MAGNUS DEGERBØL AND BENT FREDSKILD

THE *URUS* (*BOS PRIMIGENIUS* BOJANUS) AND NEOLITHIC DOMESTICATED CATTLE (*BOS TAURUS DOMESTICUS* LINNÉ) IN DENMARK

WITH A REVISION OF *BOS*-REMAINS FROM THE KITCHEN MIDDENS

ZOOLOGICAL AND PALYNOLOGICAL INVESTIGATIONS

Det Kongelige Danske Videnskabernes Selskab
Biologiske Skrifter **17, 1**

Kommissionær: Munksgaard
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Synopsis

The main purpose of this treatise is to give concrete data of a comprehensive material of Urus and domestic oxen, and on basis of this to give an account of the evolution of the Urus during postglacial times in Denmark and the earliest appearance of domestic cattle in this area. Well over 200 finds of Urus, about one half of which is dated, comprising, i. a. several complete skeletons, about 50 skulls and brain-cases, and of 30 finds of Neolithic domestic oxen, are examined. – Of special interest is the only extant complete skeleton of an Urus cow, from the Boreal period, Zone V. – In Urus as in domestic Neolithic oxen a great sex dimorphism exists. Measurements of Urus bulls are, with exception of the teeth, outside the range of Urus cows, or a small overlap occurs. Regarding length measurements the domestic oxen are generally considerable smaller than the Urus; only in one male, i. a. the basal length is within the range of Urus cows, wheras most width measures of the skull of domestic bulls are co-extensive with those of Urus cows as also the transversal widths of the limb bones merge with those of Urus cows, but the anterior-posterior widths are smaller, particularly exposed in the metapodials. A characteristic feature in the Urus is the concave frontal profile, behind the orbits. – A trend towards a reduction in size during the ages is stated, particularly seen in the hindmost lower molars of the phylogenetical latest Urus; thus the Bos-remains from the Ertebølle kitchen middens, dated to the Atlantic period, have belonged to Urus. – The earliest dated skull of Urus in Denmark, from the close of the Late Dryas period, is the largest postglacial specimen known. The Urus disappeared from Jutland at the transition to the Subatlantic period or in this period proper. From Zealand it disappeared at the close of the Boreal period, Zone VI, probably because the forest became too dense. On this island the earliest finds of domestic oxen occur at the very Elm decline, zone VIII, represented by smaller females ("longifrons" form) and larger bulls and bullocks ("frontosus" form), these animals imply a long preceding domestication, and must have been imported into this island. At the Late Bronze Age and Early Iron Age large skulls of domestic oxen are present, probably indicating draught animals and use of heavier, but more effective tools, i. a. wheel ploughs.

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I. ZOOLOGICAL PART

by Magnus Degerbøl

Introduction

In the Zoological Museum of Copenhagen and some other Danish museums an extensive material of *Bos primigenius* and Neolithic domestic cattle is kept. Much of the material has come from dated settlements, but unfortunately this part is greatly fragmentary, split open to take out the marrow or converted into implements. Fairly undamaged remains, skulls, or even complete skeletons, however, have been brought to light from peat-bogs, and by means of pollen analysis many of these finds have been dated. A dating, of course, is necessary if you want to state what has happened during the ages, and particularly to demonstrate the first appearance of domestication.

The origin of the domesticated cattle in Denmark has been discussed as long as excavations of prehistoric animal bones have been made in this country, i.e. for more than a century. Was the domesticated cattle imported into Denmark or did it originate here by domestication of the Danish *Urus*? The answer to this question must be based on a fair amount of excavated bones of *Urus* as well as of domesticated cattle, and of bulls as well as of cows, thoroughly dated and analyzed by zoologists.

The lack of knowledge of the range of variation in size and shape of the *Urus* and Neolithic domestic cattle, however, has given rise to great difficulties and confusion. Particularly complete skeletal parts of Neolithic domestic cattle were rare, and until recently (Degerbøl, 1963) only a few incomplete skulls were known.

The main purpose of this treatise thus is to give concrete data of a comparatively large collection of a dated material of *Urus* as well as of Neolithic oxen, and on the basis of this to give an account of the earliest known domestic cattle and their origin in Denmark.

In the present inquiry about 200 discoveries of *Urus* are treated, and almost one half of these have been dated, including i.a. several fairly complete skeletons and about 50 skulls and brain-cases.—The *Urus* must have been a common animal in prehistoric times in Denmark, in Jutland still existing during the Subboreal period, when the farmer culture was fully established in Denmark.—Of domestic oxen thirty dated skulls and brain-cases are at hand.

The majority of the material is preserved in the Zoological Museum of Copenhagen, which is greatly indebted to the many people, who during the years have submitted subfossil bones, and thus highly contributed to the augmentation of the collections and to our knowledge of the prehistoric fauna of Denmark. The names of the contributors are mentioned in "A Survey of the Material". For loan of material from other Danish museums, the names of which also are stated in the "Survey", I express my sincere thanks.

I also beg to express my cordial thanks to the CARLSBERG FOUNDATION, which has supported my investigations on prehistoric vertebrates from Denmark.

In several minor museums, school collections and private collections, no doubt further skulls and other remains of *Urus* as well as of large domestic cattle are kept, though generally not dated. On account of lack of time such collections have not been systematically looked out.

The usual line of procedure has been that before, or during, the zoological investigation of a find, the skull cavities were examined for possible material for pollen-analyses, and the proofs, if any, were sent to the pollen analysts.

The palynological investigation was carried out by the Danish Geological Survey and the National Museum in cooperation with the pollen analysts of the Zoological Museum (Vide FREDSKILD, Part II).

Previous Investigations.

In 1904 (V.M. pp. 286–292) H. WINGE gave a summary of the known finds of the *Urus* in Denmark together with a comment on the variations found in the skulls of the species.—From this publication it may be cited that already in 1767 PONTOPPIDAN (Danske Atlas, Bd. III, p. 503) described a frontlet and horn cores of a large bovide, no doubt a *Bos primigenius*, from Vendsyssel, North Jutland.

A couple of discoveries, brain-cases from Rosenholm N. of Aarhus, Jutland, and from Trøstrup, N.W. of Odense, Funen, were mentioned by REINHARDT senior in 1834 (O.V.S.F., pp. 2–5).

In 1853 the first discovery of an almost complete skeleton of *Bos primigenius*, from Stokholt Huse, Sorø, Zealand, was published by P. LORENZEN (V.M., pp. 66–68). Its measurements were compared with a complete skeleton of a *Urus* from Scania, measured by Professor NILSSON, Lund (Skandinavisk Fauna, Däggdjuren 1847, pp. 541–543).

Of particular interest was the observation of the position of the skeleton in the bog: "The bones were found beneath a layer of peat, about 20 feet thick (6–7 Alens Mægtighed), lying in bluish clay". (Cf. its Preboreal age, p. 9).

In the following years several finds of *B. primigenius* were commented on by JAPETUS STEENSTRUP in The Royal Danish Society. STEENSTRUP also excavated a complete skeleton of *Urus*, from Store Damme, Møen, and its "contemporaneity with the oldest pine woods in Denmark" was stated (O.V.S.F., 1870, pp. 105–110).

Also skulls of domestic oxen (*longifrons*, *frontosus*) were mentioned by STEENSTRUP (Forh. Skand. Naturforskeres Møde, 1847 pp. 946–947, O.V.S.F. 1852, pp. 236–37).

The first comprehensive investigations of Danish prehistoric cattle were published by H. WINGE in the great work on the kitchen middens of Denmark (1900); however, from these settlements very few bones of *B. primigenius* were found.

In 1905 another almost complete skeleton of *B. primigenius* was excavated, viz. at Vig, N.W. Zealand. The animal had been wounded and killed by stone implements. The skeleton was described and measured by H. WINGE; and by N. HARTZ, the geologist, dated at "the transition layer between the aspen zone and the pine zone: at the very beginning of the pine period" (N. HARTZ and H. WINGE, Aarb. 1906, pp. 225–236. – Cf. its Preboreal age, p. 8).

That the *Urus* was a common animal in the Boreal period appears from the many bones of this species in the Maglemose settlements: Maglemose at Mullerup (H. WINGE, Aarb. 1904, pp. 194–198), Sværdborg (H. WINGE, Aarb. 1919, pp. 128–133), Holmegaard (H. WINGE, Aarb. 1925, p. 30), and Aamosen at Halleby river (M. DEGERBØL, Nord. Fortidsminder III 3, 1943, pp. 167, 188–190, 195, 197–198, 201).

Unfortunately, however, bones from the settlements are generally very fragmentary.

In 1927 VON LEITHNER demonstrated the great sex dimorphism in the skulls of *Bos primigenius*, and 5 brain-cases from Denmark were described as females of the *Urus*, however, only a few of the finds were dated.

The sex dimorphism in the metapodials of *Bos primigenius* was described by M. DEGERBØL 1942 (Dyrholmen pp. 90–105), and preliminary accounts on the investigations of Danish bovines were given by the same author in 1962, 1963, and 1964.

Dated finds of *Urus* have so far been rare, particularly regarding *Urus* cows.

Survey of the *Urus* Material

Remains from the Late Dryas Period (Zone III)

1. *Millinge*, 6 km. N.W. of Faaborg, Funen (L. B. DEICHMANN, 1875).
♂ On this complete skull WINGE (1904) remarks: "Uncertain age, from a peat-bog near Faaborg. Presented by Deichmann the school principal in the times of Steenstrup.". – WINGE, furthermore, gives some measurements and an excellent picture of the skull (1904, Pl. XIII). From posthumous letters of STEENSTRUP, however, the actual locality has now been established. We are furthermore informed that the skull was found "in blue clay under peat soil", and later that this clay was "ordinary fat and sandfree blue clay". This is in good agreement with the pollen analytical dating, the final phase of Zone III (KROG, 1959, p. 147). – Cf. FREDSKILD.
This skull, together with a specimen from Bregninge (cf. No. 33) belongs to the largest of the Danish *Urus* specimens (basal length 612 and 597 mm., respectively). In the Millinge skull the anterior rim of the *premaxilla* is damaged. The ant.-posterior length

of the horizontal ramus, from the *foramen incisivum* to the anterior border is now 27 mm., as compared with 41 mm. in the older Bregninge skull, 42 mm. in the skull from Rønnebæksholm, 45 mm. in the Store Damme skull, 37 and 38 mm. in the skulls from Langeland and the Min. Museum and 37 mm. in the younger skull from Sorø; all skulls with undamaged premaxilla. Considering the larger size and fairly young age of the Millinge skull, it may be estimated that at least 12 mm. of the premaxilla are missing. In all measurements of the Millinge skull, where the anterior border of the premaxilla is involved thus 12 mm. are added in the tables. – The Bregninge skull, however, represents an old animal with all the features characterizing fairly great age: the horn cores are tuberculated at the base and moderately impressed by longitudinal grooves, the rims of the orbits are granulated and the supraorbital grooves (*sulcus supraorbitalis*) are roofed. In the Millinge skull these features are missing. The supraorbital grooves are widely open, although the teeth are moderately worn, e.g., the interior column of m 3 is just worn, indicating an age of about 5 years, and the bases of the horn cores are not granulated, or only with a faint granulation anteriorly, characters often absent in skulls with wide spreading horn cores. The Millinge skull is larger than any of the alluvial *Urus* skulls measured by LEITHNER (1927); the largest of which, from Frörum, Scania, has a basal length of 593 mm. – Regarding the shape of the horn cores the Millinge-Faaborg skull represents what may be called the "open type", in which the horn cores converge very little and the span of the horns thus is very large, the distance from tip to tip being almost as large as or equal to the largest span. In the Millinge specimen the span of the horn cores is 1140 mm., as compared with 1004 mm. of an alluvial skull, from Västra Ahlstad, near Sjörup, Scania, which so far had held the record. In these measurements the Millinge bull is within the size range of the large diluvial *Urus* from Toscana (LA BAUME, 1958), in which the span of the horn cores varies from 820 mm. to 1230 mm. – Pl. I.

1a. [Transition to Zone IV]
Terp moor. 7 km. N.W. of Randers (BRENDSTRUP, 1863).
♂ Posterior part of frontal with horn cores, both *premaxillae*, 4 upper molars and most parts of the postcranial skeleton.
The horn cores are long, but comparatively slender, not of the size dimensions seen in the Millinge skull. The frontal is fairly broad (Pl. I); as to length measurements of the skull only the premaxilla length may be taken, which is 193 mm., as in the largest skulls. – According to tooth-wear the individual age of the Terp specimen is similar to that of the Millinge skull. The teeth are small, molar length m 1–m 3, is 101 mm. (As the find was excavated by the peat workers it may be questioned, however, whether these solitary teeth in fact belong to the skull, but of course it is most likely). – The limb bones indicate a fairly large bull, almost as large as the mounted skeleton from St. Damme. (Tables 11–20). – Pl. I.

Remains from the Preboreal Period (Zone IV).

2. *Vig*, North-west Zealand (J. P. JENSEN, the National Museum, 1905).
♂ Skull and almost complete skeleton (fore feet and the phalanges of the left hindfoot are missing). Vide J. BRØNDSTED, 1957; fig., p. 53.
In two ribs fragments of flint arrow heads were found, and in the peat which filled the chest of the animal, were 3 arrow heads of flint. (Cf. p. 7). – Pollen analysis by K. JESSEN 1926, gave the result: "pollen of birch (68 per cent.) and pine (32 per cent.), which corresponds to an early phase of the Pine Period, earlier than the Maglemose culture" (N. NORDMANN 1936, pp. 75 and 210).

3. *Stokholt Huse*, N.E. of Sorø (P. Lorenzen, 1853).
♂ Skull and almost complete skeleton.
In the lower jaw the hindmost molar (m 3) is slightly worn, indicating an age of well over three years (cf. previous investigations p. 6). In the limb bones the sutures between epiphysis and shaft are open. – Pl. II.

4. *Grænge A*, 2 km. S.E. of Sakskøbing, Lolland (L. Kring, 1942).
♂ ad. jun. Skull and nearly complete skeleton. Open type of horn cores. Cf. No. 1. The posterior column of the mandibular m 3 is only faintly worn, so that an age of about three years may be assumed. Limb bones with free epiphyses. Early Preboreal period. A. Andersen and K. Møller. D.G.U. IV R. Bd 3. Nr. 1. 1946. – Pl. II.

5. *Gøderupgaards moor*, *A.*, S. of Roskilde (Siegfred Nielsen, 1941).
♂ Skull of a young animal, right part damaged; mandibles. Horn cores porous, sutures open, only interfrontal suture closed far posteriorly. The only upper tooth present, p 2, is slightly worn; in the mandible p 4 and posterior column of m 3 are erupting, and have not been functioning, indicating an age of two to three years. Medial border of *sulcus supraorbitalis* projecting and sharp. Skeletal parts: right *scapula*, lower part of right *humerus*, *pelvis*, two *femora* with free epiphyses (three of which are missing), four *costae*, *atlas*, *epistrophaeus*, cervical vertebra). The anterior rim of the premaxilla is damaged; about 15 mm. are missing, added in the tables. – Pl. II.

6. *Viesø*, Turup, N.E. of Assens (F. Lund, 1942).
♂ Fragmentary skull of young animal, the palatal region and mandibles are missing. Interfrontal suture posteriorly closed, forming a broad and high crest, well over one cm. higher than the pronounced concavities on each side of the crest. Horn cores porous, "worm-eaten", broken above middle.

7. *Vigersted*, 7 km. N.E. of Ringsted (H. Nielsen, P. D. Olsen, 1918).
♀ Brain-case, broken through orbits. Cf. p. 56. – Pl. VIII.

8. *Munke-Bjergby*, Tørnegaards moor, 8 km. N. of Sorø (Louise Kloster, 1941).
♂ Right *metacarpus*. At the upper end three cm. from the articular surface, there is posteriorly an artificial hole, length 31 mm., width 16 mm., probably made for taking out the marrow. Iversen (2.2.1943): Early part of Maglemose period.

9. *Knabstrupgaard* (No. 1), 10 km. S.W. of Holbæk (Lunn, 1852).
♂ Brain-case, broken through orbits, facial region, some skeletal parts: left half of pelvis, right *femur*, the upper and lower epiphyses of which are missing. – Interfrontal suture fused posteriorly, other sutures open; horn cores porous, tip of left horn core broken. Posterior half of the frontal is concave and the frontal part between the orbits is placed lower than the roof of the orbits. Posterior column of m 3 very slightly worn, hence about three years old. (J. Steenstrup, O.V.S.F. 1853 (p. 25). – Pl. II.

10. *Knabstrup* (No. 2), 10 km. S.W. of Holbæk (J. Frost, 1941).
♀ Brain-case, broken through orbits.
Cf. p. 56. – Pl. VIII.

11. *Røde Mølle Aa*, 13 km. N.E. of Vejle (Høst, 1855).
♂ Skull, incomplete, the upper part in front of orbits, and the *premaxillae* are missing, mandibles. Old specimen with base of horn cores and rim of orbits granulated, horn cores with longitudinal grooves. Teeth much worn. *Sulcus supraorbitalis* completely roofed only as always penetrated by a few foramina. Temporal fossae posteriorly closed by a very high bony bar, thus the width at the posterior borders very large, 240 mm. – Pl. II.

12. *Funen* (Appeldorn-Steenstrup).
♂ Brain-case, broken through orbits. Old animal, horn base granulated, granulation continued across occipital crest. An osseous lump, 40 mm. long, 25 mm. broad, and 15 mm. high, is found on the right frontal bone, 33 m. from the middle of the horn base, supraorbital groove completely roofed, only with a few holes. – Pl. II.

13. *Svebølle*, 13 km. E.S.E. of Kalundborg (P. Jørgensen, 1944).
♀ Posterior part of brain-case, occipital part fragmentary; tips of horn cores are missing. – From the close of Zone IV. Cf. p. 56. – Pl. VIII.

13a. *Tepstrup Lake*, 10 km. S. of Skanderborg (Naturhistorisk Museum, Aarhus, 1934).
♂ A very heavy skull; right premaxilla, central part of palatal plate and teeth are missing. Old specimen, base of horn cores, middle part of occipital crest, anterior rim of orbit and *proc. mastoidei* granulated. Supraorbital groove roofed and posterior half of interfrontal suture obliterated. Postcranial skeletal parts. – Pl. II.

13b. *Bjerregrav*, Kærsted, 11 km. W.N.W. of Randers (Naturhistorisk Museum, Aarhus, 1945).
♀ Frontlet, broken at nasal base, right orbit missing. Cf. p. 56. – Pl. VIII.

Remains from the Boreal Period (Zones V and VI).

Zone V.

14. *Rønnebæksholm*, S.E. of Næstved (Francisca de Carlsen, 1857).
♂ Skull (left mandible missing), skeletal parts: 11 vertebrates, 10 ribs, pelvis, parts of *os coxa*. – Old animal, base of horn cores strongly granulated, *sulcus supraorbitalis* completely roofed. Teeth much worn. In the mandible only the two hindmost molars (m 2 and m 3) are present. The first molar, m 1, is irregularly worn down; only the anterior root is still present in its alveole, but its surface is worn, as also the jaw beneath this tooth is worn down with a smooth hard surface. – Pl. III.

15. *Ullerslev*, 10 km. N.W. of Nyborg.
♀ Skull and almost complete skeleton. V. Madsen. D.G.U., 1 R, Nr. 9, p. 121, 1902. Cf. p. 53. – Pl. VIII.

16. *Knabstrup* (No. 3), 10 km. S.W. of Holbæk.
♂ Brain-case, broken through frontals, on left side between horn core and orbit; on the right side the posterior rim of the *orbit* is present. Horn cores granulated at base, tips missing. On the right side the *sulcus supraorbitalis* is roofed posteriorly. – Pl. III.

17. *Grænge, B.*, 2 km. S.E. of Sakskøbing (A. V. Nielsen, Teknisk Skole, Nakskov).
♂ Skull, nasals missing. Fairly old animal. *Sulcus supraorbitalis* partly roofed. Posterior 2/3 of interfrontal suture obliterated. Interior column of m 3 worn. Pl. III.

18. *Grænge, C.*, 2 km. S.E. of Sakskøbing (A. V. Nielsen, Teknisk Skole, Nakskov).
♀ Skull, nasals missing. Cf. p. 54. – Pl. VIII.

19. *Grænge, D.*, Idem. Ibid.
Horn cores, some skeletal parts.

20. In connection with these skulls (Nos. 17, 18, and 19) skeletal parts of three specimens of *Urus* were excavated: 1 *scapula*, 2 left *humeri*, a lower part of a right *humerus*, right and left *antebrachium*, a right smaller *antebrachium*, left *metacarpus*, 1 *costa* and 1 *thoracic*

vertebra. – With the exception of the smaller *antebrachium* all bones are large, heavily built and a light colour.
In the shoulder-blade a hole is found, no doubt produced by an arrow head, the animal having been struck by hunters (ANDERSEN og MØLLER *loc. cit.* figs. 5 and 7), and one of the *humeri* was artificially opened at its upper end, the *tuberculum major* and *minor* being cut off and the inner tissue scraped out, a treatment now and then seen just in this bone. The very upper end of the *ulna*, of the right *antebrachium*, has been gnawed, probably by dogs.

21. *Bjeverskov*, 10 km. W. of Køge (KREBS, 1942).
♀ Skull, tip of horn cores, nasals, premaxillae, and mandibles are missing; of teeth only right m 2 is present, very much worn. Horn cores fairly thin. J. IVERSEN (2.2.1944) Zone V. Cf. p. 54. – Pl. VIII.

22. *Tranemosegaard*, S.W. of Køge (H. P. CHRISTIANSEN, 1918).
♂ Brain-case, broken through orbits, fragments of facial parts, both *maxillae* containing teeth. – Posterior half of interfrontal suture obliterated, other sutures open. Horn cores "worm-eaten". Interior column of upper m 2 not worn. – Pl. III.

23. *Brændholt*, *Nyrup*, Uggerløse, Aamosen (BRORSON CHRISTENSEN, National Museum, 1937).
♂ Horn cores, parts of mandibles, postcranial skeleton. Horn cores granulated at base. Horizontal ramus of right mandible, broken in front of p 3; m 3 and m 2 present, much worn, length 89 mm. The jaw beneath m 1 and premolars is worn in such a degree that of the alveoles only the bottoms are visible. The left mandible is fragmentary, indicating a similar wear of the jaw proper. (Cf. Rønnebæksholm, No. 14).

24. *Flintinge*, Lolland, 6 km. W.S.W. of Nykøbing F. (L. KRING, 1940).
♀ Brain-case, broken through frontal, between horn cores and orbits. Cf. p. 56. – Pl. VIII.

25. *Sakskøbing*, Lolland (K. A. JACOBSEN, Jægershvile, 1948).
♂ Frontlet, fragmentary, broken in front of left orbit and right *lacrymale*. Horn cores granulated at base, but fairly "worm-eaten". – Yellow coloured.
Skull fragments, part of horn core and frontal, of a second specimen, are present.

26. *Hallenslev*, S. of Tissø (E. DIGE OLSEN, 1945).
♂ Fragmentary skull, left frontal part with horn core is missing, right horn core broken in the middle, porous, interfrontal suture open, forming a high crest; facial part broken off from brain-case. – Skeletal parts: 5 cervical and 1 costal *vertebra*. – Young animal with p 4 and m 3 erupting. – Pl. III.

27. *Niverød*, Lerbjerggaard, Nivaa, 12 km. E. of Hillerød (FR. WERNERSON, 1945 Jagt- og Skovbrugsmuseet).
♂ Posterior and upper part of brain-case with complete horn cores; broken between horn cores and orbits. Old specimen with not only a heavy tuberculation at the base of the horn cores, but also a distinct granulation of the occipital crest from horn core to horn core. – A broad and robust specimen. – Pl. III.

27a. *Kratholm*, Bellinge, 8 km. S.S.W. of Odense (Fyns Stiftsmuseum, 1938).
♂ Right *humerus*, right *antebrachium*, *os coxa*, two *vertebrae cervicales*, 9 *vert. thoracales*, 4 *vert. lumbales*, 13 *costae*.

28. *Alsønderup*, 6 km. N.W. of Hillerød (L. RASMUSSEN, 1957).
♂ Part of left horn core, broken about the middle, with a small part of the frontal; fragmentary *exoccipital*. Diameters at base 118×103 mm.; circumference 365 mm. Width across *condyli occipitales* very large, about 146 mm. (73×2).

29. *Jonstrup Vang*, 15 km. N.W. of Copenhagen (Birte Andersen, 1946).
♂ Left horn core with small part of frontal, tip missing. Diameters 120 × 101 mm.; circumference 348 mm. – Fragmentary parts of right horn core.

30. *Falster*, locality not specified (F. H. Møller, 1944).
♂ Posterior part of frontal roof with complete horn cores; exoccipital; right mandible, left *corpus mandibulae*, teeth missing, left *ramus mandibulae* with part of *corpus*, teeth missing, right *antebrachium*, right *metacarpus*, left *femur*, *atlas*, *epistropheus*, *vert. cervicalis*, 2 *vert. thoracales*, 3 *vert. lumbales*, *os coxa*, 3 *costae*.

31. *Bedsmose*, Søborg Lake, North Zealand (Gilleleje Museum, H. C. Terslin, 1944).
♂ Brain-case, broken between horn cores and orbits. Frontal fragmentary, horn cores broken in the middle. Two upper molars, m 2, m 3 length 75 mm., m 3 length 39 mm. Old, strongly built skull, horn cores longitudinally grooved, teeth much worn. Pl. III.

32. *Risby*, 15 km. E.S.E. of Næstved (J. Ferdinand, D.G.U. 1944).
Horn cores.

32a. *Ryemarksgaard*, Osted, Zealand (National Museum) (Lit. Th. Mathiassen, 1941).
Lower half of *metatarsus*, ornamented. Cf. Fredskild.

Zone VI.

33. *Bregninge*, Stensgaard, W. of Faaborg (J. K. Groth, 1953, but found many years earlier).
♂ Skull, nasals missing. Base of horn cores and rim of orbits strongly granulated, *sulcus supraorbitalis* roofed, teeth much worn. – One of the most strongly built skulls from Denmark, cf. No. 1 from Faaborg and No. 34, from Lørup Hede.
(A. Andersen 31.X.1953: Zone V. Cf. Fredskild). – Pl. IV.

34. *Lørup Hede*, near Ringe, Funen (Johs. Bredsdorff, 1915).
♂ Brain-case, broken between horn cores and orbits. Horn cores very thick, diameters at base 138 × 113 mm., frontal exceptionally broad; the least frontal width is 270 mm. as compared with 255 in the Bregninge specimen.
From the beginning of the zone. – Pl. IV.

35. *Kulemile*, moor at Mosegaardsby, 10 km. S.E. of Middelfart (J. V. Nielsen, 1851).
♂ Upper part of roof of brain-case. With a large, nearly circular artificial hole (diameters 60 × 57 mm.), particularly cut from the upper surface. The lower part of the brain-case is cut off through the *fossae temporales*, and all edges are smooth. From the beginning of the zone. – Pl. IV.
About this specimen Winge (*loc. cit.*, p. 209) only says that it was mentioned by Steenstrup in 'Oversigten' 1853, however, Steenstrup there only writes that three finds of *Urus* have been brought to light, but he does not mention the hole in the frontal. – Probably a trophy of the chase.
Very old animal. The complete horn cores are longitudinally grooved and strongly granulated at the base, granulation continuing on the occipital crest. Supraorbital grooves completely roofed (penetrated by foramina). Posterior part of frontal only slightly concave, anterior part fairly bulging. – Pl. IV.

36. *Grevinge*, Gundestrup, 15 km. S. of Nykøbing S. (Asnæs Realskole, E. Rump, 1943).
♂ Skull, nasals missing, premaxillae damaged, tip of horn cores broken. Interfrontal suture closed posteriorly. *Sulcus supraorbitalis* partly roofed posteriorly. Horn cores, however, fairly porous, "worm-eaten", but with a few longitudinal grooves. Hindmost

upper molar only slightly worn. A fairly young, but strongly built skull. About 15 mm. of the anterior border of the premaxilla is missing; added in the tables. – Pl. IV.

37. *Taageby*, 8 km. S.S.E. of Præstö (Chr. Pedersen, 1903).
♂ Small part of posterior region of brain-case, broken in front of the left horn core; the right horn core almost missing. Width of occipital ridge 200 mm. Diameters of horn core 102×80 mm.; circumference 300 mm.

38. *Bisserup*, Rude, 13 km. E.S.E. of Skelskör (E. Jørgensen, 1946).
♂ Fragmentary left mandible with m 2 and m 3 very much worn. Length 85.7 mm. Length and width at the base of m 3 = 51.8×20.8 mm. *Scapula*, *humerus*, and *tibia* from right side, one *costa*.
From the beginning of the zone.

39. *Gøderupgaard B.*, S. of Roskilde (Sigfred Nielsen, 1941).
♂ *Metacarpus*, with an artificial hole.

40. *Gøjs moor*, Kongsted, W. of Faxe (J. P. Rasmussen, 1943).
♂ Mandibles, small skull-fragments, (exoccipitale) 9 *vertebrae*. 16 *costae*.

45. *Kettinge*, Lolland (Taxidermist O. Nielsen).
Skull. – V. Nordmann 1944 p. 69. (No zoological examination).

42. *Store Damme*, Møen (H. C. Nielsen; Japetus Steenstrup, 1864–1865).
♂ Old animal. About this skeleton Japetus Steenstrup (O.V.S.F. 1870, pp. 105–110) writes (in translation):
"The ox has obviously been lying on the side; judging from the position of its feet in the substratum it had, presumably, subsided into the mud because of suction or had fallen through the ice without being able to extricate itself again. The time when this took place was during the period the peat began to form along the border of the forest bog. This is evident in view of the fact that the bones of one side of the animal were lying partly surrounded by the fine layer of precipitated clay, mixed with particles of humus or peat and siliceous shells of diatoms, which is usually found at the bottom of our forest bogs.
In this bottom layer as well as in the overlying peat in which other parts of the bones were embedded, it could easily be seen to what extent the body of the ox had by its own weight been sucked down into the layer already formed and how the layer had subsequently been formed over the sunken animal. The position of the vegetable matter in relation to the bones clearly showed that both possibilities had been realized, and in this respect it was of particular interest to observe how the pine needles had in large quantities occurred under and above the bones. They were bent in such a way that they followed the outlines and surface of the bones. Thus there was no doubt that the ox had perished at a time when the fine needles in large quantities were still being thrown on the surface of water beneath which the peat would later form, or rather, continue the process of formation already commenced.
Our animal is, consequently, from the Pine period, and this fact also became obvious to me in another but no less certain way, as there was a very large and darker spot on the lighter layer, due to a brownish mass. This was situated among the hindmost ribs within the outlines of the skeleton, and the peat diggers themselves compared it with "cow-dung".
There was no doubt that this was the contents of the stomach and the intestines; those of the latter were still formed like balls. I examined this mass with my magnifying glass on the spot and found crudely crushed pine needles in it. The contemporaneity existing

between the pine and this ox clearly appears from this factor. As a clue to future investigations, this fact is of great importance, of greater importance perhaps than one would at first be inclined to admit." – Pl. IV.
The *Urus* was hunted by the Maglemosian people. Fragmentary bones of this species are comparatively common on the Maglemose settlements: Maglemose near Mullerup, Sværdborg-mose, Lundby-mose, Holmegaards Mose, and Aamosen on the Halleby River. All in Zealand.
The Maglemose sites are of different ages. To the oldest belongs *the classical find* from *Maglemose near Mullerup*. Together with the Lundby and Vinde-Helsinge settlements it is dated at Pollen Zone V, whereas the Sværdborg, Holmegaard, and Øgaarde sites belong to Zone VI.

43. On the bones from *Maglemose* near Mullerup, midway between Korsør and Kalundborg, near the coast of the Great Belt, Winge writes (1904, English translation):
"*Bos taurus urus*. Many bones: the greater part of one side of a facial region; several other parts of skulls; a horn core; several *vertebrae*; thus 2 adjoining posterior lumbar vertebrae; several ribs; parts of at least 5 *scapulae*; lower end of a *radius*; carpals of at least 5 animals; a complete *metacarpus* and lower ends of 3 others (all more or less artificially worked); parts of 5 left and 1 right innominate bones; 2 femur heads; parts of 2 *tibiae*; 4 *patellae*; 2 *astragali*; 4 *calcanei*, probably all different; 3 right and 3 left *navic.-cub.*, 13 upper ends of 1. phalangeal bones (of hand and foot); 11 of 2. phalangeal bones; 10 terminal phalanges.
Most of these bones compare completely with those of the *Urus*; only as regards a few of them the question may arise whether they were exceptionally small *Urus* specimens or belonged to large domestic cattle. This particularly holds good of two lower ends of metacarpal bones, both artificially handled (from I K 6, 2. layer and from the circular trench or upper part of Square I). Most likely these bones have belonged to domestic cattle."
From this it appears that all parts of the skeleton are represented, which probably indicates that complete animals were brought to the settlement. Bones of cows as well as bulls occur (cf. Tables 19–20). The small metacarpal bones no doubt belonged to *Urus* cows. (Cf. p. 36).

43a. *Maglemose* near Mullerup (Northern site). (Else Dige Olsen, 1949).
Scapula (right), damaged; distal half of *metatarsus* (right) (used as a hammer), *calcaneus* (r), tuber part of *calcaneus* (r), *astragalus* (r), attached to complete *calcaneus*; (*naviculo-cuboideum* (left)), *cuneiforme* (r), 2 medial phalanges.

44. *Lundby*, N. of Sværdborg. (Not zoologically worked up).
Complete *metacarpus* and *metatarsus* (cf. Table 12), complete horn core (1929, VIII G^3) with small part of frontal, cut off. Adult with longitudinal grooves, but also many holes. (Cf. Table 8).

45. Also the bones from the *Sværdborg* settlement, between Vordingborg and Næstved, were determined as to species by Winge (1919):
"*Bos taurus urus*. Remnants in large quantities, both of old as well as of young: several loose teeth, among them 4 right and 4 left lower hindmost molars of at least 7 specimens, and 1 right lower hindmost milk molar and 3 left ones, all four unlike; 4 *epistrophei*; lower ends of 4 right and 3 left shoulder blades; several carpal bones: 3 right, 4 left *scaphoidea*; 4 right, 2 left *lunata*; 2 right, 6 left *cuneiforme*; 1 right, 5 left *multangula* & *capitata*; 1 right, 5 left *hamata*; 6 right, 6 left *astragali*; 6 right, 2 left *naviculo-cuboidea*.
Most of the ox bones are from animals of a gigantic size, but some of them are relatively

small, i.a. a *metacarpus* (used as grinding surface) the width at the lower trochlea being 71.5 mm. only; another *metacarpus* of a more usual size is 84.5 mm. in width. The lengths of the existing four right lower hindmost molars are 53; 49.5; 49, and 47 mm., respectively; of the four left 53.5; 50; 49; 49 mm., and of the lower hindmost milk molars 40; 39; 38,5 and 37.5 mm., respectively."

It should be noted that a transversal width of 71.5 mm. of the distal end of a *metacarpus* is not particularly low, but, as we now know, indicates a female. In most females the corresponding width is still lower (66, 67, 67, 67, 68, 70 mm.). (Cf. Table 11).

46. *Holmegaard* settlement, 8 km. N.N.E. of Næstved.
About the *Urus* bones from this settlement WINGE writes (1925) p. 30:
"*Bos taurus urus*. Many bones, among others: several pieces of skulls, quite a number of vertebrae, some ribs, some parts of the *sternum*; several limb bones, among them: 4 left *scaphoidea*, 3 left *lunata*, 3 left *cuneiforme*, 4 left *multangula* & *capitata*, and 1 right, 3 left *hamata*, and 1 right, 1 *pisiforme*, 2 right *astragali*; 5 *calcanei*; probably all different; 4 right *naviculo-cuboidea* and 1 left; a remarkable number of toe-joints."
From later excavations, 1945 and 1948, a mandibular m 3 and a *metacarpus* are at hand. The m 3 is 48.8 mm. long and 19.5 mm. broad; the *metacarpus* is very long, 264 mm., and has belonged to a very old bull with exostoses at the proximal end of the bone.

In the large moor-complex, Aamosen, near the Halleby River, N.W. Zealand, several settlements have been excavated, dating from the beginning of the Boreal period, Zone V, to the Subboreal period, Zone VIII (TH. MATHIASSEN, 1943). Here, too, bones of the *Urus* are common on the sites from the Boreal period (M. DEGERBØL, 1943).

The oldest of these sites from the early part of Zone V is a small settlement at

47. *Vinde-Helsinge*, a few km. N. of the Maglemose sites.
Upper part of a *metacarpus* of a cow. (Cf. Table 11).

By far the largest of the settlements is the Øgaarde; together with two other smaller sites from Hesselbjerggaard and Magleø, it is dated at the late Maglemose period, Zone VI.

48. *Øgaarde, II, Aamosen* near Halleby River, N.W. Zealand.
Three posterior lower molars (m 3) from 2 individuals; 3 lower m 2, 2 upper m 2; nasal; parts of 5 *scapulae*, lower part of *humerus*; parts of 3 *atlases*; part of *epistropheus*; *vertebra cervicalis*; upper and lower end of *metacarpus*, part of upper end of do, 3 individuals; almost complete *metatarsus*; one upper and 3 lower ends of *metatarsus*; 2 middle parts of *metatarsus* of 2 subadult individuals; 2 lower ends of *metatarsus*, cut off and artificially worked up; part of *pelvis*; lower end and middle part of 2 *tibiae*; 4 *patellae*; 32 carpal bones (*naviculare* 7 (3 l and 4 r) *lunatum* 7, *triquetrum* 2, *pisiforme* 2, *capitatum* 7 (5 l, 2 r, most of them of young animals) and *hamatum* 7). Of *astragalus* no less than 17 complete bones are at hand, measuring: 91, 90, 89, 88, 88, 85, 85, 85, 85, 85, 85, 85, 84, 81, 80, 80, 80 mm. in length. Of naviculo-cuboid bones 6 are present, the greatest widths of which are 81, 80, 80, 78, 70, and 65 mm.; at least the two last-mentioned specimens have belonged to young animals. 12 2nd phalangeal bones, most of them are large and must have belonged to adult or old animals, several are comparatively small and must have belonged to young animals. 6 terminal phalangeal bones, 3 of which are complete. Several fragments of ribs from 12 squares; 4 *proc. spinosi* (DEGERBØL, 1943).
Also from this site bones of cows as well as of bulls are present. (Cf. Tables 12, 19–20).

49. *Hesselbjerggaard*, Aamosen.
Free lower epiphysis of *metacarpus*, 3 *capitata*, 1. and 2. phalanx, *astragalus*.

50. *Magleø I*, Aamosen.
Lower part of a *scapula*; artificially formed.

51. *Kongemosen*, Bodal, Aamosen, N.W. Zealand.
Lit. Svend Jørgensen 1956, Kuml p. 37. (Not zoologically examined.)

52. *Ulkestrup Lyng*, Kildegaard-komplex, Aamosen, N.W. Zealand.
Lit. Svend Jørgensen 1963, D.G.U. II, 87, p. 26. (Not zoologically examined.)

52 a. *Undløse Bro*, Aamosen. N.W. Zealand.
Antebrachium, large. Cf. p. 111.

53. *Store Taastrup*, 10 km. N.N.W. of Ringsted (Niels Jensen, 1880).
♀ "A mandible, several vertebrae and limb bones" H.W. 1904.
The following postcranial skeletal parts are kept in the Zoological Museum, dated 9/9 1880: Right *scapula*, right *humerus*, right *antebrachium*, right *tibia*, right and left *metacarpus*, 2 *vertebrae thoracales*, 5 *vertebrae lumbales*, os *coxa*, right half of pelvis, 1 *costa*. Besides these skeletal parts, mentioned by Winge, a brain-case and a *maxilla-palatal* part with all teeth are at hand from the same locality, but marked with another date, /2, 1880. — From Zone II to V. (Cf. p. 57). – Pl. VIII.
Furthermore, a smaller specimen is represented by a *vertebra lumbalis*, and an *os coxa*.

Remains from the Atlantic Period (Zone VII).

From bogs only a single find is known from this period.

54. *Bønnelykke*, 7 km. S.E. of Rudkøbing, Langeland (Boesgaard, 1861).
♂ Skull with mandibles and skeletal parts (part of the hyoid bone, *atlas*, 2 *scapulae*, right *humerus*, fragmentary right *antebrachium*, lower part of left *femur*, left *patella*, 11 bones from *carpus* and *tarsus*, part of *sternum*, most of the *costae*. — The tip of medial accessory column of m 3 just worn; posterior half of supraorbital grooves roofed and tip of horn cores fairly porous. — Pl. V.
Also some remains of *Urus* from kitchen middens and other settlements may be dated at the Atlantic and Subboreal period. However, not only is the age of these kitchen middens very disputable, whether of Atlantic or Subboreal age, but also the character of the ox bones, whether belonging to *Urus* or domestic cattle, may be difficult to make out. It may therefore be expedient to give a revision of these bones, which are still kept in the Zool. Mus., Copenhagen, and a short survey of the kitchen midden problems in general; cf. p. 25. — From this it appears that *Urus* remains are stated in following settlements to belong to the Ertebølle culture:

80 Ertebølle (on the map marked E)
81 Aamølle (Aa)
82 Havnø (H)
83 Mejlgaard (M)
84 Krabbesholm (K)
85 Virksund (V)
86 Lovns (L)
87 Gudumlund (G)
88 Kolding Fjord (Ko)
89 Horsø (Ho)
90 Brabrand (B)
91 Dyrholmen (D)
92 Kolind (Kl)

93 Hjerk Nor (Hj)
94 Norslund (N)
95 Godsted (Go)

For further information compare p. 25.

Remains from the Subboreal Period (Zone VIII).

55. *Ørting*, 20 km. E.N.E. of Horsens (L. JENSEN, 1896).
♂ Nearly complete skull, nasals missing, some ribs, and vertebrae. Old specimen with completely closed supraorbital sulcus and much worn teeth.
From the beginning of the zone, but later than the beginning of the earliest agriculture. Pl. VI.

56. *Østbirk*, 13 km. N.N.W. of Horsens.
♂ Nearly complete skull, most teeth missing, upper hindmost molar almost completely worn down to the roots, horn cores with strongly marked longitudinal grooves, tuberculated at base. Supraorbital sulcus completely closed. — (M. DEGERBØL, 1962).
From an early part of the zone. – Pl. VI.

57. *Pindstrup*, Ryomgaard, Djursland, 30 km. W.S.W. of Grenaa (Naturhistorisk Museum, Aarhus, 1951).
♀ Incomplete skull with mandibles, some other skeletal parts: left and right *scapula*; lower part of left *humerus*; part of right *ulna*, parts of left and right pelvis, two lumbar vertebrae; lower part of left *femur*, right *tibia*, right *astragalus* (82×52 mm.), left *metacarpus*, right *metatarsus* (cf. Tables 11–20), 7 *costae* (M. DEGERBØL, 1962). Cf. p. 58. – Pl. IX.

58. *Ugilt*, 10 km. S.E. of Hjørring (Sv. FROST, 1947, Vendsyssels historiske Museum).
♂ Complete skull, mandibles and most parts of postcranial skeleton. This skeleton must have belonged to a fairly young animal, about three years old. In the skull most sutures are open, only the interfrontal suture is posteriorly partly closed. The horn cores are porous, with many small holes, 'worm-eaten'. The lower p 4 is not completely erupted, and is faintly worn; as also in the mandibular m 3, only a faint wear on the hindmost column is indicated. — The teeth are astonishing small; the lower m 3 is only 42.5 mm. long and 18.5 mm. broad at the base, a measurement, which largely extends the range of variation in the *Urus*, and which is widely overlapping the range of variation in the domestic cattle. In the year 1962 I paid a visit to the Vendsyssels historiske Museum, and my attention was particularly fixed on this skull with the astonishing small teeth. The limb bones however also indicate, that a large bull is represented. Cf. Tables 11–19. From the first half of the zone. Cf. p. 89. – Pl. VI.

59. *Klarup*, 9 km. E.S.E. of Aalborg (1954, Vendsyssels historiske Museum).
♂ Brain-case, broken through frontal, on the right side just in front of the horn core, on the left side just behind the orbit. An old and strongly built skull. Horn cores granulated at the base and with longitudinal grooves, however, also fairly many holes are present. – In the mandibles no teeth are present, borders of alveoles beneath m 1–m 2 faintly resorbed, and pathologically swollen. Cf. No. 14 and 23. Postcranial skeletal parts. From the beginning of the B-landnam. – Pl. VI.

60. *Auning*, Lykkegaards moor, 23 km. E.S.E. of Randers, Djursland (CHR. KØHLER CHRISTENSEN, P. SIMONSEN, Jagt- og Skovbrugsmuseet, 1942).
♂ Complete skull, and some postcranial skeletal parts. This skull has belonged to an old

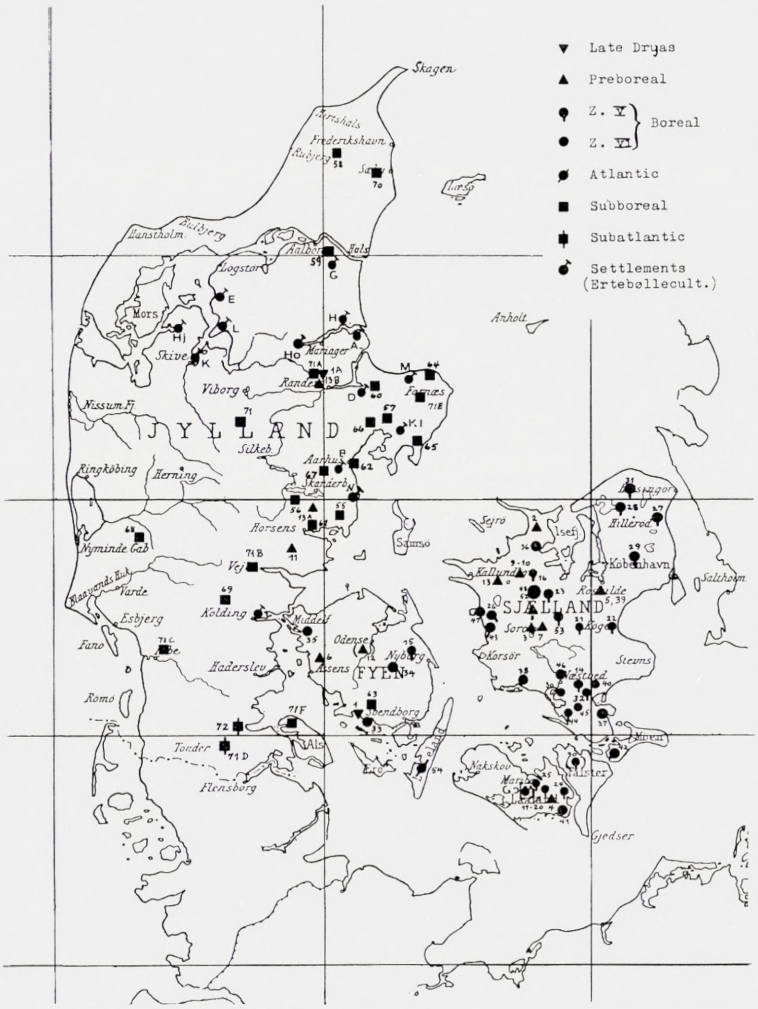

Fig. 1. Map showing the dated finds of *Bos primigenius* in Denmark.
1 Millinge, Faaborg. 1 A Terp. 2 Vig. 3 Stokholthuse, Sorø. 4 Grænge A. 5 Gøderupgaard A. 6 Viesø. 7 Vigersted. 8 Munke Bjergby. 9 Knabstrup 1. 10 Knabstrup 2. 11 Røde Mølle Aa. 12 Fyn (Appeldorn). 13 Svebølle. 13 A Tepstrup. 13 B Bjerregrav. 14 Rønnebæksholm. 15 Ullerslev. 16 Knabstrup 3. 17 Grænge B. 18 Grænge C. 19 Grænge D. 20 Grænge. 21 Bjeverskov. 22 Tranemosegaard. 23 Brændholt. 24 Flintinge. 25 Saxkøbing. 26 Hallenslev. 27 Niverød, Lerbjerggaard. 28 Alsønderup. 29 Jonstrup Vang. 30 Falster. 31. Bedsmose. 32 Risby. 33 Bregninge. 34 Lørup Hede. 35 Kulemile. 36 Gundestrup. 37 Taageby. 38 Bisserup. 39 Gøderupgaard B. 40 Gøjsmose. 41 Kettinge. 42 St. Damme. 43 Maglemose, Mullerup. 44 Lundby. 45 Sværdborg. 46 Holmegaard. 47 Vinde Helsinge. 48 Ogaarde II. 49 Hesselbjerggaard. 50 Magleø I. 51 Kongemose. 52 Ulkestrup Lyng. 53 St. Taastrup. 54 Bønnelykkegaard. 55 Ørting. 56 Østbirk. 57 Pindstrup. 58 Ugilt. 59 Klarup. 60 Auning. 61 Toftum. 62 Aarhus. 63 Korinth. 64 Bønnerup. 65 Holme Mose. 66 Hornslet. 67 Hørning. 68 Ølgod. 69 Tranekær, Staus Hede. 70 Skovlund. 71 Kjærsholm. 71 A Læsten Mose. 71 B Grejs Mølle. 71 C Fæsted. 71 D Tinglev Lake. 71 E Ørum Aa. 71 F Bundsø. 72 Rise.

Fig. 2. Map showing discoveries of *Bos primigenius* of uncertain age.[1]

Jylland, pollen analyzed, but not dated: 73 Jelling. 74 Skaarup. 75 Mariager. 76 Mjesing. 77 Asaa. 78 Understed. 79 Julianelyst. – Sjælland: 97 Aagerup. 98 Lyngby. 99 Eskildstrup. 100 Mørkøv. 101 Skellingsted. 102 Trønninge-Kundby. 103 Højby. 104 Gl. Køgegaard. 105 Ollerup. 106 Hove. 107 Vanløse. 108 Hedehusene. 109 Gentofte. 109A Brønshøj. 110 Jonstrup Vang. 111 Alsønderup. 112 Ganløse. 113 Kirkerup. 114 Viksø. 115 Øresund. 116 Gundsømagle. 117 Strødam. 118 Lille Lyngby. (119 Sjælland). 120 Torpe. 121 Holbæk. 122, 123 Faarevejle. 124 Løgismølle. 125 Vedde. 126 Næstved. 127 Holmegaards Mose. 128 Kongsted. 129 Køge Bugt. 130 Sonnerupgaard. 131 Lyngby. – Fyn: 132 Bro. 133 Trostrup. 134 Tevring. 135 Dommestrup. 136 Næsbyhoved. 137 Vissenbjerg. 138 Broby. 139 Østerby. 140 Kirkeby. 141 Aspedam. 142 Ejsemoseløkke. 143 Bøllemose, Gudbjerg. 144 Barløse. 145 Frøbjerg. 146 Turup. – Lolland: 147 Handermelle. – Jylland: 148 Mors. 150, 151 Ølholm. 152 Fuglekjær. 153 Gjødvad. 154 Formyre. 155 Aakjær. 156 Løgenkjær. 157 Odder. 158 Vintved. 159 Ølgod. 160 Egum. 161 Barrit. 162 Horsens Fjord. 163 Staugaards Mose, Tørring. 164 Rathlousdal. 165 Nørre Vissing. 166 Stilling Lake. 167 Aarhus Mølleaa. 168 Aarhus Harbour. 169 Bjørnekjær, Lading. 170 Rosenholm. 171 Tjerrild. 172 Thorsager. 173 Benzon Estate. 174 Vindum. 175 Hvidbjerg. 176 Vibholm. 177 Ørtoft. 178 Serridslev. 179 Hørbylund. 180 Vidstrup. 181 Vittrup. 182 Hastrup. 183 Balslev. 184 Gudsøvig. 185 Kolding. 186 Almind. 187 Grejsdalen. 188 Agersbøl. 189 Løsning. 190 Havstrup. 191 Solbjerg Lake. 192 Silkeborg. 193 Randers Fjord. 194 Skørping. 195 Nørlund. 196 Feldborg. 197 Vinderup.

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[1] As no remains of dated *Urus* are known from Zealand later than Zone VI, it is probable that undated remains from this island actually are older than the transition period between Zones VI and VII.

individual. Most sutures are closed, even the internasal suture with the exception of the tip proper. The *sulcus supraorbitalis* is completely roofed (only as ordinarily penetrated by a few foramina). The bases of horn cores and the rims of orbits are granulated. Teeth worn. – A large specimen with fairly much upwards directed horn cores. – Pl. VI.

61. *Toftum* (Søltoft, 1878).
♀ Brain-case, broken in front of fronto-nasal suture; mandibles. (Cf. p. 60). – Pl. IX.

62. *Aarhus*, from a bog near the town (Hecquet, J. Steenstrup O.V.S.F., 1853, p. 25).
♀ Brain-case.
Later than the landnam of the Single-Grave people. Cf. p. 60. – Pl. IX.

63. *Korinth*, Egneborg moor, 8 km. N.E. of Faaborg, Funen (K. Borne, Jagt- og Skovbrugsmuseet).
♀ Brain-case, broken at the middle of the orbits, outer part of right horn core broken off. Old specimen with closed sutures, only interfrontal suture open anteriorly. Beginning of the zone. Cf. p. 60. – Pl. IX

64. *Bønnerup*, 15 km. N.W. of Grenaa, Djursland (J. Rybner, 1951).
♀ Fragments of skull and other skeletal parts of 2 individuals. Outer part of left horn core, left upper m 1 and m 2, worn; left and right m 1 and m 2, much worn, lower part of right *humerus*, dist. width 90 mm., of articular surface, anteriorly 84 mm., middle part of left *humerus*, right *antebrachium*, upper inner side of right *radius*, right *femur*, middle part of left *femur*, right and left *tibia*, lower half of right *tibia*, middle part of left *tibia*, 2 right *metacarpi*, left and right *metatarsus*, right *metatarsus*, upper part of left *metatarsus*, left *calcaneus*, part of right *calcaneus*, left *astragalus* (80×49 mm.), 2 right *astragali* (80×50 mm. and 77×47 mm., respectively), left *naviculo-cuboideum*, 5 *phalanges*; several other fragments, thus of the pelvis. Cf. p. 60.

65. *Holme moor*, 5 km. N.E. of Æbeltoft (Ørting, 1868).
♂ Old. Brain-case, broken through frontal, between horn cores and orbits. Tips of horn cores missing, granulated at base.
From the beginning of the zone, between A-landnam and the landnam of the Single-Grave people. – Pl. VI.

66. *Hornslet*, Djursland, 23 km. S.E. of Randers (Silkeborg Museum).
♂ Incomplete skull, broken in front of rows of teeth. Most sutures open, interfrontal suture, however, closed posteriorly. Horn cores 'worm-eaten'. Teeth slightly worn, accessory column of hindmost molar (m 3) not yet worn. – In size and individual age the Hornslet skull is similar to the Ugilt skull, about 3 years old. The frontal width, interorbital width, and maxillary width are equal, 220–222 mm., 193–195 mm., and 153–153 mm., respectively. Also the distance from the occipital condyle to the *foramen infraorbitale* is the same, 385 and 386 mm., in the two individuals. However, the distance from the occipital crest to the nasal base is shorter in the Hornslet skull, 305 mm., as compared with 318 mm. in the Ugilt skull and the same holds good of the distance to the *foramen infraorbitale* 410 and 425 mm., respectively; probably the condylobasal length was almost the same in the two skulls, whereas the total length was somewhat shorter in the Hornslet skull. – Pl. VI.

67. *Hørning*, 8 km. N.E. of Skanderborg (Dr. Poulsen, 1868).
♂ Posterior part of brain-case, with long and slender horn cores, granulated at the base. – Old specimen.
From the beginning of the zone. – Pl. VI.

68. *Ølgod*, 25 km. N. of Varde (H. Øllgaard, N. Raunkjær, 1941).
Horn core.

69. *Tranekær moor*, Staus Hede, Gesten, 15 km. N.W. of Kolding (Leo Novrup, 1945).
(a) ♂ Skull, right side of facial part damaged, left side broken through premaxilla; bases of horn cores and rims of orbits faintly granulated, interior column of m 3 worn, both mandibles, 2 *femora*, *costa*.
The mandibles were found about 10 m. from the skull together with a large number of bones. Probably a complete skeleton was present, but with the exception of the said remains it was taken to a refuse dump and was lost before Mr. Novrup arrived at the spot. – Pl. VI.
(b) Part of right mandible with teeth, *metatarsus*. Sent in together with the above-mentioned remains, but of a more yellowish colour (28/5 1945).
(c) Middle part of right mandible, with m 1–m 3, thoracal vertebra, part of juvenile costa (11/5 1945).
(d) *Metacarpus*, lower m 1 and m 2 (23/7 1945).
Thus 4 specimens are represented by mandibles alone. Only the skull is dated. It is kept at the Koldinghus Museum.

70. *Skovlund*, Hørby, 10 km. W. of Sæby (Sv. Jørgensen, National Museum, 1962).
Atlas.
A little later than the earliest agriculture.

71. *Kjærsholm*, Kjærs Aa, between Kjærsholm and Kjærsmølle, Torning, 20 km. S. of Viborg (Torning Museum).
♂ Almost complete skull, left horn core broken; nasals and some premolars are missing. Horn core with longitudinal grooves. Total length 710 mm., condylobasal length 660 mm., basal length 566. Measured by Mr. Møhl with a folding rule.

71a. *Læsten*, at the source of the Skals river, 12 km. N.N.W. of Randers (Naturhistorisk Museum, Aarhus, 1961).
♂ Practically complete skull; nasals present, tips of horn cores complete, anterior border of premaxillaries undamaged, teeth present with the exception of p 2, which has fallen out. Posterior 2/3 of interfrontal suture closed; however, the supraorbital grooves are only partly roofed, enclosed by sharp edges, and the medial column of the posterior molar is only just worn. Age about 4–5 years. – After the immigration of the Passage-Grave people, 2500–2000 B. C. – Pl. VI.

71b. *Grejs Mølle*, 5 km. N. of Vejle (R. Mortensen, Vejle Museum; Naturhistorisk Museum, Aarhus).
Skull roof of old bull, left mandible and postcranial skeletal parts. Skull broken transversally through supraoccipital and below orbits. On the right side *os premaxillare* and upper part of the *maxilla* are present, but on both sides the *maxilla* parts, containing teeth, are missing. Horn cores and nasals are complete. Naso-frontal sutures and posterior 2/3 of interfrontal suture are strongly fused. The supraorbital grooves are roofed and the bases of horn cores and anterior rims of orbits are granulated. All characters indicate an old and large animal. The basal length cannot be taken, but the total length is 700 mm., as in the skulls from Vig and Rønnebæksholm, in which the basal length is 580 and 583 mm., respectively. Only 5 Danish *Urus* skulls have larger total lengths: Millinge (742 mm.), Sorø (715 mm.), Bregninge (716 mm.), Kjærsholm (710 mm.), and Lyngby 706 mm. By comparison with these skulls the basal length of the Grejs Mølle skull may

be estimated at about 580 mm. The mandibular teeth are greatly worn, m 1 almost to the root. – The metapodials are uncommonly large (cf. Tables 11–12), the largest in the Danish material. – Later than B-landnam – Pl. VI.

71c. *Fæsted*, Hygum, 12 km. E.N.E. of Ribe (Haar, 1944, Antikvarisk Samling, Ribe).
♂ Skull of an old animal; as to the teeth only m 1 and m 2 are present. Supraorbital sulcus roofed. Interfrontal suture very broad and elevated, on each side posteriorly bordered by a well-marked concavity, and anteriorly, between the posterior part of the orbits, ending in a very deep concavity, too. – Pl. VI.

71d *Tinglev Lake*, 18 km. S.W. of Aabenraa, Southern Jutland (King Frederik VII, 1858).
♂ Skull. *Premaxilla* and parts of *maxilla* are missing. The following postcranical parts are present: 4 *vertebrae cervicales*, 6 *vert. thoracales*, 6 *vert. lumbales*, *os coxa*, 15 *costae*, right *scapula*, both *humeri*, both *antebrachia*, both *metacarpi*, both *femora*, right *tibia*, both *metatarsi*, *astragalus*.
"The find dates back to the summer of 1858 when the lakes of Tinglev were drained. In 1863 Prefect Heltzen presented it to King Frederik VII, and the King donated it to the Zoological Museum." H.W. 1904, p. 287.
The Tinglev skull is broken at the premaxilla suture. In length it is almost equal to the Østbirk skull. In both the distance from the *foramen magnum* to the *foramen infraorbitale* is 360 mm. Also the length from the occipital condyle and the occipital ridge to the suture between premaxilla and maxilla, on the palatal part, is equal in both, 490 mm. and 557 mm., respectively. However, the distance from the *foramen magnum* to the said suture is a little larger in the Tinglev skull, 462 mm., as compared with 455 mm. in the Østbirk specimen. Accordingly, the total length in the Tinglev skull may be estimated at 630 mm., the condylobasal length at 555 mm., as in the Østbirk skull, and the basal length at well over 530 mm.
The Tinglev skull thus is also of about the same length as the skull of the large Ullerslev cow, but although the two skulls are almost the same individual age – the interior column of m 3 is almost unworn in the Tinglev skull and only slightly worn in the Ullerslev skull – they are of different shape, the Tinglev skull clearly showing the characteristic features of the male sex. The bases of horn cores and rims of orbits are much more strongly granulated than in the Ullerslev skull, the supraorbital sulcus is roofed and the horn cores are longer, thicker, and more grooved, but particularly all width measurements are larger; this also holds good of the postcranial skeletal parts (cf. metapodials, Tables 11–12, and *astragalus*, Table 19, fig. 22).
The Tinglev skull is dated at the transition zone between the Subboreal and the Subatlantic periods, or to the last-mentioned period proper. – Pl. VI.

From two Subboreal, farmer settlements some remains of *Urus* are present:

71e. *Ørum Aa*, at Fannerup, 10 km. W.S.W. of Grenaa, on the north side of Kolind Sund. Of this site Winge states (1900, p. 146):
"*Bos taurus urus*. Upper end of *ulna*, *calcaneus*. – From previous collection: part of upper end of *radius* and a proximal phalanx of the *pes*. – In form and size as in *Urus*." – The *radius* part, the medial half of the articular surface, must have belonged to a strongly built bull, the bone wall at the coalescence with the *ulna* is 20 mm. thick. The greatest length of the phalanx is 84 mm.
The great majority of *Bos*-bones from the Ørum Aa settlement, however, are by Winge grouped among the domestic cattle, and are, as usually in settlements, incomplete or very fragmentary. An exception makes a part of a hind limb (*tibia*, *astragalus*, *(calcaneus*, not present any more*)*, *naviculo-cuboideum*, *metatarsus*, phalanx) of a not quite full-grown animal. According to Winge "these bones greatly surpass in size the main race

in the settlement, and in several measurements approach the *Urus*, though being of lighter build".
From the material now at hand for comparison it is evident that these limb bones do not belong to a domestic ox, but represent the *Urus* cow. In form and size they are equal to the corresponding bones of females from Pindstrup and Bønnerup. (Cf. Tables 12, 17, and 19).
In the *metatarsus* and *tibia* the suture between the distal epiphysis and shaft is still visible, indicating that the Ørum Aa specimen was a little younger, than the Pindstrup cow.

71 f. *Bundsø*, island of Als, Southern Jutland.
Bos primigenius.
Horn core (Tables 7–8), fragment of horn core; upper m 1–m 3 (length 92 mm.), upper m 3, lower end of *humerus* (trochlea width 102 mm.), prox. phalanx of *pes* (greatest length 84 mm.).
M. Degerbøl: Bundsø, 1939.

Remains from the Subatlantic Period (Zone IX).

72. *Rise*, 4 km. W. of Aabenraa (Agnete Bisgaard, Aabenraa Statsskole, 1942).
From the bank of a brook.
Brain-case, broken in front of *orbitae*; horn cores together with parts of the frontal bone, cut off by sharp cuts by iron implements, probably removed as a trophy.
This brain-case must have belonged to an old animal. Posteriorly the supraorbital grooves are completely roofed, the interfrontal suture obliterated, and the temporo-frontal and presphenoid sutures are only just visible. It represents a medium-sized bull, probably the size of e.g. the specimens from Ørting and Østbirk from the Subboreal period. The distance from the occipital ridge to the nasal base (in the middle) is 315, 314, and 308 mm., respectively, and the distance from this ridge to the anterior rim of the orbit is the same in three specimens, 340 mm.; however, these measurements are fairly variable in *Urus* skulls.
The width of the brain-case is fairly considerable. The postorbital width being 293 mm., as compared with 314 and 310 mm., respectively, in the Ørting and Østbirk skulls; but as the Aabenraa brain-case is slightly water-worn, the original width must have been

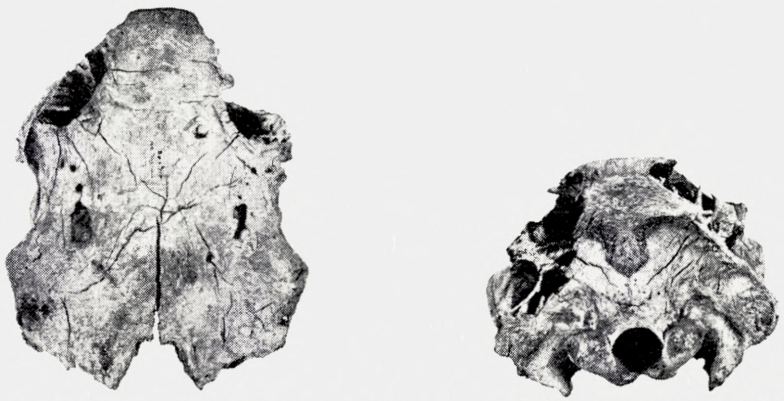


Fig. 3A and B. Brain-case of *Bos primigenius* from Rise (Aabenraa). Subatlantic. Zone IX. Horn cores cut off. – A. Frontal view. B. Occipital view. – Scale as in plates.

somewhat greater. The Ørting and Østbirk skulls, however, are the comparatively broadest ones in the Danish material. The Aabenraa brain-case is not by far so heavily built as these two skulls, on the contrary, it is rather light, which may partly be explained by its water-worn condition, but no doubt also indicates that the Rise animal lived under not too favourable conditions. – The smallest frontal width is fairly low, 230 (+), as compared with 248 and 243 mm., respectively, and the width across the occipital condyles is 133, 142, and 132 mm., respectively. The occipital height, from the upper border of the *foramen magnum*, is 163, 171, and 165 mm., respectively, from the lower border 210, 225, and 210 mm., respectively.

The brain-case was excavated from the bank of a brook, in a bog or meadow, about one meter below the surface of the earth. Pollen analyses of material from the interior of the brain-case and of the earth outside the skull were made by Dr. J. Iversen (The Geological Survey of Denmark). The results were identical: Willlow 1%, birch 6%, pine 9%, alder 62%, elm 1%, lime 7%, oak 7%, ash 1%, beech 5%, hornbeam 1%, *Picea* 1%. Besides hazel 11%, herbs 109%, heather 2%.

The pollen flora is greatly influenced by culture, thus 7% cereals, 7% plantain, 3% *Rumex*, and 2% Chenopodiaceae. In particular the high per cent. of cereals is remarkable, indicating that rye (wind-pollinator) was cultivated. Coal particles were numerous in the samples. This spectrum no doubt indicates the Subatlantic period.

There is a possibility that the skull is in a secondary position, having originally occurred in older layers, which have been washed away, and new, younger earth deposited, not only around the skull, but also in the interior of the brain-case, which then in advance had to be completely cleaned even in the interior. This is not, however, very likely. Generally speaking, the Rise skull makes a "dry" appearance, as seen in skeletons of domestic animals which have been kept on comparatively short commons, in contrast to the wellfed large bulls from the Boreal period.

Finds pollen analyzed, but dating uncertain.

73. *Jelling*, marlpit, 10 km. N.W. of Vejle (H. Bayer, 1947).
Left horn core with part of left frontal bone; right horn core, tip missing, right mandible with molars, lower border of left mandible and *ramus ascendens*, *atlas*, *epistropheus*, Diameters, at the base, of left horn core 106×85 mm., circumference 320 mm., curvature 330 mm. (tip missing), length of lower m 1–m 3 is 111 mm. at the base, length and width, at the base, of m 3 are 48.5×19.5 mm.
Zone VII or VIII.

74. *Skaarup*, 4 km. S.E. of Skanderborg (Holtet, Skanderborg Museum, now Naturhistorisk Museum Aarhus).
♀ Fragmentary brain-case and most parts of facial region.
M. Degerbøl, 1942, p. 97.
Zone VII or VIII.

75. *Mariager* (Cement works "Dania", 1949).
2 horn cores.
Zone VII or VIII.

76. *Mjesing*, Skanderborg (A. Andersen, D.G.U., 1917).
♂ Part of *tibia*. – The smallest diaphysis width is 58 mm. Table 17.

77. *Asaa*, 23 km. S. of Sæby (E. Dalsgaard, 1947).
Horn core.

78. *Understed*, 10 km. S.S.W. of Frederikshavn (Hans Jensen, Johs. Boolsen, 1960).
♂ Left half of occipital-frontal region, with horn core broken in the middle, 2×3 molars. Diameters at the base of horn core 114×90 mm., circumference 330 mm.; width across *condyli occipitales* 139 mm.

79. *Julianelyst*, 10 km. N.W. of Horsens (N. Lund, 1882).
♂ Brain-case, on the left side broken anteriorly to the orbit, on the right side through the orbit. Old animal. Bases of horn cores very strongly granulated. *Sulcus supraorbitalis*, however, broad and only partly roofed. Frontal concave. – Pl. VII.

Bos-remains in the Kitchen Middens *(Shell Mounds)*

and other Settlements from the Ertebølle Culture.

In 1851 a committee consisting of a zoologist (Steenstrup), an archaeologist (Worsaae), and a geologist (Forchhammer) made it clear that the shell mounds along the Danish coasts were refuge heaps or "køkkenmøddinger", literally 'kitchen middens'—a word coined by Japetus Steenstrup—and not emerged shell beds. In the present chapter the word is primarily used in its original sense, restricted to the classical kitchen middens from the Ertebølle culture, formed of shells (*Ostrea*, *Cardium*, *Mytilus*, *Nassa*, *Littorina*) in which the animal bones are scattered. This was the first incident of co-operation in Denmark between archaeology, zoology, and geology. The advantages of this teamwork were so evident that ever since there has been an intimate collaboration between these branches of sciences and humanities in Denmark.

This was also the case in the first great publication on these kitchen middens from the Stone age in Denmark from the year 1900 (A. P. Madsen, *et al.*). Two kinds of refuse heaps were described, partly older ones containing bones of wild animals, apart from superficial layers, and representing a population of hunters and fishers, the Ertebølle culture; and partly younger kitchen middens, predominantly with bones of domesticated animals, which indicate an agricultural people. It was believed that the Ertebølle culture belonged to the Atlantic period or Pollen Zone VII, when it was succeeded by agriculture in the Subboreal period or Pollen Zone VIII. Later it was proved, however, that the geological guide horizon, the Littorina transgression, was not a single transgression in the Atlantic period, but really four, the latest belonging to the Subboreal period (Rydbeck 1928, Iversen 1937, Troels-Smith 1937, K. Jessen 1937). Furthermore, it was shown that the Ertebølle culture continued far into the Subboreal period. The problem then arose how the connection between these two cultures had been and, particularly from a zoological point of view if any remains of domestic animals apart from the dog were found in the kitchen middens from the Ertebølle culture and to what time did the kitchen middens belong. As to the cattle, it was a question of category: *Urus* or domestic cattle?

However, as we now know the large sex dimorphism in the *Urus* and the existence of this species in Jutland in the Subboreal period, it is highly probable that

the smaller bones, which originally were reckoned as belonging to large domestic cattle really were bones of *Urus* cows, (cf. e. g. the Ørum Aa settlement, p. 22). In fact, according to our present knowledge it must be expected that large, as well as small bones, that is bones which may be just as small as seen in domestic cattle, are to be found in Ertebølle kitchen middens. When in a kitchen midden large bones of *Urus* bulls are found to occur—and they are easily identified—it may *a priori* be supposed that also smaller bones of *Urus* cows may be present. In such a case it may be reasonable to group the small bovine bones, if at hand, and not identificable, as belonging to *Urus* cows.

The existence of domestic cattle can only be proved when bones are with certainty identified as belonging to this form.

Much has been written about these problems right from the days of Steenstrup to the present time (Troels-Smith, Iversen, Th. Mathiassen, cf. Degerbøl, 1961).

In the following Ertebølle kitchen middens, and other settlements, remains of bovine animals are found. (Cf. list p. 16):

80. *Ertebølle*, on the Limfjord, 18 km. S. of Løgstør.
Winge (1900, p. 87) writes about the bovine bones: "*Bos taurus urus*. Part of base of *os occipitale* and *basisphenoid*. Part of an upper end of a *metatarsus* and part of a rib probably belong to this species."

The occipito-basisphenoid part is very strongly built and, no doubt, belonged to a large *Urus* bull. The width of the basisphenoid is 42 mm., as compared with 39 and 40 mm. in the large bulls from Sorø and Ølholm, respectively, and 34 mm. in the large Ullerslev cow.

The upper part of the *metatarsus* is from the right side of an adult specimen. It consists of the medial articular surface and the anterior part of the lateral surface. The greatest diameter of the medial part is 44 m., as compared with 40 mm. in the fairly small *Urus* cow from Pindstrup, and 44 mm. in the largest of the two small Bønnerup cows. The equivalent measurements in a large *B. t. domesticus* from Bjerget is 39 mm., in two *metatarsi* from the settlements of Troldebjerg and Bundsø, Passage-Grave period, 37 and 35 mm and in the Holmene bull and cow 39 and 35 mm., respectively.

This fragment thus may have belonged to a fairly small *Urus* cow; and the same holds good of the part of the rib.

The Ertebølle kitchen midden is placed on coarse, marine sand, and at several places in the shell heap bands of marine gravel were observed. This means that not only was the area flooded by the sea before the Ertebølle people settled there, but also that the kitchen midden was submerged several times.

From an archaeological point of view Th. Mathiassen (1940 and 1942) tried to estimate the comparative age of the kitchen middens from the Ertebølle culture. According to these investigations, the main part of the proper Ertebølle kitchen midden belongs to a fairly early part of the Danish "Older Stone Age",

comparable to Dyrholmen II, the Atlantic period (Group I of BRØNDSTED, 1957, p. 123). Only in the upper layers some archaeological remains from the Dolmen period have been found.

Also from a zoological point of view the Ertebølle kitchen midden seems fairly old. Apart from dog bones, only remains of wild animals were found, 56 species in all.

The animals that particularly provided the settlement with meat were Wild Boar (*Sus scrofa ferus*), Roe (*Capreolus capreolus*) and Red Deer (*Cervus elaphus*), a large number of bones of which is present. In fact it is surprising that so few bones of *Urus* are reported from the Ertebølle kitchen midden, thus especially considering, that remains of this species are predominating in the settlement of Hjerk Nor, only about 20 km. farther west.

For the sake of completeness I shall add that a few bones of *Bos taurus domesticus* were found on the Ertebølle kitchen middens, but under such circumstances that WINGE was of opinion that they did not belong to the settlement; and they are not mentioned in the publication from 1900:

A lower end of a *radius*, from the top soil (F 3'), a *metacarpus*, not split open, and the lower end of a *metacarpus*, "the appearance of both bones clearly disclose that they are an intermixture from later times."

81. *Aamølle*, on the south side of Mariager Fjord.

WINGE, 1900, p. 103, writes: "*Bos taurus urus*. Part of lower end of *ulna*; *metacarpus*, with 5th *metacarpus*, broken; 3 phalanges. The *metacarpus* compares completely with the *Urus*, this also applies to all other pieces, but they are less characteristic."

WINGE adds: "Bones, obviously intermixed from later times, are found from *Equus caballus*, horse: *calcaneus* from the surface soil. *Ovis aries*, sheep: a complete *metacarpus* from the upper layer.

Bos taurus domesticus, domestic cattle. Several upper and lower molars, 2 *condyli occipitales*, part of *premaxilla*, part of mandible, part of *scapula*, part of *ulna*, some phalanges. All from the upper, partly mould-like layer."

The *metacarpus* of *Urus* belongs to a large bull (Table 11), and the same applies to the phalanges. The maximum length and width of a complete distal and a mediate phalanx are 104×38 mm., and 54×39 mm., respectively. (Tables 22–23). From the main excavation from 1893 (according to original lists kept in the Zoological Museum) several teeth and a mediate phalanx are present. They are of a clear yellow-brownish colour, different from the dark appearance of the bones from the upper mouldy layer (excavated in 1899). In size the phalanx is equal to the corresponding phalanx in the Bønnerup cows, maximum length 47 mm., and thus no doubt belonged to an *Urus* cow.—2 lower and 3 upper molars are at hand. Owing to the fact that in the lower, hindmost molar (m 3) the posterior lobe shows no signs of wear, this tooth must have belonged to an adult, but fairly young animal. It is of almost the same size as the lower m 3 in the small Pindstrup *Urus* cow, and thus a little larger than in the Ugilt bull;

the maximum lengths are 44.5, 45.5, and 42.5 mm., respectively, and the maximum widths at the base are the same in the three specimens (cf. DEGERBØL, 1962, fig. 4). The lower m 2 is comparatively smaller; the length of the grinding surface, it is true, is the same, 32 mm., as in the 3 specimens mentioned, but in the middle of the tooth the Aamølle specimen is a little shorter.

Also an upper hindmost molar (m 3) shows no sign of wear and is just as large as the equivalent tooth in the Pindstrup cow, 35.5 mm., as compared with 32 mm. in the Ugilt bull. The two upper molars, are much shorter; thus it appears that the hindmost lower and upper molars may have belonged to a small *Urus* cow, but the other molars are smaller than hitherto found in the *Urus*.

Apparently the age of these bones is uncertain; judging from their appearance they do not originate from the superficial layer, as indicated by WINGE, which otherwise no doubt applies to the rest of the bones referred to domestic cattle. According to TH. MATHIASSEN (1942, p. 57) the Aamølle kitchen midden may, from an archaeological point of view, be placed at the same evolutionary stage as Dyrholmen II and late Dyrholmen III (Dolmen period or later).

"Also in the upper part of this kitchen midden several things from the Younger Stone age were found. However, these were not only, as in Ertebølle and Havnø, from the Dolmen period, but also from later parts of the period, probably originating from accidental visits to this old hunting settlement." (TH. MATHIASSEN).

82. *Havnø*, on the north side of Mariager Fjord.

WINGE (1900, p. 111): "*Bos taurus urus*. Part of *epistropheus*, lower end of *metacarpus*, upper end of a phalanx. All similar to bones of the *Urus*. A *naviculo-cuboideum* bone undoubtedly belongs to the same species."

The distal width of the *metacarpus* is 81 mm.; the proximal width of the innermost phalanx is 44 m.; indicating an *Urus* bull. The *naviculo-cuboideum* is similar to this bone in the Ullerslev cow, greatest width 69 mm. (Tabel 20).

Also in this kitchen midden *Bos taurus domesticus* is represented: "Several teeth and bones of at least 4 specimens, very different in size, some of them large, some small. All from superficial layers." (WINGE, *loc. cit.*, p. 111).

All in all, no less than 50 fragments of bones of domestic cattle are present. Thus the distal width of the lower ends of two *metatarsi* are 55 and 47 mm., respectively, no larger than in small cows from the Middle Ages.

The distal width of a *tibia* is 60 mm., the greatest width of *navicolo.-cuboideum* is 59 mm., indicating domestic oxen. (Table 20, No. 67).

From superficial layers furthermore, some bones of horse and sheep or goat are at hand.

MATHIASSEN (1942, p. 57) states that the older part of the Havnø kitchen midden belongs to the Dyrholmen II. phase (including thick-walled Ertebølle pottery), the upper part to the Dolmen period. There are no indications that the settlement was not continuously inhabited.

In the publication on the kitchen middens from 1900 also two settlements from

Zealand belonging to the Ertebølle culture were described, viz. from *Faarevejle*, on the drained Lammefjord, N.W. Zealand, and *Klintesø* on the N.W. coast, at the base of Sjællands Odde, but as was to be expected from our present knowledge, no bones of *Bos primigenius* were found. Klintesø has later been dated at the Subboreal period (K. Jessen 1937).

83. *Mejlgaard*, N.W. of Grenaa.

"*Bos taurus urus*. A few bones of a bovid, so large that they probably belong to the *Urus*: part of a mandible with the three premolars, a hindmost molar (labelled 15.6.1861), jugal, part of *epistropheus* (labelled 15.8.1861), upper end of *femur*." (Winge 1904, p. 286).

The lower border of the mandible fragment is split open to take out the marrow. The teeth show only very slight signs of wear, p 4 not quite in place in the jaw They are a little larger than the equivalent teeth in the Pindstrup *Urus* cow and in the Ugilt bull, length of premolars 63, 59, and 58 mm. (Cf. Table 10). Even if the premolars may be very large in prehistoric domestic cattle (M. Degerbøl, 1939, p. 116, fig. 7), they probably do not compare with this specimen from Mejlgaard.

The length and width of the hindmost lower molar is 46.5 mm. and 18.3 mm., respectively. Also this tooth may belong to an *Urus* (cf. M. Degerbøl, 1962, p. 249, fig. 4).—The *epistropheus* is heavily built, as in *Urus*; it is true, that the greatest width of the anterior border is 114 mm., as compared with 113 mm. in the large domestic animal from Bjerget; however, this last specimen is much more slightly built: the width of the *dens epistropheus*, at the base, e.g., is only 50 mm. as against 57 mm. in the Mejlgaard bone.—The diameter of the *caput femora* is 61 mm., as in the Tinglev specimen.

Besides these heavy bones (mentioned by Winge) several fragmentary skeletal parts of *Bos* have been recovered from the Mejlgaard kitchen midden and identified as belonging to domestic cattle; they are still preserved in the Zool. Mus. With our present knowledge of the great sex dimorphism in the skeletal parts of *Urus* it is likely, however, that most of these bones belong to *Urus*. This applies to the following bones (labelled 14–15.6.1861): Lower end of *metacarpus*, the distal width of which is 71 mm., as compared with 66 mm. in the Pindstrup cow (cf. Table 11), thickness above epiphysis 35 and 34 mm., respectively, and greatest diameter of trochlea is 40 and 38 mm., respectively.

Part of medial side of right *tibia*, heavily built, height at *crista anterior*, anteriorly — posteriorly, is 59 mm., as compared with 52 mm. in the domestic oxen from Bjerget and 48 mm. in the Pindstrup cow.

The proximal width of a second phalanx is 40 mm., as compared with 34 mm. in the Ullerslev cow.

A lower end of a *tibia* is almost the same size as the *tibia* of the Pindstrup cow, the distal width being well over 70 mm., in the Pindstrup cow 73 mm.

An upper half of a *metatarsus* (marked 0) is in size and shape similar to the corresponding part of the Pindstrup cow (Table 12). This also holds good of an

upper, lateral part of a right *metacarpus*; the length of the lateral articular surface is 38 mm., greatest width 26 mm., as compared with 34 and 26 mm., respectively, in the Pindstrup cow.

In an anterior part of a right mandible the distance from the *foramen mentale* to the anterior border of the first premolar is fairly long, 75 mm., as compared with 73 mm. in the Pindstrup cow. The length of the two anterior premolars present is 31 mm., as compared with 34 mm. in the Pindstrup specimen, thus fairly small, probably too small for an *Urus*.

A lower m 2 is 33 mm. long at the grinding surface, 25 mm. at the base; in the Pindstrup cow the equivalent measurements are 33 mm. and 27 mm.; the width at the base is 16.7 mm. in the Mejlgaard tooth. Probably this tooth, too, belonged to a domestic ox. An upper posterior part of a left *radius* belongs to a small *domestic cow*. The width, anteriorly-posteriorly, of the lateral articular surface is only 22 mm. (31 mm. in the Pindstrup cow). This bone is dark-coloured, probably from the superficial layer, but has been split open for taking out the marrow. An *astragalus* is also a dark colour, 63 mm. long, belonging to a *B. t. domesticus*. Besides, 3 carpal bones, 2 upper teeth, 2. premolars and 2 molars, and a free epiphysis of a femur are present.

Mathiassen (1942, pp. 58–59) informs us that the axes in the Mejlgaard kitchen midden belong to a late stage, probably Dyrholmen II. According to H. Andersen (1960, p. 34), however, an early Neolithic intermixture is indicated in the upper and superficial layers.

84. *Krabbesholm*, N. of Skive, on the Limfjord.

"*Bos taurus urus*. A few bones, part of a frontal bone, part of a mandible, a few lower teeth, i.a. 2 different hindmost lower molars, upper part of a *radius*" (Winge 1904).

The following bones of *Bos primigenius* are kept in the Zoological Museum, Copenhagen: part of horn core (♂), part of left frontal, with part of orbit (♂), part of right mandible, distance from the *foramen mentale* to the anterior border of p 2 is 68 mm., least height 33 mm.; posterior part of left mandible, width (ant.-post.) below *proc. articularis* 66 mm.; 4 lower molars (m 1 — m 2); from the left and the right side, length of grinding surface 61 mm., at the base 57 mm., as compared with 61 and 59 mm. in the Pindstrup cow, and 60 and 57 mm. in the Ugilt bull; in a mandible of the domestic bull from Vedbæk II (Maglemosegaard) the corresponding measurements are 53 and 52 mm.

The length and width of the two mandibular, hindmost molars (m 3) are 47.1×19.0, and 43.5×18.5 mm., respectively. Particularly the last-mentioned tooth is remarkably small, however, often seen in m 3 from kitchen middens. (Cf. p. 89). — *Scapula*, width of collum 75 mm. ("Bjerget" 70 mm.). Upper part of right *radius*, largest proximal, transversal width 109 mm., width of articular surface 99 mm., greatest width anteriorly-posteriorly 54 mm. ♂ ("Bjerget" 99 mm., 90 mm., and 48 mm., respectively). Lower part of left *antebrachium*; distal width 107 mm. ("Bjerget" 87 mm.); *fibula*; 2 carpal bones.

Besides, several bones were classified as *Bos taurus domesticus*; however, no doubt some of these belonged to *Urus* cows, as was also the case in the Mejlgaard kitchen midden.

A lower part of a *metatarsus* is in shape *Urus*-like, gradually getting narrower upwards, whereas this part in domestic oxen is narrowing more sharply. In *Urus* the anterior-posterior measurements are larger than in domestic oxen; the diameter of the largest trochlea is in the Krabbesholm specimen 38 mm., as compared with 38.5 mm. in the Pindstrup cow and 36 mm. in the domestic ox from Borremose and in a large domestic ox from the Neolithic settlement on Lindø, whereas the distal transversal width roughly is the same in the said bones, 65 mm.; the corresponding anterior-posterior width of the diaphysis are: 30, 30, 26.5, and 24 mm.

2 complete *astragali* and an incomplete one are in size equal to these bones in the Pindstrup and Bønnerup cows; total length 80–82 mm. (Cf. Table 19). A lower m 3, 40.8×17.2 mm., is probably too small to be grouped with *Urus*.

Some bones of mould-like colour belong to *Bos taurus domesticus*: upper part of a *radius*, the largest transversal width of which is 86 mm., 80 mm. of articular surface; an *astragalus* is only 65 mm. long. A small lower m 3 is 34 mm. long and 15.3 mm. broad.

85. *Virksund*, 15 km. E.N.E. of Skive, on the south coast of the Limfjord.

"*Bos taurus urus* ? Part of mandible, lower end of *humerus*, fragment of *ulna*, *caput femoris*. The bones are comparatively small, but probably too large to belong to domestic cattle. *Bos taurus domesticus*. Some isolated lower teeth. Collected partly by Andersen the controller in the year 1861 and through Professor Eschricht forwarded to Steenstrup, and partly by Steenstrup 1865" (Winge 1904, p. 205, 287).

The fragment of the lower jaw consists of a horizontal part bearing the two hindmost molars, m 2 and m 3, and is broken just in front of and a little behind the teeth, which are much worn. The total length of the two teeth is 72 mm.; the length and width of m 3 is 43.5 mm. and 17.4 mm., respectively. Although the cement layer and the enamel are thick and well marked and the jaw comparatively heavy it is problematic whether this piece belonged to a *Urus*; the combined m 2–m 3 length and the width of m 3 are particularly small. The height between m 2 and m 3 is 57 mm., behind m 3 67 mm., and the greatest thickness of the jaw is 31.5 mm.

It should furthermore be noticed that similar jaw fragments occur, e. g., in the Lyø settlement, and that it also roughly corresponds to the mandible of the Søndersø domestic ox, in which the m 2–m 3 length is 70 mm., the respective heights of the jaw being 59 and 69 mm., and the thickness 35 mm.

Also the *humerus* part is fairly large, almost as broad as in the Ullerslev cow, but similar *humerus* parts occur, e. g., in the Troldebjerg settlement.

The *femur* head, however, is very large, and no doubt belonged to *Urus*. The greatest width of the *caput*, anteriorly-posteriorly, is 59 mm., of the *collum*,

anteriorly-posteriorly, 37 mm., as compared with 57 and 34 mm., respectively, in the Ullerslev cow.

86. *Lovns*, on the north side of Lovns Bredning, on the Limfjord, about 15 km. S. of Ertebølle (National Museum, 1908).
Bos primigenius. Upper part of *metacarpus*, ♂. Proximal width, transversal, 85 mm.
Bos taurus domesticus. A few bones from superficial layers.

87. *Gudumlund*, on a small inlet of Lille Vildmose, on the south of the Limfjord, about 15 km. S.E. of Aalborg (H. Winge 1904).
"*Bos taurus urus*. Part of horn-core", — large, ♂.

88. *Kolding Fjord*. (Museum at Koldinghus).
Bos primigenius. From the dredging in the year 1896: Upper and lower part of *metatarsus*, proximal width, transversal, 59 mm, anteriorly-posteriorly, 56 mm., ♀; distal width 75 mm., ♂; lower part of *metacarpus*, partly soot-coloured, distal width 80 mm., ♂; lower part of *metacarpus*, distal width 77 mm., ♂; *calcaneus*, the free epiphysis is missing.
From the year 1900: Part of right mandible, broken in front of tooth row, of young animal with milk premolars and m 2 erupting, showing no signs of use. Right horn-core. ♂.
From the year 1915: Upper half of *metacarpus*, proximal width 82 mm., ♂. Upper and lower part of *metatarsus*; prox. width 62 mm., ♂, dist. width 78 mm., ♂; *calcaneus*, broken posteriorly.
According to Th. Mathiassen (1942, p. 61) it is probable that this settlement belongs to Dyrholmen II (however, a couple of potsherds from the Dolmen period are present).

89. *Horsø*, Hobro. (K. Jessen, 1927).
Astragalus, lower hindmost molar (m 3) (M.D.).

90. *Brabrand* settlement, near Brabrand Lake, 5 km. W.S.W. of Aarhus. (Publ.: Th. Thomsen and A. Jessen, 1906).
The bone material from Brabrand was sent to the Zoological Museum, and examined by H. Winge. The investigations by Winge, however, were not published directly, but were reported by Th. Thomsen (*loc. cit.* pp. 51–52). In the original lists, kept in the Zool. Mus., Winge wrote about *B. primigenius:* (21.12.1903).
"Anterior and posterior part of mandible, part of *atlas*, part of one of the hindmost *vert. cervicales*, some fragments of ribs, part of *radius*, *pisiforme*, upper end of *metacarpus*, lower end of *metatarsus*, 3 phalanges.
(14.11.1904): parts of 3 horn cores, part of *epistropheus*, part of two *vert. thoracales*, a rib, *scapula*, some carpal-bones, 5 *astragali*, 2 *nav.-cub.*, a few phalanges. — Some of the bones are relatively small, particularly some of the *astragali*.

1 2 3 4

Fig. 4. Upper part of *metacarpus* from the Brabrand settlement, II C 6^{4-5}, (No. 2), placed together with a corresponding part from Øgaarde, Boreal period (No. 1), and 2 complete metacarpals, of the *Urus* cow from Pindstrup (No. 3) and of the domestic bull (bullock) from Holmene, Hillerød. – In shape and size the Brabrand specimen is similar to the metacarpals of the *Urus* from Øgaarde and Pindstrup. × $^1/_2$.

Bos taurus domesticus (?). Upper end of a *metacarpus* (II C 6^{4-5}) and lower end of a *metatarsus*, cut off, (II B 8^{1b}). In size as that a good-sized domestic ox. May perhaps originate from an unusually small *Urus*."

The Brabrand settlement was originally dated at the period just before, during and immediately after the maximum of the Littorina Sea; the deepest part thus older than the kitchen middens built on the highest shore line of the Littorina Sea (Th. Thomsen and A. Jessen, 1906).

Later it was stated that the find was younger, only the deepest part, belonging to the late Atlantic transgression (Troels-Smith, 1937).

Of particular interest is the upper half of the *metacarpus* from one of the deepest layers (II C 6^{4-5}), which by Winge, although with some reservation, as just mentioned, was determined to be *B. t. domesticus*. In the publication by Troels-Smith it was characterized as a bone which with a probability amounting almost

to certainty had belonged to a domestic ox, and it was taken as a proof of the existence of domestic cattle in Denmark already at the border line between Zones VII and VIII.

It must be admitted that not until recently, with the appearance of the new material for comparison, have we got a possibility for a real judging of this bone. In size and shape it is similar to the corresponding part of the small metacarpals from, e.g., Pindstrup and Bønnerup A. On the other hand, it should be emphazised that it also is much like the corresponding parts of several metacarpals of Neolithic domestic cattle, e.g. the male from Holmene, Hillerød, the measurements of the proximal end being almost the same in the said specimens.

In the Brabrand fragment the proximal transversal width is 65.5 mm., as compared with 66.4 mm. and 63.0 mm. in the Pindstrup and Bønnerup specimens, respectively; in the Holmene male, however, the said measurement is even a little larger, 67.0 mm. The anterior-posterior widths are: 41.0, 41.0, 39.0, and 41.3 mm., respectively, and the anterior-posterior width of the articular surface: 36.2, 37.5, 36.0, and 36.0 mm., respectively. — It may be noted, however, that the upper half of a *metacarpus* from the Øgaarde settlement, Zone VI, is quite conformal with the Brabrand specimen. The transversal, proximal width is similar, 66 mm., but as the medial articular surface is opened posteriorly, probably for taking out the marrow, the anterior-posterior width cannot be taken. The diaphysis is broken in the middle, just as in the Brabrand *metacarpus*; its transversal width is 35.5 mm., as compared with 36.2 mm. in the Brabrand specimen (Fig. 4). — It may also be mentioned that Stampfli (1963) depicts the upper part of a *metacarpus*, referred to *Urus*, which is similar to the Brabrand bone; proximal transversal width 66 mm., and anterior-posterior width 40 mm.

The Brabrand fragment seems to have belonged to a comparatively long *metacarpus*. It is broken 122 mm. from the proximal end, measured on the lateral side, but even at this distance from the upper end the diaphysis has its smallest transversal width, 36.2 mm., as also the metacarpals from Pindstrup and Bønnerup get their minimum widths, 37.0 and 40.0 mm., respectively, at that distance. In accordance with the shorter *metacarpus* of the domestic oxen is the least diaphysis width, 37.5 mm. in the Holmene male placed more proximally, and from there the bone is growing broader; at the said distance, 122 mm. from the proximal end, the width is 38.5 mm.

Also the very thick bone walls of the Brabrand piece indicate the *Urus*; the anterior wall in the median line is 11 mm. thick, the lateral wall 10 mm.

To sum up, it must be said that the Brabrand fragment not only may have belonged to an *Urus* cow, but that no doubt it represents this animal. At least, on the basis of the much larger reference material now at hand the said bone cannot serve as a proof of the existence of domestic cattle in Denmark prior to the *Ulmus* decline.

Another proximal end fragment of a *metacarpus* is posteriorly cut just below the

articular surface. The transversal width is 72 mm., the anterior-posterior width is 45 mm. and of the articular surface 40 mm. On the lateral part there is a faint granulation, the bone wall is thick, about 11 mm. Also this fragment no doubt belonged to an *Urus* cow, an old, robust animal. In size and shape this fragment is comparable to the corresponding part of the large St. Taastrup *metacarpus*, but here too it may be noticed that the measurements correspond very well with those of the metacarpal of a domestic male, e. g., from Borremose. (Table 11).

The thick bone walls, about 11 mm. thick, and a general impression, e.g., based on a more clear-cut relief, may indicate its belonging to *B. primigenius*. Furthermore, as already emphasized, when large bones belonging to *Urus* bulls are present in a settlement, it must *a priori* be expected that smaller, and perhaps questionable *Bos*-bones from the same site belong to female *Urus* specimens. No less than 5 *astragali* occur, representing 5 individuals. They are all, as mentioned by WINGE, comparatively small, i.e. representing *Urus* cows, the largest are in size as the *astragalus* of the Ullerslev cow, the 2 smallest as the *astragali* of the Bønnerup cows, length 76 and 79 mm., as compared with 77 and 80 mm. in the Bønnerup specimens, but outside the upper range in domestic oxen: 74 mm. (Cf. Table 19). Two (Nos. 72 and 74, Table 19) belonged to young animals, as appears from the porous consistency of the bone; however, even with growing size these two specimens would not have attained the large width characteristic of males. Cf. e.g. the *astragalus* of the Ullerslev cow, which is almost as long as the *astragalus* of the small bull from Tinglev, lengths 82 and 84 mm. respectively, but is much narrower, distal widths 52 mm. and 57 mm., respectively.

A naviculo-cuboid from Brabrand is 61 mm. broad, as in the Bønnerup cow; it has belonged to a young animal, and, together with a second fragmentary *naviculo-cuboideum* represents the *Urus* cow. (Cf. Table 20).

A medial part of a 1st *phalanx* of a hindlimb is of similar size as the corresponding part of the Ullerslev cow; the smallest length is 65 mm. in both; the greatest heights are 62 and 61 mm., respectively.

Four 2.d. phalanges are at hand. In two, probably from the forelimb, the smallest lateral lengths are 38 and 36 mm., respectively, as compared with 38 mm. in the Ullerslev specimen; the diaphysis widths are 32 mm., 27 mm., and 28 mm., respectively, the largest one thus probably belonging to a bull, the smallest one to a cow. The other two phalanges, from the hind limb, measure 39×26 mm. and 35×27 mm., as compared with 41×29 mm. in the Ullerslev cow.

Also the mandibular fragments may find their place among *Urus* cows; the length from the *foramen mentale* to p 2 is 75 mm., the height of this part 28 mm.

Of the many fragments of *horn cores* present it has been possible to form a measurable left horn core, which on the frontal side bears a number of longitudinal, deep and narrow furrows. In size it is comparable to the horn cores of

Fig. 5. Distal parts of the two metatarsals from Dyrholmen settlement (Nos. 2 and 3) placed together with corresponding parts from Ogaarde (No. 1) and Maglemose 1949 (used as a hammer), Boreal period (No. 4). – Nos. 5 and 6 (opposite side). Complete right metatarsals of the *Urus* cow from Pindstrup (No. 6) and of the domestic Holmene bull (bullock). × $^1/_2$.
The distal transversal width of the metatarsals of *Urus* cows falls within the size range of the domestic oxen, but e.g. the anterior-posterior width is larger in *Urus*. – Cf. fig. 6.

the young bull from Hallenslev, but must have belonged to an adult animal. Diameters at the base are 98×80 mm., the circumference at the base 285 mm., and the length along the outer curvature 500 mm. It should particularly be emphasized that this specimen by pollen analysis has been dated at the Atlantic period, Zone VII.

A fragment of the frontal side of a horn core, broken at the base, represents a large, young bull, as indicated by the porous, "worm-eaten" appearance. Also the *cervical vertebra* mentioned belonged to a bull.

Summary: In the Brabrand settlement *Bos* remains are comparatively numerous. They may be identified as belonging to the *Urus*, bulls as well as cows, but females are predominant amongst the specimens recovered. Owing to the *astragalus* alone, 5 specimens of cows are represented.

91. *Dyrholmen* settlement, Djursland.
(Publ. Th. Mathiassen, M. Degerbøl og Troels-Smith, 1942).

Fig. 5, continued.

As at the Brabrand settlement comparatively many bones of *Bos* occur at the Dyrholmen site, several of these being so small that they are comparable with the corresponding bones of domestic Neolithic oxen. At the time of the publication of 1942 the measurements of some of these small bones fell outside the size range of *Urus* cows then known. However, on the basis of the frame of comparison now procured, most of these dubious bones may be referred to *Urus* cows. This holds good, i.a., of two incomplete horn cores, from the earliest part of the settlement, Dyrholmen I, (cf. p. 63). It is not so much the width of the horn core as the length, which is indicative of *Urus* cows as compared with domestic cattle. — Also two distal parts of metatarsals now find their natural place within the size range of *Urus* cows. The distal transversal width, it is true, falls within the

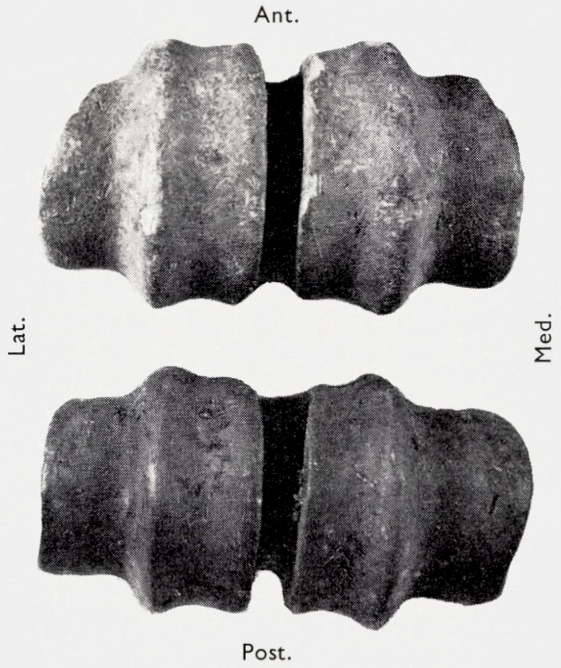


Fig. 6. Distal ends, from below, of metatarsals of the *Urus* cow from Dyrholmen, at the top (No. 3 in fig. 5), and of the domestic bull (bullock) from Holmene, Hillerød, at the bottom (No. 5 in fig. 5). – In the *Urus* the anterior-posterior width of the sagittal ridge of the trochlea is larger than in domestic oxen. Further information in text. × $^1/_1$.

size range of domestic cattle, but the anterior-posterior width is larger in the *Urus*, e.g., measured as the smallest width of the distal part of the diaphysis or as the greatest width of the sagittal ridge of the trochlea of metatarsus No. 3. In domestic oxen the outer half of this trochlea (on the medial side of the cannon bone) is very broad, considerably broader than the outer half of the trochlea of metatarsus No. 4 (on the lateral side of the cannon bone). In *Urus* this difference in width is not at all so pronounced, and particularly the lateral width is anteriorly small. Also the height of the trochlea, from below-upwards, is greater in the *Urus*. In shape of the distal end of *metatarsus* thus a considerable difference exists between *Urus* cows and domestic oxen; figs. 5–6. (Cf. p. 158).

Furthermore, two proximal ends of metatarsals are present; one (from Squares II D1 and II E1) belonging to a bull (transversal width 67 mm., anterior-posterior width 61 mm.); the other (from Squares P 5 and M 45) to a cow (width 56 mm. and 52 mm.) respectively.

Also regarding other skeletal parts from Dyrholmen similar differences in size occur, the larger bones representing bulls, the smaller ones cows. Of 4 *calcanei* 2 belong to bulls, 2 to cows (cf. Table 18) and of 2 *astragali* from the oldest part of the site one is representing a bull (total length 87 mm.), whereas the smaller

one, with a total length of 81 mm., is only slightly smaller than the *astragalus* in the Ullerslev cow (82 mm.).

Two *naviculo-cuboidea* belong to bulls; the greatest transversal width is 75 and 73 mm., respectively; a third specimen is small, the greatest width 60.5 mm., and it was originally considered as probably belonging to a domestic ox. However, in size and shape it is conformal with a *naviculo-cuboideum* of the *Urus* cow from Bønnerup, the greatest width of which is 61 mm. A similar external width, 62 mm., it is true, is also found in the *naviculo-cuboideum* of the old domestic male from Holmene, but the upper articular surface proper in this specimen is smaller than in *Urus* cows.

Particularly small are the teeth from Dyrholmen, the interpretation of which has involved great difficulties (Degerbøl, 1963).

Only the appearance of the Ugilt skull with the astonishingly small teeth has brought most of the Dyrholm teeth within the size range of the *Urus*. Of the 4 hindmost mandibular teeth (m 3) present at Dyrholmen (also from the oldest layers, Dyrh. I) 2 are a little larger than m 3 in the Ugilt skull, length and width 42.7 mm.×18.7 mm., as compared with 42.5×18.5 mm. in the Ugilt skull, but the 2 other specimens are smaller, 41×18 mm., that is, within the range of *B. t. dom.*, however, as certain remains of domestic cattle are not found in this settlement, it is probable that these teeth, too, may be referred to *Urus* cows. Also the very small maxillary fragment from Dyrholmen, bearing teeth, premolars and first molar, p 2–m 1, is similar to the corresponding part of the Ugilt skull, in fact a little larger. The p 2–m 1 length at base, is 85 and 82 mm., respectively.

Accordingly it is probable that the small teeth from the Dyrholmen settlement, as well as several other small teeth from the Atlantic and Subboreal sites, represent the *Urus*.

Summary: The bovine bone material from the Dyrholmen settlement represents the *Urus*; it naturally falls into two groups, larger bones representing males an smaller ones females; however, some of the smaller remains, particularly teeth, are very small, some teeth scarcely reaching the size range of the exceptionally small teeth in the Ugilt skull. However, bones of distinct domestic oxen do not occur.

92. *Kolind*, on the now drained Kolind Sund, Djursland, about 20 km. S.E. of Dyrholmen. (Th. Mathiassen, M. Degerbøl, and J. Troels-Smith 1942).

As regards almost complete, measurable bones of *Urus* two *astragali* and a proximal *phalanx* are at hand. The *astragali* are of almost equal size, representing females (Table 19), one is from Stage I, older than the Dyrholm find, the other is from Stage III (= Dyrholmen 1 and 2). The phalanx, from Stage I, has been opened for taking out the marrow, the lateral length (shortest) is 69 mm., as compared with 66 mm. in the Ullerslev cow.

93. *Hjerk Nor*, east side of Salling Sund about 16 km. N.N.W. of Skive (M. Reffsgaard. Skive Museum).

Bos primigenius.

Lower part of right horn core with small part of frontal bone, diameters 85×63 mm. ♀. Left premaxilla and maxilla. Fragment of mandible with m 3, worn, 43.8×19.0 mm. Anterior part of mandible, the distance from *foramen mentale* to the anterior border of p 2 is 55 mm., height 26 mm., thickness 15.5 mm., ♀, small. Left lower p 2, much worn, and p 3, worn; left upper molar. Proximal part of right *antebrachium*, transversal width 95 mm. (articular surface 87 mm.), anterior-posterior width 49 mm., ♀, a little smaller than in the Ullerslev cow. Proximal end of left *radius*, corresponding measurements 113 mm. (101 mm.), 60.5 mm. (art. 52.5 mm.), ♂, large. Medial side of upper end of *radius*, anterior-posterior width 53 mm., ♂. Lower part of right *antebrachium*, distal width 110 mm., ♂, large. Distal end of right *antebrachium*., 97 mm., ♀, a little larger than the Ullerslev specimen. Distal end of left *antebrachium* 101 mm. (art. 90 mm.), ♂, as the Tinglev specimen. Proximal end of left *metacarpus*, prox. width 86 mm. (trans.)×49 mm. (art. 45 mm.), anterior-posterior, ♂, large. Distal end of *metacarpus*, distal width 66 mm., diameter of trochlea 37.5 mm., ♀. Medial side of upper end of *metacarpus*. 3 distal ends of *metatarsus*, distal width 64–64–75 mm., respectively, diameters of trochlea 39–38 and 44 mm., respectively, representing two females and a male. Distal end of *tibia*, distal width, transversally 86 mm., ♂. Posterior part of shaft of *tibia*, ♂. Right *astragalus*, greatest length 90 mm., distal width 56 mm., height 46 mm., ♂. Right *astragalus* 81×53×42 mm., respectively; anteriorly soot coloured, ♀. 2 right *naviculo-cuboidea*, greatest width 79 mm., ♂, and 70 mm., ♀. Left *naviculo-cuboideum* 67 mm. long, ♀. *Lunatum*, Proximal phalanx (*pes*), greatest length, lateral 74 mm., diaphysis width 29 mm., proximal width 34.8 mm., ♀, similar to the Ullerslev cow; proximal halves of two proximal phalanges, width 41 and 42 mm., ♂, ♂; medial phalanx, proximal width 42 mm., diaphysis width 33 mm., ♂; two distal phalanges, greatest length 96 mm., ♂, and 87 mm., ♀. Fragments of a small foetus.

The Hjerk Nor settlement is submarine and has been privately excavated by ketching. It has not yet been worked up, but here for the first time zoologically treated. An extraordinary feature of this settlement is the very high number of bones of Wild Cat and Lynx. The Hjerk Nor settlement leaves the impression of being a particular fur station where people hunted for the purpose of procuring skins for winter clothing or perhaps even for sale.

94. *Norslund*, on Norsminde Fjord, about 15 km. S. of Aarhus.
(Lit.: S. H. Andersen and C. Malmrose, 1966).

As mentioned above, the age of the kitchen middens proper is questionable, but the fact that the *Urus* was a common animal in Jutland during the Atlantic period is evident not only from the many *Urus* bones from the Brabrand and Dyrholmen settlements, but also from a site at Norslund.

According to Møhl, who has examined the osseous material from this site, no bones of domestic cattle were found. The bones of *Urus*, together with bones of Wild Boar and Red Deer, predominated. The bulk of the bones originate from Stratum 3, i.e. that they are contemporaneous with Dyrholmen I, from the beginning of the High Atlantic transgression, the transgression between Zones

VIIa and VIIb. A C-14 analysis of charcoal from the layer gave ages of 3780 ± 120 and 3730 ± 120 B.C.

As MØHL does not give any measurement I shall call attention to some of the more remarkable bones.

Two mandibular hindmost molars (m 3) are present, they are comparatively small, as also pointed out in several kitchen middens mentioned: 45.2×18 mm. and 43.5×18.2 mm.

Also a third lower hindmost molar, which earlier, in 1962, from the same locality, by the physician A. JØRGENSEN was sent to the Zoological Museum for examination, is small, 44.5×18 mm. emphasizing the common occurrence of small mandibular m 3 from Zone VII.

The proximal width of an upper part of a *metatarsus*, transversal, is 67 mm.; anteriorly-posteriorly, 66 mm., ♂, almost as in the Sorø bull; the lower part of a *metatarsus* is 75 mm. broad, distally, and the diameter of the largest trochlea is 43 mm., as compared with 78 and 45 mm., respectively, in the Sorø bull. An *astragalus* is 88 mm. long and 57 mm. broad, distally, as compared with 84 mm. and 57 mm. in the Tinglev bull; in a slightly porous *astragalus*, from a young animal, the measurements are 84×50 mm.; ♀, almost as in the Pindstrup cow.

The transversal width of two *naviculo-cuboidea* is 75 mm. in both (♂♂). 2 fragments of the upper end of a *metacarpus* are similar to the corresponding parts in the Pindstrup cow.

95. *Godsted*, at Hejrede Lake, Lolland. (National Museum, 1904).

"*Bos taurus urus*. Parts of three lower molars probably from the same individual. Furthermore, an upper molar, of *Urus* or large domestic ox." (WINGE det., 1907). — The length of the 2. lower molar is 34 mm., at the grinding surface, 27 mm. at the base; width at the base 19 mm. — May have belonged to *Urus*.

Summary of the Bos-remains in the Kitchen Middens.

From these investigations it appears that in some kitchen middens particularly in the old classical finds (Ertebølle, Aamølle, Mejlgaard, Krabbesholm, Lovns, Gudumlund, Virksund) only a few bones of *Urus* were recorded, whereas in another group of settlements (Brabrand, Dyrholmen, Hjerk Nor, Kolding Fjord, Norslund) comparatively many *Urus* bones are present. — Thus it was just the large number of *Urus* bones which originally were assumed to endow the Brabrand settlement with a stamp of comparatively old age and which also in working up the bone remains from Dyrholmen were particularly emphasized. Later the settlements from Hjerk Nor and Norslund were attached to this last-mentioned group.

Only one of these settlements, from Norslund, is not only relatively dated, the bones chiefly belonging to the High Atlantic transgression, like Dyrholmen I, but also absolutely dated: C 14-analysis 3780 ± 120. The settlements from Hjerk Nor, Kolding Fjord, Brabrand, and Norslund are today subaquatic.

When in the older publications on kitchen middens *Urus* bones are recorded, it generally only means bones of large *Urus* bulls; the smaller bones of *Urus* cows were referred to domestic cattle.

It is a remarkable fact that the *Urus* teeth from the kitchen middens are very small; the mandibular m 3-length, e.g., only slightly passing the minimum length of this tooth from the Maglemose settlements, Zealand (cf. fig. 17). This isolated position, however, is now partly broken by the discovery of similar small *Urus* teeth in mandibles attached to skulls (Pindstrup, Toftum, Gesten) or in single finds of mandibles (Kundby), from the Subboreal period; the lower m 3 is exceptionally small in the large Ugilt bull, 42.5 mm. (Table 10).

But what is the explanation of these comparatively small teeth? Are they due to a difference in time, Preboreal-Boreal as against Atlantic-Subboreal? or are they caused by a difference in space, Zealand as against Jutland? The *Urus* disappeared from Zealand at the close of Zone VI and apart from the Subboreal finds just mentioned only a few lower m 3 teeth are known from Jutland, and those are of uncertain age; but a couple of them belong to the largest known ones, well over 52 mm. long. This might indicate that in Jutland a decrease in the size of teeth took place during the ages. It is a well-known fact that many species of prehistoric mammals on an average are larger than the corresponding recent ones, as I have pointed out, e.g., regarding the Danish carnivores from the Boreal period (Degerbøl, 1933) and as Kurtén later (1959) has calculated at the rate units of "Darwins".

It is likely that a similar fast, short-term rate of evolution has taken place regarding the *Urus*, particularly at the close of its existence. (Cf. p. 91).

Remains of Uncertain Age.

More than a hundred finds are undated or have not been dated with certainty. As no remains of *Urus* are known from Zealand later than Zone VI, it is, however, highly probable that undated *Urus* remains from this island in fact are actually older than the transition period between Zones VI and VII.

Zealand.

*Skulls and parts of skulls.**

97. *Aagerup*, 7 km. N.E. of Roskilde (Qvistgaard, 1850).
♂. Complete skull. Old specimen, *sulcus supraorbitalis* roofed. Bases of horn cores, occipital crest, anterior rims of orbits and *proc. mastoidei* highly granulated. Interfrontal suture obliterated. Teeth worn. — Premaxilla damaged, about 12 mm. are missing, added in tables. (Cf. p. 8) — Pl. VII.

98. *Lyngby moor*, 10 km. N. of Copenhagen (Steenstrup).
♂. Almost complete skull; nasals missing. Old animal of about the same individual age as the Aagerup skull. Open type of horn cores. — Pl. VII.

99. *Eskildstrup* (Zoneredningskorpset, 1946).
♂. Skull, kept by the regional salvage corps.

* Regarding measurements cf. Tables 1–23, and I–III.

100. *Mørkøv*, 15 km. S.W. of Holbæk (Fr. Wulff, 1875).
♀. Brain-case, broken through orbits; tip of right horn core and outer half of left horn core are missing. (Cf. p. 61). — Pl. IX.

101. *Skellingsted*, S. of Mørkøv (R. Andersen, 1932).
♂. Right horn core with small part of frontal. Diameters at base 118×96 mm., circumference 350 mm., outer curvature about 610 (575+) mm.

102. *Trønninge*, *Kundby* moor, 10 km. W. of Holbæk (G. H. Thomsen, 1943).
♀. Right mandible, *femur*, part of *os sacrum*.

103. *Højby*, 4 km. S.W. of Nykøbing S. (R. Madsen, 1884).
Some upper molars (H.W. 1904, p. 291: It has not been stated whether more was sent in; a complete skeleton was apparently found, one also in 1885, according to a letter to Steenstrup from Mr. Madsen).

104. *Gammel Køgegaard*, W. of Køge (Carlsen, 1872).
♂ Part of horn core. Found by ditching.

105. *Ollerup Vestermose*, 6 km. N.N.E. of Slagelse (P. L. Peitersen, 1903).
♂ Part of horn core.

106. *Hove*, 15 km. N.E. of Roskilde (Mertz Nielsen, 1942).
Part of left *maxilla*.

107. *Vanløse*, 15 km. N.N.E. of Sorø (National Museum, 1944).
♂ Mandible, *metacarpus*, right *humerus* (upper part missing), 6 vertebrae (*lumbales*), 3 ribs.

108. *Hedehusene*, W. of Copenhagen (Hög, 1941).
♂ Part of right horn core with small part of frontal. Diameters at base 100×94 mm.

109. *Gentofte*, 7 km. N. of Copenhagen (Steenstrup).
♂ Horn core with small part of frontal. Diameters at base 109×85 (+) mm.

109a. *Brønshøj*, Copenhagen (P. Juhl, 1923).
♂ Part of horn core.

110. *Jonstrup Vang*, 15 km. N.W. of Copenhagen (Birte Andersen, 1946).
♂ Left horn core with small part of frontal, tip missing. Diameters 120×101 mm.; circumference 348 mm. — Fragmentary parts of right horn core.

111. *Alsønderup*, 6 km. N.W. of Hillerød (L. Rasmussen, 1957).,
♂ Part of left horn core, broken about the middle, with a small part of the frontal; fragmentary *exoccipitale*. Diameters at the base 118×103 mm.; circumference 365 mm. Width across *condyli occipitales* about 144 mm. (72×2).

Postcranial skeletal parts (Not previously mentioned).

112. *Ganløse*. 20 km. N.W. of Copenhagen (Aa. Nemming, National Museum, 1959).
♂ Left *humerus*, upper end missing; left *antebrachium*, lower end missing.

113. *Kirkerup*, Stengaardens mose, 13 km. N. of Roskilde (National Museum, 1945).
♀ Left *femur*. Greatest length from *caput* 428 mm. (Cf. Table 16).

114. *Østrup*, Viksø, Stengaardens mose, 13 km. N. of Roskilde (National Museum, 1946).
Right *scapula*, *atlas*, *epistropheus*, parts of *vertebrae*.

115. *Øresund* (I. J. Kristiansen, 1960).
Right *humerus*, upper end missing; right *antebrachium*, lower end laterally mutilated, ♀.

116. *Gundsømagle* Nordmark, 12 km. N. of Roskilde (E. Henriksen, E. Madsen, 1939).
♂ Left *tibia* (Table 17), *astragalus* (Table 19), *phalanx* (innermost, prox. width 42, length, lateral, from incisure, 69 mm.).

117. *Strødam, Hillerød.* (Jarl, 1944).
♂ Left *radius*; lower end missing, upper end mutilated. Width at middle 66 mm.; large, but fairly young bull.

118. *Lille Lyngby*, south side of Arresø (C. Becker, National Museum, 1947).
♀ Right *tibia*, upper end missing.

119. *Sjælland* (Visby, 1847).
Epistropheus, 2 *vertebrae thoracales.*
Probably from a moor by Arresø, Frederiksværk, together with a skull; mentioned by Steenstrup. V. M. 1851, p. 65. H. W. 1904.

120. *Torpe*, 10 km. E.N.E. of *Kalundborg* (Hofman Bang, 1849).
♂ *Antebrachium.*

121. *Holbæk.* From a moor below the road to Roskilde (Holbæk Museum, 1955).
Metatarsus.

122. *Faarevejle*, 20 km. S.W. of Nykøbing S. (M. Knudsen, 1951).
♂ Left *antebrachium.*

123. *Faarevejle*, 20 km. S.W. of Nykøbing S. (Troels-Smith, 1942).
Below the Faarevejle kitchen midden (together with remains of *Lagenorhynchus*).
♂ Part of left *humerus*, very stout, smallest width of diaphysis 60 mm.

124. *Løgismølle*, Rerslev, 17 km. N. of Slagelse (Berthelsen, 1891).
Costa, upper end missing.

125. *Vedde*, Bødal, 10 km. N.N.W. of Sorø (M. Rasmussen, 1942).
Costa, upper end broken off.

126. *Næstved* (Frederiksen, 1960).
♂ 2 *vertebrae cervicales*, fragment of *costa.*

127. *Holmegaards moor*, N.E. of Næstved (A. M. Petersen, 1942).
6 *costae*, in all of which the upper part is broken off; 2 have been gnawed by squirrels.

128. *Kongsted* moor, *Rønnede*, 15 km. E. of Næstved (L. Jensen, 1907).
♂ Left *scapula*, *metacarpus*, 3 *vertebrae thoracales*, 2 *phalanges* (middle), 2 *costae.*

129. *Køge Bugt*, Solrød (G. Olafson, 1947). Submarine.
Distal end of *tibia*, water-rolled, distal width, transversally 83 mm. (Cf. Tinglev bull 83 mm.), medial upper half of *radius*, fragment of rib.

130. *Sonnerupgaard*, Hvalsø (N. C. Breit, S. Jensen, 1946).
♂ *Tibia*, upper end mutilated, *astragalus*, *calcaneus*, upper end gnawed by dogs, *metatarsus.*

131. *Lyngby* Rørdamsvej 26. 10 km. N. of Copenhagen. (P. Hansen, National Museum).
Metatarsus, worked up into an axe.

Funen

132. *Bro*, 7 km. S.W. of Bogense (Mineralogical Museum, 1839).
♂ Almost complete skeleton. — (Lit. Hofman Bang, 1843 and H.W. 1904). Hindmost molar worn almost to the tip of medial column.

133. *Trøstrup*, 10 km. N.W. of Odense (Kühl, 1833).
♂ Brain-case, broken in front of horn cores; horn cores greatly granulated at base. — Pl. VII.

134. *Tevring*, 12 km. S.S.E. of Bogense (National Museum, 1851).
2 horn cores (H.W. 1904).

135. *Dømmestrup*, Nr. Lyndelse, 10 km. S. of Odense (J. Nielsen, 1941).
5 *vert. costales*, 5 *vert. lumbales*.

136. *Næsbyhoved Mølle*, 2 km. N.W. of Odense (Trolle, 1848).
♂ Horn core with part of frontal, left *femur*, left *tibia*, *metatarsus*. J. Steenstrup O.V. S.F., 1848 (H.W. 1904).

137. *Vissenbjerg*, 14 km. W. of Odense (King Frederik VII, 1850).
♂ Brain-case (cast).

138. *Broby*, 14 km. N. of Faaborg (Steenstrup and Lütken, 1852).
♂ *Antebrachium*, lower part missing.

139. *Østerby*, from calcareous deposit. 4 km. N.N.W. of Faaborg (H. Rasmussen, 1919).
♂ Right *femur*, upper and lower end missing, *vertebra cervicalis*. Large, width of diaphysis 54 mm.

140. *Kirkeby*, 7 km. N.N.W. of Svendborg (Svendborg zoologiske Museum).
♀ Right *femur*, upper end mutilated; left half of *pelvis*, part of *os coxa*. In size almost as the Ullerslev cow, smallest width of diaphysis 44 mm., length from *trochanter major* 346 mm.
(Skeletal parts of calf: left *scapula*, right femur, both epiphyses missing, *costa*; species?).

141. *Aspedam*, 6 km. N.E. of Svendborg.
Horn core. — (H.W. 1904).

142. *Ejsemoseløkke*, Broholm, 10 km. N.E. of Svendborg (Broholm Collection).
Scapula. (Sehested, 1878, pp. 237, 280; H.W. 1904, p. 289).

143. *Bøllemose*, Gudbjerg, 10 km. N.N.E. of Svendborg (Broholm Collection).
Some teeth and skeletal parts. Ibid. Idem., p. 280.

144. *Barløse*, 7 km. N.E. of Assens (Vedel Simonsen, 1858).
♀ Horn core with small part of frontal.

145. *Frøbjerg*, 15 km. N.E. of Assens (Johansen, 1912).
♂ Right *scapula*, right *humerus*, *os coxa*, *vertebra lumbalis*, *costa*.

146. *Turup*, Viesø, 7 km. N.E. of Assens. (F. Lund, 1942).
♂ Lower end of *humerus*, greatest width of trochlea 106 mm.

Lolland

147. *Handermelle*, V. Ullerslev (G. Larsen, 1945).
♂ Left *scapula*, left *antebrachium*, left *femur*, *costa*.

147 a. *The Baltic Sea*, 6 km. S.W. of the lighthouse of Møen (Fisherman Aksel Jacobsen, Bagenkop, Langeland).
In a fishing net at a depth of 22 meters. — Left horn core with part of frontal, tip broken off. Very large. Cf. Table III. (Not on map).

Jutland.

Skulls and part of skulls.

148. *Mors.* (Steenstrup).
♂ Skull, broken through maxilla; hind limb. — Teeth much worn. — Pl. VII.

150. *Ølholm*, 4 km. E.S.E. of Tørring (Amtsvejvæsenet, 1961).
♂ Skull, nasals missing. Brought to light by road work. Teeth much worn. — Pl. VII.

151. *Ølholm* (Ibid. Idem., 1961).
♀ Brain-case, broken in front of fronto — nasal suture. Cf. p. 61. — Pl. IX.

152. *Fuglekjær*, 7 km. S. of Horsens (Therkildsen, 1921).
♀ Incomplete skull; one *vert. thoracalis*. Cf. p. 61. — Pl. IX.

153. *Gjødvad*, 5 km. E.N.E. of Silkeborg (Silkeborg Museum).
♀ Brain-case, broken through orbits. Cf. p. 62. — Pl. IX.

154. *Formyre*. Slope at Tjele Aa, 12 km. N.E. of Viborg, about 1920 (Børge Jensen, 1956).
♂ Horn core (tip missing) with small part of skull.

155. *Aakjær*, Falling, 15 km. E.N.E. of Horsens. (Frode Neergaard. Jagt- og Skovbrugsmuseet, 1915).
♀ Frontlet, cut off between horn cores and orbits. Cf. p. 62. — Pl. IX.

156. *Løgenkjær*, Astrup, 10 km. E. of Skanderborg (J. Kr. Jensen).
♀ Left mandible, teeth much worn (Table 10).

157. *Odder* moor, S. of Odder (Odder Museum, Didriksen, 1953).
♂ Brain-case, broken just in front of horn cores. Fig. 7.

158. *Tønder*, Vintved Canal (F. Jensen, 1932. Jagt- og Skovbrugsmuseet).
♂ Two horn cores with part of frontal. Yellow coloured.
♂ Part of horn cores of a second specimen. Dark coloured. Porous. Diameters at the base 107×85 mm. A young but large specimen.

159. *Ølgod*, Egknud, 23 km. N.N.E. of Varde (J. Bondesen, H. Øllgaard, 1945).
♂ Brain-case with horn cores (Photos seen). "Circumference of horn core, at the base 37 cm., largest span of horn cores 78 cm." On a level with the skull, $3^1/_2$ m. away, a Younger Stone-age axe was found.

160. *Egum*, 4 km. N.N.W. of Fredericia (O. Iversen, about 1917. Fredericia Museum).
♂♂ 2 right horn cores. (1) Fragmentary at the base, length along outer curvature 600 mm. (2) Length along outer curvature about 525 mm., circumference at the base 305 mm., diameters 104×86 mm.

Fig. 7. Brain-case of *Bos primigenius* from Odder (No. 157). × ca. ab. $^1/_6$.

161. *Barrit Forest*, 22. km. E. of Vejle (Brockenhuus Schack).
♂ Right horn core with small part of frontal, tip missing. Diameters at the base 117×96 mm.; circumference 320 mm. Part of left horn core. *Os occipitale*, the width across *condyli occipitales* is 120 mm.; *tibia*, proximal end missing, length 398 mm., distal width 85 mm., diaphysis width 55 mm. From calcareous deposit, at the bottom; 125 cm. beneath the surface of the earth. (Table 17).

162. *Horsens Fjord* (National Museum, Seligmann, 1896).
Horn core.

163. *Staugaards moor*, Tørring, 22 km. W. of Horsens (P. Jensen, 1943).
♀ Left mandible (Table 10), *vert. cervicalis*, left *calcaneus* (Table 18).

164. *Moor between Randlev and Rathlousdal* 20 km. N.E. of Horsens (Holm, 1850).
♂ Occipital part. Width across *condyli occipitales* 134 mm.

165. *Nørre Vissing*. 12 km. N.N.W. of Skanderborg (Danmarks geologiske Undersøgelse, 1941).
♂ Left and right horn core with small parts of frontal, granulated at the base. Diameters at the base 121×99 mm., circumference 355 mm. Exoccipital part, width across *condyli occipitales* 134 mm., other small parts of skull with 4 upper molars; parts of left and right mandible. 4 *vertebrae cervicales*.

166. *Stilling Lake*, in a moor, 6 km. N.E. of Skanderborg (Steenstrup).
♂ Brain-case, *metatarsus*, *phalanx* (Table 12).

167. *Aarhus* Mølleaa (C. M. Poulsen, Steenstrup).
Horn core.

168. *Aarhus Harbour.* (Müller and Braem, 1859).
Part of mandible with 3 hindmost molars.

169. *Bjørnekjær*, Lading, 15 km. N.W. of Aarhus. (Saabye, 1843).
Posterior part of frontal, with horn cores. Old specimen.

170. *Rosenholm*, Ulvemosen, Rodskov, 15 km. N.N.E. of Aarhus. (Hübertz, 1834).
♂ Part of frontal with horn cores.
At the bottom of the moor, depth of two metres. Pl. VII. (Reinhardt sen. O.V.S.F. 1834).

171. *Tjerrild*, 25 km. W.S.W. of Grenaa (Ørnæs Christensen, 1947).
♂ Small part of frontal with right horn core broken in the middle; diameter 113×90 mm., circumference 328 mm. Fragment of left horn core; part of 2 horn cores, diameters 100×97 mm.
♀ Left *radius*, left *metacarpus*, small; total length 231 mm., proximal width 69×42 mm.; width of diaphysis 38 mm.

172. *Thorsager*, Søndervang moor, Djursland, 26 km. N.W. of Kalø Vig. (Jagt- og Skovbrugsmuseet, 1948).
♂ Posterior and upper part of brain-case; horn cores complete, granulated at the base and with longitudinal grooves.

173. *Benzon Estate*, 10 km. N.N.E. of Grenaa (Benzon, 1864).
Premaxilla, *atlas*, 1 *vert. thoracalis*, ribs.

174. *Vindum*, 13 km. S.E. of Viborg. — No information.
♀ Left mandible.

175. *Hvidbjerg*, 7 km. W. of Skive (P. Sølling, 1944).
♀ Both mandibles with teeth, *atlas*, 1 *costa*.

176. *Vibholm moor*, 17 km. N. of Ringkøbing (Nørregaard, Mineralogical Museum, 1903).
1 upper and 4 lower molars.

177. *Ørtoft*, 6 km. W. of Sæby (Chr. Kjærsgaard, Sæby 1945).
Part of brain-case, broken between horn cores and orbits. Mandible. Pl. VII.

178. *Ulvhøj moor*, S. of Serridslev, 14 km. S. of Hjørring (Vendsyssels historiske Museum).
Horn core. (H.W., 1904).

179. *Hørbylund*, 10 km. N.W. of Sæby (Vendsyssels historiske Museum).
Horn core. (H.W. 1904).

180. *Vidstrup*, 3 km. N.W. of Hjørring (Vendsyssels historiske Museum).
Horn core. (H.W. 1904).

181. *Vittrup*. (No further information).
♀ *Metacarpus*.

182. *Hastrup*. Road S. of Frederikshavn (Oluf Sørensen. Jagt- og Skovbrugsmuseet).
♂ Posterior and upper part of brain-case with almost complete horn cores, broken in front of horn cores.

183. *Balskov*, Løgstør (Baron Rosenkrantz, 1922).
Part of horn core, 2 molars.

Postcranical skeletal parts.

184. *Gudsø Vig*, Kolding Fjord (Deleuran and Thure Schachner, 1935).
Lower part of left *femur*.
Found one m. below surface of the bottom. $^3/_4$ m. water.

185. *Kolding* (E. Walther, 1957).
♂ Left *scapula*; upper part missing. Width of collum 83 mm.

186. 186. *Almind-dalen*, Stagebjerggaard. (J. Jensen, 1954).
♀ *Metacarpus*. By cleaning of a brook. (Table 11).

187. *Grejsdalen*, N.W. of Vejle (N. Hartz, 1906).
♀ Right *tibia*, upper end missing; middle part of *femur*.
Found under calcareous deposits.

188. *Agersbøl*, forest between Ø. Snede and Lindved, 10 km. N. of Vejle (E. V. B. Eriksen, 1937).
Atlas, ♂ large. Calcareous deposits.

189. *Løsning*, 15 km. N.E. of Vejle (Naturhistoriske Museum Aarhus, 1934).
♂ *Metacarpus*.

190. *Havstrup Lake*, *Tørring*, 25 km. W. of Horsens (O. Voss. National Museum, 1945).
♀ *Metatarsus*, upper part of *radius* (greatest width 102 mm.).

191. *Solbjerg Lake*, 5 km. N.E. of Skanderborg (M. Martin, 1951).
♂ Right *scapula*.

192. *Silkeborg* (Godske Nielsen, 1922).
♂ *Calcaneus*. Washed together with other bones at the paper-factory, from stone age or later.

193. *Randers Fjord* (M. Brunse, 1951).
♂ Lower part of left *humerus*. At drainage work. Smallest diaphysis width 61 mm.

194. *Skørping Holme*, Skørping, 20 km. S. of Aalborg (Aalborg historiske Museum. Peter Riismøller, 1945).
4 *vertebrae cervicales*.

195. *Nørlund Forest*, in a moor, 14 km. N.N.W. of Hobro (H. Hansen, 1897).
♂ *Metacarpus*. In marl, about a depth of two metres; $^1/_3$ m. from the bottom.

195 a. *Nørlund Forest*.
♂ Left *humerus*, upper end missing. Smallest diaphysis width 55 mm., trochlea width 105 mm.; anterior-posterior medialis 117 mm.

196. *Feldborg* Plantation, in a moor, 18 km. E. of Holstebro. (Jensen Tusch, and Gad, 1881).
♂ Left *humerus*, upper end damaged, *antebrachium*, upper end of *ulna* missing.

197. *Vinderup*, 20 km. N.E. of Holstebro. (Stæhr-Larsen, 1947).
♀ *Metatarsus*, *tibia*, upper free epiphysis missing, *calcaneus*.

198. *Auning*, Pindstrup, Djursland, 30 km. W.S.W. of Grenaa. (Cf. No. 57).
♀ *Metacarpus*.

Several specimens are preserved from ancient times, without any information, they no doubt, however, originate from Denmark.

199. *Danmark*. (From STEENSTRUP's time. Deposited at the Jagt- og Skovbrugsmuseum, C.N., 1891).
♂ Part of brain-case with complete horn cores, broken between base of horn cores and orbits. A very heavy and strongly built skull. The tuberculation at the bases of the horn cores is exceptionally developed, high and up to 45 mm. broad, longitudinal grooves. Diameters at the base of the right horn core are 160×147 mm., of the left horn core 146×140 mm.; just laterally to this swelling the diameters are 130×116 and 130×110 mm. respectively.
Also the greatest span of horn cores is remarkable, 950 mm.
According to the high individual age the occipital width, at the posterior border of the *fossae temporales*, is great, 245 mm., only outdistanced by a specimen from Auning (No. 60) with an occipital width of 260 mm. In contrast, the width of the occipital condyles is very small, 122 mm. — Pl. VII.

200. *Danmark*. (Mineralogical Museum).
♂ Complete skull of an old animal. The bases of the horn cores and rims of orbits are granulated. Tips of horn cores compact and teeth very much worn.
Pl. VII.

201. *Danmark*. Marked 2. Afd. (i.e. STEENSTRUP's old division).
♂ Brain-case; broken through lacrymals; base of skull just below upper border of the *foramen magnum* is sawn off; probably indicating that it has been mounted on a shield. Left horn core broken below middle. A very old skull, sutures obliterated, with the exception of the lacrymal sutures which are visible. The bases of the horn cores are highly granulated and the tip of the right horn core is compact. The region between the orbits is domed and the two concavities in front of the occipital ridge are only slightly marked.
Pl. VII.

202. *Danmark*. (2. Afd.) 2.
♂ Posterior part of brain-case of old animal, on the right side broken just behind the orbit, the right horn core complete, tip compact; left frontal partly cut off, and of the left horn core only the posterior rim of the base is present.

203. *Danmark*. (From Study Collection).
♂ Also this brain-case must have belonged to a very old bull. The bases of the horn cores are highly granulated; granulation continuing across occipital crest. Tips of horn cores compact; supraorbital grooves highly roofed. — Pl. VII.

204. *Danmark*.
2 *antebrachia*.

Zoological Investigation of the Material

Females.

The great variation in size of the *Urus* skulls has caused great trouble to zoologists. Some have been of opinion that different subspecies or even species were represented. LEITHNER was the first who clearly demonstrated the great sex dimorphism in the *Urus* (1927); but although LEITHNER studied the *Bos* material in several European zoological museums, he was able to describe only five complete skulls and 12 brain-cases of the *Urus* cow, none of which were dated. However, two from Romanuppen and Pogrimmen in Poland probably belonged to animals which the Teutonic Order had preserved in its territory, probably analogous to the preservation of the European bison in the forests of Białowies, and thus of a very late date.

An explanation of the fact that relatively few cow skulls are kept in the museums should undoubtedly, at least in Denmark, be sought in their small size. Most of the Danish *Urus* skulls and skeletons originate from bogs, having been brought to light by peat cutters. Generally, the small skulls were considered by the workers as belonging to simple domesticated cows, whereas the big bull skulls attracted their attention, and the local authorities were informed. However, it is worth noting that most female skulls known have belonged to old or fairly old animals; young skulls with their open sutures in which the bones easily fall to pieces have not been noted by the workers.

LEITHNER made a survey of the differences in the skulls of bulls and cows. As in other mammal species the females are, so to say, retarded in their development, are more juvenile-like. As compared with the bulls, their skulls are shorter and particularly narrower, the sutures are closed later or not at all. The orbits are generally less protruding, the horn cores in particular are reduced in length and thickness, and the occipital ridge is much slighter. All these characters, however, are correlated to age, and are not so decisive as generally stated by LEITHNER.

Later several other *Urus* skulls have been described as belonging to cows (LA BAUME, 1958), and an incomplete skull, from Star Carr, Yorkshire, England, is dated as belonging to the Preboreal period (FRASER and KING, 1954).

The sex dimorphism is also clearly demonstrated in the size and shape of the metapodials. In the cows the metapodials are much slighter and narrower than in the bulls, but almost the same length; on this last-mentioned point easily distinguishable from the much shorter metapodials of domestic cattle (DEGERBØL, 1942).

From Denmark LEITHNER mentioned five brain-cases of *Urus* cows, but none of these were then dated. Later a complete skull and skeleton from Ullerslev, a complete skull from Grænge, three incomplete skulls, from Bjeverskov, St. Taastrup and Pindstrup (with several skeletal parts), and a couple of brain-cases of females have been unearthed in Denmark; all in all skull remains of 27 specimens are at hand and most of this material is now dated.

Bos primigenius

List of skulls and parts of skulls of females (apart from settlements).

Material	Locality	Zone	Remarks
1. Complete skeleton	Ullerslev (15)	V	
2. Skull	Grænge (18)	V	Nasals missing.
3. Incomplete skulls	Bjeverskov (21)	V	Broken in front of rows of teeth.
	Pindstrup (57)	VIII	Broken in front of rows of teeth. Mandible and parts of postcranial skeleton are present.
	St. Taastrup (53)	II–V	Mandible present.
	Skaarup (74)	Not dated	Fragmentary parts.
	Bønnerup (64)	VIII	Very fragmentary horn cores, 6 upper molars, postcranial skeletal parts.
4. Brain-cases	Vigersted (7)	IV	
	Knabstrup (10)	IV	
	Svebølle (13)	IV	Broken in front of horn cores.
	Bjerregrav (13 b)	IV	Frontlet.
	Flintinge (24)	V	Broken between horn cores and orbits.
	Toftum (61)	VIII	Mandibles present. Broken in front of nasal base.
	Aarhus (62)	VIII	
	Korinth (63)	VIII	Broken in the middle of orbits.
	Fuglekjær (152)	Not dated	Broken through nasal base.
	Mørkov (100)	Not dated	Broken through orbits.
	Gjødvad (153)	Not dated	Broken through orbits.
	Aakjær (155)	Not dated	Broken between horn cores and orbits.
	Ølholm (151)	Not dated	Broken in front of nasal base.
5. Horn core	Barløse (144)	Not dated	
6. Mandibles	Kundby-Trønninge (102)	Not dated	
	Tørring (163)	Not dated	
	Gesten B (69)	Not dated	
	Hvidbjerg (175)	Not dated	
	Løgenkjær (156)	Not dated	
	Vindum (174)	Not dated	

Considering the above-mentioned rarity of female skulls generally kept in the museums, this number is astonishingly large, which indicates that cow skulls, when determined and taken care of are not at all so rare as ordinarily indicated. Probably the numbers of cows and bulls in the population were almost equal. (Cf. p. 121).

Only one complete skeleton of a female outside Denmark has so far been known, viz. from Stockholm. — In discussing the size and morphology of the *Urus* cows we shall start with the almost complete skulls from the Boreal period: Ullerslev, Grænge, and Bjeverskov.

The Ullerslev skull. The Ullerslev skeleton belonged to a powerful animal, which had just passed the prime of its development. The teeth are worn, but not much; in the lower jaw the roots of the 1. molar are visible. At the base of the horn cores and at the rim of the orbits the bone is tuberculated or bead-formed, however, to a lesser degree than seen in old bulls.

The surface of the skull is not so smooth or china-like as, according to LEITHNER, is characteristic of the female skull, and as e.g. seen in the young Grænge skull of a bull.

The fairly high individual or ontogenetical age also partly explains why the orbits in the Ullerslev cow are just as protruding as in old bulls, particularly pronounced on account of the small frontal width. Most of the sutures, however, are open. Only the sutures of the occipital part, the posterior third of the interfrontal suture and the posterior half of the suture between the lacrymal and the frontal are completely closed. The frontal or supraorbital groove (*sulcus supraorbitalis*) is open, not covered with a bony roof as in old bulls. The *fossa temporalis*, however, is posteriorly bound by a low bone bar, as also seen in several other female skulls.

It is worth noting that of full-grown bull skulls only one, the particularly small skull from Ørting has as small a cranial length as the Ullerslev cow, (fig. 8). — A comparison with the subadult Gøderup bull clearly demonstrates the sex dimorphism in the *Urus* skulls. The two skulls are of the same length, basal length 525 mm. (Ullerslev), and 527 mm. (Gøderup), but even in the young Gøderup bull the skull is more heavily built, and the brain-case in particular is much broader. The smallest frontal width is 230 and 203 mm., respectively.

Significant is furthermore the great width of the occipital condyles in the bull, 138 mm., as compared with 125 mm. in the Ullerslev cow; and the height of the occipital region, from the upper border of the *foramen magnum*, is 172 mm. and 142 mm., respectively.

According to the greater developmental age the width across the posterior edge of the orbits (postorbital width) is, however, greater in the Ullerslev female, 268 mm., than in the Gøderup bull, 255 mm.; and the diameters of the orbits are smaller, 66×66 mm., as compared with 83×66 mm. in the Gøderup specimen. Partly as a consequence of the greater orbits, the distance from the anterior border of the orbits to the *foramen infraorbitale* is shorter in the last-mentioned animal, 163 mm., than in the Ullerslev cow, 182 mm., but in accordance with the younger age, the facial region, on the whole, is shorter in the Gøderup bull, as is also seen in the shorter palatal lengths, 190 and 198 mm., respectively.

The horn cores in the young bull are much bigger, longer, and thicker, but more porous, of a "worm-eaten" appearance, than in the older cow, where the horn cores are compact right to the tip, and grooved, as generally seen in adult bulls. The teeth in the bull are longer; the length of the upper tooth row is 180 mm. and 162 mm., respectively. The determination of the Ullerslev skull as belonging to a female is unmistakably also emphasized by the rest of the skeleton, i.a. by the width of the metapodials (Tables 11 and 12).

The *Grænge* skull is almost complete, only the nasals are missing. It is of almost the same developmental age as the Ullerslev skull, perhaps a little older, the right supraorbital groove being completely roofed posteriorly, a character generally found in old bulls only. From side to side the occipital ridge is nearly straight, only with a small concavity at the bases of the horn cores; the concavity from behind, however, is deeper than found in the Ullerslev specimen. The contouring of the posterior third of the frontal is less pronounced than ordinarily seen; the interfrontal suture is not elevated, and this part of the frontal, anteriorly-posteriorly, forms an unbroken concavity; the roof of the orbits is placed higher than the frontal part between the orbits.

The Grænge skull is fairly small and narrow. The basal length is 496 mm., (condylobasal length 527 mm.), thus belonging to a group of skulls which generally has been characterized as extraordinarily small. Among Danish *Urus* cows, however, the specimen from Fuglekjær has about the same skull length, and the Pindstrup cow, from Zone VIII, is a little smaller (cf. Table 1), and the same holds good of several brain-cases (Ølholm, Korinth, Aarhus, Gjødvad).

The smallest frontal width of the Grænge skull is 180 mm., as compared with 203 mm. in the Ullerslev skull. However, several of the Danish *Urus* cows have about the same small width: Vigersted 183 mm., Aarhus 182 mm., Pindstrup 178 mm., Fuglekjær 177 mm., Ølholm 177 ., and Korinth 175 mm.

Also the horn cores are noticably small in the Grænge cow. The largest span is 580 mm.; a measurement, however, also found in several Danish skulls: Bjeverskov 580 mm., Ølholm 580 mm., and Fuglekjær 585 mm.

The circumference of the horn core at the base is 225 mm. in the Grænge specimen, as compared with 270 mm. in the Ullerslev skull. However, the very small cows from Pindstrup, Ølholm, and Aarhus have still smaller measurements: 181, 195, and 195 mm., respectively.

The well-proportioned Grænge skull is thus of particular interest as it clearly indicates that, already in the Boreal period, a fairly small Urus cow existed. That is, from a time prior to any possibility of morphological change caused by domestication or by intermixture with domestic cattle. Through this skull a new light is thrown on several incomplete Danish skulls of similar size, the understanding of which was till now fairly problematic. Such "small" *Urus* cows have been no rare exceptions, but they find their natural place within the size variation, as also seen in the small *Urus* cow from Star Carr (cf. p. 64) and the Stockholm cow (basal length 496 mm.).

By further comparison in the present treatise the Grænge skull will be taken as the "type" of a distinctly pure *Urus* cow of comparatively small size. — This skull was excavated in 1943. It was passed to Mr. A. V. Nielsen, Technical School, Nakskov, who later donated it to the zoological museum.

The Bjeverskov skull is incomplete. On the right side it is broken immediately in front of the tooth row, and on the left side, anterior to the first molar. As regards teeth only m 2 and the lateral half of m 1 are present. They are very much worn; m 1 is worn right down to the roots. The Bjeverskov skull thus must have belonged to a very

old animal, the oldest of the Danish *Urus* cows. The left supraorbital groove is partly roofed posteriorly. The interfrontal suture is broad, and the two concavities on its sides are pronounced. The occipital ridge is slightly convex, raised in the middle.

From length measurements which can be taken of this incomplete skull it appears that it must have been somewhat longer than the Grænge skull. The distance from the occipital ridge to the nasal base is almost the same in the two specimens measured in the middle line 286 and 280 mm., respectively (laterally 278 and 274 mm., respectively), it is true; but the distance from the occipital ridge to the anterior border of the row of teeth is 465 mm. in the Bjeverskov skull, as compared with only 445 mm. in the Grænge skull; measured from the occipital condyles, the distances are 388 and 370 mm., respectively. In the Ullerslev cow the three corresponding measurements are 315 mm., 485 and 395 mm., respectively. On the basis of this, the basal length of the Bjeverskov skull may be estimated at about 515 mm.

Also most of the width measurements are larger in the Bjeverskov specimen than in the Grænge cow. The smallest frontal widths are 188 and 180 mm., respectively; the postorbital widths 250 and 244 mm., respectively. The interorbital width, in particular, seems to be very large in the Bjeverskov cow, but this is partly explained by the fact that the incisures generally found there in the rim of the orbit, and between which the measurement is taken are closed in the Bjeverskov skull, because of its great age. The zygomatic width and the greatest maxillary width are comparatively great in the Bjeverskov specimen, 214 mm. and 175 mm., respectively, as compared with 201 and 165 mm. in the Grænge cow.

The mastoid width and the supraoccipital width, however, are identical in the two specimens; and the *condylus* width is even a little smaller in the Bjeverskov cow. The occipital height (from upper rim of *foramen magnum*) is great, 154 mm., as compared with 140 mm. in the Grænge skull. — The horn cores are broken below the middle; they are fairly small, although a little thicker than in the Grænge specimen; the circumferences at the base are 235 and 225 mm., respectively. Also the span of the horn cores must originally have been larger. It is now in its incomplete state 580 mm., but the greatest span in the undamaged skull may be estimated at about 600 mm. — To sum up, it may be said that the Bjeverskov skull is more coarsely built than the Grænge skull. It is somewhat longer and particularly broader. The horn cores are fairly small. — All in all, the Bjeverskov skull also emphazises the fact that fairly small *Urus* cows existed in the Boreal period.

Actually the Bjeverskov skull on several points is not larger than the large domestic cattle from the Neolithic period, and provisionally it was labelled as belonging to a domestic animal. However, the concavity and typical relief of the frontal, the immediately upward bend of the horn cores, and the length of the tooth row, etc. clearly show that it represents an *Urus* cow. (Cf. p. 151).

On the following pages the discoveries will be mentioned in conformity with their geological age.

From the *Preboreal period*, Zone IV, parts of four brain-cases are at hand, from Vigersted, Knabstrup, Svebølle, and Bjerregrav, belonging to old animals.

The Vigersted skull is broken through the orbits, the occipital ridge is almost straight, only with a small concavity in the middle; the concavity on each side of the interfrontal ridge is distinctly formed. The Vigersted brain-case is somewhat larger than the corresponding part of the female skull from Grænge, the gracefully curved horn cores in particular are longer. The greatest spans of horn cores are 666 mm. and 580 mm., respectively. Even in the large Ullerslev cow the corresponding span is 645 mm. only; but the horn cores are thicker; the circumference at the base in the Ullerslev cow is 270 mm., as compared with 240 mm. in the Vigersted cow, and 225 mm. in the Grænge cow.

The Knabstrup brain-case is broader than in the Vigersted and the Grænge specimens; the smallest frontal width is 192 mm., as compared with 183 and 180 mm., respectively, and the smallest occipital widths are 169 mm., 153 mm., and 157 mm., respectively. The span of the horn cores, however, is somewhat smaller, about 640 mm., than in the Vigersted cow, 666 mm.

The Svebølle brain-case belonged to a fairly old animal with almost closed cranial sutures. The surface of the horn cores is smooth, but with small holes, clearly indicating a female. The brain-case is broken in front of the horn cores. Tips of horn cores are missing, and the occipital part is fragmentary. As in the Flintinge female the horn cores converge little, the greatest span thus being fairly large, about 715 mm.; after the Flintinge specimen the largest measurement in Danish *Urus* cows. The diameters of horn cores at the base are 82×71 mm., the circumference at the base 245 mm. The width across the occipital condyles is 121 mm., also indicating a female.

The Bjerregrav frontlet is broken at the nasal base; the right orbit is missing. The interfrontal suture posteriorly obliterated for about 60 mm. The posterior frontal concavities are deep, separated by a 25 mm. broad interfrontal ridge. The occipital crest is exceptionally concave, that is, in a degree not otherwise seen in any other *Urus* skull, and only rarely in domestic cattle (cf. No. XXII). The supraorbital sulcus is partly closed, bordered by a sharp, projecting edge. Both horn cores are complete, with undamaged, compact tips, and fairly granulated at base. All features indicate a fairly old animal. According to the concave occipital ridge, the distance from this ridge to the nasal base is short, but otherwise this specimen may be characterized as a medium-sized cow skull with fairly thick horn cores.

It is a most remarkable fact that already at this early period, Preboreal, such an aberrant *Urus* skull occur.

The Flintinge brain-case (Zone V) is broken through the frontals, between horn cores and orbits. It belonged to an old animal with almost closed frontal-parietal suture, which is just visible below the horn cores. The interfrontal suture is broad and elevated, and the concavity on each side is well marked, anteriorly the suture is secondarily open owing to exsiccation while kept in the museum. According to the great developmental age, the *fossa temporalis* is posteriorly bound by a seven mm. high

bone bar, and the right *sulcus supraorbitalis* is partly roofed. The surface of the horn cores is smooth and solid but with deep longitudinal furrows; many small holes, however, are present, producing a "worm-eaten" appearance. The horn cores converge very little; a shape also seen in the large bull skulls from Faaborg and Grænge, from the Late Dryas and Preboreal periods, respectively, and from about the same area. Consequently, the span of the horn cores is large; although the outer part, probably about one fourth, is missing, the span now measured is 770 mm., as compared with 640 mm. in the complete skull of the Ullerslev cow, and 680 mm. in the Toftum skull. In size the Flintinge brain-case is fairly similar to the 2 last-mentioned specimens, only a little larger. The circumference at base of the horn core is 275 mm., as compared with 270 and 270 mm., respectively. The smallest frontal width is 205 mm., as compared with 203 mm. in the Ullerslev skull, and 200 mm. in the Toftum skull. The breadth between the occipital openings of the temporal fossae is very large, 185 mm., as compared with 171 mm. in the Ullerslev cow and 176 mm. in the Toftum cow; however, this is partly explained by the great age of the Flintinge skull. Also the breadth across the occipital condyles is considerable, 127 mm., thus overlapping the width of the condyles in bulls (fig. 13). This might give rise to the question whether the determination of this skull as belonging to a cow is correct.

In order to give a simple means of sex determination in *Bos primigenius*, M. Howard (1962, fig. 6) plots the frontal breadth against the occipital breadth/occipital height-index. Thus plotted, it appears that the Flintinge skull is placed in the interval between bulls and cows, however, nearer the cows. Also the comparatively thin and smooth horn cores and the small frontal width, the measurements of which are within the size range of females, no doubt indicate that this skull belonged to a cow.

The Store Taastrup brain-case, Zones II to V, is broken through the nasal base, and the horn cores are broken about 15 cm. from the base. It belonged to a young animal, with all sutures wide open (secondarily exaggerated) only the interparietal suture is not visible. The *linea nuchalis sup.* and *protuberantia occipitalis externa*, however, are fairly well marked. This skull must have belonged to an individual which was about 3 years old.

The occipital ridge is concave at the base of the horn cores, and highly elevated between these parts. The posterior half of the frontal, between the horn cores and orbits, is concave anteriorly-posteriorly; still more than seen in the Grænge specimen. The interfrontal ridge is fairly broad, about 25 mm., but low. The frontal part between the orbits is placed lower than the roof of the orbits; as found in the Grænge skull, although in a less degree.

Also in size the Taastrup brain-case is similar to the Grænge specimen. However, considering the young age of the Taastrup animal, this specimen is of a more robust type, and with growing age it would have grown larger; particularly the horn cores are larger than in the Grænge specimen. The distance from the occipital ridge to the middle of the nasal base is the same, 285 mm., in the two skulls, and this also

holds good of the smallest frontal width, 180 mm. The width of the occipital ridge, between the horn cores, however, is 200 mm. in the Taastrup cow, as compared with 180 mm. only in the Grænge specimen. The circumferences at base of the horn core are 240 and 225 mm., respectively. The diameters 84×67 mm. and 80×60 mm., respectively. The young age of the Taastrup specimen, however, is clearly expressed in its small occipital width, 145 mm., as compared with 157 mm. in the old Grænge cow.

From St. Taastrup also a facial part, comprising parts of the two *maxillae* and *palate*, and a right mandible are at hand. In the upper jaw the 2. and 3. premolars have not fully erupted, and are only very faintly worn, as also the posterior column of the posterior molar (m 3) is very slightly worn. Regarding length, this facial part, too, is similar to the corresponding part of the Grænge skull. The length of the palate, in the middle, from the posterior incisura to the premaxillar suture, being 190 mm. in both. Corresponding to the higher individual age of the Grænge cow, the greatest maxillar width is in this specimen greater than in the Taastrup skull, 150 and 146 mm., respectively.

Also the Taastrup mandible must have belonged to a young specimen, in which the posterior column of m 3 is unworn, and the premolars slightly worn. The Taastrup mandible, however, is longer than the Grænge mandible, the total lengths being 470 and 460 mm., respectively, which indicates that this mandible may have belonged to a larger skull than the Grænge one. The basal length of the full-grown skull may be estimated at 510 mm., as compared with 496 mm. in the Grænge skull.

However, as the occlusion of the mandible teeth fits into the maxillar teeth, the Taastrup jaws probably originate from the same individual. There may be some doubt about this connection with the brain-case, as in STEENSTRUP's correspondence regarding the discovery—kept in the Royal Library—the sender of the remains is referring to a possible intermixture of two specimens. It should be noted, too, that there is a slight difference in size between the two metapodials, (cf. Table 11).

From the *Subboreal period*, Zone VIII, when the farmer culture was established in Denmark, five finds of *Urus* cows are present, from *Pindstrup*, *Aarhus*, *Korinth*, *Toftum*, and *Bønnerup*.

The Pindstrup cow is represented by an incomplete skull, the left mandible, and some limb bones. It is the smallest known *Urus* cow from Denmark; particularly the horn cores are thin.

As the Pindstrup specimen has been discussed earlier (DEGERBØL, 1962). I shall here give only a short description of the specimen.

On the upper side the skull is broken at the naso-frontal suture and on the palatal side just in front of the rows of teeth, which are undamaged. The teeth are worn, and indicate an age of 3–4 years. Most sutures are open, only quite posteriorly the interfrontal suture is closed. The mandible is broken a little in front of the *foramen mentale*. The distance from the *condylus occipitalis* to the broken tip of the mandible

is 490 mm., from the *foramen magnum* to this tip 460 mm., and from the *crista occipitalis* 555 mm. On the basis of similar measurements of length and a comparison with domestic cattle and *Urus*, the basal length was estimated at 490 mm., at most. After this was written (*loc. cit.* 1962, p. 246) the female skull from Grænge has become available (basal length 496 mm.), and a comparison with this complete skull emphasizes that the said estimate is fairly correct. The length from the occipital condyle to the anterior border of the tooth row is 367 mm., as compared with 371 mm. in the Grænge skull. The corresponding length from the occipital crest is 435 and 445 mm., respectively. Also the mandibles of the two skulls are almost the same length, the Pindstrup specimen being only about 5 to 10 mm. shorter. The Pindstrup skull thus is a little shorter than the longest skull of a domestic ox, Holmene bull (basal length 497 mm.). However, the shape of the Pindstrup skull is conformal with the *Urus* skull, thus the characteristic contouring of the frontal region: a well marked concavity on each side of the interfrontal suture, in front of the occipital ridge, and the typical relief between the orbits with a concavity or furrow in the middle line, on each side limited by a longitudinal swelling usually situated higher than the rim of the orbits.

The horn cores are fairly large with a beautiful double curvature, but they are remarkably thin, the circumference at the base being smaller, 181 mm., than in domestic bulls from the Subboreal period. As long as the Pindstrup skull was the only find with so thin horn cores, it might be regarded as unique. However, the Bjeverskov and Grænge skulls have shown, as already mentioned, that even in Zone V a reduction of the strength of the horn cores took place. Furthermore, horn cores almost as thin are found in some other skulls (cf. the Aarhus and Ølholm specimens).

The same holds good of the narrow forehead; the smallest frontal width is 178 mm., as compared with, e.g., 175 mm. in the Korinth skull, 177 mm. in the Fuglekjær skull, 178 mm. in the Ølholm skull and 180 mm. in the Grænge skull. All in all, it must be said that on the background of the new finds of *Urus* cows, the Pindstrup skull belonged to a small, but typical *Urus*, there is no reason to suppose that any intermixture with domestic cattle has taken place.

The lengths of the tooth rows are great, in the upper jaw 162 mm., the same as in the Ullerslev cow; in the lower jaw 165 mm., as compared with 170 mm. in the Ullerslev specimen. Nevertheless, the hindmost molar is much reduced in the Pindstrup cow, the length and width at the base of the lower m 3 being only 45.5×18.7 mm., as compared with 48.5×19.8 mm. in the Ullerslev cow. Furthermore, it should be noted that the teeth are much narrower in the Pindstrup skull than in the Ullerslev cow, (cf. p. 89).

For the determination *Bos primigenius versus Bos taurus domesticus* the lengths of the metapodials are decisive. The long metapodials of the Pindstrup cow are quite similar to the proportions found in the *Urus*, and are different from the short metapodials in domestic cattle, (cf. Tables 11–12).

Of almost similar shape and size as the Pindstrup skull is a *brain-case from Aarhus*. The horn cores are nearly as thin as in the Pindstrup specimen, diameters at the base are 65×57 mm. and 60×52 mm., resp., and circumferences at the base 195 and 180 mm., respectively. The length of the horn cores, too, is a little greater in the Aarhus skull, 410 mm., as compared with 365 mm. in the Pindstrup cow. — As the posterior part of the interfrontal suture is closed, the Aarhus brain-case must have belonged to a fairly old animal. It is very heavy; although it is broken behind the orbits and the outer half of the left horn core is missing, the weight is 1820 g. (cf. e.g. the Toftum skull).

The Korinth brain-case, which is broken in the middle of the orbits, must have belonged to an old animal, in which most sutures are closed; only the interfrontal suture is open anteriorly (secondarily exaggerated), posteriorly forming a broad, elevated crest, on each side bordered by a well-marked cavity. In the middle of the occipital ridge there is a faint concavity. Despite the high individual age the supra-orbital sulcus is open, thus indicating a female skull. In size the Korinth skull is almost equal to the corresponding part of the Grænge skull. The frontal widths are 175 and 179 mm., respectively; the zygomatic widths 204 and 201 mm., respectively, and the occipital height, from the upper border of the *foramen magnum*, both 137 mm. Also the thickness of the horn cores is the same, 220 mm. in circumference, but the span of horn cores is considerably larger in the Korinth specimen, 630 mm., as compared with 577 mm. in the Grænge skull.

This specimen is the only one known from the island of Funen later than Zone VI.

In the Subboreal period, however, also large cows of *Bos primigenius* existed, as demonstrated by the incomplete *skull and mandibles from Toftum*, which is broken immediately in front of the fronto-nasal sutures. The length from the occipital ridge to the base of the nasals is 295 mm., as compared with 315 mm. in the Ullerslev skull. The *Toftum* skull, however, is not nearly so heavily built. The weight is only 2450 g. The smallest frontal widths are similar in the two specimens, 200 and 203 mm., respectively, and the same holds good of the interorbital width, 190 and 193 mm., respectively. The greatest span of the horn cores is a little larger in the Toftum specimen, 680 mm., as compared with 640 mm. in the Ullerslev skull; but the circumference at the base of the horn cores is the same in both specimens, 270 mm. As also the mandibles of the two specimens are alike, the basal length of the two skulls must have been almost the same, 525 mm., probably the Toftum skull, however, with its shorter brain-case having been a little shorter (about 520 mm.).

The Bønnerup skull is very fragmentary; only a horn core may be measured. In size and shape it is almost similar to the horn core of the Grænge female. The lengths of the inner and outer curvature are 280 and 350 mm., respectively, as compared with 270 and 380 mm., respectively in the Grænge specimen; however, as the very base is missing in the Bønnerup horn core, this must originally have been somewhat larger; 290 mm. from the tip the diameters of the horn cores are the same in the two specimens, 55×65 mm.

Six finds, from *Skaarup, Mørkøv, Fuglekjær, Ølholm, Gjødvad,* and *Aakjær,* are of *uncertain age.*

Skaarup. The Skaarup skull is so fragmentary that the pieces cannot be put together, however, they belonged to a small skull. A left frontal half is broken along the interfrontal suture, indicating a smallest frontal width of 186 mm. The circumference of the horn core, which is broken almost at the base, is small, 206 mm., diameters 73×57 mm. The molars are fairly large, the length of m 1–m 3 is 97 mm., but as the length of the premolars is very small, 54 mm., the entire length of the row of teeth becomes comparatively small, too, 148 mm. The width across the occipital condyles is just as small as in the Toftum skull, 107 mm., the minimum width in *Urus* cows.

Mørkøv. As no *Urus* find is known from the island of Zealand later than Zone VI it is probable that the *Mørkøv* brain-case belongs to the Preboreal or Boreal period. It is broken through the orbits. In the shape of the frontal, the upper part of which is fairly concave, this brain-case is similar to the Grænge specimen, though broader, just as broad as the Knabstrup specimen. The smallest width of frontal is 195 mm. The greatest span of horn cores is about 600 mm., as compared with 577 mm. in the Grænge specimen; the circumferences at the base of the horn core are 227 mm. and 220 mm., respectively.

The Fuglekjær skull is, on the upper side, broken through the base of the nasal bones; of the palatal part only the alveole of the left hindmost molar is present. In size and individual age it is much like the Grænge skull. The distance from the occipital ridge to the nasal base is a little shorter, 270 mm., than in the Grænge skull, 278 mm., as measured to the posterior curvature of the nasals; but the distances from *condylus occipitalis* and the *foramen magnum* to the posterior border of the palate, in the middle line, are a little larger, 235 mm, and 198 mm., respectively, than in the Grænge skull 230 and 190 mm. The distance from the occipital condyle to the anterior border of the hindmost molar (m 3) is 260 and 257 mm., respectively. The basal length thus may be estimated at about the same size in the two specimens, or perhaps a little greater in the Fuglekjær specimen, 500 mm., as compared with 496 mm. in the Grænge skull. The horn cores, too, are almost identical; the greatest span is 585 and 577 mm., respectively, and the circumferences at the base are 227 and 225 mm., respectively. The horn cores are at the base fairly compressed, as also found in the Grænge and Mørkøv specimens (cf. DEGERBØL, 1962, fig. 3). — Also the smallest frontal widths are the same, 177 and 180 mm., respectively.

The Ølholm skull is broken a little in front of the fronto-nasal suture; the palatal part is missing. It belonged to a very old animal; the sutures of the lacrymal are only just visible or have completely disappeared, and the same applies to the upper half of the interfrontal suture, the posterior part of which is strongly elevated, forming a small boss. The surface of the bones is very hard, as in old bulls. The anterior part of the frontals, behind and medially to the orbits, is so severely corroded that the air-sinuses are opened, particularly when seen on the left side. The occipital ridge is fairly undulating. The swelling of the interfrontal suture or ridge,—immediately in

front of the two posterior concavities,—and which in the *Urus* skull may be more or less marked—is so large that the frontal region here is distinctly domed.

The length of the Ølholm brain-case is almost similar to the corresponding part of the Pindstrup skull, estimated at a basal length of about 490 mm. The distance from the occipital ridge to the anterior border of the *os lacrymale* is 340 mm. in both skulls. According to greater developmental age, however, several measurements of width are greater than in the Pindstrup cow. Mastoid width, e.g., 240 and 225 mm., postorbital width 240 and 230 mm., respectively, whereas the smallest frontal width is similar, 178 mm. Of particular interest are the thin horn cores in the Ølholm specimen which next to the Pindstrup cow—but together with the horn cores of the Aarhus cow,—are the smallest in the Danish material; the circumference at the base is 195 mm. in both, as compared with 181 mm. in the Pindstrup cow. As in *Urus* cows the horn cores are well upward directed.

The Gjødvad brain-case is broken through orbits. It belonged to an old animal; the left *sulcus supraorbitalis* is roofed posteriorly, as also the interfrontal suture posteriorly is completely fused, forming a broad ridge, on each side of which there is a distinct concavity. The frontal is concave anteriorly-posteriorly and the occipital crest is concave at the base of the very compact horn cores. These are asymmetrically, the left one anomalously bent, forming about 2/3 of a circle, the tip of which is turned inwards to only 66 mm. from the posterior rim of the orbit, a unique instance in *Urus*. This brain-case is a little larger than the corresponding part of the Grænge skull. The frontal widths are 188 mm. and 179 mm., respectively.

The Aakjær frontlet is cut off between horn cores and orbits. Although it belonged to an old animal with obliterated interfrontal suture and a hard and shining surface of the bone, no granulation at all is seen at the base of the horn cores, and only a few longitudinal grooves are present. The occipital crest is almost straight.

The Aakjær frontlet, like the skulls from Svebølle and Flintinge, represents the "open type" of horn cores, but it is smaller than these specimens.

The smallest width between horn cores is 174 mm., as compared with 215 mm. in the Flintinge skull, and the smallest frontal widths are 195 mm. and 205 mm., respectively.

Barløse. Left horn core with a small part of the frontal, which is broken at the interfrontal suture. Tip of horn core broken off, occipital crest elevated in the middle, with a concavity at the base of the horn core. The smallest width between horn cores at the occipital ridge is 220 mm. (110×2), in the middle of the frontal 240 mm. The circumference at the base of the horn core 233 mm., diameters 76×65 mm. Outer curvature of broken horn core 365 mm. (the complete length probably 1/3 more). Apart from a thinner horn core, this specimen is almost a reflected image of the Svebølle specimen.

Dyrholmen. From Dyrholmen I, i.e. from the earliest part of the settlement, two comparatively small incomplete horn cores are present (Degerbøl 1942, p. 92, fig. 5). At the time of publication the determination *Urus versus* domestic animal caused great difficulty, however, on the basis of the material now at hand, they must

no doubt be referred to *Urus* cows. The oldest specimen, belonging to an adult animal, is broken 150 mm. from the base, but the small curvature indicates a fairly long horn core (probably almost as in the large Svebølle horn core). The circumference at the base is 215 mm., diameters 71×61 mm., thus in fact larger than seen in several female *Urus* skulls (fig. 14). Cf. p. 37.

Regarding mandibles and postcranial skeletal parts cf. Tables 10–23.

To sum up, it may be said that skulls and parts of skulls of no less than 27 *Urus* cows have been recorded. Of particular interest are the two complete skulls, from Ullerslev and Grænge, the largest, and one of the smallest of the Danish females. The basal lengths are 525 and 496 mm., respectively (condylobasal lengths 556 and 527 mm.). On the basis of incomplete skulls, with mandibles, the lengths, however, may with fairly certainty, be estimated in several other skulls: The Toftum skull at a basal length almost as in the Ullerslev skull, the Bjeverskov skull at 515 mm., the Taastrup skull at 510 mm. Of about the same length as the Grænge skull, are the Fuglekjær skull 500 mm., and the Pindstrup skull 490 mm. A determination of the basal length on the basis of brain-cases alone is not possible, but it may be noted that the brain-cases from Vigersted, Korinth, Ølholm, and Aarhus are almost similar to the Grænge skull; whereas the Knabstrup and Mørkøv specimens are a little broader, but not so broad as the large Ullerslev skull.

Also in shape the skulls of *Urus* cows are fairly variable. In sturdily built skulls, the standard type, so to say, e.g., from Ullerslev and Grænge, the occipital crest is almost straight, but in more slightly built skulls this crest tends towards getting more or less wavy, generally convex, in a few specimens, however, concave, as exceptionally seen in the Bjerregrav skull.

Characteristic of the female skulls are the comparatively narrow and concave forehead, and the thinner and shorter, but generally more upwards turned, rising horn cores.

As compared with the skulls of the large bulls, the female skulls are small. — The narratives of the legendary size of the *Urus* no doubt are based on large bulls, and particularly on the enormous head and horns. Probably the said features were still more pronounced in living animals as may be seen in the palaeolithic paintings at Lascaux, where particularly the concave profile of the forehead in cows is surprisingly accentuated, perhaps indicating a local trait (F. Windels, 1948).

Comparison between males and females.

(Sex dimorphism)

A. *Skulls.*

After the survey of skulls of *Urus* cows we shall make a comparison with the remaining Danish *Urus* skulls representing bulls; besides brain-cases and other parts of skulls, thus 15 complete, or almost complete skulls are present. For further information and particularly to find out the range of variations, measurements of skulls from adjacent countries are included in the investigations.

The *length* of the cranium is indicated by the total length or profile length, the condylobasal length, and the basal length. Of these measurements the total length is most affected by the developmental age and sex of the animals, being proportionally large in old bulls in which the occipital part is sloping greatly backward. As now the basal length and now the condylobasal length are used in different publications, the basal length mostly in German and condylobasal length particularly in English publications, I have for the sake of comparison stated both.

The *basal length* is given in Table 1 and plotted in fig. 8. From this it appears, as mentioned above and as seen in other measurements, that a very large sex dimorphism exists in the *Urus*. The basal length of the largest female skull (Ullerslev) from Denmark just comes up to the smallest male skull from Østbirk, measuring 525 mm. In males the basal length varies between 612 and 525 mm.; in females between about 490 mm. (496 mm. in the complete Grænge skull) and 525 mm.

However, a still larger female skull, the basal length of which is 534 mm., has been mentioned by LEITHNER from Skåne, Sweden, now kept in the Riksmuseum, Stockholm.—Smaller skulls of females, too, have been described. The basal length of a complete, but undated skull from Rethen, Hannover, Germany, is only 475 mm. (LA BAUME, 1958).

An astonishingly small measurement is stated for the incomplete skull from Star Carr which is broken a little in front of the tooth row and the *foramen infraorbitale* (FRASER and KING, 1954). Thus by comparison i. a. with domestic cattle the condylobasal length was estimated at 459 mm. The distance from the occipital ridge to the upper end of the nasals is, however, stated to be 265 mm., which is fairly large, as compared with 242 mm. in the Rethen skull, 255 mm. in the Pindstrup skull, and 278 mm. in the Grænge skull. In contrast the distance from the condyle to the "anterior edge of 4th upper molar" is exceptionally short, 293 mm. In the Pindstrup skull this length is 310 mm., in the Grænge skull 320 mm.—Similar proportions occur in the other length measurements. In the Star Carr specimen the distance from the *foramen magnum* (*basion*) to the middle point of the line between the front of the first premolar, p 2, is 309 mm., from *condylus occipitalis* to the same point 344 mm. (C. CRIGSON *in lit.*). In the Grænge cow the corresponding measurements are 337 mm. and 369 mm., in the Pindstrup cow 332 mm. and 364, respectively.

In the complete skull from Grænge the distance from the said middle point of the line between the front of p 2 to the anterior rim of the premaxilla is 159 mm., corresponding to a basal length of 496 mm. and a condylobasal length of 528 mm. The Pindstrup skull is, like the Star Carr skull, broken in front of the row of teeth, but using the said length of the missing part, 159 mm., as found in the Grænge skull, we find the basal length of the Pindstrup skull to be 491 mm. and the condylobasal length 523 mm.

The length of the corresponding missing premaxilla part in the Star Carr specimen may be estimated in proportion to the said overall length, from the basion or condylus, thus: $159 \times 309/337$ and $159 \times 344/369$, which gives a length of 146 mm. and

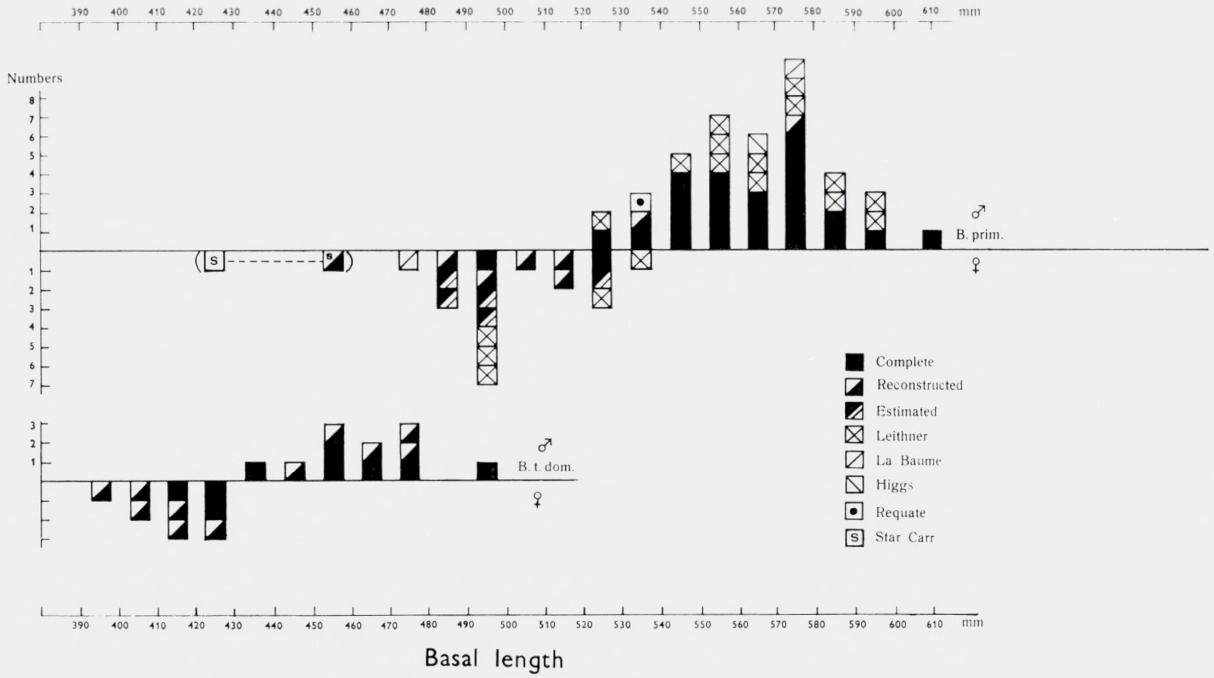


Fig. 8. *Basal length.* Males are placed above the line; females below. – Measurements in 10 mm. groups: 401/410–411/420 etc. The largest female skull from Denmark (Ullerslev, Zone V), just reaches the smallest male skull (Østbirk, Zone VIII). Only one skull (from Holmene) of domestic cattle (male or bullock) is within the size range of Danish *Urus* cows.

148 mm., respectively, averaging 147 mm. Accordingly the basal length of the Star Carr skull is 456 mm., the condylobasal length 491 mm., at least, probably a little larger, corresponding to the fact that the premaxilla may have been longer than estimated here. Still the Star Carr skull must be characterized as small, if the association of the facial part with the cranial portions is right, and it is stated to be so. It is quite outside the range of other *Urus* skulls, a remarkable exception, but similar exceptions are now and then seen in other measurements. (Cf. p. 77, fig. 13).

As to the size of the *Urus* during prehistoric times, it is worth noting that the earliest specimen, from the Late Dryas period, is not only the largest male known from Denmark, but in fact the largest postglacial specimen known. The smallest males, from Østbirk and Tinglev Lake are the youngest, from the Subboreal period or the beginning of the Subatlantic period. Similarly, the largest complete female skull (Ullerslev) and the very large brain-case from Flintinge, with its exceptionally large span of horn cores, belong to the Boreal and Preboreal periods, respectively; the smallest female (Pindstrup) to the Subboreal period. This would seem to indicate a reduction in size during the ages. However, also large and smaller skulls are known from the intermediate periods.

For the sake of comparison also measurements of domestic cattle are recorded in the tables and graphs, fig. 8–16 (cf. the capter on domestic cattle).

TABLE 1.

Basal length.

Bos primigenius.

♂♂		Zone
Østbirk	525	VIII
(Tinglev	532)	VIII/IX
(Gøderup, subad.	532)	
Ugilt (ad. jun.)	542	VIII
Bønnelykke	543	VII
Fæsted	548	VIII
Danmark (Min. Mus.)	549	
Ørting	551	VIII
Grænge A (ad. jun.)	553	IV
Læsten	554	VIII
Bro	555	(Fyn)
Tepstrup	562	IV
Grevinge	564	VI
Grænge B	565	V
Auning	571	VIII
Lyngby	571	(Sjælland)
Ølholm	572	
Sorø	575	IV
Vig	580	IV
(Grejs Mølle	580)	VIII
Store Damme	581	(V)
Aagerup	583	(Sjælland)
Rønnebæksholm	583	IV
Bregninge	597	VI
Faaborg (Millinge)	612	III

♀♀		Zone
Pindstrup (reconstr.)	490	VIII
(Ølholm, Aarhus, estimated)		
Grænge	496	V
(Gjødvad, Korinth, estimated)		
Fuglekjær (reconstr.)	500	
St. Taastrup (reconstr.)	510	II/V
Bjeverskov (reconstr.)	515	V
Toftum (reconstr.)	520	VIII
Ullerslev	525	V
(Flintinge, estimated)		

From LEITHNER, ♂♂: 526, 546, 554, 555, 558, 566, 566, 575, 577, 588, 590, 592, 593.
From LEITHNER ♀♀: 496, 500, 500, 528, 534.
From LA BAUME ♂: 573.
From LA BAUME ♀: 475.
From HIGGS ♂: 568.
From REQUATE ♂: 532.
From FRASER and KING ♀: (Star Carr) 429 (Condylobasal length 459).

Bos taurus domesticus

♂♂		
[Vedbæk I, jun.	405]*	
Snoldelev	435	
Store Lyng, subad.	450	(calculated)
Vedbæk II	455	
Vedbæk III	455	(calculated)
Gammellung	455	
Verupgaard	465	
Veddinge	470	(calculated)
Ærø	475	(calculated)
Søndersø	480	(calculated)
Bodal	480	
Holmene	497	

* [ ] not plotted.

♀♀		
Gammellung	400	(calculated)
Nyrup III	403	(calculated)
Øgaarde III, subad.	410	(calculated)
Øgaarde II	411	(calculated)
Sandhuse	413	
Sandhuse II	415	(calculated)
Holmene	426	
Nyrup I	427	
Nyrup II	430	(calculated)

From Table 1 and fig. 8 it appears that the basal lengths of large domestic oxen and *Urus* cows are overlapping, inasmuch as the exceptionally large male skull from Holmene is just as large as skulls of medium-sized *Urus* cows.

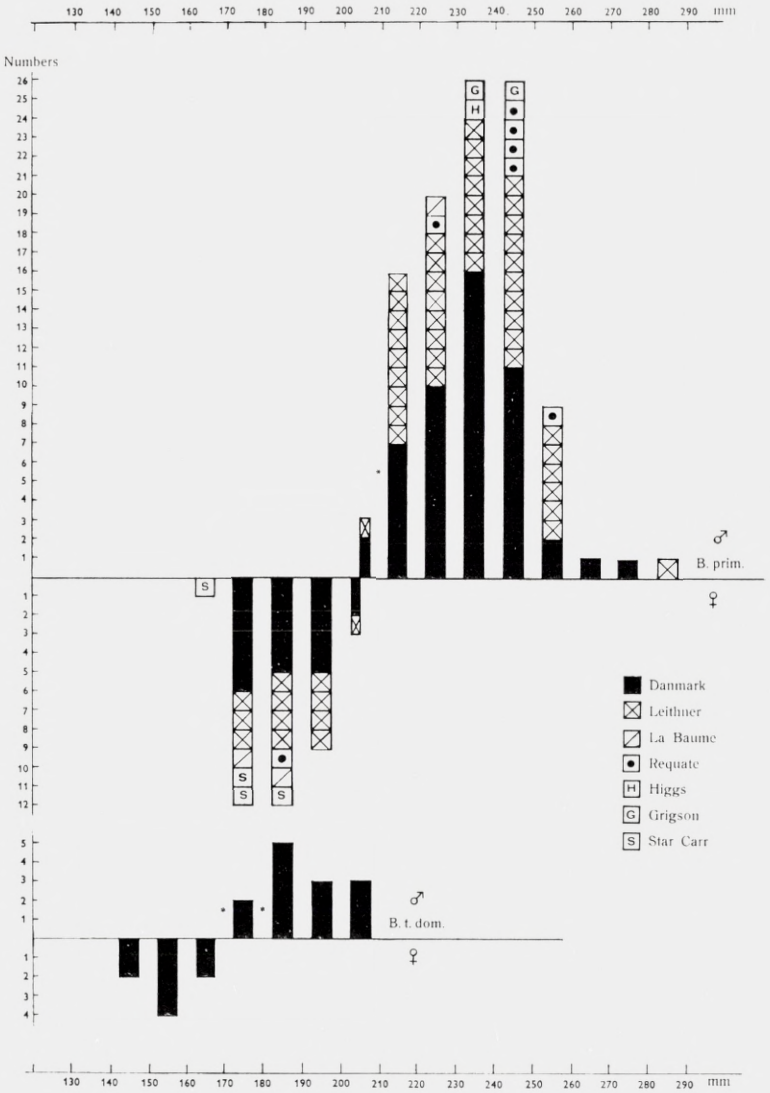


Fig. 9. *Least frontal width* is in *Urus* cows outside the range in *Urus* bulls, but co-extensive with the range in domestic bulls. Here, too, the largest measurements of females come from the geologically oldest skulls (Ullerslev, Flintinge, Zone V).

Least frontal width.

The narrow frontal of the female skulls is demonstrated in Table 2 and fig. 9. This shows that the range of the frontal width in females is just outside the range of the male skulls.

Furthermore, the largest measurements of females come from the two geologically old skulls, Flintinge and Ullerslev, belonging to the Boreal period.

Table 2.

Least frontal width.

Bos primigenius.

♂♂

Ølholm	207
Fæsted	210
Klarup	212
Tinglev	214
Tranekær	216
Mors	217
Hornslet	220
Hallenslev (jun.)	220
Danmark (Stud. Coll.)	220
Ugilt (ad. jun.)	222
Danmark (2. afd.)	225
Knabstrup 1	226
Tepstrup	226
Læsten	228
Fyn	230
Store Damme	230
Gøderup (subad.)	230
Aabenraa	230
Holme Mose	230
Vig	231
Danmark (CN. 1891)	232
Julianelyst	232
Knabstrup 3	234
Grevinge	234
Røde Mølle Aa	235
Bro	236
Tranemosegaard	237
Lading	237
Grejs Mølle	237
Sorø	238
Auning	238
Grænge A (ad. jun.)	240
Grænge B	240
Niverød	240
Lyngby	240
Faaborg	241
Bønnelykke	242
Aagerup	242
Østbirk	242
Kulemile	242
Ørting	245
Hørning	246
Sakskøbing	247
Danmark (Min. Mus.)	247
Hastrup	250

♂♂

Rønnebæksholm	250
Bedsmose	254
Bregninge	255
Lørup Hede	270
Danmark (2. afd.)	275

♀♀

Korinth	175
Fuglekjær	177
Ølholm	178
Pindstrup	178
Grænge	180
St. Taastrup (ad. jun.)	180
Aarhus	182
Vigersted	183
Skaarup	186
Bjeverskov	188
Gjødvad	188
Kærsted	191
Knabstrup	192
Mørkøv	195
Aakjær	195
Toftum	200
Ullerslev	203
Flintinge	205

Leithner ♂♂: 205, 211, 212, 214, 216, 216, 218, 220, 220, 220, 221, 224, 225, 225, 226, 226, 227, 228, 231, 232, 232, 232, 233, 233, 237, 240, 241, 241, 241, 242, 242, 244, 245, 245, 245, 249, 252, 252, 255, 257, 260, 260, 289.

Leithner ♀♀: 179, 179, 179, 182, 185, 190, 190, 192, 194, 194, 197, 202.

Requate ♂♂: 224, 246, 247, 249, 250, 254.
♀: 189.

La Baume ♂: 230. ♀♀: 180, 189.

Grigson ♂♂: 240, 243.

Higgs ♂: 234.

Fraser ♀♀: 170, 178, 179, 180.
(Star Carr)

TABLE 2 (continued).

Bos taurus domesticus.

♂♂		♀♀	
Gammellung I	177	Sandhuse I	148
[St. Lyng (subad.)	180]	Øgaarde II	148
Gammellung III	183	Gammellung II	151
Veddinge	184	Nyrup III	153
Løgtved Enge	184	Nyrup I	158
Snoldelev I	184	Holmene	159
Vedbæk II	188	Nyrup II	164
Vedbæk III	191	Sandhuse II	170
Bodal	192		
Verupgaard	193		
Ærø	204		
Søndersø	208		
Holmene	208		

It should be noted that even in the subadult bull skull from Gøderup and the not full-grown skull from Grænge (A), the frontal widths are great, 230 and 240 mm., respectively (Table 2).

The range of variation of the smallest frontal widths in *Urus* cows is co-extensive with the range of variation in domestic males.

Postorbital width.

The width across the posterior edge of the orbits also emphasizes the relative narrowness of the frontal part in *Urus* cows. The postorbital width, however, particularly depends on the individual age, fairly small even in almost adult animals. Thus, it should be noted that of the three bulls which have the smallest postorbital widths (fig. 10) two, from Ugilt and Hornslet, are young animals. In the Ugilt skull the lower p 3 has not fully erupted, and the brain-case from Hornslet is of about the same age. In this case there is a slight overlapping. The subadult skulls from Hallenslev and Gøderup are not incorporated in the graph, fig. 10. Their postorbital widths are 254 and 260 mm., respectively, indicating that the protruding orbits are established fairly late. Here, too, the ranges of variations in *Urus* cows and domestic males are largely overlapping.

Mastoid width.

From Table 4 and graph fig. 11 it appears that the mastoid measurements of skulls of cows and bulls do not overlap. Here, too, the greatest width in females originates from the Ullerslev skull, from Zone V. The smallest mastoid width in bulls plotted (fig. 11) are found in fairly young animals: Hornslet, Ugilt (cf. postorbital width), Knabstrup I and Tranemosegaard, in which the interior column of m 2 is unworn. In old bulls the mastoid process is strongly granulated, forming a great lump.

TABLE 3.

Postorbital width.

Bos primigenius.

♂♂	
[Hallenslev, jun.	254]*
[Gøderup, (subad.)	260]
Ugilt (ad. jun.)	262
Fæsted	266
Hornslet	268
Tranekær	274
Ølholm	275
Tinglev	280
Læsten	280
Knabstrup 1	285
Holme Mose	286
Tranemosegaard	287
Tepstrup	287
"Stud. Coll."	289
Bønnelykke	290
Bro	291
Mors	292
Aabenraa	293
Grevinge	295
Aagerup	295
Grænge A (ad. jun.)	297
Fyn	297
Auning	298
"2. Afd."	298
Vig	299
Knabstrup 3	300
Røde Mølle	300
Lyngby	301
Sorø	301
Grænge B	302
Grejs Mølle	303
Julianelyst	305
"Min. Mus."	307
Rønnebæksholm	310
Østbirk	ca. 310
Ørting	314
Faaborg	315
St. Damme	320
Bregninge	328

* [ ] not plotted.

♀♀	
Korinth	222
Pindstrup	230
St. Taastrup	233
Fuglekjær	235
Gjødvad	240
Ølholm	240
Vigersted	240
Mørkøv	242
Grænge	244
Kærsted	248
Bjeverskov	250
Toftum	253
Knabstrup	260
Ullerslev	268

LEITHNER ♂♂: 261, 270, 270, 270, 273, 280, 285, 288, 290, 290, 290, 292, 295, 296, 297, 297, 298, 299, 300, 301, 302, 302, 303, 303, 304, 305, 308, 310, 314, 315, 316, 320, 324, 326, 336.
♀♀: 232, 233, 236, 240, 242, 247, 249.

LA BAUME ♂♂: 286, 295. ♀♀: 221, 243.

HIGGS ♂: 305.

GRIGSON ♂: 313.

FRASER ♀: 231 (No. 2).

Fig. 10. *Postorbital width.* There is a small overlapping, particularly caused by the small postorbital widths of the young bulls from Ugilt and Hornslet; the protruding orbits of the bulls are established fairly late. – In *Urus* cows and domestic males the ranges of variation are largely overlapping.

TABLE 3 (continued).

Bos taurus domesticus.

♂♂		♀♀	
[St. Lyng (subad.)"	211]	Sandhuse I	188
Snoldelev	218	Øgaarde	189
Gammellung II	223	Gammellung	189
Løgtved	225	Sandhuse II (jun.)	201
Gammellung I	226	Nyrup I	201
Vedbæk III	233	Nyrup II	206
Veddinge	234	Nyrup III	210
Verupgaard	235	Holmene	220
Vedbæk II (Maglemosegaard)	237		
Ærø	239		
Bodal	244		
Holmene	257		
Søndersø	260		

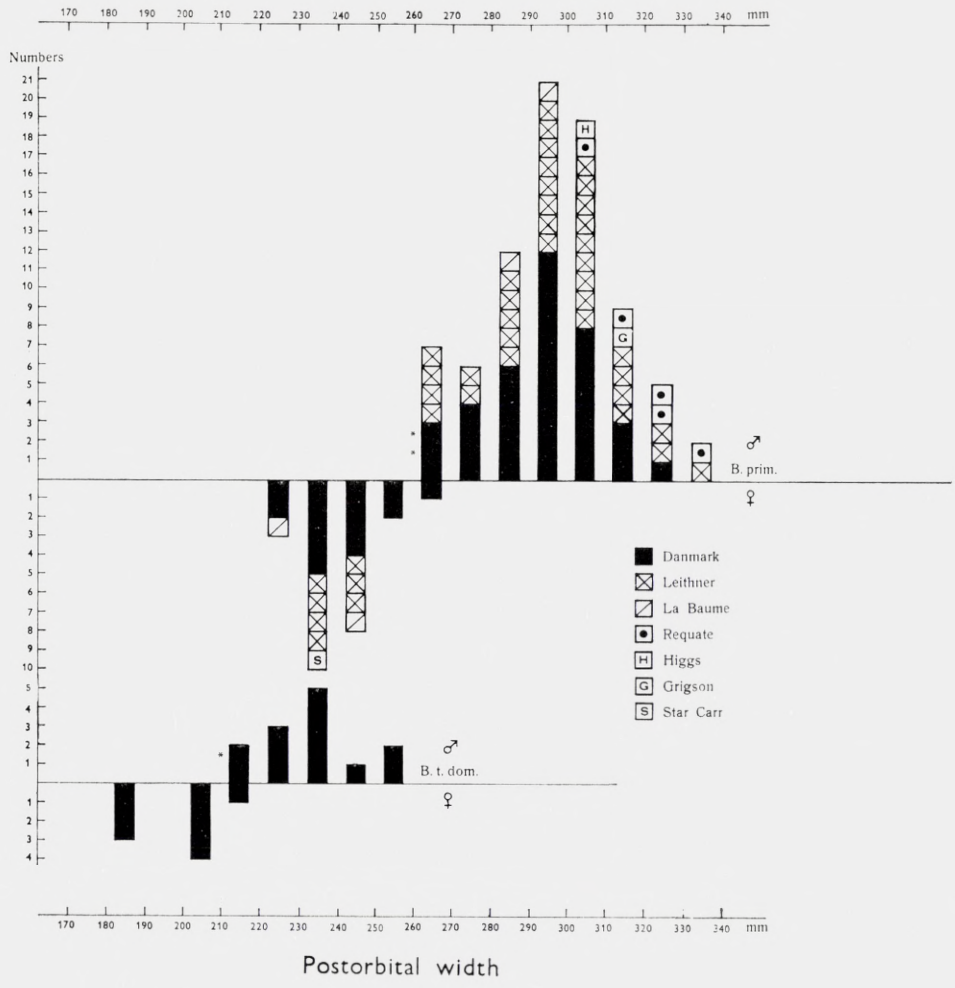


TABLE 4.

Mastoid width.

Bos primigenius.

♂♂		♀♀	
[Hallenslev (jun.)	244]	Korinth	210
[Gøderup (subad.)	262]	Pindstrup	225
Hornslet ab.	270	Fuglekjær	227
Knabstrup 1	275	St. Taastrup (ad. jun.)	232
Ugilt (ad. jun.)	280	Bjeverskov	234
Tranemosegaard	281	Mørkøv	234
Fæsted	285	Grænge	236
Vig	288	Gjødvad	240
Danmark (CN. 1891)	290	Ølholm	240
Fyn	292	Vigersted	240
Tranekær	293	Knabstrup	242
Tinglev	294	Ullerslev	267
Ølholm	295		
Bro	295		
Klarup	300		
Holme Mose	300		
"2. Afd."	300		
Mors	300		
Læsten	301		
Grevinge	303		
St. Damme	305		
Knabstrup 3	305		
Sorø ab.	305		
Lyngby	305		
Rønnebæksholm	308		
Tepstrup	308		
Auning	310		
Bønnelykke	310		
Grænge A (ad. jun.)	310		
Lørup Hede ab.	315		
Bedsmose	315		
Ørting	320		
Østbirk	320		
"Min. Mus."	320		
Grænge B	320		
Aagerup	322		
Faaborg	325		
Røde Mølle	325		
Bregninge	326		

From LEITHNER ♂♂: 280, 285, 295, 300, 301, 304, 304, 306, 307, 308, 310, 310, 310, 311, 312, 312, 313, 314, 315, 315, 316, 316, 317, 320, 320, 321, 322, 325, 325, 326, 327, 328, 337, 346, 350.

„ „ ♀♀: 222, 226, 230, 231, 236, 243, 246, 251, 261.

From REQUATE ♂: 323, ♀: 255.

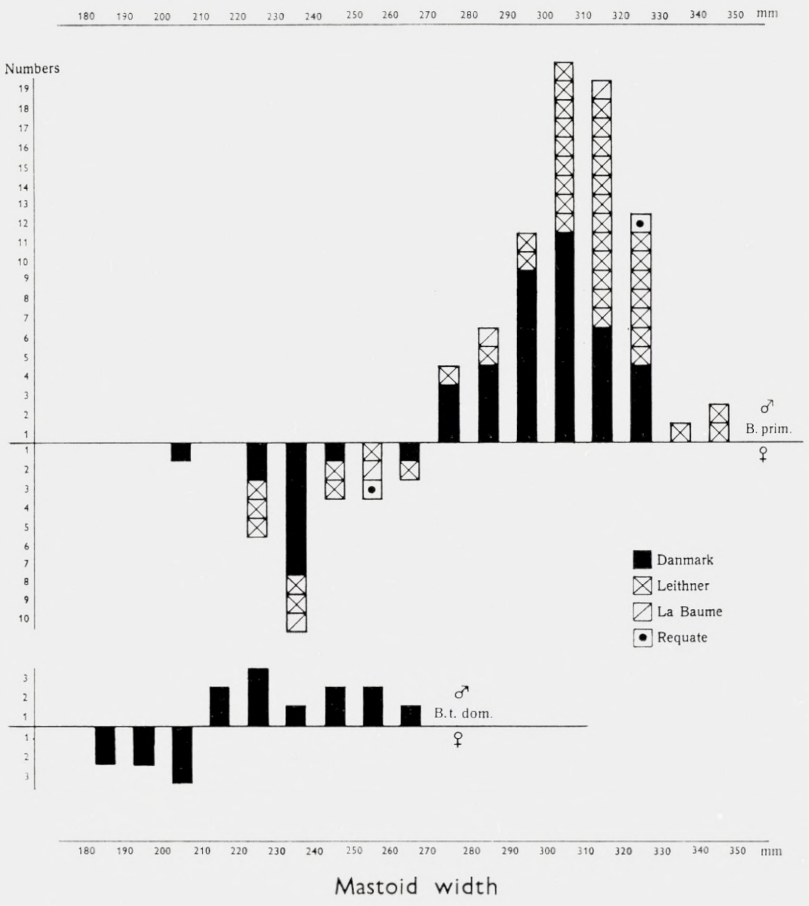
From LA BAUME ♂: 289, 315. ♀: 235, 260.

Fig. 11. *Mastoid width.* The measurements of *Urus* bulls and cows do not overlap; whereas the measurements in *Urus* cows coincide with those of domestic bulls.

TABLE 4 (continued).

Bos taurus domesticus.

♂♂		♀♀	
[Vedbæk I (jun.)	188]	[Viksø I (subad.)	178]
[Snoldelev II (jun.)	191]	Sandhuse I	184
[St. Lyng (subad.)	215]	Sandhuse II	186
Gammellung III	215	Øgaarde II	194
Gammellung I	216	Nyrup III	ab. 200
Snoldelev I	227	Nyrup I	202
Vedbæk III	230	Holmene	205
Verupgaard	230	Nyrup II	207
Vedbæk II (Maglemosegaard)	232		
Ærø	245		
Veddinge	249		
Bodal	256		
Søndersø	256		
Holmene	263		



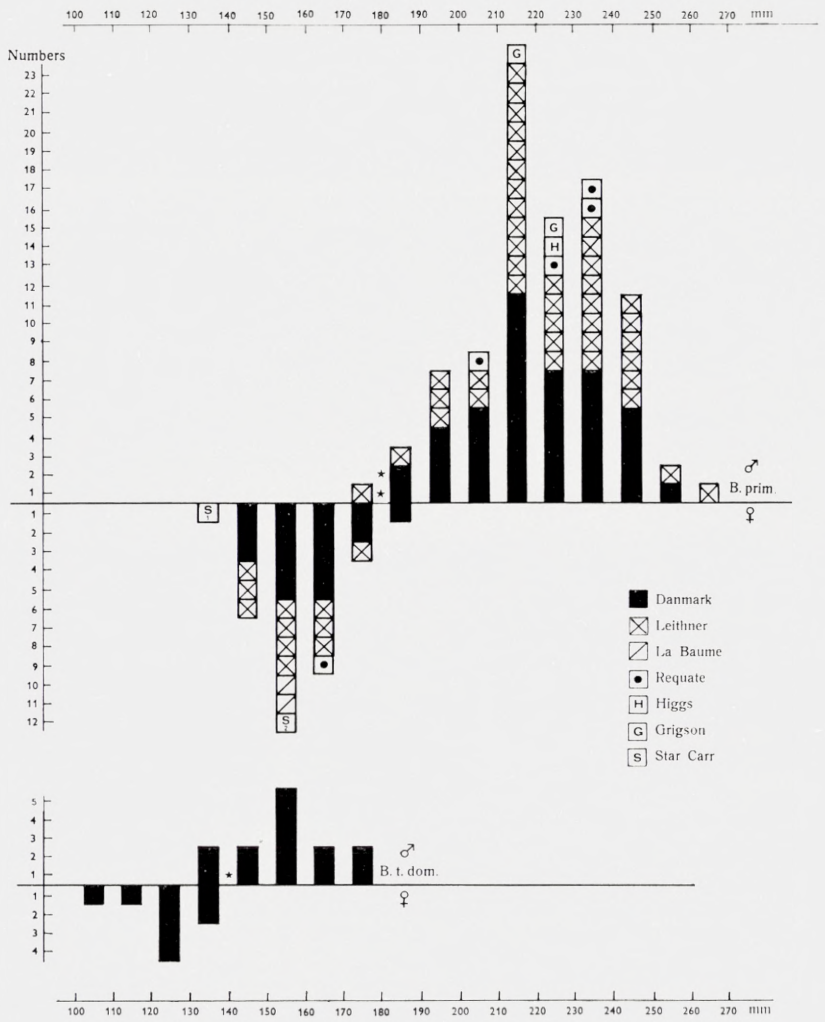


Fig. 12. *Width between temporal fossae*, posteriorly. The width in the young Ugilt bull is slightly smaller than in the large Flintinge cow, 183 and 185 mm., respectively. – As in most other width measurements the ranges of variation in *Urus* cows and domestic bulls are overlapping.

The subadult skulls from Gøderup (262 mm) and Hallenslev (244 mm) are not plotted. — As in the smallest frontal width and postorbital width the absolute measurements of the mastoid width in *Urus* cows coincide with the absolute measurements in domestic males.

Width between temporal fossae, posteriorly (*Supraoccipital width*).

In this measurement the females and males are slightly overlapping. Here, too, the individual age of the animals plays a considerable rôle. In old animals, particularly bulls, the temporal fossae are posteriorly closed by a bony bar, missing in young

Table 5.

Width between temporal fossae, posteriorly.

Bos primigenius.

♂♂

[Gøderup (subad.)	180]
[Hallenslev (jun.)	184]
Ugilt (ad. jun.)	185
Knabstrup 1	189
Store Damme	192
Sorø	198
Tranemosegaard	198
Grænge A	200
Bønnelykke	203
Ølholm	205
Grevinge	210
Knabstrup 3	210
Fæsted	210
Julianelyst	211
Vig	212
Bedsmose	212
Tinglev	213
Mors	215
Grænge B	215
Bregninge	216
Læsten	218
Bro	219
Fyn	219
Klarup	220
Østbirk	222
Trøstrup	222
Faaborg	222
Rønnebæksholm	226
Tepstrup	226
"Stud. Coll."	226
Min. Mus	230
Lørup Hede	231
Thorsager	232
Holme Mose	233
Grejs Mølle	235
"2. Afd."	238
Ørting	240
Røde Mølle	240
Aagerup	244
Lyngby	244
"Danmark" (CN. 1891)	245
Niverød	245
"2. Afd." 2	247
Auning	260

♀♀

Korinth	144
St. Taastrup	145
Pindstrup	148
Vigersted	153
Aarhus	155
Grænge	157
Ølholm	159
Bjeverskov	160
Fuglekjær	163
Mørkøv	165
Gjødvad	167
Bjerregrav	168
Knabstrup	169
Ullerslev	171
Toftum	176
Flintinge	185

From Leithner ♂♂: 175, [180 calf], 186, 191, 196, 200, 207, 210, 211, 211, 212, 212, 215, 215, 215, 216, 217, 217, 220, 220, 224, 224, 227, 227, 229, 231, 232, 233, 233, 235, 236, 237, 239, 241, 241, 242, 248, 248, 248, 257, 267.

„ „ ♀♀: 144, 148, 150, 154, 155, 155, 155, 161, 164, 167, 172.

From Requate ♂♂: 105, 225, 235, 238.

„ „ ♀: 164.

From La Baume ♀: 152, 155.

From Higgs ♂: 225.

From Grigson ♂: 219, 228.

From Fraser ♀: 140, 153.

TABLE 5 (continued).

Bos taurus domesticus.

♂♂		♀♀	
[Vedbæk I (jun.)	130]	Sandhuse I	108
[Snoldelev II (jun.)	135]	Øgaarde II	116
St. Lyng (subad.)	151	Nyrup III	126
Snoldelev I	134	Sandhuse II	127
Gammellung I	134	Gammellung	128
Løgtved Enge	145	Nyrup II	129
Verupgaard	154	Nyrup I	133
Vedbæk III	154	Holmene	137
Gammellung III	158		
Bodal	158		
Vedbæk II (Maglemosegaard)	160		
Søndersø	167		
Ærø	168		
Veddinge	171		
Holmene	179		

individuals. The largest supraoccipital width measured in female skulls originates from the very large Flintinge brain-case from the Boreal period, Zone V.

LEITHNER indicates a very low supraoccipital width of 125 mm., which, however, no doubt is a misprint, as also seen from the very large mastoid width (246 mm.) in the same individual. This measurement therefore is not plotted here. In males the two smallest measurements plotted originate from the young skulls from Ugilt (width 185 mm.) and Knabstrup (189 mm.), cf. the postorbital width (these young skulls are in the graph marked with an asterisk. Of the 4 Danish skulls in the next size column (fig. 12) two from Tranemosegaard (width 198 mm.) and Grænge (width 200 mm.), also belong to relatively young animals. LEITHNER does not indicate the individual age of his material, however, as an exception, he states that a supraoccipital width of 180 mm. occurs in a skull of an *Urus* calf.

As in most other measurements of width the ranges of variation in *Urus* cows and domestic males coincide.

Condylus width.

Also regarding the width across the occipital condyles there is an overlapping of measurements of males and females. It occurs from Table 6 and the graph fig. 13, however, that there is a great variation in this measurement. The greatest width is not always found in the largest or broadest skulls. In the very large and strongly built Danish skull from Bregninge, e.g., the condylus width is fairly small (129 mm.), and the same applies to the large and broad female skull from Toftum, which together with the small Skaarup skull has the smallest condylus width known (107 mm.); on the contrary the smallest, but broadest bull skull from Ørting, has a very great condylus width (142 mm.).

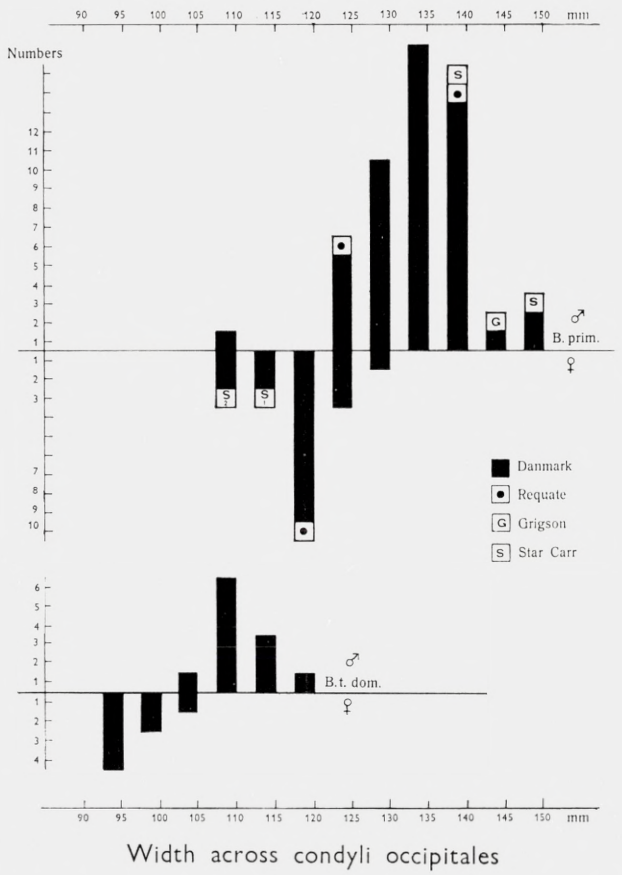


Fig. 13. *Condylus width.* Much overlapping occurs. – Particularly small is the condylus width (110 mm.) in a robust *Urus* bull skull from Mors.

An exceptionally small measurement quite outside the range of other males, occurs in a robust bull skull from Mors (110 mm.). If only the exoccipital part of this skull had been found, it would no doubt have been recorded as belonging to a female. Similar remarkable exceptions are now and then seen in other measurements. —It may be noted, that the condylus width is comparatively great in young animals, in the subadult skull from Gøderup, e. g., 138 mm.

The ranges of variation of condylus width in *Urus* cows and domestic males are largely overlapping.

Horn cores, circumference at the base.

In smooth horn cores this measurement may be taken without difficulty, but in the large horn cores of bulls, in which the base is highly granulated, this measurement is more or less inaccurate.

From Table 7 it appears that in young adult or even subadult bulls, the horn

Table 6.

Width across *condyli occipitales*.

Bos primigenius.

♂♂

Mors	110
Terp	121
Danmark (CN. 1891)	122
Bro	123
Tinglev	124
Grænge B	125
Holme Mose	127
Store Damme	127
Faxe (Gøjs Mose)	127
Grevinge	128
Julianelyst	128
Aagerup	128
"Min. Mus."	128
Ølholm	129
Bregninge	129
Knabstrup 3	130
Røde Mølle	131
Fæsted	131
Bønnelykke	132
Knabstrup 1	132
Østbirk	132
Klarup	132
Lyngby	132
Vig	133
Aabenraa	133
Hornslet	134
Nørre Vissing	134
Rathlousdal	134
Læsten	134
Viesø (jun.)	135
Fyn	135
Bedsmose	135
Rønnebæksholm	136
Tranemosegaard	136
Trøstrup	136
Auning	136
Ugilt	137
"2. Afd." 2	137
[Gøderup (subad.)	138]
Understed	139
Faaborg	139
Sorø	139
Tepstrup	139
Grænge A	140
Hørning	140
Ørting	142
Alsønderup	146
Lørup Hede	147

♀♀

Skaarup	107
Toftum	107
Pindstrup	111
Mørkøv	114
Bjeverskov	116
Fuglekjær	116
Knabstrup	117
Vigersted	117
Korinth	117
Ølholm	118
Gjødvad	118
Aarhus	119
St. Taastrup	120
Svebølle	121
Grænge	122
Ullerslev	125
Flintinge	127

From Requate ♂♂: 125, 137. ♀: 118.
From Grigson ♂: 143.
From Star Carr ♂♂: 139, 146. ♀♀: 110, 113.

TABLE 6 (continued).

Bos taurus domesticus.

♂♂		♀♀	
[St. Lyng	100]	[Vedbæk I (subad.)	94]
[Snoldelev II (jun.)	103]	[Øgaarde III (subad.)	87]
Gammellung	102	Sandhuse	92
Snoldelev I	106	Nyrup I	92
Verup	106	Øgaarde II	95
Bodal	107	Gammellung	95
Holmene	108	[Sandhuse II (subad.)	96]
Veddinge	108	Nyrup II	97
Gammellung II	110	[Viksø (subad.)	98]
Løgtved Enge	112	Nyrup III	98
Vedbæk II	112	Holmene II	104
Søndersø	114		
Ærø	118		

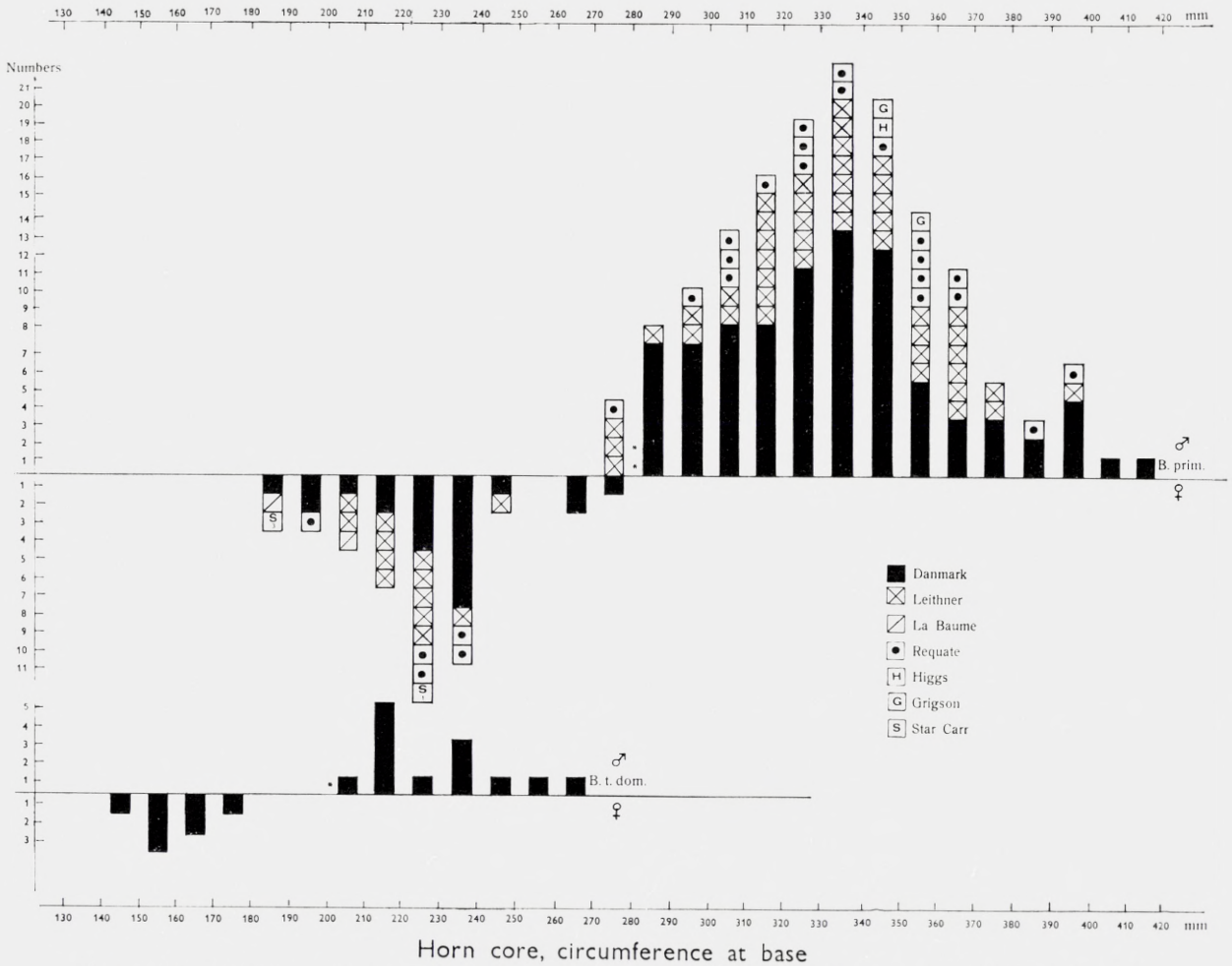


Fig. 14. *Circumference at the base of horn cores.* Even in young *Urus* bulls the horn cores are comparatively thick, being outside the range in *Urus* cows. It is remarkable that the width of horn cores in domestic bulls almost coincides with that of *Urus* cows.

TABLE 7.

Circumference at the base of the horn cores.

Bos primigenius.

♂♂	
[Hallenslev (jun.)	285]
[Viesø (subad.)	290]
Læsten	283
Ugilt	283
Fæsted	285
Brabrand	285
Hornslet	290
Ølholm	295
Tinglev	295
Næsbyhoved	295
Tranemosegaard	295
Lundby	298
Holme Mose	300
Taageby	300
Danmark 1	305
Knabstrup 1	305
Vintved	305
Dyrholmen	305
Egum	305
Hedehusene	308
Danmark (5)	308
Grænge A	310
Terp Mose	315
Gøderup (subad.)	315
Grænge B	315
Grevinge	315
Gentofte	315
Bro	318
Sorø	320
Jelling	320
Bedsmose	322
Klarup	323
Østbirk	325
Vig	325
Falster	325
Røde Mølle	325
Danmark (9)	325
Tepstrup	325
Tjerrild	328
Understed	330
Danmark (8)	330
Niverød	335
Bundsø	335
Odder	335
Lading	335
Grejs Mølle	335

♂♂		
Danmark (3)		335
Bønnelykke		337
Ulvemose, Rosenholm		338
Barrit Skov		338
Ørting		340
Thorsager		340
Hastrup		340
Hørning		340
St. Damme		341
"Mus. Min."		345
Sakskøbing		345
Kulemile		345
"2. Afd.(1)"		345
Knabstrup 3		345
Aagerup		345
Danmark (4)		346
Jonstrup Vang		348
Fyn		350
Rønnebæksholm		350
Skellingsted		350
Danmark (6)		354
Nørre Vissing		355
Mors		355
Danmark (7)		357
Lyngby		358
Alsønderup		365
Auning		365
Horsens Fjord		368
Bregninge		375
Trøstrup		375
Danmark (Lotze)		375
2. Afd.		385
Julianelyst		385
Danmark (2)		395
Lørup Hede		397
Østersøen		398
Faaborg		400
Brændholt, Nyrup		405
Danmark (CN. 1891)	(right)	445
	(left)	420

TABLE 7 (continued).

♀♀	
Pindstrup	181
Aarhus	195
Ølholm	195
Skaarup	206
Dyrholmen	215
Korinth	220
Grænge	225
Fuglekjær	227
Mørkøv	227
Barløse	233
Bjeverskov	235
Aakjær	235
Gjødvad	235
Taastrup	240
Knabstrup	240
Vigersted	240
Bjerregrav	240
Svebølle	245
Ullerslev	270
Toftum	270
Flintinge	275

From LEITHNER	♂♂: 275, 280, 280, 288, 293, 294, 310, 310, 312, 313, 315, 318, 320, 320, 323, 324, 328, 330, 330, 333, 333, 334, 334, 339, 340, 340, 343, 345, 350, 350, 350, 357, 358, 360, 360, 361, 363, 367, 368, 370, 370, 378, 378, 398.
	♀♀: 203, 208, 212, 215, 216, 220, 222, 222, 223, 225, 227, 237, 246.
From LA BAUME	♂: 320. ♀♀: 190, 205.
From REQUATE	♂♂: 275, 298, 304, 307, 309, 316, 325, 325, 330, 331, 333, 341, 351, 352, 354, 360, 365, 365, 290, 392.
	♀♀: 200, 224, 228, 232, 235.
From GRIGSON	♂♂: 343, 355.
From HIGGS	♂: 342.
From FRASER. (Star Carr)	♀♀: 189, 224.

Bos taurus domesticus.

♂♂	
St. Lyng (subad.)	205
Veddinge	214
Gammellung III	215
Vedbæk III	215
Løgtved Enge	220
Vedbæk II (Maglemosegaard)	220
Verupgaard	230
Snoldelev I	232
Ærø	235
Holmene	240
Bodal	245
Gammellung I	257
Søndersø	265

♀♀	
Sandhuse I	145
Øgaarde II	157
Gammellung	157
Sandhuse II	160
Holmene	164
Nyrup III	170
Nyrup II	175

cores are comparatively thick, being outside the range in females; this applies, e.g., to the subadult bulls from Hallenslev and Viesø, circumference 285 and 290 mm., respectively, which are plotted in fig. 14.

Probably also the smallest measurements given by LEITHNER come from young animals.

As the granulation at the base of the horn cores continues even in very old bulls,

Table 8.

Horn core, outer curvature, length.

Bos primigenius.

♂♂

Ugilt		495
Brabrand		500
Sakskøbing		515
Grevinge	(475 +)	515
Bro		525
Fæsted		540
Lundby		540
"Stud. Coll."		548
Hornslet		550
Ølholm		552
Aagerup		555
Bundsø		570
Knabstrup 1		570
Grænge B		570
Tranemosegaard		570
Læsten		575
Horn core, 2		575
Thorsager		580
Vintved		580
Sorø		590
Bønnelykke		590
Mors		595
Julianelyst		595
Lading		595
Egum		600
Tinglev		610
Skellingsted	(575 +)	610
Fakse		615
Knabstrup 3	(580 +)	615
Lyngby		615
Klarup	(510 +)	620
Hastrup	(595 +)	620
Østbirk		620
Rønnebæksholm		625
Tranekær		630
"2. Afd. (1)"		635
Trøstrup		645
Rosenholm		645
Tepstrup		645
Auning		650
Grænge A		660
Fyn		660
Kulemile		665
Vig		667
Nyrup		675
Grejs Mølle		675

♂♂

No information		680
Ørting	(600 +)	680
Danmark (CN. 1891)		685
Horn core 1		685
St. Damme		686
Røde Mølle	(600 +)	690
"Min. Mus"		695
Dyrholmen (VII H_2)		700
Odder		710
"2. Afd. (2)"		710
Terp		750
Faaborg	(700 +)	780

♀♀

Pindstrup		365
Gjødvad		380
Ølholm		385
Mørkov		385
Grænge		395
Aarhus		410
Fuglekjær		412
Bjerregrav		430
Ullerslev		450
Korinth		465
Toftum	ab.	480
Vigersted		495
Aakjær	(445 +)	500

From Leithner ♂♂: 460, 490, 530, 540, 545, 549, 550, 556, 559, 575, 578, 580, 580, 583, 597, 600, 604, 607, 608, 610, 610, 612, 615, 626, 631, 639, 640, 643, 646, 650, 657, 658, 670, 680, 688, 720, 730, 730, 736, 740, 780.
♀♀: 335, 357, 371, 377, 395, 396, 420, 426, 445, 450, 488, 530 (r), (488 l.).

From La Baume ♂: 555. ♀: 360.

From Requate ♂♂: 548, 588, 601, 605, 618, 655, 660, 693, 695, 720, 752.
♀: 415.

From Higgs ♂: 785.

From Grigson ♂♂: 705, 735.

TABLE 8 (continued).

Bos taurus domesticus.

♂♂		♀♀	
[Snoldelev II (jun.)	235]	[Øgaarde III (subad.)	153]
[Vedbæk II (subad.)	235]	Sandhuse I	(185)
Veddinge	(295)	Øgaarde II	210
Gammellung III	(295)	Nyrup III	215
Holmene	305)	Gammellung II	215
[St. Lyng (subad.)	(310)]	Holmene	230
Gammellung I	(335)	Nyrup II	255
Vedbæk II (Maglemosegaard)	(340)	Sandhuse II	285
Verupgaard	(375)		
Snoldelev I	(380)		
Bodal	(385)		
Søndersø	(415)		
Ærø	(430)		

the shape of the graph fig. 14 differs from the other graphs given by a less pronounced drop.

It is remarkable that in domestic males the horn cores are just as thick as in *Urus* cows.

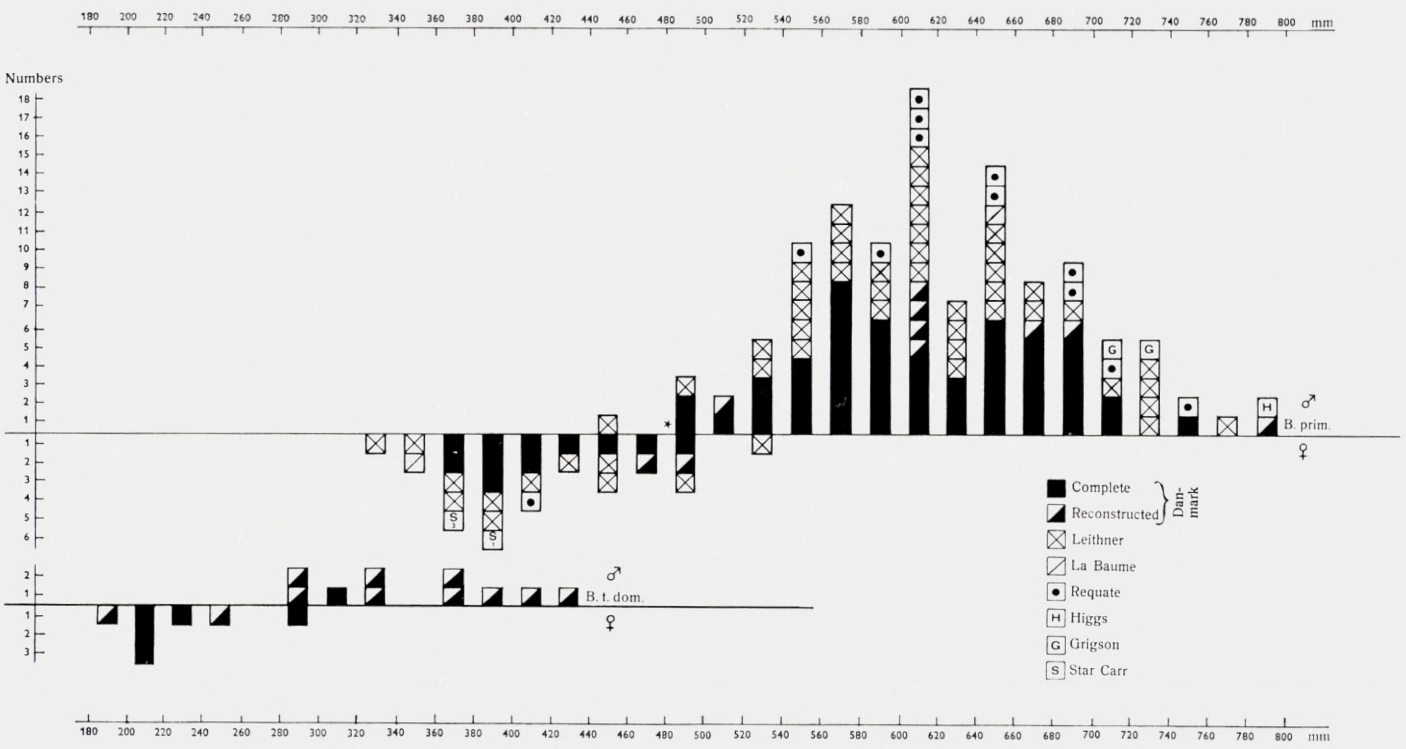
Length along the outer curvature of the horn core.

From graph, fig. 15, it will be seen that the largest complete horn core in cows, that of the Vigersted cow, just comes up to the length of the smallest horn cores in bulls. However, these specimens originate from the young bulls from Ugilt and Brabrand. As the incomplete horn cores of females from Svebølle and particularly from Flintinge probably originally surpassed the length of the horn cores from Vigersted there is a small overlapping.

The ranges of variation in domestic males overlap the range in *Urus* cows, but do not come up to the upper limit in these animals.

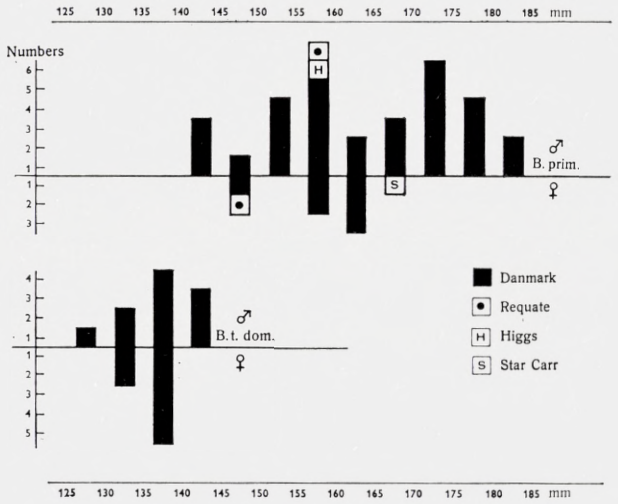
Length of upper tooth row.

In *Urus* cows the teeth are comparatively large; the length of the row of upper teeth falls within the range of *Urus* bulls.—There is a small overlapping between teeth of large domestic males (Ærø, Søndersø, Vedbæk III) and small *Urus* males (Østbirk, Fæsted, Læsten); however, the width of the teeth in domestic cattle is smaller. The widths at the base of the hindmost molar, e.g., are: Søndersø 26,7 mm., Ærø 24 mm., Vedbæk III 23 mm.; in *Urus* cows: Ullerslev 28, Grænge 30 and Bjeverskov 30 mm. As also known from other species the length of the row of teeth varies to no small extent during the life of the animal; greatest at the close of the eruption of the teeth, when the premolars, p 3 and p 4, have not fully erupted, and comparatively small in old animals (Østbirk).



Horn core, outer curvature

Fig. 15. *Length along outer curvature of horn core.* In fully adult Danish animals no overlapping between *Urus* bulls and cows exists. The range in domestic bulls largely overlap that in *Urus* cows.



Length of upper tooth row (p2 - m3)

Fig. 16. In *Urus* cows the *length of upper tooth rows* falls within the range in *Urus* bulls, not, however, reaching the maximum length in bulls. Between small and old *Urus* bulls and large domestic males there is a small overlapping.

TABLE 9.

Length of upper tooth row (p2–m3).

Bos primigenius.

♂♂		Zone
Ostbirk	143	VIII
Fæsted	143	VIII
Læsten	145	VIII
Ølholm	147	–
Min. Mus.	151	–
Ugilt	154	VIII
Ørting	155	VIII
Tinglev	155	VIII/IX
Auning	156	VIII
Hornslet	158	VIII
Tepstrup	158	IV
Røde Mølle	158	IV
Rønnebæksholm	160	V
St. Damme	161	IV/V
Bønnelykke	163	VII
Lyngby	168	(Sjælland)
Aagerup	168	(Sjælland)
Knabstrup	170	IV
Bro	172	(Fyn)
Grænge A	173	IV
[Hallenslev (jun.)	174]	V
Bregninge	174	VI
Sorø	174	IV
Grænge B	175	V
Faaborg	179	III
Vig	180	IV
Tranemosegaard	180	V
[Gøderup (subad.)	180]	IV
Grevinge	182	V
Maglemose (IIJ 10^2)	182	V

♀♀		Zone
Skaarup	148	–
Bjeverskov	158	V
St. Taastrup	160	II/V
Grænge	161	V
Ullerslev	162	V
Pindstrup	162	VIII

From REQUATE	♂: 157. ♀: 145.	
From HIGGS	♂: 159	VIII
From Star Carr	♂: 168	IV

Bos taurus domesticus.

♂♂	
Snoldelev I	125
Verupgaard	134
Veddinge	134
Holmene I	137
Vedbæk II (Maglemosegaard)	138
Bodal	138
Gammellung I	139
Søndersø	142
Ærø	143
Vedbæk III	145
[St. Lyng (subad.)	149]

♀♀	
Øgaarde II	133
Nyrup III	133
Gammellung II	136
Sandhuse	138
Nyrup I	139
Holmene II	139
Nyrup II	140
[Viksø I (subad.)	141]

In the subadult domestic male from Store Lyng, e.g., the length of the row of teeth is 149 mm., and the same holds good of the Viksø I cow, 141 mm. (Table 9), these two animals have not been graphed.

Table 9 emphasizes the remarkable fact that the shortest rows of teeth occur in the geologically latest skulls, from the Subboreal period, Zone VIII. All Subboreal bull skulls, bearing teeth, 8 in all, are placed at the top of this table.

It should also be noted that the tooth row in the comparatively large skull from Lowe's farm (Great Britain) from the Bronze Age, is fairly short, 159 mm. (Higgs). Cf. p. 129.

Mandibles and mandibulary dentition.

As was to be expected, the mandibles of *Urus* bulls are generally larger than the mandibles of the cows, corresponding to the length of the skulls, e.g. basal length; only a small overlapping may exist. It should be noted, however, that the length of mandibles stated (Table 10)—as measured from the hind border of the medial incisor (i 1)—are not quite reliable because the anterior border of the mandibles is more or less damaged, and the same applies to the measurements of length from the *foramen mentale*, as this foramen is variable in size and even may be double (Ullerslev).

A sex determination of isolated finds of mandibles of a size that is on the borderline between bulls and cows, may be very difficult, if possible at all. The mandible of the Ullerslev cow, e.g., is almost similar to the mandible of the Tinglev bull, in fact a little more sturdy, with stronger teeth. The overlapping area between mandibles of bulls and cows may be placed at about 485–490 mm. It seems, however, that the symphysis tends to be longer and more strongly built in the bulls. In the example mentioned the length of the symphysis, when the two mandible branches are brought together, is 81 mm. in the Tinglev bull, as compared with 70 mm. in the Ullerslev cow, as measured at the lower boundary; measured along the inner side of the mandible half, from the hindmost elevation, the lengths are 104 mm. and 90 mm., respectively.—It should be emphasized that the mandibles which in Table 10 are grouped with females have—with the exception of Gesten B and Løgenkjær—been found together with skeletal parts which also indicate females.

The mandibles proper of small *Urus* cows, Pindstrup, e.g., are in size and shape almost equal to the mandibles of large domestic oxen (Søndersø, Maglemosegaard); on several points, however, somewhat larger, cf. e.g. the smallest length, anterior-posteriorly, of the vertical ramus just below the *processus condyloideus* (Table 10). An exception is the distance from the hind border of m 3 to the posterior border of the vertical ramus, which may be longer in the domestic oxen, in accordance with the fact that the tooth row is shorter in these animals. The longer row of teeth is a character which distinguishes the *Urus* from domestic cattle (Degerbøl, 1962, fig. 2).

Also the entire lengths of the premolars and molars are longer in the *Urus*, whereas the difference in lengths of the individual teeth in the *Urus* and domestic cattle are variable and there is an overlapping, particularly marked in the hindmost

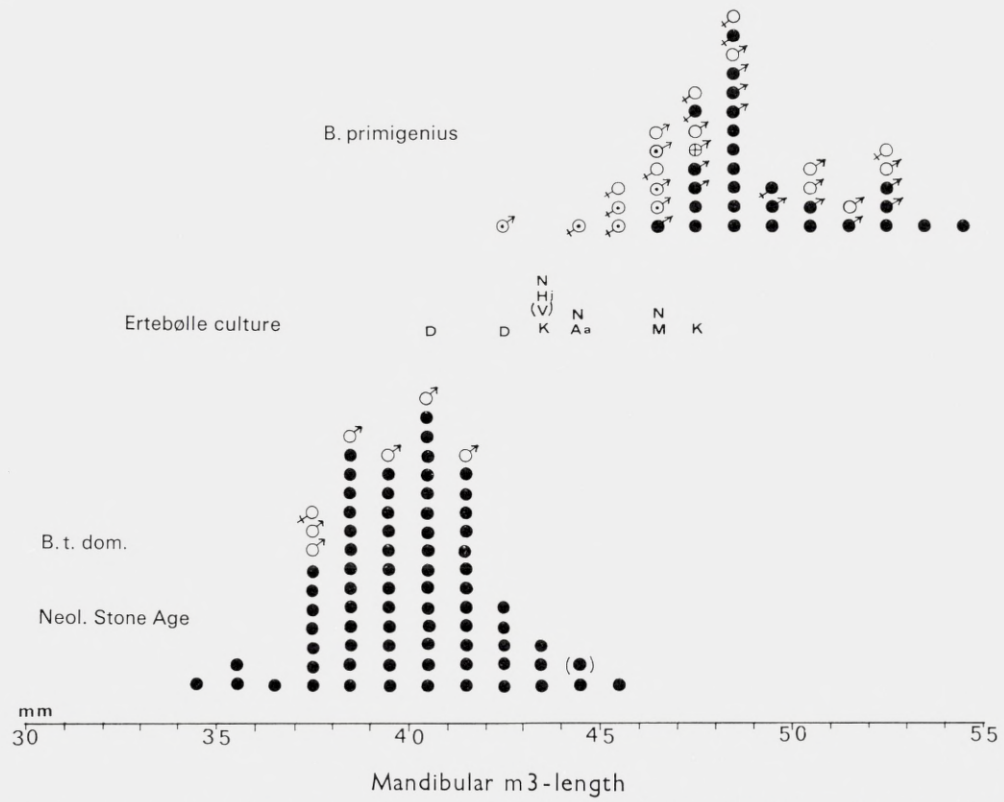


Fig. 17. *Urus* teeth marked ● originate from single finds of teeth from Maglemose sites; Boreal period. Teeth attached to skulls or mandibles, the sex of which is stated, are marked as to sex, ♂ or ♀. A filling in the sex signatures indicates animals older than Zone VII. From Zone VII only one skull is at hand, marked by a cross in the sex signature. Animals from Zone VIII, the Subboreal, are marked by a dot in the symbols. Open symbols indicate undated animals.

Ertebølle culture: localities marked by their initials. (Cf. p. 16).

B. t. domesticus: teeth marked ● are single teeth from prehistoric settlements (Degerbøl, 1963). Sex signatures indicate teeth from skulls of Neolithic domestic cattle examined in the present treatise.

molar (m 3). In fig. 17 the greatest length of this tooth, measured at the basal part is shown. The length of the individual tooth varies considerably according to the place where the measurement is taken. As an example the m 3 in the Gesten B mandible may be mentioned. This tooth is only slightly worn, the posterior column is still unworn. Measured when placed in the jaw the greatest m 3 length that may be found, is 42 mm., but when it is sawn out of the jaw, it appears that the length in the middle is 45 mm. and at the base 46 mm. The corresponding measurements of width are 16.5, 17, and 18.8 mm. By comparison it is thus quite decisive that the teeth investigated are measured in the same way. The measurement at the base is easily taken in isolated teeth, and in strongly worn teeth even when placed in the jaw, but otherwise the teeth must be taken out of the jaw and that, of course, may give rise to some difficulties.

TABLE

	Bos primigenius ♂♂										
Zone	IV					V			VI		IV/V
Mandibles	Grænge	Vig	Sorø	Gøderupgaard subad.	Røde Mølle	Rønnebæksholm	Nyrup	Falster	Bisserup	Fakse	St. Damme
	1	2	3	4	5	6	7	8	9	10	11
1. i 1, post. bord. – *proc. condyloidius*	510	—	520	480	500	532	—	495	—	495	525
2. *For. mentale* – *proc. condyloideus*	445	—	450	420	440	465	—	435	—	433	463
3. i 1, post. bord. – *proc. angularis*	470	—	475	455	465	480	—	455	—	460	485
4. *For. mentale* – *proc. angularis*	395	—	400	383	400	415	405	388	—	385	420
5. *For. mentale* – p 2	87	—	90	74	93	98	—	87	87	77	96
6. Smallest length of *ramus verticalis*	67	—	70	72	75	69	—	71	—	69	73
7. Smallest depth of diastema	32	—	36	34	37	39	—	38	35	34	38
8. Depth at m 2, medial	72	—	72	76	73	76	77	75	—	73	72
9. Depth behind m 3, medial	82	—	84	88	85	84	80	81	—	81	81
10. Largest thickness	34	—	35	33	35	36	37	34	35	35	37
11. p 2 – m 3 length	179	—	173	194	160	172	—	177	168	186	167
12. p 2 – p 4 length	64.5	—	60	(70)	58	(66)	—	62	—	62	61
13. m 1 – m 3 length	114.5	—	114	119	103	111	—	114	109	124	105
14. m 3 length at lower half	50.4	48.5	46.5	48.5	47.5	48.5	52.2	49.8	51.8	52.2	47.2
15. m 3 width, at base	19.5	—	20.5	20.2	21.5	19.8	20.8	19.5	20.8	20.4	20
16. m 3 – *ramus verticalis*	128	—	135	116	141	133	13.3	124	—	123	150
Skull present = ×	×	×	×	×	×	×	—	—	—	—	+

* No. 9 associated with *scapula*, *humerus*, and *tibia*.

In fig. 17 the *Urus* teeth marked ● originate from Maglemose sites, Boreal period, and indicate single or isolated finds of teeth, the sex determination of which is not possible. Teeth belonging to skulls or mandibles, the sex of which is stated are marked to sex, ♂ or ♀. A filling in of the sex signatures indicates that the animal in question originates from a period before Zone VII. With this group are, in this connection, also placed some not directly dated skulls from Zealand. (Cf. p. 42).

From Zone VII only one skull is at hand; it is marked by a cross in the symbol. Animals from Zone VIII, the Subboreal period, are marked by a dot in the symbols. Open sex symbols indicate undated animals.

From this figure it appears that the range of sizes of m 3 length in *Urus* cows falls within the range of variation in *Urus* bulls. The m 3 in the small Grænge cow is a little longer than in the large Ullerslev specimen (49.8 mm. and 48.8 mm.), but it is a well-known fact that length of teeth does not always correspond to the length of the

10.

Bos primigenius ♂♂														*Bos primigenius* ♀♀					
VII	VIII					Uncertain age								V		II/V	VIII		U. a.
Bønnelykke	Grejs Mølle	Ugilt	Klarup	Gesten A	Tinglev	Bro Mølle	Vanløse	Jelling	Ortoft	Aarhus Havn	Gesten C	Danmark (2. afd.)	Danmark (Schmidt)	Ullerslev	Grænge	St. Taastrup	Pindstrup	Toftum	Gesten B
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
492	520	485	490	495	(490)	505	(510)	(480)	(520)	—	—	—	—	485	450	470	—	480	—
425	464	420	422	432	427	445	450	430	455	—	—	457	—	410 425	387	415	380	425	405
455	487	450	455	460	(450)	470	460	450	465	—	—	—	—	455	420	445	—	450	—
383	417	380	372 395	390	385	395	400	400	400	—	—	408	—	375 395	350	380	345	390	355
88	96	90	63 71	85	83	96	90	95	90	—	—	83	—	91 78	71	78	74	90	71
74	—	70	70	72	65	65	70	68	71	—	—	77	70	68	65	70	68	71	72
36	33	35	35	34	33	34	34	33	37	—	—	39	—	32	30	30	29	32	32
73	73	67	54	70	66	76	71	65	73	75	75	70	70	72	72	71	58	72	61
86	78	82	81	80	74	83	76	80	78	86	86	86	86	80	78	84	76	82	73
35	36	33	40	33	32	33	34	34	38	—	35	36	35	34	32	33	31	32	32
173	168	158	174	171	166	179	176	167	170	—	176	175	168	170	169	178	165	166	167
59	(63)	58	—	63	57	(65)	(62)	56	(60)	—	(67)	62	56	57	56.5	65	59	58	63
111	(102)	100	—	107	106	114	114	111	112	107	107	109	110	111	110	113	104	105	105
47.3	47.0	42.5	—	46.9	46.6	48	50.8	48.5	52.3	51.5	46.9	47.2	50.6	48.8	49.8	47.4	45.5	44.3	45.9
19.6	19.3	18.5	—	20.0	20.5	183	19.5	19.4	21.5	20.5	19.5	18.2	20.5	19.8	19.5	18.7	18.7	18.6	18.8
121	148	127	(138)	132	137	117	133	136	140	—	—	—	—	130	112	119	110	132	120
×	×	×	—	—	×	×	—	—	—	—	—	—	—	×	×	×	×	×	—

jaw. The largest m 3 in cows just passes 52 mm. The smallest m 3, attached to a mandible, was until recently known from the Pindstrup cow (45.5×18.7 mm.). In the present material two more m 3 teeth are of about equal length: Kundby 45.8 mm. and Gesten B 45.9 mm., and a still smaller m 3 is found in the Toftum cow (44.3× 18.6 mm.). A most remarkable deviation, however, is the Ugilt bull with an m 3 length of only 42.5 mm.; width 18.5 mm. If this tooth had been found isolated, it probably would have been referred to domestic animals. As previously mentioned, for the first time, however, it is here definitely proved that so small an m 3 may occur in *Urus*, and even in a large bull. A fact which throws new light on the isolated m 3 from several kitchen middens, and which must involve a new examination and judgment of these teeth.

From the Krabbesholm kitchen midden (No. 84) three mandibular m 3 specimens are at hand, the largest of which, 47.1 mm., clearly belongs to a young *Urus*,—the

TABLE 10

	Bos primigenius ♀♀								
Zone	Uncertain age					Var.			
Mandibles	Kundby	Tørring Stougaardskjær	Hvidbjerg	Løgenkjær	Vindum subad.	♂♂	♀♀	Aamølle	Mejlgaard
	32	33	34	35	36			37	38
1. i 1, post. bord. – *proc. condyloideus*	465	(455)	(465)	455	445	485–532	450–485	—	—
2. *For. mentale* – *proc. condyloideus*	396	395	405	390	385	420–465	380–425	—	—
3. i 1, post. bord. – *proc. angularis*	(422)	(425)	(435)	420	412	450–487	420–455	—	—
4. *For. mentale* – *proc. angularis*	355	365	365	355	354	(372)–417	345–395	—	—
5. *For. mentale* – p 2	66	78	71	68	75	(63)71–98	68–91	—	—
6. Smallest length of *ramus verticalis*	65	70	69	67	61	65–77	65–72	—	—
7. Smallest depth of diastema	31	28	31	31	32	32–39	28–32	—	—
8. Depth at m 2, medial	68	67	66	68	67	(54)65–77	58–72	—	—
9. Depth behind m 3, medial	79	77	77	82	84	74–88	73–84	—	—
10. Largest thickness	36	29	34	34	33	32–40	29–36	—	—
11. p 2 – m 3 length	175	177	175	171	(177)	158–179	165–178	—	—
12. p 2 – p 4 length	62	64	59	59	(69)	56–65	57–65	—	63
13. m 1 – m 3 length	108	114	113	114	(105)	100–124	104–114	—	—
14. m 3 length at lower half	45.8	46.9	48.8 49.3	52.2	47.5	42.5–52.3	44.3–49.8	44.5	46.5
15. m 3 width, at base	18.5	18.8	19.8	(19.7)	19.5	18.3–21.5	18.5–19.8	18.7	18.3
16. m 3 – *ramus verticalis*	112	109	120	116	133	121–150	109–132	—	—
Skull present = ×	—	—	—	—	—				

* No. 32 associated with *femur*; No. 33 ass. with *metatarsus*; No. 34 ass. with *atlas*.

posterior half of the hindmost column is unworn, indicating an age of about 3 years. The next in size is comparatively short, 43.5 mm., but broad 18.5 mm., which together with the clear-cut shape no doubt indicates an *Urus*, too (about 4 years old). The third is very small (40.8×17.2 mm.) and light-coloured, of quite another tinge than the rest of the remains, it represents a domestic cow, but obviously does not belong to the kitchen midden proper and was not mentioned by WINGE either.

The m 3 from Mejlgaard (p. 29) is 46.5 mm. long, and no doubt originates from a *Urus*.—Two m 3, from Hjerk Nor (43.8×19.0 mm.) and Aamølle (44.5×18.7), also may be representing the *Urus* (cf. Table 10). The tooth from Hjerk Nor is much worn and belonged to a fairly old animal, whereas the unworn posterior column in the Aamølle tooth, indicates an age of about 3 years.

From the much discussed Dyrholm settlement four m 3 teeth are at hand. On the basis of the above-mentioned material the two largest of these (42.7×18.7 mm.) no doubt must be grouped with the *Urus*. The two smaller ones (41×18 mm.) are,

(continued).

Bos primigenius											*Bos taurus domesticus*									
Kitchen middens																				Var.
Krabbesholm	°	Hjerk Nor	Virksund	Dyrholmen II K 1	Dyrholmen M 13	Dyrholmen VI A 10	Dyrholmen VII G 7	Norslund	Norslund	Norslund	Gammellung ♂	Maglemosegaard ♂ Vedbæk II	Holmene ♂	Sønderso ♂	Bodal ♂	St. Lyng ♂ subad.	Sandhuse II ♀	Vikso ♀	Bundsø (♀)	♂♂
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	
—	—	—	—	—	—	—	—	—	—	—	400	425	435	425	420	380	340	326	375	400–435
—	—	—	—	—	—	—	—	—	—	—	357	371	380	372	365	340	300	276	358	357–380
—	—	—	—	—	—	—	—	—	—	—	390	405	415	413	405	355	355	310	—	390–415
—	—	—	—	—	—	—	—	—	—	—	337	345	360	350	340	305	285	254	—	337–360
68	—	55	—	—	—	—	—	—	—	—	62	77	70	68	70	56	50	49	68	62– 77
66	—	—	—	—	—	—	—	—	—	—	64	63	70	61	66	52	55	50	—	61– 70
—	—	—	—	—	—	—	—	—	—	—	31	31	32	29	34	26	28	20.5	27	29– 34
—	—	—	—	—	—	—	—	—	—	—	53	61	61	52	63	56	56	49	—	52– 63
—	—	—	67	—	—	—	—	—	—	—	69	70	70	69	74	70	—	62	73	69– 74
—	—	—	31.5	—	—	—	—	—	—	—	31	33	33	35	33	29	26	24	—	31– 35
—	—	—	—	—	—	—	—	—	—	—	147	145	148	148	138	159	148	128	133	138–148
—	—	—	—	—	—	—	—	—	—	—	54	51	56	54	(40)*	59	(58)	47	47	51– 56
—	—	—	—	—	—	—	—	—	—	—	92	91	(91)	94	95	100	91	81	85.5	91– 95
47.1	43.5	43.8	43.5	42.5	42.7	41	40.5	45.2	43.5	44.5	37.3	37.5	40.5	38.9	41.5	39.5	37.2	35.0	39.5	37.3–41.5
19.0	18.5	19.0	17.4	18.7	18.7	18	17.5	18	18.2	18	16.5	16.5	15.8	17.5	18.8	16.8	15.8	(14)	17.5	15.8–18.8
—	—	—	73	—	—	—	—	—	—	—	125	120	139	126	130	89	—	78	—	120–139

it is true, smaller than the m 3 in the Ugilt bull skull; however, this specimen is not at all a small skull, so it is probable that still smaller m 3 may occur, in a *Urus* cow, e.g. These teeth from the earliest part of the Dyrholmen site, Dyrholmen I, thus tentatively may be placed with the other *primigenius* remains from the period, (cf. p. 39).

It should be noted that the smallest dated m 3 teeth originate from the geologically latest period, the Subboreal period: Pindstrup, ♀, 45.5 mm.; Toftum, ♀, 44.3 mm.; Ugilt, ♂, 42.5 mm., and from the Ertebølle settlements: Aamølle, 44.5 mm.; Krabbesholm, 43.5 mm., Hjerk Nor, 43.8 mm., and Dyrholmen 42.7 mm., whereas the largest m 3 belong to the Boreal period. This might of course be accidental, but together with the short rows of upper teeth in all subboreal skulls (Table 9, p. 85) it no doubt indicates a trend towards a reduction in size of the hindmost molar in the phylogenetically latest *Urus*. Cf. p. 42.

It may seems strange, too, that so many small m 3 teeth, dated and undated,

TABLE

	Bos primigenius ♂♂									
Zone	III		IV		V				IV/V	
Metacarpus	Terp	Sorø	Grænge A ad., jun.	Munkebjergby	Grænge D	Nyrup	Falster	Lundby (DEGERBØL 1942)	St. Damme	Gøderupgaard B
	1	2	3	4	5	6	7	8	9	10
I. Total length	251	258	252	252	245	245	249	253	258	248
Length, smallest, medial	240	—	235	238	230	232	235	241	246	235
II. Proximal width:										
1. Transversal	89.5	87	87	82	83.5	86.5	78	84	86	77
2. Anterior-posterior, greatest	55	53.5	52	53	49	54	46	51.5	55.5	50
3. Articulation, anterior-posterior	48	48	50	44.5	45	45	43	47	50.5	43
III. Diaphysis width:										
1. Middle, transversal, smallest	53	50	52	51	49	53	50	51.5	48.5	50
2. Middle, anterior-posterior	35	31.5	35	36	31	35	32	32	34	33
3. Smallest width, anterior-posterior	31.3	30.5	—	—	—	—	—	—	—	—
IV. Distal width:										
1. Transversal	85.5	85	87.5	82	83.5	88	81	86	84.5	—
2. *Trochlea medialis*, anterior-posterior	45	45.5	45.5	42	45	46	44	44.5	46.5	43
Index:										
II/I	35.7	33.7	34.4	32.5	34.1	35.3	31.3	33.2	33.3	31.1
III/I	21.1	19.4	20.6	20.2	20.0	21.6	20.1	20.4	18.8	20.2
IV/I	34.1	32.9	34.7	32.5	34.1	35.9	32.5	34.0	32.8	—

belonged to morphologically young animals, in which the posterior column is unworn or but slightly worn. As teeth, however, do not increase in size after eruption, because the enamel is developed before that time, the small size has nothing to do with the individual age. It is true that the cement which surrounds the tooth, may be thicker in old animals, but this increase is comparatively small and may, at least as to length, be disregarded.

These slightly worn teeth may indicate that the Ertebølle people particularly hunted young *Urus*, perhaps preeminently cows.

Only seven mandibles attached to skulls of domestic cattle examined here are at hand, five belonging to adult bulls (or bullocks) and two to subadult animals. From previous excavations only one complete mandible from the Subboreal period, the Bundsø settlement, occurs, probably belonging to a cow; cf. Table 10.

Isolated hindmost molars, however, are present in a comparatively large number in prehistoric settlements. To give an idea of the size variation of domestic cattle during prehistoric periods I have previously (1963, fig. 14) stated the measurements of a series of these teeth in domestic cattle. In fig. 17 in the present treatise I have

11.

Bos primigenius ♂♂

VI		VII	VIII					Uncertain age				Settlements (Fragmentary bones)				
Holmegaard 386/48	Sværdborg (Degerbøl, 1942)	Aamølle	Ugilt	Klarup	Gesten D Tranekær Mose	Grejs Mølle	Tinglev	Vanløse	Kongsted	Nørlund	Løsning	Sværdborg	Øgaarde	Havnø	Hjerk Nor	Holmegaard 1928
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
264	248	248	264	249	244	278	249	250	252	256	260	—	—	—	—	—
250	233	231	250	235	230	262	236	238	242	242	247	—	—	—	—	—
83	87	82.5	86	81	83	88	81	87	78	86	90	—	—	—	86	78
54	51.5	51.5	53	52	49	54	46	53	49	49	54	—	—	—	52	51
47	47	43	47	47	43	48	43.5	46	46	44	45	—	—	—	45	45
51	51	—	49	49	47	52	45	52	49.5	53	53	—	—	—	—	(48)
34.5	35	—	33	33	35	38	33.3	32	30.5	33.5	35	—	—	—	—	31.5
31	29.5	—	32	30	—	36	31	30	30	32	31	—	—	—	—	—
83	84.5	82	84	81	80	88	80	84	81.5	(83)	83	84.5	85	80	—	—
45	42	45	45	46	42	46	42.5	45.5	43.5	—	43	—	46.5	—	—	—
31.4	35.1	33.3	32.6	32.5	34.0	31.7	32.5	34.8	31.0	33.6	34.6	—	—	—	—	—
19.3	20.6	—	18.6	19.7	19.3	18.7	18.1	20.8	19.6	20.7	20.4	—	—	—	—	—
31.4	34.1	33.1	31.8	32.5	32.8	31.7	32.1	33.6	31.9	(32.4)	31.9	—	—	—	—	—

inferred the new measurements marked by sex signatures. It should be noted that although the mandibles under consideration are large, the m 3 teeth are of modest length, being outside the size range of *Urus* and not reaching the maximum of this tooth in domestic cattle from the Subboreal settlements.

This might give rise to the question whether the largest of the said isolated finds of teeth in fact belong to domestic animals?

The quoted teeth in graph fig. 17 come from Subboreal farmer settlements, in which with two exceptions, from Ørum Aa and Bundsø, no remains of *Bos primigenius* are stated. From Ørum Aa five m 3 specimens exist, the largest measuring 41.5×18.4 mm. They, no doubt, all belong to *Bos taurus domesticus*. From Bundsø only two m 3 teeth are longer than 40 mm.: 44.4×18.2 and 44.0×18.2 mm., respectively. In fact it is impossible to distinguish the first of these from the Ugilt and Dyrholmen m 3 specimens, and of course it may have belonged to a *Urus*. In the other the large measurements are found only at the very base, which is tuberously swollen, whereas the rest of the crown is fairly small. No doubt it belongs to a *Bos taurus domesticus*.

TABLE 11

	Bos primigenius ♀♀									
Zone	V	VI			II–V		VIII			
Metacarpus	Ullerslev	Holmegaard	Sværdborg XXIII C 4	Sværdborg (1918, A)	St. Taastrup	St. Taastrup	Pindstrup	Bønnerup	Bønnerup	Alminddalen
	28	29	30	31	32	33	34	35	36	37
I. Total length	246	235	243	244	249	245	235	245	230	240
Length, smallest, medial	235	227	239	234	238	231	225	234	219	228
II. Proximal width:										
1. Transversal	74	—	67	72	75.5	70	66.4	70	63.0	71
2. Anterior-posterior, greatest	45	—	42	45	46.5	42	41.0	(44)	39.0	43
3. Articulation, anterior-posterior	39	—	40	(40)	43	39	37.5	(40)	36.0	38
III. Diaphysis width:										
1. Middle, transversal, smallest	40	—	38	—	41	38.5	37	(40)	40.0	39
2. Middle, anterior-posterior	28	—	26	29	29	26.7	28.4	(28)	28	28
3. Smallest width, anterior-posterior	27.5	—	25.8	27.8	29	26.7	27	—	26	27
IV. Distal width:										
1. Transversal	73	70	69.5	72	77.5	70.0	66	67	67	68
2. *Trochlea medialis*, anterior-posterior	41	37.5	38.7	39	41.2	38.5	38	39	37	38
Index:										
II/I	30.0	—	27.8	29.5	30.3	28.6	28.3	28.6	27.4	29.6
III/I	16.3	17.9	15.6	—	16.5	15.8	15.7	—	17.4	16.3
IV/I	29.7	29.8	28.6	29.5	31.1	28.5	28.1	27.3	29.1	28.1

* Probably bullock.

Most teeth graphed come from settlements on Langeland (Troldebjerg, Blandebjerg, Lindø) and from Lyø, a small island S.W. of Funen. From these settlements we have bones of large domestic oxen. The largest m 3 (45.5×18.5) originates from Lindø, but it is highly curved from side to side, indicating a *Bos taurus domesticus* (H. WINGE, 1928, p. 48). From Lyø an m 3 measures 42.8×17.5, thus fairly thin also indicating a *B. t. domesticus*. From the same settlement a mandibular fragment with highly worn m 2 and m 3 occurs. It is split open to take out the marrow. The m 3 is large 44.8×18.5 mm., but the m 2–m 3 length is fairly short 72 mm., as compared with 78 in the Pindstrup *Urus* and 89 mm. in the Nyrup *Urus*, also this tooth no doubt belonged to a *B. t. domesticus*. A large m 3 (43.1×19.3 mm.) is furthermore known from the Troldebjerg settlement, but although it is similar to the Ugilt m 3, the occurrence at this particular settlement in which a large amount of remains of large domestic cattle, but none of *Urus*, has been reported, and where in a series of mandibular m 3 a gradually increasing tooth length is demonstrated, makes it probable that it belonged to a domestic ox.

(continued).

Bos primigenius ♀♀										*Bos taurus domesticus*						
Uncertain age			Settlements (Fragmentary bones)							VIII						
Tjerrild	Vittrup	Auning/ Pindstrup	Sværdborg	Vinde Helsinge	Ogaarde	Mejlgaard	Hjerk Nor	Brabrand (II C 6[a3])	Brabrand	Store Lyng (♂)*	Maglemosegaard (♂) (Vedbæk II)	Vedbæk III (♂)*	Borremose (♂)*	Holmene ♀	Holmene (left) (♂)*	Holmene (right) (♂)*
38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
231	253	232	—	—	—	—	—	—	—	201	199	204	217	205	210	216
—	242	220	—	—	—	—	—	—	—	—	189	194	207	195	199	205
69	75.5	70	—	72.7	66	—	—	65.5	72	62	64	63	72	61	67.0	68
42	46	44	—	44	—	—	—	41.0	45	37	40	38	44	36	41.3	41
40	39.5	39	—	39.5	—	—	—	36.2	40	34	34	36	37	31	36.0	36
38	43	39	—	37.5	35.5	—	—	36.2	—	33	39	36	37	33	37.5	38.7
28	32	28	—	27	—	—	—	—	—	25	25.5	23.8	26.5	24.5	28	28
26	32	27	—	—	—	—	—	—	—	23.5	23.5	21.8	23.8	22.0	23	23
—	70	67	71.5	—	—	71	66	—	—	61	65	68	73	59	70	70
—	40	39	—	—	—	40	37.5	—	—	—	34.5	34.7	37.5	32.0	36	35.7
29.9	29.8	30.2	—	—	—	—	—	—	—	30.8	32.2	30.9	33.2	29.8	31.9	31.5
16.5	17.1	16.8	—	—	—	—	—	—	—	16.4	19.6	17.6	17.1	16.1	17.9	17.9
—	27.7	28.9	—	—	—	—	—	—	—	30.3	32.7	33.3	33.6	28.8	33.3	32.2

On the other hand, it should be noted that the only discovery of *Urus* on Funen later than Zone VI—the Korinth brain-case from Zone VIII, the Subboreal period,—just originates from southern Funen, with which Langeland and Lyø at that time probably were connected. These examples stress the importance of working with complete skulls or mandibles.

To sum up, it may be stated that the large teeth from Langeland and Lyø no doubt belong to domestic cattle and thus there is an overlapping in size of the mandibular m 3 in *Urus* and domestic oxen.

Limb Bones.

Limb bones belonging to complete skeletons or attached to comprehensive skeletal parts are of particular interest, as the sex *eo ipso* is settled. — Several complete or almost complete skeletons of *Urus* bulls are available (Vig, Sorø, Grænge, Store Damme, Nyrup, Langeland, Terp, Tinglev, etc.). Complete skeletons of *Urus* cows, however, are very rare. Leithner has depicted a fairly young individual, preserved

TABLE 11

	Bos taurus domesticus									
Zone	VIII									
Metacarpus	Viksø ♀	Hallebygaard	Bundsø (♂)*	Bundsø (♀)	Bundsø (♂)	Bundsø (♀)	Bundsø (♀)	Troldebjerg (♂)	Troldebjerg (♂)*	Aamosen 1941 (♂)*
	55	56	57	58	59	60	61	62	63	64
I. Total length	187	177	(215)	204	196	202	196	210	212	210
Length, smallest, medial	180	—	205	192	185	192	190	199	201	199
II. Proximal width:										
1. Transversal	48	52.5	67	62	60.5	60	53.3	66.5	68	69
2. Anterior-posterior, greatest	30	31	39	37	40	34.5	34	40	42	41
3. Articulation, anterior-posterior	28	—	36	—	—	—	—	38	38	38
III. Diaphysis width:										
1. Middle, transversal, smallest	22.5	26.5	36.6	35	35	30	27.5	40	38	36
2. Middle, anterior-posterior	18.5	—	25.7	22.2	23,4	23.6	21.8	28	28.5	26
3. Smallest width, anterior-posterior	18.7	—	25.2	—	—	—	—	26	23	25
IV. Distal width:										
1. Transversal	48	48.5	63.7	63.5	63.5	57.8	58.8	67.5	70	69
2. *Trochlea medialis*, anterior-posterior	27.5	27	34.5	34.2	34.7	29.6	31	35.7	37	35.7
Index:										
II/I	—	—	(31.1)	30.4	30.9	29.7	27.2	31.7	32.1	32.8
III/I	—	15.0	(17.0)	17.2	17.9	14.9	17.3	19.0	17.9	17.1
IV/I	—	—	(29.6)	31.4	32.6	28.6	30.0	32.1	33.0	32.8

* Probably bullock.

in Stockholm, but the postcranial parts are not described, nor measured. A unique specimen, to the best of my knowledge, is the complete and dated skeleton of the *Urus* cow from Ullerslev, from the Boreal period (Zone V), treated here. From Denmark furthermore comprehensive skeletal parts of females are at hand from Pindstrup, Bønnerup, and Store Taastrup.

A considerable number of fragmentary limb bones of *Bos* originate from the Maglemose settlements, the age of which is so considerable, that bones of domestic cattle are excluded. Particularly for comparison with corresponding bones from kitchen middens proper this material is included in the present investigations.

Metapodials. In bulls the metapodials are considerably more robustly formed than in cows. They are not only on an average longer, (figs. 18 and 19), but a distinct sex dimorphism exists regarding width (Table 11).

The metapodials of a bull from Grejs Mølle are exceptionally long, astoundingly dated at the Subboreal period; the metacarpal length is 278 mm., as compared with

(continued).

Bos taurus domesticus										*Bos primigenius*		*B. t. dom.*	
VIII						Recent				Var.		Var.	
Orum Aa (Winge 1900)	Kærup, Bjerget (♂)	From Imhof	From Jewell	From Hescheler & Rüeger 1942	Prize bull (Stamtyr) (Fr. the year 1870)	Red Danish breed (Rød dansk mælkerace) (7 years)	K 565 (Bullock)	A 740 ♂	A 588 ♂♀	♂♂ (Nos. 22)	♀♀ (Nos. 13)	Holmene ♂♀	♂♂ (Nos. 6)
65	66	67	68	69	70	71	72	73	74	75	76	77	78
—	210	179–221	186–218	175–215 (Nos. 15)	200	228	223	205	214	244–278	230–253	205	199–217
—	199	(Nos. 45)	(Nos. 13)		—	217	219	194	204	230–262	219–242	195	189–207
—	71	—	—	—	71	65	73	75	66	77–90	63–75.5	61	63–72
—	45	—	—	—	—	43	47	47	43	46–55	39–46.5	36	38–45
—	37	—	—	—	—	37	39	41	34	43–50	36–43	31	34–38
—	39.5	—	—	—	39.5	40	39	42	36	45–53	36–43	33	36–40
—	27	—	—	—	—	28.7	28	27.5	26	31–35	26–32	24.5	23.8–28.5
—	25	—	—	—	—	28.4	29	27	26	30–36	26–32	22.0	21.8–26
57–66.5	71	—	—	—	71	66	67	72	64	80–88	66–77.5	59	63.7–73
—	38	—	—	—	39	38.5	39	42	37	42–46.5	37–41.2	32.0	34.5–38
—	33.8	—	—	—	35.5	28.5	32.0	36.6	30.8	31–35.7	27.4–30.3	29.8	30.9–33.8
—	18.8	—	—	—	19.8	17.5	17.1	20.5	16.8	18–21.6	15.6–17.9	16.1	17.1–19.6
—	33.8	—	—	—	35.5	28.9	29.4	35.1	29.9	31.4–35.9	27.3–31.1	28.8	32.2–33.8

264 mm. in the longest specimen but one from the Holmegaard settlement, from the Boreal period and Ugilt, from the Subboreal period. Again, one of these deviations mentioned above, e.g., regarding the width of the occipital condyles (p. 77). In this connection also the small skull from Star Carr may be referred to.

As compared with earlier statements (Degerbøl, 1942, p. 99) it should be noted that the lower limits of the range variation of metacarpal lengths in *Urus* cows are displaced downwards, from 243 mm. to 230 mm. The metacarpal bones from Bønnerup, Tjerrild, and Auning (No. 60), are exceedingly small, the lengths of them being 230, 231, and 232 mm., respectively (Table 11, No. 36, 38, and 40). These measurements are not, however, unprecedented, as Hilzheimer (1909) mentions a *metacarpus* length of 233 mm., but that was until now an isolated example. The metacarpal of the Pindstrup cow, originating, like the Bønnerup cows, from the Subboreal period is also comparatively small (235 mm.) (Degerbøl, 1962). It should be emphasized that small metapodials occur already in the Boreal period. From Holmegaard settlement

TABLE

	Bos primigenius ♂♂												
Zone	III	IV			V	VI	IV/V	VIII					
Metatarsus	Terp	Vig	Sorø	Grænge A ad. jun.	Lundby (DEGERBØL 1942)	Ogaarde III F 6°	St. Damme	Ugilt	Klarup	Auning (Lykkegaard)	Gesten (Tranekær)	Grejs Mølle	Tinglev
	1	2	3	4	5	6	7	8	9	10	11	12	13
I. Total length (posterior)	287	293	304	288	280	(285)	295	295	283	285	270	315	283
Length, lateral, smallest	274	287	291	276	271	275	288	284	269	276	254	298	266
II. Proximal width:													
1. Transversal	71	68	69	67	71	—	73	68	68	73	65	72	65
2. Anterior-posterior	66	—	66	67	65	—	71	67	66	67	63	68	60
III. Diaphysis width:													
1. At middle, transversal	43	44	42	41	41	37	42	39	41	43	38	42	39
2. At middle, anterior-posterior	41	—	41	41	42	37	42	40	39	45	38	43	39.5
3. Smallest, anterior-posterior, distal.	36.4	—	35.5	35.5	34.5	32.5	35	35	33	37	34	39	33.2
IV. Distal width:													
1. Transversal	79	82	78	79	73	77	81	79	74	75	73	79	74
2. *Trochlea medialis*, ant.-post.	44.5	—	45.5	45	44.2	44.5	47	45	45	44	41	45	41.6
3. Index $^{2}/_{1}$	56.3	—	58.3	57.0	60.5	(57.8)	58.0	—	60.8	58.7	(56.9)	57.0	56.2
Index:													
II/I	24.7	23.2	22.7	23.3	25.4	—	24.7	23.1	24.0	25.6	24.0	22.9	23.0
III/I	15.0	15.0	13.8	14.2	14.6	—	14.2	13.2	14.5	15.1	14.1	13.3	13.8
IV/I	27.5	28.0	25.7	27.4	26.1	(27.0)	27.5	26.8	25.1	26.3	(26.7)	25.1	26.1

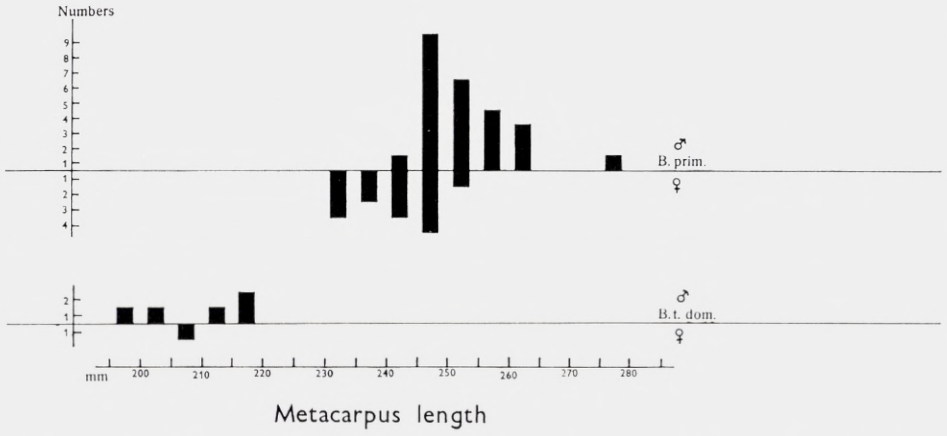


Fig. 18. *Metacarpus* length. The metacarpal lengths of domestic oxen are widely outside the range of that in *Urus*.

12.

Bos primigenius ♂♂											*Bos primigenius* ♀♀								
Uncertain age					Settlements						V	VIII				U. age			
Hvalsø (Sonnerupgaard)	Holbæk Museum	Næsbyhoved	Stilling Sø (Skanderborg)	Mors	Ogaarde	Ogaarde	Hjerk Nor	Norslund	Hescheler & Rüeger	Hescheler & Rüeger	Ullerslev	Pindstrup	Bønnerup B	Bønnerup A	Ørum Aa	Tørring	Vinderup Struer	Maglemose 1949	Sværdborg (Degerbøl 1942)
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
293	308	290	278	293	—	—	—	—	280	302	280	275	283	268	275	281	270	—	—
275	—	282	265	275	—	—	—	—	—	—	269	260	270	257	263	267	255	—	—
72	68	68	64	69	—	—	—	67	67	67	62	56	56	50	56	54	58	—	—
67	62	65	61.5	68	—	—	—	66	—	—	57	56.5	56.5	50.5	56	55	57	—	—
43	42	46	38.5	41	—	—	—	—	40	45	35.5	31.8	34	34	33	33	31	35	—
43	—	42.5	40.5	42	—	—	—	—	—	—	37	35.2	37	36	33	34	33	35	—
37	—	37	31	34	—	—	—	—	—	—	31.5	31	34	31	—	29.5	30	30.5	—
78	77	80.5	75	75	77	74	75	75	76	76	68	64	62.5	62	63	66	68	66	67.5
45	44	46.5	43.5	44	44	43	44	43	—	—	41.5	38.5	39.5	36	(38)	38	40	40	40.5
57.7	57.1	57.8	58.0	58.7	57.1	58.0	58.7	57.3	—	—	61.0	60.2	63.2	58.1	60.3	57.6	58.8	60.6	60.6
24.5	22.1	23.5	23.0	23.5	—	—	—	—	23.9	22.1	22.1	20.4	19.8	18.7	20.4	19.2	21.5	—	—
14.7	13.6	15.9	13.8	14.0	—	—	—	—	14.3	14.9	12.7	11.6	12.0	12.7	12.0	11.7	11.5	—	—
26.6	25.0	27.7	27.0	25.6	—	—	—	—	27.1	25.1	24.3	23.3	22.1	23.1	22.2	23.5	25.2	—	—

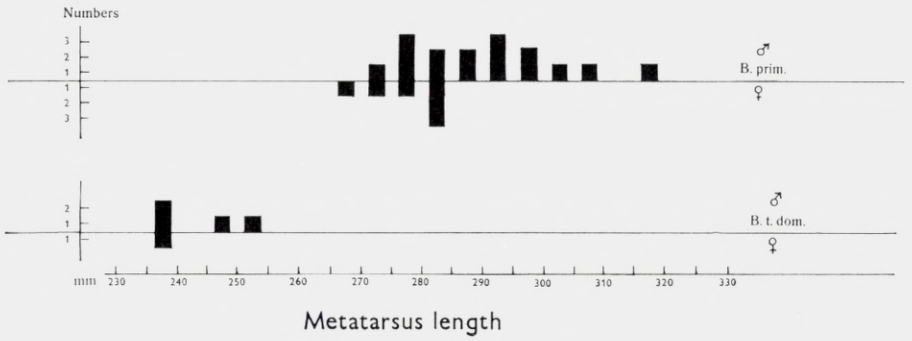


Fig. 19. *Metatarsus* length. Cf. fig. 18.

TABLE 12

	Bos primigenius ♀♀								*Bos taurus*				
Zone		Kitchen middens											
Metatarsus	Øgaarde	Krabbesholm	Hjerk Nor	Hjerk Nor	Hjerk Nor	Dyrholmen	Dyrholmen	Mejlgaard	St. Lyng ♂ subad.*	Maglemosegaard ♂ (Vedbæk II)	Vedbæk III ♂*	Borremose ♂*	Holmene ♀
	34	35	36	37	38	39	40	41	42	43	44	45	46
I. Total length (posterior)	—	—	—	—	—	—	—	—	(235)	235	236	247	236
Length, lateral, smallest	—	—	—	—	—	—	—	—	—	224	228	235	228
II. Proximal width:													
1. Transversal	57	—	—	—	—	—	—	57	50	52	49	59	49
2. Anterior-posterior	54	—	—	—	—	—	—	55	50	48	49	54	47
III. Diaphysis width:													
1. At middle, transversal	34.4	—	—	—	—	(34)	—	32	27	34	29	28	27
2. At middle, anterior-posterior	37	—	—	—	—	—	—	—	31	31	29	35	29
3. Smallest, anterior-posterior, distal	29.5	30	—	—	—	32.7	31	—	26	27.5	25	26.5	25
IV. Distal width:													
1. Transversal	66	65	66	64	64	66	63.5	—	—	60	58	65	55
2. *Trochlea medialis*, ant.-post.	39.7	38	37.5	39	38	39.3	37.5	—	—	33.5	33.5	35.8	31.5
3. Index $^{2}/_{1}$	60.2	58.5	56.8	60.9	59.4	59.5	59.1	—	—	55.8	57.8	55.1	57.3
Index:													
II/I	—	—	—	—	—	—	—	—	(21.3)	22.1	20.8	23.9	20.8
III/I	—	—	—	—	—	—	—	—	11.5	14.5	12.3	11.3	11.4
IV/I	—	—	—	—	—	—	—	—	—	25.5	24.6	26.3	23.3

* Probably bullock.

Zone VI (Table 11, No. 29), e.g., a *metacarpus* is of a similar length, 235 mm., as that of the Pindstrup specimen. In the Holmegaard bone the lateral side is split open for taking out the marrow, so only the distal width can be measured; partly according to the higher individual age of this bone the transversal width is comparatively large, 70 mm., as compared with 66 mm. in the younger Pindstrup specimen. – A metacarpal length of 235 mm. is also recorded by STAMPFLI (1963) in two specimens from the Neolithic Age at Seeberg Burgäschisee-Süd, Switzerland.—Complete metatarsal bones of *Urus* cows are of rare occurrence. In 1942 none was at hand; however, in the present treatise measurements of 7 complete metatarsals are reported, four of which belong to skulls or other skeletal parts the sex of which is evident. On the basis of most width measurements it is possible to distinguish the two sexes. The metapodials of cows are narrower than those of bulls. The range of variation of some measurements, however, may meet, or an overlapping may just occur, but if other measurements available are considered, a determination as to sex may be established. Thus is may be mentioned that two metatarsals from Egolzwil, published by HESCHE-

(continued).

domesticus													*Bos prim.*		*Bos t. dom.*	
VIII										U. age			Var.		Var.	
Holmene ♂*	Viksø ♀	Kolind	Havnø	Bundsø, C 2 (Degerbøl 1939) (♀)	Bundsø, C 2 (Degerbøl 1939) IV F 8ª (♀)	Bundsø, C 2 (Degerbøl 1939) (♂)	Bundsø B (Degerbøl 1939)	Aalborg (Winge 1900)	Aalborg (Winge 1900)	Aamosen – Holbæk ♂*	Bjerget ♂	Prize bull (From the year 1870)	♂♂ (Nos. 18)	♀♀ (Nos. 7–16)	Holmene ♀	♂♂
47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
250	212	230	—	237	224	—	—	—	—	239	244	230	270–315	268–283	236	235–250
240	204	—	—	—	—	—	—	—	—	230	(233)	—	254–298	255–270	228	224–240
55	39.5	49	—	47	43	—	—	—	—	52	59	66	64–73	50–62	49	49–59
—	38.5	46	—	45	41	—	—	—	—	50	56	—	60–71	50.5–57	47	–56
29.5	20.3	27	—	26	23	—	—	—	—	28	34	34	36.5–42	31–35.5	27	28–34
36	21.5	29	—	29	26	—	—	—	—	32	35	33.3	37–45	33–37	29	29–36
27	20	—	—	24	—	—	—	—	—	28.5	29	—	31–39	29.5–34	25	25–29
64	44.5	56	55 47	53	52	63	59.5	64	71	61	68	68	73–82	62–68	55	58–71
34.5	26.8	35	—	32	31	35.7	35	35.5	38	34	36.6	37.7	41–47	36–41.5	31.5	33.5–38
53.9	60.2	55.4	—	60.4	59.6	56.6	58.8	55.5	53.5	55.8	53.9	55.4	56.2–60.8	56.8–61 (63.2)	57.3	55.1–57.8
22.0	18.6	21.3	—	19.8	19.2	—	—	—	—	21.8	24.2	28.7	22.1–25.4	18.7–22.1	20.8	20.8–24.2
11.8	9.6	11.7	—	11.0	10.3	—	—	—	—	11.7	13.5	14.8	13.5–15.9	11.5–12.7	11.4	11.3–14.5
25.6	21.0	24.3	—	22.4	23.2	—	—	—	—	25.5	27.9	29.6	25–28	22.1–25.3	23.3	24.6–27.9

LER and RÜEGER, 1942, p. 483, but without sex indication, must belong to males (Table 12, Nos. 23–24). The absolute width measurements of these two bones are large, distinctly indicating bulls, and the same holds good of the distal and diaphysis index; only the proximal index is fairly small (22.2 mm.) in the longest of the two metatarsals, as compared with a maximum index of 22.1 in females. When NOBIS (1954, p. 168) was of opinion that these bones together with two metatarsals from Denmark, labelled as belonging to males (DEGERBØL, 1942), in fact were of females, this was just based on the proximal index; however, the said Danish metatarsals, from Sorø and Tinglev, are attached to skulls and skeletons distinctly indicating bulls. In addition the augmented material now at hand has etablished a distinct borderline between measurements of metatarsals of males and females.

In Tables 11–12 I have stated the measurements of metapodials of domestic cattle investigated here, and which, with the exception of the Borremose specimen, are attached to skulls. Furthermore, the measurements of some complete and dated metapodials from Denmark, 5 metacarpals and 2 metatarsals, from the Bundsø

TABLE

	Bos primigenius ♂♂								
Zone	III	IV				V		VI	
Scapula	Terp	Vig	Sorø	Grænge A	Gøderupgaard subad.	Grænge D	Nyrup	Bisserup	Sværdborg 1918
	1	2	3	4	5	6	7	8	9
1. Greatest width of *cavitas glenoidalis*:									
a. anterior-posterior (lateral)	85	79	85	82	78	82	81	84	—
b. Transversal	71	69	75	74	67	72	70	69	—
2. Smallest width of *collum*, ant.-post.	87	(81)	84	82	74	78	86	80	82
3. Greatest width of *collum*, from *proc. coracoideus* to post. border of *cavitas*	106	—	107	94	99	98	99	103	—
4. Width of upper end, greatest	305	290	303	—	—	270	—	—	—
5. Max. height	515	520	470	—	—	517	475	—	—
6. Height from middle of *cav. glenoid.* to *margo dorsalis* at top of the *spina scapulae*	490	—	450	440	400	495	(450)	—	—

	Bos primigenius ♀♀							
Zone	Maglemose settlements							
Scapula	Maglemose 1900 III B II[4]	Maglemose 1904	Maglemose 1900 ad.	Maglemose 1900	Maglemose 1949	Sværdborg 1918	Ogaarde III I 10[3] ad.	Ogaarde III I 10[3] ad.
	25	26	27	28	29	30	31	32
1. Greatest width of *cavitas glenoidalis*:								
a. anterior-posterior (lateral)	74	69	69	66	68	72	69	70
b. Transversal	62	60	60	58	61	60	59	58
2. Smallest width of *collum*, ant.-post.	67	66	63	59	—	66	—	—
3. Greatest width of *collum*, from *proc. coracoideus* to post. border of *cavitas*	86	81	86	81	80	86	83	86
4. Width of upper end, greatest	—	(235)	(230) (210+)	—	—	—	—	—
5. Max. height	—	(420)	(380) (330+)	—	—	—	—	—
6. Height from middle of *cav. glenoid.* to *margo dorsalis* at top of the *spina scapulae*	—	—	—	—	—	—	—	—

* Probably bullock.

13.

Bos primigenius ♂♂													♀	
IV/V	VII		VIII			Uncertain age							V	VIII
St. Damme	Bønnelykke	Krabbesholm	Grejs Mølle	Tinglev	Ugilt	Østrup Viksø	Kongsted	Frøbjerg	Handermelle	Kolding	Solbjerg Lake	Danmark	Ullerslev	Pindstrup
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
87	87	—	88	79	86	(80)	76	88	91	86	81	84	70	70
71	70	—	77	64	68	74	70	73	77	74	73	74	60	58
82	84	75	84	80	79	85	70	92	78	83	84	76	69	63
110	102	—	100	95	105	102	93	113	105	98	96	96	89	82
295	275	—	—	260	—	—	—	295	—	—	—	270	(245)	–
505	486	—	520	490	—	—	—	(503)	—	—	—	495	(445)	–
495	463	—	500	465	—	—	—	491	—	—	—	475	(430)	–

		Bos prim.		*Bos taurus domesticus*						
		Var.								
Ogaarde III G 10^3	Ogaarde III F 8^1 ad. jun.	♂♂ (Nos. 9-19)	♀♀ (Nos. 10)	Holmene ♀	Søndersø ♂*	Bundsø (Nos. 12)	Bjerget ♂	From Hescheler & Rüeger (Nos. 3)	From Nobis, 1954 (Weiszenfels)	
33	34	35	36	37	38	39	40	41	42	43
75	67	76–91	66–75	56	65	52–64	74	52–58	50	53
58	56	64–77	58–62	49	55	—	63	45–48	40	45
68	—	70–92	59–69	56	58	45–63	70	47–55	37	51
88	78	93–100	81–89	69	74	61–77	85	—	—	—
—	—	260–305	(235–245)	200	195	—	—	—	—	—
—	—	470–520	(380–445)	375	400	—	—	295–330	233	321
—	—	440–505	—	357	385	—	—	—	—	—

settlement (DEGERBØL, 1939), and two of the largest metacarpals from Troldebjerg, probably also belonging to the Subboreal period, are added. It will be seen that regarding length the metapodials of domestic cattle are widely separated from those of *Urus* (figs. 18–19); the width measurements from side to side, however, are so great that they merge with the corresponding measurements in *Urus* cows. The distal transversal metacarpal width of the Holmene domestic male, e.g., is greater (70 mm.) than the corresponding width measurements in several *Urus* cows: Pindstrup (66 mm.), Bønnerup (67 and 67 mm.), Auning (67 mm.), Almind (68 mm.), or of similar size as in two *metacarpi* from the Boreal period, Sværdborg (70 mm.) and Holmegaard (69.5 mm.). — The anterior-posterior width of the sagittal ridge of the *trochlea medialis*, however, is smaller in the Holmene specimen, 36 mm., than in the said *Urus* cows, 37–39 mm. In domestic cattle the trochlea width ranges from 32 mm. (Holmene ♀) to 37 mm., as compared with 37–41 mm. in *Urus* cows.

Metatarsal bones show similar proportions. The transversal widths of the two much discussed distal parts of the *metatarsi* from Dyrholmen are 66 and 64 mm., respectively, as compared with 64 mm. in the Holmene male, but the anterior-posterior widths are 39.3 and 37.5 mm. in the Dyrholmen individuals, and only 34.5 mm. in the Holmene specimen. Cf. figs. 5 and 6, p. 36–38. The range of the anterior-posterior widths in domestic oxen is 31.5 (Holmene cow) and 36 mm., in *Urus* cows 36–41 mm., and in *Urus* bulls 41–47 mm.

An expression of the correlation between the said distal widths, transversal and anterior-posterior, exists in the "distal width index" (trochlea width × 100/transversal width. DEGERBØL, 1942). In the Dyrholm individuals this index is 59.5 and 59.1,

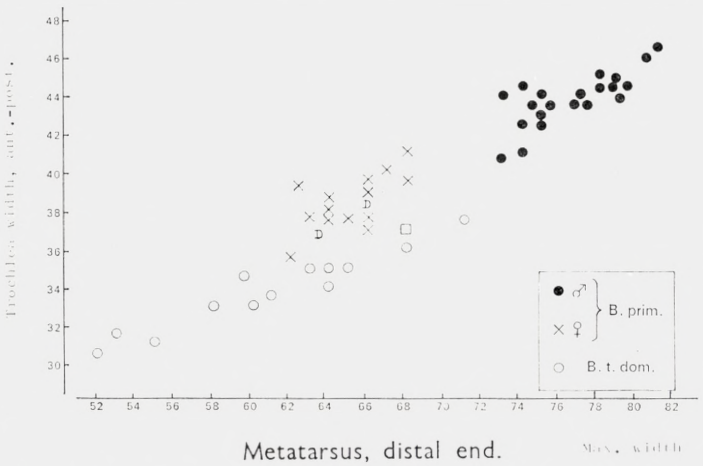


Fig. 20. *Metatarsus*, distal end. – Ordinate axis: absolute measurements, anterior-posteriorly, of the largest (medial) sagittal ridge of the trochlea; abscissa: absolute transversal width. Prize bull marked by a square. D. Dyrholmen. The transversal width in domestic cattle may be just as large as in *Urus* cows, but the anterior-posterior width is smaller. The two broadest specimens of domestic cattle represent the largest one known from the kitchen middens (71 mm., Aalborg) and the very old bull from Bjerget.

respectively, as compared with 53.9 in the domestic male from Holmene. This index is fairly variable, however, in the Holmene female, e.g., 57.3; in females—as also in small and young animals—the distal part is more rounded than in old males; however, in this connection it is the large domestic males *versus Urus* females that may cause difficulties; the *Urus* males are recognizable by their large transversal widths. In diagram fig. 20 the absolute width measurements (anterior-posterior) of the trochlea is plotted against the absolute transversal, distal, width. Hence, an identification, as to *Urus* or domestic cattle, of distal parts of *metatarsi*, which often occur in prehistoric sites, is normally possible.

Scapula.

18 *scapulae* of *Urus* bulls are available, 10 attached to skeletons from peat bogs and 8 isolated specimens. Attached to skeletons of *Urus* cows only two pairs, from Ullerslev and Pindstrup, occur. From Maglemose sites a surprisingly small number of *scapulae* are measurable, 5 distal parts, 4 of which originate from *Urus* cows, (cf. *astragalus* p. 121). Probably the most robust *scapulae* were sorted out by the Maglemose people for later use, just as was the case regarding metapodials. (Cf. the Brabrand settlement, 1904, pp. 37–38, fig. 11).

The *scapulae* of males are considerably larger than those of females (Table 13). The anterior-posterior width of the collum, e.g., varies from 70 to 92 mm. in males, as compared with 59 to 69 mm. in females; this also applies to the *scapula* of the subadult Gøderup bull, the collum length of which is 74 mm. The individual age of the *scapula* is indicated by the development of the muscular attachments; the lateral side of the collum, e.g., in the Gøderup bull is smooth, whereas the muscular attachments in older animals are strongly marked.

Hence it may be noted that the comparatively small Øgaarde *scapula* (Table 13, No. 33) belonged to a young individual.

Only two *scapulae* of domestic cattle, from Holmene, ♀, and Søndersø, occur in the material examined here.

For the sake of comparison I have added the corresponding measurements of the *scapulae* from Bundsø (Degerbøl, 1939); the largest collum width given by Winge (1900) from Ørum Aa is 69 mm., from Lejre Aa 59 mm. — From this it appears that the *scapulae* in domestic cattle from these kitchen middens are comparatively small. A very large *scapula*, however, originates from the old but undated bull from Bjerget, the measurements of which can compare with those of the largest *Urus* females. Stampfli mentions 62 mm. as minimum width of *collum scapulae* of *Urus*, and the maximum width in domestic cattle as 55 mm. only (Hescheler and Rüeger).

Humerus.

The measurements of the small number of *humeri* of *Urus* cows available are outside the range in bulls. In the comparatively large upper arm of the St. Taastrup

TABLE

	Bos primigenius ♂♂														
Zone	III	IV				V					VI	V/VI	VII	VIII	
Humerus	Terp	Vig	Sorø ad. jun.	Grænge A	Gødrupgaard ad. jun.	Grænge D	Grænge D	Grænge D	Nyrup	Bellinge	Bisserup	St. Damme	Bønnelykke	Ugilt ad. jun.	Tinglev
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Greatest length, *tub. maj.–cond. med.*	430	410	410	—	—	397	—	—	417	—	—	410	410	—	400
2. Length, caput-trochlea, medial	358	—	350	—	—	342	352	—	345	350	347	340	350	(360)	345
3. Prox. width, greatest ant.-post.	143	—	133	—	—	143	—	—	137	—	—	—	151	—	126
4. Diaphysis width, smallest	64	51	57	55	48	55	56	56	58	56	53	56	54	55	53
5. Diaphysis width, middle	70	—	61	64	50	60	62	—	65	61	57	58	64	59	59
6. Trochlea width, articul.	105	—	107	108	101	102	102	105	102	103	102	104	99	105	95
7. Distal width, greatest	108	111	110	116	103	105	105	107	105	106	106	110	105	106	100

* Probably bullock.

cow—attached to the Taastrup *antebrachium*—the proximal epiphysis is still free, and the same holds good of the Sorø specimen.

In old bulls the *humerus* is very large and particularly broad and thick-walled. In the two *humeri*, from Turup and Grænge D, broken at the narrowest part of the diaphysis, the bone walls are 16 mm. and 19 mm. thick, respectively.

A *humerus*, however, without upper end, of the small Pindstrup cow is in width within the range of domestic cattle, and the same holds good of the corresponding *humerus* parts from Bønnerup. The greatest distal widths are 86 and 85 mm., respectively, as compared with 86 mm. in the domestic ox from Aamosen (Holbæk) and 90 mm. in the Borremose specimen. From single finds of *humeri* STAMPFLI gives still smaller measurements. In 9 specimens, referred to *Urus*, the following *trochlea* width has been stated: 81, 82, 84, 85, 86, 86, 92, 95, and 97 mm., whereas REQUATE, NOBIS, and HESCHELER & RÜEGER indicate 91, 93, and 90 mm., respectively, as minimum widths of the *trochlea* in *Urus*.

For the sake of comparison, furthermore, some measurements of domestic oxen from the farmer settlements from Bundsø and Blandebjerg (DEGERBØL, 1943, p. 24) may be recorded: Bundsø 81, 73, 69, and 69 mm.; Blandebjerg 85, 85, 81, 79 mm. The *humeri* from Borremose and Bjerget represent large domestic animals, the diaphysis and distal widths of which are largely overlapping the range of variation in *Urus* cows, in length, however, they are outside, below, the range in *Urus* cows.

14.

	Uncertain age										*Bos prim.* ♀♀					Var.		*Bos taurus domesticus*					
											V	II/V	VIII										
	Grejs Mølle	Frøbjerg	Vanløse	Ganløse ad. jun.	Faarevejle	Furup	Nørlund	Feldborg	Øresund	Zealand	Ullerslev	St. Taastrup ad. jun.	Pindstrup	Bønnerup	Bønnerup	♂♂ (Nos. 8-23)	♀♀ (Nos. 2-5)	Holmene ♀	Maglemosegaard ♂	Sønderso ♂*	Borremose ♂*	Aamosen (Holbæk) ♂*	Bjerget ♂
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
	425	420	—	—	—	—	—	—	—	422	359	367	—	—	—	397–430	359–367	290	290	315	342	—	344
	360	356	—	—	—	—	—	360	—	348	309	340	—	—	—	342–360	309–340	250	250	280	290	(282)	300
	—	148	—	—	—	—	—	—	—	141	127	130	—	—	—	126–148	127–130	100	85	112	—	—	120
	61	61	59	52	60	—	55	59	52	58	46	48	42	45	—	51–64	42–48	39	32	41	49	40	49
	63	67	61	56	67	—	—	62	54	62	50	52	44	46	50	54–70	44–52	40	—	44	50	43	50
	106	105	107	101	—	102	105	102	105	100	89	98	81	83	—	95–108	81–98	75	75	81	89	85	90
	112	110	109	103	—	106	—	114	—	104	92	99	86	85	—	100–116	85–99	76	79	83	90	86	91

Antebrachium

Only one *antebrachium* is attached to a complete skeleton of an *Urus* cow, from Ullerslev. It is very short, the length of the *radius* is 320 mm., as compared with other forearms present (Table 15) and in contrast to its metapodials, which are comparatively long (Tables 11–12).

In an *antebrachium* from Høje Taastrup, found together with a female skull, the *radius* length is considerable greater, 345 mm., almost as large as the one in the Tinglev bull, 350 mm., but as ordinarily seen regarding limb bones considerably narrower than in bulls, the diaphysis width, e. g., is in the Taastrup and the Ullerslev specimens 57 mm., as compared with 63 mm. in the Tinglev bull.

In the three animals, however, the metacarpals are similar in length, 245 mm. in the Taastrup cow, 246 (Ullerslev) and 249 (Tinglev).

The Taastrup *antebrachium* belonged to a not quite full-grown animal. The suture between the lower epiphysis and the shaft is closed, but the upper epiphysis of the *ulna* is not fused with the diaphysis, which indicates an age of about $3^1/_2$ years, It is attached to a comparative large *humerus*, which, however, also indicates a female.

The forearms of the cows from Bønnerup and Pindstrup are extraordinarily small, radius lengths 312 and 314 mm., respectively, only a little greater than that of the forearm of the very old domestic ox from Bjerget, the *radius* length of which is 310 mm., whereas the lengths of the *metacarpus* of the three specimens are 230, 235, and 210 mm., respectively.

TABLE

	Bos primigenius ♂♂								
Zone	III	IV			V				V/VI
Antebrachium	Terp	Vig	Sorø ad. jun.	Grænge A ad. jun.	Grænge D	Bellinge	Nyrup	Falster	St. Damme
	1	2	3	4	5	6	7	8	9
Ulna:									
1. Greatest length	478	500	481	(485)	461	470	—	(485)	487
2. Olecranon width, greatest	96	—	(90)	—	93	96	—	—	94
3. Olecranon width, smallest	82	—	77	75	78	82	—	77	81
Radius:									
4. Length, medial	363	(367)	362	355	345	357	355	357	363
5. Prox. width, transv.	121	121	122	118	114	115	107	109	121
6. Prox. width, articul.	108	—	110	108	100	102	97	96	107
7. Prox. width, medial, ant.-post.	64	—	60	60	56	62	52	53	60
8. Prox. width, medial, articul.	52	—	53	53	51	52	48	48	54
9. Diaphysis width, middle	70	68	64	65	67	63	68	64	69
10. Distal width, greatest	113	109	109	110	113	106	104	101	108
11. Distal width, articul.	99	—	97	101	93	95	96	91	—

	Bos primigenius ♀♀								*Bos*
Zone	V		II/V	VIII		Uncertain age			
Antebrachium	Ullerslev	Grænge C	St. Taastrup	Pindstrup	Bonnerup	Havstrup Torring	Tjerrild	Oresund	Krabbesholm
	25	26	27	28	29	30	31	32	33
Ulna									
1. Greatest length	421	—	(465)	—	407	—	—	—	—
2. Olecranon width, greatest	75	—	—	—	64	—	—	—	—
3. Olecranon width, smallest	66	—	73	—	59	—	—	—	—
Radius:									
4. Length, medial	320	335	345	312	314	—	—	—	—
5. Prox. width, transv.	100	102	110	91	92	102	95	—	109
6. Prox. width, articul.	90	93	98	83	84	93	86	—	99
7. Prox. width, medial, ant.-post.	52	52	54	46	46	51	48	56	54
8. Prox. width, medial, articul.	46	47	49	—	42	—	—	—	—
9. Diaphysis width, middle	56.5	56	57	47	50	56	50	56	—
									♂
10. Distal width, greatest	92	91	93	84	78	—	—	—	107
11. Distal width, articul.	83	80	84	75	73	—	—	—	—

15.

Bos primigenius ♂♂														
	VII	VIII			Uncertain age									
Undløse Bro (A 35668)	Bønnelykke	Ugilt	Tinglev	Grejs Mølle	Klarup	Ganløse ad. jun.	Faarevejle	Tissø 1965	Handermelle	Broby	Torpe (Kalundborg)	Feldborg	Danmark I	Danmark II
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	—	—	472	500	—	—	(472)	(485)	—	—	482	—	486	490
—	84	—	79	95	—	—	—	—	—	—	91	—	92	90
—	75	76	75	83	78	77	81	82	80	—	84	—	80	81
371	—	370	350	372	353	—	(360)	356	362	—	365	364	367	371
(113+)	—	118	108	121	113	110	115	121	118	104	116	116	116	119
108	—	106	95	107	100	100	103	110	109	96	108	101	105	106
61	—	62	56	59	56	57	59	63	61	(60)	57	57	62	60
56	—	56	48	52	51	53	51	52	55	—	55	53	56	52
70	—	59	62.5	71	54	60	67	67	62	—	70	69	68	65
114	108	107	100	113	104	—	(107)	110	113	—	108	106	108	112
100	97	102	92	107	97	—	—	102	102	—	96	92	93	97

primigen. Kitchen middens			*Bos taurus domesticus*							*Bos primigenius*	
										Var.	
Hjerk Nor ♀+	Hjerk Nor ♂	Hjerk Nor ♂	Holmene ♀+	Nyrup ♀+	Bundsø DS 2 (Degerbøl 1939)	Bundsø DS 2 (Degerbøl 1939)	Orum Aa (Winge 1900)	Bjerget ♂	From Hescheler & Rüeger (Nos. 4)	♂♂ (Nos. 11-22)	♀♀ (Nos. 3-8)
34	35	36	37	38	39	40	41	42	43		
—	—	—	360	—	—	—	—	421	—	461–500	407–(465)
—	—	—	62	—	—	—	—	—	—	79–96	64–75
—	—	—	54	—	—	—	—	64	—	75–84	50–73
—	—	—	274	(290)	307	—	—	310	242–275	345–372	312–345
95	113	—	83	86	93	71 76 81	76 87 —	99 90 —	63–68 —	107–121	91–110
85	101	—	74	80	—	—	—	—	—	95–110	83–98
49	60.5	—	41	44	—	—	—	48	—	52–64	46–54
—	52.5	—	39	40	—	—	—	47	—	48–56	42–49
—	—	—	42	45	43	—	—	50	34–40	63–71	47–57
♀	♂										
97	110	101	72	79	78	—	—	87	—	100–114	78–93
83	94	90	66	—	—	—	—	80	56–62	91–107	73–84

TABLE

	Bos primigenius ♂♂								
Zone	U. a.	IV				V		IV/V	VII
Femur	Terp	Vig	Sorø ad. jun.	Grænge A ad. jun.	Gøderupgaard subad.	Nyrup	Falster	St. Damme	Bønnelykke
	1	2	3	4	5	6	7	8	9
1. Greatest length, to condyle	—	518	—	—	—	509	470	524	—
2. Length, caput–condyle	475	495	470	467	(460)	465	440	470	—
3. Prox. width, transversal	—	—	—	174	—	168	164	—	—
4. Diameter of caput	—	—	66	68	—	65	61	—	—
5. Diaphysis width	67	57	54	57	47	59	52	57	—
6. Distal width, greatest	145	138	136	(133)	(126)	—	130	141	139

* Upper and lower epiphysis free.

	Bos primigenius ♀♀				*Bos prim.*		*B. t. dom.*	
Zone	Uncertain age				Var.		Var.	
Femur	Kundby	Kirkerup	Kirkeby	Grejsdalen	♂♂ (Nos. 8-17)	♀♀ (Nos. 2-8)	♀♀ (Nos. 2)	♂♂ (Nos. 2-5)
	24	25	26	27	28	29	30	31
1. Greatest length, to condyle	427	—	—	—	470–524	427–445	370	358–(430)
2. Length, caput–condyle	405	428	(428)	—	440–482	400–428	341	340–(395)
3. Prox. width, transversal	138	—	—	—	157–183	138–147	119	108–133
4. Diameter of caput	54	59	—	—	61–69	52–59	44.5	49.5–51
5. Diaphysis width	45	50	45	48	(47)51–60	39–50	36	31–49
6. Distal width, greatest	(105)	—	(110)	—	122–146	105–116	98	98–118

* Probably bullock.

In the Pindstrup and Bønnerup specimens the proximal articular widths of the radius are 83 and 84 mm., respectively. For the sake of comparison it may be mentioned that STAMPFLI gives 79 mm. as the minimum width of this articular surface in *Urus,* whereas BOESSNECK and REQUATE state 86 mm. and HESCHELER and RÜEGER 91 mm. as lower limit.

It should be noted that the large bull from Grejs Mølle with the large metapodials, also has very large forearms; the total length of the *ulna* is 500 mm.; *radius* length, medially 372 mm.

16.

Bos primigenius ♂♂										*Bos primigenius* ♀♀			
VIII				Uncertain age						V	VIII		
Ugilt	Gesten A Tranemosegaard	Grejs Mølle	Tinglev	Næsbyhoved	Handermelle	Danmark I	Danmark II	Gudsø Vig ad. jun.	Osterby	Ullerslev	Pindstrup	Bønnerup	Bønnerup
10	11	12	13	14	15	16	17	18	19	20	21	22	23
—	470	518	476	505	510	—	—	—	—	445	—	—	—
(470)	(440)	482	450	478	475	476	466	—	—	418	(400)	400	—
—	—	180	157	173	183	174	—	—	—	147	—	—	—
62	—	65	61	63	67	69	63	—	—	57	—	52	—
51	53	59	51	57	53	59	53	—	54	54	39	45	47
132*	129	140	122	136	146	142	135	132	—	116	—	—	—

Bos taurus domesticus													
Holmene ♀	Nyrup ♀	Maglemosegaard ♂	Sønderø ♂*	Borremose ♂*	Aamosen (Holbæk) ♂*	Bjerget ♂	Imhof (1964) ♂	Imhof (1964) ♂	Imhof (1964) ♂	Imhof (1964) ♂	Hescheler & Rüeger	Hescheler & Rüeger	Hescheler & Rüeger
32	33	34	35	36	37	38	39	40	41	42	43	44	45
370	—	358	399	(420)	408	(430)	—	—	—	—	—	—	—
341	335	340	375	384	382	(395)	360	349	321	314	333	307	306
119	113	108	128	—	133	—	(120)	(125)	(110)	(84)	110	—	—
44.5	46	—	49.5	51	50	—	43	43	37	37	34	31	31
36	36	31	40	44	38	49	37	37	29	28	—	—	—
98	94	98	108	118	106	118	(95)	96	79	78	88	85	84

Only a *radius* from Undløse Bro can compare with this specimen, length 371 mm. The *ulna* has been cut off, and on the *radius* there is distally a small artificial hole, enclosed by radial furrows, just visible.

The forearms belonging to the large bulls from Grænge and Sorø are comparatively narrow, the diaphysis widths of the *radius* are 65 and 64 mm., respectively; but this is due to the young age of the animals. In the Grænge *ulna* the upper epiphysis is free, and the suture between the lower epiphysis of the *antebrachium* and shaft is open. In the Sorø specimen this last-mentioned suture is partly closed laterally,

TABLE

	Bos primigenius ♂♂																
Zone	III	IV			VI	IV/V	VII	VIII			Uncertain age						
Tibia	Terp	Vig	Sorø ad. jun.	Grænge A ad. jun.	Bisserup	St. Damme	Bønnelykke	Tinglev	Ugilt	Grejs Mølle	Gundsømagle	Sonnerupgaard	Næsbyhoved	Mors	Mjesing	Barrit Skov	Danmark
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Greatest length, middle	480	471	475	460	463	486	452	457	480	480	474	(475)	480	468	—	—	470
2. Length, lateral, greatest	422	—	420	418	415	420	408	415	425	425	420	—	430	421	—	(400)	424
3. Length, medial	463	—	454	442	442	467	438	—	460	467	452	—	458	448	—	—	452
4. Prox. width, transversal	145	140	141	137	—	140	139	129	139	145	141	—	140	132	—	—	139
5. Diaphysis width, middle transversal	63	—	60	59	60	60	58	60	58	68	60	65	65	62	—	57	63
6. Diaphysis width, smallest	60	61	58	58	56	58	56	55	54	60	56	61	58	56	58	55	61
7. Distal width, greatest	93	90	89*	90	86	91	84	83	85	88	88	90	88	87	—	85	90

* Suture of prox. epiphysis open.

whereas the epiphyses of the *ulna* are bordered by open sutures. — Several isolated forearms are large, probably on this account having been sent to the Zoological Museum.

Only two *antebrachia*, of the Holmene and Nyrup cows (*radius* length 274 mm. and about 290 mm., respectively) are attached to the remains of Neolithic domestic cattle examined here. From the Neolithic farmer settlement of Bundsø, however, a comparatively large *radius*, length 307 mm., is recorded. It is almost as long as a *radius* of the large, but undated, bull from Bjerget, not, however, nearly so broad as seen in this old animal. The measurements of 4 *radii* of domestic cattle from Egolzwil (HESCHELER & RÜEGER 1942) are, as generally seen in remains from this locality, considerably smaller than in the said Danish animals, the length, e.g., varying between 242 and 275 mm. (Table 15).

Femur.

Femora, or parts of *femora*, of no less than 8 *Urus* cows are available, 4 of which belong to skulls (Ullerslev, Pindstrup, Bønnerup), one to a mandible (Kundby). The femur of females is considerable shorter than that of males. The length from caput to the medial condyle varies in 4 adult females from 400 to 428 mm., as compared with 440 to 482 mm. in 14 femora of bulls.

Of the young Pindstrup cow only one femur is at hand, and the upper end is missing; however, the length from *trochanter minor* to the *condylus* is 318 mm., as compared with 315 mm. in the adult Bønnerup *femur* and 322 mm. in the Kundby specimen, indicating a length from the caput of about 400 mm. In the incomplete

17.

Bos primigenius ♀♀									*Bos prim.*		*Bos taurus domesticus*									
V	IV/V	VIII				Uncertain age			Var.											
Ullerslev	St. Taastrup	Pindstrup	Bønnerup (left) ad. jun.	Bønnerup (left)	Ørum Aa	Grejsdalen	Vinderup	Lille Lyngby	♂♂ (Nos. 12-17)	♀♀ (Nos. 3-9)	Holmene ♀	Nyrup ♀	Bjerget ♂	Bundsø (Degerbøl 1939)	Ørum Aa (Winge 1900)	Weiszenfels (Nobis 1954)	Schafis (Imhof 1964)	Lattrigen (Imhof 1964)	Lattrigen (Imhof 1964)	Lattrigen (Imhof 1964)
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
420	—	400	415	—	—	—	—	—	452–480	400–420	350	338	400	—	—	328	309	321	347	350
375	—	350	350	—	—	—	—	—	408–430	350–375	312	295	350	—	—	—	—	—	—	—
400	—	382	387	—	—	—	—	—	438–467	352–400	336	325	387	—	—	—	—	—	—	—
126	—	111	110	—	—	—	—	—	129–145	110–126	99	95	120	—	—	89	(86)	90	(90)	96
52	53	46	49	51	48	54	52	46	57–68	46–54	42	43	50	—	—	—	—	—	—	—
50	51	44	46	48	47	52	49	44	55–63	44–52	38	41	48	—	—	37	335	33	35	36
78	83	73	68*	73	73	79	79	73	83–93	68–83	62	62	76	57–70	59–62	60	53	54	58	(56)

* Sut. of prox. epiphysis anteriorly open.

femur from Kirkeby, the length from the said *trochanter* is about 340 mm., as in the corresponding part of the Kirkerup *femur*, in which the length from caput to condyle is 428 mm. — A *femur* from Grejsdalen, missing the upper and lower end, is of about the same length as that of the Ullerslev cow, but is more strongly built; the diaphysis widths are 48 and 46 mm., respectively.

The *femur* length in domestic cattle is outside the range in *Urus* cows.

The *femur* of the domestic bull from Maglemosegaard (Vedbæk II) like the other limb bones of this animal, is short; the length from caput to condylus is 340 mm., as compared with 375, 382, and 384 mm. in the specimens from Søndersø, Borremose, and Aamosen (Holbæk), which probably represent bullocks.

From outside Denmark only a few complete *femora* are known. Imhof, however, gives the measurements of four specimens, one of which is so long, 360 mm., that he is of opinion that it represents a bullock, another is a little longer than the Maglemose *femur*, 349 mm., whereas the remaining two are small, 321 and 314 mm. long. Also three *femora* measured by Hescheler and Rüeger are small: 333, 307, and 306 mm., respectively (Table 16).

Regarding the *tibia* there is a well marked sex-dimorphism; in all measurements taken (Table 17) the size range in *Urus* cows is outside the range in *Urus* bulls. With the exception of the Holmene and Nyrup cows, no complete *tibia* of Neolithic domestic cattle is at hand, length 350 and 338 mm., respectively. The *tibia* from the undated find from Bjerget is exceptionally robust, 400 mm.,in length, as in *Urus* cows from Pindstrup and Bønnerup.

TABLE

Zone	*Bos primigenius* ♂♂								
	IV	V	IV/V	VIII	Uncertain age				V
Calcaneus	Vig	Nyrup	St. Damme	Ugilt	Mors	Hvalsø	Danmark	Silkeborg	Ullerslev
	1	2	3	4	5	6	7	8	9
1. Max. length	185	189	190	189	187	—	190	178	165
2. Greatest length, lateral	—	181	181	183	181	—	181	173	161
3. Height, lateral	—	70	71	70	71	70	71	67	64
4. Width of fasc. art., posterior	—	22	22	20	24	23	21	22	19
5. Greatest width	—	54	57	49	58	58	55	51	46
Corpus:									
6. Length, upper	—	109	109	112	104	—	109	103	94
7. Length, greatest	—	122	123	127	119	—	124	115	107
8. Width, smallest, transversal	—	28	28	25	27	29	28	28	22
9. Height, smallest	—	50	47	46	48	52	50	44	42
10. Width, greatest, posterior	—	48	52	48	48	—	48	44	43

Zone	♀♀ Sværdborg settlement (Z. VI)								
Calcaneus	XXXV H 2	XXIV A 8	XXIV A 3	XXIV A 3	XXIV A 3	XXIV A 3	XXXVI H 10 jun.	XXXVI K 4 jun.	XXIV A 5 jun.
	27	28	29	30	31	32	33	34	35
1. Max. length	—	—	167	—	—	—	(145)	(133)	—
2. Greatest length, lateral	—	—	163	—	—	—	—	—	—
3. Height, lateral	—	—	69	—	—	—	(65)	(60)	—
4. Width of fasc. art., posterior	—	—	20	—	—	—	(19)	(17)	(17)
5. Greatest width	45	44	48	—	—	—	(45)	(40)	(42)
Corpus:									
6. Length, upper	106	96	92	—	—	—	(81)	(78)	(81)
7. Length, greatest	119	109	105	—	—	—	—	—	—
8. Width, smallest, transversal	24	24	24	—	—	—	(22)	(19)	(18)
9. Height, smallest	43	43	42	44	—	44	(37)	(34)	(34)
10. Width, greatest, posterior	44	42	42	40	42	41	—	—	—

18.

♀♀			♂♂				♀♀		♂♂						♀♀	
VIII	U. a.		Maglemose settlement (Z. V)						Sværdborg settlement (Z. VI)							
Bonnerup	Staugaardskær Torring	Vinderup (epiphysis missing)	V A 3–9 (Bottom)	I B 7[1]	1949	II I 9[2]	III F 2[5]	1949	1918	XXXVI K 3	XXXVI C 10	1918	1918	1918	XXXVIII I 9	XXXV E 2
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
168	165	(145)	188	—	—	—	166	162	192	—	—	—	—	—	166	164
164	161	—	182	—	—	—	162	156	187	—	—	—	—	—	160	160
64	63	(62)	70	—	—	—	62	64	77	—	—	—	—	—	66	66
18	19	(17)	26	—	—	—	18	20	24	—	—	—	—	—	19	19
46	44	(42)	60	55	—	—	46	47	57	57	53	—	—	—	44	44
97	100	(89)	108	107	105	—	97	92	112	105	(103)	—	—	—	97	93
110	110	—	124	119	116	—	109	105	123	116	(116)	—	—	—	109	106
22	21	(19)	31	26	27	27	23	26	30	29	26	—	—	28	23	23
42	38	(37)	48	48	49	46	44	41	51	51	48	49	49	48	41	44
38	37	—	50	48	47	47	41	41	48	—	48	47	47	—	40	40

	♂♂			♀	♂	*B. prim.*		♂♂	♀♀			*B. t. dom.*	
	Holmegaard (Z. VI)					Var.		Dyrholmen					
						♀♀ (Nos. 5-9)	♂♂ (Nos. 5-13)						
1918	1922	1922	1922	1922 – epiphysis	1922 – epiphysis	Ogaarde VI H 3[7]	Maglemose settlements		II B 5	VI D 2	XIX F 7[2] (porous)	I A 2	Holmene ♀	Bjerget ♂
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
—	178	179	—	(148)	—	171+	162–167	178–192	177	—	163	—	138	158
—	173	176	—	—	—	—	156–163	173–187	175	—	160	—	130	154
(63)	67	69	—	(66)	—	67	62–69	(67)–69–77	72	73	64	—	53	62
(18)	22	24	—	(19)	—	22	18–20	22–26	22	24	—	—	15	20
(43)	51	53	—	(44)	—	—	44–48	51–60	—	—	—	—	38	45
(80+)	104	104	—	(84)	—	106	92–97 (106)	104–112	100	—	100	96	80	89
—	117	117	—	—	—	—	105–109 (119)	116–124	(111)	—	(106)	(110)	90	103
(21)	24	22	—	(22)	—	25	23–26	24–31	24	27	22	22	18.5	23
(38)	44	48	—	(40)	—	48	41–44	44–51	48	—	42	44	34	40
—	46	44	47	(29)	38	—	40–44	44–50	42	—	39	40	34	41

Calcaneus

Only two *calcanei* attached to skeletons of adult *Urus* cows are at hand, from Ullerslev and Bønnerup, but from Maglemose sites furthermore 5 complete and 2 tuber parts are available and a single *calcaneus* comes from Staugaardskær; in size and shape they are of similar lengths, 162–167 mm., greatest widths 44–48 mm., as compared with 178–192 mm. lengths, and 51–60 mm. widths in *calcanei* of 10 bulls.

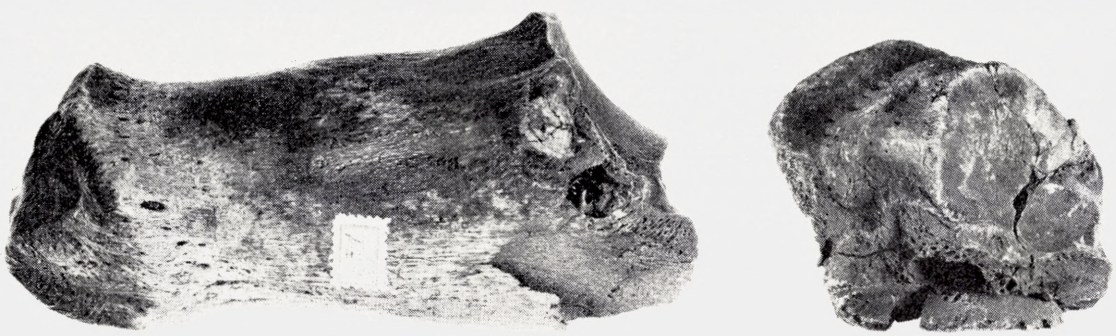
Furthermore, 6 *calcanei* lack the posterior epiphysis, representing young animals, less than about 3 years old. The specimen from Vinderup (Table 18, No. 12), is attached to a *tibia* which also indicates a female. The five other *calcanei* come from Maglemose settlements emphasizing that comparatively many young animals were hunted. Judging from the fact that these *calcanei* are comparatively narrow, the greatest widths 40–45 mm., it is probable that they also belonged to females. According to DOTTRENS (1947, p. 526) the *calcanei* of subadult domestic oxen are somewhat broader than those of adult animals.

Only the posterior half of the corpus of no less than 8 *calcanei* from settlements is present, obliquely cut off or broken for the purpose of obtaining the marrow, which in *calcanei* of old animals occurs in a medullary cavity placed immediately behind the articular surface, (Fig. 21). 4 *calcanei* are fragmentary, i.a. missing the posterior half of the corpus just mentioned.

The four *calcanei* from Dyrholmen all clearly belonged to *Urus*, two very massive and sturdy ones representing bulls, two smaller ones, with "floured" surface, cows, corresponding in size and shape to the *calcanei* belonging to the Ullerslev and Maglemose cows.

In domestic cattle the *calcaneus* does not reach the measurements in *Urus* cows. In the very large domestic ox from Bjerget the *calcaneus* is 158 mm. long.

The maximum lengths of 8 *calcanei* from the farmer settlement Bundsø are: 112, 120, 145, 145, 150, 153 (and 160) mm. From the literature it may be cited that the range of 31 adult *calcanei* from the Neolithic settlement at Saint Aubin, Switzer-



A B

Fig. 21 A + B. A. Posterior half of *calcaneus*; lateral view. B. Anterior view. – A medullary cavity occurs immediately behind the articular surface. $\times {}^{2}/_{3}$.

Fig. 22. *Astragali* of Tinglev bull (A), of Ullerslev cow (B); from Holmegaard settlement, Boreal period (C and D). In *Urus* bulls the *astragali* are longer and particularly broader than in *Urus* cows. × $^{2}/_{3}$.

land, is from 117 to 134 mm., and in a *calcaneus* of the large, recent Simmenthaler ox the length is 152 mm. (DOTTRENS, 1947). A *calcaneus* of only 150 mm. in length is by STAMPFLI referred to the *Urus*.

Astragalus

In skeletons from peat bogs the *astragali* of *Urus* bulls are longer and particularly broader than in *Urus* cows. The range in size of bulls is outside the range in size of cows; or only a small overlap may occur. The length, e.g., of the *astragalus* of

TABLE

	Bos primigenius ♂♂										*Bos primigenius* ♀♀				
Zone	III	IV			V	VIII		Uncertain age			V	VIII			
Astragalus	Terp	Vig	Sorø	Grænge A ad. jun.	Nyrup	Ugilt	Tinglev	Gundsømagle	Hvalsø Sommerupgaard	Mors	Ullerslev	Pindstrup	Bønnerup	Bønnerup	VII B 5[2]
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Maximum length	93	90	93	90	89	89	84	89	92	92	83	82	80	77	93
2. Greatest width, distal	63	62	61	62	59	59	57	61	62	63	52	52	50	47	62
3. Lateral height, from upper incisure	48	—	48	47	48	46	44	47	47	—	43	42	—	—	48

	Sværdborg settlement												Holmegaard	
Zone	♂♂					♀♀							♂	♀
Astragalus	1918	1918	1918	1918	1918	1918	1918	1918	1918	1918	1918	juv.		
	36	37	38	39	40	41	42	43	44	45	46	47	48	49
1. Maximum length	97	92	91	90	89	85	85	81	81	(82)	(83)	68	86	84
2. Greatest width, distal	63	63	60	56	53	50	52	52	52	—	54	42	58	51
3. Lateral height, from upper incisure	49	50	44	46	45	43	40	40	39	42	—	33	44	42

	Bos primigenius		Kitchen middens (*Bos primigenius*)						
Zone	Maglemose settlements Var.		♀♀					♂	♂
Astragalus	♀♀ (Nos. 34)	♂♂ (Nos. 21)	Brabrand					Dyrholmen II D 9[3]	Dyrholmen VII 2[7]
			porous jun. ad.		porous		II A 10[3]		
	70	71	72	73	74	75	76	77	78
1. Maximum length	79–86	86–97	84	81	81	79	76	90	87
2. Greatest width, distal	49–55	(53) 56–63	51	51	48	48	49	60	56
3. Lateral height, from upper incisure	39–45	44–50	41	41	40	39	41	46	46

19.

Maglemose settlement					Sværdborg settlement													
♂♂		♀♀			♂♂							♀♀						
I B 9[1]	I B 8[2]	I K 2[3]	1949	1949	XXXVI G 2	XXIII D 5	XXIV C 8	XXXVI K 9	XXIV E 3	XXXV B 4	XXXV H 2	XXIV B 4	XXXVI F 10 (porous)	XXIII C 4	XXXV G 2	XXXVI K 7	XXIII B 4	XXXV H 2	XXIV A 2 juv.
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
89	89	79	82	83	94	94	93	92	91	89	88	86	86	84	84	(83)	(83)	81	(74)
60	60	49	52	52	62	—	58	60	56	58	58	52	55	49	51	53	—	50	(44)
46	46	43	42	42	48	48	46	47	46	47	46	42	45	40	41	44	45	40	36

Ogaarde settlement																			
♂♂					♀♀														
II D 10[3]	P V 5[4]	IV C 3[4]	III I 1[3]	X K 10[3]	IV D 1[3]	III G 8[4]	V A 1[3]		IV F 4	III I 10[1]	IV A 6[3]	IV D 3[3]	I D 3[3]	III H 2[3]	II H 2[2]	III K 1[3]	III B 10[2]	IV C 3[4]	Hesselbjerggaard I H 8
50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
91	(90)	89	88	(88)	85	85	85	85	85	85	(83)	(85)	84	(82)	81	80	80	80	82
62	—	60	60	60	53	53	54	51	51	52	—	50	52	(51)	51	51	52	—	—
50	—	46	46	46	42	43	45	43	44	44	—	—	42	—	41	41	40	—	—

Kitchen middens (*Bos primigenius*)										*Bos taurus domesticus*							
♀	♀	♀	♂	♀	♂	♀	♀	♀	♀	♂							
Dyrholmen XXX B 6	Kolind I	Kolind III (porous)	Hjerk Nor	Hjerk Nor	Norslund	Norslund	Krabbesholm	Krabbesholm	Orum Aa	Bjerget	Troldebjerg settlement	Troldebjerg settlement	Orum Aa settlement	Lindø settlement	Bundsø (Degerbøl)	Orum Aa (Winge)	Aalborg (Winge)
79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
81	79	79	90	81	88	84	81	80	87	73	73	71	69	72	60–74	62–70	63–74
51	50	50	56	53	57	50	51	52	52	49	49	48	46	46	(Nos. 19)	(Nos. 15)	(Nos. 4)
43	40	40	—	—	45	40	41	40	43	40	39	39	35	37	—	—	—

TABLE

	Bos primigenius ♂♂						♀♀		*Maglemose* settlement							
Zone	III	IV			V	V/VI	V	VIII	♂♂					♀♀		
Naviculo-Cuboideum	Terp	Vig	Sorø	Grænge A ad. jun.	Nyrup	St. Damme	Ullerslev	Bønnerup	I G 4	I B 7[2]	I B 9[2]	III B 4[2]	1949	1904 II H 6[2]	1904 II K 8	1904 II G 1[2]
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Greatest width	88	80	78	80	80	81	67	61	82	80	78	78	74	67	66	65
2. Width, prox. articular surface	68	—	61	63	62	65	55	50	61	64	62	60	57	52	52	52
3. Height, greatest, anterior	31	—	31	30	30	31	26	24	29	28	30	30	27	26	26	26
4. Height, greatest, medial	22	—	22	20	18	21	17	16	19	19	18	19	18	17	18	17
5. Length, greatest, ant.-post. medial	73	—	71	73	71	77	61	63	78	75	72	72	68	62	63	62

	Holmegaard settlement					Ogaarde						Var.	
Zone	♂♂		♀♀			♂♂			♀♀			♂♂	♀♀
Naviculo-Cuboideum	1922	1922	1922	1922	1922	I D 1[3]	I D 6[3]	II A 8[6]	X B 10[4]	IV A 2	III F 10[4] ad. jun.	(Nos. 18)	(Nos. 21)
	37	38	39	40	41	42	43	44	45	46	47	48	49
1. Greatest width	76	75	66	66	63	81	80	80	78	70	65	74–82	(61) 63–72
2. Width, prox. articular surface	59	57	52	51	53	63	62	62	61	54	55	57–64	(50) 51–57
3. Height, greatest, anterior	27	27	25	26	27	32	30	29	30	25	24	27–32	23–29
4. Height, greatest, medial	18	16	16	16	15	21	19	19	20	17	15	16–21	14–19
5. Length, greatest, ant.-post. medial	69	67	66	60	59	75	71	71	70	63	60	67–79	58–67

Tinglev bull is 84 mm., as compared with 83 mm. in the Ullerslev cow, whereas the distal width is 57 and 52 mm., respectively (Fig. 22).

As no epiphyses, and thus no sutures either, exist in the *astragalus*, a more definite age determination is difficult. In fact, it is possible only to distinguish between adult specimens with a hard and compact bone surface and bones of younger, subadult or juvenile, animals the bones of which are more or less porous. It should be noticed, however, that already in the fairly young animals from Sorø, ♂, and Pindstrup, ♀, the bone-surface is hard and shining.

Furthermore, a considerable number of *astragali* are known from prehistoric settlements in Denmark. From Maglemose sites about fifty are at hand and, as mentioned above, these sites are so old that any intermixture with domestic oxen is ex-

20.

		Sværdborg settlement																	
		♂♂							♀♀										
1904 VII K 4²	1904 I K 6²	XXXVI F 6	XXIV C 2	1918	1918	1918	XXXV I 2	XXIII B 4	1918	XXXVI K 6	1918	1918	XXXV E 3	XXXVI D 6	XXXVI G 3	XXIV A 5	XL F 9	1918	1918 porous
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
65	64	81	81	80	80	79	79	78	72	72	70	69	69	69	69	67	66	65	61
51	54	63	63	62	61	60	61	60	57	57	57	53	55	53	—	56	53	54	50
23	27	31	30	32	(27)	30	29	30	27	28	29	25	28	26	—	28	25	24	24
15	17	20	20	19	19	21	19	21	16	19	19	16	18	18	—	18	16	14	13
61	62	74	78	79	71	73	73	74	67	67	(65)	64	64	67	67	—	64	58	56

	Kitchen middens (*Bos primigenius*)										*Bos taurus domesticus*						
♀	♂♂		♀♀		♂	♀	♀	♂	♂	♀							
Brabrand (porous)	Dyrholmen XV I 8 (porous)	Dyrholmen VII G 10	Dyrholmen XI H 8	Dyrholmen Brook	Hjerk Nor	Hjerk Nor	Hjerk Nor	Norslund	Norslund	Havnø	Holmene ♂	Troldebjerg settlement	Troldebjerg settlement	Troldebjerg settlement	Lindø settlement	Orum Aa settlement	Havnø settlement
50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
61	75	73	61	61	79	70	67	75	75	69	62	60	57	57	57	60	59
(50)	60	57	48	52	61	57	54	59	58	(56)	49	47	47	46	46	49	47
—	—	28	24	25	29	26	25	28	30	27	24	22	24	23	23	24	22
15	—	19	15	15	20	17	16	20	22	17	15	16	14	14	16	17	17
(59)	(69)	69	58	60	72	64	64	70	(66)	66	56	51	50	51	56	62	53

cluded; these *astragali* belonged to unquestionable *Urus*. Just as the *astragali* attached to skeletons or skeletal parts from the bogs, the Maglemose *astragali* form two groups, large bones no doubt representing *Urus* bulls and smaller ones belonging to cows. It deserves notice that in this fairly large material the cows are in the majority, 34 out of 55 individuals.

The variation in the two groups is almost as seen in the *astragali* from the skeletons, there being only a small overlapping. Typical are the two *astragali* from the Holmegaard settlement, measuring 86 and 84 mm., in length, but 58 and 51 mm. in width, no doubt representing a bull and a cow, respectively (Fig. 22). The three *astragali* from the Mullerup or Maglemose site, from Zone V, are just as small as the *astragali* of the Pindstrup and Bønnerup cows, from the Subboreal period, Zone VIII,

TABLE

	Bos primigenius ♂♂				*Bos primigenius* ♀♀					
Zone	IV		U.a.	VIII	V		VIII			
Phalanx 1	Sorø Forelimb	Sorø Hindlimb	Mors Hindlimb	Tinglev Forelimb	Ullerslev Forelimb	Ullerslev Hindlimb	Pindstrup Forelimb	Bønnerup Forelimb	Bønnerup Hindlimb	Bønnerup 2 Forelimb
	1	2	3	4	5	6	7	8	9	10
1. Greatest length, lateral, posterior	77	81	77	69	69	72	68	68	74	63
2. Greatest length, medial, anterior	76	79	75	71	68	70	65	67	72	60
3. Smallest length, lateralis	71	75	70	65	64	66	62	65	69	59
4. Smallest length, medialis	69	73	69	66	65	65.5	61	64	68	58
5. Prox. width, greatest	45	43	40	41	39	35.5	34	35	34	34
6. Prox. width, articular surface	40	37	35	37	33	32.5	33	34	32	32
7. Prox. height, articul.	41	43	42	39	36	39	35	34	35	34
8. Diaphysis, smallest width, middle	37	34	32	34	33	29	29	31	28	29
9. Diaphysis, height at middle	34	34	33	36	32	30	31	33	30	30
10. Diaphysis, smallest, distal	27	26	26	26	22	23.5	22	22	22	21
11. Distal width, articular surface, post	41	40	37	38	34	35	33	31	30	31

* Probably bullock.

but several cow-*astragali* are somewhat longer than the Ullerslev *astragalus*, 84, 85, and a single 86 mm. in length, as compared with 83 mm. in the Ullerslev cow. Aberrant is an *astragalus* which is 89 mm. long, but only 53 mm. broad, it probably also belonged to a large cow (Fig. 23).

A determination as to sex of such long, but narrow *astragali* found single, if belonging to a large cow or a slender bull, as e.g. seen in the Ølholm bull-skull, may be difficult. — Regarding measurements of width, however, a hiatus exists at 55 mm., probably indicating a distinct limit between female and male *astragali*, also emphazised by the fact that the *astragalus* from the almost complete hind limb of the *Urus* cow from Ørum Aa is 87 mm. long, but only 52 mm. broad (Table 19, No. 88).

In domestic cattle the *astragali* are shorter than even those in *Urus* cows. The largest measurements, 73–74 mm., come from the very old bull from Bjerget and the largest *astragali* out of numerous specimens from farmer settlements, i.a. Bundsø and Troldebjerg. The lengths of 19 *astragali* from Bundsø vary from 60 to 74 mm. (DEGERBØL, 1939), of 15 *astragali* from Ørum Aa from 62 to 70 mm. (WINGE, 1900), and 4 specimens from Aalborg are 63, 66, 72, and 74 mm. long.

STAMPFLI gives 76 mm. as the smallest length in *Urus astragali* and 64 (72?) as the greatest length in domestic oxen.

The *Urus astragali* from skeletons, and from the Boreal period are noteworthy

21.

Bos primigenius (Kitchen middens)										*Bos taurus domesticus*						
♂	♂	♀	♀	♀	♂		♀	♂	♂	♂ *	♂ *	♀	♀	♂	♂	♂
Orum Aa Hindlimb	Havnø	Brabrand Hindlimb	Dyrholmen (XXXI C 9[2])	Dyrholmen (XV G[3])	Dyrholmen (M 3)	Kolind (IV F 2[3])	Hjerk Nor Hindlimb	Hjerk Nor Hindlimb	Hjerk Nor Hindlimb	Holmene Forelimb	Holmene Hindlimb	Holmene Forelimb	Holmene Hindlimb	Maglemosegaard Forelimb	Maglemosegaard Hindlimb	Bjerget Hindlimb
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
84	—	—	71	—	—	74	74	—	—	64	66	61	65	59	61	62
79	—	70	—	—	—	—	—	—	—	59	64	57	60	57	60	60
74	—	—	67	—	—	69	—	—	—	58	61	55	58	53	56	58
75	—	65	—	—	—	—	—	—	—	56	60	53	57	52.5	56	58
41	44	—	—	38	—	38	35	41	42	35	32	31.5	30	33	30.5	39
38	41	—	—	38	—	35	—	—	—	34	29	29	27	33	29	34
45	42	—	—	—	43	37	—	—	—	36	35	31	32	35	34	35
34	—	—	—	—	—	—	29	—	—	28	26	27	25	28	25	33
36	—	—	—	—	—	—	—	—	—	27	24	26	26	27	25	27
26	—	24.5	—	—	—	—	—	—	—	21	19	18.5	17.5	21	19	22
38	—	—	—	—	—	—	—	—	—	33	29	26.5	26	32	29	36

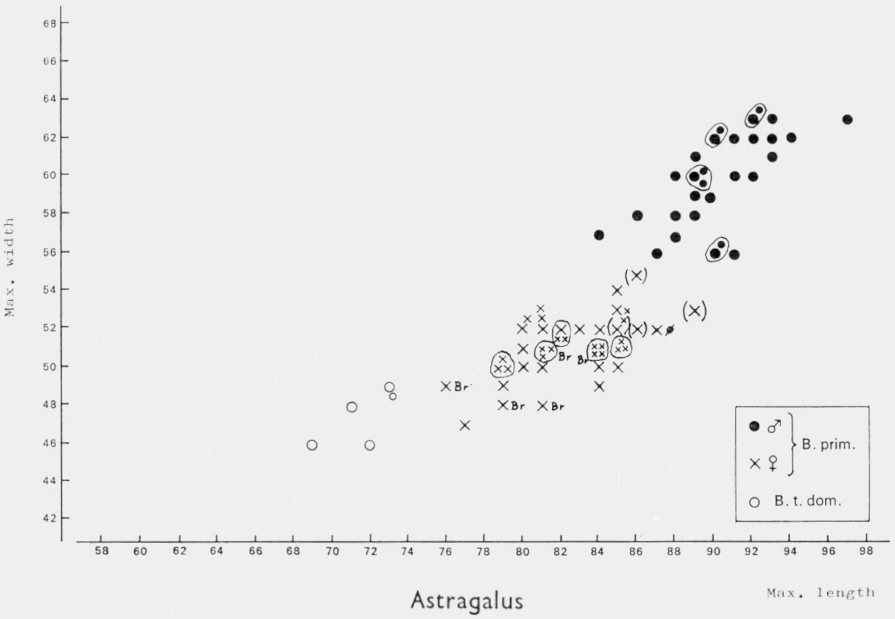


Fig. 23. *Astragalus*. Maximum width plotted against maximum length. Br. Brabrand. Encircled measurements are equal. – Even the small Brabrand *astragali* join the female group of *B. primigenius*. The *B. t. dom.* indicated represent very large animals.

TABLE

	Bos prmigenius						*Bos primigenius*		
Zone	♂♂			♀♀			♂	♀	♂
Phalanx 2	Sorø Forelimb	Sorø Hindlimb	Mors Hindlimb	Ullerslev Forelimb	Ullerslev Hindlimb	Bønnerup Forelimb	Aamølle	Aamølle	Brabrand Forelimb
	1	2	3	4	5	6	7	8	9
1. Greatest length, lat. post.	54	56	56	50	47	44	54	47	—
2. Greathest length, med.	47	50	49	45	46	41	48	—	—
3. Smallest length, lat.	42	46	44	38	41	35	41	36.5	38
4. Smallest length, med.	45	49	46	40	43	39	—	—	—
5. Prox. width, greatest	43	42	40	36	34	32	39	33	—
6. Prox. height, greatest	46	44	45	40	36	36	—	—	—
7. Diaphysis, smallest width	34	31	31	28	27	26	33	26	32
8. Diaphysis, height, smallest	36	33.5	31	30	26	28	34	27.5	—
9. Distal width	38	33	36	31	29	28	33	28.5	—

* Probably bullock.

in that they are so numerous that they provide enough material to arrive at a decision of the old problem of affiliation, whether the *astragali* from the kitchen middens, Zones VII and VIII, belong to the *Urus* or domestic oxen. As proved under the respective settlements, the results are unambiguous and important; the *astragali* from the settlements proper represent the *Urus* (Table 19).

Brabrand: 5 *astragali* are present; they all belong to ♀♀. Length and breadth: 84×51 mm., 81×51 mm., 81×48 mm., 79×48 mm., and 76×49 mm.

Dyrholmen I: 2 *astragali* are at hand, representing a ♂ (87×56 mm.) and a ♀ (81×51 mm.).

Kolind I (older than Dyrholm I): a single *astragalus*, ♀ (79×50 mm.).

Kolind III (Subboreal): ♀ (79×50 mm.).

Hjerk Nor: 2 *astragali*, ♂ (90×56 mm.), ♀ (81×53).

Norslund: 2 *astragali*, ♂ (88×57 mm.), ♀ (84×50 mm.).

Krabbesholm: 2 ♀♀ (81×51 mm. and 80×52 mm.).

Ørum Aa (Subboreal): a single *astragalus*, belonging to a ♀ (87×52 mm.).

Naviculo-cuboideum.

Like the other carpal bones the majority of *nav.-cuboidea* originate from the Maglemose settlements: Maglemose near Mullerup (Zone V), Sværdborg, Holmegaard, and Øgaarde (Zone VI). In 18 specimens the range of the greatest widths is

22.

(Kitchen middens)									*Bos taurus dom.*			
♀	♀	♀	♂	♂	♀	♀		♂	♂*		♀	
Brabrand Forelimb	Brabrand Hindlimb	Brabrand Hindlimb	Dyrholmen (VII K 6) Forelimb	Dyrholmen (porous) Hindlimb	Dyrholmen (II B 5) Forelimb	Dyrholmen (XXX G 9a) Hindlimb	Kolind (II B 7)	Hjerk Nor	Holmene Forelimb	Holmene Hindlimb	Holmene Forelimb	Holmene Hindlimb
10	11	12	13	14	15	16	17	18	19	20	21	22
—	—	—	52	50	45	47	—	—	42	44	40	40
—	—	—	48	43	42	42	48	—	41	41	37	40
36	39	35	41	38	35	39	42	—	34	37	31	35
—	—	—	44	40	39	42	41	—	38	39	35	37
—	—	—	41	39	35	33	—	42	33.5	31	28.5	27
—	—	—	44	38	36	37	41	—	38	34	33	33
27	26	27	32	33	26	26	30	33	28	25	22	21
—	—	—	32	31	27	26	30	—	28	23	23	21
—	—	—	36	35	30	27	32	—	31	27	24	22

74–82 mm., in 21 specimens 61–72 mm., no doubt representing bulls and cows, respectively. Less affected by age than this measurement is the upper articular width, the range of which is 57–64 mm. and 50–57 mm., respectively.

In the very old domestic male from Hillerød, in which the *nav.-cub.* and *cuneiforme* are fused, the greatest width is 62 mm., the articular width 49 mm., thus just reaching the range in *Urus* cows. In 4 of the largest *nav.-cub.* from the Troldebjerg and Lindø settlements the corresponding measurements are 57–60 and 46–47 mm. According to Dottrens (*loc.cit.*) the range of greatest widths of 44 specimens of domestic Neolithic cattle is 43–57 mm. — Stampfli gives 60 mm. as greatest width in a small *nav.-cub.* referred to *Urus*.

All *nav.-cuboidea* from the kitchen middens, too, belonged to *Urus*, bulls and cows. — Two *nav.-cub.* from Brabrand (p. 35) originate from young animals, as appears from the porous surface, and the small height and length, anterior-posteriorly. They are corroded, and one of them is fragmentary. They are comparatively small, but judging from the said conditions they should no doubt be referred to *Urus* cows. The upper articular surface, against *os naviculare*, is larger than found in domestic oxen; particularly large is the articular length, measured anterior-posteriorly, medially (chord), 41 mm. as compared with 35 mm. in the Hillerød domestic male, and 35–36 mm. in the specimens examined from the Troldebjerg and Lindø settlements.

Two of the 4 *naviculo-cuboidea* from Dyrholmen (p. 38) are comparatively large, representing bulls; two are small, on the borderline to domestic oxen, but as just

TABLE 23.

	Bos primigenius					(Kitchen middens)					*Bos t. dom.*			
Zone	♂♂			♀		♂			♂	♀	♂*	♂*	♀	♀
Phalanx 3	Sorø Forelimb	Sorø Hindlimb	Mors Hindlimb	Ullerslev Forelimb	Ullerslev Hindlimb	Aamølle	Dyrholmen (M 14)	Dyrholmen (XV 12	Hjerk Nor	Hjerk Nor	Holmene Forelimb	Holmene Hindlimb	Holmene Forelimb	Holmene Hindlimb
	1	2	3	4	5	6	7	8	9	10	11	12	12	14
1. Greatest length	90	86	86	95	93	104	90	92	96	87	85	79	78	73
2. Length of upper margin	70	69	72	71	68	—	73	70	—	—	64	63	58	57
3. Length of rear margin (chord.)	65	63	63	61	57	—	61	(60)	—	—	56	54	49	46
4. Greatest width	35	32	32	32	29	38	31	34	—	—	29	28	27	23

* Probably hullock.

mentioned under Brabrand, the chord lengths are great, 41 and 44 mm., and the medial lengths of the bones are great, too, 58 and 60 mm. Cf. Table 20.

3 *nav.-cub.* from Hjerk Nor (♂, ♀, ♀), 2 from Norslund (♂, ♂) and one from Havnø (♀) are within the range of *nav.-cub.* from Maglemose sites. From superficial layers at Havnø furthermore a *nav.-cub.* of a domestic ox is present; greatest width 59 mm., as compared with 69 mm. in the *Urus* cow from this locality.

Phalanges.

To distinguish solitary phalanges from forelimb and hindlimb may be difficult, particularly in the case of small or weak animals, but in complete skeletons this difficulty does not exist, cf. the Sorø bull and the Ullerslev cow. Table 21. The phalanges of the forelimb are shorter, but broader than in hindlimbs, a character probably connected with the fact that the forelimbs must carry the largest weight, the weight of the large forepart of the body and the heavy head. The total length of the phalanges of the forelimb of the Sorø bull is 177 mm., as compared with 186 mm. of the hindlimb. Furthermore, a slight difference in length between medial (toe-joint 3) and lateral (toe-joint 4) phalanges may occur (DOTTRENS, 1947).

As in other limb bones the proximal phalanges (Phalanx 1) of *Urus* cows are considerably smaller than in *Urus* bulls. The length of Phalanx 1 of the small Tinglev bull, e.g., it is true, is almost of similar length as in the Ullerslev cow (Table 21, Nos. 4 and 5), but is much broader. — A particularly small phalanx is Phalanx 1 of the forelimb of the Bønnerup cow 2, which is almost equal to the corresponding bone of the bullock from Holmene (Nos. 10 and 21), but apart from this the measurements of the proximal phalanges of the Danish Neolithic cattle are outside the range in *Urus* cows.

The phalanges from the kitchen middens clearly belong to *Urus*, bulls as well as

cows. From the Brabrand settlement a median part of Phalanx 1 (hindlimb), which longitudinally has been split open for taking out the marrow, is at hand; in size it is equal to the proportions in the Ullerslev cow; and the same applies to a similar piece from Dyrholmen (XXXI, C 9^2) and Kolind (IV F 2^5). From Dyrholmen, furthermore, a lateral half of the proximal part of a large Phalanx 1 is present, a prox. height of 43 mm. indicates a bull, of the same size as the Sorø bull.

What is said about Phalanx 1 also holds good of Phalanges 2 and 3 (Tables 22 and 23). Also here the phalanges from the kitchen middens belong to *Urus*.

Summary (limb bones).

From this survey it appears that the limb bones of *Urus* bulls are considerable larger, particularly broader, than in *Urus* cows.—In metapodials there is a distinct sex dimorphism regarding width (fig. 20). In domestic oxen the lengths of the metapodials are widely separated from those in *Urus* (fig. 18–19); the transversal measurements of width, however, merge with those in *Urus* cows, which, however, may be separated from domestic oxen by larger anterior-posterior width.

In other limb bones the size range of *Urus* cows is outside the range in *Urus* bulls, or only a slight overlapping may occur.

In domestic Neolithic cattle examined here, the lengths of the limb bones are outside the range in *Urus*.

Shoulder Height.

A fairly reliable statement of the shoulder height of the *Urus* may be based on complete and mounted skeletons of bulls as well as of cows, however, the correctness of the mounting of the skeleton may always be open to discussion. The height of the skeleton of the *Urus* cow from Ullerslev is 150 cm. (Pl. XIV), of the *Urus* bulls from St. Damme 175 cm. (Pl. XIV), and Sørø 172 cm. In the living animals with their horny hoofs and layer of muscles, the shoulder height probably was 5 to 10 cm. higher and in wintertime furthermore a thick coat was added.

A calculation of the shoulder height on the basis of single bones must always be tentative and made with reservations; particularly the metapodials have often been used for this purpose.

As mentioned above (p. 107), however, the size relation of the various limb bones is very variable.

If the *metacarpus* length of the St. Damme specimen (25.8 cm.), e.g., is taken as a comparatively standard measure in bulls, the shoulder height of these animals will vary between 165 cm. (Gesten) and 189 cm. (Grejs Mølle).

In the St. Damme specimen, however, the *radius* length is 36.3 cm., as compared with 37.2 cm. in the Grejs Mølle bull; with the *radius* length as standard measure the shoulder height of the Grejs Mølle bull is calculated at 179 cm., thus 10 cm. lower than after a calculation on the basis of the *metacarpus*.

A more reliable calculation is obtained if the sum of the two bones, *metacarpus* and *radius*, is taken as a standard measure. In this case the shoulder height of the Grejs

Mølle specimen is calculated at 183 cm. On the same basis the shoulder heights of the adult, but young bulls from Sorø and Ugilt are calculated at 174 and 176 cm., almost as in St. Damme, but with age they would have been somewhat higher. In the still younger bull, Grænge A, the shoulder height is 171 cm., in the Terp bull 173 cm., in the Klarup bull 170 cm., in the Tinglev specimen 169, and in Grænge D, if the bones belong to the same individual, 166 cm. Thus a range of the shoulder height from 169 (166) to 183 cm.

In the rest of the limb bones of bulls measured, only the *metacarpus* or the *radius* of the single individual is available. Of these the *radius* length, as mentioned, is more indicative of the shoulder height than the *metacarpus*. Several *radii* are comparatively large (Table 15); three (Undløse (No. 10), Ugilt (No. 12) and Danmark II (No. 23)) are just as large as the Grejs Mølle specimen 37.1, 37.0, and 37.1 cm. (as against 37.2 cm.) and five are as large as, or somewhat larger than, the St. Damme *radius* (36.3 cm.): 36.2, 36.4, 36.5, 36.7, and 36.7 cm.

Accordingly the shoulder height in the majority of the Danish bulls was about 175 cm. ± 5 cm.

Before the preparation of this treatise no direct measurement of the shoulder height of a skeleton of an *Urus* cow was carried out. In the Ullerslev cow it is, as mentioned, 150 cm. Only of two other cows, from St. Taastrup and Bønnerup II, the *metacarpus* as well as the *radius* are present; the total sum of which is 59.4 cm. and 55.9 cm., respectively, as compared with 56.6 cm. in the Ullerslev cow. On the basis of this the shoulder height may be calculated at 157 cm. and 148 cm., respectively.

An impression of the shoulder height of other cows represented, may be based on the *metacarpi* only. Practically speaking two *metacarpi* from Sværdborg are equal to the Ullerslev *metacarpus*, 24.3, 24.4, and 24.6 cm., respectively, whereas one from Vittrup is larger, 25.3 cm., corresponding to a shoulder height of 156 cm., but probably would this long-leged animal in fact have been somewhat higher. The *metacarpi* from Bønnerup II, 23.0 cm., from Tjerrild, 23.1 cm., and Auning, 23.2 cm., are very small, indicating a shoulder height of about 140 cm. The height of the Pindstrup cow and a cow from Sværdborg is calculated at 143 cm., and the cow from Alminddalen at 146 cm.

Several research-workers have discussed the shoulder height of the *Urus*. Lilljeborg (1874, p. 871) states the shoulder height of a mounted skeleton of a bull from Sweden to be 171 cm. — The length of the *metacarpus* is 25.5 cm., and the length of the *radius* 36.0 cm. The sum total of 61.5 cm., as compared with 62.1 cm. in the St. Damme bull, gives a calculated shoulder height of 173 cm., thus emphazising the applicability of the said method of calculation in animals of the same sex, individual age and growthform.

Lilljeborg furthermore gives the measurement of a "somewhat older and larger", but incomplete skeleton the metacarpal length of which is 25.8 cm., the *radius* length 39.0 cm., total sum 64.8 cm. With the total sum of 61.5 cm. in the complete Swedish skeleton as a measure, the shoulder height may be calculated at 180 cm. (on the basis of St. Damme measurements at 183 cm.).

The shoulder heights of two mounted skeletons of bulls from northern Germany have by NEHRING (1888) been measured at 165 and 168 cm., respectively. The *radius* length was by NEHRING measured as the maximum length, but may be reduced to medial length, which is used in the present work, by a deduction of about 20 mm. Calculated on this basis the shoulder height in both is 165 cm. A shoulder height of 165 cm. is comparatively small, but the said individual was also characterized as a small animal, and was in fact originally determined as a cow.

From England the anterior part of a large bull skeleton, dated at the Bronze Age, is at hand. According to HIGGS (1961) "The bones fall within the size range of the measured Pleistocene specimens; indeed some parts of the body appear to be larger. The Mesolithic animals are substantially smaller." — However, the metacarpal length (26.0 cm.) and the *radius* length (maximum 39.0 cm.) are equal to those of the St. Damme bull. Thus probably the two animals would be the same height. — In both the teeth are of comparatively moderate size (Table 9).

Considerably greater shoulder heights have been reported; in bulls right up to 2 metres (Lengerken, Herre); and REQUATE (1957) in summarizing states that the height of cows varies from 160 cm. to 180 cm. — On the basis of extensive studies BOESSNECK (1957) concluded that in most bulls the shoulder height of living animals was calculated at about 175 cm. (range 165–185 cm.). In *Urus* cows the minimum height may have been comparatively small, probably less than 150 cm. — A result which indicates that the shoulder height in Central European *Urus* probably varied within the same size range as in Denmark. As the German material, however, is undated, we do not know the state of variation within the various age periods.

The shoulder height of the Neolithic domestic cattle is difficult to establish with any certainty, as no complete skeleton is at hand, and we do not know whether the proportions between limb bone length and shoulder height in these animals correspond to recent conditions. It should be mentioned, however, that the lengths of the *metacarpus* and *radius* of the Holmene cow are equal to those of the corresponding limb bones of the complete and mounted skeleton of the primitive cow which is kept in the Zoological Museum, and the shoulder height of which is 120 cm (cf. p. 139). The shoulder height of bulls is probably somewhat greater than in cows with a similar limb-bone length. This would seen to indicate that the Maglemosegaard bull (Vedbæk II) is of about a similar height as, or a little higher than, the Holmene cow, (metacarpal lengths 199 mm. and 205 mm. respectively).

It is generally accepted that the shoulder height of bullocks is 9–10 % higher than that of cows (NOBIS, KOCK), which at a rough estimate would give a shoulder height of 130–140 cm. in the bullocks from Holmene and Borremose (*metacarpus* length 216–217 mm.).

These measurements are smaller than that calculated by NOBIS (1954) on the basis of three *metacarpi* from the Neolithic site at Weiszenfels; the metacarpal lengths are 193, 204, and 207 mm. and the corresponding shoulder heights are stated to be 125, 132, and 137 cm.; and similar proportions occur in some generally used tables,

in which the shoulder height on the basis of the *metacarpus* is calculated in different breeds of cattle (BOESSNECK, 1956).

Thus the shoulder heights of the Danish Neolithic cattle are perhaps stated as too small, calculated on the basis of the complete skeleton of the said cow, and may be somewhat raised; the skulls are comparatively large. The cows from Viksø are very small, almost dwarfish (*metacarpal* length 187 mm.; diaphysis width 22.5 mm.).

It is remarkable to find so small cows dated at Zone VIII, but probably they originate from the end of the zone, or at the transition to zone IX, Bronze Age—Iron Age. Similar small animals otherwise are earliest known from the Roman Iron Age, first century A.D. (*metacarpus* length from 160–175 mm.; DEGERBØL, 1944). Extraordinarily small are the cows from the Rislev find, from the 4th century A.D. Measured on a complete forelimb the shoulder height is 106 cm. (Length of *metacarpus* 159 mm.) (MØHL, 1961).

The Occurrence in Time and Space and the Ecological Conditions

The earliest dated remains of *Bos primigenius* in Denmark belong to the close of the Late Dryas period (Zone III). Profound and rapid climatic changes and corresponding adjustments in flora and fauna were characteristic of that time. The late-glacial tundra animals (reindeer, wild horse, alpine hare, ground squirrel (*Spermophilus major*) pika (*Lagomys pusilla*) disappeared or were able to survive only into the Preboreal period (tundra bison), while new species immigrated (DEGERBØL, 1964). During the transition period between the Late Dryas and the Preboreal period the temperature rose so quickly that the immigration of the heat-demanding species of trees ("the climax species", IVERSEN, 1960) could not keep pace with the climatic improvement. Denmark was still a fairly open country although the summer temperature was rather high, surpassing 13–14° C. The pioneer species of trees spread quickly. *Juniperus* had a striking but short-lived maximum, followed by aspen (*Populus tremula*). *Salix* still existed. During the Preboreal period, however, birch predominated, increasingly mixed with pine. According to these conditions grasses, sedges and other herbaceous plants were decreasing. *Empetrum*, however, also had a short maximum at the transition from Late Glacial to Postglacial. Rapidly acting climate-indicators are found in thermophilous aquatic plants and mobile mammals.

It is remarkable that a forest animal like the *Urus* already was represented in the Late Dryas period, but it is in good agreement with the fact that remains of three typical forest animals, beaver, wild pig, and lynx, are found at the Late Dryas settlement of Stellmoor, N.E. of Hamburg. It is true that this last locality is situated farther south, at the base of the Cimbrian Peninsula. However, the Faaborg region, on the south coast of the island of Funen, was at that time joined to the European mainland and thus was situated only 150 km. north of Stellmoor.

Previous to the present investigations only a few finds of *Urus* from the Preboreal period have been analysed, from Vig, N.W. Zealand (No. 2), and from Star Carr,

Yorkshire (Fraser and King, 1954). The comparatively numerous discoveries now known from Denmark, and the large size of the individuals, however, indicate that the open temperate forests of that time offered the *Urus* particularly favourable natural conditions. From the Preboreal period (Zone IV) 14 finds are known from Denmark, as compared with 20 finds from Zone V and 11 from Zone VI, apart from numerous bones from settlements belonging to the two last-mentioned zones.

Although the temperature during the Boreal period attained a considerably higher maximum than today, as is seen from the occurrence of the mistletoe (*Viscum album*), ivy (*Hedera helix*), and pond tortoise (*Emys orbicularis*) (Iversen, 1944, Degerbøl & Krog, 1951)), the succession of the species of trees was no doubt still a question of the rate at which the different species were able to immigrate, and was not climatically determined.

At the beginning of the Boreal period (Zone V) hazel (*Corylus avellana*) was the first shade-tolerant species to immigrate. It soon became dominant as undergrowth under birch and pine. Later, when other shade-tolerant trees, *Ulmus* and *Tilia* immigrated, the hazel either succumbed or showed a marked decline. Lime (*Tilia*) immigrated at the transition to Zone VI.

At the beginning of the Atlantic period (Zone VII) the great changes in the composition of the forest came to an end, and general stability was attained. During this period the mixed oak forest prevailed; besides *Tilia* and *Ulmus* the light-demanding oaks were dominants. The distribution of the species was now particularly determined by their edaphic requirements. Oak (*Quercus petraea*) could thrive on poor soil, and was presumably prevalent on high and sandy ground, i.a. in Central Jutland. Also lime is met with on high, but not too poor soil; elm occurs on rich soil only. The oak species *Quercus robur*, presumably had its natural habitat on moist clay, lowlying ground, and even peaty soil (Iversen, 1960). On soil with a high ground-water level there was an alder carr (*Alnus glutinosus*).

During the Boreal period the *Urus* was of common occurrence, particularly in Zealand and Funen. However, as demonstrated by many bog finds and numerous bones from the Maglemose settlements on Zealand, the *Urus* seems to have disappeared from that island at the close of the period. No find is known from the Atlantic period or later, although several settlements have been excavated. From South Funen a single find from the Subboreal period occurs.

A similar occurrence is the elk (*Alces alces*) which, like the *Urus* was common during the Preboreal and Boreal periods.—But what is the cause of this disappearance? Was it affected by change in the natural conditions, or were the two species exterminated by man's hunting activities?

We shall first discuss the still living species, the elk, the ecological requirements of which are fairly well known (Peterson, 1955). The elk is distributed in the coniferous forests of both the Old and the New World. Its favourite biotope is an open pine forest with moors, swamps, and small lakes, intermingled with deciduous trees. It is a pronounced browser, which prefers leaves, buds, twigs, bark, etc., whereas grasses

are less significant in the diet. In winter it bites off the terminal twigs and branches and chews the bark. Among important food plants, aspen (*Populus*), willow (*Salix*), birch (*Betula*), oak (*Quercus*), hazel (*Corylus*), and *Sorbus* may be mentioned. However, a variety of foods, i.a. aquatic and semiaquatic plants, too are important factors in a balanced diet. Quality more than quantity is necessary for a healthy elk population.

These food habits clearly indicate that the young and open forest, the pioneer forest, is essential for the elk, whereas the dense, mature, or climax forest is avoided, even if small clearances there may be maintained by heavy browsing. — Transferred to prehistoric times, this means that the food conditions of the elk were excellent in the Preboreal, and very good in the greater part of the Boreal period, but in the course of time, as the forest grew darker, environmental conditions became increasingly poor.

But are the ecological requirements of the *Urus* similar to those of the elk? It has been much discussed whether the *Urus* was a browser (i.a. Zeuner, 1963) or a grazer (Heck, 1952). A priori it might be supposed that wild oxen, having high-crowned, hypsodont teeth, would be less pronounced browsers than deer with brachyodont teeth. The *Urus*, no doubt, was primarily a grazer rather than a browser, even though leaves, twigs, etc., in forested areas may have formed an important part of its food. The graminovorous nature of the *Urus* is also indicated by the very wide distribution of the species, from Great Britain and the Atlantic coast in the west, to China in the east, and from, i.g., Väster- and Östergötland, Sweden, 59° lat. N., to Egypt and North Africa. According to Gromova (1931), the occurrence of the *Urus* in USSR was particularly bound to the mixed or deciduous forest zone, but discoveries are also known from the transition area to the steppes (cited by Reguate, 1957).

Little is known about the ecological requirements of the *Urus* at the time when the species was still genuinely wild. The conditions under which the last specimens lived before the final extinction of the species actually tell us only about the conditions in the reserves, where the now semi-wild animals died, but they probably indicate, in a reduced or limited form, how the original biotopes looked.

The last *Urus*, a cow, died in the year 1627, when 30 years old, in the forest of Jaktorówka some 60 km. southwest of Warsaw, but in most European countries the species was almost exterminated centuries before that time.

On the basis of newly discovered sources from Polish archives, Lukaszewicz (1952) has given the detailed history of the extinction of the species within Polish reserves. The Jaktorówka reserve occupied an area of about 200 square km. and consisted of a great number of tree species, including pine, oak, ash, alder, maple, elm, hornbeam, and birch. The forest environs were marshy.

From very early times, at least from the beginning of the 16th century, herds of *Urus* in the Jaktorówka forest were under the protection of special gamekeepers. In the winter months the animals were fed with hay from the adjoining meadows. Occasionally hybrids with domesticated cows occurred, but these animals were not robust and most of them died in severe winters. On the whole, severe winters caused a

great mortality in the *Urus* herds. Also several bulls were killed when, in the mating season, they fought for the cows. In the year 1557 the total number of *Urus* cattle at Jaktorówka is said to have been over 50, but twelve years later the number was reduced to 38: 8 old and 3 young bulls, 22 adult cows, and 5 calves. Owing to timber-cutting and pasturing of horses, cattle, and domestic pigs, which especially consumed acorns in autumn, the biotope was gradually devastated. In 1599, after the severe winter of 1598, the total number was only 24. On account of the complete collapse of the protection of the animals many specimens were now killed by poachers, a fact which together with epidemics sealed the fate of the last animals. Two years later, in 1601, only 4 *Urus* specimens were left in the Jaktorówka forest: three bulls and a cow.

The importance of the acorns in the diet of the *Urus* is emphasized by GESNER (1551), who writes that in the autumn the *Urus* cattle eat acorns, which leads to increased weight and shinier coats. GESNER also states that in winter the animals forgathered in small herds browsing on leaves and buds.

On the basis of the associated fauna in Central Europe, LEHMANN (1949) also concludes that the preferred biotopes of the *Urus* had been open forests together with the adjoining grassland.

From this survey it must be stated that the increase of the deciduous trees during the Boreal period in Denmark did not reduce the quality of the natural environment to the *Urus*. On the contrary, the increase in oak trees with their acorns offer a valuable food supply. This, however, only holds good as long as the forest was so open that grass and other herbs were available in fairly large quantities. The distribution in time of the Danish *Urus* discoveries during the Boreal period clearly confirms this view. The great number of finds of large animals in the early half of the Boreal period, Zone V, (cf. the survey of the material), indicate a most favourable habitat for the *Urus*.

It seems that the animals in Zealand were strongly decreasing in number at the end of Zone VI. From the latest settlements in Aamosen from this period only a few *Urus* bones are known (Magleø, Hesselbjerggaard, Verup).

For the sake of completeness it may be mentioned that a single *Urus* bone, a *hamatum*, and 2 *astragali* of Alces, are known from the Tingbjerggaard settlement in Aamosen (DEGERBØL, 1943). This site is of Mesolithic age with a faint intermixture from the Dolmen period. However, according to the excavator, Dr. TH. MATHIASSEN, the said bones no doubt belong to the old phase, e.g. with microliths, thus dating back to Maglemose times.

It is remarkable to note that the *Urus* already disappeared from Zealand before the density of the mixed oak forest culminated, in the Atlantic period, Zone VII. This might indicate that the forest already at the end of the Boreal period was so dark that it was difficult for the Urus to survive. It is probable, however, that the activities of man have played a considerable rôle in the decrease of the *Urus*. The great number of bones of this species known from the great Maglemose settlements indicates that the *Urus* was a favoured quarry. With the increasing density of the forest the *Urus*

would seek out the more open areas, e.g., where oak trees, filled-up lakes, and dried-up moors dominated. These places, no doubt, were soon known to men, and the animals were severely hunted.

The continous existence of the *Urus* and elk in Jutland is in accordance with the more open country in this region (Jonassen, 1950), and, furthermore, an immigration from Central Europe was still a possibility.

From a zoological point of view, it may be difficult to elucidate in detail the problem of the density of the forest. It should be emphasized, however, that the two ungulate species, the red deer (*Cervus elaphus* L.) and the roe (*Capreolus capreolus* L.), still survived on the island of Zealand; the open forest being for the roe in particular the preferred habitat.

On the other hand, it is a remarkable fact that from the Atlantic period only one discovery of *Urus* from bogs is recorded, from Langeland, which at that time was connected with the south-eastern corner of Funen. However, *Urus* remains are known from several kitchen middens, representing a population of hunters of the Ertebølle culture. It is true that this culture continued well into the Subboreal period, but it is probable that most bones of the *Urus* from these settlements originate from the Atlantic period, as i.a. has been proved regarding a horne core from Brabrand.

The existence of the *Urus* in the Subboreal period was, as noted by Winge, demonstrated from a kitchen midden at Ørum Aa, Jutland (cf. p. 22), and later from the Bundsø settlement (cf. p. 23). However, only a few bones were present, and the *Urus* was considered a rare animal in the Subboreal period. Surprisingly enough, pollen analytical investigations have now proved that this species is represented in no less than 23 Jutland discoveries.

Regarding the question of the origin or later changes of the domestic cattle in Denmark, this implies that the *Urus* in Jutland may have formed part of the domestic cows, but no indication of this is found; whereas in Zealand these animals must have been introduced, and any hybridization with the *Urus* was impossible.

The earliest Subboreal finds of *Urus* belong to the beginning of the period, the latest find, from Tinglev Lake, to the transition to the Subatlantic period or to this period proper.

The Subboreal skulls are on an average smaller than the geologically earlier skulls, even if the Subboreal skulls from Grejs Mølle and Auning are fairly large, and the limb bones from Grejs Mølle belong to the largest ones known. The tooth rows in all Subboreal skulls are comparatively short (cf. p. 85) as also the *Urus* teeth known from the Ertebølle kitchen middens are small.

The find from Rise (No. 72, p. 23) makes it probable that the *Urus* still existed in southern Jutland in the Subatlantic period (Zone IX).

According to Requate (1957, p. 305) part of a horn core of *Urus* was excavated at Haithabu from the period 800 to 1050 A.D. This is not, however, a conclusive proof of the occurrence of the *Urus* in Schleswig-Holstein at that time. Haithabu was a famous commercial centre, and this piece may have come from a cut-off trophy—furthermore,

the horn sheath was used as a drinking horn—and it may have been imported from far away.

A pollen analytical dating of the Swedish finds of *Bos primigenius* was made by O. Isberg, and a treatise on the subject was almost finished at his death 1950; it was later revised and published by E. Mohrén 1962. No osteological examination of the material has been made, but some of the finds had earlier been examined by Leithner (1927). As in Denmark most Swedish discoveries belong to the Boreal period. From the Atlantic period only one find exists and from the Subboreal period a few finds are known. The most remarkable of the last-mentioned finds is an almost complete skeleton from Hammarlöv, Scania, belonging to the Bronze age or perhaps to the close of the Neolithic age. According to Leithner this skull is very large, basal length 593 mm.; however, no teeth measurements have been published. — The latest Swedish find is from the Subatlantic period, the Iron age or Late Bronze age, just as the Danish Tinglev specimen.

According to Adam of Bremen the *Urus* was still living in Scandinavia in the 11th century; however, the interpretation of his Latin text must have been incorrect, as clearly shown by the additional information that the *Urus* lived under water, just as the white bears (cf. Prell 1939, Degerbøl 1945, p. 31; and Isberg & Morén 1962).

In the Netherlands *Urus* remains are recorded from the Terpen, the finds of which belong to the beginning of our era and the early mediaeval period (Clason, 1965).

It is remarkable that no discovery of the *Urus* is known from the island of Bornholm in the Baltic. During the Dryas periods the reindeer (*Rangifer tarandus*) was very common in that area, which at that time was part of the European continent. Also the elk (*Alces alces*) was well represented. (Degerbøl and Krog, 1959). The duration and extent of the Bornholm landbridge have often been discussed (Isberg, 1950), but the non-existence of the *Urus* on Bornholm would seem to indicate that the Bornholm area was already isolated at the beginning of the Preboreal period (Zone IV).

From the maps (figs. 1 and 2) it will be seen that only a few discoveries are recorded from South-Western Jutland. This is not expressive of the commonness of the *Urus*, but is only to emphasize the fact that most bogs in this area are so acid that no bones will keep.

Domesticated Cattle (*Bos taurus domesticus* L.)

Survey of the Material.

The question when domestic cattle may be demonstrated with certainty for the first time, must be answered on the basis of a certain zoological identification of a reliably dated osseous material. In the following more detailed study of domestic cattle in Denmark, I shall begin with skulls of such a character that it is absolutely certain that domestic oxen are represented:

Dated finds. Arranged according to time-scale. (Cf. B. FREDSKILD).

I. *Øgaarde* complex, Undløse, Aamosen, N.W. Zealand (National Museum).
♀ juvenile (Heifer). Skull with mandibles and parts of postcranial skeleton. (Marked "Øgaarde I"). A-landnam. Zone VIII.

II. *Store Lyng*, Undløse, Holger Jørgensen's moor, Aamosen, N.W. Zealand (National Museum, 1941).
♂ subadult. Skull with mandibles and postcranial skeleton-parts — B-landnam. Zone VIII.

III. *Verupgaard*, Niløse, Aamosen, N.W. Zealand (National Museum, 1942).
♂ skull with mandibles. The very beginning of B-landnam.

IV. *Øgaarde* complex, Undløse, Aamosen (National Museum 1943).
♀ Skull (Marked "Øgaarde II"). Beginning of B-landnam.

V. *Øgaarde* complex, Undløse, Aamosen (National Museum 1943).
♀ subadult. Brain-case (Marked "Øgaarde III"). Beginning of B-landnam.

VI–VIIIA. *Gammellung moor*. Troldebjerg, Langeland (Langelands Museum). B-landnam.
I ♂, skull. II ♀, incomplete skull. III ♂, brain-case. IV ♂, brain-case, subad.

IX–XA. *Nyrup moor*. 16 km. W. of Næstved (J. FERDINAND, Herlufsholm). About B-landnam.
I ♀ (85/1945), incomplete skull and some limb bones. I ♀ (87/1945), brain-case. III ♀ Skull.

XI. *Snoldelev*. 8 km. S.S.E. of Roskilde (V. MORTENSEN, 1904).
♂ Skull. B-landnam.

XII. *Vedbæk*. I. 20 km. N. of Copenhagen (1942).
♂ Skull. Subboreal transgression; the middle of Zone VIII.

XIII. *Vedbæk II, Maglemosegaard*. (P. LORENTZEN, 1942).
♂ Skull with mandibles, metapodials, and toe-joints, *vertebrae*. — Subboreal transgression. — Probably just below the border of Zones. VIII–IX.

XIIIA. *Vedbæk III*. Idem.
♂ Skull. — Regression period after the Subboreal transgression in the middle of the Subboreal period.

XIV. [*Ordrup* moor. (Litt. J. IVERSEN, 1941, p. 61).
A bone. — B-landnam.]

XV. *Holmene, Hillerød.* I (C. B. Jacobsen, E. Jensen, 1941).
♂ Skull and limb bones. — Zone VIII. — B-landnam oldest possible dating.

XVI. *Holmene, Hillerød.* II (C. B. Jacobsen, E. Jensen, 1941).
♀ Skull and postcranial skeleton. Zone VIII, B 1. J. Iversen in litt. 2.2.1943.
(Vide: XXXIII, Søndersø.)

XVII. *Borremose*, Midt-Falster (I. Kring, 1949).
Postcranial skeleton. — Zone VIII, B 1.

XVIII. *Sandhuse moor.* Jordløse. Lille Aamosen. N.W. Zealand (Harald Andersen).
♀ Incomplete skull. — End of Zone VIII, Subboreal.

XIX. *Sandhuse moor.* Jordløse. Lille Aåmosen. N.W. Zealand (Harald Andersen).
♀ Skull. — Late Bronze Age or beginning of Iron Age.

XX. [*Vejlby.* Kiselgurværk. 5 km. N.N.W. of Fredericia. (S. Th. Andersen, Danmarks geologiske Undersøgelse).
Parts of fragmentary skeleton. — Bronze Age.]

XXI. *Ærø.* In the cove of Ærøskøbing (Assessor Steenstrup, 1862).
♂ Skull. — Zone VIII.

XXII. *Løgtved Enge.* 17 km. E. of Kalundborg. (Saltofte).
♂ Brain-case. The middle or late part of Zone VIII.

XXIII. *Viksø*, Lindebjerggaard, Smørum. 18 km. W.N.W. of Copenhagen. (Thomsen, 1943).
♀ Fragmentary skull. — Zone VIII.

XXIV. *Viksø*, Lindebjerggaard, Smørum. 18 km. W.N.W. of Copenhagen. (Simonsen, 1940).
♀ Fragmentary skull with mandible, parts of postcranial skeleton. Zone VIII.

XXV. [*Holt*, Alme, Græsted. 5 km. S. of Gilleleje. (Gilleleje Museum, 1941–42).
(Lit. A. Andersen, 1943, pp. 64–65 (No. 64). Zone VIII.]

XXVI. [*Odense* river. N. of Odense, between Seden and Skibshuse. Zone VIII.]

XXVII. *Veddinge.* 4 km. N. of Faarevejle. N.W. Zealand. (P. Rasmussen, 1909).
♂ Skull. — Late Bronze Age or early Iron Age. Zones VIII–IX.

XXVIII. *Snoldelev* II. 8 km. S.S.E. of Roskilde. (Th. Mölby, 1945).
♂ juvenile. Skull and postcranial skeleton. End of Zone VIII.

XXIX. *Bodal.* Ondløse. Aamosen. N.W. Zealand. (O. Schram, M. Rasmussen, 1940).
♂ Skull. Late Bronze Age or early Iron Age. — J. Iversen.

XXX. *Mors.* (1891).
♀ Skull. Beginning of Zone IX. Litt.: Degerbøl, 1963.

XXXI. *Gundsømagle.* 12 km. N.N.E. of Roskilde (Mosegaard, 1945).
Horn core. Zone VIII.

XXXII. [*Rislev.* Litt.: U. Møhl, 1962].

XXXIII. *Søndersø*, Vestergaards moor. (O. A. Andersen, 1941).
♂ Skull, skeletal parts. As the pollen analytical dating was uncertain, a C-14 dating was made with the result: 4070 ± 120 (before 1950) or 2120 B.C. (H. Tauber, in lit. 21.7.1966).

The Øgaarde Complex I

The earliest skulls of domestic cattle in Denmark are 2 specimens, from a heifer and a subadult bull, at the Øgaarde Complex I, St. Lyng, Aamosen, from the border line between the Atlantic and the Subboreal periods, or Zones VII and VIII, i.e., at the very characteristic Elm decline in the Danish pollen diagrams, or the A-landnam contemporaneous with the first-known agriculture. By C-14 dating tests the age was established to be about 2800 B.C. (2930 + 160, 2820 + 80, Tauber, 1961). From the same locality, but from a little later, the B-landnam or Iversen's landnam, are 2 skulls, belonging to a subadult and an adult cow (Øgaarde II and III).

No. I. (Øgaarde I) comprises considerable parts of a skeleton of a heifer. The skull is almost complete, only the occipital, the right nasal bone and the left *premaxilla* are missing. All sutures are open, even the suture between the *parietale* and *frontale*. The deciduous or milk dentition is present, and of the permanent teeth the 1st and 2nd molar are at hand. In the upper jaw the 1st molar is slightly worn, whereas the 2nd molar has not broken through the gum. In the mandible the incisors and the canine teeth have dropped out and a permanent incisor is visible at the bottom of the alveole of the median milk incisor. The 1st molar is worn, but of the 2nd molar only the first lobe is slightly worn. Accordingly the age may be estimated at about a year and a half (Pl. X, No. I).
As the occipital is missing from all-over measurements of length, only the profile or "total-length" can be taken. It is 362 mm., but when allowance is made for probable changes with growth, the adult length may be estimated to have increased by about 13% (Klarer, 1953, Table 5, p. 20). Klarer studied the growth in living Allgäuer Braunvieh, of the *Bos taurus longifrons* group. The increase of the total length of the head (from the top of the head to the hairless part of the muzzle) from the age of one year to the full grown animal, may be calculated at about 20%; from the age of a year and a half to about 13%.
It may thus be estimated that the total length of the Øgaarde skull as an adult would have increased to about 410 mm. or to the size of a fairly small Jersey cow. Also by a comparison with specimens of equal individual age, it appears that the Øgaarde skull is small. The mandible, e.g., is of the same size as the smallest mandibles from the Bundsø settlement, in fact not larger than some mandibles from medieval settlements in Denmark (Table III, No. 1).
The Øgaarde skull No. I has previously been briefly referred to as representing a small cow of the *Bos taurus longifrons* type (Degerbøl, 1963, p. 74, and 1962, p. 71).
The existence of this type in Denmark at the beginning of the late Stone Age, is furthermore emphasized by an almost complete skull of a cow, and that of an adult specimen, Øgaarde Cow II.

No. IV. Øgaarde-complex, Cow II. In this skull both *premaxillae* and both nasals are missing, and the left *maxilla* is anteriorly a little injured. The two anterior premolars of the left side and the first right premolar have dropped out. The posterior third of the

interfrontal suture is closed, however still visible. This in addition to the fairly worn teeth, even the interior column of the posterior molar is worn, indicates an individual about 8 years old (Pl. X, No. IV).

The shape of the skull shows the features ordinary stated as characteristic of the *longifrons* type, the occipital crest is wavy with a concavity at the base of the horn cores and seen from behind a forward directed Cupid's bow at the middle convexity. The horn cores are very small, but are not set close into the frontal. No doubt, this feature only holds good of weak specimens of the *longifrons* type. As the *premaxilla* is missing, the overall length of the skull must be established by comparison with complete skulls of a similar size. A comparison with 3 recent female skulls kept in the Zoological Museum of Copenhagen for more than a hundred years is of particular .nterest. Two of these skulls (No. 860 and No. 861), are labelled "Jydsk Ko" (Jutland cow) and arrived at the Museum in the years 1847 and 1849, respectively. The third skull, attached to a complete skeleton (No. 296), has come from the "Zootomical-Physiological Museum", which was abolished 1841. Previously this last skull has several times been used at a comparison with a prehistoric material (Degerbøl 1939 and 1948, fig. 183).

The greatest length to be measured in Øgaarde Cow II, is the distance from the occipital crest almost to anterior point of the maxilla-premaxillary suture on the palatal plate, medial; it is 435 mm.; exactly the same as in the recent skull No. 296, the total length of which is 475 mm. The distance from the *condylus occipitalis* to the same point of the *maxilla* is 395 mm. in Cow II, as compared with 400 mm. in the recent skull, whose condylobasal length is 445 mm. Similarly the distance from the *foramen magnum* to the point mentioned is 368 and 375 mm., respectively, and the basal length of the recent skull is 415 mm.

Accordingly, the total length, the condylobasal length and the basal length of the Øgaarde skull may be indicated to 475 mm., 440 mm., and 410 mm., respectively, thus in fact the same in the two specimens. The Jutland cow (No. 860) is of the same size: condylobasal length 440 mm., basal length 410 mm. According to the less posteriorly sloping occipital part, however, the total length is shorter, 460 mm. For the sake of comparison, it may be stated that the three above-mentioned measurements, to the maxilla-intermaxillary suture, in this Jutland skull are 415, 395, and 373 mm., respectively. It should be noted, however, that the length of the frontal (from occipital ridge to nasal base) in the Øgaarde cow is particularly great 235 mm., as compared with 224 mm. and 200 mm. in the two recent cows. No. 296 and No. 860; thus being consistent with the name of *longifrons*.

Also regarding most width measurements the three skulls, Øgaarde II, Nos. 296 and 860 are similar, e. g., zygomatic width 184, 185, and 191 mm., respectively, mastoid width 194, 200, and 200 mm., respectively, palatal width, across m 1: 128, 130, and 125 mm., respectively; interorbital width anteriorly 146, 146, and 143 mm., respectively, however, the smallest frontal width is fairly narrow in the Øgaarde skull, 148 mm., as compared with 161 and 159 mm., in the two recent skulls. As the horn cores in the Øgaarde cow have long "pedicles", the intercornual distances, however, are fairly alike in the three specimens.

When considering these measurements, it should be noted that regarding individual age the Jutland cow (No. 860) is the oldest of the three as seen from the almost closed sutures, more worn teeth, and the partly roofed *sulcus supraorbitalis*. In this specimen the horn sheaths are present, having conspicuous circular furrows, 13 in all, which probably indicates an age of more than 15 years.

In Øgaarde and the recent skull No. 296 the horn cores are of equal size and fairly

small, the outer curvature about 200 mm., as compared with 255 mm. of the large horn cores of the Jutland cow (No. 860). The corresponding greatest spans of horn cores are 396, 397, and 480 mm. In the Jutland cow the horn sheaths, as already mentioned, are present; the length along the outer curvature is no less than 425 mm., the greatest span is 495 mm. With their double curvature, black tips and upward direction they are beautifully shaped, actually in miniature recalling the pictures of the *Urus* cows from Lasceaux (cf. F. Windels, 1948).
The second specimen of a Jutland cow, No. 861, is smaller. It was said to be a smallholder's cow.

No. V. Of the same geological age as Øgaarde Cow II is a brain-case of a young cow, Øgaarde III. On the frontal side it is broken anteriorly at the nasal base (Pl. X). The sutures are open, almost as in the complete skull from St. Lyng, which indicates an individual age of well over two years. In shape it is similar to Øgaarde Cow II. It is smaller (Table 1), but when fully adult it would have been almost of the same size. This skull thus, furthermore, emphazises the existence of a small cow at that time.

It is a most remarkable fact that these earliest known skulls, and brain-cases, from Denmark represent a *Bos taurus longifrons* type, in size similar to skulls from the 19th century. For about 5000 years this phenotype thus has existed in Denmark.

The existence of these small and well characterized domestic cattle clearly emphasizes that the starting of the domestication of cattle must have taken place much earlier than the date of the sites, about 3000 years B.C. These cattle from the Øgaarde complex either must have been imported into Denmark, or evidence of a possible domestication of the large *Urus* in Denmark must be sought for in much earlier deposits.

No. II. From the very beginning of Zone VIII (A- and B-landnam) furthermore two skulls are at hand, from St. Lyng and Verupgaard, Aamosen.
Holger Jørgensen's bog, St. Lyng.
This skull belonged to a young animal.
In the *maxilla* the posterior molar (m 3) has not fully erupted, only the lateral points show signs of wear. The milk premolars dp. 3 and dp. 4, have been functioning, but have dropped out. Of the permanent premolars, p. 3 has partly erupted, and p. 4 is just visible in the jaw. In the mandible the permanent first premolar, p. 2, has dropped out, the second premolar (p. 3) is very slightly worn, whereas p. 4 is concealed in the jaw, which indicates that dp. 4 was still used. The 1st and 2nd molar are moderately worn, and of the last molar the posterior column is unworn. Hence, the age may be estimated at about $2^1/_2$–3 years. With the exception of the maxillo-zygomatic suture, which is almost closed, all sutures, even the suture between supraoccipital and frontal are wide open; no doubt *post mortem* exaggerated. In the upper part of the supraoccipital bone three large openings into the frontal sinuses are seen.
This skull differs from Øgaarde Skull II by its larger size and particularly broader and posteriorly convex frontal and heavier horn cores. — Pl. X, Table III.
The smallest frontal widths are 180 mm. and 148 mm., respectively, and the intercornual widths 200 and 148 mm., respectively. The horn cores are fairly large, at base a little downwards and backwards directed, whereas the smaller horn cores in Øgaarde II are more upturned.

The circumferences at the bases of the horn cores are of the two specimens 205 mm. and 153 mm., respectively, and the lengths of the outer curvatures are about 250 and 205 mm., respectively. When full-grown the St. Lyng skull would almost in size and partly also in shape have been similar to an adult skull from Verupgaard, from a slightly later period, the transition to or the beginning of the B-landnam.

No. III. The Verupgaard skull represents a "*B. t. frontosus* type" with a posteriorly dome-shaped frontal, and the occipital crest formed as a projecting boss between the horn cores. The profile is convex, increased by a pronounced elevation medial to the anterior part of the supraorbital sulcus. Although the teeth are fairly much worn — the posteriorly molar (m 3) just down to the tip of the interior column, which indicates an age of about 7 years — most sutures are unfused. In the occipital area, the temporal sutures are open, as also the suture below and behind the horn cores are unclosed. The interfrontal suture is only fused in its posterior 60 mm. (cf. bullocks p. 152).
For comparison it may be mentioned that in two 4-year old Spanish fighting bulls, in which m 3 is very slightly worn, all sutures in the occipital area are completely closed.

Thus it appears that from the same time, the beginning of the Neolithic Age, and from the same narrow territory, Aamosen, N.W. Zealand, two kinds of skulls of domestic cattle are at hand, originally accepted to represent two different breeds or races: *B. t. longifrons* and *B. t. frontosus*. — However, the existence of two breeds of cattle living so to say side by side, under these circumstances is very unlikely. A simple and natural explanation would be, that the small skulls belonged to cows, and the large skulls to bulls; what generally have been considered different races, may be explained as sex dimorphism, a view now generally accepted.

The sex determination of prehistoric domestic cattle must be based on the same characters as mentioned in the *Urus*. Particularly characteristic of the bull is the broad frontal (smallest frontal width, the inter- and postorbital widths) and the large horn cores. Also the total length of the skulls of prehistoric cattle seems to be larger in bulls than in cows, in contrast to what is the case in modern cattle breeds (Bohlken 1962, p. 600). All in all, the sex dimorphism in prehistoric cattle is fairly large, considerably larger than in recent breeds.

Also from other dated, and many undated, finds of skulls of cattle from Denmark, the difference in shape and size is naturally explained as depending on sex and not on race.

Large skulls as well as smaller skulls are found together in the same settlement and belonging to the same time, as will appear from the following.

No. VI–VIII A. From the "village"-site *Troldebjerg*, Langeland, from the lower part of Zone VIII, the Early Passage Grave Period, J. Winther (1935, p. 57) has depicted three "sacred bullheads". — Two of these were found already in 1906 in Gammellung bog by peat ketching at the bottom of the moor at a depth of about 4 metres. They were identified by H. Winge as "domestic cattle, killed by a blow on the frontal bone, if anything belonging to the *brachyceros* race, the small one rather typical, the larger one approaching the typical *frontosus*." The third skull (No. III) was

found later in the same bog, which at the time of the site was a lake. According to WINTHER these heads must have been sailed out into the lake and sunk there as an offering to the gods.

On a visit to the Langelands Museum I had the opportunity of examining these skulls and of taking samples of the gytja in the skull cavities for pollen analythical examinations. The samples were handed over to Dr. J. IVERSEN, Danmarks geologiske Undersøgelse, and the result of the analyses (IVERSEN 1941, p. 58) clearly proved that at Troldebjerg, too, there had been a pronounced occupation phase, Iversen's landnam or the B-landnam.

No. VI. Gammellung moor I, Troldebjerg (Langelands Museum).

♂ By the blow on the forehead, the frontal bone was fractured, the posterior part was pressed somewhat downward and the left part with the horn core was turned a little forward. The worn teeth and longitudinal ridges on the horn cores indicate a fairly old animal. At the middle of the occipital crest is a faint boss. The nasals are narrow. This skull is somewhat smaller and less robustly built than the Verupgaard skull. (Vide bullocks, p. 160). — Pl. XI, Tab. III.

No. VII. Gammellung moor II, Troldebjerg (Langelands Museum).

♀ Incomplete skull broken anteriorly 2–3 cm. in front of the tooth row, upper part of the *maxillae* and nasals is missing. The upper part of the right frontal is broken at middle, the tips of the horn cores are broken off. As the last premolar, p 4, and the last molar, m 3, are only slightly worn, the age of the animal, when killed, may be estimated at well 3 years. Considering this young age, the skull is very heavy.

In shape this skull is similar to the cow skull from Øgaarde II, however, somewhat shorter.

The length from the occipital crest to the nasal base (in the middle line) is 221 mm. as compared with 240 mm. in the Øgaarde cow, and the lengths to the *foramen infraorbitale* are 334 and 352 mm., respectively. More important measurements are the lengths from the *condylus occipitalis* to the anterior border of the tooth row: 305 and 311 mm., respectively, and the lengths from the *foramen magnum* to the anterior border of the row of teeth are 278 and 286 mm., respectively. On basis of this the total length of the Gammellung cow may be calculated at 455 mm., the condylobasal length at 430 mm., and the basal length at 400 mm.

The width of the frontal and the height of the occipital part are practically the same in the two specimens. The least frontal width is 151 mm. as compared with 148 mm. in the Øgaarde cow, the postorbital width is 189 mm. and the largest occipital height 148 mm. in both. The zygomatic width, however, is much larger in the Øgaarde cow, 184 mm., than in the Gammellung specimen, 172 mm., whereas the smallest supraoccipital width is smaller, 116 mm., as compared with 128 mm. in the Langeland specimen, these two measurements are fairly variable.

Also in the shape and size of the horn cores, the two skulls are almost identical. — Pl. XI, Table III.

No. VIII. Gammellung moor III, Troldebjerg (Langelands Museum).

♂ A brain-case broken anteriorly on the left side just in front of the eye-socket, on the right side through the eye-socket; the horn cores are broken well over the middle, they are strongly grooved and posteriorly exceptionally flattened, platymer. The interfrontal suture is closed, and the orbits are very protruding, characters indicating a fairly high individual age, well over 8 years.

It was this brain-case, which WINGE characterised as almost a typical *frontosus* form; the frontal surface is swollen and domed, as seen in this "type".

The length of the brain-case from occipital crest to nasal base is equal to that of Gammellung I, but it is broader, the measurements of width come within the range of variation in bulls and outside the size range in cows. The smallest frontal width is 183 mm., as compared with 177 mm. in the Gammellung bull and 151 mm. in the Gammellung cow. The postorbital widths are 223, 226, and 189 mm., respectively. As bulls go, the horn cores are fairly small and weak, and the occipital crest is wavy, with a concavity in the middle, the frontal thus not terminating in a boss as ordinarily seen in bulls. This makes the sex determination fairly uncertain, and the question arises whether this skull perhaps may have belonged to a bullock? The problem of castration in prehistoric cattle is an interesting one, but very difficult to clear up (cf. p. 160). – Pl. XI.

VIII. A. *Gammellung moor* IV. Troldebjerg 1947.
♂ Subadult. Fragmentary brain-case; broken through the *os lacrymale* and in front of the nasal base. Forehead crushed behind and medially of the supraorbital grooves; the *basioccipitale* missing, loosened along the open sutures; horn cores very porous. The age may be estimated at nearly a year and a half, a little younger than the Snoldelev II Skull and the recent bull skull, from the Study Collection. In shape it is similar to the last-mentioned skull, particularly marked by the comparatively plane frontal, but it is considerably broader, just as broad as the extremely broad Snoldelev II Skull, which, however, is characterized by the much domed frontal (cf. p. 150). In the Gammellung skull the smallest frontal width is 192 mm., as compared with 187 mm. in the Snoldelev II Skull. and only 166 mm. in the recent skull; the postorbital widths are 212, 210, and 196 mm., respectively, and the smallest supraoccipital widths are 130, 135, and 110 mm., respectively (Table III). The Gammellung IV Skull thus represents a young bull; in shape it is similar to a recent bull skull of equal age, but it is considerably larger and more robust in shape. Pl. XI.

IX. *Nyrup* moor I.
♀ Sacrifice by the side of a collared vessel (B-landnam). Skull, without mandibles; the posterior part of the frontal is crushed; the horn cores and the occipital crest are missing, no doubt removed by the Stone Age people. Furthermore, some skeletal parts are preserved: the left *radius* and the lower part of the *ulna*, left and right *femur*, left *tibia*, one *vert. cervicalis*, the *os coxa*. The *os coxa* was placed above the skull, the limb bones about one metre from the skull.
The hindmost molar is only slightly worn, which indicates an age of well over three years. In size, and also in shape, this skull is similar to a recent skull of a cow which for many years has been kept in the Zoological Study Collection (Table III), thus the basal length is practically identical, 428 and 427 mm., respectively, and the same holds good of the postorbital width, 201 and 200 mm., respectively. The teeth, however, are somewhat larger, 139, as compared with 130 mm. in the recent cow.— Nyrup Skull I thus is also somewhat larger than Øgaarde Skull II. The distance from the *condylus* to the maxillo-intermaxillare suture, medial (cf. Øgaarde II) is 405 mm., as compared with 395 mm. in the Øgaarde cow. This is in good agreement with the fact that the condylobasal length in Nyrup Skull I is 455 mm., as compared with an estimated condylobasal length of 440 mm. in Øgaarde Skull II. – Pl. XI, Tab. III.

X. *Nyrup moor* II.
♀ adult. As was the case in Nyrup Skull I, this skull, too, is a very light yellow-brownish colour, corresponding to the fact that it was found deep in the gytja.

The skull is incomplete, broken in front of the tooth rows, nasals are missing, horn cores broken above middle. On the occipital parts several holes lead into the frontal sinuses, and on the right frontal bone a deep depression indicated a severe blow, dealt when the animal was alive. Interior column of m 3 just worn.

Nyrup Skull II is a little larger than the corresponding part of Skull I. The distance from the occipital condyles to the *foramen infraorbitale* is 315 mm., as compared with 300 mm. in Nyrup I, and from the condyle to the anterior border of the 1st premolar, p 2, the distance is 325 and 317 mm., respectively. From the *foramen magnum* to p 2 the distance is 298 and 290 mm., respectively. On the basis of this the condylobasal length may be estimated at 465 mm., the basal length at 435 mm. Nyrup Skull II is also broader than Skull I, and thus much broader than Øgaarde Skull II. The frontal widths are 164 mm., 158 mm., and 148 mm., respectively. The posterior part of the frontal is fairly dome-shaped, giving the specimen a slightly *frontosus*-like aspect; however, the occipital crest is not shaped as a boss, but is wavy as in Øgaarde Cow II. The eye-sockets protrude more than in the two skulls mentioned, the postorbital widths are 206, 201, and 189 mm., respectively. However, the widths across the first molars (ml–ml) are fairly equal, 134 mm., 130 mm., and 128 mm., respectively, and the zygomatic widths are identical in the three specimens, 184 mm. In size Nyrup Skull II is comparable to the Holmene cow (p. 146). The horn cores are larger than in Øgaarde Cow II, the circumferences at the base are 175 mm. and 157 mm., respectively, and the lengths of outer curvature of the reconstructed horn cores are 255 mm. and 220, respectively; however, equal to the horn cores in the recent skull of the Jutland cow, No. 860. Pl. XI, Table III.

X. A. Nyrup moor III.

♀ Almost complete skull. Nasals, about 10 mm. of the anterior rim of premaxilla, 2 anterior premolars, the right m 2 and the tip of the horn cores are missing. The interfrontal suture posteriorly fused and the tip of the interior column of m 3 worn, indicating the age of about 5 years. The occipital crest is convex, forming a boss between the horn cores. Peculiar to this skull is a well marked longitudinal elevation on each side of the frontal, from the supraorbital groove stretching almost to the occipital crest.

This skull is the smallest of the Nyrup skulls; the basal length is 403 mm., as compared with 427 mm. in Nyrup I Skull, and the smallest frontal width is 153 mm., as compared with 158 mm. in Nyrup I Skull, and 164 mm. in Nyrup II Skull, but all in all, it emphasizes the existence of a fairly uniform breed in the Nyrup area. Pl. XI.

XI. *Snoldelev.* Aamosen.

♂ An almost complete skull; only the outer half of the right horn core and the tip of left horn core are missing. The worn teeth and partly closed supraorbital sulcus indicate a fairly old animal. In the configuration of the forehead and the horn cores this skull is *Urus*-like. The occipital crest is fairly straight, only with a concavity at the base of the horn cores, which just from the base are directed immediately upwards and outwards as in *B. primigenius*, whereas in most prehistoric domestic cattle the base of the horn cores are directed a little downwards, and thus placed below the frontal plane. A line connecting the most posterior part of the horn cores runs behind the occipital crest. The frontal part between the orbits, it is true, forms a single large concavity, without the two longitudinal ridges generally seen in *B. primigenius*. However, as found in the Danish *Urus* skulls, this character is fairly variable. In several skulls of *Urus* cows (Store Taastrup, Bjeverskov, Mørkøv,

Grænge) the frontal bone between the orbits is concave, too, and the same holds good of some male skulls (Mors, Knabstrup, No. 9), in which the roofs of the orbits are more elevated than the frontal parts between the orbits.
The Snoldelev skull thus is a representative of the type which has been called the *B. t. primigenius*.
But how is the occurrence of this fairly isolated form to be explained?
The relatively small size, basal length 435 mm. and short upper row of teeth, 125 mm. indicates that the Snoldelev animal is not the result of interbreeding with the *Urus*. Furthermore, at that time the *Urus* was extinct on Zealand. Probably the Snoldelev skull only represents an extreme form of a variable population.
This slightly built and fairly small skull with the well raised horn cores might give one an impression of a female skull. However, i.a. the broad frontal —the smallest frontal width is 184 mm.— indicates a bull. — Pl. XII.

From Vedbæk three skulls of bulls are present.

XII. *Vedbæk* I.
♂ A fairly complete skull with mandibles, several vertebrae and ribs. Nasals, a single premolar and the tip of the left horn core are missing. The last molar, m 3, is still concealed in the jaw; of the second molar, m 2, only the very tips are slightly worn, the last two premolars are milk premolars, dp 3 and dp 4. On the basis of this the age may be estimated at about a year and a half, thus about one year younger than the prehistoric bull skull from St. Lyng (Holger Jørgensens moor) No. II. Considering this age-difference the Vedbæk skull is in shape similar to the Aamose skull. The Vedbæk skull may be compared with a recent bull skull of equal age, for many years kept in the Zoological Study Collection. It is longer than this specimen and comparatively much slenderer. Particularly the total length is longer, 484 mm., as compared with 440 mm. in the recent skull. When full-grown the Vedbæk skull probably would have attained the same size as the Verupgaard skull. The smallest frontal width is 161 mm., as compared with 166 mm. in the recent bull skull, postorbital widths are 190 and 196 mm., respectively. The teeth are much longer in the prehistoric skull. Although the degree of eruption is equal in the two specimens, the lengths of the rows of teeth are 145 and 132 mm., respectively, however, the teeth are broader in the recent skull. In the skull from St. Lyng the tooth row is 149 mm. long. — Pl. XII.

XIII. *Maglemosegaard, Vedbæk* II.
♂ This almost complete skull belonged to an adult, but fairly young animal about 4 years old; in the hindmost upper molar the interior column is still unworn. With a condylobasal length of 480 mm. it is of the same dimensions as the skull from Verupgaard. It is a well-shaped skull, in shape very *Urus*-like, almost an *Urus* skull *in miniature*. The occipital crest is only a little more convex and the relief of the frontal region is not so sharply indicated as in the *Urus*, but looks a little swollen. The posterior part of the frontal is broader than in most *Urus* cows, the shortest width between horn cores on the occipital crest is 210 mm., as compared with 190 mm. in the Pindstrup skull and 156 mm. in the Grænge skull, and the shortest frontal widths are 188, 178, and 180 mm., respectively. The width across the posterior rim of the orbits (postorbital width), however, is, as previously emphasized, comparatively large in the *Urus*, the respective measurements being 237, 230, and 244 mm. In most other width measurements the Vedbæk skull is also comparable to the smaller *Urus* cows, the mastoid width, e.g., is 232 mm., as compared with 225 mm. and

about 236 mm. in the Pindstrup and Grænge skulls, and the zygomatic widths are 205, 207 and 201 mm respectively

Quite different from the *Urus*, however, is the very short row of teeth, the lengths are 138, 162, and 161 mm., respectively, and the shorter horn cores, the outer curvatures of which measure about 310, 365, and 390 mm., respectively. Furthermore, the horn cores are not so much upwards directed as in the *Urus* cows, which in connection with the larger frontal width in the Maglemosegaard specimen gives the astonishing result that the greatest span of the horn cores nevertheless is larger in the domestic Vedbæk skull, 590 mm., than in the two *Urus* skulls, 500 and 577 mm., respectively. A clear domestic feature is the small metapodials (cf. p. 156). — Pl. XII.

On the basis of this skull it might perhaps be tempting to speak about interbreeding with *B. primigenius*. However, here, too, the geological age of the specimen, the Bronze Age or possibly the Iron Age, clearly indicates that such interbreeding could not have occurred on Zealand, nor probably in Denmark.

XIII. A. Vedbæk III.

♂ A large, typical "frontosus" skull; frontal strongly dome-shaped and occipital ridge posteriorly forming a large projecting boss between the stalked horn cores. A fracture in the frontal indicates that the animal was felled. The dorsal part of the facial region in front of the *os lacrymale* is fragmentary, nasals and the anterior part of premaxillare are missing, which also applies to the *os exoccipitale*, which has come loose along the open suture. P4 and m 3 slightly worn, indicating an age of 3–4 years, nevertheless all sutures are unfused.

In size this skull is equal to the above-mentioned skull from Maglemosegaard, Vedbæk II, thus from the same locality and time, but in shape it is quite different. As the premaxillare has broken through the maxillar suture and the *os occipitale* is missing, no overall length can be stated. The largest length that may be measured is from the occipital crest to the said suture on the palatal plate, 508 mm., as compared with 504 on the Maglemosegaard skull; and also most other measurements are identical (cf. Table III). Accordingly, the total length, or profile length, is about 550 mm. As also from a judgment of the wear of the teeth, the individual age of the two specimens is almost the same, the basal length and the condylobasal length may be identical, 455 and 480 mm., respectively.

As appears from the description of the two skulls, the Vedbæk III specimen is in the shape of the forehead quite different from the Maglemosegaard specimen. In Vedbæk III the posterior half of the frontal bone is very convex, almost formed as a roof ridge, and medially to the supraorbital grooves, in the region of the posterior part of the orbits, there are well marked swellings, which give the skull a fairly convex profile, almost as seen in the Verupgaard skull and in the recent bullock skull kept in the Study Collection. The horn cores are outwards and downwards directed; 80 mm. from the horn base the broken horns are 15 mm. below a horizontal plane through the interfrontal suture, whereas the horn cores in the Maglemosegaard skull are upwards and more backwards directed (cf. bullocks p. 157). Pl. XII.

XV–XVI. *Holmene, Hillerød.*

From a bog near Hillerød two large and in fact complete skulls are known, one of which, however, has a large hole in the frontal (114 mm. long and 95 mm. broad); no doubt the animal was felled. The size and shape of these skulls at once indicate that a bull and a cow are represented. It is the bull that has been killed by a severe blow on the frontal. The skulls must have belonged to fairly old animals. In the

cow the teeth are so much worn that the roots of m 2 is just visible. In the bull skull three molars are present, very much worn, height of crown, interiorly, of m 1 is only 5 mm. The horn cores are strongly grooved.
A comparison of the two skulls will demonstrate the typical sex dimorphism in prehistoric cattle. In the form of the skull the bull is, with its dome-shaped frontal, typically *frontosus*-like, while the cow with an almost plane frontal is a "*longifrons* type" of large size. The bull skull is much larger and broader than the cow skull. The basal lengths are 497 and 426 mm., respectively, the smallest frontal widths are 208 and 159 mm. respectively, and the postorbital widths 257 and 220 mm., respectively. The length of the tooth row, however, is the same in the two skulls, 137 and 139 mm., respectively. Considering that the bull skull is the largest in the Danish dated material, the horn cores are small and compressed at the base (platymer). The greatest span is 556 mm. (cf. bullocks, p. 156).
Also the cow skull is large, together with the Nyrup skulls belonging to the largest of the dated cow skulls. Exceptionally large, however, are the widths across the orbits, the post- and interorbital widths, 220 and 162 mm., respectively, as compared with 206 and 146 mm., respectively, in the Nyrup Skull II, whereas the smallest frontal widths are practically equal, 159 and 162 mm., in the two specimens. — Pl. XII.

XVII. (*Borremose*, long limb bones.)

Also from Jordløse, Sandhuse moor, two skulls, of females, are present, one narrowly built, the other fairly broad.

XVIII. *Sandhuse moor* I, *Jordløse*, Lille Aamose (Harald Andersen 489/46, K XXXIX 19). ♀ Skull. A large, irregular hole, about 65 × 65 mm. in diameter, and with crushed sides, indicates that this animal was felled. The individual age is similar to that of the Nyrup Skull I. Thus a little younger than the Øgaarde Cow II. In shape and length it is similar to the last-mentioned skull, though narrower. The condylobasal length of the two skulls is the same 440 mm., and the same holds good of the smallest frontal width 148 mm., but all other measurements of widths are much smaller in the Jordløse cow. The distance between horn cores at the occipital crest is 132 and 148 mm., respectively, and the horn cores are much shorter; the greatest span is 316 and 395 mm., respectively. Also the facial part of the skull is narrower; the greatest widths of the maxillae, at the zygomatic suture, are 136 and 145 mm , respectively, and on the outer side of m 2 124 and 130 mm., respectively. The zygomatic widths are 172 and 184 mm., respectively. In time this lightly formed skull originates from the transition between Zones VIII and IX. — Pl. XIII.

XIX. *Sandhuse moor* II, *Jordløse*.
♀ This incomplete skull was felled and no doubt was a sacrifice. The hole in the frontal is almost circular, 40 × 40 mm. in diameters. The left mandible is present, the *processus angularis* is split open, probably for taking out the marrow. This skull is broken through the anterior part of the tooth row. On the left side the posterior margin of the *foramen infraorbitale* is visible. Of premolars only the posterior one, p 4, is present, just erupting from the palatal plate; laterally to this tooth the alveoles of dp 4 are found, indicating that this milk premolar still was functioning. Of the hindmost molar, m 3, only the first column is laterally slightly worn. — Of the lower premolars only p 3 has almost erupted, but is not worn, and the same holds good of the posterior column of the lower, hindmost molar, indicating an age of about two years and a half.

As the anterior part of the facial region is missing, the measurements of total length, condylobasal length and basal length cannot be taken, but may be replaced by measurements to the anterior border of the mandible, placed on the skull. The difference between these sets of measurements is not great, in this skull the condylobasal length and the basal length may be about 10 mm. longer than the respective measurements to the anterior point of the mandibles. — After this the condylobasal length and the basal length are about 415 and 390 mm., respectively, i.e., about 25 mm. shorter than those of the Jordløse Skull I. The correctness of these dimensions is emphasized by the fact that the same proportion exists in the respective distance to the *foramen infraorbitale* — the longest measurement that can be taken in Skull II — in the two skulls, 300 and 278 mm., respectively. When full-grown, however, the length of the subadult skull II may have increased by about 6 per cent., or about 25 mm., and thus attained the same length as skull I. Although it is broader than this skull and the frontal is fairly dome-shaped, it no doubt belonged to a cow, too. The horn cores are directed fairly upwards, proportionally long and thin. The largest length of outer curvature is now 275 mm., but as the tip is broken off, the original length may be estimated at 305 mm., the largest horn cores of the females dated. The circumference at the base, however, is only 160 mm. — Pl. XIII.

XXI. *Ærø.*

♂ The Ærø skull is broken anteriorly, about 50 mm. in front of the tooth row or 65 mm. in front of the *foramen infraorbitale*. The outer parts of the horn cores are missing. It belonged to an adult animal, in which the teeth have been worn to such an extent that the medial column of the last molar, m 3, has become worn down. However, the interfrontal suture is conspicuous in its total length, and even the sinuated inter-parietal suture is visible on the frontal region. In the middle the occipital crest is concave.

As the anterior part of the premaxilla has been broken off, the overall length cannot be immediately measured, but in length this skull may be estimated to be a little longer than the Verup skull. — The distance from the occipital condyles to the said fracture in front of the tooth row is 410 mm., which is 10 mm. longer than the corresponding distance in the Verup skull, the condylobasal length of which is 495 mm. From the anterior border of the *foramen magnum* to the said fracture the length is 382 mm., as compared with 370 mm. to the corresponding point in the Verup skull, which has a basal length of 465 mm. Accordingly, the condylobasal length of the Ærø skull may be estimated at about 505 mm., the basal length at 475 mm. — similarly the total length may be calculated at 555 mm. It should be noted that other length measurements are equal in the two specimens. The length from the occipital ridge to the *foramen infraorbitale* is 400 mm. in both and the lengths from the occipital condyle to the same foramen are 341 and 342 mm., respectively. This means that the muzzle proper was longer in the Ærø skull than in the Verup skull. A characteristic feature of the Ærø skull is the very broad frontal region, which is fairly domed with a marked hump or protuberance posterior and medial to the raised roof of the orbits, separated from these by the supraorbital sulcus.

The smallest width of the frontal is 204 mm., which in the Danish material is only surpassed a little by the large Holmene skull, ♂, and the Søndersø skull, in which the corresponding measurement is 208 mm.

The distances between the horn cores, at the occipital crest, are 192, 220, and 189 mm., respectively, surpassing even the corresponding measurements in the *Urus* cows. However, as mentioned above under Vedbæk II, the orbits are much more protruding in the *Urus* as seen in the larger post- and interorbital widths. — This

in connection with the exceptionally long and twisted horn cores, which are outward directed, and in relation to age fairly open suture may probably indicate that the Ærø skull belonged to a bullock. — Pl. XIII.

XXII. *Løgtved Enge.*
♂ Brain-case. Adult specimen with grooved horn cores and posterior part of interfrontal suture closed. Broken in front of the *os lacrymale*, nasal base visible; outer part of horn cores and lower part of skull missing. Posterior part of frontal almost plane and entirely without any swelling between the bases of the horn cores. Occipital crest with a pronounced concavity in the middle. — Pl. XIII.

XXIII. *Viksø.* Remains of two females from Zone VIII.
♀ Fragmentary skull of subadult animal. Upper part severely damaged, felled. The posterior part of the right frontal bone and the upper part of the facial region are missing. Left horn core cut off at base. The posterior molar (m 3) is just cutting the maxillary bone; m 2 is very faintly worn and the milk premolars are present; dp 2 and right dp 3 have dropped out.
Age at death almost two years.
When full-grown probably in size dimensions as the Sandhuse Cow II.

XXIV. ♀ Parts of skull, but so severely broken that it cannot be assembled; left mandible; some vertebrae (*atlas*, *epistropheus*, *vert. thoracalis*, *vert. lumbalis*, *vert. sacralis*, *vert. coccygis*), several ribs, 2 *scapulae*, 2 *humeri*, 2 *antebrachia*, part of *tibia*, 2 *metacarpi*, 2 *metatarsi*, 1 *phalanx*. — Adult but young animal with m 3 slightly worn. In the lower jaw the posterior column of m 3 is not worn, and the third premolar (p 4) is but very slightly worn. The age at death about three years.
These bones represent a very small cow. In size dimensions the skull is comparable to the small cow skull from Mors, Zone IX. The distance from the hind border of the *fossa glenoidalis* to the anterior point of the maxilla is the same, 305 mm., and the lengths of the upper tooth rows are 122 mm. and 120 mm., respectively. The limb bones are dwarfish. The *metacarpus* length, e.g., is 187 mm. and the diaphyseal width is 22 mm. (Cf. Tables 11–12).

XXVII. *Veddinge*, Faarevejle.
♂ As was the case with the Ærø skull, the Veddinge skull, too, is broken through the premaxilla, 37 mm. in front of the tooth row and 45 mm. in front of the *foramen infraorbitale*. This skull is a very fine example of the "*frontosus*" form. The frontal is dome-shaped, and the uniformly rounded sides slope gently outwardly, the frontal part between the horn cores are uniformly rounded, and the occipital crest is strongly convex. Interior column of m 3 worn.
In shape the Veddinge skull, so to say, is a refined edition of the Verup skull, and also in size it is equal to this skull.
The distance from the occipital condyle to the fracture mentioned is the same in the two specimens, 380 mm., as also the lengths to the *foramen infraorbitale* and to the anterior end of the tooth rows are similar. Thus also the condylobasal lengths may be estimated to be equal, 495 mm.
The distances from the *foramen magnum* to the said fracture, however, are some mm.s longer in the Veddinge skull; thus the basal length must have been about 470 mm., as compared with 465 mm. in the Verup skull. — Calculated in the same manner also the total length is equal in the two specimens, 545 mm.
Width measurements also agree. The postorbital widths are 234 and 235 mm. respectively, and the interorbital widths 171 and 175 mm., respectively. However,

the smallest frontal width is narrower in the Veddinge skull, 184 mm., a compared with 193 mm. in the Verup skull; whereas the maxillary widths (across the molars) are larger in the Veddinge skull, 145 and 135 mm., respectively, and particularly the mastoid widths and the supraoccipital widths are larger, 249 and 171 mm., as compared with 230 and 154 mm. in the Verup skull. — Pl. XIII.

XXVIII. *Snoldelev* II.

♂ Almost complete skull, only the nasals and the outer half of the left horn core are missing. It represents a subadult animal. The last molar has not erupted, only the anterior half of m 2 is very slightly worn and all milk premolars are present. Thus it is almost at the same age, one year and a half, as Vedbæk Skull I and a recent bull skull kept in the Study Collection. However, it is shorter, and much more strongly built than these skulls. The frontal is domed, extremely broad, and the horn cores are much thicker. In shape it is thus quite unlike the slenderly built Vedbæk Skull I, but conforms better to the shorter and broader recent skull. The condylobasal lengths in the three skulls are 409, 432 and 419 mm., respectively, however, regarding basal length this Snoldelev skull is only 6 mm. shorter than the recent skull, 381 and 387 mm., respectively. Due to the heavy and convex occipital crest in the Snoldelev skull the total length of this specimen is much larger, 458 mm., than is the case in the recent skull, 440 mm.

The smallest frontal width in the Snoldelev skull is 187 mm., as compared with only 166 mm. in the recent skull and 161 mm. in Vedbæk Skull I; and the postorbital widths are 210 mm., 196 mm., and 190 mm., respectively. The large width of the Snoldelev brain-case is also demonstrated in the large supraoccipital width (distance between the posterior openings of the temporal fossae), 135, as compared with 110 mm. in the recent skull; as also the height of the occipital part is considerable, from the upper border of the *foramen magnum*, 124 mm., as compared with 110 mm. in the recent skull. However, the mastoid width, the zygomatic width and the *condylus* occipital width are equal in the two skulls, and the palatal width, across the first molar, is even larger in the recent animal, 124, as against 118 mm. in the Snoldelev skull.

The very broad and dome-shaped frontal in the Snoldelev skull may suggest a skull of a bullock. However, the horn cores are conical and fairly short as seen in bulls, the outer curvature is 228 mm., circumference at base 214, as compared with 200 mm. and 170 mm., respectively, in the recent bull skull. — Pl. XIII.

XXIX. *Bodal, Ondløse, Aamosen.*

♂ Complete skull, only the premolars have dropped out, and the tips of the horn cores are missing. The frontal is only faintly convex. The occipital crest is somewhat raised between the horn cores, but does not form a pronounced domed convexity as in the "*frontosus*" variety, and the outline of the occipital crest is wavy.

The Bodal skull belonged to an adult animal. The teeth are worn, the posterior part of the interfrontal suture is closed and the horn cores are strongly grooved. The basallength is 480 mm., only surpassed by the very large skull from Holmene I. Regarding several measurements, a skull this size is within the range of variation in *Urus* cows. A comparison, e.g., with the relatively large skull of the *Urus* cow from Bjeverskov (No. 21) is illustrative of the similarities and differences between domestic cattle and the *Urus*. – In size of the frontal the two specimens are almost equal. The smallest frontal width is 3 mm. broader in the Bodal skull, 191 mm., than in the Bjeverskov skull, 188 mm., whereas, in accordance with the general rule, the postorbital width in domestic cattle is relatively smaller than in *Urus*,

244 mm. in the Bodal skull, as compared with 250 mm. in the Bjeverskov skull. Also the zygomatic widths are equal, 213 and 214 mm., respectively. As an *Urus* the Bjeverskov skull has fairly small horn cores, in fact it is almost equal to the Bodal skull. The length of the outer curvatures of the restored horn cores are 400 and 385 mm., respectively, the circumference at the base is a little smaller, 230 mm., as compared with 240 mm. in the Bodal skull; the diameters are 77×67 mm. and 81×67 mm., respectively.

From these measurements it appears that in this case it is not possible on the basis of size alone to distinguish between even the horn cores of the two specimens, the *Urus* and the domestic ox. In shape, however, the forehead of the two skulls are quite dissimilar. The posterior part of the frontal region in the Bjeverskov skull is concave and of a typical *Urus* contouring (cf. p. 55), in the Bodal skull convex as in domestic cattle. The longitudinal grooves of the horn cores, even in the very old female *Urus* from Bjeverskov, are fine and very narrow, but in the Bodal bull they are very broad, up to 10 mm. deep and with almost perpendicular sides, in fact more pronounced than even in old *Urus* bulls, where these grooves generally have more rounded walls.

In length, however, the Bjeverskov skull is larger than the Bodal skull. The distance from the *foramen magnum* to the anterior border of the row of teeth is 355 mm. as compared with 336 mm. in the Bodal skull, which gives a difference of 19 mm. From the occipital condyle to the same point the lengths are 388 mm. and 362 mm., respectively. The greater difference in these measurements, 26 mm., is partly explained by the larger condyles and the narrower anterior border of the *foramen magnum* in the *Urus* skull. Still greater are the differences in length from the occipital crest to the said anterior border of the tooth row, 465 mm. and 420 mm., respectively. The height of the occipital region is considerable larger in the Bjeverskov skull. The heights from the upper and lower border of *foramen magnum* are in the Bjeverskov skull 154 mm. and 192 mm., respectively, in the Bodal skull 126 and 173 mm., respectively. — Pl. XIII.

XXXI. ♂ *Gundsømagle.* A very thick, compressed horn core, the tip missing. The deep longitudinal grooves and obliterated sutures beneath the horn core indicate an old animal. Circumference at base 280 mm., diametres 98×67 mm.

XXXIII. *Søndersø.*

♂ A fragmentary skull, mandibles and some postcranial skeletal parts.

Also this skull is broken through the *premaxilla*, 52 mm. in front of tooth row and 70 mm. in front of the *foramen infraorbitale*. The left maxilla containing teeth is broken off, but at hand. In the right maxilla all teeth have dropped out. The outer part of the horn cores are missing.

Just as in similar broken skulls the overall length must be calculated by measuring the greatest length possible and by comparing these measurements with corresponding distances in complete skulls of similar dimensions. In this case the Søndersø skull is compared with the Bodal skull and the Holmene male skull.

In the Søndersø skull the distance from the occipital crest to the fracture mentioned is 480 mm., as compared with the corresponding lengths in the Bodal skull and in the Holmene skull, 455 and 490 mm., respectively. The total lengths of these two skulls are 546 and 585 mm., respectively. Accordingly the total length in the Søndersø skull may be calculated at 575 mm. – The distances from the *condylus occipitalis* to the said fracture on the three skulls are 405, 405, and 423 mm., respectively, and the condylobasal length in the Søndersø skull may be estimated at same length

as found in the Bodal skull, 505 mm. The length from the anterior border of the *foramen magnum* to the same fracture is in the Søndersø skull 380 mm., and the corresponding length in the two other skulls are 385 and 400 mm., respectively. The basal length in the Søndersø skull is calculated at 480 mm., as in the Bodal skull.

In the Søndersø skull the teeth are worn, p 2 relatively much worn, the interfrontal suture is closed in the posterior third and the horn cores are grooved. It is of about the same individual age as the Bodal skull.

A faint swelling of the frontal sinuses has caused an almost plane frontal bone, completely missing the typical relief of this bone in the *Urus*. The occipital crest is wavy, with a deep concavity at the base of the horn cores and a faint concavity in the middle. The frontal is very broad; the smallest frontal width is, as in the Holmene bull, 208 mm., (the largest measurements in the Danish domestic oxen). In the large female *Urus* skull from Ullerslev the corresponding width is only 203 mm.

In the Søndersø specimen the horn cores are remarkably thick, the thickest in all Danish domestic oxen, and heavier than in most *Urus* cows. The circumference at the base is 265 mm.; diameters at the base 93×71 mm.; only in the large *Urus* cows from Ullerslev, Toftum, and Flintinge the horn cores are just as thick, circumferences 270, 264 and 270 mm., respectively, and diameters 94×74, 90×74, and 89×84 mm., respectively. – The length of the tooth row in the Søndersø skull, however, is typical of the domestic ox, 142 mm., as compared with 162 mm. in the Ullerslev cow (Pl. XIII).

As a pollen analytical dating of the Søndersø skull was highly uncertain, but might indicate a comparatively late period, Bronze Age or Iron Age, I asked the C14-laboratory to try to carry out a C14-dating. The result was that the find belonged to a fairly early period, 2120 years B.C. (4070 ± 120 before 1950). — Cf. limb bones p. 159.

Were bullocks represented in the Neolithic Period in Denmark

The possibility of proving the presence of remains of castrated bulls, bullocks, or steers, from prehistoric times has been much discussed. It is of course an important problem, but available evidence for castration is often self-contradictory and unconvincing (Wertnik 1926, Nobis 1954, Bohlken 1962, Jewell 1962, Howard 1962, Bachmann 1962, Imhof 1964).

The castration involves a retarded development of the animal, the sutures fuse later or not at all (Figdor, 1927). Bullocks therefore have longer, but comparatively narrower, limb bones than sex animals.

It is generally claimed that the bulls have the shortest and most conical shaped horn cores; the bullocks the longest horns, which are gradually decreasing in thickness towards the tip, whereas the cows occupy an intermediate shape. The circumference of the base of horn cores should be greatest in bulls, smallest in cows. The forehead in bullocks is stated to be narrow (Nobis, 1954, p. 160) or broad. This may generally be so in some modern breeds, however, the shape and size of horn cores are very variable in different breeds. In the Spanish fighting bulls the horn cores thus are not short and conically shaped, and this no doubt also holds good of prehistoric domestic cattle.

In fact, a certain sex determination, particularly regarding the existence of bul-

locks, is only possible, when the bones compared belong to the same breed or animal population. Regarding prehistoric remains this means that a fairly comprehensive amount of skeletal parts from a comparatively limited area and space of time must be at hand.

My experience from living bullocks in Denmark is that the variation of the horn cores, in shape as well as in size is very large. The horn cores may even be short and compressed at the base, platymer, and directed more or less downwards, but generally the horn cores are long and robust and directed outward-upwards. This, however, may also be different in different breeds.

In the Institute für Züchtungsbiologie, Wien, I have had an opportunity to study some skulls of bullocks. They are very different in shape. In one, from Austria, the forehead is flat and narrow, the horn cores are raised and the span is fairly small, but in a couple of bullocks of the Hungarian steppe cattle the forehead is very broad, flat, or dome-shaped (Bohlken, 1962, p. 396, fig. 30). — The great variation in the skulls of bullocks partly depends on the question in what period of the animal's life the castration took place.

As already mentioned, three *Bos* skulls are kept in the Zoological Study Collection in Copenhagen, labelled as cow, bullock, and bull (cf. p. 143). — The cow skull must have belonged to an adult and fairly old animal with worn teeth.

In the bullock skull the tips of m 3 are just slightly worn, indicating an age of about three years.

The age of the bull skull may be estimated at about two years. In spite of this young age the frontal is very broad, the smallest frontal width is 185 mm. and the horn cores are turned outwards.

As compared with the bull, the bullock skull is conspicuous by its small width between the horn cores, 120 mm.; the frontal is swollen and faintly spongy, giving a convex profile.

This corresponds fairly well with the descriptions given by Wertnik (1926).— This author has compared 9 skulls of recent bullocks, castrated at an early age, with skulls of cows and bulls. He states that a characteristic feature in the skulls of bullocks is a conspicuous bending or convexity of the frontal and nasal region, particularly the nasal base is arched, as in a ram's head, as also may be seen in living bullocks. Besides the occurrence of the longer but relatively narrower horn cores he emphasizes that the zygomatic width, the palatal width, and the width across the premaxillaries are smaller than in both cows and bulls, giving the impression of a more conical skull. Furthermore the basal length of the premaxillary is shorter in bullocks.

Evidence of a possible existence of bullocks in a prehistoric material thus no doubt must be based on general observations and considerations in connection with numerical calculations.

As horn cores, fragmentary frontal parts, and metapodials are fairly numerous in Neolithic settlements from different parts of Europe, a considerable material of these remains for comparison is present.

Nobis, in examining prehistoric remains (1954) distinguishes between horn cores of cows, bulls, and bullocks. He states that in 11 cows the circumferences of the horn cores vary between 150 and 176 mm., in 5 bulls between 199 and 210 mm.; but in 4 bullocks the circumferences are 218, 220, 223, and 268 mm. (No. 6, subadult).

In a scatter diagram, in which the circumference at base of horn cores is plotted against the horn core indices (smallest diameter × 100/greatest diameter), Nobis demonstrated that the bullocks with their lower indices are placed outside, below, the range of the bulls. If the Danish males are inserted in this diagram it appears that most of them are placed with the bullocks, only one, from Maglemosegaard, is placed with the bulls, and a second skull, from Bodal, lies on the border line between bulls and bullocks.

Survey of the variation of the circumference of horn cores in Neolithic cattle, 106 specimens in all, have furthermore been given by Bachmann (1962) and Imhof (1964) on the basis of the literature. Bachmann (p. 19) states that the size range in cows is between 122 and 190 mm. The greatest measurements, from 245 to 268 mm., come from bullocks only, whereas measurements below that boundary may be due to bulls as well as bullocks. According to this the Danish skulls from Bodal (245 mm.), Gammellung I (257 mm.) and Søndersø (265 mm.) unquestionable should belong to bullocks.

Imhof has re-investigated the cattle remains from early Swiss settlements, from Bielersee and Neuenburger See, which originally, at the latter half of the 19th century, were studied particularly by Rütimeyer, Studer, and David. He obtained the result that the great variation stated in this material in fact is not based on the existence of different races (brachyceros, frontosus) but is explained by sex only, and he furthermore is of the opinion that besides remains of cows, bulls, and bullocks of domestic cattle also horn cores of *Urus* are at hand. Imhof claims that some of the large horn cores stated by Nobis and Bachmann (loc. cit.) as belonging to bullocks in fact originate from the *Urus*. This applies, e.g., to the bullock of Nobis (No. 6) with a circumference of 268 mm. and a length of outer curvature of 440 mm.

Considering that this skull fragment belonged to a subadult animal, this interpretation may be right. It is true that in the two large Danish domestic skulls from Søndersø and Ærø, the corresponding measurements are 265 and 415 mm., respectively (Søndersø), and 235 and 445 mm. (Ærø), but a better accordance is seen in the measurements of the large *Urus* cow from Ullerslev: 270 mm. and 450 mm., respectively. These examples clearly show that a certain identification on the basis of the said two measurements alone is not possible.

Like Nobis also Imhof has a scatter diagram, in which the circumference at the base of the horn cores is plotted against the said index. In this case, too, the range of the bullocks is stated generally to be outside the range of bulls, but not below, as in the diagram of Nobis, but above the range of bulls. Corresponding to the more rounded horn cores in bullocks, the indices are higher than in the more flattened horn cores of bulls. In the bullocks the index is above 79, in bulls below (Imhof).

Entered in this diagram, however, the Bodal- and Maglemosegaard-skulls (index

82) are not, as in the diagram by Nobis, plotted together with bulls but on the border line to female *Urus*.

According to Imhof horn cores which along the outer curvature are longer than 300 mm., and the circumference of which at the base is more than 210 mm., belong to bullocks.

Hence, most of the large Danish skulls should belong to bullocks: Ærø 430 (235), Sønderso 415 (265), Bodal 385 (245), Snoldelev I 380 (232), Verupgaard 375 (230), Maglemosegaard or Vedbæk II 340 (220), Gammellung I 335 (257), Holmene I 305 (240); and probably also Veddinge 295 (214).

Also Jewell (1962), in dealing with some large skulls from the Neolithic site at Maiden Castle which originally were considered by Jackson (1943) to represent a *B. t. primigenius* type of domestic ox, doubts this identification, and he is of the opinion that these skulls in fact belong to the *Urus*. The circumferences of the bases of three horn cores are stated to be 245 (II), 217 (III) and 228 mm. (IV). The last two measures, however, are not very large even in domestic animals, and a circumference of 245 mm. is found in the Danish Bodal skull; and in the skull from Langeland, in time belonging to the B-landnam, the circumference is 257 mm. Thus these measurements are not decisive; they emphasize that a reliable determination is not possible on the said basis— Jewell, however, furthermore states that the length of the outer curvature of the thick horn core (II) is 615 mm., and so large a measure, in the middle of the size range in *primigenius* bulls, clearly indicates a *Urus*. The same probably applies to the other two specimens, No. III with a length of outer curvature of 445 mm., and No. IV, in which the greatest width of the occipital condyles is 127 mm. (cf. fig. 13, p. 77).— Also from the Neolithic site Wind Mill Hill the circumferences of three horn cores are stated: 145, 168, and 220 mm. A comparison of these measurements with the Danish graphs, based on complete skulls, however, clearly indicates domestic animals. As the result of this revision Jewell claims that evidence for very large, long-horned domestic Neolithic oxen in Britain has not been substantiated.

On the basis of skull indices (occipital height/frontal breadth and occipital breadth/occipital height) Miss Howard (1962) tries to give an easy means of sex-determination. In males the O.H./F.B. index is lower than the O.B./O.H. index, in females reversely. An exception from this rule, however, makes the immature bulls, which in the highest results of O.H./F.B. index agree with the results obtained from the female skulls. Unfortunately, the indices of the bullocks are now on one side, now on the other. The identification of bullocks, however, may be shown in a scatter-diagram, in which the frontal breadth is plotted against the O.B./O.H. index Here the bulls are separated by their greater frontal breadth, while the large bullocks are grouped with the cows.

In the Danish skulls of domestic males two specimens have the O.H./F.B. index higher than the O.B./O.H. index: Maglemosegaard (Vedbæk II), with the indices 96 and 89 respectively and Langeland I, 97 and 77 respectively, as ordinarily seen in cows.—The Maglemosegaard skull belonged to an adult but fairly young animal,

about four years old, an age which perhaps might explain the departure in the indices. The Langeland skull (I), however, originates from a completely adult animal, in which the horn cores are strongly grooved and the teeth worn.

If you compute the said indices of the Danish *Urus* skulls you will find that even in fully mature or fairly old bulls the O.H./F.B. index may be higher than the O.B./O.H. index. In the subadult bull skulls from Hallenslev, Viesø, and Gøderupgaard, e.g., the indices are: 96–87, 100–78, and 94–84, respectively; in the young adult animals from Ugilt and Stokholt Huse (Sorø), in which the teeth are very slightly or slightly worn, the indices are 92–89 and 100–83 respectively; but even in the old bull skull from Ølholm with much worn teeth and strongly grooved horn cores and at the basis granulated the indices are: 102 and 97. The divergent indices in subadult animals may be explained by the comparatively narrow frontal in these specimens, a feature also seen in bullocks (Wertnik) and which also exists in narrow skulls of adult bulls.

On the basis of this it is apparent that these indices do not always form a distinct decision of sex-determination.

If the measurements of the Danish domestic male skulls, however, are inserted in the above-mentioned scatter diagram (Howard, loc. cit.), it appears that with one exception, the Gammellung skull I (indices 97–77), all adult skulls are grouped with bulls, though most of them are placed in the periphery of the group.

The sex dimorphism, however, is also, as mentioned, manifested in the *limb bones* and particularly in the metapodials. But only a few of the Danish skulls have been found in connection with postcranial skeletal parts. Metapodials are only known from four adult specimens, the Holmene cow and three males, from Maglemosegaard (Vedbæk II), Holmene I and Vedbæk III, and in addition from the subadult male from Store Lyng and the heifer from Aamosen.

The length of the metapodials is almost equal in females and males, but the width particularly of the diaphysis and the distal end, is larger in bulls. Bullocks have particularly long metapodials, the width of which, however, is intermediate between those of cows and bulls. (Figs. 24–26).

The metacarpals of the Holmene cow are long, 205 mm., but comparatively narrow, the diaphysis width is 33 mm., which gives an index (in relation to length) of 16.1. The broadest metacarpals belong to the Maglemosegaard specimen (Vedbæk); they are fairly short, 199 mm. in length, but the width in the middle is 39 mm., giving an index of 19.6 mm., no doubt indicating a bull.

Regarding the metacarpal length the presumed border line between Neolithic bulls and bullocks is stated at well over 205 mm., as seen in the scatter diagrams of Dürr (1961, No.V) and Imhof (loc. cit.). In length the metacarpals of the Holmene male passes this boundary. Strange to say, the length of the two metacarpals is different, 210 (left) and 216 mm., whereas the metatarsal lengths are equal, 250 mm. Similar length of metacarpals (217 mm.) also occur in the postcranial skeleton from Borremose, characterized by very long limb bones. Probably both the Holmene and the

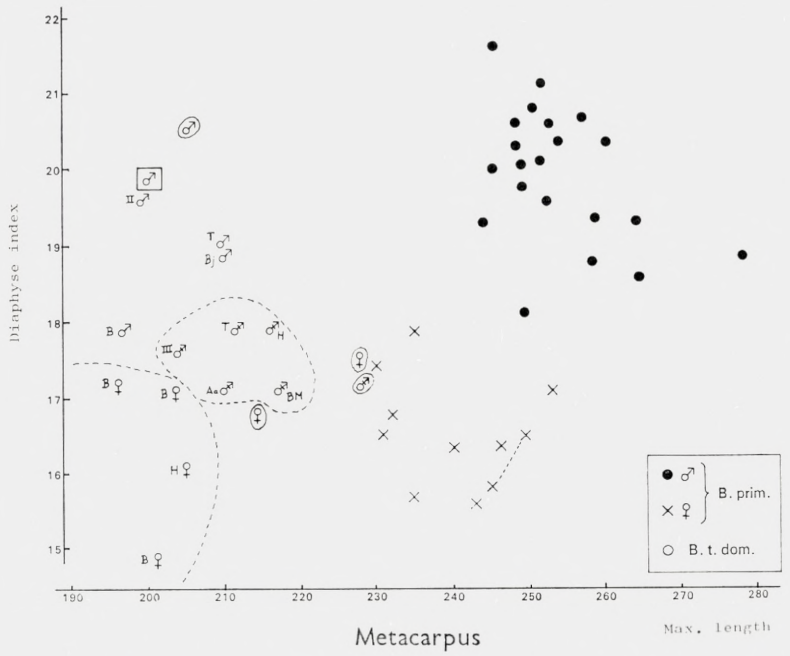


Fig. 24. *Metacarpus.* – Ordinate axis: diaphysis index (diaphysis width/maximum length, Table 11). Abscissa: maximum length.
The *Urus* bull on the extreme right is from Grejs Mølle, the specimen at the bottom from Tinglev. The *Urus* cow connected by a dotted line is from St. Taastrup.
B. t. dom. Sex symbols indicate estimated sex. A stroke through the male symbol indicates presumed bullocks. Recent animals the sex of which is known, are encircled or placed in a square (Price bull). II and III: Vedbæk II and III. Aa. Aamosen, B. Bundsø, B.M. Borremose, H. Holmene, T. Troldebjerg, Bj. Bjerget.

Borremose specimens represent bullocks, as also stressed by the comparative slenderness of the bones, in which the diaphysis indices are 17.9 and 17.1, respectively. Regarding the Holmene male this view is furthermose confirmed by the unfused sutures in a very old skull (p. 160).

Also the metacarpals from Vedbæk III are comparatively narrow with a diaphysis index of 17.6, probably indicating a bullock.

For the sake of comparison I have in Table 11 stated the measure of some further metacarpals.

Two of the largest *metacarpi* from Troldebjerg are 210 and 212 mm. long and the diaphysis indices are 19 and 17,9, thus, according to what has been mentioned above, representing a bull and a bullock. A still smaller diaphysis index, 17.1, occurs in a specimen from Aamosen (Holbæk), length 210 mm., indicating a bullock. Of similar length, 210 mm., is the metacarpal bone of the often mentioned animal from Bjerget, the diaphysis width is 39.5 mm., which, although the bone belonged to a very old individual, might indicate a male, diaphysis index 18.8. In three *metacarpi* from Bundsø (Degerbøl, 1939) the diaphysis indices are 14.9, 17.2, and 17.3, probably representing cows. As a sort of proof of the validity of the said indices it should

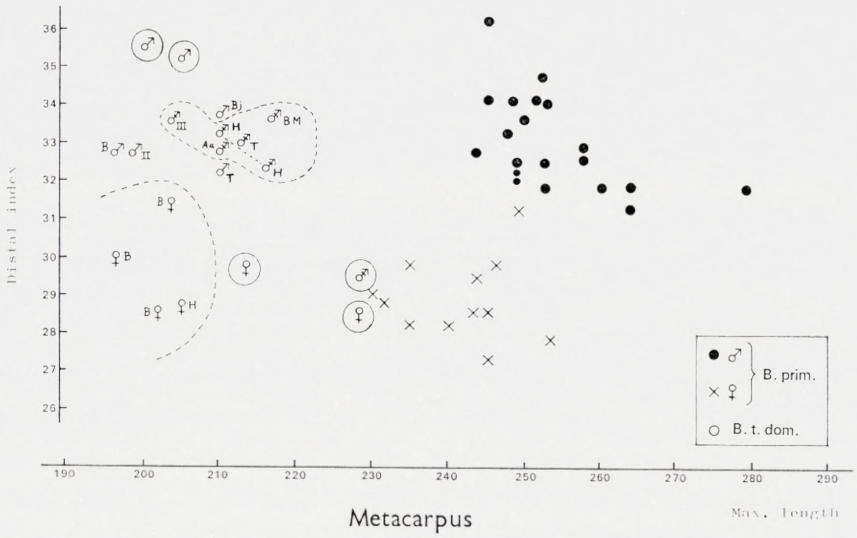


Fig. 25. *Metacarpus.* Distal index plotted against maximum length. Legend as in Figure 24.

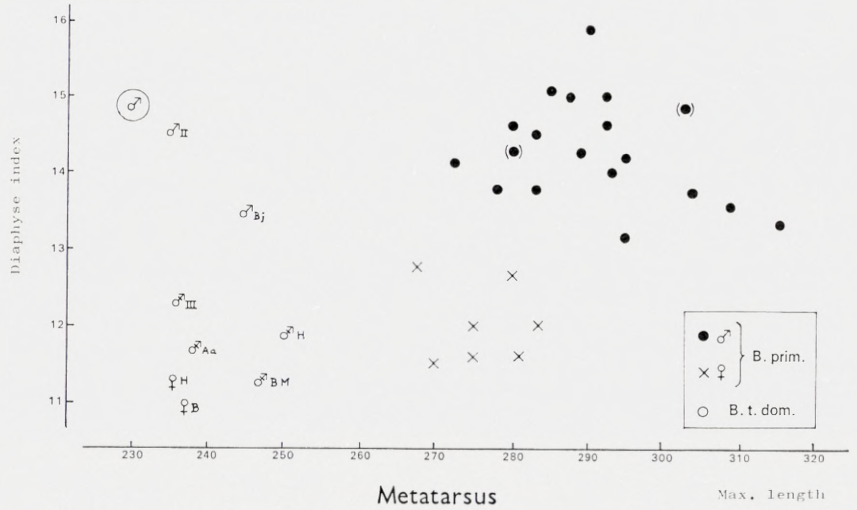


Fig. 26. *Metatarsus.* Diaphysis index plotted against maximum length. Legend cf. Figure 24. (•) from Hescheler og Rüeger.

The three longest *metatarsi* (Grejs Mølle, Holbæk (Aamosen), Sorø) have the smallest diaphysis indices

be noted that in a prize bull ("stamtyr") from the year 1870 the diaphysis index is 19.8, and a similar high index, 20.5, is also seen in the recent bull No. A. 740. In some recent females (Table 11, Nos. 74 and 71) the metacarpals are comparatively large, 214 and 228 mm. in length, but the diaphysis indices is small, 16.8 and 17.5. — A similar figure appears when the distal index of metacarpus is plotted against maximum length (Fig. 25).

Also the metatarsals of the said prehistoric Danish animals indicate the same relations as seen in the metacarpals (fig. 26).

A sexdetermination on the basis of metacarpals of subadult specimens is difficult to carry out. In the metacarpus of the subadult animal from St. Lyng, the distal epiphysis is completely free, but nevertheless the length of the bone is 201 mm., thus a little longer than the metacarpus from Maglemosegaard, and when fully developed it would no doubt pass the length of the metacarpals from Vedbæk III and Holmene ♀.

As mentioned under the heading of the skulls, the age of the St. Lyng animal, on the basis of the stage of eruption of teeth, may be estimated at $2^1/_2$–3 years. At that age, however, the epiphysis is generally more or less fused with the shaft, as also the sutures in the skull normally are more closed than seen in this specimen. As the ossification in bullocks is retarded, this might indicate that this animal might have been a bullock.

One more skull is excavated together with limb bones. To the skull form Sønderso belong a *scapula*, a *humerus*, and a *femur*. This skull is one of the largest in the Danish material and the horn cores are remarkable thick. The teeth are much worn, the height of the medial column of m 3 is only 26 mm.; indicating an age of about ten year. However, most sutures of the skull are open. In the brain-case the fronto-parietal suture beneath the horn core is unfused, and this also applies to the sutures visible in the temporal fossa, even in the occipital region the parieto-occipital suture is laterally visible. Almost closed, however, is the posterior half of the interfrontal suture. For the sake of comparison it may be mentioned that in three four-year old Spanish fighting bulls the hindmost molar, as also the last premolar (p. 4), are only slightly worn, whereas the posterior half of the interfrontal suture and the fronto-lacrymal suture are obliterated, and no suture is visible in the occipital area. In three five-year old bulls the teeth are still slightly worn.

In the *humerus* the suture of the proximal epiphysis, which in sex-animals normally is closed at the age of $3^1/_2$–4 years, is wide open, and the same holds good of the *femur*, with the exception of *trochanter major*, that posteriorly is completely fused with the diaphysis; the proximal as well as the distal suture are open, also normally closed at $3^1/_2$–4 years of age.—As already mentioned—this late fusion of the epiphysis with the shaft might indicate a bullock. Of course, the time of fusion of the sutures and the stage of wear of the teeth may vary a good deal, but in this case the difference in age indication is very large, perhaps so large that it may be a question whether the limb bones and skull belong to the same individual, excavated as they are by workers during peat-digging.

However, the explanation may be that the late closed sutures in bullocks have less firmly coalesced with the bones as in sex-animals, and therefore in the dry air of the museum are more easily broken up. At least the muscular attachments are in these bones strongly marked, as in adult animals.

The limb bones from Søndersø must be characterized as long and slender, al-

though smaller than the corresponding bones from Borremose, and almost not so broad as the bones from Bjerget. Vide: limb bones Tables 11–23.

From this examination of the limb bones present it appears that bullocks probably are represented already in the Danish Neolithicum. Particularly the placing in the diagrams (figs. 24–26) of a group of metapodials between those of bulls and cows is indicative. On the other hand, it should be noted that in *Urus* bulls an almost similar figure in the diagrams turns up, just comprising the largest specimens.

Attached to metapodials of presumed bullocks are the skulls from Vedbæk III, Holmene I, and St. Lyng.

Furthermore, it is of particular interest that also the metapodials emphasize that the Maglemosegaard (Vedbæk II) animal was a bull. A distinct, complete skull of a bull thus is as conclusively established in the Danish material.

After this I shall offer a general view of the rest of the large domestic skulls.

Two skulls, *Holmene I* and *Gammellung III*, are divergent on account of the strongly compressed bases of horn cores (platymer). On basis of the long limb bones and open sutures in a very old skull the *Holmene I* skull is included among bullocks. This probably also applies to the second platymer skull *Gammellung III*. This peculiar flattening of the horn core base is known from other Neolithic skulls, as mentioned by Duerst and Imhof. Duerst (1904) was of opinion that it is caused by the use of a frontal yoke. However, in Danish bullocks I have observed this feature in individuals which never had been used as draught animals.

A third divergent skull is the *Ærø* skull, in which the horn cores are extraordinarily long, wide-spread and strongly twisted. Although this skull belonged to a fairly old individual most sutures are not fused. It no doubt represents a bullock.

A particular type is characterized by the distinctly dome-shaped, laterally broadly rounded forehead, with the occipital crest raised as a bony boss between the stalky horn cores; the frontal between horn cores and eysockets is narrow—the very ideal of the *frontosus* type, so to say; a shape quite unknown in the *Urus*. The skull from Vedbæk III, which according to the metapodials belongs to a bullock, may be taken as a paradigm of this group which furthermore comprises the skulls from Veddinge and Verupgaard.

The *Gammellung I* skull is astonishingly narrow, the smallest frontal and maxillary width (at the zygomatic suture) thus are smaller than in any of the adult Danish skulls, 177 and 154 mm., respectively, as compared e.g. with 188 mm. and 162 mm., respectively, in the male skull from Maglemosegaard, which has the same basal length, 455 mm.—The narrow frontal, between horn cores and orbits, as mentioned above, indicates bullocks, which are castrated at a young age (Wertnik), perhaps the only real feature characterizing bullocks of this stamp. If this should be correct, the type specimen of *B. t. frontosus* Nilsson represents a bullock.

The above-mentioned platymer skull Gammellung III may also be placed in this group; the smallest frontal width is only a little larger than in Gammellung I, 183 mm., as compared with 184 mm. in the Veddinge skull, 190 mm. in the

Vedbæk III skull, 193 mm. in the Verupgaard skull, and 191 mm. in Nilsson's *frontosus* type.

In the brain-case from Løgtved Enge the occipital crest is strongly concave, which may indicate a bullock, however, a similar feature occurs in the skull of the *Urus* cow from Bjerregrav (p. 56).

The remaining four skulls, from Bodal, Snoldelev I and II, and Gammellung IV probably represent bulls, just as also the Maglemosegaard skull must have belonged to a bull.

Against this sex-determination it may be objected that it is unlikely that so many of these skulls should have belonged to bullocks. It should be noted, however, that this material only comprises dated skulls, which in a way is a selected material, as some of the largest specimens no doubt have been sent to the Zoological Museum, just on account of their large size. Furthermore, comparatively many of these skulls are felled, representing sacrifices, which also may indicate a selection.

Killed by a blow on the forehead are the four known specimens from Gammellung moor (two bullocks, a bull and a cow) two cows from Nyrup moor (posterior part of frontal crushed), Maglemosegaard (bull), Holmene I (bullock), and two cows from Jordløse; that is 10 out of 24. Probably also some of the other skulls have been placed as sacrifices.

Some of the skulls mentioned, from Holmene and Nyrup, have been found in moors, where particularly shaped places of sacrifice have been excavated together with Neolithic pottery and axes and now and then human bones. At the bank of the Holmene moor, or Salpeter moor, as it was named by the investigator (C. J. Becker, 1948, p. II), about 6 m. from the firm ground, a stage consisting of a thick layer of branches and twigs, supported by vertical piles and posts was found. This platform was strong enough to carry people and was no doubt built to facilitate the deposition of offerings in vessels from Early Neolithic Period B and Period I of the Middle Neolithic, which indicates that the spot was visited several times during a long period.

As regards bones, only a few marrow-split bones of cow and lamb were found, but there was neither flint waste nor other settlement-refuse present.

Besides the finds of oxen here described, ox bones of a sacral character are known from other places in bogs or from springs (cf. Becker, loc. cit.). They no doubt indicate that the old Danes in prehistoric times were so pronounced stock-breeders that it influenced their religious life.

In connection with the Funnel-Beaker culture and later similar finds at burials of animals along with men are known from several places in Central and Eastern Europe (Behrends, 1964).

Summary. (*Domestic oxen*). From these investigations of domestic cattle it appears that no less than 30 complete or almost complete skulls and brain-cases are present. From a numerical point of view this number is not, perhaps, particularly large, but it should be borne in mind that the occurrence of skulls of domestic cattle from the

Neolithic period have only recently been established in Denmark (DEGERBØL, 1963) and are on the whole either very rare, or information supported by measurements is not at hand. JEWELL (1963) and NOBIS (1954) give no overall length, although the latter figured three fragmentary skulls, broken through the premaxilla. However, BÖKÖNYI (1962) states that skulls are missing from the Hungarian material. The size range of Neolithic cattle has mostly been based on more or less fragmentary skeletal parts.

The variation in size of the Danish prehistoric cattle is comprehensive, inasmuch as fairly small cow skulls as well as large bull skulls are present; subadult animals are also represented. The Danish material is of special interest because measurements published are based on unambiguous domestic animals. In other cases it may often be a problem whether singly found skull-parts, particularly of large animals, originate from small *Urus* or large domestic animals.

As mentioned above, a considerable sex dimorphism has been established in the Danish Neolithic cattle. It is a characteristic feature that most width measurements of the bull skulls overlap the corresponding measurements in the female *Urus*.

The basal length is shown in fig. 8. From this it will be seen that the range of variation in the female skulls is outside the variation limits of the males. The basal length of the two largest cow skulls, from Holmene II and Nyrup I, is 422 mm., as compared with 435 mm. in the shortest male skull, from Snoldelev I.

The earliest bull skull known, from the beginning of Zone VIII, at the very Elm decline, is fairly large (St. Lyng), and the same is true of the Verup skull from the beginning of the B-landnam. However, it is worth noting that the largest bull skulls (Bodal, Holmene), belong to the close of the period. — According to BÖKÖNYI a similar state of things has been established in Hungary, and this author is of the opinion that it was caused by interbreeding with the *Urus*. However, this cannot be the case regarding the Danish material. At the time the *Urus* had long been extinct in Zealand, and at the end of the period the *Urus* was a rare animal even in Jutland. The existence of such large-sized cattle in Zealand must either be explained by a change within the domestic stock on this island, or importation must have occurred.

Even if these skulls belonged to bullocks, they must be characterized as very large (cf. p. 66), just as large as large recent animals. For the sake of comparison it may be mentioned that the basal length of 17 recent bull skulls, belonging to different breeds, varies between 355 mm. and 510 mm.; the largest measure originating from a very large shorthorn bull (BOHLKEN, 1962, p. 616).

However, only the large Holmene skull falls within the size range of Danish *Urus* cows.

The occurrence of these large domestic oxen from Maglemosegaard (Vedbæk II), Bodal, Holmene I and II from the Bronze Age or Iron Age is particularly remarkable because at that time a decrease in size of domestic cattle already had taken place in western and northern Europe (WINGE 1900, DEGERBØL 1928, 1962, BOESSNECK 1958, and JEWELL 1964). These data are, however, based on fragmentary remains from settlements (teeth, horn cores, limb bones) whereas the present material comprises

complete, or almost complete, skulls. There is a possibility, however, that skeletal parts of such large and more aged animals did not end up in the refuse heaps of the settlements, probably these animals were used as draught animals, and at last as sacrifices. On the other hand, it may be mentioned that there is evidence of larger animals from the Pre-Roman and Roman Iton Age in Central and Western Europe (Boessneck, 1958, p. 73 and Jewell 1962, p. 164), either originating from importation or based on better feeding of the original stock, perhaps under the influence of the Romans.

Possibly, however, the large size of the said Danish domestic oxen may have a certain bearing on the use of new tools, e.g., larger and heavier ploughs, particularly the very heavy wheel ploughs known from the early Iron Age, but probably having been in use earlier, in working up greater parts of land for cultivation.

Regarding further measurements of skulls reference may be made to Tables 2–10 and figs. 8–17. It should be noted that also in the length of tooth rows, upper and lower, only a very small overlap between *Urus* and domestic oxen exists, but ordinarily the teeth are much smaller in domestic oxen and the same holds good of the width of the hindmost molar. However, on account of the great overlapping of several other measurements it may often be impossible on the basis of size alone to distinguish the two bovine categories, also the shape must be taken into consideration; eventually the total impression of the complete skull.

The *Urus* skull is characterized by a concavity on each side of the original interfrontal suture, between the orbit and the horn core, giving the posterior part of the frontal a concave profile; in domestic cattle this part is more or less swollen, involving a more or less convex profile of the said frontal part. Also the position and shape of the horn cores distinguish the domestic oxen from the *Urus*. In most of the Danish prehistoric domestic oxen the base of the horn cores is directed a little downwards, thus placed below the frontal plane; only in the Snoldelev skull the horn cores are directed immediately upwards, as in the *Urus*.

Concluding Remarks

The problem of the origin of domestic cattle in a particular area, whether introduced or of autochtonous origin in the area involved, must be solved on the basis of a sufficient large skeletal material of *Urus*, or wild Aurochs, as well as of domestic oxen, zoologically examined and reliably dated. The lack of concrete data on the size range and appearance of the *Urus*, bulls and cows, and particularly of the earliest Neolithic domestic cattle, has created great difficulties and confusion. It is an old problem how to distinguish between remains of small *Urus* cows and large domestic bulls. In case of doubt the judgment must be based on complete, or almost complete, skulls or skeletons.

In the present inquiry about 200 finds of *Urus*, about one half of which is dated, have been treated, comprising, amongst other items several almost complete skeletons,

and about 50 skulls and brain-cases, well over 20 of which must have belonged to cows. Considering that skulls of *Urus* cows are stated to be rare, this number is comparatively high, about two fifths of the totality, indicating that skulls of cows, when recognized and taken care of, probably would be just as common as bull skulls.

Two female skulls are of particular interest because they are almost complete and well dated, belonging to the Boreal period, Zone V. This early dating clearly excludes any possibility of incipient domestication or interbreeding with domestic cattle. They represent pure *Urus* cows. The one, from Ullerslev, is attached to a complete skeleton, the limb bones of which also evidently indicate a female, the only extant skeleton of an adult *Urus* female. The second skull, from Grænge, is a typical representative of the so-called "small *Urus*", but in fact specimens of this size are fairly common, and do not represent rare exceptions. The renowned size of the *Urus* is based on the large bulls. In general males especially benefit from particularly good ecological environments, which give them a surplus of strength, whereas females, which must provide for the offspring, unborn and born, remain on a more modest size. An exceptionally large bull skull originates from Zone III, at the close of the Late Dryas period; the earliest known find of *Urus* from Denmark.

The range of sex dimorphism in *Urus* and domestic cattle as well as the difference in size between these two categories of oxen is demonstrated in Tables 1–23, and the figs. 8–25.

As compared with the bull skulls the female skulls in *Urus* are shorter (fig. 8) and particularly narrower (fig. 9), the orbits are less protruding (fig. 10), the horn cores in particular are reduced in length (fig. 15) and thickness (fig. 14), and are directed more upwards, and the occipital crest is weaker, characters that also are correlated to age. The females are, so to say, retarded in their development; they are more juvenile-like.

With the exception of the length of teeth, the sex dimorphism in skulls of adult *Urus* is so considerable that no or only a slight overlapping occurs, if so, it is mainly caused by comparing animals from different geological ages, e. g., large cows from the earlier periods, Preboreal and Boreal (Zone IV and V) with small bulls from the Subboreal period (Zone VIII), cf. p. 66.

Regarding the basal length there is in the Danish material a very slight overlapping between *Urus* bulls and cows (Table 1, fig. 8).— Only one skull of the Neolithic domestic males (from Holmene) is within the size range of *Urus* cows, but the shape is different.

The narrow frontal of the *Urus* females is demonstrated in smallest frontal width (between orbits and horn cores) and in the postorbital width (width across the posterior rims of orbits) Tables 2 and 3, and graphs, figs. 9 and 10. In full-grown skulls these measures are in females just outside the range of variation in male skulls. Even in subadult and not quite full-grown animals (e. g. animals in which not all teeth are in place) the postorbital width particularly depends on the individual age, fairly small even in almost adult animals.

In domestic males the range of variation of "smallest frontal width" is co-extensive with the size range in *Urus* cows; and also the size range of postorbital width of domestic oxen and *Urus* cows is largely overlapping.

In most other width measurements too, the size range of *Urus* bulls is outside the range of *Urus* cows, as seen in the mastoid width (Table 4 and fig. 11), and in the supraoccipital width (smallest width between temporal fossae, posteriorly), fig. 12; here, too, the absolute measurements in domestic males are co-extensive with the measurements of *Urus* cows.

In the width across the occipital condyles great variation exists (Table 6, fig. 13); an exceptionally small measure, quite outside the range of other *Urus* males, occurs in a robust bull skull from Mors.

Measurements of horn cores are stated in Tables 7–8 and figs. 14–15. In *Urus* males, even in subadult and young adults, the horn cores are comparatively thick, being outside the size range in *Urus* females. Domestic males may have just as thick horn cores as seen in *Urus* cows.

The length of horn cores, measured along the outer curvature, are in full-grown bulls, with one ecception, outside the range in *Urus* cows measured here; however, fragmentary horn cores from large female skulls, e.g., in the Flintinge and Svebølle specimens, may indicate an overlapping. Between *Urus* cows and domestic oxen overlapping occurs.

The teeth of *Urus* cows are comparatively large. The length of the row of upper teeth is within the range of *Urus* bulls. In large domestic males the said length is just reaching the size range in small, old *Urus*. The width of the teeth in domestic cattle, however, is outside the range of *Urus* (Table 10).

From prehistoric settlements a comparatively large number of single, or solitarily found, mandibular hindmost molars (m 3) of *Urus* as well as of domestic oxen are at hand, the sex of which is unknown (graph fig. 17, filled circles). Teeth from mandibles attached to skulls, or otherwise determined as to sex, are marked as sex symbols.

From this figure it appears that the range of m 3 length in *Urus* cows falls within the range of *Urus* bulls. — The smallest m 3, placed in the jaw, was till now known from the Pindstrup cow, from the Subboreal (Degerbøl, 1962), the only m 3 length below 46 mm. (45,5×18.7 mm.). In the present material furthermore three cows, also from the Subboreal period, have similar or still smaller m 3: 45.9 mm., 45.8 mm., and 44.3 mm. (Toftum). A most remarkable deviation, however, is constituted by the subboreal Ugilt bull with an m 3 length of only 42.5 mm. (width 18.5 mm.).

If this tooth had been found isolated it would no doubt have been referred to domestic animals. However, it now definitely proves that so small an m 3 may occur in *Urus*, and even in a large bull. A fact which must give rise to a new estimation of the small questionable solitary m 3 from several Ertebølle kitchen middens, and which has involved so great difficulties. These teeth naturally fill in the place between the Ugilt and the Toftum specimens: Dyrholmen 42.7 mm., Norslund 43.5 mm.

(44.5 mm., and 45.2 mm.), Hjerk Nor 43.8 mm., Krabbesholm 43.5 mm. (and 47 mm.), Aamølle 44.5 mm. They no doubt represent the *Urus*.

It is a well-known fact that teeth of many subfossil mammal species on an average are larger than the corresponding recent ones, as e.g., pointed out regarding several Danish carnivores from the Boreal period (DEGERBØL, 1933).

It is likely that a similar fast, short-term rate of evolution has occurred regarding the *Urus*, and particularly at the close of its existence (p. 42).

The large dimorphism is also demonstrated in the size of the limb bones (Tables 11–23), which in *Urus* bulls are considerably larger, particularly broader, than in *Urus* cows.

Complete metatarsal bones of *Urus* cows have been rare. In 1942 I had none at my disposal, but in the present work measures of seven cows are given. In metapodial length a considerable overlap occurs, but in most width measurements the range of variations does not meet (figs. 18–20). Regarding length the metapodials of domestic oxen are widely separated from those of *Urus*, in fact the most distinctive mark between these animals.—The transversal width measurements of domestic cattle merge with those in *Urus* cows; the anterior-posterior width of the trochlea, however, is comparatively larger in the *Urus*. (figs. 6, and 20) thus indicating that the small metatarsals from Dyrholmen represent the *Urus*.

In other limb bones the size range of width in females is outside the range in *Urus* bulls, or only a slight overlap exists, cf. e.g., *astragalus* fig. 23.— From this figure it also appears that the "small" *astragali* from Ertebølle kitchen middens, e.g., Brabrand and Dyrholmen I and II unambiguously belong to the *Urus*.

Most measurements of limb bones of Neolithic domestic cattle here examined are outside the corresponding range in *Urus*.

For the first time a fairly comprehensive material of skulls or brain-cases of Neolithic domestic cattle is provided, 30 specimens in all. — Here, too, the sex dimorphism is considerable. From the same time and from the same narrow localities smaller and larger skulls exist, originally supposed to represent two different breeds or races; *B t. longifrons* and *B. t. frontosus*, but no doubt in fact representing cows and bulls respectively. — Already at the earliest Neolithicum, at the Elm decline, about 2800 B.C., these two "types" occur: the males with a domeshaped or swollen frontal and the occipital crest formed as a posteriorly projecting boss between the horn cores, a new cranial shape in the *Bos*-evolution, quite different from the concave frontal profile and fairly straight occipital crest in the *Urus*. The cow skulls represent small animals, e.g., similar to a cow skull from Jutland, from the middle of the nineteenth century. During about 5000 years this phenotype thus has existed in Denmark.

The occurrence of these early Neolithic skulls, which in shape and size are so divergent from *Bos primigenius* clearly indicate that the domestication of the *Urus* must have taken place long before the period mentioned. This cattle must have been imported into Zealand, or the domestication of the *Urus* in Denmark must be sought for at a still earlier period.

In this connection particularly the small bovine bones in the kitchen middens from the Ertebølle culture were a controversial problem, much discussed. However, these bones generally were included among domestic cattle. With the material for comparison now at hand, with the demonstration of the large sex dimorphism in the *Urus* and the common appearence of this species in the Subboreal period in Jutland, a basis of a real judging of these bones was established.

The age of many kitchen middens is questionable. In some kitschen middens, particularly the classical finds (Ertebølle, Aamølle, Mejlgaard, Krabbesholm) only a few bones of *Urus* were present, whereas in an other group of settlements (Brabrand, Dyrholmen I and II, Hjerk Nor, Kolding Fjord, Norslund) comparatively many *Urus* bones occur.

Only one of these settlements, from Norslund, is not only relatively dated, — the layer with bones chiefly belonging to the High Atlantic transgression, Zone VII, as Dyrholm I, — but also C14-dated, about 3780 B.C. (cf. p. 40). Also the bones from the Brabrand settlement belong to Zone VII, and the same probably applies to the remains from Hjerk Nor and Kolding Fjord.

As mentioned above even the small bovine bones from these kitchen middens, belong to *Urus* cows.

Lack of knowledge of the range of variation, in size and shape of modern bullocks, makes a statement of these animals in prehistoric time problematic. — The castration involves a retarded development of the animals, the sutures fuse later or not at all (Figdor, 1927). Bullocks therefore have longer, but comparatively narrower limb bones than sex animals.

Only a few Neolithic skulls of domestic oxen, however, are found in connection with limb bones.

Belonging to the skull of the Holmene cow is a typical female *metacarpus*, and long and comparatively narrow metapodials are attached to the male skull from Holmene, indicating a bullock, which is in accordance with the unfused sutures in the very old skull.

Also the metacarpals from Vedbæk III are comparatively narrow, with a diaphysis index of 17.6, probably indicating a bullock. This is of particular interest, as these metapodials are attached to a typical *frontosus* skull, similar to Nilsson's *frontosus* type specimen.

The broadest metacarpals belong to the skull from Maglemosegaard (Vedbæk II). They are fairly short, 199 mm. in length, but broad; the width in the middle is 39 mm., giving an index of 19.6, and thus confirming the supposition that this skull represents a bull.

A group of comparatively long metapodials, in width between bulls and cows, as seen in the diagrams, figs. 24–26, furthermore indicates that bullocks probably were represented in Denmark in prehistoric times.

Summary

About 200 finds of *Urus*, almost one half of which is dated, and 30 finds of Neolithic domestic oxen have been examined.

In *Urus* as well as in domestic oxen a great sex dimorphism exists. Measures of Danish *Urus* cows are outside the range in *Urus* bulls (basal length, smallest frontal width, mastoid width, cicumference at base of horn cores) or a small overlap occurs (postorbital width, supraoccipital width, condylus width, length of outer curvature of horn cores). In *Urus* cows the teeth are comparatively large; the length of upper tooth row falls within the range of *Urus* bulls.

The domestic oxen are in general considerably smaller than the *Urus*. The lengths of metapodials are widely outside the corresponding range in *Urus*, and only in one skull of domestic cattle is the basal length within the range of *Urus* cows; almost the same applies to the length of rows of teeth, where only a slight overlap occurs. In most other skeletal parts, however, a large overlapping has been established, the measures in domestic males are co-extensive with those of *Urus* cows (figs. 8–25). A characteristic feature in *Urus* is a concave frontal profile, behind the orbits.

The earliest discoveries of *Urus* in Denmark originate from the close of the Late Dryas, Zone III. In Zealand the *Urus* disappeared at the close of the Boreal period, Zone VI, and, with one exception from Zone VIII, the same applies to Funen. In Jutland the *Urus* was still living during the Subboreal, and probably also at the beginning of the Subatlantic period, Zone IX. From the Atlantic period only one find from peat bogs is known, from the isle of Langeland, S.E. of Funen. — However, remains of *Urus* have been found in several Jutland kitchen middens from the Ertebølle culture, probably Zone VII (Brabrand, Dyrholmen I and II, Hjerk Nor, Norslund). Several *Bos* remains from these settlements are comparatively small, even for cows, but they no doubt represent the *Urus* (figs. 4–6 and 23–26). Thus the hindmost lower molar (m 3) in *Urus* from the Ertebølle kitchen middens and from the Subboreal period no doubt indicate a trend towards reduction in size of these teeth in the phylogenetical latest *Urus* (p. 91, fig. 17). — The skulls of domestic cattle treated are all from Zealand. From the Elm decline two skulls, of a female and a male (bullock), are at hand, indicating that already at that early period an advanced cattle breeding existed, which might imply a long preceding domestication. These animals must have been imported into this island, perhaps from the southeast.

From the close of the Subboreal period, late Bronze Age and early Iron Age comparatively large skulls of domestic oxen are at hand, mostly characterized by a domeshaped frontal and the occipital crest formed as a projecting boss between the stalked horn cores ("frontosus" form), a shape quite unknown in the *Urus*. The corresponding metapodials are long and slender, in width intermediate between bulls and cows (fig. 24–26). The occurrence of these large animals probably indicates the use of new, heavier, but more effective tools (e. g. wheel ploughs.)

(*Quaternary-Zoological Department, University of Copenhagen*)

TABLE

Zone	III		IV									
Bos primigenius ♂♂	Faaborg (Millinge)	Terp	Vig	Sorø (Stokholt Huse)	Grænge A ad. jun.	Gøderup subad.	Viesø jun.	Knabstrup 1	Røde Mølle Aa	Funen	Tepstrup	Rønnebæksholm
	1	2	3	4	5	6	7	8	9	10	11	12
1. Total length	744	—	700	715	685	645	—	—	—	—	684	700
2. Condylobasal length	653	—	610	608	592	567	—	—	—	—	598	625
3. Basal length	612	—	580	575	553	532	—	—	—	—	562	583
4. Occipital ridge – nasal base	368	—	333	337	330	307	(300)	—	—	—	325	325
5. Nasal base – tip of premaxilla	380	—	329	379	357	339	—	—	—	—	368	382
6. For. magnum upper border – nasal length	320	—	—	290	290	272	—	—	—	—	290	295
7. Occipital ridge – nasal tip	630	—	580	600	—	—	(520)	—	—	—	570	588
8. Occipital ridge – for. infraorbitale	548	—	—	532	510	460	(450)	—	467	—	494	505
9. Cond. occipitalis – nasal tip	550	—	—	515	—	—	(460)	—	—	—	510	545
10. Cond. occipitalis – orbita	258	—	—	232	230	218	—	—	—	—	243	250
11. Cond. occipitalis – for. infraorbitale	450	—	—	425	412	378	(355)	—	390	—	400	427
12. Orbita – for. infraorbitale	198	—	—	190	185	163	—	—	171	—	187	193
13. Orbita – tip of premaxilla	402	—	—	382	365	350	—	—	—	—	382	395
14. Nasal length, largest	262	—	247	258	250	—	(220)	—	—	—	255	260
15. Nasal width, largest of both	92	—	82	—	—	—	—	—	—	—	80	—
16. Length of premaxilla (outer side, chord)	192	193	—	170	169	—	—	—	—	—	180	190
17. Palatal length: palatinum, middle	227	—	(192)	215	207	190	—	—	—	—	—	—
18. Palatal length: to tip of premaxilla	369	—	—	—	—	—	—	—	—	—	340	361
19. Diametres of orbits:	84	—	80	82	83	83	—	—	64	—	76	71
20. Diametres of orbits:	68	—	71	68	72	66	—	—	67	—	76	67
Least width between horn cores:												
21. a. at occipital ridge	248	255	258	290	270	230	(280)	270	220	160	198	170
22. b. at frontal, middle	335	294	306	315	325	280	(340)	300	265	223	220	220
23. Frontal width, least	242	240	231	238	240	230	(220)	226	235	230	226	250
24. Postorbital width	315	—	299	301	297	260	(284)	285	300	297	287	310
25. Interorbital width: least, incisur	255	—	250	225	228	202	—	—	—	—	215	255
26. Interorbital width: anterior	252	—	—	230	230	(190)	—	—	—	—	225	250
27. Maxillary width: m 1–m 1, outer border	164	—	—	158	161	158	—	—	—	—	(165)	167
28. Maxillary width: zyg. sut.	196	—	—	193	188	170	—	—	165	—	187	198
29. Premaxillary width: largest	123	—	—	109	111	105	—	—	—	—	114	135
30. Premaxillary width: anterior	—	—	—	109	105	—	—	—	—	—	110	114
31. Zygomatic width	256	—	250	249	255	226	—	—	255	231	237	245
32. Mastoid width	325	—	288	(305)	(310)	262	—	275	325	292	308	308
33. Width, post. border of fossae temporalis	222	—	212	198	200	180	(172)	189	240	219	226	226
34. Condylus occipitalis, width	139	—	133	139	140	138	(135)	132	131	135	139	136
35. Height of fossa temporalis, least	37	—	—	40	44	36	—	—	42	39	44	41
36. Occipital height: for. magn., lower border	230	—	—	238	195	220	(220)	227	209	201	223	232
37. Occipital height: for. magn., upper border	178	—	183	195	182	172	(177)	180	165	152	178	185
38. Greatest span of horn cores	1140	930	910	855	940	760	870+	790	(870)	849	812	800
39. Tip to tip of horn cores	—	660	780	710	—	—	—	(600)	(730)	670	664	580
40. Circumference of horn cores, base	400	315	325	320	310	315	(290)	305	325	350	325	350
41. Diametres of horn cores, base:	135	106	126	109	108	107	(100)	100	107	120	113	120
	115	97	97	87	91	91	(85)	90	95	95	91	110
42. Length of horn cores, outer curvature	(770)	750	667	590	(660)	—	—	570	590	660	615	625
43. Length of upper tooth row	179	—	180	174	173	180	—	—	158	—	157	160
44. Length of premolars (p 2–p 4)	74	—	72	67	70	71	—	—	—	—	—	65
45. Length of molars (m 1–m 3)	111	101	111	103	105	112	—	—	(100)	—	—	102

I.

V							VI					VII	VIII						
Knabstrup 3	Grænge B	Tranemosegaard	Sakskøbing	Hallenslev subad.	Niverød	Bedsmose	Bregninge	Lørup Hede	Kulemile	Grevinge	Store Damme (IV–VI)	Bønnelykke	Ortting	Ostbirk	Ugift ad. jun.	Grejs Mølle	Auning	Holme Mose	Hornslet
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
—	(690)	—	—	—	—	—	716	—	—	680	690	650	685	630	660	700	670	—	—
—	600	—	—	—	—	—	635	—	—	592	615	580	581	555	577	—	602	—	(570)
—	565	—	—	—	—	—	597	—	—	564	581	543	551	525	542	(580)	570	—	(540)
—	360	—	(310)	(317)	—	—	345	—	340	338	317	311	314	308	318	342	310	—	305
—	350	—	—	—	—	—	375	—	—	357	375	341	365	330	358	366	370	—	—
—	295	—	—	270	—	—	305	—	—	292	280	283	278	285	278	—	285	—	—
—	—	—	—	—	—	—	520	—	—	—	590	530	—	520	566	595	575	—	—
—	510	—	—	462	—	—	—	—	—	495	494	468	492	467	475	502	475	—	460
—	—	—	—	—	—	—	—	—	—	—	542	483	—	475	505	—	530	—	—
—	240	—	—	195	—	—	—	—	—	(244)	250	225	250	228	214	—	245	—	—
—	415	—	—	366	—	—	424	—	—	400	412	382	402	390	386	—	405	—	385
—	186	—	—	169	—	—	190	—	—	175	185	170	183	170	178	181	170	—	—
—	370	—	—	—	—	—	400	—	—	365	390	356	360	343	374	385	370	—	—
—	—	—	—	—	—	—	—	—	—	—	270	220	—	215	264	256	270	—	—
—	—	—	—	—	—	—	—	—	—	—	96	83	—	—	—	93	—	—	—
—	205	—	—	—	—	—	193	—	—	—	192	170	177	185	202	197	190	—	—
—	215	—	—	180	—	—	240	—	—	222	210	221	—	200	210	—	220	—	206
—	350	—	—	—	—	—	378	—	—	365	355	—	322	—	330	—	346	—	—
—	83	—	—	75	—	—	76	—	—	86	68	75	79	70	82	72	77	—	80
—	70	—	—	63	—	—	67	—	—	72	69	67	59	64	67	68	63	—	70
215	193	250	187	254	205	230	146	232	160	200	206	212	200	167	215	235	173	190	200
260	220	305	250	306	230	300	(200)	295	205	(285)	215	245	240	194	265	287	200	210	265
234	240	237	247	220	240	254	255	270	242	234	230	242	245	242	222	237	238	230	220
300	302	287	—	254	—	—	328	—	286	295	320	290	314	(310)	262	303	298	286	268
—	225	—	—	186	—	—	—	—	—	225	255	220	268	262	195	256	258	—	193
—	230	—	—	—	—	—	270	—	—	232	255	235	255	244	204	256	235	—	206
—	170	—	—	146	—	—	170	—	—	163	165	158	173	168	153	—	160	—	153
—	185	—	—	185	—	—	200	—	—	180	200	185	205	191	194	—	180	—	175
—	120	—	—	—	—	—	123	—	—	—	118	107	—	119	106	—	112	—	—
—	—	—	—	—	—	—	130	—	—	—	128	113	—	118	101	—	118	—	—
243	250	245	—	220	—	246	255	270	—	240	246	245	263	—	238	252	246	248	231
305	320	281	—	244	—	315	326	(315)	—	303	305	310	320	320	280	—	310	300	(270)
210	215	198	—	184	245	212	216	231	—	210	192	203	240	222	185	235	260	233	—
130	125	136	—	125	—	135	129	147	—	128	127	132	142	132	137	—	136	127	134
—	40	41	—	39	—	35	37	40	—	50	38	39	38	38	52	—	38	—	47
220	215	226	—	(212)	—	229	225	230	—	224	216	—	—	208	205	—	205	206	212
180	170	169	—	(162)	—	183	180	178	—	177	160	187	171	165	160	—	155	160	165
785	818	797	815	(770)	792	—	750	—	876	770	855	825	884	790	774	900	845	750	790
—	705	600	705	—	640	—	—	—	695	(700)	660	720	—	600	705	688	700	—	(765)
345	315	295	345	285	335	322	375	397	345	315	341	337	340	325	283	335	365	300	290
122	113	100	122	100	123	107	123	138	112	115	110	115	110	111	97	115	132	101	102
97	87	85	95	78	86	87	103	113	79	85	100	92	89	83	82	95	100	99	78
580	570	570	515	320	—	370+	490+	—	655	(515)	686	590	(680)	625	490	675	650	410+	550
—	175	—	—	171	—	—	174	—	—	182	161	163	155	143	157	—	156	—	158
—	70	70	—	69	—	—	62	—	—	80	65	65	62	57	64	—	65	—	60
—	110	—	—	108	—	—	107	—	—	114	100	103	93	89	95	—	95	—	100

TABLE I

Zone	VIII							IX	Uncertain Age			
Bos primigenius ♂♂	Hørning	Klarup	Tranekær Gesten	Læsten	Fæsted	Tinglev	Kjærsholm[1])	Aabenraa	Julianelyst	Aagerup	Lyngby	Danmark (Min. Mus.)
	33	34	35	36	37	38	39	40	41	42	43	44
1. Total length	—	(630)	—	651	640	(630)	(710)	—	—	700	706	675
2. Condylobasal length	—	(585)	—	592	580	(555)	(610)	—	—	617	616	587
3. Basal length	—	—	—	554	548	532	(566)	—	—	583	571	549
4. Occipital ridge – nasal base	—	—	316	290	295	300	—	315	—	322	(340)	320
5. Nasal base – tip of premaxilla	—	—	—	372	348	—	—	—	—	380	(380)	367
6. For. magnum upper border – nasal length	—	—	—	268	270	277	—	—	—	290	305	280
7. Occipital ridge – nasal tip	—	—	—	545	555	532	—	—	—	585	—	574
8. Occipital ridge – for. infraorbitale	—	—	—	457	462	460	—	—	—	502	510	488
9. Cond. occipitalis – nasal tip	—	—	—	505	520	495	—	—	—	533	—	510
10. Cond. occipitalis – orbita	—	—	—	235	230	226	—	—	—	246	227	230
11. Cond. occipitalis – for. infraorbitale	—	—	—	390	—	395	—	—	—	415	408	395
12. Orbita – for. infraorbitale	—	—	180	164	175	166	—	—	—	180	192	183
13. Orbita – tip of premaxilla	—	—	—	368	360	—	—	—	—	382	400	380
14. Nasal length, largest	—	—	240	270	262	235	—	—	—	258	—	260
15. Nasal width, largest of both	—	—	—	90	—	82	—	—	—	83	—	92
16. Length of premaxilla (outer side, chord)	—	—	—	183	165	—	—	—	—	200	205	184
17. Palatal length: palatinum, middle	—	—	—	225	(190)	—	—	—	—	230	215	200
18. Palatal length: to tip of premaxilla	—	—	—	340	—	—	—	—	—	362	355	340
19. Diametres of orbits:	—	—	—	97	75	77	—	—	—	71	74	74
20. Diametres of orbits:	—	—	—	70	64	64	—	—	—	66	74	69
Least width between horn cores:												
21. a. at occipital ridge	175	200	204	215	160	235	—	—	187	177	—	215
22. b. at frontal, middle	235	235	262	265	245	260	(240)	—	218	235	—	255
23. Frontal width, least	246	212	216	228	210	214	(238)	230	231	242	240	247
24. Postorbital width	—	—	274	280	266	280	(300)	293	305	295	301	307
25. Interorbital width: least, incisur	—	—	—	217	(238)	224	—	—	226	256	(195)	245
26. Interorbital width: anterior	—	—	—	217	—	218	—	—	—	245	245	255
27. Maxillary width: m 1–m 1, outer border	—	—	—	158	—	156	—	—	—	162	160	165
28. Maxillary width: zyg. sut.	—	—	—	186	173	177	—	—	—	200	203	190
29. Premaxillary width: largest	—	—	—	110	(105)	(119)	—	—	—	117	119	118
30. Premaxillary width: anterior	—	—	—	110	—	—	—	—	—	115	117	123
31. Zygomatic width	—	—	—	245	—	240	—	250	—	250	252	250
32. Mastoid width	—	300	293	301	285	294	(325)	—	—	322	305	320
33. Width, post. border of fossae temporalis	—	220	—	218	210	213	—	—	211	244	244	230
34. Condylus occipitalis, width	140	132	—	134	131	124	—	133	128	128	132	128
35. Height of fossa temporalis, least	—	—	—	38	—	49	—	—	—	37	36	39
36. Occipital height: for. magn., lower border	—	228	—	202	218	215	—	210	225	(220)	244	218
37. Occipital height: for. magn., upper border	—	180	158	154	175	166	—	163	172	177	194	165
38. Greatest span of horn cores	915	—	770	822	730	774	—	—	—	762	890	925
39. Tip to tip of horn cores	—	—	—	712	605	560	—	—	—	627	810	760
40. Circumference of horn cores, base	340	323	310	283	285	295	(340)	—	385	350	358	345
41. Diametres of horn cores, base:	122	109	105	98	100	99	—	—	—	125	123	116
	97	92	90	77	80	86	—	—	—	95	95	103
42. Length of horn cores, outer curvature	505+	(620)	630	575	540	610	(680)	—	595	525	615	695
43. Length of upper tooth row	—	—	—	145	143	155	(145)	—	—	171	168	153
44. Length of premolars (p 2–p 4)	—	—	—	61	—	60	—	—	—	68	68	59
45. Length of molars (m 1–m 3)	—	—	—	88	92	103	(94)	—	—	105	104	98

[1]) Measured by a folding rule.

(continued).

Uncertain Age

Bro	Trøstrup	Mors	Olholm	Rosenholm	Thorsager	Hastrup	Vintved	Danmark (2. afd.)	Danmark (C. N. 1891)	Danmark (2. afd. 2)	Ortoft	Danmark (Study Coll.)	Nørre Vissing	Rathlousdal	Alsønderup	Ladung	Odder	Baltic Sea
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
669	—	—	687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
586	—	—	610	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
555	—	—	572	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
328	—	327	323	—	—	—	—	305	—	—	—	320	—	—	—	—	—	—
347	—	—	380	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
290	—	285	295	—	—	—	—	—	—	—	—	275	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
485	—	—	492	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
235	—	228	(230)	—	—	—	—	—	—	—	—	235	—	—	—	—	—	—
395	—	—	405	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
175	—	—	195	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
360	—	—	395	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
179	—	—	240	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
215	—	—	235	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
340	—	—	365	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80	—	72	74	—	—	—	—	69	—	—	—	68	—	—	—	—	—	—
69	—	65	62	—	—	—	—	66	—	—	—	65	—	—	—	—	—	—
225	143	175	205	210	180	240	220	193	145	220	141	155	—	—	—	210	230	—
255	230	230	200	270	225	252	250	220	230	260	(273)	188	—	—	—	250	—	—
236	—	217	207	—	—	(250)	—	225	232	275	(235)	220	—	—	—	237	—	—
291	—	292	275	—	—	—	—	298	—	—	—	289	—	—	—	—	—	—
220	—	246	235	—	—	—	—	249	—	—	—	233	—	—	—	—	—	—
210	—	224	220	—	—	—	—	251	—	—	—	225	—	—	—	—	—	—
150	—	160	164	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
175	—	180	190	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
112	—	—	118	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
117	—	—	129	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
236	—	245	236	—	—	—	—	246	—	260	—	235	—	—	—	—	—	—
295	(275)	300	295	—	—	—	—	300	290	—	—	(310)	—	—	—	—	—	—
219	222	215	205	—	232	—	—	238	245	247	—	226	—	—	—	—	—	—
123	136	110	129	—	—	—	—	—	122	137	—	(130)	134	134	146	—	—	—
42	—	44	45	—	—	—	—	—	—	40	—	36	—	—	—	—	—	—
223	230	—	212	—	—	—	—	—	216	230	—	238	—	—	—	—	—	—
170	185	170	166	—	—	—	—	165	172	182	—	171	—	—	—	—	—	—
700	780	825	730	890	770	915	(870)	900	950	(880)	815	720	—	—	—	826	932	—
500	560	690	620	745	645	(810)	780	720	805	(700)	575	555	—	—	—	(710)	740	—
318	375	355	295	338	340	340	305	345 r 327 l	445 r 420 l	385	370	355	—	—	365	335	342	398
107	135	127	102	113	120	120	104	127 114	160 146	135 106	130 116	122 88	—	—	—	116 95	118 95	—
89	97	100	78	97	94	95	86	96	—	—	—	—	—	—	—	—	—	—
525	645	595	540	645	580	(620)	580	635	685 r 670 l	710	665	548	—	—	—	595	710	—
172	—	—	147	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
66	—	—	59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
108	—	—	89	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE

Zone	IV				V		
Bos primigenius ♀♀	Vigersted	Knabstrup	Svebølle	Bjerregrav	Ullerslev	Grænge	Bjeverskov
	1	2	3	4	5	6	7
1. Total length	—	—	—	—	635	585	—
2. Condylobasal length	—	—	—	—	556	527	540
3. Basal length	—	—	—	—	525	496	(515)
4. Occipital ridge – nasal base	—	—	—	264	315	288	274
5. Nasal base – tip of premaxilla	—	—	—	—	327	300	—
6. For. magnum – nasal base	—	—	—	—	257	263	260
7. Occipital ridge – nasal tip	—	—	—	—	530	—	—
8. Occipital ridge – for. infraorbitale	—	—	—	—	466	422	—
9. Cond. occipitalis – nasal tip	—	—	—	—	470	—	—
10. Cond. occipitalis – orbita	—	210	—	—	210	205	205
11. Cond. occipitalis – for. infraorbitale	—	—	—	—	380	357	—
12. Orbita – for. infraorbitale	—	—	—	—	182	156	—
13. Orbita – tip of premaxilla	—	—	—	—	358	327	—
14. Nasal length, largest	—	—	—	—	230	—	—
15. Nasal width, largest of both	—	—	—	—	62	—	—
16. Length of premaxilla	—	—	—	—	—	157	—
17./18. Palatal length { palatinum, middle	—	—	—	—	198	189	—
17./18. Palatal length { to tip of premaxilla	—	—	—	—	—	—	—
19./20. Diametres of orbita {	—	—	—	—	66	70	71
19./20. Diametres of orbita {	—	—	—	—	66	67	67
Least width between horn cores:							
21. a. at occipital ridge	157	200	—	165	184	156	156
22. b. at frontal, middle	190	210	—	207	240	200	200
23. Frontal width, least	183	192	—	192	203	180	188
24. Postorbital width	(230)	260	—	248	268	244	250
25./26. Interorbital width { least, incisur	—	—	—	—	193	173	181
25./26. Interorbital width { anterior	—	—	—	—	206	185	202
27./28. Maxillary width { molars, outer border	—	—	—	—	157	150	162
27./28. Maxillary width { zyg. sut	—	—	—	—	185	165	175
29./30. Premaxillary width { largest	—	—	—	—	99	95	—
29./30. Premaxillary width { anterior	—	—	—	—	100	105	—
31. Zygomatic width	—	—	—	—	220	201	214
32. Mastoid width	240	242	—	—	267	236	234
33. Width, post. border of fossa temporalis	153	169	—	168	171	157	160
34. Condylus occipitalis, width	117	117	121	—	125	122	116
35. Height of fossa temporalis, least	—	42	—	—	44	38	41
36./37. Occipital height { for. magnum, lower border	190	192	—	—	189	183	192
36./37. Occipital height { for. magnum, upper border	148	149	—	—	142	140	154
38. Greatest span of horn cores	666	640	715	586	640	557	580+
39. Tip to tip of horn cores	580	—	—	460	515	488	—
40. Circumference of horn cores (base)	240	240	245	240	270	225	235
41. Diametres of horn cores, base {	79	80	82	87	94	80	77
41. Diametres of horn cores, base {	68	67	71	65	74	60	70
42. Length of horn core, outer curvature	495	(330+)	(360+)	430	450	395	300+
43. Length of upper tooth row	—	—	—	—	162	161	158
44. Length of premolars (p 2–p 4)	—	—	—	—	65	67	64
45. Length of molars (m 1–m 3)	—	—	—	—	101	103	97

II.

	II/V	VIII				Uncertain Age						
Flintinge	St. Taastrup	Pindstrup	Toftum	Aarhus	Korinth	Skaarup	Mørkøv	Barløse	Ølholm	Fuglekjær	Gjødvad	Aakjær
8	9	10	11	12	13	14	15	16	17	18	19	20
—	—	(570)	—	—	—	—	—	—	—	—	—	—
—	—	(520)	(555)	—	—	—	—	—	—	(525)	—	—
—	(510)	(490)	(520)	—	—	—	—	—	—	500	—	—
—	285	255	290	—	—	—	—	—	275	270	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	245	273	—	—	—	—	—	—	241	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	412	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	190	216	—	—	—	208	—	—	198	—	—
—	—	355	—	—	—	—	—	—	—	—	—	—
—	—	158	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	71	—	—	—	—	—	—	—	72	—	—
—	—	68	—	—	—	—	—	—	—	65	—	—
215	200	190	186	190	162	—	168	(220)	—	168	192	174
250	210	220	220	220	178	—	215	(240)	—	210	202	200
205	180	178	200	182	175	186	195	—	178	177	188	195
—	233	230	253	—	222	—	242	—	240	235	240	—
—	—	168	190	—	—	—	—	—	180	163	—	—
—	173	172	—	—	—	—	—	—	—	—	—	—
—	—	140	—	—	—	—	—	—	183	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	207	—	—	204	—	—	—	—	—	—	—
—	232	ab. 225	—	—	(210)	—	234	—	240	227	240	—
185	145	148	176	155	144	—	165	—	159	163	167	—
127	120	111	107	119	117	107	114	—	118	116	118	—
—	—	38	—	—	42	—	33	—	—	43	—	—
196	212	178	206	—	178	—	180	—	175	185	188	—
150	165	135	166	143	137	—	142	—	131	142	144	—
770 +	—	500	680	600	630	—	600	—	580	585	535	685
—	—	360	—	—	520	—	—	—	—	—	—	—
275	240	181	270	195	220	206	227	233	195	227	235	235
89	84	60	90	65	78	73	76	76	65	79	86	82
84	67	52	74	57	64	57	59	65	58	58	61	70
380	—	365	ab. 480	410	465	—	385	366 +	—	412	380	ab. 500
—	160	162	—	—	—	148	—	—	—	—	—	—
—	—	67	—	—	—	54	—	—	—	—	—	—
—	99	97	—	—	—	97	—	—	—	—	—	—

TABLE

Bos taurus domesticus (Zone VIII)	Ogaarde II ♀	Ogaarde ♀ jun. I	Ogaarde ♀ subad. III	Store Lyng ♂ subad.*	Verupgaard ♂*	Gammellung I ♂*	Gammellung II ♀	Gammellung III ♂*	Gammellung IV subad. ♂	Nyrup I ♀	Nyrup II ♀	Nyrup III ♀	Snoldelev I ♂	Vedbæk I ♂ subad.*
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Total length	475	(362)	—	510	545	513	(455)	—	—	—	485	(480)	510	484
2. Condylobasal length	440	—	—	460	495	478	(430)	—	—	455	465	(430)	465	432
3. Basal length	411	—	—	433	465	455	(400)	—	—	427	435	(403)	435	405
4. Occipital ridge – nasal base	235	187	225	265	270	254	221	—	215	—	235	242	240	250
5. Nasal base – tip of premaxilla	—	180	—	245	282	257	—	—	—	280	—	208	271	238
6. For. magnum – nasal base	215	—	207	240	250	240	215	—	—	210	222	—	210	229
7. Occipital ridge – nasal tip	—	—	—	—	—	411	—	—	—	—	—	—	410	—
8. Occipital ridge – for. infraorbitale	352	260	—	372	400	381	334	—	—	—	360	355	376	358
9. Cond. occipitalis – nasal tip	—	—	—	—	—	395	—	—	—	—	—	—	380	—
10. Cond. occipitalis – orbita	165	—	158	175	195	194	170	—	—	165	170	165	170	163
11. Cond. occipitalis – for. infraorbitale	305	—	—	317	242	335	296	—	—	300	315	290	320	306
12. Orbita – for. infraorbitale	135	97	—	131	142	135	125	—	—	129	135	121	142	125
13. Orbita – tip of premaxilla	—	206	—	280	295	279	—	—	—	282	—	—	282	258
14. Nasal length	—	—	—	—	—	139	—	—	—	—	—	—	169	—
						(168)								
15. Nasal breadth	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16. Length of premaxilla (laterally)	—	102	—	—	143	134	—	—	—	170	—	—	141	122
17. Palatal length: Os pal., middle	162	123	—	149	183	165	—	—	—	172	—	155	169	165
18. Palatal length: to tip of premaxilla	—	197	—	260	—	271	—	—	—	272	—	—	—	251
19. Diametres of orbita:	66	56	61	73	73	72	61	—	—	66	65	66	69	63
20. Diametres of orbita:	61	52	—	63	71	65	58	—	—	65	60	62	61	56
Least width between horn cores:														
21. a. at occipital ridge	148	124	139	200	203	(180)	145	175	210	—	150	136	174	165
22. b. frontal, middle	160	145	150	235	240	(195)	154	192	—	—	178	165	200	190
23. Frontal width, least	148	133	145	180	193	177	151	183	192	158	164	153	185	161
24. Postorbital width	189	158	179	211	235	226	189	223	212	201	206	210	218	190
25. Interorbital width: least	135	112	128	143	175	165	132	—	147	137	146	150	165	145
26. Interorbital width: anterior	146	118	—	160	178	177	143	—	—	151	160	160	167	142
27. Maxillary width: m 1–m 1, outer bord	130	101	—	130	135	141	125	—	—	130	134	135	133	119
28. Maxillary width: sut. zygomat	145	118	—	147	164	154	144	—	—	150	145	143	—	142
29. Premaxillary width: largest	—	53	—	78	96	91	—	—	—	77	—	78	91	69
30. Premaxillary width: anterior	—	(52)	—	74	—	89	—	—	—	72	—	—	87	69
31. Zygomatic width	184	150	170	190	206	195	172	—	180	184	184	185	206	167
32. Mastoid width	194	146	173	(215)	230	216	—	215	189	202	207	(190)	227	188
33. Width, post. bord. fossae temp.	116	88	107	151	154	134	128	158	130	133	129	126	134	130
34. Condylus occipitalis, width	95	—	87	100	106	102	95	110	—	92	97	98	106	94
35. Height of fossa temp., least	38	30	—	36	44	33	36	34	—	31	35	32	41	33
36. Occipital height: lower bord. for. magn.	148	—	—	172	160	171	148	158	—	—	150	149	154	156
37. Occipital height: upper bord. for. magn.	108	—	—	130	120	134	108	121	—	—	111	110	115	116
38. Greatest span of horn cores	396	283	355+	515+	610	560+	395	470+	600	—	400+	405	560	466
39. Tip to tip of horn cores	—	283	355+	—	—	—	—	—	—	—	—	—	—	455
40. Circumference of horn cores, base	157	130	—	205	230	257	157	215	215	—	175	170	232	190
41. Diametres of horn cores, base	54	40	45	68	80	88	57	75	71	—	60	58	78	66
	40	35	35	62	60	68	40	50	66	—	46	45	60	49
42. Length of horn cores, outer curvature	210	125	153	240+ (250)	275+ (365)	227+	180+ (205)	—	250	—	185+ (255)	185+ (200)	(380)	233
43. Length of upper tooth row	133	(110)	—	149	134	139	136	—	—	139	140	133	125	(152)
44. Length of premolars (p 2–p 4)	52	(61)	—	63	51	58	53	—	—	56	61	56	—	(62)
45. Length of molars (m 1–m 3)	82	(35)	—	92	82	84	85	—	—	86	85	82	75	—

* Probably bullock.

III.

Maglemosegaard (Vedbæk II) ♂	Vedbæk III ♂*	Holmene ♂*	Holmene ♀	Sandhuse I ♀	Sandhuse II ♀ subad.	Ærø ♂*	Løgtved ♂	Viksø I ♀ subad.	Viksø II ♀	Veddinge ♂*	Snoldelev II ♂ subad.	Bodal ♂	Sønderso ♂*	Gundsømagle	Mors – Zone IX ♀	*B. t. domesticus. – Recente*					Spanish fighting bull. CN. 2814 ♂
																CN. 860 ♀	CN. 296 ♀	Study Coll. ♀	Study Coll. ♂ subad.	Study Coll. ♂ Bullock	
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
550	(550)	585	500	465	(445)	(555)	—	447	—	(545)	458	546	(575)	—	400	460	475	485	440	470	497
480	(480)	525	450	440	(415)	(505)	—	411	—	(495)	409	505	(505)	—	380	440	445	465	419	442	465
455	(455)	497	426	413	(390)	(475)	—	382	—	(470)	381	480	(480)	—	355	410	415	428	387	414	442
270	275	296	246	215	238	262	238	—	—	258	250	278	275	—	186	200	224	215	215	228	248
290	—	304	250	260	—	—	—	—	—	—	218	275	—	—	215	262	253	275	229	248	252
235	—	(262)	220	205	225	(252)	225	—	—	239	228	245	235	—	192	212	215	215	226	226	232
465	—	475	416	380	—	—	—	—	—	—	—	442	—	—	—	367	405	418	355	380	411
405	411	426	360	320	312	400	—	327	—	392	340	393	415	—	297	326	355	345	325	344	356
413	—	432	385	365	—	—	—	—	—	—	—	420	—	—	—	360	395	415	346	365	397
180	—	198	168	165	—	208	—	147	(150)	—	158	200	183	—	140	162	185	174	166	180	190
330	—	356	310	300	278	341	—	280	—	340	284	345	340	—	266	298	320	320	298	305	312
142	150	152	130–140	125	106	143	—	117	105	139	114	145	141	—	114	125	128	133	115	122	117
300	—	322	276	270	—	—	—	246	—	—	244	308	—	—	—	267	258	280	240	262	267
197	—	187	178	166	—	—	—	—	—	—	—	176	—	—	—	167	178	205	140	150	164
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	65
166	—	172	152	142	—	—	—	110	—	—	118	148	—	—	—	146	138	165	120	129	137
—	—	180	168	174	—	176	—	156	—	—	142	178	(190)	—	141	174	155	178	144	155	158
—	—	300	273	270	—	—	—	241	—	—	230	—	—	—	222	265	256	273	241	280	270
72	—	75	56	64	62	76	—	57	—	66	71	72	78	—	58	66	62	68	65	62	66
64	—	67	58	60	56	72	—	58	—	62	63	66	67	—	56	57	55	61	55	57	62
210	183	220	162	132	185	192	197	—	—	196	193	180	189	—	113	125	148	155	187	120	211
232	229	235	172	150	198	237	220	—	—	226	218	210	238	—	136	158	163	164	200	157	252
188	190	208	159	148	170	204	184	158	—	184	187	192	208	—	135	161	159	155	165	163	197
237	233	257	220	188	201	239	225	178	—	234	210	244	260	—	167	200	200	200	196	212	233
—	180	192	162	130	(145)	171	163	128	—	171	156	184	—	—	108	131	139	130	134	152	169
—	—	202	171	144	—	188	—	—	—	183	158	195	190	—	119	146	143	148	147	159	—
138	142	155	142	124	120	140	—	120	(115)	145	118	147	154	—	116	130	125	132	124	125	137
162	164	171	161	136	145	160	—	134	—	160	145	170	—	—	121	146	143	147	144	144	150
89	—	95	82	75	—	—	—	65	—	—	75	101	—	—	70	79	81	80	70	79	94
—	—	95	81	76	—	—	—	68	—	—	70	102	—	—	66	75	78	78	70	70	90
205	208	226	192	172	186	212	194	174	—	212	184	213	224	—	159	185	191	196	188	188	207
232	230	263	205	184	186	245	—	178	—	249	191	256	256	—	165	200	200	202	191	210	234
160	154	179	137	108	127	168	145	116	—	171	135	158	167	—	89	131	109	129	110	142	156
112	—	108	104	92	96	118	112	98	—	108	103	107	114	—	76	96	98	104	103	98	103
—	—	33	33	34	—	40	—	30	—	34	30	37	39	—	34	33	37	41	36	38	35
180	—	171	152	148	154	180	152	147	—	164	162	173	184	—	132	145	159	140	147	143	125
136	—	—	112	110	116	140	107	113	—	123	124	126	138	—	105	113	118	110	110	105	166
590	—	556	398	316	480	801	—	—	—	532	532	620	600	—	347	480	397	372	515	400	667
—	—	510	346	—	460	—	—	—	—	—	532	—	—	—	342	470	395	367	515	400	633
220	215	240	164	145	160	235	220	—	—	214	214	245	265	280	142	175	155	125	170	155	222
76	73	81	59	50	52	84	75	—	—	74	71	80	93	98	48	59	52	43	58	56	78
62	58	56	43	40	46	60	57	—	—	56	60	67	71	67	35	47	42	35	46	42	58
340	—	305	209	155+	305	445	—	—	—	(295)	228	(385)	(415)	—	165	255	200	162	200	175	395
138	145	135+	139	138	—	143	—	dp4 (142)	122	134	dp4 (145)	138	142	—	120	132	120	130	dp4 (131)	132	143
58+	58	—	60+	58	—	57	—	66	51	50	(62)	55	62	—	49	53	56	53	(55)	54	59
85	90	82	83	85	85	88	—	82	76	87	92	89	(84)	—	73	80	73	78	85	79	86

PLATES I—XIV

I–VII: Skulls of *Bos primigenius*, ♂♂.
VIII–IX: Skulls of *Bos primigenius*, ♀♀.
X–XIII: Skulls of Neolithic *Bos taurus domesticus*.

Arranged according to geological age.

XIV: Skeletons of *Bos primigenius*, ♀ and ♂.

PLATE I: Skulls of *Bos primigenius*. ♂♂. Zone III. Late Dryas.
1. Millinge/Faaborg; 1 A. Terp. (Transition to Zone IV).

Millinge (1).

Terp (1 A), – at the bottom.

PLATE II: Skulls of *Bos primigenius*. ♂♂. Zone IV. Preboreal.
(A) Nos: 3. Sorø; 4. Grænge; 5. Gøderupgaard; 9. Knabstrup; 11. Røde Mølle Aa; 12. Funen.

Sorø (3). Grænge (4).

Gøderupgaard (5). Knabstrup (9).

Røde Mølle (11). Funen (12).

Plate II: Skulls of *Bos primigenius*. ♂♂, Zone IV. Preboreal.
(B) No. 13A. Tepstrup. – Frontal, lateral, and occipital view.
Palatal view: Nos. 3 (Sorø), 4 (Grænge), 5 (Gøderupgaard), 11 (Røde Mølle Aa); 13A (Tepstrup).

Tepstrup (13 A).

(3), (4), (5).

(11), (13 A).

Plate III: Skulls of *Bos primigenius*. ♂♂. Zone V. Boreal.
Nos: 14. Rønnebæksholm; 16. Knabstrup 3; 17. Grænge B; 22. Tranemosegaard; 26. Hallenslev; 27. Niverød; 31. Bedsmose.
Palatal view: Nos. 14 (Rønnebæksholm); 17 (Grænge B); 26 (Hallenslev).

Rønnebæksholm (14).

Knabstrup 3 (16).

Grænge B (17). Tranemosegaard (22).

Hallenslev (26).

Niverød (27).

Bedsmose (31).

(14), (17), (26).

PLATE IV: Skulls of *Bos primigenius*. ♂. Zone VI. Boreal.
Nos: 33. Bregninge; 34. Lørup Hede; 35. Kulemile; 36. Gundestrup, Grevinge; 42. Store Damme.
Palatal view: Nos. 33 (Bregninge); 36 (Gundestrup); 42 (Store Damme).

Bregninge (33). Lørup (34).

Kulemile (35). Gundestrup (36).

St. Damme (42). (33), (36), (42).

Plate V: Skull of *Bos primigenius*. ♂. Zone VII. Atlantic.
54. Bønnelykke.

Bønnelykke (54).

Plate VI: Skulls of *Bos primigenius*. ♂♂. Zone VIII. Subboreal.
(A) Nos: 55. Ørting; 56. Østbirk; 58. Ugilt; 59.Klarup; 66. Hornslet; 60. Auning; 65. Holme Mose; 67. Hørning; 69. Tranekær; 71A. Læsten.

Ørting (55). Østbirk (56).

Ugilt (58). Klarup (59), Hornslet (66), the lowest figure.

Auning (60). Holme Mose (65), Hørning (67), – at the bottom.

Tranekær (69). Læsten (71 A).

Plate VI: Skulls of *Bos primigenius*. ♂♂. Zone VIII. Subboreal.
(B) Nos: 71 B. Grejs Mølle; 71 C Fæsted, Ribe; 71 D. Tinglev.
Palatal view: Nos. 55 (Ørting); 56 (Østbirk); 58 (Ugilt)); 60 (Auning); 71 A (Læsten); 71 C (Fæsted); 71 D (Tinglev).

Grejs Mølle (71 B). Fæsted (71 C).

Tinglev (71 D). (55), (56), (58).

(60), (71 A), (71 C). (71 D).

Plate VII: Skulls of *Bos primigenius*. ♂♂. Uncertain age.
(A) Nos: 79. Julianelyst; 97. Aagerup; 98. Lyngby; 132. Bro Mølle; 133. Trostrup; 148. Mors; 150. Ølholm; 198. Danmark.

Julianelyst (79). Aagerup (97).

Lyngby (98). Bro (132).

Trostrup (133). Ølholm (150).

Mors (148). Danmark (198).

Plate VII: Skulls of *Bos primigenius*. ♂♂. Uncertain age.
(B) Nos: 170 Rosenholm; 177. Ørtoft; 199. Danmark (Min. Mus.); 200. Danmark (2 Afd.); 202. Danmark (Study Coll.).
Palatal view. Nos. 97 (Aagerup); 98 (Lyngby); 132 (Bro Mølle); 150 (Ølholm); 148 (Mors); 199 (Min. Mus.).

Rosenholm (170) Ørtoft (177) – the lowest figure.

Min. Mus. (199).

2. Afd. (200).

Study Coll. (202).

(97), (98).

(132), (150).

(148), (199).

Plate VIII: Skulls of *Bos primigenius*. ♀♀.
Zone V. Three complete or almost complete skulls. Nos: 15 Ullerslev; 18 Grænge; 21 Bjeverskov, and brain-case 24 Flintinge.
Zone IV. Nos: 7 Vigersted; 10 Knabstrup 2; 13 Svebolle; 13B Bjerregrav.
Zones II–V. No. 53 St. Taastrup.
Palatal view. Nos. 15 (Ullerslev); 18 (Grænge); 21 (Bjeverskov); 53 (St. Taastrup).

Ullerslev (15). Grænge (18). Bjeverskov (21).

Vigersted (7). Knabstrup (10).

Flintinge (24). Svebolle (13), upper figure. Bjerregrav (13 B).

St. Taastrup (53). (15), (18), (21). (53).

Plate IX: Skulls of *Bos primigenius*. ♀♀.
Zone VIII. Nos: 57 Pindstrup; 61 Toftum; 62 Aarhus; 63 Korinth. —
Not dated: 152 Fuglekjær; 151 Ølholm; 155 Aakjær; 153 Gjødvad; 100 Mørkøv.
Palatal view: 57 (Pindstrup); 61 (Toftum); 152 (Fuglekjær).

Pindstrup (57). Toftum (61).

Aarhus (62). Korinth (63).

Fuglekjær (152). Ølholm (151).

Aakjær (155), Gjødvad (153), the lowest figure. Mørkøv (100). (57), (61), (152).

PLATE X: Skulls of *Bos taurus domesticus*. Zone VIII. (A-landnam and beginning of B-landnam). I (Øgaarde I, ♀ jun.); V (Øgaarde III, ♀ subad.); IV (Øgaarde II, ♀); II (Store Lyng, ♂*, subad.); III (Verupgaard, ♂*).

* Probably bullock.

Øgaarde I. Øgaarde III. Øgaarde II.

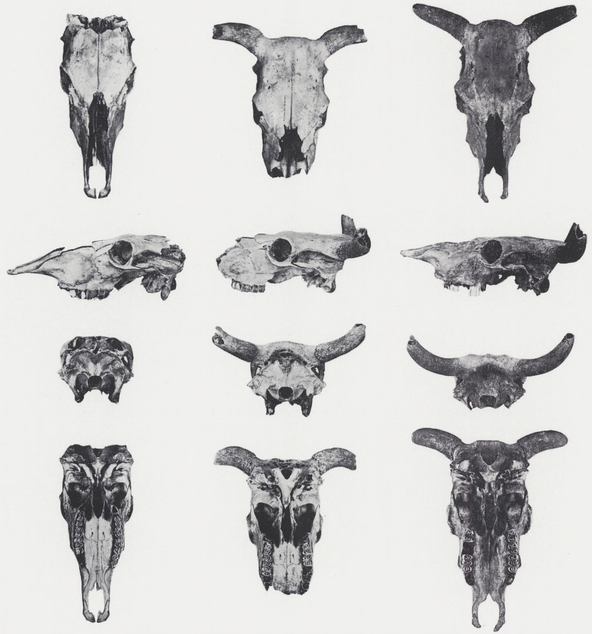
St. Lyng. Verupgaard.

PLATE XI: Skulls of *Bos taurus domesticus*. Zone VIII.
VI–VIIIA Gammellung, (I ♂*, II ♀, III ♂*, IV ♂ jun.). IX–XA Nyrup, (♀, ♀, ♀).

* Probably bullock.

I. II. III. IV, the lowest figure.

Gammellung.



I. II. III.

Nyrup.

PLATE XII: Skulls of *Bos taurus domesticus*. Zone VIII.
XI (Snoldelev, ♂); XII (Vedbæk I, ♂ subad.*); XIII (Maglemosegaard (Vedbæk II), ♂); XIII A (Vedbæk III, ♂*); XV (Holmene I, ♂*); XVI (Holmene II, ♀).

* Probably bullock.

Snoldelev. Vedbæk I. Vedbæk II, (Maglemosegaard).

Vedbæk III.

Holmene.

Plate XIII: Skulls of *Bos taurus domesticus*. Zone VIII.
XVIII–XIX (Sandhuse moor, ♀, ♀ subad.); XXI (Ærø, ♂*); XXII (Løgtved Enge, ♂*); XXVII (Veddinge, ♂*); XXVIII (Snoldelev II, ♂ jun.); XXIX (Bodal, ♂); XXXIII (Søndersø, ♂*).

* Probably bullock.

Sandhuse. Ærø.

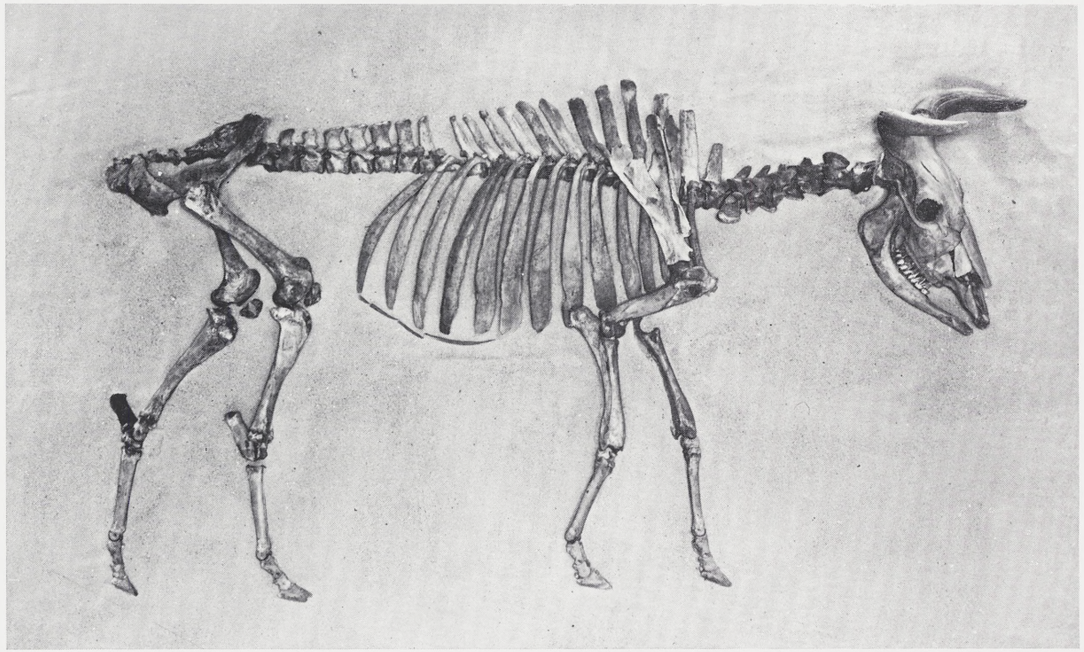
Løgtved. Veddinge.

Snoldelev II. Bodal. Søndersø.

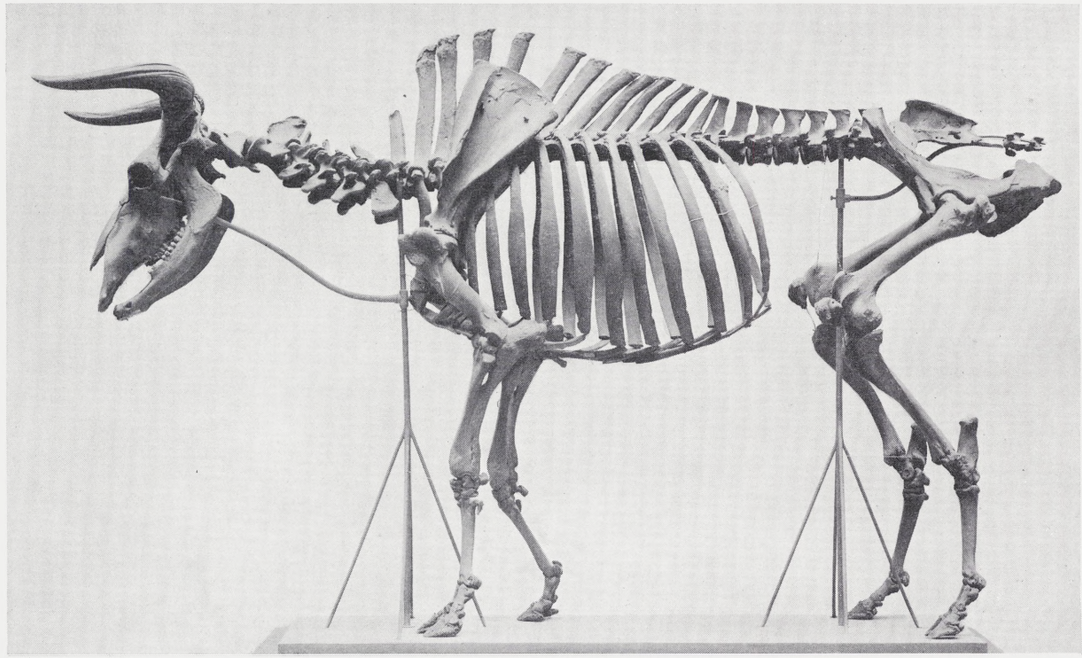
Plates I–XIII photographed by mr. H. V. Christensen, the photographer at the Zoological Museum.

Plate XIV: *Bos primigenius.* ♀, from Ullerslev. Boreal period. (Zone V).
Mounted and photographed by U. Møhl.
(Complementary bones: left *calcaneus* (black) of *Bos primigenius*, Sværdborg XXX E2; *atlas*, *epistropheus* from *Bos taurus domesticus* of similar size).

Bos primigenius. ♂, from St. Damme. Boreal period (H. Winge, 1904).



Bos primigenius. ♀. – Ullerslev.



Bos primigenius. ♂. – Store Damme.

II. PALYNOLOGICAL PART

By Bent Fredskild

Introduction

Up to 1955 most of the work of dating bones found in bogs was carried out at the Geological Survey of Denmark in collaboration with the Zoological Museum of the University of Copenhagen, a collaboration resulting, amongst other things, in the publication of various monographs—on the occurrence of bison in Danish Pleistocene deposits (Degerbøl & Iversen 1945), on the pond tortoise (Degerbøl & Krog 1951), and on the reindeer (Degerbøl & Krog 1959).

In 1955 the dating was taken over by the Department of Natural Sciences of the National Museum, where Dr. Svend Jørgensen and the author since then have carried out a long series of datings of various animals, of recent years mainly *Urus* and domestic ox.

My colleagues at the Geological Survey of Denmark and at the National Museum, first of all Alfred Andersen, Harald Krog, and Svend Jørgensen, have been kind enough to place their material at my disposal so that all the datings can be co-ordinated in the present publication. My thanks also due to the head of the Department of Natural Sciences of the National Museum, Dr. J. Troels-Smith, for good advice.

As some of the analyses were made up to 30 years ago, the material presented is bound to be highly heterogeneous. In general only about 100 pollen grains were counted in the oldest samples, and beyond the usual forest tree pollen (sub-fossil pollen of *Populus* and *Juniperus* were unknown) only Ericales, Cyperaceae, Gramineae and Chenopodiaceae, and a few others were normally determined. Since then pollen analysis has undergone a remarkable development, and in contrast to the primitive analyses of the early days we find today's samples, where the total in each sample may be 2–3000 pollen grains, covering more than 100 species or higher taxa. (In Table B 153 taxa of pollen and spores have been listed, and in the appendix p. 211 13 further taxa are mentioned). Many of the old samples are nevertheless fully adequate for accurate dating. A handsome example of this is Professor Knud Jessen's dating in 1926 of the *Urus* from Vig (No. 2). On the basis of a pollen spectrum containing 68 % *Betula* and 32 % *Pinus*, besides the find of epidermis of pine needles, hair of

Nymphaea, and fern spores, he dated the bull at Zone IV. Three samples from the skull were analyzed by the present author in 1965, and the 4554 pollen grains counted confirmed the dating, only with the addition that the middle of the zone would seem most likely.

Cases in which old datings have had to be substantially corrected do, of course, occur, e.g. the revision of the datings of the Swedish bisons (Fredskild 1966).

The treatment of the samples is as described in Jørgensen (1963, vol. II). This is, in short, boiling with KOH, acetolyzing, treatment with KOH, staining with fuchsine, and embedding in glycerine. At different stages in the process treatment with HF, decanting of sand, or treatment with HCl may, if needed, be introduced. All slides are sealed before being analyzed and afterwards stored.

Sources of Error

The dating of an animal the size of an *Urus* based on a single pollen sample taken somewhere in the skeleton is hazardous, but often this was the only choice: either no dating at all of a beautiful skull, or analysing an only sample which might date the animal.

Isberg (1949) mentions a very interesting case which deserves translation (from the Swedish): "The animal, found at the depth of one metre, lay with the skull—heavily corroded by humic acid—in dark-brown fen dy, while the rest of the body was embedded in chalk gyttja. The right ribs were in an almost vertical position, while the left ribs lay almost horizontally. The proximal segments of the limbs were vertical, while the distal segments were bent under the body. The skull lay on its left side with the left horn partly stuck down into the grey-white gyttja, and with the condyle of the left mandible in situ, while the right one had slipped. The hand-sized stones, kicked up from the moraine and found a bit higher up in the gyttja, were proofs of the animal's violent struggle to survive. The distinct borderline between the gyttja and the fen dy was deranged at the spot, and at a distance of approximately one metre from the skull three lumps of chalk gyttja were found in the dy, 12 cm. above the borderline. Thanks to these bits of chalk a dating was made possible by analyzing the place of contact between the lumps and the dy, as these, with the kicks of the animal, had been thrown up, and had fallen down on to the bottom of the lake at that time."

One conclusion to be drawn from this is that, as a rule, the dating of samples from the skull will get nearer to the truth than dating of samples from the limbs.

Excavations of more or less complete skeletons carried out in the bog Aamosen, Western Zealand, however, have also shown examples where all the bones were embedded horizontally in the same thin layer, and in cases like these only a surface sample from the distal end of a vertical horn may be slightly younger. The analyses of 14 samples from different places in the skeleton of an Ox gave almost the same dating (cf. Øgaarde I, p. 205).

When possible, more than one sample from the same animal have been analyzed,

and several examples of highly different pollen spectra can be found in the text. An example of this is the dating of the bison from Bjärsjöholm, Scania (Fredskild 1966), where five samples from the skull were almost identical, with a spectrum from the transition between Zones III and IV, while a sample from the big nerve foramen on the left metatarsus was so severely contaminated with recent or sub-recent material that the dating of this sample, if anything, would be at Zone IX.

This example leads from the question of the contemporaneousness of a sample and the death of the animal concerned to the question of the reliability of the sample. Krog (1951) has written a survey of this, dividing the samples into four groups, A–D, ranging from fresh material in situ without any possibility of contamination to a sample which in all probability is contaminated.

Comments on Table A

In Table A are listed the frequencies of pollen of a number of species (or genera, or families) important for the dating, expressed in percentages of AP, including *Alnus*, *Betula*, *Carpinus*, *Corylus*, *Fagus*, *Fraxinus*, *Juniperus*, *Picea*, *Pinus*, *Populus*, *Quercus*, *Salix*, *Tilia*, and *Ulmus*.

In the case of some of the first analyses a "?" had been put against the number of the species in question at the time because of uncertainty concerning the determination. This has been retained in the table. An "x" under *Calluna* instead of a number denotes that some Ericaceae were found in the sample in question, but that no separation between *Calluna*, *Empetrum*, and others has been made. In the great majority of the cases, apart from early Preboreal samples, all the ericaceous pollen undoubtedly originates from *Calluna*.

At the bottom of the table the sum of AP is listed, and finally the degree of destruction (D.b.). This is the percentage of the most common pollen with a fairly smooth exine (*Alnus*, *Betula*, *Corylus*, *Carpinus*, Gramineae, and *Tilia*) in which destruction could be observed. When discussing the reliability of a dating, D.b. must be kept in mind, as the differential destruction of different pollen may influence the dating.

Comments on Table B

The results of the pollen analyses are presented in Table B, giving the numerical values of the occurrence of the various types of pollen and spores. Included are all analyses carried out in 1948 and later. Before that year *Juniperus* and *Populus* were not determined, and only rarely other plants than those listed in Table A.

The first and major part of the table is taken up by the phanerogams (Spermatophyta), arranged alphabetically according to family, by means of the terminology suggested by Hylander (1941). The families are followed by what is termed "a.i.d.", i.e. pollen which it has not been possible to determine because of a too high degree of destruction, "a.i.p.", indeterminable because of the pollen being too much folded,

and finally "a.i.l.", indeterminable because of the pollen being partly concealed under remains of another plant, being filled up with microscopical pyrite crystals, etc.

Next in the table we have the vascular cryptogams (Pteridophyta), followed by mosses (Bryophyta), represented only by *Sphagnum* and Thallophyta—a somewhat heterogeneous section. Finally the easily recognizable hairs of *Ceratophyllum* and *Nymphaea*, recent pollen contamination, rebedded pollen and spores, microscopical charcoal, and three spore-types: "Hystrix", "Pentagon", and "Paraplya". The category "recent pollen contamination" only includes pollen so highly deviating in colour in the freshly stained slides that there was no doubt at all about the recent origin. Pollen judged to be recent (e.g. Cerealea in Pollen Zones IV or V), but not deviating in colour, is listed in the first part of the table. Rebedded pollen and spores include *Platycaria*, *Engelhardtia*, *Pinus haploxylon* type, *Sciadopitys*, and other types, as well as the trilete spores. "Hystrix" includes the common types of Hystricosphaeridae. "Pentagon", which looks like a picture of *Cymatiosphaera canadensis* (Deunff 1956, p. 80) is often met with in Danish clayey marine sediments. "Paraplya" is supposed to be a rhizopod. It is very common in Danish alder-swamp peat.

An "x" under *Empetrum* denotes that in the sample in question the *Empetrum* has not been separated from the other ericaceous pollen. A "+" in the table denotes a pollen which was not found during the counting, but during the preparation or later during the revision of the rarer pollen, the position of which is always noted. (All slides analyzed by Sv. J. and B. F. are permanent mounts, sealed before analysis).

Fern spores of the *Dryopteris* type, and colonies of *Botryococcus* and *Pediastrum* are often met with in so large quantities that a counting of the number in all the slides of the sample is too time-consuming. In such cases the number is counted on the first slide only. In the table the extrapolated number as well as the number actually counted is listed.

By means of Table B a good deal of information can be obtained about the occurrence of different species in the pollen zones. Before evaluating these records, however, it must be remembered that most of the samples from Zones IV–VI are lacustrine sediments (gyttja, fine gyttja, gyttja with a touch of swamp peat, with fine drift, etc.), where pollen of amphiphytes are to be expected, whereas, with few exceptions, swamp peat, usually a highly destructed alder-swamp peat, is the main component in the samples from Zones VIII–IX. On pp. 197, 207 and 211–215 pollen lists for 24 further analyses are given in the text. They include 13 taxa, not mentioned in Table B: *Scleranthus* sp. and *Euphrasia* type (incl. *Euphrasia* and *Rhinanthus*) from Tinglev, *Juglans* from Gundsømagle, *Hordeum* and *Rumex acetosa* from Læsten, *Centaurea cyanus* from Nyrup III and *Elymus*, *Oxyria digyna*, *Polygonum viviparum*, *Primula* sp., *Pyrola* type, *Selaginella selaginoides* and *Trollius europaeus* from Terp.

Araliaceae. One pollen of *Hedera* in sample 17b and another in No. 19, both from the same locality (Grænge) on Lolland are unexpected, as the spectra are clearly Zone V, cf. the diagram in Andersen and Møller (1946, Plate I). But two grains would hardly be there by accident, and as long-distance transport of *Hedera* pollen

is unlikely, this may be a case of local immigration of *Hedera* into southern Denmark prior to the QM. Another example may be the sample from Hallenslev in western Zealand (No. 26). One pollen grain of *Hedera* was found in No. 26a, another in 26b, but while 26b is obviously contaminated, 26a, originating from the middle of Zone V, or even more likely from Va, was clean. In this latter sample *Ulmus*, the only QM-constituent, represented only 0.3 %, and *Alnus* was lacking.

Cannabaceae. All pollen from this family is listed under *Humulus lupulus*, even though the possibility can not be excluded that some pollen from the youngest samples may be *Cannabis*.

Caprifoliaceae. One find of *Lonicera periclymenum* was made in Rislev (No. XXXII, Iron Age). *Sambucus nigra* was found together with this, and also in one sample from Zone VIII (No. 71), and in one from Zone V, the latter from the same locality (Grænge) as that in which the early *Hedera* was found. *Viburnum opulus* flourished in Zones V–VI, being found in one sample from Zone IV, 13 from V–VI, 4 from VIII, and one from IX.

Cistaceae. *Helianthemum* was found in the only skull from Zone III (No. 1), in the one from the transition III–IV (No. 1 A) and, presumably rebedded, in VIII (No. XX).

Compositae. One pollen of *Centaurea cyanus* was found, cf. No. XA. Liguliflorae has been favoured by forest clearance, but it was also found in 14 samples out of 53 prior to that time. Pollen of the *Cirsium* type was met with only once (No. 16) before the landnam, but in 7 finds (in 10 samples) later.

Cyperaceae. Like *Viburnum*, *Cladium* flourished in Zones V–VI, but an odd pollen grain may be found now and then up to the very latest sample.

Empetraceae. *Empetrum* is frequent in Zones III–IV, rare in V–VI, and, with two exceptions (Nos. XXXII and 71 D) absent later. In earlier analyses *Empetrum* has been included in Ericaceae; cf. p. 181.

Ericaceae. In some analyses no distinction was made between *Calluna* and Ericaceae sp.

Gramineae. It has often been impossible to determine as to genera the pollen of the *Cerealea* type.

Guttiferae. *Hypericum* was found only in Zones VIII–IX, occurring in 18 samples.

Haloragaceae. Pollen of *Myriophyllum alterniflorum* was found three times (No. 71 D, No. 1 A, and No. V). *M. spicatum* is very frequent in Zone IV, but from later samples we have only one uncertain find (No. 53). This agrees with many lake diagrams from Denmark and Greenland, which show that the species flourished in the alkaline facies of the early Post-glacial lakes. *M. verticillatum* occurs more scattered, yet with a preference for Zone IV.

Juncaceae. Fægri and Iversen (1964, p. 194) describe the pollen of *Luzula* and *Juncus* as follows: Psilate pollen grains united in tetrads. "Inaperturate, exine extremely thin. Normally not preserved in fossil state, or at any rate not recognized". Wodehouse (1935, fig. 88 and Plate V, 7) shows drawings of *Juncoides campestris*

(= *Luzula campestris*), and writes (p. 321): "The germinal furrow is not sharply defined but is represented by a thin area of the exine on the outer face of each grain. . . Though these thin elastic areas are generally overlooked, they are undoubtedly true furrows." ERDTMAN (1952, p. 217), like WODEHOUSE, describes the pollen grains as, as a rule, united in tetrahedral tetrads, monaperturate, but adds that the dissepiments (i.e. the partition walls) are thinner than the outer walls. HYDE and ADAMS (1958, pp. 50–51) have photographs of *Luzula campestris* and *Juncus acutiflorus* in a defatted, but not acetolyzed state, clearly showing the tetrad with the big thin areas.

If, however, pollen grains of Juncaceae are acetolyzed, they will not appear as tetrads, as the partition walls disappear and only the outer exine is left, and they will thus only show as 4-aperturate, psilate pollen with extremely big apertures (cf. fig. 1). In some, but far from all, grains the position of the partition walls are seen as a very low, thin crest on the inner side of the exine. A total of more than 25 sub-fossil pollen grains of Juncaceae has been recorded in the past 10 years from localities in Switzerland, Greenland, and Denmark by Sv. J. and B. F. One pollen grain from Nyrup (No. IX), three from Rislev (No. XXXII). No doubt the usually very crumpled pollen of sub-fossil Juncaceae is often mistaken for thin-walled Cyperaceae. Nine preparations of *Juncus* (seven species) and seven preparations of *Luzula* (three species) have been used for reference.

Liliaceae. 11 pollen grain of *Allium* have been found, all of them in Zones VIII–IX. Judged from length of the colpe, the sculpture and structure, and the size, seven of them have been determined as *A. ursinum* (cf. p. 205), while four of them were too badly preserved for a closer determination to be made.

Lythraceae. In the present material pollen from the ubiquitous *Lythrum salicaria* was rare prior to Zone VIII. One pollen grain only was found (No. 26c), originating from Zone V, whereas it has been recorded from 21 samples in Zones VIII–IX. Even considering the differences in the sediments, this points to late immigration, and, not least, to a flourishing state from late Zone VII (unpublished diagrams from Aamosen) and up through Zones VIII and IX. GODWIN (1956) mentions one record from Zone VI a, three from VII b and two from VIII in England. Late flourishing is also emphasized by the material from Aamosen, comprising more than half a million pollen grains (JØRGENSEN 1963), and covering late Zone IV up to the beginning of Zone VII. A total of 8 pollen grains of *Lythrum* was found, all of them in the latter part of Zone VI.

Menyanthaceae. Menyanthes trifoliata is frequent throughout the whole period, especially in Zone IV.

Orchidaceae. 5 tetrads of Orchidaceae sp. were found in a sample from Zone VIII (No. XXVII). This is, to the best of the author's knowledge, the first finds of sub-fossil pollen in Denmark. GODWIN (1956) has no records either. Within only some genera of Orchidaceae the pollen is united in tetrads (BEUG 1961). The 5 tetrads (fig. 1) were very similar to those in *Epipactis palustris*, but too little reference material (*Epipactis palustris* and *Listera ovata*) was at hand to make a safe determination as to genus or even species.

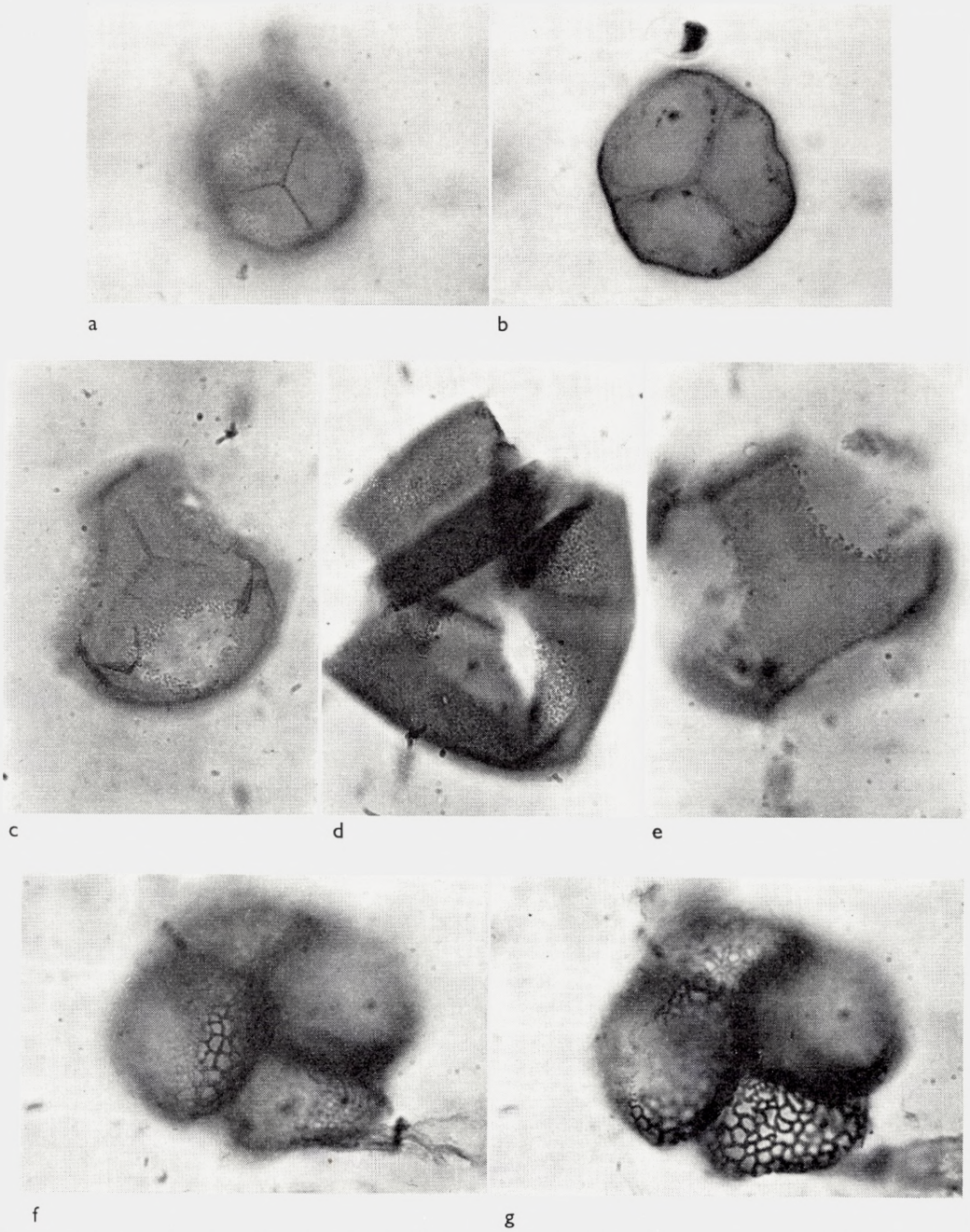


Fig. 1 a–b Recent *Juncus trifidus* L. boiled in KOH, stained (a: High level, b: Optical section).
c Recent *Juncus compressus* Jacq., high level, boiled in KOH, stained.
d Recent *Juncus articulatus* L.; Lagerst. og Krok, boiled in KOH, acetolysed, stained.
e Fossil Juncaceae, boiled in KOH, acetolysed, stained (Andbjerg, Jutland, Pollen Zone IX).
f–g Fossil *Epipactis* type, boiled in KOH, acetolysed, stained (Veddinge, Zealand, Pollen Zone VIII).
Magnification a, b, e ca. 775×: c, d, f, g ca. 700×.

Polygonaceae. Two pollen grains of *Polygonum viviparum* type and one of *Oxyria digyna* were found in two samples from the same locality (No. 1 A) dating from the transition III–IV.

Potamogetonaceae. In some older samples no distinction has been made between the two easily distinguished pollen types: *Coleogeton* (including in our area only *Potamogeton pectinatus* and *P. filiformis*) and *Eupotamogeton*, but most probably all the pollen in the table under *Potamogeton* sp. are *Eupotamogeton*. *Coleogeton* was found twice: one pollen grain in No. XII in a marine gyttja (probably *P. pectinatus*) and another in a limnic gyttja together with 15 *Eupotamogeton*.

Primulaceae. Subfossil pollen of *Hottonia* is rarely found, and in the present material only in the very localcoloured spectras from Rislev (No. XXXII), where 8 pollen grains were recorded in 3 samples.

Ranunculaceae. Most, if not all, the pollen listed as Ranunculaceae sp. and *Ranunculus* sp. is presumably of the *Ranunculus repens* type, including most of the genus *Ranunculus*, apart from *Batrachium*. One pollen grain of *Trollius europaeus* was found in Terp (No. 1 A, transition Zone III–IV).

Rosaceae. *Prunus padus* was met with thrice: Terp (No. 1 A, one pollen grain) from Zones III–IV, Vig (No. 2, four pollen grains in three samples) from Zone IV, and Ullerslev (No. 15, two pollen grains in two samples) from Zone V. One pollen grain of *Sanguisorba minor* from late Iron Age was found in Rislev (No. XXXII).

Saxifragaceae. *Saxifraga oppositifolia* type includes *S. aizoides*, *S. aizoon*, *S. cotyledon* and *S. oppositifolia*. Three pollen grains were found from Zones III–IV (Nos. 1, 3, and 9).

Scheuchzeriaceae. One dyad of *Scheuchzeria palustris* was found in Brændholt (No. 23) from Zone V.

Sparganiaceae. Pollen of the *Sparganium* type comprises *Sparganium* as well as *Typha augustifolia*, i.e. all single pollen grains, whereas tetrads are referred to *T. latifolia*.

Tiliaceae. In earlier analyses *Tilia* pollen is listed as *Tilia* sp. In later analyses, after the morphological distinction between *T. cordata* and *T. platyphylla* had been realized, only pollen grain of *T. cordata* has been found.

Equisetaceae. The table reflects ample occurrence in the early Post-glacial Period in contrast to the very sparse occurrence in the later part.

Ophioglossaceae. *Botrychium* was found in two localities only: Faaborg (No. 1) from Zone III, and Knabstrup (No. 9) from Zone IV, whereas *Ophioglossum vulgatum* was found in 7 localities (19 pollen grains in 10 samples), covering the whole of Zones III to IX.

Polypodiaceae. As usual *Thelypteris dryopteris* is commonest in early Post-glacial samples, yet single spores occur right up to the latest samples. *Pteridium aquilinum* was found throughout the whole period, yet a little more frequently in Zones VIII–IX, favoured by human activity. The distribution of *Polypodium vulgatum* is very marked: one spore in Zone III (and one in Allerød, cf. Iversen 1954), none

at all in Zones IV–VII, and 56 spores in 27 samples (from 19 localities) in Zones VIII–IX. In the material from Aamosen (Jørgensen 1963) single spores were found throughout IV–VII, but the particular distribution of this acidiphilous species in the present material may reflect the retrogressive vegetational succession (sensu Iversen 1964) more than the influence of human activity.

Selaginellaceae. One microspore of *Selaginella selaginoides* was found in Terp (No. 1 A, transition III–IV).

Dating of the Individual Finds

Comments.

With every find the following information, if available, is given: (1) The geological and archaeological circumstances in connection with the find, with quotations from former references to the find, if of interest, (2) the place where the sample was taken, (3) when and by whom, (4) when the sample was analyzed and by whom, (5) the kind of sediment, generally with use of the terms defined by Troels-Smith (1955). The nature of the sediment is mainly based on observations made during the preparation, and finds of macrofossils are mentioned; cf. XXVII, Veddinge Mose, p. 210, where 12 seeds of 8 species besides 12 oospores of a characeous plant were found in a pollen sample of normal size. Finally (6), a short discussion of the pollen spectrum (-spectra). All percentages mentioned in the text are with AP (cf. Comments on Table A, p. 181) as the basic sum.

For reasons of simplification the following abbreviations of names have been used in the text: A.A. = Alfred Andersen, geologist, M.Sc., The Geological Survey of Denmark, Sv.J. = Svend Jørgensen, assistant keeper, Ph.D., The National Museum, Department of Natural Sciences, Copenhagen, H.K. = Harald Krog, geologist, M.Sc., The Geological Survey of Danmark, U.M. = Ulrik Møhl, taxidermist, The Zoological Museum, University of Copenhagen, T-S = Jørgen Troels-Smith, Keeper, Ph.D., Head of the Department of Natural Sciences, The National Museum, Copenhagen, and B.F. = Bent Fredskild, the present writer, assistant keeper, The National Museum, Department of Natural Sciences, Copenhagen.

The pollen zones used are those shown in the schematic diagram suggested by Iversen (1960, fig. 7), apart from the borderlines V–VI, where the definition (the rational limit of QM), suggested by Jørgensen (1954, p. 176) was preferred.

The numbering of the finds is in chronological order, though with a few exceptions.

One skull only can be dated at Zone III, and one skull dates from the transition III–IV.

Within Zone IV even a single sample can often be dated more accurately than at the zone in general by reference to absence or presence of *Juniperus*, the amount of *Populus*, *Salix*, *Empetrum*, and *Corylus*, besides the ratio *Pinus/Betula*. If an insufficient number only of pollen grains has been counted and determined, the theoretical

possibility exists that the sample may originate in Zone II, but as hair and pollen of *Nymphaea alba* (a plant which has not been found in Zone II (Iversen 1954, p. 115)) were noted even in the first pollen analyses from the 1930es, the possibility can mostly be excluded. In the more recent investigations there has been no problems as far as the question: Zone II or Zone IV is concerned.

Within Zone V it may be difficult to date a sample more precisely, only the amount of *Corylus* may give a hint.

Most of the samples dated at Zone VI originate from the beginning of the zone, still with high frequencies of *Corylus* and with few QM, of which *Ulmus* is the most frequent. Three samples were dated at the middle of the zone.

From Zone VII only two samples can be said with reasonable certainty to originate, while a few insufficiently analyzed samples may be dated at either Zone VII or Zone VIII.

Within Zone VIII samples from the "A-landnam" has a characteristic spectrum (cf. p. 205), but as regards most samples from the zone a closer dating than: contemporaneous with, or later than the "B-landnam" (sometimes also termed the "Iversen-landnam") is not possible without a standard pollen diagram from the basin proper. Towards the end of the zone a small number of *Fagus* occurs, and it may be difficult to decide the dating unless *Secale* is found. *Secale* was introduced into Denmark during the Iron Age at the beginning of Zone IX, presumably about the beginning of our era. The great number of *Calluna* and *Sphagnum* and the sparser occurrence of *Carpinus* is also characteristic of Zone IX.

Bos primigenius

1. *Faaborg.*

This find was made in "blue clay underlaying peaty soil" in Gule Mose, Millinge. It was given to the Zoological Museum some time in the 19th century by a Mr. Deichmann. H. Krog (1959, p. 147 and 152–53) has published two pollen analyses in connection with the skull: (a) from a big gyttja clod in the brain case, and (b) from a cavity at the occipital condyle. Both samples originate from the end of Zone III. A new sample—egg-sized—was taken (U.M. 1961) from the brain-case, and from the centre of this a pollen sample, (c) was analysed (Sv. J. 1961). The sediment was a slightly sandy clay gyttja with some lime. Both the sediment, the ratio of *Betula/Pinus* and of NAP/AP, and the high frequency of *Empetrum* (incl. in Ericaceae in the table) date this sample, which much resembles sample (a) at the very end of Zone III.

1 A. *Terp moor.*

vide p. 211.

2. *Vig.*

As mentioned by Nordmann (1936, p. 75 and 210), this find (made famous by the flint arrow heads found in two of the ribs) originates from Zone IV, based on analyses made by Knud Jessen in 1926, and further indicated by the profile from the finding place, described by N. Hartz (Hartz and Winge 1906). Jessen found 68 % *Betula* and 32 % *Pinus*, besides epidermis of pine needles, hair of *Nymphaea alba*, and spores of a fern (*Dryopteris thelypteris*?).

New samples were taken from the skeleton on exhibition in the National Museum, Copenhagen (B.F. 1965). 4 samples were analyzed (B.F. 1965): (a) from a groove in the left orbit, (b) alveole in right mandible, (c) nerve foramen on frontalis, and (d) cavities and nerve foramina in the occipital region. The sediments as well as the pollen spectra were much alike, and may be mentioned together. The sediment was gyttja with very little macroscopial plant remains. The spectrum is typical of the Preboreal; noteworthy is *Juniperus*, of which only one pollen grain was found out of a total of 4,554 pollen grains counted. Accordingly the dating cannot be the beginning of the Preboreal, and with very sparse *Corylus*, the middle of the zone is most likely.

3. *Stokholt Huse.*

A sample from a cavity in the occipital region (U.M. 1961) was analyzed (Sv. J. 1961). The sediment was a gyttja with a bit of rootfelt, moss-leaves, fine sand, and clay. The sample originates from the beginning or the middle of Zone IV.

4. *Grænge moor A.*

This find was dated by A.A. in 1943–44, and published two years later (A. Andersen and K. Møller, 1946). A profile from the finding place was as follows (translated from Danish):

0–36 cm.: Surface layer of humified peat.
36–231 cm.: Blackish brown, highly humified fen peat, in the upper part a few rhizomes of *Equisetum*, farther down many *Alnus* roots.
231–304 cm.: Transitional layer with the dark fen peat intermingling with the brown-yellow *Phragmites* peat.
304–436 cm.: *Phragmites* peat. Many seeds of *Nuphar luteum*. Besides, shells of freshwater molluscs.
436– cm.: Slightly clayey and sandy chalk gyttja, in the upper part with shells of freshwater molluscs (*Anodonta*, *Sphaerium*, *Planorbis*, etc.).

The bones were found in the uppermost part of the chalk-gyttja. A sample from the skull, consisting of calcareous gyttja, originates from the beginning of Zone IV.

5. *Gøderupgaard A.*

A sample (a) from a cavity in the occipital region (U.M. 1961), analyzed by Sv. J. in 1961, and another (b) (B.F. 1961) from a nerve foramen on the upper side of the left half of the atlas, analyzed by B.F. in 1964, are almost identical. The sediment was gyttja with a little rootfelt, and, besides, in (b) some remains of characeous plants. They originate from Zone IV, and the percentages of *Populus* (1.5 respectively 7.0 %), *Juniperus* (0.2 respectively 0.3 %) and of *Corylus* (1.2 respectively 0.4 %) indicate the middle of the zone.

6. *Viesø.*

A sample from the skull, analyzed by A.A. in 1942, originates from Zone IV. The ratio *Betula/Pinus* indicates the first part of the zone, in spite of the frequency of *Corylus* (3.1 %), as some of the pollen of this may have been confused with *Betula*. The pollen of *Myriophyllum spicatum* and *Nymphaea* indicate a gyttja.

7. *Vigersted.*

A sample from the skull was analyzed by H.K. in 1945. The sediment is gyttja with mollusc shells and swamp peat. The sample is from Zone IV. Another sample, taken from the brain-case (U.M. 1961), was analyzed by B.F. 1964. The sediment is a swamp peat with fine

drift-gyttja and shells. During the preparation one seed of *Menyanthes*, two fragments of *Nymphaea alba* seeds, and a fruit of *Ranunculus* sp. (not *Batrachium*) were found. The pollen spectrum clearly indicates the middle of Zone IV.

8. *Munke-Bjergby.*

A peat sample from this metacarpus was analyzed by A.A. in 1942. He found 9 *Corylus* pollen grains out of a total of 159 pollen grains counted, and this refers it to the transition IV–V. Another sample was taken from the marrow cavity (B.F. 1964) and analyzed by B.F. 1964. A wingless nut of *Betula* and some fruits of *Cyperaceae* sp. were found. The sediment is a rather highly humified swamp peat. One *Corylus* pollen grain was found in a total pollen-grain sum of 795, and this, together with other indices, refers the sample to the middle or the later part of Zone IV.

9. *Knabstrup 1.*

A sample taken in a foramen at the posterior wall of the orbit (U.M. 1961) was analyzed by Sv. J. in 1961. The sediment was a clayey calcareous gyttja with a little swamp peat and a touch of sand. The frequencies of *Juniperus* (3.9%), *Salix* (4.8%), and *Empetrum* (0.9%) indicate the beginning of Zone IV.

10. *Knabstrup 2.*

The sender (Johan Frost) states that the skull was found at a depth of approximately 3 m. in a bog in Knabstrup Enge, about 800 m. ENE of Dyrehavegård. A sample, (a) from the skull was analyzed by A.A. in 1942. The spectrum (*Pinus* 22%, *Betula* 58%, *Corylus* 13%, and *Alnus* 6.5%) seems very strange and must be due to contamination of the material, and another sample, (b) from the brain-case (U.M. 1961) therefore was analyzed by B.F. 1962. The sediment consists of gyttja and swamp peat; during the preparation some undetermined *Carex* nuts were found. The sample originates from the first part of Zone IV.

11. *Røde Mølle Aa.*

A sample was taken from a nerve foramen in the posterior wall of the orbit (U.M. 1961), and analyzed by Sv. J. in 1961. The sediment was a gyttja with a little fine root felt. The sample originates from Zone IV. *Corylus* constitutes 1.1%, but there is still twice as much *Betula* as *Pinus*, and the middle of the zone therefore is most probable.

12. *Fyn.*

Nothing is known about this find except that it was given to the Zoological Museum about the middle of the 19th century by a clergyman, Mr. Appeldorn. A sample was taken from the frontal cavity (U.M. 1961) and analyzed by Sv. J. in 1961. The sediment was a gyttja, originating from late Zone IV.

13. *Svebølle.*

Two samples, (a) from a cavity in the horn core and (b) from between pars petrosa and basi occipitale, were taken (U.M. 1962). They were analyzed by B.F. in 1963. Sample (a) was very small, possibly a gyttja with a little fine drift and a great content of microscopical pyrite crystals. No pollen of water plants was found. It was very poor in pollen, one slide containing only 73 AP besides two unmistakably recent pollen grains of *Tilia*. Due to destruction *Pinus* is heavily over-represented, and it is most likely that the sample dates from Zone IV. Sample (b) is a rather destructed swamp peat with no traces of gyttja, and this is also poor in pollen. 6 slides were counted in order to obtain an AP-sum of 500. *Pinus* must be over-represented

(82%), but as the sum contains only one pollen grain of QM and 11 of *Corylus*, late Zone IV is the most likely. 5 pollen grains of *Alnus* may be a more recent contamination.

13 A. *Tepstrup Lake.*

The find was made at the edge of the lake. A sample consisting of lake marl was analyzed by Johs. Iversen in 1934. A total of 134 pollen was counted, giving the following spectrum: *Salix* 2%, *Betula* 34%, *Pinus* 57%, and *Corylus* 7%. Late Zone IV or the beginning of Zone V seems to be the most likely dating.

13 B. *Bjerregravs moor.*

Vide p. 212.

14. *Rønnebæksholm.*

No information is available about the finding place except that the find was made in a bog. A sample from the nasal cavity was analyzed by H.K. in 1948. The sediment is a somewhat humified gyttja with swamp peat (or vice versa). *Corylus* constitutes 32%, and no QM was found. The sample originates from Zone Va.

15. *Ullerslev.*

The find — made during peat-digging — has been mentioned by V. Madsen (1902, p. 121). About the finding place, a bog situated 700 m. east of Ullerslev railway station, he gives the following information:

> A profile at the finding place showed:
> Approximately 2.5 m. peat.
> 1.6 m. yellow warp with many snail shells, the lowermost bluish and clay-like.
> Below this at least 1.6 m. of grey-blue, gravelly, calcareous sand with a few bryozoa. Late-glacial?

The *Urus* skeleton, according to the finders, was found on the border between the peat and the layer of warp. In the peat bricks they found birch-twigs, hazelnuts, and pine cones, a fact which showed that the lowermost part of the peat must originate from the pine period, if not even from a period before this time. In a sample of the warp N. Hartz found *Nymphaea alba* L. and *Potamogeton* sp. (*natans* L.?). In the same sample A. C. Johansen determined a number of molluscs. (A list of 17 species is given).

Two samples were taken (U.M. 1960), (A) an egg-sized lump from the brain-case, and (B) a smaller one from a nasal cacity. They were analysed by Sv. J. in 1960–61. In both samples there was a kind of fine stratification, one half of which consisting mainly of chalk-gyttja with a few shells, the other half of layers rich in shells. Four samples were taken from fresh surfaces, viz. from (A):

(a) from the shell-fraction:
The following shells were determined:
Valvata piscinalis, *Bithynia tentaculata*, *Sphaerium corneum*, *Pisidium*, *Planorbis planorbis*, and *Planorbis* sp. (det. Sv. J.) Oospores of characeous plants, one seed of *Nymphaea alba* and one seed of *Pedicularis palustris* (!) (det. B.F.) A little fine sand and some swamp peat was found.

(b) from the gyttja-fraction:
Three fruit stones of *Potamogeton* sp. and a fruit of a grass were found.

And from (B):

(c) from the shell-fraction:
The same as at (a), with oospores, fine sand, and some swamp peat.

(d) from the gyttja-fraction:
Oospores and some swamp peat.
All samples were very rich in pyrite.

The four pollen spectra are very similar. *Corylus* varies between 41 and 53 %, QM between 0.4 and 0.6 %. The samples originate from Zone V, and, as most published diagrams from Fyn, have a *Corylus*-maximum of about 80 %. Va is most likely.

16. *Knabstrup 3.*

Two samples were taken (U.M. 1962): (a) from *sulcus supraorbitalis* and (b) from the brain-case. They were analyzed by B.F. in 1963–64. The sediments were highly humified swamp peat with a great content of pyrite. Due to the destruction—about every fourth pollen was indeterminable because of this—a safe dating cannot be made, but it seems likely to be close to the zone-border V–VI. The high frequency of *Corylus* and the absence of *Tilia*, *Fraxinus*, *Viscum*, and *Hedera* points to Vb, whereas the high frequency of *Ulmus* points to the beginning of VI.

17. *Grænge B.*

A sample from the brain-case (a) has been analyzed and published by A. Andersen (1946). Another sample, (b) was taken (U.M. 1962) from a frontal cavity behind the lacrymale, and analyzed by B.F. 1962. The sediment was a slightly humified gyttja with some fine drift and a little fine sand. Seeds of, amongst others *Menyanthes* were observed. *Corylus* constitutes 35 %, QM 0.1 % and *Alnus* 0.1 %. The sample must originate from Zone Va, as is the case with the sample dated by A.A. A single grain of *Hedera* may be a hint of an early immigration into southern Denmark (cf. p. 182–183).

18. *Grænge C.*

A sample (a), has been dated and published by A. Andersen (1946). Another sample, (b), was taken from the *foramen supraorbitale* (U.M. 1962) and analyzed by B.F. 1962. The sediment was a slightly humified swamp peat with gyttja (or vice versa) and a little fine sand. *Corylus* constitutes 42 %, QM 0.5 %, *Alnus* 0.4 %. The sample seems a little younger than the one from Grænge B, but still—as sample (a)—from Zone Va.

19. *Grænge D.*

Two samples: (a) from the mandible and (b) from the pelvis, were analyzed and published by A.A. (*loc.cit.*). The sediment is unknown. The spectra are very similar, and are presumably intermediate between Grænge B and C. In (a) a pollen grain of *Hedera* was found (cf. Grænge B, Sample b).

21. *Bjeverskov.*

A sample was analyzed by A.A. in 1942. No information is available about the sediment. *Corylus* constitutes 86 %, and the sample must originate from the *Corylus* maximum in the middle of Zone V. In the table *Corylus* (710 pollen grains) is extrapolated from 500 *Corylus* pollen grains, corresponding to 82 AP excl. *Corylus*.

22. *Tranemosegaard.*

A sample taken from a cavity between the meatus acusticus and the basi occipitale (U.M. 1961) was analyzed by Sv. J. in 1961. The sediment was slightly humified swamp peat with gyttja (or vice versa). The percentage of *Corylus* is 37, and both QM and *Alnus* constitutes less than 1 %. The sample thus originates from Zone V, most likely Va.

23. *Brændholt.*

The finding-place was examined shortly after the find was made by S. Th. Andersen, B. Brorson Christensen, and Sv. J. from the National Museum. Beside a pollen series close to the skeleton two pollen samples were taken: (a) from the impression of the scapula, and (b) from between two ribs. These two samples were counted by B.F. 1964. The sediment was a fine detritus gyttja. The two spectra are almost identical, except for local plants, thus *Lemna* (0.1 resp. 1.5%). The high frequency of *Corylus* (58 resp. 63%), and the very low frequency of QM point towards the middle of Zone V, presumably the very end of Zone Va.

24. *Flintinge.*

A sample from a frontal cavity (U.M. 1962) was analyzed by B.F. in 1963. The sediment was a somewhat humified swamp peat with a few scraps of moss. The spectrum is from the very beginning of Zone Va (*Corylus* 14%, QM 0.2%, *Alnus* 0).

25. *Saxkøbing.*

A sample from a frontal cavity was taken and analyzed by H.K. in 1949. The sediment was a *Dryopteris*-Cyperaceae swamp-peat. *Corylus* constitutes 45%, QM 1.2%, and *Alnus* 0.8%, and the sample presumably originates from Zone Va. H.K. calls attention to the fact that the sun-bleached appearance of the skull indicates that it must have been exposed during a prolonged period.

26. *Hallenslev.*

The find was made in the lower-most peat layer on the border of a sand layer in a bog belonging to the farm "Sandhøjgaard" in the village of Hallenslev. Two samples were taken (U.M. 1962): (a) from the central part of a big peat-lump in the brain-case and (b) from the frontal sinus. They were analyzed by B.F. in 1963. The sediment in (a) was a finely stratified gyttja with a little fine sand and much microscopical charcoal and pyrite, and in (b) a highly humified swamp-peat with gyttja, pyrite, charcoal, and a little fine sand. As the two pollen spectra differed greatly new samples were taken, two of which were analyzed by B.F. in 1964, viz. (c) from the right foramen costotransversarium in a vertebra cervicalis, and (d) from the P^4. Both sediments were like (a). The three spectra (a), (c) and (d) are very similar. QM and *Alnus* are missing or constitute less than 0.5%, and *Corylus* varies from 33 to 40%. A pollen grain of *Hedera* was found in (a). These three samples date the animal at Zone Va. Sample (b) is obviously contaminated, as also indicated by the crushed frontal region.

27. *Lerbjerggaard, Niverød.*

A sample was taken from a frontal cavity by Valdemar Mikkelsen in 1945. It was analyzed by B.F. in 1964. The sediment was a highly humified forest peat, but the spectrum is so characteristic (*Corylus* 58%, QM 1,0%) that the middle of Zone V is the only possible dating.

27 A. *Kratholm.*

The find was made at a depth of approximately 5 m. below a marl pit on a slope towards the river Odense å. A sample consisting of travertine was analyzed by Johs. Iversen in 1935. The spectrum: *Betula* 5.6%, *Pinus* 62%, *Ulmus* 2.8%, *Corylus* 26%, Varia 3.5% indicates the latter half of Zone V.

28. *Alsønderup.*

Two samples were taken (B.F. 1964): (a) the innermost part of a sample from the distal end of the cavity in the horn core, and (b) from the central part of a big lump in the horn core

at the base. The sediment was a highly humified swamp peat with a little gyttja and a few grains of sand, and in (b) many seeds of *Menyanthes*. The samples were analyzed by B.F. in 1964. The spectra are very similar, and the samples seem to originate from Zone V. The small frequencies of *Corylus* (27 respectively 25%) indicate Va, whereas the frequencies of QM (1.0 respectively 1.7%), and not least of *Alnus* (2.2 respectively 6.4%) indicate late Zone Vb.

29. *Jonstrup Vang.*

A sample was taken from the deepest part of a peat-plug in the cavity of a complete horn core (B.F. 1964). It was analyzed by B.F. in 1964. The sediment was a highly destroyed swamp peat, and a normal pollen counting was abandoned, but a slide, rich in pollen (500–1000), was carefully examined. Neither QM nor *Alnus* pollen was observed, whereas *Corylus* was very common. This seems to point to Zone V as the most likely.

30. *Falster.*

A sample taken from a cavity in a horn core (U.M. 1962) was analyzed by B.F. in 1963. The sediment was highly humified swamp peat with a great content of pyrite. The sample was clearly contaminated with recent material—thus three pollen grains of Gramineae sp. and one of Tubuliflorae sp. were recent, and one pollen grain of *Plantago major* or *P. media* was probably recent as well. Apart from this the spectrum is characterized by the high frequency of *Pinus* (55%) (due to the destruction). A dating of the sample can only be uncertain—the transition between Zones V and VI is the most likely.

31. *Bedsmose.*

The finder took two samples from the skull. They were analyzed by A.A. in 1945–46. The one, (a) was a peat with a spectrum from Zone V (32% *Corylus*, 1.6% *Alnus*, 1.6% QM). One *Hystrix*, 1.5 *Picea* pollen grain, and possibly the two *Tilia* pollen grains indicate some contamination with secondary pollen. The other sample, (b) was a clay gyttja with an apparently uncontaminated spectrum from the beginning of Zone V (*Corylus* 4.3%, QM totally missing). The possibility exists that the skull was lying with its deepest part in a gyttja from the beginning of Zone V, and the upper part embedded in swamp peat—later contaminated—from a slightly later stage of the zone, but this cannot be confirmed.

32. *Risby.*

From a peat pillar sent to the Geological Survey of Denmark by the finder, J. Ferdinand, 3 pollen samples were taken by A.A., one, (a), from the very layer with the horn cores, another, (b) from 5 cm. above this layer, and a third from 5 cm. below the layer. The two former were analyzed by A.A. in 1944. The sediments were: (a) a *Dryopteris* peat, and (b) a Cyperaceae-peat. The spectra are very similar, and originate from the beginning of Zone Va, with a *Corylus* percentage of 7.4 and 11, respectively.

32 A. *Ryemarksgaard.* (Vide p. 212.)

33. *Bregninge.*

A sample was taken from the concha nasalis superior (H.K. 1953), and was analyzed by A.A. in 1953. The sediment was a somewhat humified gyttja. *Corylus* constitutes 60%, and of the 3.5% QM, *Ulmus* constitutes 2.5% and *Quercus* 1.0%. Two grains of *Hedera* were found. The sample must therefore originate from the very beginning of Zone VI.

34. *Lørup Hede.*

Two samples were taken (U.M. 1961) from the skull: (b) from the frontal cavity and (c) from a cavity in the horn core—this latter immediately after a fracture had occurred, the

sample thus certain to be without recent contamination. Both were analyzed by Sv. J. in 1961. The sediment in both samples was a humified chalk gyttja with fragments of shells and a great content of pyrite. A slide from sample (b) contained a total of 19.5 pollen grains and further counting was abandoned. (c) was also poor in pollen, but 6 slides gave 316.5 AP with a spectrum from the beginning of Zone VI.

A sample (a) which had been taken in 1938 was analysed by H. K. in 1945. The spectrum is from the middle of Zone V (*Corylus* 68 %).

35. *Kulemile.*

A sample taken from a cavity in the *supraoccipitale* (U. M. 1961) consisted of a big lump of gyttja, hard as a stone. From the central part of this a sample was analyzed by Sv. J. in 1961. It originates from Zone VI, and as *Corylus* constitutes 60 %, QM 7.6 %, with *Ulmus* (4.4 %) as the dominant species, and *Alnus* 1.5 %, the very beginning of the zone is most likely.

36. *Grevinge, Gundestrup.*

This find was made in a bog 600 m. east of Sylebjerg and 125 m. north-north-east of the farm Annexgården, and belonging to the farm. Of the samples taken from the skull (B. F. 1963) two were analysed by B. F. in 1963: (a) from a nasal cavity on the right side, and (b) from the right foramen infraorbitale. The sediment in both cases was a drift gyttja with swamp peat, (a) containing a fruit of a *Carex*. The pollen spectra are very similar, and to some extent characterized by the local vegetation: *Viburnum* (2.2 respectively 0.2 %), *Populus* (5.4 respectively 2.5 %), and *Tilia* as frequent as *Ulmus*, 5 to 10 times as common as *Quercus*. *Corylus* is very frequent (56 respectively 67 %), *Alnus* and *Quercus* absent or rare, and the sample must be dated at the beginning of Zone VI.

37. *Taageby.*

H. Winge (1904, p. 290) offered the information that the find was made at a depth of 8 alen (app. 16 feet) in a bog beneath big trunks of oak. A sample was taken from the interior cavity of the horn core (U. M. 1962). The sediment is a highly humified swamp peat. It was analyzed by B. F. in 1962. The sample originates from the beginning of Zone VI (QM being 3.1 %, out of which *Ulmus* constitutes 2.4 %, no *Alnus* found, and because of the extremely high frequency of *Corylus* (79 %)).

38. *Bisserup.*

A sample taken (U. M. 1962) from the *foramen mentale mandibulae* was analyzed by B. F. in 1963. The sediment was a slightly humified gyttja with a little fine sand. The spectrum seems to be very local, with 31 % *Salix*. As *Ulmus* constitutes more than half the QM and the *Corylus* percentage is very high (48 %) it is most likely that the sample originates from the beginning of Zone VI. It should be mentioned that the skull was very much sun-bleached and covered on the underside with green, dried-out algae, which indicates an extended exposure out-of-doors.

39. *Gøderupgaard.*

A plug-like sample was pulled out from the interior of the metacarpus, and from its deepest part a pollen sample was taken (B. F. 1956). It was analyzed by B. F. in 1956. The sediment was a gyttja with some swamp peat and a little sand. The spectrum is from the beginning of Zone VI, with a high frequency of *Corylus* (51 %), small amounts of QM (2.8 %), and very few *Alnus* (0.3 %).

40. *Gøjs moor.*

A sample, probably from a vertebra (U.M.) was analyzed by INGER BRANDT 1945. The sediment was a swamp peat. Few pollen grains were counted, but as QM constitutes 6.0% the sample must be assumed to originate from the very beginning of Zone VI.

41. *Kettinge.*

A sample from the brain-case, taken by O. NIELSEN, Nykøbing F., was analyzed by A.A. in 1950. The sediment seems to be a gyttja (18% *Nymphaea*). QM constitutes 7.3%, *Corylus* 46%, and the dating is the beginning of Zone VI.

42. *St. Damme.*

STEENSTRUP, who excavated a part of the almost complete skeleton in 1865, has given a very detailed description of the excavation, the position of the bones in the peat, etc. (1870, p. 106–110. With a summary in French). Large numbers of pine needles were found between the bones and in the supposed stomach, but as no other macrofossils were found, it cannot be decided whether the find originates from Zone IV or Zone V.

43. *Maglemose, Mullerup.*

This site has been pollen-analytically dated by K. JESSEN (1935, p. 5–13). According to the diagram of Maglemose finds published by Sv. J. (JØRGENSEN, 1954, p. 183) Mullerup is dated at Zone Vb.

44. *Lundby.*

K. JESSEN (1935, p. 23–31) has made a pollen-analytical investigation of this site. From his diagrams it can be seen that this dwelling place, found in the same bog as No. 45, Sværdborg, can be dated at Zone V, apparently having come into existence at the end of Zone Va and lasting into Zone VI.

45. *Sværdborg.*

This site, dated by K. JESSEN (1935, p. 16–23), seems to be slightly later than Lundby, dating at the first half and the middle of Zone VI. But it should be kept in mind that many of the great finds from Danish bogs excavated in the first decades of the 20th century are difficult to date pollen-analytically, mainly because the sites were used again and again during long periods of time.

46. *Holmegaard.*

This site has been pollen-analytical dated by K. JESSEN (1935) and by T. NILSSON (1947). Sv. JØRGENSEN has discussed the divergency between the two datings of the Holmegaard West settlement (JØRGENSEN, 1954, p. 175), finding himself a dating at the very beginning of Zone VI most probable. This is confirmed by the dating of two skulls of dog (*Canis familiaris*), found in the settlement Holmegaard IV, made in 1964 by B.F. The analyses are included in the list as No. 43a (skull marked 58 E—a sample taken (B.F. 1964) above the palatinum consisting of gyttja with a little swamp peat and drift, i.a. a seed of *Nymphaea*) and 43b (skull marked 46–48. X. E-F.—a sample taken (B.F. 1964) from the left bulla tympani, consisting of a chalk-gyttja with few shells and a little swamp peat). Both spectra clearly belong to the very beginning of Zone VI.

47. *Vinde Helsinge.*

TROELS-SMITH (unpuslished) investigated the bog in 1935 and worked out a pollen diagram. The dwelling-place was situated directly on dried-out lake marl, i.e. in a period when

the water-level was low. The diagram is from just outside the small "island" where the people settled, and the culture layer covers the transition V–VI.

48. *Øgaarde II.*

This site has been dated at the middle of Zone VI by Troels-Smith (1943, p. 148–53).

49. *Hesselbjerggaard.*

This site has been dated at the middle of Zone VI by Troels-Smith (1943, p. 161).

50. *Magleø I.*

This site has been dated by Troels-Smith (1943, p. 153–58). The settlement can be dated at the middle of Zone VI, though the upper and lower limits are a bit uncertain, cf. Jørgensen (1954, p. 183).

51. *Kongemose.*

A preliminary pollen-analysis by the excavator, Sv. Jørgensen (1956, p. 37), has shown that the site can be dated at the transition between Zones V and VI, or the very beginning of Zone VI.

52. *Ulkestrup.*

Sv. Jørgensen (1963, p. 25–26) has published a diagram from the site. Due to the occurrence of floating islands the dating cannot be more accurate than Zone VI in general.

53. *St. Taastrup.*

A sample taken in 1938 was analyzed by H.K. 1945. The sediment was a slightly sandy gyttja with a very strange spectrum. In Japetus Steenstrup's correspondence in the Royal Library a letter tells us that many years earlier a skull of a *Urus* was found in the same bog, but that it was thrown into the bog again. It seems very likely that it is the same skull which was found in 1880, and this may be the explanation of the very mixed pollen spectrum dominated by *Betula* and *Pinus*. The occurrence of a few pollen grains of *Corylus* and *Alnus*, and a single one of *Ulmus* may be contamination, and if this is the case, the dating may be Zone IV, this supposition being reinforced by the plentiful occurrence of *Empetrum*. Theoretically Zone II is a possibility, too. In any case, the animal seems to be older than Zone VI.

54. *Bønnelykkegaard.*

A sample, (a) was taken from cranial cavities (H.K. 1948) and analyzed by H.K. in 1948. The sediment was peat, and the sample originates from Zone VII. Another sample, (b) was taken (U.M. 1961) between the orbita and M^3, and was analyzed by Sv. J. in 1961. This sediment was a slightly humified swamp peat with some gyttja. A seed of *Menyanthes* was found. The spectrum is very similar to that of sample (a).

As this seemed to be only Atlantic find of the *Urus* made in a bog, two further samples were taken to be analyzed after the completion of the tables (B.F. 1965): (c) from the humerus dextra below the proximal trochanter minor, and (d) from the lacrymale dextra. The sediments were coarse detritus gyttja with some slightly humified swamp peat. The spectra are from Zone VII, as were (a) and (b). The following pollen grains were found: *Hedera* (3–6), *Alnus* (348–471), *Betula* (99–86), *Humulus* (2–0), Chenopodiaceae (1–0), *Artemisia* (0–2), Tubuliflorae (1–1), *Corylus* (196–139), Cruciferae (0–1), Cyperaceae (48–53), *Quercus* (147–183), Gramineae (24–14), *Secale* (1–0), Lemnaceae (1–1), *Viscum* (1–1), *Menyanthes* (1–4), *Nuphar* (1–0), *Nymphaea* (4–2), *Fraxinus* (2–3), *Abies* (1–0), *Pinus* ($94^1/_2$–100), *Eupotamogeton* (3–5),

Ranunculus repens type (0–1), *Galium* (0–1), *Populus* (1–9), *Salix* (2–4), *Sparganium* type (7–9), *Tilia* (91–61), *Typha latifolia* (1–0), *Ulmus* (74–79), Umbelliferae (3–1), *Urtica* (3–0), a.i.d. (4–1), a.i.p. (0–1), *E* (1164½–1239), *Dryopteris* type (111–113), *Pteridum* (1–1), *Botryococcus* (4–1), *Pediastrum* (11–9), *Ceratophyllum* hair (3–5), charcoal (4–5), "*Paraplya*" (4–1), recent *Corylus* (1–0), D.b. (14–17).

55. *Ørting.*

A big sample was taken from the brain-case (U.M. 1960), and later a sample (a) taken from the centre of this lump was analyzed by Sv. J. 1960–61. Another sample from a nerve foramen in the orbit was analyzed by B.F. in 1964. The sediments were very similar, namely a somewhat humified alder-swamp peat with a few grains of sand. The spectra are also very similar, with a few pollen grains of *Plantago lanceolata* and of other plants favoured by human activity. There is no doubt that the samples originate from Zone VIII, and the *Ulmus* decline in the very beginning of the zone is most likely, as the sum of pollen of *Tilia* and *Ulmus* is almost the same as the number of *Quercus* pollen. The different land occupation phases (the "A-landnam", the "B-landnam" and the "passage grave landnam") are mentioned in connection with the cattle on p. 205 ff., and a survey is also given in S. HANSEN (1965).

56. *Østbirk.*

From the centre of a big sample from the brain-case (U.M. 1960) a pollen sample was taken out and analysed by Sv. J. in 1960. The sediment was a slightly humified gyttja with swamp peat (or vice versa) with a little sand. The find of a pollen grain of *Plantago lanceolata*, together with the scanty amount of *Tilia*, and not least of *Ulmus* in relation to *Quercus* (2.4, 1.1, and 19% respectively) date the sample at Zone VIII.

57. *Pindstrup.*

4 samples were taken (H.K. 1951): (a) from the nasal cavity, (b) from the *bulla tympani*, (c) from a cavity in the maxilla just behind M_3, and (d) from a big protected lump in the distal inter-condylar notch of a femur. The sediments were alder-swamp peat with some gyttja. The spectra are very similar, originating from Zone VIII. The very sparse *Ulmus* (max. 0.5%) shows that the very beginning of the zone is out of the question; on the other hand there is the fact that neither *Fagus* nor *Carpinus* were found (the total sum of AP is 1574).

58. *Ugilt.*

A big sample was taken from a skull cavity under the orbita (U.M. 1962). From the centre of this a small sample was analyzed by B.F. in 1963. The sediment was a highly humified swamp peat, originating from Zone VIII, indicated amongst other things by one pollen grain of *Viscum*, one of *Hedera*, two of *Plantago lanceolata*, and none of *Fagus*. Of special interest is 18% *Rumex acetosella* and/or *R. acetosa*, and this, together with 14% Gramineae, indicate extended forest-less areas, but without a diagram from the very basin, a closer dating cannot be given, as it can be related to any local forest clearance.

59. *Klarup.*

A sample, (a), was taken from a cavity between the radius sinistra and the ulna, and another, (b) between the lower epiphyses of the metatarsus sinistra (U.M. 1963). These were analyzed by B.F. in 1963. The sediments were rather humified swamp peat. The spectra are very similar, and characteristic of Zone VIII. As in the sample from Ugilt, *Rumex acetosella/acetosa* was very common (9.4 and 4.6%, respectively). *Tilia* and *Ulmus* constitute approximately half of the QM, and may thus possibly indicate the beginning of the zone.

60. *Auning, Lykkegaards moor.*

Valdemar Mikkelsen analyzed three samples in the 1940es, dating the animal at Zone VIII. The three spectra are very similar, and they have been averaged in Table A as No. 60a. A sample, (b), from a calcaneus was analyzed by B.F. in 1964. The spectrum confirms the dating. Another sample from the centre of a big peat-lump from the brain-case gave the same result; this sample was prepared, but not counted.

61. *Toftum.*

A sample was taken (a) from a cavity near the *meatus acusticus* and (b) from a nasal cavity (T-S 1960). Both were analyzed by Sv. J. in 1960. The sediments were highly humified alder-swamp peat (10–20 % of all the pollen counted could not be determined because of destruction), and as a consequence but few pollen were counted. In spite of this pollen grains from culture-plants and culture-favoured plants were met with (*Plantago lanceolata*, Liguliflorae, *Polygonum* cf. *aviculare*), and the AP-spectum also indicates Zone VIII.

62. *Aarhus.*

A sample was taken in a cavity near the *meatus acusticus* (T-S 1960). It was analyzed by B.F. in 1960. The sediment was a slightly sandy-clayey, rather humified swamp peat with gyttja. The occurrence of 27 pollen grains of *Ruppia* (of a total of 380.5) showed that it must be a marine sediment. The spectrum is from Zone VIII. (*Tilia*, and especially *Ulmus* rare, a single pollen of *Plantago lanceolata*). From Brabrand sø (lake), a few km. west of Aarhus, a pollen diagram covering Zones VII–VIII has been published by Troels-Smith (1937). Lake Brabrand was an inlet during a long period until the end of the Subboreal transgression. It is not possible to fit the spectrum from the *Urus* into the diagram, but at the end of the transgression *Quercus* and *Fraxinus* reach high percentages, as is the case with the present spectrum. The sediment as well would indicate the time just before the regression.

63. *Korinth.*

From the centre of the very big lump of stone-hard mud in the brain-case a sample was taken to be analyzed by B.F. (1964). The sediment was a very highly humified alder-swamp peat. The spectrum is from Zone VIII, and the relatively high frequencies of *Tilia* and *Ulmus* (4.1, respectively 2.7 %) might indicate the beginning of the zone.

64. *Bønnerup.*

H.K. has analyzed samples from the smaller animal: (a) from the metacarpus, (b) from the metatarsus, (c) from a nerve foramen in the metatarsus, and one sample from the larger animal: (d) from the metacarpus. The spectra are very similar, originating from Zone VIII.

65. *Holme moor.*

A sample was taken from a frontal sinus (U.M. 1962). It was analyzed by B.F. in 1963. The sediment was a highly humified swamp peat originating from Zone VIII—indicated by three pollen of *Plantago lanceolata*, etc. Several features point to the regeneration phase after a forest clearance in the beginning of the zone (the "B-landnam"): *Tilia* 5.1 %, *Ulmus* 1.1 %, *Betula* 21 %, and *Corylus* 43 %, and relatively few herb-pollen grains, apart from Cyperaceae.

66. *Hornslet.*

A sample was taken from the centre of a big lump of gyttja found in the brain-case (B.F. 1964). It was analyzed by B.F. in 1964. The sediment was but slightly humified coarse detritus-gyttja with a touch of clay. Two seeds of *Betula*, small fragments of *Nymphaea* seeds,

besides two oospores of a characeous plant were found. The AP-spectrum shows that the sample originates from Zone VIII, as indicated also by *Plantago lanceolata*. The find of one pollen of the marine *Ruppia*, one "*Hystrix*", besides a Tertiary (?) spore ("Pentagon"), often met with in Danish marine sediments, are in sharp contrast to the freshwater sediment (pollen and seeds of *Nymphaea*). No explanation can be given, as nothing is known about the finding-place.

67. *Hørning.*

A sample was taken from a sinus in the occipital crest (U.M. 1961). It was analyzed by Sv.J. in 1961. The sediment was a highly humified swamp peat. The sample originates from Zone VIII, as indicated by 3 pollen grains of *Plantago lanceolata*, etc. The high percentage of *Tilia* (7.0%) in contrast to the low one of *Ulmus* (1.8%) and the high *Betula* percentage (19%), and six pollen grains of *Hedera* (0.5%), tend to date the sample to the stage just after the *Ulmus* decline and before the *Tilia* decline and the *Corylus* incline.

68. *Ølgod.*

A sample was analyzed by A.A. in 1942. According to the spectrum the sediment was an *Alnus*-fen peat. A.A. notes that it was somewhat humified and that treatment with hydrofluoric acid was necessary, indicating the presence of either sand or clay. The AP-spectrum might be either Zone VII or Zone VIII, but two pollen grains of *Plantago lanceolata* were found, indicating VIII. As nothing is known about the taking of the sample, the dating of the animal on the basis of this analysis is rather uncertain.

69. *Tranekær, Staus Hede.*

Two samples were taken (U.M.), (a) from the nasal cavity and (b) from the *meatus acusticus*. They were analyzed by H.K. in 1945. (a) is a slightly sandy peat, too poor in pollen to justify a counting. (b) according to H.K. was a light sandy gyttja, but the very high percentages of *Alnus* and Cyperaceae (66 and 18, respectively) and enormous quantities of spores of ferns seem to indicate a high content of *Alnus*-swamp peat. The sample originates from Zones VII–VIII. Too few pollen grains have been counted to make a safe dating; the lack of pollen of cultivated plants, and the fact that *Tilia* and *Ulmus* are rare in diagrams from the heath plains of West Jutland point to Zone VII, whereas the high frequency of *Fraxinus* points to Zone VIII.

70. *Skovlund.*

The atlas was found during ploughing in a small cultivated bog 200 m. south of the farm Skovlund, one km. northeast of the village of Dybvad. Two samples from nerve formina were taken a few months after the finding (Sv.J. 1962), and analyzed in 1963 by Sv.J. The samples were very similar according to sediment as well as spectrum, and will be regarded as one in the following. The sediment was a somewhat humified swamp peat with some gyttja and a little sand. Finding of pollen of *Cerealea*, *Plantago lanceolata*, *P. major*, a *Polygonum aviculare* type, and high frequencies of a *Rumex acetosella* type and, in contrast to these, only two pollen of *Fagus* and one of *Carpinus* (out of a total of 2238 AP) date the samples at Zone VIII. *Ulmus* is still rather frequent and a little more so than *Tilia* and *Populus* is frequent; this and others features seem to narrow the dating down to the "A-landnam", or to the beginning of the "B-landnam". The latter is most likely.

71. *Kjærsholm.*

Three samples were taken by T-S in 1960: (a) in the cavity behind the right M_3, (b) behind the left condyle of the mandible, and (c) in the nerve foramen in the right orbit. All

samples were analyzed by B.F. in 1965. (a) was a highly humified alder-swamp peat with a few grains of sand, (b) was like (a), but in addition had a piece of *Menyanthes* seed and small pieces of twigs; (c) was a less humified swamp peat with a touch of gyttja beside some few grain of sand.

The pollen spectra are somewhat different, mainly because of being to a great extent characterized by local vegetation, demonstrated by 25% of *Urtica* and 57% of *Alnus* etc., in (a). This local over-representation may be the cause of the very high frequencies of *Betula* and *Pinus* (20, respectively 41%) in (c), or it may have been caused by contamination with Boreal material. It should be mentioned that the find was made in the course of regulation of the river Tange Aa, and the possibility of a rebedding of the skull cannot be excluded. (a) and (b) are very similar as far as the AP-spectrum and also the NAP-spectrum are concerned, which dates the samples at Zone VIII (*Plantago lanceolata* 1.0, respectively 1.5%, *Rumex acetosella* type 2.6, respectively 3.5%, *Fagus* 0.2, respectively 0%, and no *Carpinus*). In (c) *Plantago lanceolata* was not found, but one *P. major*.

71 A. *Læsten.* (Vide p. 212).

71 B. *Grejs Mølle.* (Vide p. 212).

71 C. *Fæsted.* (Vide p. 213).

71 D. *Tinglev.* (Vide p. 213).

72. *Rise.*

Two samples from the skull, (a) and (b), were analyzed by A.A. in 1942–43. The frequencies of *Fagus* (10, respectively 2.1%) together with other indices point to Zone IX. But it should be kept in mind (1) that the find was made in the bank of a brook running through a meadow or bog, (2) that the samples were sandy, and (3) that the skull was water-worn, and that the dating—the only dating of a Danish *Urus* at Zone IX—therefore is slightly uncertain.

73. *Jelling.*

Two samples were taken (B.F. 1964): (a) from a nerve canal in a vertebra and (b) from the interior of the distal end of the horn core. They were analyzed by B.F. in 1964. The sediment was a chalk-gyttja with swamp peat, in (a) with chalk-gyttja as the dominating fraction (*Potamogeton* 11% and Polypodiaceae 21%) and in (b) with the swamp peat dominating (1.7, respectively 667%). The pollen was highly destructed in both samples (D.b. 86, respectively 90%). The AP-spectra are very similar, and both are characterized by over-representation of *Pinus*, *Tilia* and other easily recognizable pollen. A dating of the samples can only be very uncertain, but no culture pollen was found, although a very dense slide was examined (but not counted) to look for *Plantago*, etc. *Ulmus* constitutes a great part of the QM, partly due to over-representation, and *Fraxinus* was not found. The *Rumex acetosella* type on the other hand, is, in general very scarce in Zone VII. The samples must be dated at Zone VII, or the very beginning of Zone VIII.

74. *Skaarup, Skanderborg.*

The finder brought a sample, still with the impressions of the teeth, which was analyzed by A.A. in 1941. Too few pollen grains were counted for a safe dating, but the sample originates from Zone VII or Zone VIII.

75. *Mariager.*

A sample from the interior of the horn core was taken (U.M. 1949) and was analyzed by H.K. in 1949. The sediment was a chalky clay gyttja with fragments of shells and a great content of fine sand. The spectrum is Atlantic, but as it contains many secondary pollen grains (*Pinus haploxylon* type, *Sequoia*, etc.) besides *Hystrix*, the dating at Zone VII is somewhat uncertain, even though no culture pollen was found. The risk of the horn core being re-bedded may be added.

76. *Mjesing.*

A sample was analyzed by A.A. 1940. The sediment seems to be a *Dryopteris* swamp peat. The spectrum is somewhat strange (23 % *Tilia*, 53 % *Ulmus*) and is most likely to be Atlantic — but only 131 AP were counted. The dating at Zone VII is also uncertain, as nothing is known about the taking-out of the sample.

77. *Asaa.*

A sample from grooves on the outer surface of the horn core was analyzed by H.K. in 1946. As the find was made during dredging of a brooklet, and the spectrum was clearly mixed, the result is too uncertain and will not be given in the table.

78. *Understed.*

The find of the horn core was made during dredging of a brooklet. The finding-place was visited on Sept. 29th, 1960 by T-S and U.M., who further found some teeth and other parts of the skull. From the sediment, in which the impression of one of these was made, a sample was taken (B.F.). A profile was dug near the finding-place, showing:

0–108 cm.: heterogeneous, loamy fine sand with more peaty or sandy parts.
108–? cm.: sandy moraine clay.

The parts of the skull were found at a depth of 80–90 cm. The sediment of the pollen sample was sand with coarse drift. The spectrum was from Zone VIII (1.1 % of *Ulmus*, 1 pollen grain of *Plantago lanceolata*). But as parts of the skull are likely to be re-bedded, the dating is, to put it mildly, very uncertain.

79. *Julianelyst.*

A sample taken in a frontal sinus (U.M. 1961) was analyzed by Sv.J. 1961. The sediment was a rather humified, sandy swamp peat, possibly originating from the beginning of Zone VI, but possibly being a mixture of a sediment from Zones IV–V (37 % *Pinus*, relatively high frequencies of *Populus*, *Salix*, *Filipendula*, *Thelypteris dryopteris*) and a sediment from VII or VIII (2 uncertain *Cerealea* pollen grains, but no *Plantago*).

90. *Brabrand.* (Vide p. 214).

94. *Norslund.* (Vide p. 214).

Summary of the Datings of the Urus

In the diagram, fig. 2, a survey is given of the results of the pollen-analytical datings. It should, however, again be pointed out that the reliability of the datings will be very fluctuating. No attempt has been made at classifying the samples according to reliability, for example by means of different signatures in the diagram. The reader

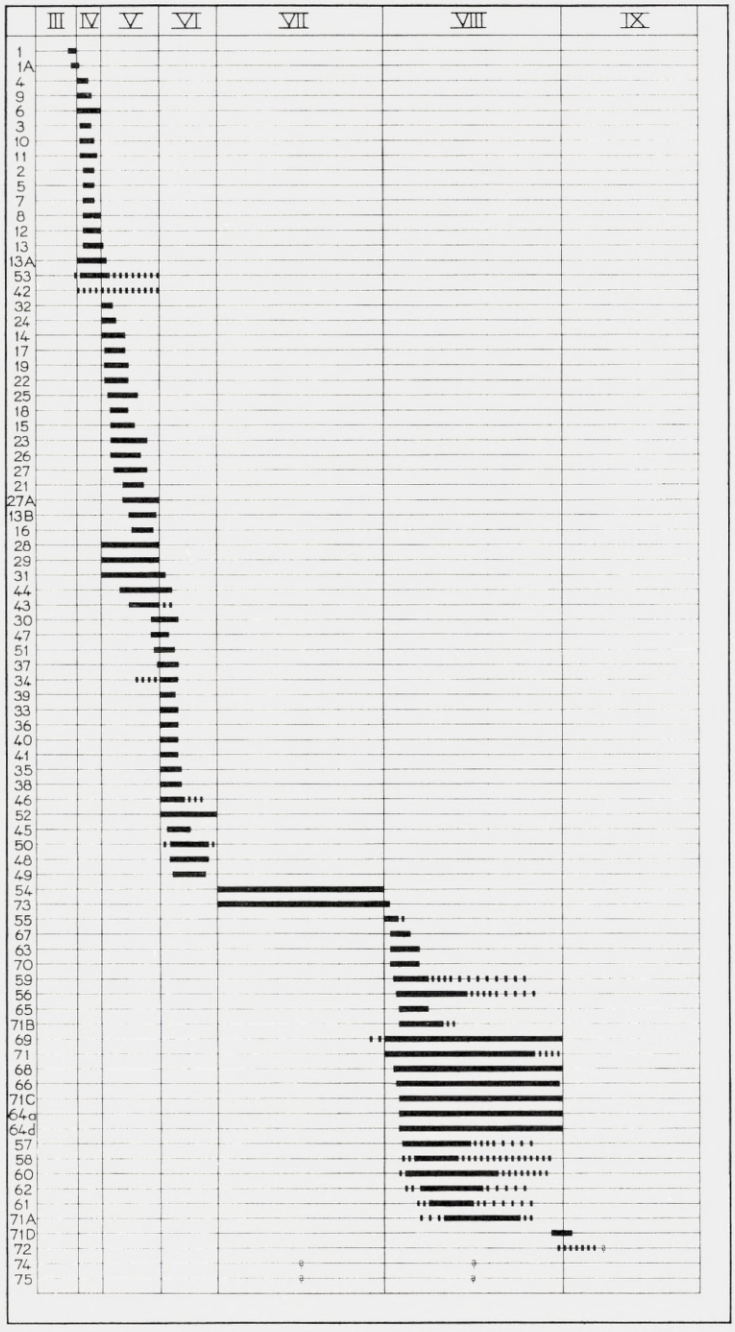


Fig. 2. Pollen-analytical dated finds of *Urus* (*Bos primigenius*) in Denmark. The finds No. 32A (Pollen Zones V–VI) and No. 90 (Zone VII) have not been included.

therefore, is referred to the text dealing with the individual samples to learn under what circumstances the sample was taken. The datings should be within the space of time marked with a continuous line; only if there is some uncertainty concerning the limits, a dotted line is used, frequently, though, with an unbroken line to suggest the most likely period.

One animal has been dated at Zone III, one at the transition III–IV, 12–16 at Zone IV (12 are from the zone proper, while 4 may be from another zone), 17–29 date from Zone V, 15–22 from Zone VI, 2–3 from Zone VII, 21–23 from Zone VIII, and one or two from Zone IX. In other words: From Zones IV–VI, covering a period of about 2.5 millenia 54 finds are known, from Zone VII, covering another 2.5 millenia only 2 or 3 are known. From the following 2.5 millenia, Zone VIII, we have 21 finds, while from the last 2 millenia and up to the present time only two uncertain finds are known. To this it may be added that some of the *Uruses* found in "kitchen-middens" from the so-called "Ertebølle culture" may originate from Zone VII, e.g. Brabrand (cf. p. 214), but as the problems concerning the dating of the Ertebølle culture have not yet been solved—besides the fact that they are usually mixed up with material covering several millenia—they have not been included in this summary.

The *Urus* seems to have invaded Denmark at the end of the Late-glacial Period, but the possibility of a temporary immigration as early as the Allerød Period does exist. During the Preboreal and the Boreal it was very common all over the country as it was in southern Sweden, especially in Scania (cf. Isberg, 1962). From the transition to the Atlantic period and during the following 2.5 millenia up to the forest clearances at the beginning of the Subboreal it must have been very rare as were also other big mammals, including man. This fact is usually interpreted as being a consequence of the dense growth of the climax-forest.

20 of the 21 finds from the Subboreal are from Jutland, one from Funen and none from Zealand, nor from the other isles east of the Great Belt, which were formed during the period from late Zone V to early Zone VII (Krog 1960, p. 127). This seems to indicate that the *Urus* died out in the eastern part of Denmark during the Atlantic, and if this holds good, the cattle on Zealand cannot be locally domesticated *Urus* oxen.

The diagram, fig. 2, very much resembles the corresponding one from Sweden (Isberg 1962, fig. 13), where only one find dates from the Atlantic as against 68 from the Preboreal and the Boreal, and 19 finds scattered through the Subboreal and Subatlantic. In Denmark the *Urus* seems to have died out at the end of the Subboreal (the two uncertain Subatlantic finds are very close to the German frontier and may be accidental guests). For a discussion of the possible late extinction of the *Urus* in Sweden (1100–1200 A.D.) see Degerbøl (1945 p. 31–32) and Isberg (1962 p. 514).

Bos taurus domesticus

I. *Ogaarde I.*

The find of a skull was made during peat cutting close to an Ertebølle settlement with thin-walled ceramics, and the same day the place was investigated by T-S and B. Brorson Christensen. A section could not be obtained, but 36 bones were found in addition to the skull, all of them rebedded. A number of pollen samples were taken from the skull and from the inside or outside of various bones in order to discover possible discrepancies between pollen-analytical datings of various samples from the same animal. 14 samples were analyzed by Sv. J. in 1955–56.

The result will be published later by Sv. J., but it can briefly be stated that the variations in the spectra are very slight. Several published and unpublished pollen diagrams from within a distance of a few hundred metres of this settlement, and covering the same period, are available at the National Museum, and the 14 samples analyzed originate from the period of the *Ulmus* decline at the very beginning of Zone VIII. The well-known settlement Mul I, situated approximately 1 km. from Øgaarde in the same basin, Aamosen, originated from the same period. Mul I is the "type locality" of the "semi-farmer culture", responsible for the "A-landnam" (cf. Troels-Smith 1954 and 1960). In the pollen diagrams this period is characterized, amongst other things, by few, but on the other hand constantly occurring pollen grains of *Allium ursinum* and *Plantago major*, and a but slight increase in grasses, possibly indicating that the cattle was stable-fed, in contrast to the later "B-landnam", as described by Iversen (1941), when herds of cattle were untethered and left to graze on extensive pastures of grass, *Plantago lanceolata*, *Trifolium repens*, etc., but with no *Allium ursinum*, and rarely *Plantago major*.

In the Mul I excavation as well, bones of domesticated cattle were found. The site, dated by radiocarbon (Tauber 1960) was used only during a short period about 2.800 B.C., and pollen-analytically it is placed in the very *Ulmus*-decline.

II. *Store Lyng.*

The third animal from the period of the "A-landnam" is from Store Lyng, a couple of hundred metres from Øgaarde. Less than a month after the find the place was investigated by T-S, who took a series of samples. In the profile he found a phalanx in situ and took a sample, (c). In 1960 and 1962 he obtained some further samples from the Zoological Museum, two of which: (a) from the nasal cavity and (b) from the brain-case, were analyzed by B. F. in 1962–64, together with (c). The sediments were gyttja with a little drift, some swamp peat, and a few grains of sand, besides, in (a) and (c) some snail shells. In (c) was found a seed of *Nuphar luteum*, and in (b) a seed of *Urtica*.

III. *Verupgaard.*

This find as well is from Aamosen. A sample, (a), from the brain-case was analyzed by H. K. in 1949, and later, in 1964, B. F. analyzed another sample, (b), which is assumed to have come from the same glass tube as (a). The sediment in (b) was a drift gyttja with a little swamp peat. Three fragments of fruits of *Najas marina* (fairly common in Danish Post-glacial freshwater sediments), three oospores of characeous plants, one seed of *Lythrum salicaria*, and two *Carex* nuts were found. Apart from minor deviations in the frequencies of *Fraxinus* and Gramineae the spectra are very similar. The percentages of *Tilia* (3.9, respectively 3.2 %) and especially of *Ulmus* (4.5, respectively 4.6 %) are relatively high, indicating the beginning of Zone VIII, but with 2.1 % *Fraxinus* and 0.9 % *Plantago lanceolata* in (b), a dating slightly later than the "A-landnam" is most likely.

IV. *Øgaarde II.*

The skull was presumably found by peat workers who had placed it on the surface near the peat pitch, where it was discovered by T-S. Three samples were also taken by B. Brorson Christensen shortly afterwards, in 1943, (a) from the brain-case, (b) from the nasal cavity, and (c) from the right glenoid fossa. They were analyzed by Sv. J. in 1955. The sediment was the same in all samples: a fine detritus gyttja with a little swamp peat. The spectra are also very similar, and with sparse *Tilia* (1.1–1.5%) and *Ulmus* (0.9–1.0%), more frequent *Fraxinus* (1.3–2.2%), plenty of *Corylus* (38–40%) and a relatively high frequency of *Plantago lanceolata* (0.7–0.9%) a dating at the "B-landnam" in the middle of the 3rd millenium B.C. is most likely.

V. *Øgaarde III.*

The skull was found together with the preceding find. B. Brorson Christensen took the following samples in 1943: (a) from the brain-case, (b) from the left meatus acusticus, and (c) from the interior cavity of the left horn core. They were analyzed by Sv. J. in 1955. The sediment was the same in the three samples: a fine detritus gyttja with a little swamp peat, and the pollen spectra are almost identical with the three from Øgaarde II as well.

VI, VII, VIII. *Troldebjerg, Gammellung moor.*

Four skulls of bulls were found during the excavation, and pollen-analytical dating of three of them was published by Iversen (1941, p. 58). In Table A the three analyses are included as VIa, VIb, and VIc, as it is not known which sample belongs to what skull. The pollen spectra are very similar, characterized by high frequencies of *Corylus* and *Alnus*, and very low frequencies of *Tilia* and *Ulmus*. In the diagram from the same bog, published by Jessen (1938, p. 127), no corresponding pollen spectrum can be found, and Iversen (*loc. cit.*) takes these three samples as a proof that "at Troldebjerg, too, there is a pronounced occupational phase"—in the present paper called the "B-landnam".

IX. *Nyrup I.*

The skull was found together with a collared flask of Early Neolithic age and five hand-sized stones, indicating an offering. At a distance of approximately 1 m. bones (the skull and sacrum, etc.) of another ox, and further away, but still at the same depth below the surface, two further skulls were found (Becker 1947, p. 40).

Two samples were taken (B. F. 1964): (a) from cavities in the left occipital region and (b) from a nerve foramen in a vertebra. They were examined by B. F. in 1964. (a) was a drift gyttja with swamp peat and a little sand; one seed of *Nymphaea alba*, one fruit of *Carex* sp., one seed of *Fragaria* sp., and one oospore were found. (b) was a highly humified alder-swamp peat, mainly consisting of alder roots.

The pollen spectrum in (a) is characteristic of the "B-landnam", in accordance with the archaeological dating. (b) was very poor in pollen and was not counted.

X. *Nyrup II.*

Another of the skulls from Nyrup (vide above) has been dated. Three samples were taken: (a) from sinus occipitalis dextra, (b) between the nasals (B. F. 1964), and (c) from a nasal cavity (T-S 1962). They were analysed by B. F. in 1964. The sediments in (a) and (b) were fine detritus gyttja with a little drift, in (a) thus one fruit of *Betula* sp. and six oospores and in (b) small fragments of stems of water mosses. (c) was a drift gyttja with swamp peat containing one fruit of *Betula* sp. and one badly preserved fruit of a Cyperaceae, presumably a *Carex*. The pollen spectra are very similar to IX.

X A. *Nyrup III.*

Only lately, during the writing of the present paper, another skull from Nyrup bog has been pollen-analytically dated. The sample was taken from a cavity in a horn core (U.M. 1965) and analyzed by B.F. in 1965. The sediment was a fine detritus gyttja with a few grains of sand. The spectrum is very similar to the four spectra from IX and X.

As the analyses were made after the closing of Table B, but before the closing of Table A, the figures of the species not mentioned in Table A will be given: *Centaurea cyanus* 1, Chenopodiaceae 1, Cruciferae 1, *Hypericum* 2, Lemnaceae 18, *Mentha* type 1, *Menyanthes* 1, *Plantago major* 1, *P. major/P. media* 1, *Sparganium* type 1, *Thalictrum* 1, *Typha latifolia* 23, Tubuliflorae 3, Umbelliferae 3, a.i.d. 2, a.i.p. 2. Summa spermatophyta 1017. *Dryopteris* type 312, *Pteridium* 4, *Botryococcus* 1, *Pediastrum* 34, *Ceratophyllum* hair c, charcoal c, "*Paraplya*" 3, fragment of Characea oospore 1.

A remarkable find is that of *Centaurea cyanus*, which has not otherwise been recorded between the Late Glacial and the 14th century A.D., when it becomes common with the introduction of cultivation of winter crops. Contamination cannot, of course, be excluded, and this find is not very suitable for demonstrating an Early Neolithic occurrence, though a rare occurrence of this weed cannot be ruled out.

XI. *Snoldelev I.*

The sample was taken in 1938. It was analyzed by H.K. in 1946. The sediment was a sandy gyttja. The spectrum is very similar to the five spectra from Nyrup, thus indicating a dating at the "B-landnam".

XII. *Vedbæk I* (1942).

Two samples were taken (B.F. 1964): (a) from cavities in the occipital region and (b) from the centre of a big lump of sediment between the nasals. Both were analyzed by B.F. in 1964. (a) was a marine, clayey-sandy peat with a little swamp peat and many pieces of wood besides three fruits of *Alnus*. (b) was a marine, slightly sandy, clayey gyttja with fragments of mollusc shells, of *Mytilus edulis* and others.

The spectra are almost identical, with *Alnus* the dominating species (62, respectively 60 %). Of special interest is the find of one pollen grain of *Allium ursinum* in (b). As mentioned above, this species occurs in freshwater diagrams in the period of the "A-landnam", but disappears during the "B-landnam", presumably having been eaten by the grazing cattle (Troels-Smith 1954, p. 55). The analysis of a diagram from the former inlet at Dyrholmen (B.F. unpublished; part of the diagram published in Troels-Smith 1960) gave eight pollen grain of *Allium ursinum* throughout the "A-landnam" and during the "B-landnam".

Concerning the dating of the samples the frequencies of *Plantago lanceolata* and the occurrence of pollen of the *Trifolium pratense* type, the *T. repens* type, and the *Polygonum aviculare* type, together with the sparse *Tilia* and *Ulmus* and the relatively high frequencies of *Fraxinus* indicate that the oldest possible dating is the "B-landnam". A total of five *Carpinus*, some of which may have been rebedded, together with *Engelhardtia* and others, but no *Fagus* (AP total: 2780.5) point to the middle of Zone VIII. During the Subboreal transgression the valley was an inlet, but the exact time of the regression is not known.

XIII. *Maglemosegaard, Vedbæk II.*

Another skull from the same inlet as in XII has been dated. Two samples were taken (B.F. 1964): (a) from the middle of a big lump from the interior cavity of the right horn core, and (b) from a frontal cavity. They were analyzed by B.F. in 1964. The lump from which (a) was taken was heterogeneous, mainly consisting of gyttja, hard as stone, but in places with many fragments of molluscs. During the preparation of the pollen sample the sediment proved

to be marine, sandy clay-gyttja with small pieces of wood, a little swamp peat, five fruits of *Ruppia maritima*, one fruit of *Najas marina*, one fruit of *Betula* sp., besides some oospores. (b) was a marine, sandy-clayey peat with some gyttja. Two fruits of *Alnus* and one fruit of a Chenopodiaceae sp. were found. Nine pollen grains of Lemnaceae sp. indicate outflow of fresh water. In both samples pollen of *Eupotamogeton* was found.

The sediments must originate from shallow, brackish- or salt water. *Ruppia maritima* can be met with in brackish water with a NaCl-concentration of less than 0.3‰. (Mathiesen and Nielsen 1956, p. 19). High frequencies of *Alnus* and Cyperaceae may indicate that the sedimentation took place immediately before the regression.

Like the preceding find (XII) the earliest possible dating is the "B-landnam", but XIII seems to be later, presumably from just below the zone border VIII–IX, as six pollen grains of *Carpinus* and nineteen of *Fagus* (AP total: 3.122.5) were found. In the case of both animals the possibility of some rebedding of material in the shallow water near the beach should be kept in mind.

XIII A. *Vedbæk* ((vide p. 214).

XIV. *Ordrup moor.*

The dating of the bone as well as a diagram from the bog proper have been published by Iversen (1941 p. 61). The sample originates from the beginning of Zone VIII, just above the layer with the many pieces of charcoal (the result of the burning of part of the forest during the "B-landnam").

XV–XVI. *Holmene, Hillerød.*

A sample from one of the animals was analyzed by A.A. in 1942. The spectrum is characterized by *Corylus* (36‰) and *Alnus* (52‰). 1.3‰ *Plantago lanceolata* suggests the "B-landnam" to be the oldest possible dating.

XVII. *Borremose.*

The find was made during peat cutting "at the bottom of the peat layer". A sample from the os sacrum (H.K. 1949) was analyzed by the same worker in 1949. The sediment was an alder-swamp peat with a little gyttja, owing to the fact that the bottom of a peat ditch usually borders on an underlying gyttja. Neither *Fagus* nor *Carpinus* was found; the frequency of *Plantago lanceolata*, on the other hand, indicates that the sample cannot be older than the "B-landnam".

XVIII. *Sandhuse moor I.*

A sample from a cavity in the left occipital area was taken and analyzed by B.F. in 1964. The sediment was a humified alder-swamp peat with coarse and fine drift gyttja (thus one seed of *Nymphaea alba* and one of *Scirpus* sp.), a little fine-sand and pyrite.

The frequency of *Fraxinus* in relation to *Tilia* and *Ulmus* and the relatively few *Corylus* pollen grains (16‰) point to a time after the "B-landnam". Neither *Fagus* nor *Carpinus* was found (AP total: 1331.5).

XIX. *Sandhuse moor II.*

Two samples were taken during the excavation of some sites in the bog by Harald Andersen in 1945–46: (a) from a frontal cavity and (b) from the foramen magnum. They were analyzed by B.F. in 1964. (a) as well as (b) was a highly humified, slightly sandy, coarse detritus gyttja with fine and coarse drift. In (b) small fragments of seeds of *Nuphar luteum*, *Nymphaea alba*, and *Najas marina* were found.

Both skulls from Sandhuse Mose had a crushed frontal area and must have been laid out in the lake at that time as offerings. If the pollen samples really date the skulls, they are not of the same age, the second being considerably later, indicated amongst other things by the *Fagus* pollen grains and one *Carpinus* (AP total: 1448), and a much higher frequency of NAP. The large number of archaeological finds in the bog cover a long period and thus cannot give any hint as to the dating.

XX. *Vejlby.*

Two big gyttja cubes with marrow-split ox bones in situ were brought to the Zoological Museum by Sv. Th. Andersen. B. F. took five samples a few days later, in 1964. Three of the samples were analyzed by B. F. in 1964: (a) from the deepest part of a plug at the proximal end of the marrow cavity of the humerus dextra, (b) from the impression of the proximal end of a radius, and (c) from the impression of the os sacrum. The sediment in the samples was a slightly sandy clay-gyttja with a little swamp peat. High frequencies of *Ruppia* testified to the marine origin of the sediment, and so did the amount of rebedded Tertiary or early Quaternary pollen from *Engelhardtia*, Juglandaceae, *Platycaria*, *Sciadopitys*, etc. The single pollen grain of *Ilex* in (c) may well have been rebedded (cp. Troels-Smith 1960 p. 20: a total of eight *Ilex* pollen grains found in the Atlantic period in Danish diagrams, and eleven in the Subboreal), as may the two *Helianthemum* pollen grains in (c).

XXI. *Ærø.*

A sample, taken in 1938, was analyzed by H. K. in 1945. The sediment was a sandy, slightly clayey gyttja. The spectrum is characterized by high frequencies of Chenopodiaceae (10 %), but apart from the absence of *Fagus* and *Carpinus* (AP total: 239) it gives no hint as to the time from which in Zone VIII the sample originates.

XXII. *Logtved Enge.*

A sample taken in 1938 was analyzed by H. K. in 1945. The sediment was described as a gyttja, but with 76 % of *Alnus* and no aquatic plants, a dy (in this case a highly humified alder-swamp peat) is mot likely. Apart from *Alnus*, the species *Corylus* and *Fraxinus* are commonest within AP; *Plantago lanceolata* and the other NAP are frequent, pointing to the middle or later part of Zone VIII. No *Fagus* or *Carpinus* was found.

XXIII. *Viksø I.*

This skull and the following one were found together with nine vertebrae and a fragment of a mandible at a depth of 2.5 m. in a bog in a tunnel valley. A sample, from "the interior of the skull', taken by the finder, was analyzed by B. Brorson Christensen in 1944. Very few pollen grains were counted, and a closer dating than at Zone VIII cannot be given on the basis of the spectrum.

XXIV. *Viksø II.*

A sample, from "the interior of the skull", taken by the finder in 1944, was analyzed by H. K. in 1950. The sediment was a slightly sandy, highly humified peat. The spectrum dates the sample at Zone VIII, but like the preceding one, a closer dating cannot be given.

XXV. *Holt.*

The find was made in peat at a depth of 3 m. A sample, taken by T-S in 1942, was analyzed by A. A. the same year and published in 1943 (Andersen 1943, p. 64–65). The sediment must be an alder-fen peat (90 % *Alnus*). Due to this the sum of AP exclusive of *Alnus* is very

small (41.5), and a dating is difficult. Three pollen grains of *Plantago lanceolata*, but none of *Fagus* or *Carpinus*, point to Zone VIII, and a period not earlier than the "B-landnam".

XXVI. *Odense Aa.*

The find was made between Seden and Skibhuse, approximately 2 m. above the bottom of a bog which fills a depression in the ground close to the inlet, being itself a former marine or brackish inlet. A sample was taken by the finder in cavities outside as well as inside the horn core. It was analyzed by H.K. in 1950. The sediment was a marine or brackish, sandy gyttja with many *Ruppia* pollen grains.

The spectrum is characterized by high frequencies of NAP. Neither *Fagus* nor *Carpinus* was found, and the sample must originate from Zone VIII, a period not earlier than the "B-landnam".

XXVII. *Veddinge moor.*

Two samples were taken and analyzed by B.F. in 1964: (a) from a cavity in the occipital area and (b) from the interior cavity in the left horn core. (a) was a slightly sandy gyttja with some fine drift, thus a fruit of a *Potamogeton*, and four oospores. (b) resembles (a), but has a higher content of drift, fine as well as coarse. Of macrofossils were found half a seed of *Ranunculus* sp., one seed of *Batrachium* sp., two seeds of *Menyanthes trifoliata*, three fruits of *Carex* sp., two fruits of *Potamogeton* sp., one of *Ceratophyllum demersum*, one of *Potentilla* sp. (incl. *Comarum*), one undetermined seed, twelve oospores and fragments of mosses, all in one pollen sample!

The NAP frequencies in the two spectra are very high, and this, together with the frequencies of *Fagus* (1.6, respectively 1.0 %) and *Carpinus* (0.4 % in both) date the samples at the border VIII–IX. In the vicinity of the bog Bronze Age as well as Iron Age settlements are common.

In (a) a pollen grain of *Allium ursinum* was found, and in (b) five tetrads of an Orchidaceae sp. of the *Epipactis* type, the first published fossil record of an orchid in Denmark (fig. 1, f–g).

XXVIII. *Snoldelev II.*

Two samples: (a) from the nasal aperture and (b) from a thoracic vertebra, both taken by U.M., were analyzed by H.K. in 1946. The sediments were peat with gyttja, slightly sandy, and in (a) with some snail shells. *Plantago lancolata* was found in both samples; in (a) four *Fagus* pollen grains (AP total: 350), but in (b) none (AP 326) were seen. Zone VIII, not earlier than the "B-landnam", and possibly as late as the late Zone VIII, is the resulting dating.

(XXIX. *Bodal.* Vide zoological part.)

XXX. *Mors.*

A sample from "nerve foramen in the skull" was taken and analyzed by H.K. in 1948. The sediment was a sandy peat. NAP constituted approximately $^3/_4$ of the pollen counted (NAP + AP: 272), and as one pollen of *Secale* was found, a dating at the beginning of Zone IX is most convincing, in spite of the fact that no *Fagus* was found (AP: 54).

XXXI. *Gundsømagle* (vide p. 215).

XXXII. *Rislev.*

The Rislev offering find has been dated archaeologically to about 300–400 A.D. Four of the samples from a pollen series taken during the excavation by T-S were analyzed by B.F. in 1961, and later published by Troels-Smith (1962 p. 93–96). No pollen list or diagram was published, and as it may be of some interest to publish four thoroughly worked-out pollen spectra from this period (a total of 13.677.5 pollen grains was counted) they are included in

Table B. (a) in TROELS-SMITH (*loc. cit.*) mentioned as M 17, was a fine detritus gyttja with a few grains of sand, (b) = M 14, (c) = M 2, and (d) = M 12 were drift gyttja with some swamp-peat. (a) was found beneath the culture layer, (b) and (c) within, and (d) above the culture layer.

Several rare pollen types occur, thus one *Lonicera periclymenum* in (a) (cp. TROELS-SMITH 1960 p. 21), two *Juncus* or *Luzula* in (a) and one in (c), one *Sanguisorba minor* in (c), besides *Hottonia palustris*, *Hypericum* sp., *Jasione montana*, *Sambucus nigra*, *Succisa pratensis* and others.

XXXIII. *Søndersø.*

A sample was analyzed by A.A. in 1942. The sediment was an alder-fen peat, which gave a spectrum so uncharacteristic that the dating of the sample may be any time between the "B-landnam" and the Middle Ages. In 1964 B.F. took another big lump from a cavity in the interior of the brain-case at the base of the left horn. From the middle of the lump a pollen sample was taken. The sediment was an alder-fen peat so much humified that about every second pollen grain was indeterminable, and counting was given up, but a much concentrated slide was examined. No *Fagus* pollen was seen, a fact which indicates Zone VIII, but several *Picea* pollen grains were found, pointing to a very late dating, as *Picea* was only introduced into Denmark about 1730 A.D. The *Picea* pollen on the other hand was of a slightly deviating colour, indicating recent contamination, but as the sample was taken from the middle of a lump, it should not have been recently contaminated. The conclusion to be drawn must be that the animal cannot be dated by means of pollen analysis.

In 1966 a radiocarbon dating was made at the Copenhagen Radiocarbon Laboratory. The material used was a fragment of the pelvis. The age was 2120 ± 120 B.C. (K 1116).

Appendix

Having finished the manuscript in the autumn of 1965 the author has carried out some additional investigations, and would like also to add some already published pollen-analytical data.

Bos primigenius

1 A. *Terp moor.*

Three samples, (a) from a cavity in the supraoccipitale sinister, (b) from the lower part of the sutur between the left and right part of pubis, and (c) from foramen nutricium in a femur (U. M. 1968) were analyzed by B. F. in 1968. The sediments were sandy, slightly clayey gyttja, in (a) and (b) with one fruit of *Potamogeton* sp. The spectra are very similar with *Juniperus* ranging between 34 and 44 % and *Betula* between 31 and 33 %. *Empetrum*, *Salix* and *Filipendula* are common, *Polygonum viviparum* type, *Oxyria*, *Helianthemum*, *Trollius* and *Selaginella* noteworthy. The spectra are characteristic of the transition between Zone III and Zone IV.

The following pollen grains were found: *Alnus* 3-2-1, *Betula* 172-157-166, Caryophyllaceae 0-1-0, Chenopodiaceae 1-0-2, *Helianthemum* 0-1-0, *Artemisia* 4-8-9, Liguliflorae 7-3-5, Tubuliflorae 3-2-2, Cruciferae 1-1-0, *Juniperus* 228-190-171, Cyperaceae 154-133-165, *Empetrum* 18-7-14, *Pyrola* type 1-0-0, *Quercus* 0-1-0, Gramineae 322-254-320, *Elymus* 1-0-0, *Myriophyllum alterniflorum* 28-29-33, *Myriophyllum spicatum* 35-11-32, *Hippuris* 0-0-1, Labiatae 0-1-0, Leguminosae 0-0-2, *Picea* 0.5-0-0, *Pinus* 85-84-88, *Plantago maritima* 0-1-0, *Oxyria* 1-0-0, *Polygonum viviparum* type 1-0-1, *Rumex acetosella* type 6-2-7, *Eupotamogeton* 31-5-22, *Primula* 1-0-0, *Caltha* 0-0-1, *Ranunculus repens* type 13-12-12, *Thalictrum* 5-20-4, *Trollius* 0-+-0, *Filipendula* 10-31-33, *Potentilla* 13-12-13, *Prunus padus* 1-0-0, *Galium* 1-7-3, *Populus* 2-2-2, *Salix* 25-70-73, *Sparganium/Typha angustifolia* type 1-0-1, *Ulmus* 0-0-1, Umbelliferae 3-5-2, *Urtica* 0-0-2, a.i.d. 2-0-1, a.i.p. 3-1.4, a.i.l. 2-1-1, Σ 1184.5-1054-1194, *Equisetum* 11-8-9, *Botrychium* 2-2-3, *Dryopteris*

type 0-1-0, *Selaginella* 0-0-1, *Sphagnum* 2-3-1, *Botryococcus* 177-300-281, *Pediastrum* 1442-514-511, Rebedded 1-0-0, Charcoal c-r-c, D.b. 6.6-4.9-4.1.

13 B. *Bjerregravs moor.*

A sample from a frontal cavity (U.M. 1967) was analyzed by B.F. 1967. The sediment was a slightly humified *Carex-Dryopteris* peat with a touch of gyttja. Achenes from a distigmate and a tristigmate *Carex* were found. The spectrum is typically Preboreal, with the latter part of Zone IV as the more likely dating.

The following pollen grains were found: *Betula* 199, *Cerastium* type 2, *Corylus* 4, Cruciferae 1, *Juniperus* 1, Cyperaceae 374, *Cladium* 1, Ericaceae 1, *Calluna* 2, Gramineae 42, *Menyanthes* 1, *Pinus* 302, *Rumex acetosella* type 2, *Eupotamogeton* 6, *Ranunculus* 1, *Salix* 4, *Populus* 15, *Melampyrum* 2, *Sparganium/Typha angustifolia* type 4, *Typha latifolia* 17, a.i.d. 7, a.i.p. 4, Σ 992. *Equisetum* 5, *Dryopteris* type 382, *Thelypteris dryopteris* 10, *Pediastrum* 4, *Sphagnum* 5, D.b. 25.

32 A. *Ryemarksgaard.*

Th. Mathiassen (1941) mentions and depicts a find of an ornamented metatarsus of a *Urus* from Ryemarksgaard near Osted, Zealand. In an appendix Troels-Smith gives the results of the analyses of two very small samples of peat from the bones: *Salix* 0.5, respectively 1 %, *Betula* 29 – 33 %, *Pinus* 43 – 57 %, *Alnus* 15 – 0 %, *Ulmus* 4 – 6 %, *Tilia* 3 – 0 %, *Quercus* 5 – 3 %, AP exclusive of *Corylus* 173 – 101, *Corylus* 116, respectively 200 %, Cyperaceae 7 – 3 %, Gramineae 0 – 1 %, Chenopodiaceae 0 – 2 %, Rosaceae 0.5 – 0 %, *Calluna* 0 – 1 %, hair of *Nymphaea* few – single, *Dryopteris thelypteris* many in both samples. Pollen zone ex Knud Jessen VI, respectively V.

In most early analyses Rosaceae are identical with pollen of *Filipendula*, and *Dryopteris thelypteris* must be spores of the *Dryopteris* type. The later samples must be dated at the transition V–VI or the very beginning of VI.

71 A. *Læsten moor.*

A sample from the centre of a big, solid clod in the brain case (U.M. 1967) was analyzed by B.F. in 1967. The sediment was a dy-like forest peat. The spectrum is clearly Zone VIII, and the high frequencies of NAP may indicate a time after the immigration of the Passage-grave people between 2500 and 2000 B.C.

The following pollen grains were found: *Hedera* 1, *Alnus* 95, *Betula* 52, *Campanula* 1, Caryophyllaceae 1, *Cerastium* type 1, Chenopodiaceae 1, Liguliflorae 3, Tubuliflorae 2, *Corylus* 128, *Sedum* 1, Cruciferae 2, *Juniperus* 2, Cyperaceae 23, *Cladium* 1, *Calluna* 13, *Quercus* 135, Gramineae 46, *Hordeum* 1, Labiatae 1, *Fraxinus* 28, *Pinus* 28, *Plantago lanceolata* 4, *Rumex acetosella* type 88 (quite a number were definitely *Rumex acetosa*), Ranunculaceae 1, *Caltha* 1, *Filipendula* 1, *Populus* 1, *Salix* 1, *Tilia* 31, *Ulmus* 5, Umbelliferae 1, *Urtica* 2, a.i.d. 30, Σ 722. *Dryopteris* type 39, *Thelypteris dryopteris* 1, *Polypodium* 1, *Pteridium* 2, *Sphagnum* 40, *Tilletia* 11, charcoal c, D.b. 51.

71 B. *Grejs Mølle.*

Six samples were taken (U.M. 1966–67) from (a) between the distal condyles of the metatarsus sinistra, (b) between the distal condyles of the metacarpus sinistra, (c) the left part of the pelvis in the incisura acetabulum, (d) cavity beneath the orbita sinistra at the lacrymale, (e) nasal cavity underneath the proximal suture of the nasale, and (f) cavity in occipital region behind the left horn core. They were analyzed by B.F. (1966–67).

The sediments were: (a) clayey-sandy, highly humified forest peat, (b) clayey sand with humified forest peat, (c) slightly clayey sand with a touch of highly humified forest peat, (d) slightly sandy clay with some highly humified forest peat, (e) sandy clay, rich in microscopical pyrite, with some highly humified forest peat, and (f) clay with sand, gravel, and a touch of

humic substance, probably humified forest peat. Five samples were counted, while the counting of (f) was omitted as the very sparse pollen turned out to be mainly rebedded pollen (*Sciadopitys*, *Castanea*, *Engelhardtia* type, *Hystrix*, etc.). The five spectra are very similar, although stamped by the local vegetation. Notable are the extremely high frequencies of *Tilia* (23, 14, 24, 21, and 18%, respectively) and the abundance of *Acer* 1.0, 4.6, 2.7, 11, and 4.9%). The samples originate from Zone VIII. The very low frequencies of NAP may possibly indicate the period between the B-landnam and the immigration of the Passage-grave people.

The following pollen grains were found: *Acer* 5-23-6-41-30, *Ilex* 0-0-0-1-0-, *Hedera* 0-0-0-3-0, *Alnus* 143-214-66-65-257, *Betula* 6-17-5-14-14, *Campanula* 0-1-0-0-0, *Cerastium* type 0-0-0-0-1, *Melandrium* type 0-0-0-1-0, Chenopodiaceae 0-1-0-1-0, Tubuliflorae 1-0-1-0-0, *Artemisia* 1-0-1-1-1, *Cirsium* type 0-1-0-0-0, *Corylus* 124-91-41-60-116, Cruciferae 0-3-13-1-1, *Juniperus* 2-0-0-1-1, Cyperaceae 7-3-2-0-1, *Calluna* 0-2-0-4-3, *Quercus* 64-66-36-73-68, Gramineae 24-32-14-30-29, *Cerealea* 0-1-0-0-0, *Hypericum* 0-0-0-2-1, *Fraxinus* 26-23-11-28-13, *Pinus* 22.5-12-5.5-34-15, *Plantago lanceolata* 3-6-0-3-3, *Rumex acetosella* type 2-2-1-2-1, *Rumex hydrolapathum* 0-0-0-1-0, Ranunculaceae 0-1-0-0-0, *Anemone* 9-1-0-0-3, *Caltha* 0-0-0-0-1, *Ranunculus* 1-1-1-0-1, Rosaceae 1-1-0-0-0, *Filipendula* 2-2-1-6-5, *Galium* 1-2-0-1-0, *Salix* 0-1-0-0-1, *Euphrasia* type 4-0-0-0-0, *Tilia* 121-68-54-77-111, *Ulmus* 13-9-5-8-17, Umbelliferae 8-5-4-4-7, *Urtica* 4-4-0-1-0, a.i.d. 9-10-18-20-14, a.i.p. 1-0-1-6-2, a.i.l. 0-1-0-3-0, Σ 604.5-604-286.5-492-717. *Dryopteris* type 2-1-4-8-8, *Thelypteris dryopteris* 7-3-3-0-1, *Polypodium* 2-6-0-1-2, *Pteridium* 1-2-1-2-2, *Sphagnum* 2-0-0-1-0, *Pediastrum* 1-0-0-1-0, *Botryococcus* 0-0-0-1-0, rebedded pollen 0-0-0-9-1, *Hystrix* 0-0-0-3-0, charcoal cc-c-c-c-c, D.b. 59-43-61-43-36.

71 C. *Fæsted.*

Two samples were taken from the skull (M. Degerbøl 1966): (a) was shaken out from the interior of the skull, while (b) was exposed in the glenoid fossa. The sediment in (a) was a highly humified, sandy alder-fen peat without traces of gyttja (neither algae (*Pediastrum* and *Botryococcus*) nor pollen grains of limnophytes were found), while in (b) it was sand with a bit of highly humified alder-fen peat with fragments of wood and a single sclerotie of *Cenococcum geophilum*. The samples were analyzed by B.F. in 1966.

With a few exceptions the spectra are identical, characteristic of Zone VIII, but a closer dating cannot be made. The following pollen grains were found: *Alnus* 406 – 380, *Betula* 25 – 25, *Humulus* 0 – 2, *Viburnum* 1 – 1, Liguliflorae 0 – 2, Tubuliflorae 4 – 1, *Corylus* 54 – 27, Cyperaceae 11 – 8, *Succisa* 1 – 0, *Calluna* 7 – 4, *Quercus* 56 – 27, Gramineae 36 – 29, *Cerealea* 0 – 1, *Hypericum* 1 – 1, *Fraxinus* 6 – 3, *Pinus* 16 – 11, *Plantago lanceolata* 2 – 0, *Rumex acetosella* type 1 – 3, *Ranunculus acris* type 0 – 4, *Filipendula* 8 – 7, *Potentilla* 0 – 2, *Galium* 2 – 0, *Salix* 2 – 2, *Melampyrum* 1 – 0, *Solanum dulcamara* 0 – 3, *Sparganium/Typha angustifolia* type 0 – 1, *Tilia* 34 – 26, *Ulmus* 3 – 1, Umbelliferae 2 – 1, *Urtica* 9 – 18, a.i.d. 19 – 6, a.i.p. 0 – 2, a.i.l. 1 – 0, Σ 708 – 598. *Dryopteris* type 16 – 10, *Polypodium* 1 – 2, *Pteridium* 0 – 6, *Thelypteris dryopteris* 5 – 0, *Sphagnum* 4 – 0, Charcoal cc – c, D.b. 60 – 46.

71 D. *Tinglev Lake.*

Two samples were taken from the skull (U.M. 1966): (a) from the middle of a big clod in the brain case, and (b) from foramen infraorbitale. Both were analyzed by B.F. in 1966. (a) was a heterogenous sediment consisting mainly of microscopical pyrite, with fragments of shells, macroscopical plant remains (e.g. a *Carex*-achene), a touch of swamp peat and gyttja. (b) was a gyttja with a few fragments of shells and sand grains. Sample (a) originates from the very end of Zone VIII, while (b) is from the beginning of Zone IX (*Fagus* 0.2, respectively 4.1%, *Calluna* 2.9 – 15, *Rumex acetosella* type 3.4 – 16, *Plantago lanceolata* 0.2 – 2.0, *Secale* 0 – 3.7, Gramineae 13 – 61, *Sphagnum* 0.9 – 11).

Andersen (1954) has published two pollen diagrams from the former lake Tinglev Sø. (a) matches the diagram from Tinglev Søndersø at a depth of 1.30 – 1.35 m. and the diagram

from Tinglev Nørresø at a depth of 1.55 m., while for (b) the corresponding depths are 1.20, respectively 1.05 m.

The following pollen grains were found: *Hedera* 1 – 0, *Alnus* 215 – 166, *Betula* 53 – 99, Caryophyllaceae 2 – 5, *Cerastium* type 0 – 1, *Scleranthus* 0 – 1, Chenopodiaceae 2 – 4, Liguliflorae 0 – 8, Tubuliflorae 2 – 4, *Artemisia* 5 – 1, *Carpinus* 0 – 3, *Corylus* 121 – 55, Cruciferae 3 – 4, *Juniperus* 0 – 5, Cyperaceae 22 – 172, *Succisa* 0 – 1, *Empetrum* 0 – 4, *Calluna* 16 – 74, *Fagus* 1 – 21, *Quercus* 92 – 87, Gramineae 71 – 291, *Cerealea* 1 – 0, *Secale* 0 – 19, *Myriophyllum alterniflorum* 0 – 2, Leguminosae 0 – 1, *Menyanthes* 0 – 4, *Myrica* 0 – 5, *Nymphaea* 0 – 1, *Fraxinus* 8 – 5, *Picea* 0 – 1, *Pinus* 39.5 – 51.5, *Plantago lanceolata* 1 – 10, *Polygonum aviculare* type 0 – 1, *Rumex* sp. 1 – 0, *Rumex acetosella* type 19 – 82, *Eupotamogeton* 0 – 1, *Caltha* 1 – 5, *Ranunculus acris* type 0 – 3, *Filipendula* 1 – 1, *Potentilla* 0 – 5, *Galium* 0 – 3, *Salix* 0 – 3, *Euphrasia* type 0 – 1, *Melampyrum* 1 – 1, *Sparganium/Typha angustifolia* type 13 – 8, *Tilia* 22 – 6, *Typha latifolia* 0 – 4, *Ulmus* 8 – 6, Umbelliferae 2 – 6, a.i.d. 9 – 14, a.i.p. 8 – 4, a.i.l. 2 – 2, Σ 742.5 – 1261.5, *Equisetum* 1 – 4, *Dryopteris* type 152 – 358, *Polypodium* 1 – 0, *Pteridium* 8 – 8, *Thelypteris dryopteris* 1 – 0, *Sphagnum* 5 – 55, *Botryococcus* 1 – 1, *Pediastrum* 41 – 719, *Tilletia* 0 – 2, Charcoal c – c, D.b. 17 – 28.

90. *Brabrand.*

In Troels-Smith (1937) an analysis is given of a sample consisting of marine, sandy clay-gyttja from the marrow-cavity in a metacarpus of a *Bos* from the kitchen midden at Brabrand, Jutland, presumed to be from a *B. domesticus*. He found the following spectrum: *Betula* 4%, *Pinus* 10%, *Alnus* 21%, *Ulmus* 21%, *Tilia* 13%, *Quercus* 29%, AP exclusive of *Corylus* 183, *Corylus* 27%. The determination of the bone as belonging to *B. domesticus* cannot be maintained with the much greater reference material now at hand, and this analysis, therefore, cannot be used as a proof of cattle in Denmark prior to the *Ulmus* decline—apart from the fact that the problem of dating kitchen middens is far from having been solved.

A sample from a horn core of *Urus* from the kitchen midden of Brabrand was taken out and analyzed by B. F. in 1965. The sediment was a very sandy clay-gyttja with fragments of shells, thus of *Mytilus*, as well as charcoal, besides a seed of a *Chenopodium* sp. and the chitin of an oribatid. The spectrum is clearly Zone VII, and compared with the diagram (Troels-Smith *loc.cit.*) the sample should originate from the *Corylus* minimum at a depth of 3.40–3.50 m., i.e. half a metre deeper than the border VII–VIII. The following figures were found: *Hedera* 6, *Alnus* 203, *Betula* 87, Chenopodiaceae 10, *Artemisia* 12, Liguliflorae 1, *Corylus* 155, Cruciferae 1, Cyperaceae 4, *Juniperus* 10, *Calluna* 2, *Quercus* 397, Gramineae 19, *Viscum* 1, *Fraxinus* 14, *Pinus* 56, *Filipendula* 1, *Ruppia* 3, *Populus* 2, *Salix* 4, *Tilia* 96, *Ulmus* 127, *Urtica* 3, a.i.d. 5, a.i.p. 11, a.i.l. 1, Σ 1231, *Dryopteris* type 10, *Polypodium* 5, *Pteridium* 9, *Thelypteris* 2, *Botryococcus* 3, *Hystrix* 45, "*Pentagon*" 30, rebedded pollen grains 3, D.b. 2.0%.

94. *Norslund.*

At the mesolithic coastal settlement Norslund, 15 km. south of Aarhus, Jutland, 182 fragments of bones of *Bos primigenius* have been determined (U. Møhl in: Andersen and Malmros 1966). They were found in layers 3 and 4, and both layers were radiocarbon dated (Layer 3, charcoal samples: 3780 and 3730 ± 120 B. C., Layer 4, shell fragments: 4470 ± 130 B. C.).

Bos taurus domesticus

XIII A. *Vedbæk.*

A third animal originating from the same former inlet as Nos. XII and XIII has been dated. Three samples were taken (T-S 1966): (a) from a cavity in the sixth vertebra, (b) from the sinus frontalis, and (c) from the lacrymale dextra. They were analyzed by B. F. in 1966.

(a) was a highly humified gyttja with swamp peat, while (b) and (c), very alike, were but slightly humified gyttjas with a little swamp peat, a touch of sand and clay, and with numerous fragments of small snails.

The spectrum in (a) is characterized by the swamp. Within AP *Quercus*, *Alnus*, and *Corylus* each constitute a quarter of the Σ AP. *Tilia* and *Ulmus* are rare, and this, connected with the frequent occurrence of *Plantago lanceolata*, dates this sample to after the A-landnam. Pollen of *Ruppia*, besides the presence of *Hystrix*, etc., indicate a slight contamination with marine sediments. The spectra in (b) and (c) are almost identical, dominated by *Alnus* and *Corylus* and with but relatively few herbs. *Tilia* and *Ulmus* as well as *Fagus* and *Carpinus* are sparse, but in spite of the discrepancy with (a) they may be of about the same age. *Ruppia* pollen also occurs in (b) and (c) side by side with *Eupotamogeton*. A likely explanation of the three strange spectra might be the following: Soon after the isolation of the inlet from the sea a swamp of reeds, sedges, bulrushes, etc., spreads into the shallow lake. Caused by wave-action some of the underlying marine sediment may from to time have been stirred up and embedded in the lake-gyttja. If this holds good, the samples originate from the regression period after the Subboreal transgression in the middle of Subboreal.

The following pollen grains, spores, etc., were found: *Hedera* 0-0-1, *Alnus* 96-322-215, *Betula* 30-66-53, *Jasione* 1-0-0, *Humulus* 1-2-1, Caryophyllaceae 1-0-0, *Cerastium* type 1-0-0, *Spergularia* 4-1-0, Chenopodiaceae 8-6-4, *Artemisia* 1-5-3, Tubuliflorae 22-2-7, *Carpinus* 1-1-0, *Corylus* 92-264-200, Cruciferae 1-0-1, Cyperaceae 138-24-30, *Calluna* 0-4-0, *Fagus* 0-1-2, *Quercus* 97-115-78, Gramineae 70-39-38, *Cerealea* 1-0-0, cf. *Triglochin* 0-0-1, *Mentha/Lycopus* type 1-0-0, *Trifolium repens* type 0-1-0, *Allium* sp. 1-0-0, *Allium ursinum* 0-1-0, *Lythrum* 1-0-1, *Fraxinus* 2-23-12, *Picea* 0.5-0.5-0, *Pinus* 32-29-37, *Plantago lanceolata* 11-4-9, *Polygonum persicaria* 0-1-0, *Rumex acetosella* type 1-3-2, *Eupotamogeton* 52-2-0, *Lysimachia* 0-1-0, *Caltha* 1-4-1, *Galium* 3-0-0, *Ruppia* 1-9-1, *Populus* 0-2-1, *Salix* 6-0-2, *Odontites* 5-0-0, *Solanum dulcamara* 0-1-1, *Sparganium/Typha angustifolia* type 0-3-1, *Tilia* 1-6-3, *Typha latifolia* 0-16-35, *Ulmus* 1-5-7, Umbelliferae 4-2-3, *Urtica* 2-3-6, a.i.d. 50-8-4, a.i.p. 2-1-5, a.i.l. 1-0-0, Σ 743.5-977.5-765. *Dryopteris* type 13-55-51, *Pteridium* 1-10-7, *Sphagnum* 0-1-0, *Botryococcus* 0-2-1, *Pediastrum* 0-11-7, *Ceratophyllum* hairs 0-1-1, "*Paraplya*" 0-2-0, "*Pentagon*" 1-0-1, *Hystrix* 1-0-0, charcoal c-c-c, D.b. 51-8.7-10.

XXXI. *Gundsømagle moor.*

A sample was taken from a cavity at the distal end of the horn core (U.M. 1966) and analyzed by B.F. shortly afterwards. The sediment was a drift-gyttja with swamp peat. 6 oospores, one seed of *Urtica dioica*, one fragment of a seed of *Nymphaea alba* and two fragments of fruits of *Najas marina* were found. The spectrum is Subboreal, but a closer dating within the zone is difficult, yet the sample must be later than the B-landnam.

The following pollen grains were found: *Acer* 1, *Alnus* 285, *Betula* 42, *Humulus* 4, *Viburnum* 1, Chenopodiaceae 1, Liguliflorae 6, Tubuliflorae 2, *Artemisia* 17, *Cirsium* type 1, *Corylus* 361, Cruciferae 4, *Juniperus* 2, Cyperaceae 62, *Cladium* 5, *Quercus* 78, Gramineae 114, *Cerealea* 3, *Hypericum* 2, *Juglans* 1, *Menyanthes* 4, *Nymphaea* 20, *Fraxinus* 18, *Pinus* 19.5, *Plantago lanceolata* 30, *P. major/media* 1, *Rumex acetosella* type 5, *Eupotamogeton* 1, *Ranunculus repens* type 2, *Crataegus* type 1, *Filipendula* 3, *Potentilla* 2, *Rubus* type 1, *Salix* 6, *Solanum dulcamara* 1, *Sparganium/Typha angustifolia* type 1, *Taxus* 1, *Tilia* 2, *Typha latifolia* 2, *Ulmus* 9, *Umbelliferae* 3, *Urtica* 12, a.i.d. 2, Σ 1138.5. *Dryopteris* type 105, *Pteridium* 3, *Botryococcus* 21, *Pediastrum* 26, *Ceratophyllum* hairs 2, "*Paraplya*" 1, charcoal c, D.b. 7.3.

TABLES

TABLE A.

	1a	1b	1c	2a	2b	2c	2d	3	4	5a
Betula	61	63	62	74	77	76	66	65	66	52
Pinus	26	15	25	22	20	18	25	21	30	44
Salix	7.5	9.7	3.4	1.3	0.8	2.2	1.5	4.9	3.7	1.0
Juniperus	2.5	13	3.1	0.1	—	—	—	1.7	—	0.2
Populus	—	—	1.1	2.5	2.0	3.9	6.2	1.9	—	1.5
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	—	—	3.9	0.3	0.2	0.1	1.8	5.1	—	1.2
Quercus	0.6	0.3	0.7	—	—	—	—	0.4	—	0.1
Fraxinus	—	—	—	—	—	—	—	—	—	—
Tilia	—	—	0.1	—	—	—	—	—	—	—
Ulmus	—	—	0.1	0.1	0.1	0.1	—	0.2	—	0.1
Alnus	0.6	—	0.5	—	—	—	—	—	—	—
Hedera	—	—	—	—	—	—	—	—	—	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	0.6	—	—	—	—	—	—	—	—	—
Calluna	—	—	x	—	—	0.1	—	1.3	—	0.1
Gramineae	36	25	11	3.1	2.3	3.7	3.6	11	12	18
Cyperaceae	29	36	27	1.6	1.7	1.2	1.8	35	12	5.4
Artemisia	3.1	2.8	3.9	0.1	—	0.1	0.1	0.7	0.8	—
Rumex acet.	0.6	—	0.1	0.1	—	0.1	0.2	0.3	—	—
Plantago lanc.	—	—	—	—	—	—	—	—	—	—
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	158.5	320	1162.5	1032.5	917	1479	1125.5	1146	240	1034
Destruction D.b.	—	—	0.0	1.0	1.1	0.3	1.0	0.3	—	4.7

	5b	6	7a	7b	8a	8b	9	10a	10b	11
Betula	51	66	48	54	41	45	55	58	72	62
Pinus	38	29	51	34	53	50	30	22	27	32
Salix	2.8	1.1	0.8	2.1	—	1.0	4.8	—	0.3	3.3
Juniperus	0.3	—	—	0.3	—	—	3.9	—	0.1	0.2
Populus	7.0	—	—	9.7	—	2.2	2.1	—	0.2	1.4
Viburnum	—	—	—	—	—	0.2	—	—	—	—
Corylus	0.4	3.1	0.4	—	5.9	0.2	3.9	13	0.1	1.1
Quercus	0.2	—	—	—	—	0.7	0.2	0.5	—	0.2
Fraxinus	—	—	—	—	—	—	—	—	—	—
Tilia	—	—	—	—	—	—	—	—	—	—
Ulmus	0.1	—	—	—	—	—	—	—	—	0.3
Alnus	0.2	?0.3	—	—	0.7	0.5	0.2	6.5	—	—
Hedera	—	—	—	—	—	—	—	—	—	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	0.2	—	—	—	—
Calluna	0.2	x	—	—	—	—	1.4	—	0.1	0.5
Gramineae	30	14	12	13	1.3	12	9.2	6.0	15	3.8
Cyperaceae	7.6	3.4	2.7	8.9	2.6	16	46	11	73	38
Artemisia	0.1	0.3	—	—	—	0.2	1.8	—	0.1	0.4
Rumex acet.	—	0.3	—	0.1	—	—	—	—	—	0.4
Plantago lanc.	—	—	—	—	—	—	—	—	—	—
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	1144	350	258.5	773.5	152	598	564	201	931.5	1031
Destruction D.b.	32	—	—	13	—	48	0.0	—	11	1.3

TABLE A (continued).

	12	13a	13b	14	15a	15b	15c	15d	16a	16b
Betula	37	8.2	13	41	26	23	25	27	8.3	3.5
Pinus	57	86	82	23	20	21	23	27	23	23
Salix	0.7	2.7	1.0	1.8	0.8	0.5	0.5	0.8	3.4	1.2
Juniperus	0.5	—	—	—	—	—	—	—	—	—
Populus	2.0	1.4	0.8	1.8	2.9	2.2	1.5	3.6	0.6	—
Viburnum	—	—	—	?0.4	—	—	0.1	0.1	0.2	—
Corylus	1.9	—	2.1	32	49	53	50	41	57	69
Quercus	0.5	—	0.2	—	0.1	0.1	0.1	0.1	1.1	—
Fraxinus	—	—	—	—	—	—	—	—	—	—
Tilia	0.2	—	—	—	—	—	—	—	—	—
Ulmus	0.3	1.4	—	—	0.5	0.5	0.3	0.4	5.9	2.3
Alnus	0.8	—	1.0	—	—	—	—	0.1	0.6	1.2
Hedera	—	—	—	—	—	—	—	—	—	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	—	—	—	—
Calluna	—	—	—	—	0.2	0.4	0.3	0.1	0.2	1.2
Gramineae	5.7	15	6.0	6.2	1.7	1.3	0.5	1.9	18	16
Cyperaceae	13	49	29	15	3.6	3.8	2.4	3.7	9.1	7.0
Artemisia	0.3	1.4	0.4	—	0.1	0.1	0.1	0.1	—	—
Rumex acet.	—	—	—	0.4	—	0.1	—	—	—	—
Plantago lanc.	0.1	—	—	—	—	—	—	—	—	—
Cerelea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	1052	73	512.5	242	2173	2551	2148.5	2135	472	85.5
Destruction D.b.	0.0	24	37	—	0.5	0.4	0.1	0.7	42	57

	17a	17b	18a	18b	19a	19b	21	22	23a	23b
Betula	27	23	16	18	19	20	8.8	37	14	12
Pinus	43	38	32	36	39	38	4.9	21	23	20
Salix	—	1.1	—	0.3	0.3	0.3	0.1	1.7	0.7	1.0
Juniperus	—	0.3	—	0.1	—	—	—	0.1	—	—
Populus	—	2.2	—	1.9	—	—	—	2.3	3.7	2.2
Viburnum	—	0.1	—	—	—	—	—	0.1	0.2	0.1
Corylus	29	35	51	42	41	41	86	37	58	63
Quercus	—	—	—	0.3	0.5	0.9	—	0.2	0.1	0.3
Fraxinus	—	—	—	—	—	—	—	—	—	—
Tilia	—	—	—	—	—	—	—	0.2	—	—
Ulmus	—	0.1	0.3	0.2	0.8	0.9	0.1	0.1	0.4	1.2
Alnus	—	0.1	0.3	0.4	—	—	0.1	0.4	—	—
Hedera	—	0.1	—	—	0.3	—	—	—	—	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	—	—	—	—
Calluna	—	0.2	—	0.1	—	—	x	0.1	0.1	0.1
Gramineea	8.1	1.6	4.2	15	11	14	0.4	5.5	1.4	0.9
Cyperaceae	0.9	4.9	—	12	4.0	1.2	0.1	7.8	1.6	1.3
Artemisia	—	0.2	—	0.2	—	—	0.1	0.1	0.1	—
Rumex acet.	—	—	—	0.1	—	—	—	0.2	0.1	0.1
Plantago lanc.	—	—	—	—	—	—	—	—	—	—
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	234	939	309	9 16	397	343	826.5	1679.5	2421	2769
Destruction D.b.	—	24	—	32	—	—	—	11	2.2	1.3

TABLE A (continued)

	24	25	26a	26b	26c	26b	27	28a	28b	30
Betula	25	5.5	33	6.0	36	33	14	19	23	7.7
Pinus	53	47	18	24	22	19	25	47	40	55
Salix	1.0	0.4	1.3	0.5	2.2	1.4	0.5	1.0	1.2	1.3
Juniperus	—	—	0.3	—	0.1	0.2	—	—	0.4	0.3
Populus	6.3	—	6.0	0.5	6.0	5.7	1.4	2.6	2.7	0.7
Viburnum	0.2	—	—	—	—	—	0.9	—	—	0.3
Corylus	14	45	41	28	33	40	58	27	25	29
Quersus	0.2	0.8	—	1.4	0.1	—	0.2	0.6	1.2	1.4
Fraxinus	—	—	—	0.5	—	—	—	—	—	—
Tilia	—	—	—	9.2	—	—	—	—	0.1	1.0
Ulmus	—	0.4	0.3	0.9	0.1	—	0.7	0.4	0.3	1.3
Alnus	—	0.8	—	29	0.3	—	0.5	2.2	6.4	2.1
Hedera	—	—	0.1	0.5	—	—	—	—	—	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	—	—	—	—
Calluna	—	—	0.1	0.5	0.3	0.2	—	0.1	0.1	—
Gramineae	33	0.4	16	13	11	12	4.8	5.7	8.6	18
Cypericeae	31	13	10	16	9.2	8.3	5.0	6.4	6.0	25
Artemisia	0.3	—	—	0.5	—	0.4	—	—	—	0.3
Rumex acet.	—	—	0.2	—	—	—	—	—	—	0.1
Plantago lanc.	—	—	—	—	—	—	—	—	—	—
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	587.5	238	976.5	217	786.5	1135	422	688	771	705
Destruction D.b.	26	—	7.3	7.5	5.8	5.6	74	80	69	47

	31a	31b	32a	32b	33	34a	34c	35	36a	36b
Betula	33	40	21	12	17	18	15	13	21	17
Pixus	26	56	69	76	18	13	47	17	14	8.9
Salix	4.7	—	1.7	1.2	1.2	—	0.6	0.1	0.9	0.7
Juniperus	—	—	—	—	—	—	—	—	—	0,1
Populus	—	—	—	—	0.3	—	—	0.5	5.4	2.5
Viburnum	—	—	—	—	?0.7	—	—	—	2.2	0.2
Corylus	32	4.3	7.4	11	60	68	28	60	56	67
Quercus	—	—	—	—	1.0	0.2	3.5	3.1	0.3	0.2
Fraxinus	—	—	—	—	—	—	—	—	—	—
Tilia	1.0	—	—	—	—	—	0.3	0.1	1.7	1.6
Ulmus	0.5	—	—	—	2.5	—	5.4	4.4	1.4	1.8
Alnus	1.6	—	0.4	—	0.6	0.4	0.9	1.5	—	0.2
Hedera	—	—	—	—	0.3	—	—	0.1	—	0.1
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	—	—	—	—
Calluna	—	—	—	—	0.3	—	0.6	0.3	0.1	0.1
Gramineae	20	1.9	5.8	3.1	0.4	0.5	2.5	1.9	0.9	0.5
Cyperaceae	17	1.2	20	43	1.2	14	28	2.6	8.1	4.1
Artemisia	5.7	0.6	—	—	—	—	—	0.1	—	0.1
Rumex acet.	—	—	—	—	—	—	0.3	0.1	0.1	—
Plantago lanc.	—	—	—	—	—	—	—	—	—	—
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	191.5	161	242	160	672	559	316.5	3171	1284	3225.5
Destruction D.b.	—	—	—	—	—	—	40	0.5	11	6.1

TABLE A (continued).

	37	38	39	40	41	46a	46b	53	54a	54b
Betula	2.4	2.4	14	21	9.1	11	10	64	8.4	8.0
Pinus	15	8.0	31	38	37	9.9	9.4	29	8.0	13
Salix	0.5	31	0.7	—	0.5	0.8	0.5	1.7	—	0.1
Juniperus	—	—	—	—	—	—	—	—	—	—
Populus	0.3	0.1	0.4	—	—	0.3	0.4	—	0.4	1.1
Viburnum	—	1.2	—	—	—	—	0.1	—	—	—
Corylus	79	48	51	33	46	72	76	2.5	17	15
Quercus	0.2	1.2	0.5	1.5	3.6	0.9	0.6	—	14	18
Fraxinus	—	0.1	—	—	—	0.1	—	—	—	0.1
Tilia	0.5	2.2	0.3	1.0	1.4	0.8	0.1	—	7.7	6.3
Ulmus	2.4	4.3	2.0	3.5	2.3	2.4	2.0	0.8	8.8	9.4
Alnus	—	3.0	0.3	2.0	—	2.1	0.4	1.7	36	29
Hedera	—	0.1	—	—	—	0.1	0.1	—	0.8	0.2
Viscum	—	—	—	—	—	—	—	—	—	0.3
Fagus	—	—	—	—	—	—	—	—	—	—
Calluna	0.2	0.1	0.1	—	—	—	—	—	—	0.3
Gramineae	2.6	1.2	11	0.5	4.1	1.6	0.6	10	—	0.3
Cyperaceae	26	2.9	6.5	35	5.0	3.2	1.3	70	5.4	3.4
Artemisia	—	—	0.4	—	—	0.1	0.1	1.7	—	0.1
Rumex acet.	—	—	—	—	—	0.1	—	—	—	—
Plantago lanc.	—	—	—	—	—	—	—	—	—	—
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	578	2136	736	198.5	220.5	1304.5	1956	118.5	262	1614
Destruction D.b.	71	65	29	—	—	4.3	3.5	—	—	1.8

	55a	55b	56	57a	57b	57c	57d	58	59a	59b
Betula	7.9	4.0	17	21	22	21	18	23	23	13
Pinus	2.7	1.1	3.9	0.7	2.3	2.2	2.1	4.9	7.8	15
Salix	0.2	—	—	—	—	0.2	0.4	0.4	—	—
Juniperus	—	—	—	—	—	—	—	0.1	0.2	0.4
Populus	0.1	—	0.6	—	—	—	0.2	—	—	—
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	6.1	4.2	15	14	18	10	26	25	17	17
Quercus	4.3	6.2	19	19	13	10	23	17	10	7.9
Fraxinus	1.0	2.0	1.1	1.5	0.9	0.5	—	0.7	0.5	0.4
Tilia	1.9	3.7	2.4	4.4	4.1	1.9	3.0	6.2	4.5	6.6
Ulmus	2.2	1.2	1.1	0.5	0.5	0.2	0.2	3.2	3.6	2.8
Alnus	73	78	40	39	40	53	27	19	32	36
Hedera	0.2	0.5	—	—	0.5	0.2	—	0.1	0.2	—
Viscum	—	—	—	—	—	—	—	0.1	—	—
Fagus	—	—	—	—	—	—	—	—	0.2	—
Calluna	0.2	—	0.7	0.5	—	0.3	0.2	0.1	—	—
Gramineae	2.1	4.7	2.8	19	18	6.6	37	14	3.1	4.1
Cyperaceae	1.6	1.2	19	8.8	10	4.2	9.2	15	31	18
Artemisia	0.2	—	—	0.5	0.5	—	0.2	0.2	—	0.1
Rumex acet.	0.7	0.2	0.6	1.0	0.9	0.3	1.3	18	9.4	4.6
Plantago lanc.	0.2	0.2	0.2	0.5	0.5	0.5	—	0.1	—	0.1
Cerealea	—	—	—	—	—	—	—	—	—	—
Σ A.P.	1831	403.5	544	203.5	218	623	529.5	1421	606.5	681
Destruction D.b.	27	64	0.9	—	—	—	—	47	55	61

TABLE A (continued)

	60a	60b	61a	61b	62	63	64a	64b	64c	64d
Betula	42	36	9.0	8.5	3.8	7.9	3.8	2.1	1.2	5.5
Pinus	4.4	4.1	4.0	12	5.0	3.9	10	10	12	17
Salix	—	0.4	—	—	1.0	0.9	5.3	?0.7	1.9	0.6
Juniperus	—	—	—	—	1.0	—	—	—	—	—
Populus	—	0.2	—	—	—	0.2	—	—	—	—
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	9.7	7.8	20	21	14	20	19	16	20	18
Quercus	8.3	14	6.0	13	36	19	7.6	11	18	12
Fraxinus	—	0.9	3.0	2.8	9.1	5.8	2.3	2.1	3.7	0.6
Tilia	3.4	2.3	1.0	2.8	4.3	4.1	5.3	7.1	5.6	9.7
Ulmus	1.4	0.5	2.0	1.4	1.9	2.7	1.5	4.3	1.9	1.8
Alnus	31	34	55	38	24	36	45	46	36	35
Hedera	—	—	—	—	—	—	—	—	0.6	—
Viscum	—	0.2	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	—	—	—	?0.6
Calluna	x	0.4	—	—	—	—	—	—	0.6	—
Gramineae	2.6	9.0	12	8.5	15	5.3	16	14	19	19
Cyperaceae	7.4	9.2	59	55	27	27	9.9	16	20	27
Artemisia	—	0.2	—	—	—	0.5	0.8	—	—	—
Rumex acet.	—	2.0	4.0	—	—	0.2	3.0	—	2.5	0.6
Plantago lanc.	?0.3	0.4	1.0	—	0.5	0.2	—	0.7	0.6	0.6
Cerealea	—	0.2	—	—	—	—	—	—	—	—
Σ A.P.	351.5	554	100	70.5	209.5	660.5	131.5	140	162	165
Destruction D.b.	—	49	46	65	46	71	—	—	—	—

	65	66	67	68	69	70a	70b	71a	71b	71c
Betula	21	9.5	19	6.1	9.2	11	11	8.5	15	20
Pinus	2.6	2.6	4.9	5.2	4.4	9.7	12	7.8	12	41
Salix	0.3	0.1	0.1	—	0.4	0.2	0.2	0.7	1.0	1.3
Juniperus	0.1	0.1	—	—	—	—	0.1	0.2	—	—
Populus	—	0.1	0.1	—	—	0.8	0.2	—	—	0.4
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	43	14	19	25	8.5	25	20	15	15	14
Quercus	10	19	27	2.8	5.9	18	19	7.1	6.1	2.1
Fraxinus	2.7	3.1	3.7	—	2.9	1.1	0.8	0.2	1.0	—
Tilia	5.1	4.6	7.0	4.7	2.2	2.9	3.4	0.9	2.0	—
Ulmus	1.1	1.2	1.8	2.3	0.7	4.2	4.3	1.7	0.5	1.0
Alnus	14	45	18	54	66	28	30	57	47	21
Hedera	0.2	0.1	0.5	—	—	—	0.2	—	—	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	0.2	0.2	—	—
Calluna	0.1	0.2	0.2	x	0.4	0.4	0.5	0.7	2.8	0.8
Gramineae	1.4	1.3	0.7	6.1	5.9	2.7	2.2	19	29	4.4
Cyperaceae	6.7	2.9	7.5	0.5	18	50	55	16	22	21
Artemisia	—	—	0.2	0.5	0.4	0.1	0.1	0.5	0.8	0.4
Rumex acet.	0.2	0.1	5.4	—	—	4.6	7.8	2.6	3.5	0.4
Plantago lanc.	0.3	0.2	0.2	0.9	—	—	0.2	1.0	1.5	—
Cerealea	—	—	—	—	—	0.1	0.3	—	0.3	—
Σ A.P.	898.5	1172	1232	213	272	1123	1115	574	395.5	480
Destruction D.b.	65	8.6	73	—	—	45	46	48	54	33

TABLE A (continued).

	72a	72b	73a	73b	74	75	76	79	IIa	IIb
Betula	10	3.5	11	3.9	4.6	18	3.8	21	4.1	5.9
Pinus	4.3	9.2	20	14	3.2	25	11	37	7.1	7.8
Salix	1.7	0.7	—	—	—	—	—	1.0	1.2	0.5
Juniperus	—	—	—	—	—	—	—	—	—	0.1
Populus	—	—	—	—	—	—	—	0.7	0.3	0.4
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	5.1	12	15	17	37	18	21	23	19	17
Quercus	1.7	8.4	7.4	8.8	5.5	17	4.6	1.8	15	16
Fraxinus	1.7	0.7	—	—	—	0.7	—	0.1	3.3	4.3
Tilia	3.4	7.0	25	31	14	6.3	23	5.0	4.7	4.4
Ulmus	—	0.7	8.2	11	5.5	4.3	5.3	4.2	6.7	5.9
Alnus	58	55	14	14	30	11	32	5.4	39	38
Hedera	—	—	0.8	+	—	0.2	—	—	0.1	0.3
Viscum	—	—	—	—	—	—	—	—	—	0.1
Fagus	10	2.1	—	—	—	—	—	—	—	—
Calluna	x	0.7	0.8	—	—	0.2	—	0.3	0.2	0.2
Gramineae	22	53	5.8	7.7	5.5	2.2	—	5.3	5.2	6.6
Cyperaceae	21	20	21	22	15	2.9	26	10	10	9.2
Artemisia	—	—	—	—	—	0.2	—	—	—	0.2
Rumex acet.	—	4.2	2.5	2.7	—	—	—	—	—	0.1
Plantago lanc.	1.7	8.4	—	—	—	—	—	—	—	0.1
Cerealea	5.1	6.3	—	—	—	—	—	0.2	0.1	0.3
Σ A.P.	58.5	142	121.5	182	108.5	445	131	955	2518	2525
Destruction D.b.	—	—	86	90	—	—	—	47	7.8	7.9

	IIc	IIIa	IIIb	IVa	IVb	IVc	Va	Vb	Vc	VIa
Betula	5.5	6.5	7.6	7.2	6.3	6.7	6.6	7.2	5.6	9.8
Pinus	7.5	3.8	4.4	4.3	3.6	4.3	4.0	3.8	3.1	4.8
Salix	0.2	0.1	0.2	0.7	0.6	0.6	0.2	0.5	0.7	—
Juniperus	—	—	—	—	0.1	0.1	0.1	0.1	0.2	—
Populus	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	—
Viburnum	—	—	—	—	—	—	—	0.1	—	—
Corylus	19	32	33	38	40	38	41	38	42	32
Quercus	15	12	14	13	13	15	12	13	12	10
Fraxinus	3.0	0.4	2.1	1.3	2.2	1.9	1.2	2.4	2.3	0.6
Tilia	4.7	3.9	3.2	1.5	1.2	1.1	0.8	1.2	0.7	0.6
Ulmus	6.5	4.5	4.6	1.0	0.9	0.9	0.9	1.1	0.9	0.6
Alnus	38	37	30	33	32	31	34	33	33	42
Hedera	0.3	—	0.1	0.1	0.1	—	—	—	0.1	—
Viscum	0.1	—	—	—	0.1	—	—	—	—	—
Fagus	—	—	—	0.1	—	0.2	0.2	0.1	0.1	0.2
Calluna	0.1	0.1	0.1	0.3	0.2	0.2	0.2	0.2	0.1	—
Gramineae	8.6	2.3	6.1	2.7	3.7	3.5	2.2	3.9	3.6	0.6
Cyperaceae	9.2	3.8	4.7	5.3	5.2	6.1	4.4	5.7	5.2	3.7
Artemisia	0.1	0.1	0.1	0.3	0.3	0.2	0.1	0.4	0.2	0.4
Rumex acet.	—	—	0.1	0.1	0.2	0.2	0.1	0.1	0,1	1.2
Plantago lanc.	—	0.3	0.9	0.8	0.7	0.9	0.8	0.5	0.9	0.2
Cerealea	0.1	0.1	0.1	0.1	—	0.1	0.1	0.1	—	—
Σ A.P.	2498.5	709	1541.5	3506	3334	3293.5	3375	3321.5	3472	482
Destruction D.b.	6.7	—	7.1	1.2	2.3	1.7	1.1	1.7	4.2	—

TABLE A (continued).

	VIa	VIc	IX	Xa	Xb	Xc	XA	XI	XIIa	XIIb
Betula	4.9	4.1	6.9	13	6.9	8.4	8.7	8.0	4.3	4.6
Pinus	4.9	2.6	2.3	1.7	1.7	1.6	2.2	3.4	3.2	3.6
Salix	—	—	0.9	0.8	0.6	0.5	0.8	—	0.3	0.2
Juniperus	—	—	—	—	—	—	—	—	—	0.2
Populus	—	—	0.5	1.0	0.4	1.0	0.6	—	0.1	—
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	38	43	31	29	30	27	34	29	18	16
Quercus	6.6	3.5	8.9	10	11	12	9.2	9.2	9.2	11
Fraxinus	0.9	0.3	1.7	2.2	3.0	2.0	2.4	2.7	1.5	2.3
Tilia	0.9	1.0	2.3	1.9	3.2	3.5	2.6	1.1	0.8	1.1
Ulmus	1.8	0.6	2.5	1.2	3.1	2.0	1.1	1.5	0.6	1.1
Alnus	42	42	43	39	40	42	38	45	62	60
Hedera	—	—	0.1	—	0.1	0.2	0.1	—	0.1	—
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	0.1	—	—	—	0.4	—	—
Calluna	—	—	0.1	—	0.1	—	—	0.4	—	—
Gramineae	1.3	1.1	3.1	1.4	1.5	1.4	4.5	2.7	3.9	4.0
Cyperaceae	2.6	0.6	3.7	3.0	2.8	4.3	3.2	1.9	3.8	4.1
Artemisia	—	—	0.8	0.4	0.4	0.4	0.8	0.4	0.3	0.2
Rumex acet.	0.4	—	0.2	—	—	0.1	0.1	—	0.1	0.2
Plantago lanc.	0.4	—	1.6	0.2	0.2	0.6	1.3	1.1	0.3	0.4
Cerealea	—	—	0.1	—	—	—	0.1	—	—	—
Σ A.P.	227	315	1466	1696.5	1633.5	1530	869	263	1577	1203.5
Destruction D.b.	—	—	10	2.4	2.0	7.7	3.9	—	19	41

	XIIIa	XIIIb	XIV	XV/XVI	XVII	XVIII	XIXa	XIXb	XXa	XXb
Betula	9.4	8.5	6.7	4.7	3.8	5.0	3.2	5.0	6.8	6.5
Pinus	5.8	6.3	10	2.0	2.0	2.8	6.5	7.2	6.6	5.3
Salix	0.1	0.1	0.5	—	—	0.7	2.0	0.7	—	0.3
Juniperus	0.1	—	—	—	—	0.1	—	—	—	—
Populus	0.1	0.1	—	—	—	0.2	0.2	0.4	0.1	0.6
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	32	32	26	36	45	16	17	15	21	20
Quercus	17	14	19	4.3	8.1	10	11	9.8	19	17
Fraxinus	2.9	2.6	1.6	0.2	0.7	2.3	2.5	1.7	5.5	6.7
Tilia	1.3	0.8	1.6	0.9	0.7	1.0	2.7	2.0	2.2	2.6
Ulmus	1.1	0.8	2.3	0.2	0.5	0.6	1.2	1.4	0.4	1.3
Alnus	30	33	33	52	39	61	53	56	39	39
Hedera	—	0.1	—	—	—	—	—	0.1	—	0.2
Viscum	—	—	—	—	—	—	—	0.1	0.2	—
Fagus	0.2	1.0	—	—	—	—	0.3	0.9	0.3	—
Calluna	0.1	—	—	—	0.2	0.1	—	—	0.6	0.2
Gramineae	5.4	9.8	2.3	1.9	0.7	3.0	6.1	5.1	15	14
Cyperaceae	4.7	12	7.3	2.8	0.9	2.0	12	7.6	1.3	0.6
Artemisia	0.7	0.3	—	0.2	0.5	0.2	1.8	0.6	0.9	1.3
Rumex acet.	0.2	0.7	—	—	0.2	0.5	0.3	0.1	0.1	0.6
Plantago lanc.	1.5	1.1	1.6	1.3	0.9	0.4	0.7	0.8	0.6	1.0
Cerealea	0.2	0.3	—	—	—	0.1	—	—	0.4	0.2
Σ A.P.	1635	1487.5	218	467.5	443	1331.5	602	846	786	628
Destruction D.b.	10	11	—	—	—	19	65	41	14	12

TABLE A (continued).

	XXc	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII a	XXVII b	XXVIII a
Betula	8.4	2.5	1.9	6.0	5.7	1.7	6.8	6.9	6.5	9.1
Pinus	7.4	7.7	4.4	12	13	1.1	7.0	5.4	3.7	2.9
Salix	—	—	—	—	1.3	—	—	0.2	0.3	—
Juniperus	0.3	—	—	—	—	—	—	—	—	—
Populus	0.4	—	—	—	—	—	0.6	0.1	0.1	—
Viburnum	—	—	—	—	—	—	—	—	—	—
Corylus	19	37	7.5	29	38	4.9	29	30	24	37
Quercus	19	22	3.1	27	11	1.0	21	10	7.3	7.1
Fraxinus	8.2	3.3	3.8	0.9	1.3	0.2	2.0	1.6	2.5	0.3
Tilia	2.7	—	2.5	—	3.2	0.7	1.1	1.2	1.1	2.9
Ulmus	0.4	2.1	0.9	1.7	1.3	0.2	0.8	1.6	1.5	2.0
Alnus	34	25	76	23	25	90	32	41	52	38
Hedera	—	—	—	—	—	—	—	—	0.1	0.3
Viscum	—	—	—	—	—	—	—	—	—	—
Fagus	—	—	—	—	—	—	—	1.6	1.0	1.1
Calluna	0.9	—	—	—	—	—	—	0.6	0.4	—
Gramineae	10	4.2	6.3	2.6	6.9	2.2	9.8	26	25	0.3
Cyperaceae	0.8	1.7	6.3	17	28	—	3.4	6.7	11	0.6
Artemisia	0.5	0.8	0.9	0.9	—	—	1.1	2.7	2.5	—
Rumex acet.	0.7	—	—	—	0.6	—	0.3	1.6	1.3	—
Plantago lanc.	0.3	0.4	1.6	—	—	0.7	2.0	12	8.8	1.1
Cerealea	—	—	—	—	—	—	0.3	1.6	1.0	—
Σ A.P.	742.5	239	320	116	158.5	410.5	356.5	1456	1343.5	350
Destruction D.b.	14	—	—	—	—	—	—	5.0	7.2	—

	XXVIII b	XXX	XXXII a	XXXII b	XXXII c	XXXII d	XXXIII			
Betula	13	15	12	8.0	7.0	5.3	6.9			
Pinus	4.0	18	9.0	7.8	8.5	5.3	7.6			
Salix	—	—	12	15	8.0	13	0.3			
Juniperus	—	—	—	—	—	0.1	—			
Populus	—	—	0.1	0.2	0.2	—	—			
Viburnum	—	—	0.6	1.1	1.6	1.5	—			
Corylus	38	15	13	8.9	13	12	30			
Quercus	6.2	13	14	19	18	18	1.0			
Fraxinus	0.3	—	0.7	0.5	0.6	0.6	—			
Tilia	0.9	3.7	0.3	0.4	0.2	0.2	1.4			
Ulmus	0.9	—	0.2	0.2	0.5	0.7	0.3			
Alnus	36	35	29	35	37	39	53			
Hedera	—	—	—	0.1	—	—	—			
Viscum	—	—	—	—	—	—	—			
Fagus	—	—	8.1	3.6	7.1	5.8	—			
Calluna	—	—	1.1	0.9	0.5	0.7	—			
Gramineae	0.9	126	118	83	69	55	2.1			
Cyperaceae	0.6	135	34	27	23	27	0.7			
Artemisia	1.2	—	4.3	4.0	4.6	4.7	—			
Rumex acet.	—	5.6	16	7.5	7.2	4.3	—			
Plantago lanc.	0.6	11	7.2	7.1	4.9	5.8	0.3			
Cerealea	—	3.7	1.0	1.0	1.4	1.9	—			
Σ A.P.	326	54	1154	1065	1399.5	1135	291			
Destruction D.b.	—	—	34	28	18	25	—			

Table B.

	1 a	1 b	1 c	2 a	2 b	2 c	2 d	3	5 a	5 b	7 b	8 b	9	10 b	11	12	13 a	13 b	14	15 a	15 b	15 c	15 d	16 a	16 b	17 b
SPERMATOPHYTA																										
Aceraceae																										
Acer sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Alismataceae																										
Alisma sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aquifoliaceae																										
Ilex aquifolium L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Araliaceae																										
Hedera Helix L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Betulaceae																										
Alnus glutinosa (L.) Gaertn.	1	..	6	..	..	..	..	..	..	2	..	3	1	..	..	8	..	5	..	..	..	..	2	3	1	1
Betula sp.	98	198	718	764	706	1127	742	744	541	583	417	271	312	669	637	386	6	65	99	562	593	532	569	39	3	213
Campanulaceae																										
Campanula sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Jasione montana L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cannabaceae																										
Humulus Lupulus L.	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	1	6	2	3	4	..	..	..
Caprifoliaceae																										
Lonicera Periclymenum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sambucus nigra L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Viburnum Opulus L.	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	?1	..	..	2	1	1	..	1
Caryophyllaceae																										
Caryophyllaceae sp.	..	2	..	..	..	..	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..
Cerastium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melandrium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spergularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chenopodiaceae																										
Chenopodiaceae sp.	..	..	7	..	..	..	..	1	..	..	..	..	4	..	1	..	..	1	..	..	1	..	..	..	..	..
Cistaceae																										
Helianthemum sp.	..	1	8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Compositae																										
Liguliflorae																										
Liguliflorae sp.	..	..	1	..	..	..	..	..	..	..	..	3	..	1	..	..	..	..	..	1	2	..	..	..	..	..
Tubuliflorae																										
Tubuliflorae sp.	..	..	1	..	1	..	..	3	2	..	..	1	1	..	1	..	..	..	..	..	1	..	3	10	1	3
Artemisia sp.	5	9	45	1	..	2	1	8	..	1	..	1	10	1	4	3	1	2	..	1	2	1	1	..	..	2
Cirsium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corylaceae																										
Carpinus Betulus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corylus Avellana L.			45	3	2	1	20	58	12	5	..	1	22	1	11	20	..	11	78	1075	1349	1075	879	269	59	331
Crassulaceae																										
Sedum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Cruciferae																										
Cruciferae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	10	..	1	..	2	..	..	..	..	..	..	..	..
Cupressaceae																										
Juniperus communis L.	4	40	36	1	..6	..	..	19	2	3	2	..	22	1	2	5	..	..	..	..	..	..	..	..	..	3
Cyperaceae																										
Cyperaceae sp.	47	116	311	17	16	17	20	401	56	87	69	96	262	674	392	95	36	151	37	64	79	39	64	42	6	38
Carex hirta-type	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Cladium Mariscus (L.) R. Br.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	38	..	..	..	15	17	13	16	1	..	8
Dipsacaceae																										
Succisa pratensis Moench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elaeagnaceae																										
Hippophaë rhamnoides L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Empetraceae																										
Empetrum sp.	7	12	x	1	..	1	1	17	..	..	..	1	5	..	1	..	..	..	..	..	..	..	..	..	..	..
Ericaceae																										
Ericaceae sp.	..	..	59	..	..	..	..	15	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calluna vulgaris (L.) Hull	..	..	..	..	..	1	..	..	1	2	..	..	8	2	5	..	..	..	..	4	10	6	3	1	1	2
Vaccinium-type	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euphorbiaceae																										
Mercurialis perennis L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fagaceae																										
Fagus silvatica L.	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Quercus sp.	1	1	8	..	..	..	..	5	1	2	..	4	1	..	2	5	..	1	..	2	3	3	3	5	..	..
Gentianaceae																										
Gentiana pneumonanthe-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Geraniaceae																										
Geranium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gramineae																										
Gramineae sp.	58	81	131	32	21	55	41	123	189	343	103	72	52	138	39	60	11	30	15	36	32	11	39	87	14	148
Cerealea																										
Cerealea sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
Secale cereale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Triticum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glyceria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Guttiferae																										
Hypericum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Haloragaceae																										
Myriophyllum alterniflorum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum spicatum L.	3	9	27	1	3	2	2	4	..	1	..	..	21	..	1	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum verticillatum L.	..	..	5	..	..	..	..	8	14	36	5	..	5	..	..	37	..	..	..	..	..	..	..	..	..	..
Hippuridaceae																										
Hippuris sp.	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Iridaceae																										
Iris Pseudacorus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaceae																										
Juncaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaginaceae																										
Triglochin sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	18 b	22	23 a	23 b	24	25	26 a	26 b	26 c	26 d	27	28 a	28 b	30	33	34 c	35	36 a	36 b	37	38	39	46 a	46 b
SPERMATOPHYTA																								
Aceraceae																								
Acer sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Alismataceae																								
Alisma sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aquifoliaceae																								
Ilex aquifolium L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Araliaceae																								
Hedera Helix L.	..	..	..	..	..	..	1	1	..	..	..	..	..	..	2	..	2	..	1	..	1	..	1	1
Betulaceae																								
Alnus glutinosa (L.) Gaertn.	4	7	..	..	..	2	..	63	2	..	2	15	49	15	4	3	46	..	7	..	64	2	27	7
Betula sp.	166	620	350	332	149	13	323	13	286	377	60	134	177	54	113	46	417	264	555	14	52	100	142	205
Campanulaceae																								
Campanula sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Jasione montana L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cannabaceae																								
Humulus Lupulus L.	..	2	2	3	..	..	2	..	1	..	2	2	2	2	?1	..	9	..	8	..	1	..	1	5
Caprifoliaceae																								
Lonicera Periclymenum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sambucus nigra L.	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Viburnum Opulus L.	..	1	4	3	1	..	..	..	..	..	4	..	..	2	?5	..	..	28	8	..	25	..	..	1
Caryophyllaceae																								
Caryophyllaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cerastium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melandrium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spergularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chenopodiaceae																								
Chenopodiaceae sp.	6	1	..	..	..	3	..	..	..	..	..	..	..	1	..	..	..	..	..	..	2	1	..	..
Cistaceae																								
Helianthemum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Compositae																								
Liguliflorae																								
Liguliflorae sp.	1	1	..	..	..	..	..	..	1	..	..	1	..	2	..	..	1	..	..	..	1	2	..	..
Tubuliflorae																								
Tubuliflorae sp.	1	14	..	1	..	..	3	3	1	1	7	3	3	..	..	9	3	2	6	11	1	10	1	1
Artemisia sp.	2	1	3	..	2	..	..	1	..	4	..	..	..	2	..	..	1	..	1	..	..	3	1	2
Cirsium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corylaceae																								
Carpinus Betulus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corylus Avellana L.	388	619	1408	1750	85	106	403	60	260	458	243	187	191	205	401	87	1908	719	2155	455	1023	378	938	1490
Crassulaceae																								
Sedum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cruciferae																								
Cruciferae sp.	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Cupressaceae																								
Juniperus communis L.	1	2	..	..	..	..	3	..	1	2	..	..	3	2	..	..	..	..	2	..	..	..	..	..
Cyperaceae																								
Cyperaceae sp.	59	131	36	28	180	28	74	19	49	78	21	29	33	128	8	87	44	104	131	151	63	48	24	13
Carex hirta-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cladium Mariscus (L.) R. Br.	55	..	3	7	1	2	24	15	23	16	..	15	13	45	..	..	37	..	1	..	..	..	17	13
Dipsacaceae																								
Succisa pratensis Moench	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elaeagnaceae																								
Hippophaë rhamnoides L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Empetraceae																								
Empetrum sp.	..	..	..	..	..	..	1	..	..	..	..	..	2	..	..	..	..	..	1	..	..	..	..	..
Ericaceae																								
Ericaceae sp.	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calluna vulgaris (L.) Hull	1	..	3	3	..	..	1	1	2	2	..	1	1	..	2	2	9	1	4	1	1	1	..	..
Vaccinium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euphorbiaceae																								
Mercurialis perennis L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fagaceae																								
Fagus silvatica L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Quercus sp.	3	4	3	9	1	2	..	3	1	..	1	4	9	10	7	11	98	4	5	1	25	4	12	12
Gentianaceae																								
Gentiana pneumonanthe-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Geraniaceae																								
Geranium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gramineae																								
Gramineae sp.	134	93	34	26	195	1	155	29	90	137	20	39	66	130	3	8	60	12	16	15	25	79	21	11
Cerealea																								
Cerealea sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Secale cereale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Triticum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glyceria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Guttiferae																								
Hypericum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Haloragaceae																								
Myriophyllum alterniflorum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum spicatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum verticillatum L.	..	..	..	..	..	..	14	..	2	11	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hippuridaceae																								
Hippuris sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Iridaceae																								
Iris Pseudacorus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Juncaceae																								
Juncaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaginaceae																								
Triglochin sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..

	53	54 a	54 b	55 a	55 b	56	57 a	57 b	57 c	57 d	58	59 a	59 b	60 b	61 a	61 b	62	63	64 a	64 b	64 c	64 d	65	66	67
SPERMATOPHYTA																									
Aceraceae																									
Acer sp.	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	3
Alismataceae																									
Alisma sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aquifoliaceae																									
Ilex aquifolium L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Araliaceae																									
Hedera Helix L.	..	2	3	3	2	..	..	1	1	..	1	1	..	..	..	..	..	..	..	..	1	..	2	1	6
Betulaceae																									
Alnus glutinosa (L.) Gaertn.	2	93	471	1348	313	215	79	86	333	142	266	194	245	189	55	27	50	237	59	64	58	57	127	530	218
Betula sp.	76	22	130	144	16	94	43	47	131	94	329	142	85	198	9	6	8	52	5	3	2	9	188	112	230
Campanulaceae																									
Campanula sp.	..	..	..	..	..	..	..	?1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Jasione montana L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cannabaceae																									
Humulus Lupulus L.	..	..	..	2	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caprifoliaceae																									
Lonicera Periclymenum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sambucus nigra L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Viburnum Opulus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caryophyllaceae																									
Caryophyllaceae sp.	..	..	..	1	..	..	..	..	..	1	40	..	..	1	..	..	1	..	..	..	..	..	..	..	..
Cerastium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
Melandrium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spergularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chenopodiaceae																									
Chenopodiaceae sp.	..	..	..	..	1	..	..	..	1	1	..	..	1	..	..	..	2	2	1	..	2	..	4	1	1
Cistaceae																									
Helianthemum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Compositae																									
Liguliflorae																									
Liguliflorae sp.	1	..	..	1	..	..	..	..	1	..	..	2	1	1	..	1	1	1	..	..	..	1	..	..	..
Tubuliflorae																									
Tubuliflorae sp.	..	1	..	2	..	..	..	3	1	2	..	2	4	4	..	..	1	23	..	..	1	3	..	2	..
Artemisia sp.	2	..	1	3	..	..	1	1	..	1	3	..	1	1	..	..	..	3	1	..	..	..	..	..	3
Cirsium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Corylaceae																									
Carpinus Betulus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corylus Avellana L.	3	45	239	111	17	81	28	40	65	139	361	106	123	43	20	15	30	133	25	23	33	29	384	164	231
Crassulaceae																									
Sedum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cruciferae																									
Cruciferae sp.	..	..	..	3	..	..	..	1	..	1	25	..	2	..	..	..	1	..	..	..	1	..	1	..	1
Cupressaceae																									
Juniperus communis L.	..	..	..	..	..	..	..	..	..	..	1	1	3	..	..	..	2	..	..	..	..	..	1	1	..
Cyperaceae																									
Cyperaceae sp.	83	14	54	30	5	105	18	22	26	49	215	190	125	51	59	39	57	177	13	23	33	45	60	34	92
Carex hirta-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cladium Mariscus (L.) R. Br.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dipsacaceae																									
Succisa pratensis Moench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elaeagnaceae																									
Hippophaë rhamnoides L.	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Empetraceae																									
Empetrum sp.	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ericaceae																									
Ericaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calluna vulgaris (L.) Hull	..	..	5	3	..	4	1	..	2	1	2	..	..	2	..	..	..	..	..	..	1	..	1	2	3
Vaccinium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euphorbiaceae																									
Mercurialis perennis L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fagaceae																									
Fagus silvatica L.	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	?1	..	..	..
Quercus sp.	..	37	296	79	25	105	39	28	63	123	244	62	54	77	6	9	75	123	10	16	29	20	92	228	335
Gentianaceae																									
Gentiana pneumonanthe-type	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Geraniaceae																									
Geranium sp.	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Gramineae																									
Gramineae sp.	12	..	5	38	19	15	39	39	41	198	205	19	28	49	12	6	32	35	21	20	30	32	13	15	9
Cerealea																									
Cerealea sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Secale cereale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Triticum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Glyceria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Guttiferae																									
Hypericum sp.	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Haloragaceae																									
Myriophyllum alterniflorum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum spicatum L.	?1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum verticillatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hippuridaceae																									
Hippuris sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Iridaceae																									
Iris Pseudacorus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaceae																									
Juncaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaginaceae																									
Triglochin sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	70 a	70 b	71 a	71 b	71 c	73 a	73 b	75	79	II a	II b	II c	III a	III b	IV a	IV b	IV c	V a	V b	V c	IX	X a	X b
SPERMATOPHYTA																							
Aceraceae																							
Acer sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	1	..	2	..	..	..
Alismataceae																							
Alisma sp.	..	..	..	..	..	..	..	..	..	2	..	..	..	..	6	2	2	1	1	2	1	..	..
Aquifoliaceae																							
Ilex aquifolium L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Araliaceae																							
Hedera Helix L.	..	1	..	..	..	1	+	1	..	2	7	8	..	1	4	2	..	..	..	1	1	..	1
Betulaceae																							
Alnus glutinosa (L.) Gaertn.	315	329	329	185	100	17	26	47	52	973	948	955	260	467	1141	1067	1023	1141	1093	1142	632	662	659
Betula sp.	121	118	49	58	97	13	7	80	202	102	149	137	46	117	251	210	221	221	239	194	101	216	112
Campanulaceae																							
Campanula sp.	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Jasione montana L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cannabaceae																							
Humulus Lupulus L.	..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	1	1	3	3	4	2	..	4
Caprifoliaceae																							
Lonicera Periclymenum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sambucus nigra L.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Viburnum Opulus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Caryophyllaceae																							
Caryophyllaceae sp.	1	..	..	..	..	..	..	..	..	+	1	..	..	..	..	..	..	..	..	..	..	..	..
Cerastium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Melandrium-type	1	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spergularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Chenopodiaceae																							
Chenopodiaceae sp.	1	3	..	..	..	..	1	4	1	2	2	..	..	1	5	3	..	1	1	4	..	2	3
Cistaceae																							
Helianthemum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Compositae																							
Liguliflorae																							
Liguliflorae sp.	..	2	2	5	..	..	1	..	3	..	..	..	..	..	..	..	1	..	..	1	2	..	2
Tubuliflorae																							
Tubuliflorae sp.	2	1	2	5	1	..	..	..	5	50	42	39	2	8	48	59	47	38	72	65	4	..	2
Artemisia sp.	1	1	3	3	2	..	..	1	..	..	5	1	1	1	12	11	7	5	12	8	11	7	7
Cirsium-type	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
Corylaceae																							
Carpinus Betulus L.	1	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..
Corylus Avellana L.	275	219	88	60	65	18	30	82	221	468	430	479	226	514	1347	1322	1256	1367	1259	1449	454	491	486
Crassulaceae																							
Sedum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cruciferae																							
Cruciferae sp.	..	1	3	2	1	..	..	..	..	..	2	2	..	..	1	1	1	..	2	..	1	..	..
Cupressaceae																							
Juniperus communis L.	..	1	1	..	..	..	..	..	..	..	1	..	..	..	..	2	1	4	3	7	..	..	..
Cyperaceae																							
Cyperaceae sp.	564	614	91	86	103	25	40	13	100	251	233	230	27	73	186	174	202	146	191	179	55	51	46
Carex hirta-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cladium Mariscus (L.) R. Br.	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Dipsacaceae																							
Succisa pratensis Moench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elaeagnaceae																							
Hippophaë rhamnoides L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Empetraceae																							
Empetrum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ericaceae																							
Ericaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calluna vulgaris (L.) Hull	4	6	4	11	4	1	..	1	3	4	6	2	1	1	10	5	8	8	8	2	1	..	1
Vaccinium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euphorbiaceae																							
Mercurialis perennis L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..
Fagaceae																							
Fagus silvatica L.	..	2	1	..	..	..	..	..	..	..	..	..	..	..	5	..	5	7	2	5	..	1	..
Quercus sp.	199	208	41	24	10	9	16	76	17	389	405	374	85	217	458	449	497	392	423	411	130	173	179
Gentianaceae																							
Gentiana pneumonanthe-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Geraniaceae																							
Geranium sp.	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gramineae																							
Gramineae sp.	28	22	112	112	21	7	14	10	49	127	159	215	15	93	93	123	115	73	127	125	44	23	23
Cerealea																							
Cerealea sp.	1	3	..	1	..	..	..	..	?2	3	7	1	1	1	2	..	1	2	1	..	1	..	2
Secale cereale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Triticum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glyceria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Guttiferae																							
Hypericum sp.	..	..	3	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	2	1	..
Haloragaceae																							
Myriophyllum alterniflorum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Myriophyllum spicatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum verticillatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hippuridaceae																							
Hippuris sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Iridaceae																							
Iris Pseudacorus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaceae																							
Juncaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
Juncaginaceae																							
Triglochin sp.	..	..	..	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	X c	XII a	XII b	XIII a	XIII b	XVII	XVIII	XIX a	XIX b	XX a	XX b	XX c	XXIV	XXVI	XXVII a	XXVII b	XXX	XXXII a	XXXII b	XXXII c	XXXII d
SPERMATOPHYTA																					
Aceraceae																					
Acer sp.	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Alismataceae																					
Alisma sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
Aquifoliaceae																					
Ilex aquifolium L.	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
Araliaceae																					
Hedera Helix L.	2	1	..	..	1	..	..	..	1	..	1	..	..	..	..	1	..	..	1	..	..
Betulaceae																					
Alnus glutinosa (L.) Gaertn.	647	972	714	498	494	175	810	322	474	303	247	256	40	114	592	698	19	333	374	511	437
Betula sp.	128	68	55	154	127	17	66	19	42	53	41	62	9	24	100	87	8	143	85	98	60
Campanulaceae																					
Campanula sp.	..	..	..	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1	..	..
Jasione montana L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	..	1	1	3	..
Cannabaceae																					
Humulus Lupulus L.	4	..	..	1	..	..	2	..	1	..	..	..	..	1	2	2	..	..	1	..	..
Caprifoliaceae																					
Lonicera Periclymenum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Sambucus nigra L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	3	5
Viburnum Opulus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7	12	22	17
Caryophyllaceae																					
Caryophyllaceae sp.	..	..	..	..	..	1	..	..	..	..	1	..	1	..	1	..	3	2	..	2	1
Cerastium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melandrium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spergularia sp.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..
Chenopodiaceae																					
Chenopodiaceae sp.	2	15	5	30	28	..	1	..	3	5	5	3	..	7	9	4	1	15	13	11	12
Cistaceae																					
Helianthemum sp.	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..
Compositae																					
Liguliflorae																					
Liguliflorae sp.	..	1	2	1	6	..	..	1	5	3	2	1	1	..	4	8	9	15	24	15	12
Tubuliflorae																					
Tubuliflorae sp.	2	2	4	5	5	17	7	5	5	1	2	2	3	2	2	3	1	92	61	77	51
Artemisia sp.	6	5	3	11	5	2	2	11	5	7	8	4	..	4	40	34	..	50	42	56	53
Cirsium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	8	5	6	8
Corylaceae																					
Carpinus Betulus L.	..	2	3	3	3	..	..	..	1	..	..	..	..	..	6	6	..	6	5	9	5
Corylus Avellana L.	414	287	197	519	482	198	212	101	125	165	126	144	60	102	435	318	8	151	94	179	133
Crassulaceae																					
Sedum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cruciferae																					
Cruciferae sp.	..	2	4	2	3	..	1	1	1	1	..	..	..	2	..	1	3	20	11	14	10
Cupressaceae																					
Juniperus communis L.	..	..	2	1	..	..	1	..	..	..	..	2	..	..	..	..	..	..	..	..	1
Cyperaceae																					
Cyperaceae sp.	65	60	49	77	181	4	27	71	64	10	4	6	45	12	97	145	73	396	290	326	307
Carex hirta-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cladium Mariscus (L.) R. Br.	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
Dipsacaceae																					
Succisa pratensis Moench	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	1	2	..
Elaeagnaceae																					
Hippophaë rhamnoides L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Empetraceae																					
Empetrum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Ericaceae																					
Ericaceae sp.	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calluna vulgaris (L.) Hull	..	..	..	2	..	1	1	..	..	5	1	7	..	..	9	6	..	13	10	7	8
Vaccinium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euphorbiaceae																					
Mercurialis perennis L.	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Fagaceae																					
Fagus silvatica L.	..	..	..	4	15	..	..	2	8	2	..	..	..	..	23	13	..	93	38	99	66
Quercus sp.	178	145	133	270	206	36	139	68	83	146	108	137	18	75	152	98	7	164	207	252	207
Gentianaceae																					
Gentiana pneumonanthe-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Geraniaceae																					
Geranium sp.	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gramineae																					
Gramineae sp.	21	62	48	86	140	3	39	37	43	112	84	76	11	35	354	322	68	1348	869	947	606
Cerealea																					
Cerealea sp.	..	..	..	3	5	..	1	..	..	3	1	..	..	1	24	14	1	9	5	14	11
Secale cereale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3	6	5	11
Triticum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glyceria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Guttiferae																					
Hypericum sp.	1	..	..	1	..	..	..	2	..	1	..	..	..	..	1	2	..	..	..	2	..
Haloragaceae																					
Myriophyllum alterniflorum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum spicatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myriophyllum verticillatum L.	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	1	..
Hippuridaceae																					
Hippuris sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
Iridaceae																					
Iris Pseudacorus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Juncaceae																					
Juncaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	1
Juncaginaceae																					
Triglochin sp.	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Table B (continued).

	1 a	1 b	1 c	2 a	2 b	2 c	2 d	3	5 a	5 b	7 b	8 b	9	10 b	11	12	13 a	13 b	14	15 a	15 b	15 c	15 d	16 a	16 b	17 b	18 b	22	23 a	23 b	24	25
Scheuchzeriaceae																																
Scheuchzeria palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..
Scrophulariaceae																																
Scrophulariaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
Melampyrum sp.	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Odontites-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Solanaceae																																
Solanum Dulcamara L.	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sparganiaceae																																
Sparganium-type	12	20	27	..	1	1	..	3	7	11	6	..	1	24	1	4	2	3	10	20	14	15	28	1	..	3	..	2	10	6	4	1
Taxaceae																																
Taxus baccata L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tiliaceae																																
Tilia sp.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..
Tilia cordata Mill.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Typhaceae																																
Typha latifolia L.	5	5	5	..	..	1	3	6	5	2	7	..	7	183	14	1	..	8	..	2	2	2	1	..	..	1	..	4	..	1	1	..
Ulmaceae																																
Ulmus sp.	..	..	1	1	1	1	..	2	1	1	..	..	..	..	3	3	1	..	..	10	13	7	9	28	2	1	2	2	10	33	..	1
Umbelliferae																																
Umbelliferae sp.	4	2	10	2	1	2	1	1	7	4	4	..	4	28	6	2	..	..	..	1	..	1	1	3	..	..	..	3	1	..	..	..
Urticaceae																																
Urtica sp.	..	..	1	..	..	..	..	..	..	1	2	..	..	..	2	2	..	..	1	1	2	1	2	1	..	1	4	1	..	2	1	..
Valerianaceae																																
Valeriana sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
a.i.d. (ad indeterminabile destructum)	..	..	3	..	..	..	..	2	12	39	13	14	2	2	2	2	5	13	20	..	1	1	..	70	5	12	10	9	5	..	18	1
a.i.p. (ad indeterminabile plicatum)	..	..	10	..	2	..	..	9	4	4	3	2	..	1	..	1	..	8	..	..	5	2	..	13	..	4	1	1	..	3	5	..
a.i.l. (ad indeterminabile latitans)	..	..	7	..	..	..	..	1	7	..	1	..	2	..	1	2	..	..	..	2	..	1	..	..	..	..	..	..	..	1	1	..
Σ Spermatophyta	314.5	622	1966.5	1114.5	996	1614	1224.5	1929	1380	1724	1020.5	795	986	2012.5	1583	1337	129	735.5	334	2405	2817	2299.5	2361	710	115.5	1180	1206	1973.5	2576	2925	1001.5	275
PTERIDOPHYTA																																
Equisetaceae																																
Equisetum sp.	6	112	306	6	..	4	1	128	..	7	33	8	96	2	25	5	..	..	..	..	1	1	..	8	..	5	5	5	1	..	1	..
Lycopodiaceae																																
Lycopodium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopodium clavatum-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopodium Selago L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophioglossaceae																																
Botrychium sp.	..	1	1	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophioglossum vulgatum L.	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Polypodiaceae																																
Dryopteris-type	..	..	130	55	57	75	80	25	253	208	104	479	2	57	443	143	10	435	9	43	104	60	37	48	9	232	180	588	34	26	12	ccc
(actually counted, cf. p. 182)			58									160			147													284				
Polypodium vulgare L.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pteridium aquilinum (L.) Kuhn	..	..	2	..	..	..	..	..	1	..	..	..	..	..	..	1	..	..	..	1	1	..	1	4	..	..	2	4	1	..	..	1
Thelypteris Dryopteris (L.) Slosson	6	22	43	5	6	10	2	..	1	9	..	1	..	4	12	4	1	..	..	..	1	1	2	..	..	1	..	1	1	..	..	..
Σ Pteridophyta	12	136	483	66	63	89	83	153	255	224	137	488	102	63	481	153	11	435	9	44	107	62	40	60	9	238	187	599	37	26	13	1
BRYOPHYTA																																
Sphagnaceae																																
Sphagnum sp.	..	3	8	4	2	3	3	6	2	2	..	2	3	..	11	2	..	2	..	..	1	..	..	1	1	..	1	2	..	..	..	..
Σ Bryophyta	..	3	8	4	2	3	3	6	2	2	..	2	3	..	11	2	..	2	..	..	1	..	..	1	1	..	1	2	..	..	..	..
THALLOPHYTA																																
Botryococcaceae																																
Botryococcus Braunii Kütz.	12	45	155	3	9	12	7	121	6	16	4	..	32	..	15	13	..	1	10	5	7	6	8	..	..	..	1	7	11	5	..	..
Characeae (cf. p. 182)			69					38																								
Characeae sp. (oospores)	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hydrodictyaceae																																
Pediastrum sp.	c	r–c	1368	6	2	4	16	3813	10	36	7	..	79	19	211	18	1	..	2	13	21	6	11	..	..	..	..	24	18	8	..	..
Tilletiaceae (cf. p. 182)			609					1195							70																	
Tilletia sphagni	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Σ Thallophyta	12	45	1523	9	12	16	23	3934	16	52	11	..	111	19	226	31	1	2	12	18	28	12	19	..	..	..	1	31	29	13	..	..
Ceratophyllum-hair	..	..	..	14	7	14	9	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	28	11	..	..
Nymphaea-hair	..	..	..	2	4	1	2	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..
Recent pollen contamination	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rebedded pollen and spores	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„Hystrix“	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„Pentagon“	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„Paraplya“	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Charcoal	..	..	1	c	r	r	r	15	3	c	r	cc	6	35	..	..	..	r	..	24	8	16	12	cc	c	cc	cc	..	c	r	ccc	..

	26 a	26 b	26 e	26 d	27	28 a	28 b	30	33	34 c	35	36 a	36 b	37	38	39	46 a	46 b	53	54 a	54 b	55 a	55 b	56	57 a	57 b	57 c	57 d	58	59 a	59 b	60 b	61 a	61 b	62
Scheuchzeriaceae																																			
Scheuchzeria palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scrophulariaceae																																			
Scrophulariaceae sp.	..	..	..	..	..	1	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	3	..	..	..
Melampyrum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Odontites-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Solanaceae																																			
Solanum Dulcamara L.	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sparganiaceae																																			
Sparganium-type	54	2	41	51	..	9	11	..	1	..	6	2	5	..	4	37	2	2	1	2	7	2	..	..	2	3	5	13	6	1	1	..	..	..	2
Taxaceae																																			
Taxus baccata L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Tiliaceae																																			
Tilia sp.	..	..	..	..	..	..	..	..	..	1	4	..	..	..	..	..	..	..	..	20	102	34	..	13	9	9	12	16	..	..	..	..	1	2	..
Tilia cordata Mill.	..	20	..	..	..	..	1	7	..	..	..	22	53	3	47	2	10	2	..	..	..	..	15	..	..	..	..	..	88	27	45	13	..	..	9
Typhaceae																																			
Typha latifolia L.	3	..	2	7	1	..	..	..	..	..	1	21	29	..	..	4	..	..	1	1	2	1	..	2	7	2	2	19	23	1	..	..	..	..	..
Ulmaceae																																			
Ulmus sp.	3	2	1	..	3	3	2	9	17	17	140	18	58	14	92	15	31	39	1	23	152	41	5	6	1	1	1	1	46	22	19	3	2	1	4
Umbelliferae																																			
Umbelliferae sp.	10	1	5	7	..	1	1	2	3	7	3	1	6	..	2	3	1	..	3	..	1	8	2	6	3	7	10	19	16	16	11	5	..	..	1
Urticaceae																																			
Urtica sp.	1	1	..	2	1	4	4	..	?1	4	..	4	4	..	2	..	..	3	..	..	1	9	9	1	..	..	..	2	3	8	8	1	2	..	1
Valerianaceae																																			
Valeriana sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
a.i.d. (ad indeterminabile destructum)	7	58	11	11	54	35	28	56	11	5	5	37	7	44	93	39	..	1	..	31	4	31	45	11	11	14	21	25	123	80	80	21	17	29	33
a.i.p. (ad indeterminabile plicatum)	1	8	6	2	3	2	2	10	21	15	3	4	3	1	19	..	1	..	..	..	3	4	2	3	..	..	..	..	22	3	4	3	3	..	5
a.i.l. (ad indeterminabile latitans)	..	..	1	1	..	..	..	1	..	27	..	..	1	..	2	2	..	..	..	..	..	3	..	4	..	1	1	1	..	1	..	..	1	..	..
Σ Spermatophyta	1361.5	359	1057.5	1511	538	839	952	1092	732	482.5	3390	1544	3537.5	808	2389	980	1379.5	2013	231.5	316	1712	2043	500.5	709	290.5	320	744	880.5	2379	1009.5	989	719	199	141	380.5
PTERIDOPHYTA																																			
Equisetaceae																																			
Equisetum sp.	10	..	7	23	19	5	2	10	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopodiaceae																																			
Lycopodium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	..	..	..	..
Lycopodium clavatum-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopodium Selago L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophioglossaceae																																			
Botrychium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophioglossum vulgatum L.	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polypodiaceae																																			
Dryopteris-type	99	174	65	101	108	266	280	1534	35	144	229	257	440	66	258	228	89	21	7	28	163	311	81	29	115	71	70	1442	154	209	343	71	31	53	3
(actually counted, cf. p. 182)																						91						277							
Polypodium vulgare L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1	1	..	..	2	..	..
Pteridium aquilinum (L.) Kuhn	..	..	..	..	1	3	2	9	..	6	12	1	7	..	8	1	..	4	..	..	4	11	1	4	..	1	1	1	4	2	6	4	1	1	..
Thelypteris Dryopteris (L.) Slosson	..	..	..	2	..	..	..	1	..	..	..	..	..	..	1	..	1	..	1	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	2
Σ Pteridophyta	109	174	72	126	128	275	284	1554	35	150	241	258	447	66	269	229	90	25	8	28	167	323	82	33	115	72	71	1443	162	213	351	75	34	54	5
BRYOPHYTA																																			
Sphagnaceae																																			
Sphagnum sp.	..	..	..	1	1	8	22	1	..	2	..	..	..	..	1	..	..	..	10	..	..	3	2	..	1	..	1	..	..	..	1	..	..	..	..
Σ Bryophyta	..	..	..	1	1	8	22	1	..	2	..	..	..	..	1	..	..	..	10	..	..	3	2	..	1	..	1	..	..	..	1	..	..	..	..
THALLOPHYTA																																			
Botryococcaceae																																			
Botryococcus Braunii Kütz.	9	..	19	13	..	4	5	1	7	..	5	1	..	..	..	..	77	85	3	..	1	..	..	2	..	..	..	..	..	..	..	..	1	..	2
Characeae (cf. p. 182)																																			
Characeae sp. (oospores)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hydrodictyaceae																																			
Pediastrum sp.	20	1	15	20	..	24	6	3	..	..	11	3	3	..	..	2	10	5	..	5	8	17	..	18	..	..	..	..	..	..	..	..	6	..	..
Tilletiaceae (cf. p. 182)																						5													
Tilletia sphagni	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Σ Thallophyta	29	1	34	33	..	28	11	4	7	..	16	4	3	..	..	2	87	90	3	5	9	17	..	20	..	..	..	..	..	..	..	..	7	..	2
Ceratophyllum-hair	..	..	..	..	..	..	..	..	..	..	..	..	17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaea-hair	..	..	..	..	..	1	..	..	27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Recent pollen contamination	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rebedded pollen and spores	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„Hystrix“	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
„Pentagon“	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„Paraplya“	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	2	..	..	..	..	..	..	..	33	3	..	..	..
Charcoal	cc	cc	c	cc	c	cc	cc	r	..	..	c	c	..	..	c	..	c	c	..	..	..	32	cc	20	..	..	..	..	c	r	r	c	9	11	..

	63	64 a	64 b	64 c	64 d	65	66	67	70 a	70 b	71 a	71 b	71 c	73 a	73 b	75	79	II a	II b	II c	III a	III b
Scheuchzeriaceae																						
Scheuchzeria palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scrophulariaceae																						
Scrophulariaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melampyrum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Odontites-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Solanaceae																						
Solanum Dulcamara L.	..	..	..	..	..	..	..	..	..	..	7	1	..	..	..	..	..	1	1	3	..	..
Sparganiaceae																						
Sparganium-type	2	1	..	..	..	..	..	4	1	..	6	6	1	..	..	1	..	47	32	41	2	11
Taxaceae																						
Taxus baccata L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tiliaceae																						
Tilia sp.	27	7	10	9	16	..	..	86	..	..	..	..	..	..	..	28	48	..	..	..	28	..
Tilia cordata Mill.	..	..	..	..	..	46	54	..	33	38	5	8	..	30	57	..	..	119	111	117	..	49
Typhaceae																						
Typha latifolia L.	36	..	..	..	..	..	..	4	7	4	1	1	2	..	1	..	..	10	24	9	1	1
Ulmaceae																						
Ulmus sp.	18	2	6	3	3	10	14	22	47	48	10	2	5	10	20	19	40	167	149	163	32	71
Umbelliferae																						
Umbelliferae sp.	20	1	3	5	1	7	1	3	1	1	7	2	1	..	..	..	2	84	86	50	9	12
Urticaceae																						
Urtica sp.	24	1	..	..	..	1	1	4	4	2	144	19	9	..	1	..	3	5	6	9	..	1
Valerianaceae																						
Valeriana sp.	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
a.i.d. (ad indeterminabile destructum)	105	66	36	47	38	59	3	35	40	68	43	24	2	23	60	13	34	12	7	5	2	3
a.i.p. (ad indeterminabile plicatum)	1	..	..	..	..	8	1	..	9	7	4	3	1	5	2	..	17	2	2	1	1	5
a.i.l. (ad indeterminabile latitans)	..	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	3	1	..	..	1	..
Σ Spermatophyta	1095.5	239.5	224	289	287	1062.5	1250	1476	1854	1945	1079	741.5	642	201.5	310	489	1190	3174.5	3202	3156.5	782	1792.5
PTERIDOPHYTA																						
Equisetaceae																						
Equisetum sp.	..	..	..	..	..	..	..	..	..	..	2	2	3	..	..	..	..	..	1	..	..	..
Lycopodiaceae																						
Lycopodium sp.	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Lycopodium clavatum-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Lycopodium Selago L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophioglossaceae																						
Botrychium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophioglossum vulgatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Polypodiaceae																						
Dryopteris-type	6888	145	298	376	314	48	134	1044	289	394	106	156	95	26	1216	10	286	1245	804	1301	c	334
(actually counted, cf. p. 182)	810	73			90			390	173	276					260			427	186	313		
Polypodium vulgare L.	1	..	..	..	..	1	..	2	4	6	..	3	..	..	1	..	1	1	..	..	..	..
Pteridium aquilinum (L.) Kuhn	..	..	1	6	1	6	1	5	5	13	..	..	..	1	3	4	1	13	5	11	2	3
Thelypteris Dryopteris (L.) Slosson	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	7	..	..	..	..	..
Σ Pteridophyta	6889	145	299	382	315	55	135	1051	299	415	108	161	98	27	1220	14	296	1259	810	1312	2	338
BRYOPHYTA																						
Sphagnaceae																						
Sphagnum sp.	..	1	2	..	2	..	..	2	6	4	2	1	1	..	..	5	5	..	..	1	..	..
Σ Bryophyta	..	1	2	..	2	..	..	2	6	4	2	1	1	..	..	5	5	..	..	1	..	..
THALLOPHYTA																						
Botryococcaceae																						
Botryococcus Braunii Kütz.	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	9	26	23	79	20	29
Characeae (cf. p. 182)																	3			19		
Characeae sp. (oospores)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r
Hydrodictyaceae																						
Pediastrum sp.	..	..	..	..	..	..	2	5	..	1	..	..	1	..	..	..	1	5103	6656	4070	cc	1107
Tilletiaceae (cf. p. 182)																		1750	1540	981		350
Tilletia sphagni	..	..	..	..	..	..	..	..	..	1	1	..	..	..	1	..	..	..	..	..	..	..
Σ Thallophyta	..	..	..	..	..	..	2	9	..	2	1	..	1	..	1	..	10	5129	6679	4149	20	1136
Ceratophyllum-hair	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	r	r	..	r
Nymphaea-hair	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	r	r	c	r
Recent pollen contamination	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rebedded pollen and spores	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	..	..	..	..	..	..
„Hystrix“	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	8	..	..	..	..	..	..
„Pentagon“	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
„Paraplya“	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	34	34	20	..	..
Charcoal	cc	..	..	..	..	c	c	9	9	4	cc	c	c	r	cc	..	5	c	c	c	..	r

	IV a	IV b	IV c	V a	V b	V c	IX	X a	X b	X c	XII a	XII b	XIII a	XIII b	XVII	XVIII	XIX a	XIX b	XX a	XX b	XX c	XXIV	XXVI	XXVII a	XXVII b	XXX	XXXII a	XXXII b	XXXII c	XXXII d
Scheuchzeriaceae																														
Scheuchzeria palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scrophulariaceae																														
Scrophulariaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	9	3	4
Melampyrum sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	4	6	3
Odontites-type	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Solanaceae																														
Solanum Dulcamara L.	..	2	1	..	..	..	..	..	..	..	..	3	..	1	..	2	2	..	..	..	..	..	..	..	1	..	6	4	4	2
Sparganiaceae																														
Sparganium-type	70	98	101	57	85	65	2	3	..	4	9	15	8	23	1	17	5	11	..	..	..	1	..	29	28	2	37	14	24	6
Taxaceae																														
Taxus baccata L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	2	..	3
Tiliaceae																														
Tilia sp.	51	39	35	28	40	25	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	5	4	..	..	2	4	4	3	2
Tilia cordata Mill.	..	..	..	..	..	..	33	33	53	54	13	13	21	12	..	14	16	17	17	16	20	..	..	18	15	..	..	..	..	..
Typhaceae																														
Typha latifolia L.	18	13	20	22	16	22	22	18	19	18	16	13	11	114	..	4	..	1	1	..	..	..	..	4	3	..	10	11	8	4
Ulmaceae																														
Ulmus sp.	34	31	29	32	38	30	37	21	50	30	10	13	18	12	2	8	7	12	3	8	3	2	3	24	20	..	2	2	7	8
Umbelliferae																														
Umbelliferae sp.	123	115	102	93	202	207	5	6	..	..	7	11	2	6	2	14	14	14	2	..	2	..	1	11	12	1	61	50	78	42
Urticaceae																														
Urtica sp.	3	5	3	2	12	8	7	11	9	4	62	61	10	12	..	19	6	6	1	11	5	..	..	7	4	..	21	51	38	40
Valerianaceae																														
Valeriana sp.	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	..	2	3	4	..
a.i.d. (ad indeterminabile destructum)	4	4	9	6	10	9	14	2	..	7	41	42	16	15	14	11	49	51	21	9	22	40	19	8	10	30	71	67	42	43
a.i.p. (ad indeterminabile plicatum)	8	5	4	4	4	5	1	2	..	1	7	4	4	3	1	1	..	4	9	5	6	3	1	5	4	2	5	13	18	6
a.i.l. (ad indeterminabile latitans)	..	3	1	..	1	1	..	..	1	..	..	1	..	1	1	..	..	..	4	1	1	9	..	2	1	..	6	13	4	2
Σ Spermatophyta	4216	4054	4033.5	3916	4199.5	4184	1739	1868.5	1820.5	1720	1901	1506.5	1982	2113.5	498	1511.5	826	1083	1016	809	915.5	273.5	466.5	2315	2141	274	4029	3185	3650.5	2813
PTERIDOPHYTA																														
Equisetaceae																														
Equisetum sp.	..	..	..	..	..	..	..	1	1	..	..	1	..	..	..	..	1	2	..	..	..	..	..	..	1	..	..	..	..	..
Lycopodiaceae																														
Lycopodium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Lycopodium clavatum-type	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopodium Selago L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Ophioglossaceae																														
Botrychium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Ophioglossum vulgatum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	3	2	6	1
Polypodiaceae																														
Dryopteris-type	204	162	153	159	216	418	839	426	407	569	147	241	226	429	241	31	50	63	12	9	17	85	10	547	328	50	684	415	565	353
(actually counted, cf. p. 182)							435			352					67							40		242	189					
Polypodium vulgare L.	..	..	1	2	1	..	..	..	1	..	..	..	..	..	..	..	1	4	2	2	2	..	..	..	1	..	..	..	..	1
Pteridium aquilinum (L.) Kuhn	11	11	13	18	14	19	5	6	11	5	8	..	12	8	2	5	3	5	7	11	8	3	4	10	3	..	9	5	1	7
Thelypteris Dryopteris (L.) Slosson	1	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Σ Pteridophyta	216	173	167	179	231	437	844	433	422	575	155	242	238	439	243	36	55	74	21	22	27	88	14	557	333	51	696	422	572	365
BRYOPHYTA																														
Sphagnaceae																														
Sphagnum sp.	1	5	..	..	..	..	..	..	1	..	..	2	..	5	..	1	3	..	1	..	..	..	..	3	..	..	3	3	2	3
Σ Bryophyta	1	5	..	..	..	..	..	..	1	..	..	2	..	5	..	1	3	..	1	..	..	..	..	3	..	..	3	3	2	3
THALLOPHYTA																														
Botryococcaceae																														
Botryococcus Braunii Kütz.	14	22	13	17	31	41	5	7	5	6	1	..	3	3	..	5	..	4	..	..	..	..	..	102	61	..	..	2	1	1
Characeae (cf. p. 182)																									35					
Characeae sp. (oospores)	..	..	..	..	..	..	r	r	r	r	..	..	r	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hydrodictyaceae																														
Pediastrum sp.	289	432	360	571	1316	298	52	61	131	29	10	6	34	91	1	562	185	198	..	1	2	..	rr	262	284	..	2	1	..	1
Tilletiaceae (cf. p. 182)	70	109	128	172	351	103	27									288								116	164					
Tilletia sphagni	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Σ Thallophyta	303	454	373	588	1347	339	57	68	136	35	11	6	37	94	1	567	185	202	..	1	2	..	..	364	345	..	2	3	1	2
Ceratophyllum-hair	..	..	..	..	..	..	r	c	r	r	..	..	1	1	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaea-hair	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Recent pollen contamination	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rebedded pollen and spores	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	6	6	4	..	..	..	..	..	..	..	..	..
„Hystrix“	..	..	..	..	..	..	..	..	..	..	3	1	..	1	..	..	..	..	2	5	7	..	..	..	..	..	..	..	..	..
„Pentagon“	..	..	..	..	..	..	..	..	..	..	2	..	5	2	..	..	..	..	1	2	3	..	..	..	..	..	..	..	..	..
„Paraplya“	4	1	1	5	..	1	10	..	2	1	1	1	2	2	..	4	6	8	..	..	..	..	..	1	1	..	1	..	5	..
Charcoal	17	1	4	4	..	..	c	c	c	c	c	c	c	c	..	c	cc	c	cc	cc	cc	..	..	cc	c	..	c	c	c	c

Table B (continued).

	1 a	1 b	1 c	2 a	2 b	2 c	2 d	3	5 a	5 b	7 b	8 b	9	10 b	11	12	13 a	13 b	14	15 a
Labiatae																				
Labiatae sp.	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..
Galeopsis sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopus europaeus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mentha-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stachys sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
cf. Teucrium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Leguminosae																				
Leguminosae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Lotus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trifolium pratense-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trifolium repens-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lemnaceae																				
Lemnaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
Lentibulariaceae																				
Utricularia sp.	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
Liliaceae																				
Allium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Allium ursinum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Loranthaceae																				
Viscum album L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lythraceae																				
Lythrum Salicaria L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Menyanthaceae																				
Menyanthes trifoliata L.	..	..	..	1	..	1	1	2	6	5	3	..	..	..	5	1	..	2	..	..
Myricaceae																				
Myrica Gale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaeaceae																				
Nuphar sp.	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Nymphaea sp.	..	..	..	20	23	31	21	75	12	21	11	2	..	..	38	21	..	..	4	65
Oleaceae																				
Fraxinus excelsior L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Onagraceae																				
Onagraceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chamaenerion angustifolium (L.) Scop.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Epilobium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orchidaceae																				
Epipactis-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pinaceae																				
Abies sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Picea sp.	..	2	7.5	..	..	..	..	..	..	..	..	..	0.5	..	..	..	..	..	1	..
Pinus silvestris L.	41.5	48	288	224.5	183	260	276.5	240	451	436	263.5	299	166.5	255.5	328	595	63	421.5	56	444
Plantaginaceae																				
Plantago lanceolata L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Plantago major L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago major/media	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..
Plantago maritima L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago media L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polygonaceae																				
Polygonum acivulare-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polygonum Persicaria-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rumex sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rumex Acetosella-type	1	..	1	1	..	2	2	3	..	..	1	..	..	..	4	..	..	..	1	..
Rumex Hydrolapathum Huds.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potamogetonaceae																				
Potamogeton sp.	..	1	..	..	..	..	..	21	..	..	..	..	1	1	5	2	..	..	..	..
Coleogeton sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eupotamogeton sp.	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..
Primulaceae																				
Hottonia palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lysimachia sp.	..	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..
Ranunculaceae																				
Ranunculaceae sp.	8	27	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
Anemone sp.	..	..	..	..	..	..	..	18	..	..	..	..	3	..	..	..	..	..	..	..
Batrachium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caltha palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ranunculus sp.	..	..	96	..	1	2	..	2	9	8	..	..	2	..	6	..	..	..	..	..
Ranunculus repens-type	..	..	..	..	..	..	..	4	..	..	4	..	..	..	..	..	..	..	..	..
Thalictrum sp.	..	..	3	1	..	..	..	3	..	1	..	..	2	..	2	3	..	..	..	..
Rhamnaceae																				
Rhamnus catharticus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rhamnus Frangula L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rosaceae																				
Rosaceae sp.	..	..	2	1	..	..	..	..	..	..	..	..	2	..	..	..	1	..	1	..
Crataegus-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Filipendula sp.	4	15	29	3	8	11	5	43	8	9	8	4	22	5	21	6	..	2	..	12
Fragaria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potentilla sp.	..	2	10	..	..	..	..	5	..	..	..	..	2	..	..	..	..	..	..	..
Prunus Padus L.	..	..	..	1	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Rubus-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sanguisorba minor Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sorbus sp.	..	..	..	..	1	..	..	..	..	..	1	..	..	..	..	2	..	..	..	2
Rubiaceae																				
Galium sp.	..	..	4	..	..	2	..	3	..	1	..	..	3	..	..	..	..	..	..	..
Ruppiaceae																				
Ruppia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Salicaceae																				
Populus tremula L.	..	..	13	26	18	58	70	22	16	80	75	13	12	2	14	21	1	4	4	62
Salix sp.	12	31	39	13	7	32	17	56	10	32	16	6	27	3	34	7	2	5	4	18
Saxifragaceae																				
Saxifraga oppositifolia-type	2	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	..	..

	15 b	15 c	15 d	16 a	16 b	17 b	18 b	22	23 a	23 b	24	25	26 a	26 b	26 c	26 d	27	28 a	28 b	30	33	34 c	35	36 a	36 b	37	38	39	46 a	46 b	53
Labiatae																															
Labiatae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Galeopsis sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopus europaeus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mentha-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stachys sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
cf. Teucrium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Leguminosae																															
Leguminosae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Lotus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trifolium pratense-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trifolium repens-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lemnaceae																															
Lemnaceae sp.	..	..	..	..	..	..	..	10	3	42	..	..	2	..	6	7	..	..	..	..	..	..	..	29	59	..	..	..	..	..	..
Lentibulariaceae																															
Utricularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Liliaceae																															
Allium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Allium ursinum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Loranthaceae																															
Viscum album L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lythraceae																															
Lythrum Salicaria L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Menyanthaceae																															
Menyanthes trifoliata L.	1	..	..	..	1	5	3	..	1	1	..	..	..	1	1	..	..	..	..	..	..	..	1	..	..	..	..	2	..	..	..
Myricaceae																															
Myrica Gale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaeaceae																															
Nuphar sp.	..	..	..	..	..	1	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaea sp.	77	46	53	..	..	6	6	1	29	11	..	..	19	..	21	23	..	2	3	..	2	..	21	4	..	..	..	5	2	1	..
Oleaceae																															
Fraxinus excelsior L.	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..
Onagraceae																															
Onagraceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chamaenerion angustifolium (L.) Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Epilobium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orchidaceae																															
Epipactis-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pinaceae																															
Abies sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Picea sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pinus silvestris L.	525	487.5	580	109	19.5	359	332	356.5	545	556	309.5	113	172.5	53	171.5	217	105	320	309	389	120	149.5	540	176	288.5	86	170	227	128.5	184	34.5
Plantaginaceae																															
Plantago lanceolata L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago major L.	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago major/media	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Plantago maritima L.	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago media L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polygonaceae																															
Polygonum acivulare-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polygonum Persicaria-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rumex sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Rumex Acetosella-type	2	..	..	..	..	..	1	3	1	1	..	..	2	..	..	..	..	..	1	1	..	1	2	1	..	..	..	..	1	..	..
Rumex Hydrolapathum Huds.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potamogetonaceae																															
Potamogeton sp.	..	..	2	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coleogeton sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eupotamogeton sp.	..	..	..	..	..	..	..	..	18	7	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..
Primulaceae																															
Hottonia palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lysimachia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ranunculaceae																															
Ranunculaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anemone sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Batrachium-type	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caltha palustris L.	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Ranunculus sp.	1	..	1	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Ranunculus repens-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Thalictrum sp.	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Rhamnaceae																															
Rhamnus catharticus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rhamnus Frangula L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	..	..	..	..	1	..	..	..	..	..	..	..
Rosaceae																															
Rosaceae sp.	2	..	..	..	..	..	..	..	..	1	..	..	1	..	1	..	2	1	..	..	..	..	1	1	1	..	1	..	..	..	2
Crataegus-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Filipendula sp.	11	2	5	7	1	3	..	12	2	4	3	..	10	1	4	10	1	4	1	2	..	1	7	5	7	6	4	6	..	1	..
Fragaria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potentilla sp.	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	1	1	..
Prunus Padus L.	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rubus-type	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sanguisorba minor Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sorbus sp.	..	2	..	..	..	2	..	..	..	4	..	..	..	..	..	1	..	..	1	..	..	..	2	1	13	..	2	..	1	..	..
Rubiaceae																															
Galium sp.	1	..	..	..	..	..	2	..	..	..	..	1	..	..	1	1	..	1	2	..	..	..	..	2	..	1	..	..	..	..	..
Ruppiaceae																															
Ruppia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Salicaceae																															
Populus tremula L.	55	33	76	3	..	21	17	38	89	62	37	..	59	1	47	65	6	18	21	5	2	..	15	69	80	2	1	3	4	7	..
Salix sp.	13	11	17	16	1	10	3	28	16	27	6	1	13	1	17	16	2	7	9	9	8	2	3	12	22	3	661	5	11	10	2
Saxifragaceae																															
Saxifraga oppositifolia-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	54 a	54 b	55 a	55 b	56	57 a	57 b	57 c	57 d	58	59 a	59 b	60 b	61 a	61 b	62	63	64 a	64 b	64 c	64 d	65	66	67	70 a	70 b	71 a	71 b	71 c	73 a	73 b	75	79
Labiatae																																	
Labiatae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Galeopsis sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopus europaeus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mentha-type	..	..	..	..	..	1	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stachys sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
cf. Teucrium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Leguminosae																																	
Leguminosae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..
Lotus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trifolium pratense-type	..	..	..	..	1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trifolium repens-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lemnaceae																																	
Lemnaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..
Lentibulariaceae																																	
Utricularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Liliaceae																																	
Allium sp.	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Allium ursinum L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
Loranthaceae																																	
Viscum album L.	..	4	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lythraceae																																	
Lythrum Salicaria L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Menyanthaceae																																	
Menyanthes trifoliata L.	..	..	1	2	..	..	..	..	1	2	1	1	..	..	..	..	1	..	1	..	..	..	..	..	..	..	1	1	2	..	..	..	..
Myricaceae																																	
Myrica Gale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaeaceae																																	
Nuphar sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nymphaea sp.	2	6	..	..	4	..	2	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	1	..	..	..	..
Oleaceae																																	
Fraxinus excelsior L.	..	1	19	8	6	3	2	3	..	10	3	3	5	3	2	19	38	3	3	6	1	24	36	46	12	9	1	4	..	..	..	3	1
Onagraceae																																	
Onagraceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chamaenerion angustifolium (L.) Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Epilobium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orchidaceae																																	
Epipactis-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pinaceae																																	
Abies sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
Picea sp.	..	..	0.5	..	..	..	..	..	0.5	..	1	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..
Pinus silvestris L.	21	204	49.5	4.5	21	1.5	5	14	11	70	47.5	104	23	4	..	10.5	25.5	13.5	14	19	28	23.5	31	60	109	138	45	48.5	195	24.5	26	110	357
Plantaginaceae																																	
Plantago lanceolata L.	..	..	3	1	1	1	1	3	..	2	..	1	2	1	..	1	1	..	1	1	1	3	2	3	..	2	6	6	..	..	..	..	..
Plantago major L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	1	..	..	..	..
Plantago major/media	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago maritima L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago media L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polygonaceae																																	
Polygonum acivulare-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	..	2	..	..	..	..	..
Polygonum Persicaria-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rumex sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rumex Acetosella-type	..	..	13	1	3	2	2	2	7	261	57	31	11	4	..	..	1	4	..	4	1	2	1	66	52	87	15	14	2	3	5	..	..
Rumex Hydrolapathum Huds.	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potamogetonaceae																																	
Potamogeton sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..
Coleogeton sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eupotamogeton sp.	..	..	..	..	..	..	..	1	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	14	3	..	..
Primulaceae																																	
Hottonia palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lysimachia sp.	..	..	..	..	..	..	..	..	3	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Ranunculaceae																																	
Ranunculaceae sp.	..	..	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
Anemone sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Batrachium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caltha palustris L.	..	..	2	1	1	..	..	?1	..	2	14	..	1	..	..	..	..	..	..	..	..	..	1	3	..	..	..	1	..	..	..	..	..
Ranunculus sp.	..	..	..	..	..	..	..	1	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ranunculus repens-type	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
Thalictrum sp.	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	1	..	..	..	1	..	..	..	..	..
Rhamnaceae																																	
Rhamnus catharticus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rhamnus Frangula L.	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..
Rosaceae																																	
Rosaceae sp.	..	..	2	..	..	..	..	..	1	1	1	..	1	..	..	..	..	..	..	..	..	..	6	..	..	..	2	..	..	..	..	..	..
Crataegus-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Filipendula sp.	..	..	41	6	..	..	1	..	1	1	1	2	1	..	1	1	1	..	..	..	..	..	..	1	4	3	40	16	3	..	..	..	12
Fragaria sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potentilla sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..
Prunus Padus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rubus-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
Sanguisorba minor Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sorbus sp.	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rubiaceae																																	
Galium sp.	1	..	2	..	2	..	..	..	..	..	4	1	1	..	1	2	..	..	..	..	..	..	..	..	..	2	5	4	3	..	..	..	1
Ruppiaceae																																	
Ruppia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	27	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
Salicaceae																																	
Populus tremula L.	1	17	2	..	3	..	..	..	1	..	..	..	1	..	..	..	1	..	..	..	..	..	1	1	9	2	..	..	2	..	..	..	7
Salix sp.	..	2	3	..	..	..	..	1	2	6	..	..	2	..	..	2	6	7	1	3	1	3	1	1	2	2	4	4	6	..	..	..	10
Saxifragaceae																																	
Saxifraga oppositifolia-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

	II a	II b	II c	III a	III b	IV a	IV b	IV c	V a	V b	V c	IX	X a	X b	X c	XII a	XII b	XIII a	XIII b	XVII	XVIII	XIX a	XIX b	XX a	XX b	XX c	XXIV	XXVI	XXVII a	XXVII b	XXX	XXXII a	XXXII b	XXXII c	XXXII d
Labiatae																																			
Labiatae sp.	..	..	..	..	..	1	..	..	..	..	..	2	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Galeopsis sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lycopus europaeus L.	..	..	..	..	..	..	3	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mentha-type	1	1	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	2	7	1
Stachys sp.	..	5	1	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	..	1
cf. Teucrium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Leguminosae																																			
Leguminosae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7	6	5	4
Lotus sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
Trifolium pratense-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	5	2	3	4
Trifolium repens-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..
Lemnaceae																																			
Lemnaceae sp.	3	..	1	..	..	2	4	2	3	3	1	38	32	53	31	..	..	..	9	..	1	..	..	..	..	..	..	..	..	..	..	5	5	3	2
Lentibulariaceae																																			
Utricularia sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Liliaceae																																			
Allium sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
Allium ursinum L.	1	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
Loranthaceae																																			
Viscum album L.	..	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..
Lythraceae																																			
Lythrum Salicaria L.	13	14	7	1	1	30	11	43	9	65	16	1	1	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	2	3	4	5
Menyanthaceae																																			
Menyanthes trifoliata L.	4	2	1	..	1	1	..	..	..	..	2	2	2	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	14	10	..	33	10	11	1
Myricaceae																																			
Myrica Gale L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Nymphaeaceae																																			
Nuphar sp.	2	2	2	..	1	13	5	7	6	7	4	..	..	..	..	..	..	..	..	..	2	1	2	..	..	..	..	..	..	..	..	1	4	3	1
Nymphaea sp.	5	7	14	4	11	20	14	13	13	13	10	11	1	..	..	..	..	1	..	1	6	3	2	..	..	..	..	..	..	..	..	..	..	..	..
Oleaceae																																			
Fraxinus excelsior L.	83	109	74	3	33	44	74	62	42	79	80	25	37	49	30	23	28	47	39	3	31	15	14	43	42	61	2	7	24	33	..	8	5	8	7
Onagraceae																																			
Onagraceae sp.	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chamaenerion angustifolium (L.) Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Epilobium sp.	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orchidaceae																																			
Epipactis-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..	..	..	..	..
Pinaceae																																			
Abies sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..
Picea sp.	1.5	2.5	..	..	..	1	3.5	3	2.5	3.5	2.5	..	0.5	0.5	1	..	..	2	..	..	1	..	..	1	1	..	..	0.5	..	0.5	..	1.5	2	..	..
Pinus silvestris L.	178	197.5	187.5	27	68.5	150	118.5	141.5	134.5	127	108.5	33	29	28	25	50	43.5	95	93.5	9	37.5	39	61	52	33	54.5	20.5	25	78	49	10	103.5	83	118.5	60
Plantaginaceae																																			
Plantago lanceolata L.	..	1	..	2	14	28	22	28	28	18	32	23	3	4	9	4	5	24	16	4	5	4	7	5	6	2	..	7	169	118	6	83	75	69	66
Plantago major L.	..	..	..	..	..	..	2	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	1	2	..	1
Plantago major/media	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Plantago maritima L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	1	..	..	2	..	..
Plantago media L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..
Polygonaceae																																			
Polygonum acivulare-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	3	..	..
Polygonum Persicaria-type	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	3	1	..
Rumex sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Rumex Acetosella-type	..	2	..	..	1	3	7	5	1	3	3	3	..	..	2	2	2	4	11	1	7	2	1	1	4	5	1	1	23	17	3	186	80	100	49
Rumex Hydrolapathum Huds.	2	3	..	..	1	5	2	1	2	3	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Potamogetonaceae																																			
Potamogeton sp.	..	..	..	..	..	..	3	2	4	6	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	16	8	8	3
Coleogeton sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Eupotamogeton sp.	8	10	9	..	..	..	..	..	..	..	..	7	2	2	4	5	..	3	4	..	1	1	1	..	..	..	..	..	10	15	..	..	..	..	..
Primulaceae																																			
Hottonia palustris L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	3	..	1
Lysimachia sp.	4	1	..	..	..	1	..	1	..	1	1	1	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	2	3
Ranunculaceae																																			
Ranunculaceae sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..
Anemone sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
Batrachium-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..
Caltha palustris L.	2	1	2	..	2	1	2	1	1	1	3	..	..	..	..	2	11	1	..	..	2	1	..	..	..	..	..	..	1	1	..	10	11	15	14
Ranunculus sp.	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..
Ranunculus repens-type	1	..	..	..	..	..	1	1	2	..	1	..	..	1	..	1	..	..	1	..	2	..	2	..	..	..	..	..	1	3	..	7	5	7	8
Thalictrum sp.	..	1	..	..	..	1	1	..	1	..	1	..	..	..	..	..	..	1	..	..	..	..	..	1	2	..	..	..	1	1	..	..	2	1	..
Rhamnaceae																																			
Rhamnus catharticus L.	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	1	2	1	..	..	..	..	..	..	..	..	47	23	28	24
Rhamnus Frangula L.	..	..	..	..	..	..	..	..	..	1	..	1	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	14	16	19	7
Rosaceae																																			
Rosaceae sp.	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	4	1	..	1	..	..	..	..	1	..	..	..	..	..	1	..	2	..	1	..
Crataegus-type	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Filipendula sp.	..	..	..	..	3	3	4	1	..	1	1	..	3	1	2	1	5	2	3	..	1	..	3	7	4	6	..	1	8	7	12	179	222	196	225
Fragaria sp.	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potentilla sp.	2	..	..	..	2	..	..	1	..	..	2	..	1	..	2	..	1	..	2	..	..	..	..	..	..	..	..	..	4	..	..	11	11	2	4
Prunus Padus L.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rubus-type	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1	..	..	1	..	..	..	..	1	..
Sanguisorba minor Scop.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Sorbus sp.	..	..	..	..	..	..	1	1	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Rubiaceae																																			
Galium sp.	3	2	3	1	1	3	3	2	2	..	8	1	..	..	1	2	..	3	6	..	1	2	..	..	1	..	..	..	3	7	2	33	21	19	14
Ruppiaceae																																			
Ruppia sp.	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	10	5	33	14	..	..	..	..	26	28	18	..	16	..	..	..	..	..	..	..
Salicaceae																																			
Populus tremula L.	8	10	8	1	2	1	4	1	1	1	4	8	17	7	15	2	..	1	2	..	3	1	3	1	4	3	..	2	1	2	..	1	2	3	..
Salix sp.	30	13	4	1	3	24	20	21	8	18	25	13	14	10	8	5	2	2	2	..	9	12	6	..	2	..	2	..	3	4	..	144	164	112	149
Saxifragaceae																																			
Saxifraga oppositifolia-type	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

LITERATURE

Abbreviations

Aarb. = Aarbøger for nordisk Oldkyndighed og Historie. København.
D.G.U. = Danmarks Geologiske Undersøgelse (Bulletin of the Geological Survey of Denmark). København.
O.V.S.F. = Oversigt Kongelige Videnskabernes Selskabs Forhandlinger. København.
Z. Tierzücht = Zeitschrift für Tierzüchtung und Züchtungsbiologie. Hamburg.
V.M. = Videnskabelige Meddelelser fra Dansk naturhistorisk Forening. København.

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