978c, 1979a, 1979b, 1980a, 1980b, 1980c, 1981, 1985a 1985b, 1986a, 1986b, 1987a, 1987b, 1988a, 1988b, 1989, 1991; SOBOCIŃSKI, MAKOWIECKI 1987, 1991; STAHL 1989; STEBER 1986; STORK 1978; STREITFERDT 1972; SWEGAT 1976; TEICHERT 1975, 1985, 1988; UERPMANN 1977; UNDHEIM 1985; WACHLER 1978; WEILER 1981; WESSELY 1975; WYROST 1965; VÖRÖS 1980, 1982/83, 1986, 1988; ŽURAVLEV 1981, 1991). The considered bones bear features characteristic for the species and are easily distinguishable from the bones of goat. The dimensions served to calculate the withers height of sheep using Teichert's (1975) coefficients. We obtained a total of 1909 withers heights of sheep from the period between *ca.* 5000 BC to *ca.* 1500 AD. The animals lived in various parts of Europe, and in western and central Asia; several of the sheep came from northern Africa. The material was divided into the following chronological groups:

Period I: before 2000 BC
Period II: *ca.* 2000 to 500 BC
Period III: 500 BC to AD 500
Period IV: after AD 500

Basing on the series of withers heights of sheep from Period I, we distinguished the following categories:

(i) small sheep: max. 59.9 cm,
(ii) medium-sized sheep: 60.0-69.9 cm,
(iii) large sheep: upwards of 70.0 cm.

Depending on the presence of either small or large sheep in Period I, the considered area was divided into zone A (no large sheep) and zone B (no small sheep).

The differences between arithmetic means of withers heights were tested with the t-Student's test. The degree of differentiation of sheep in the two zones in Period I was determined by variance analysis.

Results

Period I

Material from the oldest period comprised 184 withers heights of sheep from 12 countries and regions (**table 1**). The area where no large sheep were found (Yugoslavia, Hungary, Germany, Poland, northern Turkey and Greece) was designated zone A. There were 51.1 % of small sheep and 48.9 % of medium-sized sheep here, with withers heights ranging from 48 to 69 cm.

In the remaining area, called zone B, there were large forms but no small sheep. This zone extended over central Asia, the Ukraine, southern Turkey (Anatolia) and Syria. Medium-sized sheep accounted for 68.9 % of the studied materials, and large animals - for 31.1 %. Withers heights here ranged from 60 to 78 cm.

In zone A the arithmetic mean of sheep withers height was 59.2 cm (n = 135). In the six studied areas of this zone the mean ranged from 57.6 cm in Yugoslavia to 63.1 cm in Greece. There were no small sheep in Greece, and all the animals there were of the medium-sized variety. The significance of this finding is however reduced by the fact that in our material there were only six sheep from this country. Variance analysis showed that the sheep in zone A did not differ significantly:

$F = 1.31 < F_{a=0.05} = 2.29$, $v_1 = 5$, $v_2 = 129$.

In zone B the arithmetic mean of sheep withers height was 68.2 cm (n = 44). This group comprised animals from four countries and the means ranged from 67.8 cm in southern Turkey to 69.9 cm in the Ukraine. There were no statistically significant differences among the sheep in this zone:

$F = 0.25 < F_{a=0.05} = 2.83$, $v_1 = 3$, $v_2 = 40$.

The arithmetic means of sheep withers heights in both zones differed by 9 cm and this difference was statistically significant:

$t = 11.785$, $v = 177 > t_{a=0.01} = 2.576$.

The material from Turkey was initially treated as a whole, but its territorial differentiation eventually enabled its division into three parts. In the north-western part the arithmetic mean of sheep withers height was 61.3 cm (n = 11), in the north-eastern part it was 60.8 cm (n = 8), and in the southern part - 67.8 cm (n = 12). Given that there was no significant difference between the first two means, both areas were combined into one unit called northern Turkey; the arithmetic mean there was 61.1 cm (n = 19). The difference between sheep heights in northern and southern Turkey amounted to 6.7 cm and this figure was statistically significant:

$t = 2.692$, $v = 29 > t_{a=0.05} = 2.045$.

Outside the two distinguished zones was Egypt where only large sheep were in evidence (arithmetic mean 77.2 cm, n = 4). A single large sheep was also observed in Spain, but this was insufficient material to justify the country's inclusion in any of the distinguished zones.

Period II

A total of 325 withers heights of sheep from 10 countries and regions (**table 2**) were collected. In two of these only single heights were available, and this precluded their comparison with other areas. Small sheep alone were found in

Yugoslavia and Hungary. Small and medium-sized sheep occurred in northern Turkey. The greatest, variety of sheep forms-small, medium-sized and large-was found in Greece, Germany, southern Turkey and central Asia. Medium-sized and large sheep were in evidence in Iraq, but they were not very numerous (4) and it cannot be precluded that the variety would have been greater if more material from the region was available. Poland yielded only one withers height (small sheep).

There were 295 sheep in zone A, with the majority (53.6 %) being medium-sized sheep, followed by small forms (43.0 %) and a few (3.4 %) large animals. Zone B yielded 30 animals, with 59.3 % of their number being medium-sized sheep, 21.9 % being small sheep, and 18.7 % belonging to the large variety.

The arithmetic means of sheep withers heights in both zones differed by 4.3 cm, and this difference was statistically significant: $t = 3.03$, $v = 325 > t_{a=0.01} = 2.576$.

Period III

798 withers heights of sheep from 13 countries and regions (**table 3**) were considered. Small sheep alone occurred in Yugoslavia. Small and medium-sized animals were observed in Turkey (both northern and southern), Belgium, Norway, and in what Calkin (1962) calls the zone of eastern-European forests, which corresponds to Belarus. Sheep of all three categories were present in Greece, Poland, Iran, Germany, Jordan, central Asia, and Hungary. The latter country was in this period distinct in boasting a marked predominance of large sheep, up to 85 cm in withers height, a figure exceeding that in the largest sheep elsewhere (79 cm). The Hungarian material came mainly from the Taç-Gorsium site, with only some finds uncovered in Bacs-Kiskun. In Iran there was only one large sheep, and 37 small and medium-sized ones. In terms of height differentiation Iran was very similar to southern Turkey (Anatolia), although in the latter region there were no large sheep. In Jordan and central Asia the predominant form were large sheep, and there were very few small animals. The arithmetic means of sheep heights were in this area also much higher than in Iran and southern Turkey.

The sheep in zones A and B were very similar: the difference between arithmetic means of withers heights was 0.1 cm and was not statistically significant. There were 605 sheep in zone A (65.7 % medium-sized, 17.5 % small, and 16.8 % large). In zone B we studied 77 animals, of which 70.1 % were medium-sized, 15.6 % small, and 14.3 % large.

Period IV

We considered 602 withers heights of sheep from 14 countries and regions (**table 4**). Small sheep alone were found in Belgium, only because a very small number of specimens were represented. In Norway too there were only small sheep, but here the number of heights was greater. Small and medium-sized sheep were observed in Belarus, Moravia, England and Switzerland. All three sheep forms occurred in Poland, Germany, southern Turkey, Jordan, Iran and Sweden. Worth stressing is that there were very few large sheep in southern Turkey, Germany and Sweden. There was no material from northern Turkey dating to this period.

Hungary and Bulgaria each yielded one withers height, and this was not enough to characterise sheep in these countries.

In zone A we had 238 sheep, 56.3 % of which belonged to the medium-sized category, 41.2 % to the small variety, and a mere 2.5 % to the large form.

The material from zone B comprised 124 sheep: 78.6 % medium-sized, 14.3 % small, and 7.1 % large.

The arithmetic means of sheep withers heights in both zones differed by 2.1 cm, and this was a statistically significant figure ($t = 3.41 > t_{a=0.01} = 2.576$, $v = 362$).

Changes of sheep height over time

The mean withers heights of sheep from zones A and B differed most in period I. The frequency distributions in this period were about 10 cm apart (**fig. 1**).

In period II the difference between the compared means was clearly reduced, and the respective frequency distributions were close together, with a difference of only 2-4 cm (**fig. 2**).

In period III there were no differences between means. The sheep height frequency distributions were similar, although the distribution in zone B was narrower by 12 cm, reduced symmetrically at both ends of the range (**fig. 3**).

In period IV the gap between the means again increased, and the distribution of frequencies characteristic for sheep from zone B was shifted by about 4 cm in the direction of higher figures (**fig. 4**).

In zone B the mean withers height of sheep systematically decreased over time (**fig. 5**). After several millennia it dropped by 5 cm. In contrast, the mean withers height in zone A kept increasing. The only irregularity came in period III when the size of sheep increased sharply and then decreased again. The total growth here over several millennia did not exceed 2 cm.

Discussion of results

In the period from the turn of the 6th and 5th millennium BC to the mid-2nd millennium AD domestic sheep in Europe and Asia were characterised by a wide range of withers heights, from 46 cm in the smallest animals to 85 cm in the largest ones. The difference was thus as much as 39 cm. This differentiation cannot be linked to chronological periods. In the four periods that were distinguished here, the withers height frequency distributions remained in the same range, and at all lines there were found small, medium-sized and large sheep. It seems that differences in withers height are linked to the area of occurrence of sheep, evidence of which is the significance of differences between mean withers heights of sheep from the two territorial zones that we distinguished.

One of these zones extended, generally speaking, over Europe, and the other over Asian lands. Prior to the year 2000 BC, the border between the two zones divided Turkey into the northern and southern (Anatolia) parts. This border was distinct: statistically significant differences between heights of sheep from the two parts of Turkey were noted. North of the Black Sea the border probably ran across western Ukraine, but we lacked sufficient data to plot its course with any precision.

The Luka Vrubleveckaja site on the Dniester yielded a sheep 60.1 cm high (BIBIKOVA 1953); the sheep in Michailske Poselene on the lower Dniester were 70.8 and 71.0 cm high (BIBIKOVA, ŠEVČENKO 1962); another high sheep was discovered in Matveevka on the left bank of the lower Bug river (ŽURAVLEV 1991). Commenting on the different heights of Neolithic sheep from the Ukraine, Bibikova and Ševčenko (1962) suggest two different origins of the animals. On the one hand they mention the mouflon *Ovis musimon* as the ancestor of *Ovis aries palustris*, the sheep from the site Luka Vrubleveckaja, and the present-day short-tailed races. The other ancestor of domestic sheep would be a large Asian ram, predecessor of the European sheep of the Bronze Age. We shall not discuss these suggestions here.

The zone of small sheep in the period prior to 2000 BC, which we distinguished here, may be extended to include also Switzerland: sheep from the Egolzwil layers were 57.2 and 65.5 cm high, while animals from the site Seemette ranged from 53.8 to 63.1 cm (HESCHELLER, RÜGER 1942; quoted after SCHRAMM 1967). In the upper Rhône valley the sheep of the middle Neolithic (Cartailloid culture) were 60-65 cm high (CHAIX 1988).

The zone of large sheep prior to 2000 BC comprised the listed territories of Asia (western and central) and also Egypt. Bökönyi (1985) reports that in predynastic Egypt sheep were similar to those in Europe in the Copper and Bronze Ages, but he does not give specific figures.

In each zone withers heights differed widely, despite absence of one size category of the animals. Maximal differences reached 25 cm. One could suspect that this differentiation is due to sexual dymorphism. This kind of dymorphism in sheep height is not that great however. Hall (1991) found that in present-day Nigeria difference between male and female West African Dwarf sheep was 0.3 cm, while in the long-legged Fulani sheep the figure was 1.7 cm. In the wild desert Tuareg sheep from southern Fezzan height difference was 8 cm (PETERS 1940; quoted after EPSTEIN 1971). It is thus apparent from the quoted literature that sexual dimorphism concerning withers height of domestic sheep is very limited. It is greater in wild sheep but still not as great as the diversity observed in each of the distinguished zones. Results of variance analysis show that the variability cannot be linked to geographic variability of territories within a single zone. The observed differences may be phenotypical, resulting from local peculiarities of diet and animal husbandry.

Aside from territories obviously belonging to one of the two distinguished zones, there are also others, which are difficult to classify. One of them is Spain: the only sheep with recorded withers height there was in between the medium-sized and large categories. Chaix and Grant (1987), quoting data from Hain (1982), present an illustration showing that the sheep height in the Chalcolithic period in Spain ranged from 65 to 78 cm. It these sheep may thus resemble animals from zone B, and the height range may be identical to that in Syria.

According to the literature, sheep of all size categories occurred in the western Alps about 6500-6000 years BP (CHAIX 1990), and this area seems to have been the northernmost limit of occurrence of the large sheep in western Europe. Possibly

there should the European border between our two zones be drawn.

Before 2000 BC the division of the considered territories into two zones was very distinct. In the following period, covering 1500 years, this division became blurred. The small sheep appeared in southern Turkey and central Asia, while the large variety spread to central and southern Europe. The large sheep could have reached Germany *via* Western Europe, for example from France where it was already in evidence 6000 years BP. It certainly could not have migrated from areas directly south of Germany since in that period it was not observed either in Hungary or Yugoslavia. The large sheep appeared also in Greece. It is likely that the animals did not arrive there overland, because all the areas to the north of the country as well as northern Turkey lacked this sheep form. The appearance of the large sheep in Greece may be an indication of trade links across the Mediterranean.

The spread of the small sheep into southern Turkey was facilitated by easy access from the northern part of the country. The animal also found its way to central Asia, but not as an import from Iraq (this sheep form was not to be found there); rather, it probably arrived from western Ukraine.

In the next period, lasting ca. 1000 years and including also Roman times, the large sheep consolidated its position in Europe. In Roman provinces, including present Hungary, the large sheep attained a height not observed before - 85 cm. Bökönyi (1982) writes about Pannonia: „The individuals of the sheep breed which was exported from Italy to Pannonia were certainly larger than the local aboriginal sheep ... however their most important feature - at least from the breeders' viewpoint - was that they had tine wool". Author believes that the large Roman sheep crossed with the local animals, and the effect had to be in line with the phenomenon of heterosis, the offspring being larger than their parents. In this period the difference between the smallest and the largest sheep in Hungary was 30 cm, too large to be an effect of sexual dimorphism, and testifying to a considerable differentiation of population, probably race-related. The local sheep had to be small, because only such animals were to be found there in earlier times. The large sheep must have been imports or results of special breeding.

In the next period, from AD 500 to 1500, the situation remained basically unchanged. Large sheep were not to be found in certain areas of northern, eastern and central Europe. Worth noting is that animals of this category occurred in Sweden, but absence of data for previous times makes it impossible to say whether they arrived during this particular period or earlier; there are also no clues as to their possible origin.

The differences between sheep in both distinguished zones were greatest in the oldest period, and this may be proof of the still considerable isolation of livestock animals in the various regions at that time. The subsequent gradual reduction of differences was certainly result of mixing migrating herds and economic contacts between different areas.

Another possible factor at play here was breeding which led to the emergence of superior races. However, one effect of such breeding should be increase of withers height (longer limbs), a phenomenon which took place only in the small sheep

zone A. In the large sheep zone B a reverse process was in fact observed. It was not until the middle of the 2nd millennium AD that the sheep populations from both zones became thoroughly mixed, the fact being indicated by statistically significant differences among mean withers heights of sheep in the oldest period.

What were the original reasons for the observed differences between sheep from the two zones? One of them might have related to differences in ecology. However, the distinguished zones are rather large, and each extends over areas characterised by diverse ecological conditions, to mention but the Ukraine and the Middle East in zone B, or Greece and Germany in zone A. Ecologically caused differentiation should be occurring among more uniform microregions.

Another reason for the variance could have been differences in the level of sheep husbandry in the two zones. In part of zone B (Levant) animal husbandry was probably better developed than in zone A, perhaps as a result of much longer history of this activity, which in the Middle East is about 3000 years older than in central Europe. The level of husbandry greatly affected the height of sheep, best proof of which are the exceptionally large animals from Taç-Gorsium in Hungary in the Roman period. This interpretation is challenged however by the fact that in Ukraine the domestication process lasted as long as in Germany and Poland. In Greece on the other hand sheep breeding had a much longer history than in central Europe: Boessneck's (1962) studies in Argissa-Magula suggest that this history began around 6500-6000 BC. The withers height of sheep did not increase however over such a long period of breeding. Initially the sheep in Greece were as small as in the rest of Europe.

It may be speculated that the reason for differences between sheep from zones A and B was their different origin. Different wild ancestors would explain the long lasting variance among the studied sheep.

Corbet's (1984) systematics, taking into account the karyological studies of Nadler (NADLER *et al.* 1973), distinguishes in Asia three species within the *Ovis ammon* group: *O. ammon* Linnaeus 1758 inhabiting the area from the Altai to the Himalayas (2n = 56), *O. vignei* Blyth 1841 living in the area from Kashmir and Turkestan to Elberz (2n = 58), and *O. orientalis* Gmelin 1774 occurring in the region from Elberz and Iran to Asia Minor (2n = 54).

The first of these sheep is known as the argali, and its withers height is up to 120 cm. The second sheep - the urial or arkal - attains about 80 cm, while the third, known as the mouflon, is 65-70 cm high.

Given the maximum withers heights of the various domestic sheep, it may be suspected that the small sheep from zone A originate from *O. orientalis*, and the large animals from zone B - from *O. vignei*. The domestic sheep would have been several centimetres shorter than their wild ancestors. It is rather unlikely that *O. ammon* could have been an ancestor of domesticated sheep: such animals would have been 35-40 cm lower than the wild animal. This difference seems unacceptably large given the small variability of sheep withers heights due to sexual dimorphism and the secular trend.

Both the likely wild predecessors inhabited zone B. However, because of the

geographical proximity of Asia Minor and Europe, it was only a domesticated *O. orientalis* that stood a chance of reaching our continent. This process must have occurred already during the preceramic Neolithic. Subsequently, this group of sheep could have experienced different fates. Those, which ended up in the hands of people who practised animal husbandry, became permanently domesticated and gave rise to the line of small sheep. Others could have reverted to the wild state and evolved into the European mouflons (POPLIN 1979; quoted after CORBET 1984). The feral sheep could have again been subjected to domestication already in Europe. Such cases of domestication could have taken place locally before the onset of the Neolithic in western Europe. Examples here may be the sheep from southern France dated to the mid-8th millennium BP (GEDDES 1985).

If we accept this interpretation we would face problems in explaining why the domesticated *O. orientalis* spread only into Europe, leaving Asia to be taken over by the domesticated *O. vignei*. This latter animal probably also found its way to northern Africa and continued its expansion across the Strait of Gibraltar into the Pyrenean peninsula and to the Alps. Once in western Europe, it could have slightly later moved also into central Europe.

The small sheep described here is similar to the form known in archaeozoological literature as *Ovis palustris*. The large sheep possibly corresponds to the, so called, Copper sheep, although an origin of this animal is earlier than the turn of the Neolithic and Bronze Ages.

References:

ADAMETZ, L.,

1925 *Hodowla ogólna zwierząt domowych* [Polska Akademia Umiejętności], Kraków.

AMBERGER, K.P.,

1979 *Neu Tierknochenfunde aus Magula Pevkakia* [Inaugural Dissertation, (Universität München)], München.

ANSCHÜTZ, K.,

1966 *Die Tierkochenfunde aus der mittelalterlichen Siedlung Ulm-Weinhof* [Inaugural Dissertation, (Universität München)], München.

ARBINGER-VOGT, H.,

1978 *Vorgeschichtliche Tierknochenfunde aus Breisach am Rhein* [Inaugural Dissertation, (Universität München)], München.

BENECKE, N.,

1988 *Archäozoologische Untersuchungen an Tierknochen aus der frühmittelalterlichen Siedlung von Menzlin,* Materialhafte zur Ur- und Frühgeschichte Mecklenburgs 3, p. 1-180.

BERGQUIST, H., LEPIKSAAR, J.,

1957 *Medieval animal bones found in Lund,* Archaeology of Lund. Studies in the Lund excavation material 1, p. 11-84.

BEYER, A.I.,

1970 *Tierknochenfunde der Michelsberger Kultur vom Hetzenberg bei Heilbrom-Neckargartach und aus seiner Umgebung* [Inaugural Dissertation, (Universität München)], München.

BIBIKOVA V.I.,

1953 *Fauna rannetripolskogo poselenja Luka-Vrubleveckaja,* MatIssA 38, p. 87-139.

BIBIKOVA V.I., ŠEVČENKO, A.I.,

1962 *Fauna michailskogo poselenja* in: *Michailskie Poselenja,* O.F. LAGODOVSKA, O.G. ŠAPOŠNIKOVA, M.L. MAKAREVIČ *eds.* [Izdatelstvo Akademii Nauk Ukrainskoj RSR], Kijov, p. 128-181.

BOESSNECK, J.,

1958 *Zur Etwicklung vor- und frühgeschichtlicher Haus- und Wildtiere Bayerns im Rahmen der Gleichzeitigen Tierwelt Mitteleuropas,* Studien an vor- und frühgeschichtlichen Tierresten Bayerns, München, p. 1-166.

1962 *Die Tierreste aus der Argissa-Magula vom präkeramischen Neolithikum bis zur mittleren Bronzezeit* in: *Die Deutschen Ausgrabungen auf der Argissa-Magula in Thessalien,* V. MILOJCIC, J. BOESSNECK, M. HOPF *eds.*, vol. I, Bonn, p. 27-99.

1973 *Die Tierknochenfunde aus dem Kabirenheiligtum bei Theben (Böotien),* Institut für Palaeoanatomie, Domestikationsforschung und Geschichte der Tiermedizin der Universität München, p. 1-32.

BOESSNECK, J., DRIESCH von den, A.,
1979 *Die Tierknochenfunde aus der neolithischen Siedlung auf dem Fikirtepe bei Kadiköy am Marmarameer,* Institut für Palaeoanatomie, Domestikationsforschung und Geschichte der Tiermedizin der Universität München, p. 1-81.
1985 *Knochenfunde aus Zisternen Pergamon,* Institut für Palaeoanatomie, Domestikationsforschung und Geschichte der Tiermedizin der Universität München, p. 1-90.
1988 *Knochenabfall von Opfermahlen und Weihgaben aus dem Heraion von Samos,* Institut für Palaeoanatomie, Domestikationsforschung und Geschichte der Tiermedizin der Universität München, p. 1-46.
BOESSNECK, J., DRIESCH von den, A., ZIEGLER, R.,
1986 *Die Tierreste von Maadi und Wadi Digla* in: *The Lithic Small Finds and the Structural Remains of the Predynastic Settlement,* J. RIZKANA, J. SEEHER *eds.*, Mainz am Rhein, p. 87-128.
BOESSNECK, J., PETERS, J.,
1988 *Tierknochen- und Molluskenfunde aus dem Grabungsbereich „Kuppe" in Tall Munbaqa,* MDOG 120, p. 51-58.
BOESSNECK, J., STORK, M.,
1973 *Die Tierknochenfunde der Ausgrabungen 1959 auf der Wüstung Klein-Büddenstedt, Kreis Helmstedt,* Neue Ausgrabungen und Forschungen in Niedersachsen 8, p. 179-213.
BOESSNECK, J., WIEDEMANN, U.,
1972 *Die Tierknochenfunde von Werlaburgdorf/Liet, Kreis Goslar,* Neue Ausgrabungen und Forschungen in Niedersachsen 7, p. 381-400.
BOESSNECK, J., ZIEGLER, R.,
1987 *Tierknochenfunde III. Serie 1983-1984. (7-8 Kampagne)* in: *Isin-Isan Bahriyat III. Die Ergebnisse der Ausgrabungen 1983-1984,* B. HROUDA *ed.*, AbhMünchen 94, p. 137-150.
BOGOLUBSKI, S.,
1968 *Pochodzenie i ewolucja zwierząt domowych,* Warszawa.
BÖKÖNYI, S.,
1976a *Vertebrate fauna from Anza* in: *Neolithic Macedonia,* M. GIMBUTAS *ed.* [Monumenta Archeologica I], Los Angeles.
1976b *Animal remains of sarmation sites from Bacs-Kiskun country,* Cumania 4, p. 41-72.
1981 *Early neolithic vertebrate fauna from Lanycsok-Egettmalom,* ActaArchHung 33, p. 21-34.
1982 *Trade of domestic animals between Pannonia and Italy,* Savaria 16, p. 335-339.
1983 *Domestication, dispersal and use of animals in Europe* in: *Domestication, conservation and use of animal resources,* L. PEEL, D.E. TRIBE *eds.*, Amsterdam, p. 1- 20.
1985 *The animal remains of Maadi, Egypt,* Roma.

BREU, W.,
1986 *Tierknochenfunde aus einer germanischen Siedlung bei Eggolsheim in Oberfranken (2-5 Jh. n. Chr.)* [Inaugural Dissertation, (Universität München)], München.
BUSCH, A.,
1985 *Tierknochenfunde aus einer endneolithischen Siedlung bei Riekofen (Ldkr. Regensburg)* [Inaugural Dissertation, (Universität München)], München.
CALKIN, V.J.,
1962 *Životnovodstvo i ochota v lesnoj polose Vostočnoj Evropy v rannem železnom veke,* MatIssA 107, p. 5-96.
CHAIX, L.,
1988 *La faune de l'habitat Neolithique moyen du Petit-Chasseur I (Sion, Valais),* JbSchwUrgesch 71, p. 103-105.
1990 *Domestication et animaux domestiques dans les Alpes occidentales* in: *Festschrift für Haus R. Stampfli,* J. SCHIBLER, J. SEDLMEIR, H. SPYCHER *eds.* [Beitrage zur Archäozoologie, Archäologie, Anthropologie, Geologie und Paläontologie 59-61], Basel.
CHAIX, L., GRANT, A.,
1987 *A study of a prehistoric population of sheep (Ovis aries L.) from Kerma (Sudan),* Archaeozoologia, p. 77-92.
CHRZANOWSKA, W.,
1986 *Szczątki kostne zwierząt z wczesnośredniowiecznego stanowiska we Wrocławiu na Ostrowie Tumskim* [Roczniki Akademii Rolniczej 172], Archeozoologia 11, p. 19-43.
CORBET, G.B.,
1984 *The Mammals of the Palaearctic Region: a taxonomic review* [British Museum (Natural History)], London and Ithaca, p. 217-218.
1978 *The Mammals of the Palaearctic Region: a taxonomic review supplement* [British Museum (Natural History)], London and Ithaca, p. 1-45.
DONNERBAUER, H.J.,
1968 *Tierknochenfunde aus der Siedlung „Am Hetelberg" bei Gielde/Niedersachsen* [Inaugural Dissertation, (Universität München)], München.
DRIESCH von den, A.,
1984 *Tierknochenfunde aus der spätkeltischen Siedlung von Berching-Pollaten, Ldkr. Neumarkt/Oberplak,* Germania 62, p. 364-372.
DRIESCH von den, A., KOKABI, M.,
1977 *Tierknochenfunde aus der Siedlung „Cerro de los Castellones" bei Laborcillas/Granada,* ANaturWiss 1, p. 129-143.
DUERST, J.U.,
1926 *Vergleichende Untersuchungsmethoden am Skelett bei Säugern* in: *Handbuch der biologischen Arbeitsmethoden,* E. ABDERHALDEN *ed.*, vol. VII, Berlin-Wien, p. 125-530.

EKMAN, J.,
1973 *Early Mediaeval Lund - the fauna and the landscape. An osteological investigation of bone remains from the early medieval settlement,* Archaeologica Lunddensia 5, p. 7-110.
EPSTEIN, H.,
1971 *The origin of the domestic animals of Africa,* Leipzig.
FRIEDL. H.,
1984 *Tierknochenfunde aus Kasope Griechenland (4.-1. Jhr. v. Chr.)* [Inaugural Dissertation, (Universität München)], München.
GAUTIER, A.,
1970 *Les restes d'animaux du viens romain de St-Mard,* Pays gaumais 31, p. 183-194.
1972 *Dierenresten van Het Laatromeins Grafveld te Oudenburg (Prov. West-Vlaandern, Belgie),* Helinium 12, p. 162-175.
GAUTIER, A., RUBBERECHTS, V.,
1976 *Animal remains of the Senecaberg Fortification (Grimbergen, Belgium, 12th century),* BMusBrux 18, p. 49-84.
GAWLIKOWSKI, J., STĘPIEŃ, J.,
1984 *Zwierzęcy materiał kostny z wykopalisk archeologicznych na wzgórzu klasztornym w Cedyni* [Roczniki Akademii Rolniczej w Poznaniu 154], Archeozoologia 9, p. 3-17.
GEDDES, D.S.,
1985 *Mesolithic domestic sheep in West Mediterranean Europe,* JASc 12, p. 25-48.
GODYNICKI, S.,
1973 *Materiał kostny zwierzęcy z osad późnego okresu lateńskiego i wczesnego okresu wpływów rzymskich w Poświętnem i Kołozębiu na Mazowszu,* Roczniki Akademii Rolniczej w Poznaniu 64, p. 51-60.
GODYNICKI, S., SOBOCIŃSKI, M.,
1977 *Zwierzęce szczątki kostne z grodziska kultury łużyckiej w Smuszewie, woj. pilskie,* FontAPos 28, p. 3-35.
HAIMOVICI, S.,
1969 *Bemerkungen zu den Tierknochen aus dem Begrabnis-Fundverband des 9-10 Jh. in Fintinelle (Kreis Teleorman),* Dacia 13, p. 439-441.
HALL, S.J.G.,
1991 *Body dimensions of Nigerian cattle, sheep and goats,* Animal Production 53, p. 61-69.
HANSCHKE, G.,
1970 *Tierknochenfunde aus der Wüstung Wüffingen,* vol. II, *Wiederkäuer* [Inaugural Dissertation, (Universität München)], München.
HORNBERGER, M.,
1970 *Gesamtbeurteilung der Tierknochenfunde aus der Stadt auf dem Magdalensberg in Kärnten,* Kärnten Museumsschriften 49, p. 1-144.

HOUWALD, G.,
1971 *Römische Tierknochenfunde aus Pfaffenhofen am Inn, Ldkr. Rosenheim, und aus Wehringen, Ldkr. Schwabmünchen* [Inaugural Dissertation, (Universität München)], München.
JANASZEK, J.,
1979 *Materiał kostny zwierzęcy z wykopalisk w Słupsku* [Roczniki Akademii Rolniczej w Poznaniu 115], Archeozoologia 5, p. 19-35.
JERNIGAN, S., SOBOCIŃSKI, M.,
1979 *Ogólna charakterystyka materiału kostnego zwierzęcego z wykopalisk w Mietlicy* [Roczniki Akademii Rolniczej w Poznaniu 115], Archeozoologia 5, p. 37-61.
JORDAN, B.,
1975 *Tierknochenfunde aus der Magula Pevkakia in Thessalonien* [Inaugural Dissertation, (Universität München)], München.
KARRER, H.J.,
1986 *Die Tierknochenfunde aus dem Latènezeitlichen Oppidum von Altenburg-Rheinan*, vol. III, *Shaf, Ziege und Hausschwein* [Inaugural Dissertation, (Universität München)], München.
KNECHT, G.,
1966 *Mittelalterlich-Frühneuezeitliche Tierknochenfunde aus Oberösterreich (Linz und Enns)* [Inaugural Dissertation, (Universität München)], München.
KRATOCHVIL, Z.,
1969 *Die Tiere des Burgwalles Pohansko,* Acta Scientiarum Naturalium Academiae Scientiarum Bohemoslovacae Brno 3, p. 1-39.
KRAUSS, R.,
1975 *Tierknochenfunde aus Bastam in Nordwest-Azerbaidjan (Iran)* [Inaugural Dissertation, (Universität München)], München.
KRUPSKA, A.,
1977 *Szczątki kostne owcy i kozy z wczesnośredniowiecznego Wrocławia* [Roczniki Akademii Rolniczej w Poznaniu 93], Archeozoologia 3, p. 23-37.
1978 *Szczątki kostne owcy i kozy z wczesnośredniowiecznego Opola* [Roczniki Akademii Rolniczej w Poznaniu 13], Archeozoologia 4, p. 17-29.
KRYSIAK, K.,
1950 *Szczątki zwierzęce z Biskupina, wydobyte z warstw „kultury łużyckiej" w sezonie wykopaliskowym 1948 r.,* Sprawozdania z Prac Wykopaliskowych w Biskupinie 3, p. 39-71.
1951/52 *Szczątki zwierzęce z osady neolitycznej w Ćmielowie,* WiadA 18, p. 251-290.
1966 *Szczątki zwierzęce z grodziska we wsi Sąsiadka, pow. Zamość,* Światowit 27, p. 171-201.
KUSSINGER, S.,
1988 *Tierknochenfunde vom Lidar Höyük in Südostanatolien (Grabungen*

1979-86) [Inaugural Dissertation, (Universität München)], München.

KÜHNHOLD, B.,

1971 *Die Tierknochenfunde aus Unterregenbach, einer mittelalterlichen Siedlung Würtembergs* [Inaugural Dissertation, (Universität München)], München.

KÜPPER, W.,

1972 *Die Tierknochenfunde von der Burg Siedlung bei Sagogn in Graubider. Die kleinen Wiederkäuer die Wildtiere und das Geflügel* [Inaugural Dissertation, (Universität München)], München.

LASOTA-MOSKALEWSKA, A., KOBRYŃ, H.,

1990 *The size of aurochs skeletons from Europe and Asia in the period from the Neolithic to the Middle Ages,* Acta Theriologica 35, p. 89-109.

LASOTA-MOSKALEWSKA, A., KOBRYŃ, H., ŚWIEŻYŃSKI, K.,

1987 *Changes in the size of the domestic and wild pig in the territory of Poland from the Neolithic to the Middle Ages,* Acta Theriologica 32, p. 51-81.

1991 *Two forms of domestic goats in Europe and Asia from the Neolithic Age to the Middle Ages,* Acta Theriologica 36, p. 329-348.

LASOTA-MOSKALEWSKA, A., SANEV, V.,

1985/86 *Preliminary analysis of bone remnants of animals from the Neolithic archaeological site Tumba Madžari near Skopje (Yugoslavia),* Macedoniae Acta Archaeologica 10, p. 55-78.

LIPPER, E.,

1985 *Die Tierknochenfunde aus dem römischen Kastell Abusina-Eining Stadt Neustedt a. d. Donau Lkr. Kelheim* [Inaugural Dissertation, (Universität München)], München.

MAKOWIECKI, D.,

1989a *Materiał kostny zwierząt z grodziska wczesnośredniowiecznego w Lembarku, woj. toruńskie* [Roczniki Akademii Rolniczej w Poznaniu 206], Archeozoologia 14, p. 27-40.

1989b *Zwierzęce szczątki kostne z grodziska wczesnośredniowiecznego w Bobrowie, woj, toruńskie* [Roczniki Akademii Rolniczej w Poznaniu 206], Archeozoologia 14, p. 41-50.

MENNERICH, G.,

1968 *Römerzeilliche Tierknochen aus drei Fundorten des Niederrheingebiets* [Inaugural Dissertation, (Universität München)], München.

MISSEL, M.,

1987 *Tierknochenfunde aus einer germanischen Siedlung in Hildesheim-Barenstedt (3-5 Jhdt. n. Chr.)* [Inaugural Dissertation, (Universität München)], München.

MÜLLER, H.H.,

1964 *Die Haustiere der Mitteldeutschen Bandkeramiker,* Deutsche Akademie der Wissenschaften zu Berlin. Schriften der Sektion für Vor- und Frühgeschichte 17, p. 6-148.

NEUBERT-SAUER, A.,
1968 *Tierknochenfunde aus der römischen Zivilsiedlung in Hüfingen* [Inaugural Dissertation, (Universität München)], München.
NODDLE, B.,
1977 *Animal and plant remains* in: *Excavations in King's Lynn 1963-1970,* H. CLARKE, A. CARTER *eds.*, The Society for Mediaeval Archaeology 7, p. 378-474.
PIEHLER, W.,
1976 *Die Knochenfunde aus dem spätrömischen Kastell Vemania* [Inaugural Dissertation, (Universität München)], München.
RAUH, H.,
1981 *Knochenfunde von Säugetieren aus dem Demircihüyük (Nordwestanatolien)* [Inaugural Dissertation, (Universität München)], München.
SACHENBACHER-PALAVESTRA, M.,
1986 *Tierknochenfunde aus Pod bei Bugojno, einer befestigten Siedlung der Bronze und Eisenzeit in Zentralbosnien* [Inaugural Dissertation, (Universität München)], München.
SCHRAMM, Z.,
1967 *Szczątki kostne wczesnośredniowiecznej owcy i kozy z wykopalisk północno-zachodniej Polski,* Roczniki Wyższej Szkoły Rolniczej w Poznaniu 36, p. 35-174.
1973 *Szczątki kostne ssaków domowych z wykopalisk w Kruszwicy,* Roczniki Akademii Rolniczej w Poznaniu 60, p. 21-43.
1987 *Zwierzęcy materiał kostny z osady kultury pucharów lejkowatych w Mrowinie* [Roczniki Akademii Rolniczej w Poznaniu 184], Archeozoologia 12, p. 75-89.
SCHRAMM, Z., SPYCHAŁA-BAŁĘCZNA, A.
1988 *Szczątki kostne owcy i kozy z osad kultury przeworskiej na Kujawach* [Roczniki Akademii Rolniczej w Poznaniu 198], Archeozoologia 13, p. 81-102.
SCHWARZ, W.,
1989 *Tierknochenfunde aus dem Gelände einer Herberge in der Colonia Ulpia Traiana bei Xanten am Niederrhein: II. Die Wiederkäuer* [Inaugural Dissertation, (Universität München)], München.
SOBOCIŃSKI, M.,
1964 *Szczątki kostne zwierząt domowych z wykopalisk w Kruszwicy,* Roczniki Wyższej Szkoły Rolniczej w Poznaniu 22, p. 173-193.
1967 *Szczątki kostne zwierzęce z wykopalisk w Wiślicy,* Roczniki Wyższej Szkoły Rolniczej w Poznaniu 36, p. 175-213.
1969 *Szczątki zwierzęce z wykopalisk osady wczesnośredniowiecznej we Włocławku* [Zeszyty Naukowe Uniwersytetu Mikołaja Kopernika w Toruniu, Nauki Humanistyczno-Społeczne 33], Archeozoologia 2, p. 135-150.
1971 *Szczątki kostne zwierzęce z osady kultury grobów jamowych z okresu*

wpływów rzymskich w Inowrocławiu, Roczniki Wyższej Szkoły Rolniczej w Poznaniu 54, p. 97-118.

1973a *Materiał kostny zwierzęcy z osady wczesnośredniowiecznej w Inowrocławiu,* Roczniki Akademii Rolniczej w Poznaniu 60, p. 63-79.

1973b *Materiał kostny zwierzęcy z osady późnośredniowiecznej w Inowrocławiu,* Roczniki Akademii Rolniczej w Poznaniu 60, p. 81-102.

1976a *Szczątki kostne zwierząt z osady kultury grobów jamowych z okresu wpływów rzymskich w Inowrocławiu* [Roczniki Akademii Rolniczej w Poznaniu 84], Archeozoologia 2, p. 35-47.

1976b *Materiał kostny zwierzęcy z osady halsztacko-lateńskiej w Kobylnikach* [Roczniki Akademii Rolniczej w Poznaniu 84], Archeozoologia 2, p. 49-58.

1976c *Szczątki kostne zwierząt z osady kultury przeworskiej w Dobieszewicach* [Roczniki Akademii Rolniczej w Poznaniu 84], Archeozoologia 2, p. 59-68.

1976d *Materiał kostny zwierzęcy z wczesnośredniowiecznego grodziska stożkowatego w Bninie koło Śremu,* Prace Komisji Archeologicznej 9, p. 121-150.

1977a *Materiał kostny zwierzęcy z grodziska w Gwieździnie* [Roczniki Akademii Rolniczej w Poznaniu 93], Archeozoologia 3, p. 63-80.

1977b *Materiał kostny zwierzęcy* in: *Początki i rozwój Starego Miasta w Poznaniu w świetle badań archeologicznych i urbanistyczno-architektonicznych, Materiały z Ogólnopolskiego Sympozjum, 18-19 października 1973,* Poznań, p. 219-247.

1978a *Szczątki zwierzęce z osady i grodziska wczesnośredniowiecznego w miejscowości Węgry* [Roczniki Akademii Rolniczej w Poznaniu 103], Archeozoologia 4, p. 61-72.

1978b *Zwierzęcy materiał kostny z osady otwartej kultury łużyckiej w miejscowości Węgry* [Roczniki Akademii Rolniczej w Poznaniu 103], Archeozoologia 4, p. 73-82.

1978c *Szczątki kostne zwierzęce z osady kultury łużyckiej w Gniechowicach* [Roczniki Akademii Rolniczej w Poznaniu 103], Archeozoologia 4, p. 83-88.

1979a *Szczątki kostne zwierząt z osady kultury łużyckiej w Kruszwicy (stanowisko 2)* [Roczniki Akademii Rolniczej w Poznaniu 115], Archeozoologia 5, p. 101-111.

1979b *Materiał kostny zwierzęcy z osad późnego podokresu lateńskiego w Dzbądzku i Kuninie* [Roczniki Akademii Rolniczej w Poznaniu 115], Archeozoologia 5, p. 129-141.

1980a *Zwierzęce szczątki kostne ze stanowisk archeologicznych północnej części Wysoczyzny Krajeńskiej* [Roczniki Akademii Rolniczej w Poznaniu 121], Archeozoologia 6, p. 39-55.

1980b *Szczątki kostne zwierzęce z badań wykopaliskowch w Kałdusie (woj. toruńskie)* [Roczniki Akademii Rolniczej w Poznaniu 121], Archeo-

zoologia 6, p. 79-112.

1980c *Szczątki kostne zwierząt domowych z wykopalisk w Człuchowie* [Roczniki Akademii Rolniczej w Poznaniu 121], Archeozoologia 6, p. 113-129.

1981 *Szczątki kostne ssaków domowych z grodziska halsztackiego w Jankowie nad jeziorem Pakoskim* [Roczniki Akademii Rolniczej w Poznaniu 131], Archeozoologia 7, p. 19-39.

1985a *Szczątki kostne ssaków domowych z wykopalisk w Gieczu* [Roczniki Akademii Rolniczej w Poznaniu 164], Archeozoologia 10, p. 59-86.

1985b *Szczątki kostne z osad ludności kultury ceramiki wstęgowej na Kujawach* [Roczniki Akademii Rolniczej w Poznaniu 164], Archeozoologia 10, p. 87-127.

1986a *Zwierzęta hodowlane na Pojezierzu Drawskim w średniowieczu* [Roczniki Akademii Rolniczej w Poznaniu 172], Archeozoologia 11, p. 137-160.

1986b *Materiał kostny zwierząt z osady ludności kultury przeworskiej w Łojewie* [Roczniki Akademii Rolniczej w Poznaniu 172], Archeozoologia 11, p. 161-179.

1987a *Zwierzęcy materiał kostny z wykopalisk w Dobrzyniu nad Wisłą* [Roczniki Akademii Rolniczej w Poznaniu 18], Archeozoologia 12, p. 91-117.

1987b *Szczątki kostne zwierząt z osady ludności kultury przeworskiej w Kowarach* [Roczniki Akademii Rolniczej w Poznaniu 184], Archeozoologia 12, p. 119-139.

1988a *Zwierzęce szczątki kostne z osady obronnej kultury łużyckiej w Izdebnie* [Roczniki Akademii Rolniczej w Poznaniu 198], Archeozoologia 13, p. 103-125.

1988b *Zwierzęcy materiał kostny z grodziska wczesnośredniowiecznego w miejscowości Owidz, woj. gdańskie* [Roczniki Akademii Rolniczej w Poznaniu 198], Archeozoologia 13, p. 137-153.

1989 *Materiał kostny zwierząt z wykopalisk osady z okresu wpływów rzymskich w Polanowicach, woj. bydgoskie* [Roczniki Akademii Rolniczej w Poznaniu 206], Archeozoologia 14, p. 69-90.

1991 *Zwierzęce szczątki kostne z grodziska wczesnośredniowiecznego w Sopocie, woj. gdańskie* [Roczniki Akademii Rolniczej w Poznaniu 221], Archeozoologia 15, p. 55-65.

SOBOCIŃSKI, M., MAKOWIECKI, D.,

1987 *Zwierzęce szczątki kostne z wykopalisk w Zamku Górków w Szamotułach* [Roczniki Akademii Rolniczej w Poznaniu 184], Archeozoologia 12, p. 167-192.

1991 *Szczątki kostne z wykopalisk Opactwa Benedyktynów w Lubinie, woj. leszczyńskie* [Roczniki Akademii Rolniczej w Poznaniu 221], Archeozoologia 15, p. 73-91.

STAHL, U.,
1989 *Tierknochenfunde vom Hassak Höyük (Südostanatolien)* [Inaugural Dissertation, (Universität München)], München.
STEBER, M.,
1986 *Tierknochenfunde vom Takht-i Suleiman in der iranischen Provinz Azerbaidjan (Grabungen 1970-78)* [Inaugural Dissertation, (Universität München)], München.
STORK, M.,
1978 *Die Tierknochenfunde der mittelalterlichen Siedlung Sindelfingen (Obere Vorstadt),* Forschungen und Berichte der Archäologie des Mittelalters in Baden-Würtemberg 3, p. 165-180.
STREITFERDT, U.K.,
1972 *Osteoarchäologische Untersuchungen an Tierknochenfunden aus vier Römischen Stationen im Süddeutschen Raum* [Inaugural Dissertation, (Universität München)], München.
SWEGAT, W.,
1976 *Die Knochenfunde aus dem römischen Kastell Künzig-Quintana* [Inaugural Dissertation, (Universität München)], München.
TEICHERT, L.,
1988 *Die Tierknochenfunde von der slavischen Burg und Siedlung aus der Dominsel Brandenburg/Havel,* VeröffMusPotsdam 22, p. 143-263.
TEICHERT, M.,
1975 *Osteometrische Untersuchungen zur Berechnung der Widerristhöhe bei Schafen* in: A.T. CLASON *ed., Archaeozoological studies,* Amsterdam, Oxford, New York, p. 51-69.
1985 *Die Schaf- und Ziegenknochen aus den bronzezeitlichen Kulthöhlen des Kyffhäusergebirges,* Beiträge zur Archäozoologie 3, p. 3-31.
UERPMANN, H.P.,
1977 *Betrachtungen zur Wirtschaftsform neolithischer Gruppen in Südwestdeutschland,* FBerBadWürt 3, p. 144-161.
UNDHEIM, P.,
1985 *Osteologisk materiale fra Dreggen. Havedfagsoppgave i zoologisk řkologi,* Zoologisk Museum. Universitetet i Bergen, p. 1-106.
VÖRÖS, I.,
1980 *Zoological and palaeoeconomical investigations on the archaeozoological material of the early neolithic Köros culture,* FolArch 31, p. 35-64.
1982/83 *Tierknochenfunde der spätkupferzeitlichen Siedlung Gyöngyöshalasz-Encspuszta,* Különlenyomat Az Agria 19, p. 35-62.
1986 *Animal remains from the Funeral Ceremonies in the middle copper age Cemetery at Tiszavalk-Tetes,* FolArch 37, p. 75-97.
1988 *Az ugodzi var Közepkori Allatcsontmaradva-nyai,* Acta Muzei Papensis 1, p. 99-129.

WACHLER, H.F.,
1978 *Die Tierknochenfunde aus den Burgen auf dem Weinberg in Hitzacker/Elbe und Dannenberg* [Inaugural Dissertation, (Universität München)], München.
WEILER, D.,
1981 *Säugetierknochenfunde vom Tell Hesban in Jordanien* [Inaugural Dissertation, (Universität München)], München.
WESSELY, F.,
1975 *Vorgeschichtliche Tierskelette aus einer Schachthöhle im Staatsforst-Veldenstein Landkreis Bayreuth* [Inaugural Dissertation, (Universität München)], München.
WYROST, P.,
1965 *Zwierzęce szczątki kostne z wczesnośredniowiecznego grodziska w Kędrzynie, pow. Kołobrzeg,* Przegląd Zoologiczny 9, p. 301-313.
ŽURAVLEV, O.P.,
1981 *Fauna poselenija Černomorka (na materialach kostnych ostatkov),* in: *Ispolzovanie metodov estestvennych nauk v archeologii,* V.I. BIDZILJA *ed.*, Kiev, p. 130-161.
1991 *Domašnie i dikie mlekopitajuščie po kostnym ostatkam iz poselenija katakombnoj kultury Matveevka 1. Drevnosti Pričernomorja i Krima,* Sbornik Naučnych Trudov 2, p. 188-199.

Figures:

Fig. 1. Frequency distributions of the withers height of sheep in the period I (solid line - zone A, interrupted line - zone B). Drawn by the authors.

Fig. 2. Frequency distributions of the withers height of sheep in the period II (solid line - zone A, interrupted line - zone B). Drawn by the authors.

Fig. 3. Frequency distributions of the withers height of sheep in the period III (solid line - zone A, interrupted line - zone B). Drawn by the authors.

Fig. 4. Frequency distributions of the withers height of sheep in the period IV (solid line - zone A, interrupted line - zone B). Drawn by the authors.

Fig. 5. Changes of the sheep's withers height mean in time (solid line - zone A, interrupted line - zone B). Drawn by the authors.

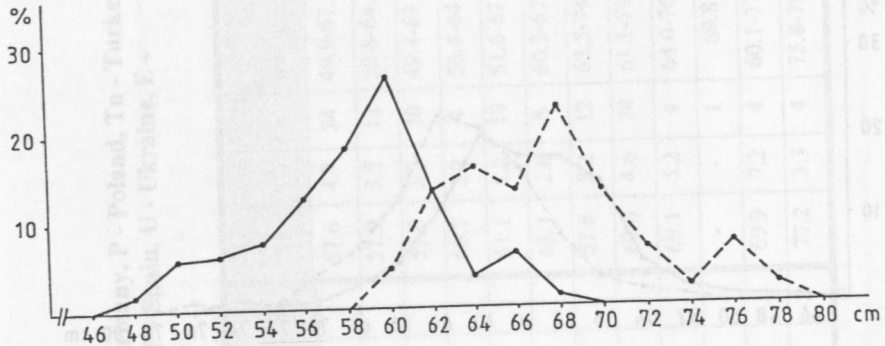

Fig. 1

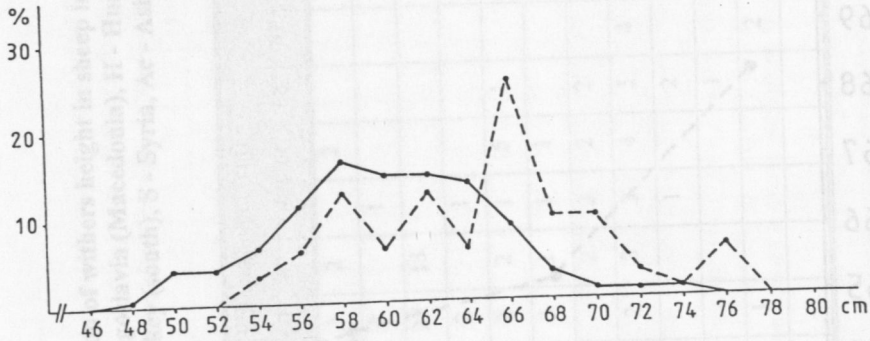

Fig. 2

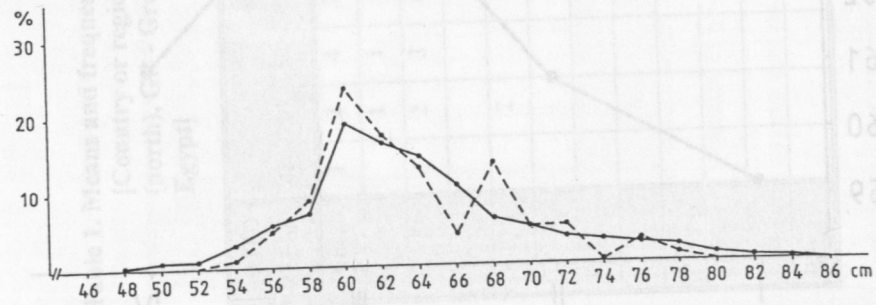

Fig. 3

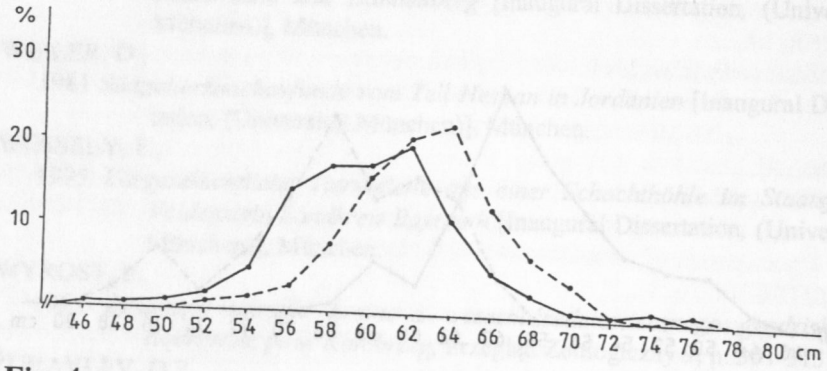
%
30
20
10
46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 cm

Fig. 4

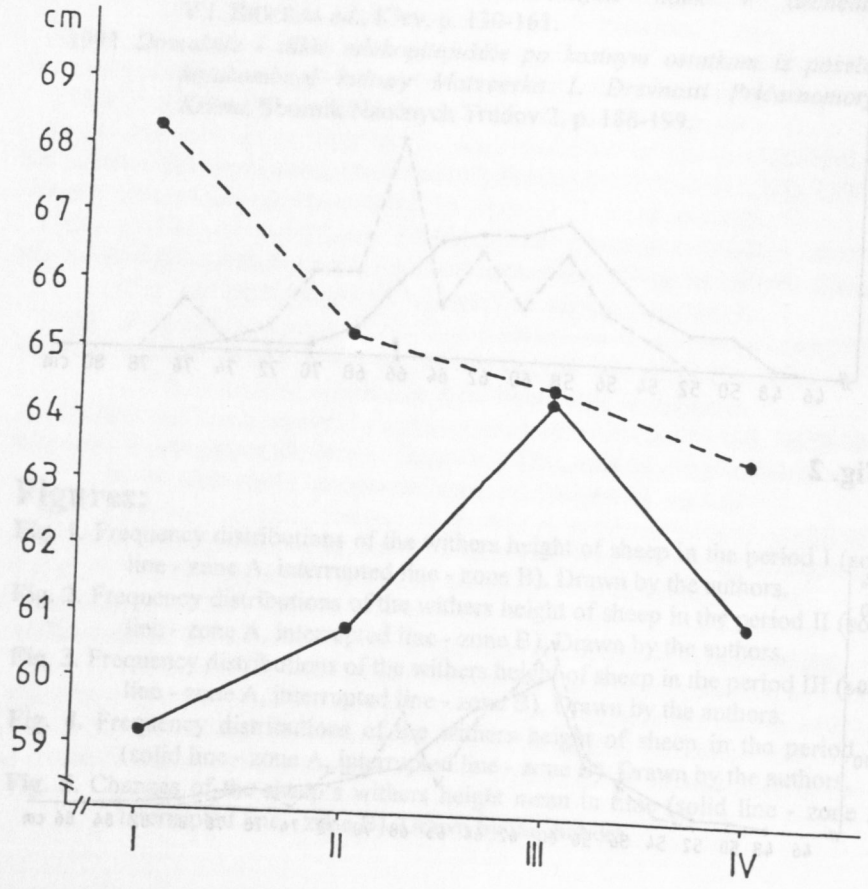
cm
69
68
67
66
65
64
63
62
61
60
59
I
II
III
IV

Fig. 5

Table 1. Means and frequency distribution of withers height in sheep in period I.
[Country or region: YUm - Yugoslavia (Macedonia), H - Hungary, G - Germany, P - Poland, Tn - Turkey (north), GR - Greece, Ts - Turkey (south), S - Syria, Ac - Asia (central), SP - Spain, U - Ukraine, E - Egypt]

Country /Region	Withers height (cm)																M	SD	n	min-max
	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78				
YUm	1	2	4	2	1	7	3	2		2							57.6	4.7	24	49.9-67.6
H		1	1	1	1	4	3		1								57.9	3.5	12	50.8-64.0
G	1	2	3	6	11	12	22	13									59.0	3.3	70	49.4-63.6
P					1		2		1								60.7	3.2	4	56.4-64.0
Tn		2		1	3	2	2	2	1	5	1						61.1	5.2	19	51.6-67.2
GR							3	1	1	1							63.1	2.6	6	60.3-67.0
Ts								2	3	2	2		2	1			67.8	8.2	12	63.5-74.0
S							2	3	3	4	5	4	1		1	1	68.0	4.6	24	61.1-79.4
Ac									1		2				1		69.1	5.2	4	64.0-76.3
SP											1						-	-	1	69.8
U							1					2			1		69.9	7.2	4	60.1-77.6
E														2		2	77.2	3.3	4	75.8-79.2

Table 2. Means and frequency distribution of withers height in sheep in period II.
[Country or region: YU - Yugoslavia, P - Poland, H - Hungary, GR - Greece, U - Ukraine, Tn - Turkey (north),G-Germany, Ac - Asia (central), Ts - Turkey (south) I-Iraq]

Country/ Region	Withers height (cm)																	
	48	50	52	54	56	58	60	62	64	66	68	70	72	74	M	SD	n	min-max
YU		3	1	2		1									53.3	2.4	135	49.9-56.3
P				1											-	-	1	54.9
H				2	2	4									57.7	1.7	8	55.5-59.9
GR	1	8	8	7	7	9	4		3	2	3		1		58.1	2.1	53	49.0-72.1
U							1								-	-	1	60.4
Tn		1			3	1	2		2	1	1				61.0	5.4	11	51.4-69.2
G			3	9	22	32	36	43	35	21	5	4	3	2	62.1	4.1	215	53.3-74.8
Ac					2	2			1	2	1		1		63.5	5.8	9	56.3-72.4
Ts				1		2	1	2	1	5	2	2			66.2	6.0	16	54.3-70.4
I								2		1		1			66.2	3.8	4	63.1-70.9

Table 3. Means and frequency distribution of withers height in sheep in period III.
[Country or region: YU - Yugoslavia, N - Norway, Ee – Eastern Europe (forest zone), Tn – Turkey (north), GR - Greece, P - Poland, Ts –Turkey (south), IR - Iran, B - Belgium, G - Germany, J - Jordan, Ac – Asia (central), H - Hungary]

Country/ Region	Withers height (cm)																			M	SD	n	min-max
	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84				
YU	1	4	1	3	2															53.3	2.4	11	49.9-56.3
N		3	4	6	6	4	4	1												56.4	3.4	28	50.4-62.6
Ee			5	14	29	19	16	1												57.7	2.3	84	52.7-63.6
Tn				2		2	2			1										59.3	4.2	7	54.6-67.3
GR				1	6	2	3	3	1	2				1						61.0	4.9	19	54.8-74.9
P				2	9	21	40	36	14	7	4	2								61.9	3.1	135	54.8-70.9
Ts						1	5	3		1	1									62.2	2.3	11	58.7-68.7
IR				1	4	3	9	9	8		3	1								62.4	3.7	38	55.5-70.4
B					1			1	1		1									63.2	4.5	4	57.7-68.5
G		1	2	8	11	19	56	42	41	28	10	11	4	1						63.2	4.1	234	50.1-77.4
J						2	4		1	2	5	2	3		2					67.5	5.6	21	58.8-77.0
Ac						1		1	1		1	1	1			1				68.3	6.6	7	59.2-78.7
H				1	4	8	12	17	26	25	21	16	16	16	15	11	5	3	3	69.4	3.1	199	54.9-85.3

Table 4. Means and frequency distribution of withers height in sheep in period IV.
[Country or region: N - Norway, B - Belgium, BG - Bulgaria, SW - Switzerland, MO - Moravia, GB – Great Britain (England), BY – Byelorussia, H - Hungary, P - Poland, G - Germany, Ts – Turkey (south), J - Jordan, IR - Iran, S - Sweden]

Country/ Region	Withers height (cm)																M	SD	n	min-max
	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76				
N	5	2	2	1													49.1	2.2	10	46.4-52.8
B				1	1	1											55.7	1.9	3	53.9-57.7
BG						1											-	-	1	56.3
SW		1	1	5	15	17	8	3		1							56.4	2.2	51	49.9-64.5
MO				2	2	2	2	2	1	1							57.8	3.8	12	52.8-64.5
GB	2		1	3	10	9	5	4	6	4	1						58.1	4.4	45	46.2-66.7
BY					5	6	21	21	23	11	7	4	1				59.8	3.2	99	53.1-68.1
H								1									-	-	1	60.6
P	1	1	1	4	6	14	24	20	20	16	4	3	1	1	3		60.9	4.8	119	46.2-74.9
G			2		6	21	18	20	28	11	8	3	1				61.0	3.7	118	50.8-70.8
Ts				2		4	2	5	8	4	2	3	2				62.6	4.5	32	53.6-70.4
J					2		5	3	2	8	4	2				2	64.0	3.2	26	59.1-76.2
IR							3	12	16	16	10	4	3	2			64.6	3.2	66	59.1-72.6
S						1	1	1	5	4	1	5	1				64.9	3.7	19	57.7-71.4