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BRONZEALDERKORN FRA VOLDTOFTE

Af Peter Rowley-Conwy

Bopladsen fra sen bronzealder ved Voldtofte på Fyn er velkendt. Den blev udgravet første gang i begyndelsen af dette århundrede, og der fremkom da enkelte planterester, som delvis er behandlet i litteraturen (Jessen og Lund, 1922, Helbæk 1952a). Materialet er dog aldrig behandlet i sin helhed. Da der iøvrigt kun vides lidt om planterester fra den sene bronzealder i Danmark, var det derfor velkomment, at forfatteren fik lejlighed til at indsamle prøver i forbindelse med nye udgravninger på Voldtofte pladsen, foretaget af Joel Berglund, som jeg er tak skyldig.

Prøverne blev tilvejebragt ved »skumning«. Den fyldigste prøve kom fra pladsens nedre lag, tilhørende bronzealderens per. V, og en mindre prøve fra grube CK stammer formentlig fra samme periode. I C-14 år vil det antagelig være omkring 800-600 f.Kr.

Den største prøve fremkom ved soldning af 182 l jord gennem en sigte med 1 mm huller og bestod af c. 105 cm^3 forkullet materiale. Heraf blev en fjerdedel minutiøst undersøgt. Resultatet vises i fig. 1, hvor dog tallet for *Panicum* refererer til indholdet i hele prøven. De finere dele, der blev sorteret fra ved sigtning gennem 0,3 mm masker, omfattede 18 cm^3 forkullet materiale, hovedsagelig af frø fra *Chenopodium album* (hvidmalet gåsefod). En sekstendedel af dette materiale blev detaljeret undersøgt.

Frøene var forkullede og må derfor tilhøre pladsens beboelsesperiode. Prøven fra grube CK, der udgjorde 82 l jord, er også opført på fig. 1. Den indeholdt kun en smule dårligt bevaret frø og vil ikke blive yderligere omtalt. Bevaringstilstanden i den førstnævnte prøve var derimod god. Ud fra udgravningerne kan prøvens oprindelige karakter ikke bestemmes, da det nedre lag fremtrådte yderst homogent uden nogen egentlig struktur. En nærmere bestemmelse skal dog blive forsøgt ud fra prøvens indhold.

UNDERSØGELSEN AF MATERIALET

a) Byg

Som det fremgår af fig. 1 bestod mere end 80 % af den bestemmelige byg af avneklædt byg. Ikke alt kornet var dog lige velbevaret, og det er muligt, at nogle af de frø, der er opført som nøgen byg, kan have været avneklædt,

A. MAIN SAMPLE

A: Bopladslaget

1. Soldet materiale. Bestemmelsen omfatter 25% af prøven på 105 cm^3.

1. Coarse Fraction. From 25 % of the 105 ccs charcoal obtained.

Korn : Cereals		
6-radet byg – *Hordeum vulgare* (hulled 6-row barley)	293	
Nøgen 6-radet byg – *H. vulgare var. nudum* (naked 6-row barley)	58	392
Byg – *Hordeum sp.* (barley not referable to type)	41	
Emner og spelt – *Triticum dicoccum* and *T. spelta* (spelt and emmer)	119	
Brød- eller dværghvede – *T. aestivum* or *T. aestivum grex aestivo-compactum* (bread or club wheat)	7	126
Hirse – *Panicum miliaceum* (Broomcorn millet)	23 §	
Havre – *Avena sp.* (Oats)	2	
Andre planter – Other plants		
Hejregræs – *Bromus sp.*	50	
Hanekro – *Galeopsis tetrahit*	29	
Vejpileurt – *Polygonum aviculare*	11	
Ferskenbladet pileurt – *P. persicaria*	12	
Haremad – *Lapsana cf. communis*	1	

§ De 23 korn af Panicum er udsórteret af hele prøven.

§ The 23 grains of *Panicum* were sorted from the complete 105 ccs of carbonized material, not just the 25 % sample.

2. Slemmeprøve. Bestemmelsen omfatter 1/16 af hele prøven på 18 cm^3.

2. Fine Fraction. From one sixteenth part of the 18 ccs charcoal obtained.

Hvidmelet gåsefod – *Chenopodium album*	c. 920
Rank gåsefod – *C. cf. urbicum*	59
Brandbæger – *Senecio sp.*	3
Svinemælk – *cf. Sonchus sp.*	14
Rottehale – *Phleum sp.*	9
Sort sennep – *Brassica cf. nigra*	3
Rødknæ – *Rumex acetosella*	1
Natlimurt – *Silene noctiflora*	2
Ubestemt – unidentified	6

B: Prøve fra grube CK

B. SAMPLE CK

6-radet byg – *Hordeum sp.* (barley, including hulled and naked grains)	20
Emner og spelt – *Triticum dicoccum* or *T. spelta*	4
Ubestemte korn – Cereals, unidentified	3
Ferskenbladet pileurt – *Polygonum persicaria*	1
Hanekro – *Galeopsis tetrahit*	1

Fig. 1. The carbonized seeds from Voldtofte.

Fig. 1: Det forkullede frø fra Voldtofte.

da deres specielle kendetegn kan være borteroderet. Det synes derimod ikke at være tilfældet for den nøgne bygs vedkommende, men det vil være rigtigt at betragte de opførte tal som maximum for denne type i forhold til den avneklædte.

Det er bemærkelsesværdigt, at relationen mellem nøgen og avneklædt byg står i omvendt forhold til hvad man kender fra de tidligere udgravninger på stedet. De små portioner forkullet korn, der fandtes i lerkarrene, som gav anledning til udgravningen i Voldtofte i 1908, omfattede »... (hovedsagelig af) nøgen byg, og o. 125 hvedekorn...« (op.cit. p. 125). Da de omtalte lerkar også hører hjemme i bronzealderens per. V, kan fænomenet ikke skyldes kronologiske forskelle. Forklaringen skal snarere søges i de forskellige fundomstændigheder. Betydningen af disse forhold er man først nylig blevet opmærksom på, og vanskeligheden ved en bestemmelse af den egentlige fundsammenhæng her er der allerede gjort opmærksom på. Det er imidlertid klart, at de to her omtalte prøver indgår i forskellig sammenhæng. Helbæks prøve, der blev fundet i lerkar, tyder på opbevaret korn, altså et lager, mens det her fremlagte kornfund var spredt ud over et område og kan være spildt (se nedenfor). Man kan derfor ikke anvende det som udtryk for, at 80 % af byggen i sen bronzealders Danmark var avneklædt, lige så lidt som Helbæks prøve indicerer, at nøgen byg var fremherskende. Det er dog mest sandsynligt, at en ikke ringe del af Voldtofte-byggen var avneklædt.

Det var muligt at måle 34 kerne af nøgen byg, og 50 kerne af avneklædt. Dimensionerne (gennemsnit, standardafvigelser og variation) er som følger:

	Længde	Bredde	Tykkelse
Nøgen byg	4.5±0.6	2.8±0.5	2.2±0.4
(Naked barley)	(3.0–6.5)	(1.6–4.2)	(1.3–2.9)
Dækket byg	4.8±0.5	2.5±0.5	2.2±0.4
(Hulled barley)	(3.6–6.8)	(1.6–3.4)	(1.1–3.0)

b) Hvede

Vanskelighederne ved bestemmelsen af denne kornsort består i at skelne mellem emmer (*Triticum Dicoccum*) og spelt (*T. spelta*). Selv om det er muligt at karakterisere enkelte kerner som »emmer-lignende« eller »spelt-lignende«, er disse to sorter så nær på hinanden, at en bestemmelse alene på de enkelte frø er vanskelig, for ikke at sige umulig. Begge kan have så store formvariationer, at nogle få spelt-lignende frø i en prøve, der hovedsagelig består af emner, ikke behøver at betyde andet, end at emner har en stor variationsbredde.

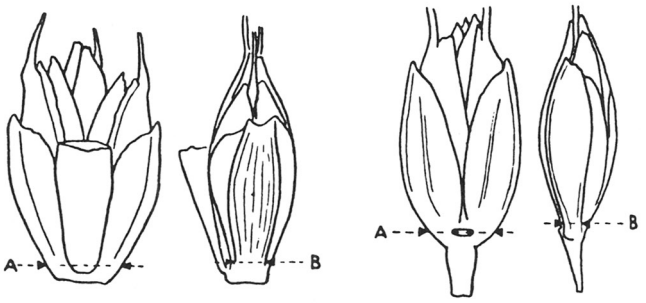

Fig. 2. Dimension A og B målt på småaks af spelt og emner (efter Helbæk 1952a).

Drawing showing measurements A and B on spikelets of spelt and emmer (after Helbæk 1952a).

Nogle af frøene fra Voldtofte kan karakteriseres som spelt-lignende, men størstedelen synes dog at være typisk emmer-lignende. De mål på småaks, der anføres af Helbæk (1952a og b) blev derfor anset for at være det mest pålidelige kriterium til at påvise tilstedeværelsen af de to sorter. Da der kun blev fundet nogle få uskadte småaks, hvor det var muligt at måle dimension A, er dimension B – målet over aksebasen – blevet anvendt i fig. 2.

I Birknæs materialet fandt Helbæk, at dimension B kunne anvendes til at skelne mellem emmer og spelt, og da målene blev nedfældet grafisk, tegnede der sig tydeligt to højdepunkter, selv om den øverste del af emmer-kurven og den nederste del af spelt dækkede hinanden en smule (Helbæk 1952a og b, diagram B).

Voldtofteprøven indeholdt 154 målelige avnebaser, sorteret fra en prøve på 105 cm^3. Ved udtegning af mål B kommer der ikke to højdepunkter på histogrammet, der tværtimod er klart unimodalt (fig. 3).

Imidlertid omfatter avnebaserne fra emmer morfologiske træk, som gør det muligt at udskille dem (Hillmann, pers. meddelelse, og Helbæk 1952a), og prøven kan derfor opdeles således:

spelt	132
emmer	26
uident.	27

Begge sorter er med sikkerhed tilstede, hvilket også Helbæk oprindelig nåede frem til på grundlag af 7 avnebaser. At der kun er én top i histogrammet skyldes, at Voldtofte-emmerens avnebase er lidt bredere end på dem fra Birknæs og dermed udfylder mellemrummet mellem de to arter. Variationsbredden er:

	emmer	spelt
Birknæs	0.61-0.95	0.91-1.52
Voldtofte	0.75-1.16	0.93-1.47

Det ser altså ud til, at dimension B ikke er et ufejlbarligt kriterium for at skelne mellem emmer og spelt, så det morfologiske kriterium må foretrækkes.

Divergensen mellem forekomsterne af spelt rejser et problem, idet undersøgelsen af avnebaserne viste en overvægt for spelt, medens denne sort er relativt fåtallig i selve kornprøverne. Det kan måske skyldes, at speltkornene fra Voldetofte morfologisk står nærmere emner end sædvanligt. En anden mulighed er, at prøven stammer fra en del af pladsen, hvor man har smidt affald. Hvis speltkornene var betydeligt større end emmerkornene, og kornet blev siet, kunne resultatet blive, at der blev frasorteret en forholdsvis stor del emmer sammen med avnerne af begge sorter. Skønt kernerne snarest er en blanding af begge slags, blev 50 af dem for en fuldstændigheds skyld målt:

Længde	Bredde	Tykkelse
5.0±0.5	2.7±0.3	2.3+−0.3
(3.6−6.3)	(1.8−3.4)	(1.8−3.0)

Herudover konstateredes yderligere tilstedeværelsen af 7 kerner af brød- eller dværghvede. Nogle af kernerne var så korte, at de formentlig er dværghvede, en antagelse, der støttes af målet på et enkelt akseled, der var 2 mm langt. Det falder godt i tråd med Helbæks mål for dværghvede fra St. Valby, der målte 1.9-2.7 mm. De 7 kerner målte:

Længde	Bredde	Tykkelse
3.7±1.4	2.6±0.4	2.5±0.4
(2.9−4.4)	(1.8−3.2)	(1.5−3.3)

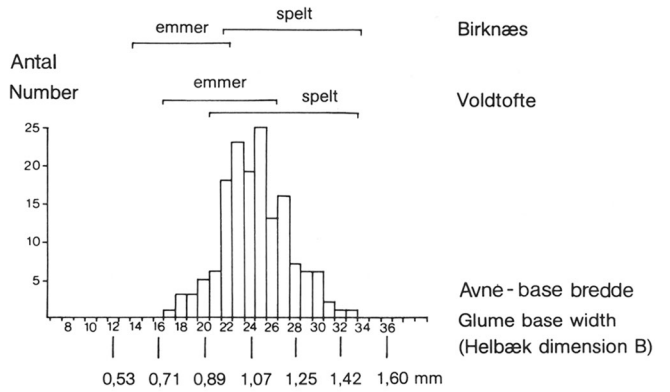

Fig. 3. Histogram over bredden af avnebaser i Voldtofte prøven (Helbæks dimension B). Begge kornsorter såvel som uidentificerede kerner er medtaget. Foroven vises de to sorters variationsbredde sammenlignet med materialet fra Birknæs. Den vandrette linje angiver det indextal, der er opnået ad mikroskopisk vej; hvert fjerde tal er omregnet til mm.

Histogram showing glume base width for the Voldtofte sample (= Helbæk's dimension B). The histogram includes both species, and also those not identified to species. The ranges of the two species are shown above, compared with Birknæs (Helbæk 1952a). The horizontal axis gives the index figure obtained from the microscope measuring scale; every fourth figure is converted into mm.

c) Hirse

Kost-durra (*Panicum miliaceum*) kendes fra sen bronzealder i de tidligere fund fra Voldtofte, og en enkelt kerne fra tidlig bronzealder eller muligvis tidligere, er fundet på Bornholm (Helbæk 1952c). Hirse kendes ligeledes i tidlig sammenhæng i Central- og Østeuropa (Renfrew 1973).

I håb om at redde mest muligt af denne bemærkelsesværdige kornsort blev hele den 105 cm^3 store prøve sigtet, hvilket gav 23 kerner, som alle er velbevarede, og det er de første af den art, der er publiceret fra Danmark, bortset fra Bornholm. Sammenlignes den ene kerne fra Nørre Sandegård på Bornholm med dem fra Voldtofte, får vi:

	Længde	Bredde	Tykkelse
Voldtofte	1.8±0.1	1.5±0.2	1.3±0.2
	(1.6–2.1)	(1.2–2.0)	(0.9–1.7)
Nørre Sandegård	1.90	1.71	1.33

d) Havre

Der blev fundet to velbevarede havrekerner, men arten kan ikke bestemmes, da lemma-basen og rachilla ikke er tilstede (Hillmann, pers. meddelelse). Det antages almindeligvis, at havre har været dyrket i Danmark siden sen bronzealder. I forrige århundrede fastslog Sarauw (upubl.) på grundlag af aftryk i lerkar, at havre blev dyrket i sen bronzealder, og der refereres ofte til hans resultater i senere publikationer (Hatt 1937; Jessen 1933; Jessen og Lind 1922). Af i alt 273 aftryk fra sen bronzealder, der anføres af Hatt med henvisning til Sarauw, er de fire kerner af dyrket havre og tre af vild havre. Det fremgår dog ikke, på hvilket grundlag opdelingen i vild og dyrket havre er foretaget. Helbæk nævner ingen fund af havre i sin oversigt over agerdyrkning i forhistorisk tid i Danmark (Helbæk 1951, 1954b). Specielt er det bemærkelsesværdigt, at det store fund fra Gørding fra førromersk jernalder ikke indeholdt havrekerner. Men selv i romersk jernalder er der forskel på, hvor stor en rolle havre spillede. I Nørre Fjand fandtes den i betydelig mængde, mens den var meget sparsom i Østerbølle, hvor kun nogle få havrekerner kunne udskilles af en stor mængde byg (Helbæk 1938). I Sydengland var forholdet noget anderledes. Der fandtes havre på adskillige førromerske pladser, omend ikke med overvægt (Helbæk 1952b).

Der er således kun nogle få antydninger af, at havre blev dyrket i Danmark i førromersk jernalder. På den baggrund er det nok bedst at anse kerner fra tidligere perioder, hvoraf de to fra Voldtofte er blandt de tidligste, som ukrudt. De to kerner målte henholdsvis l 5.5, br. 1,6 t 1.3 og l 5.3, br. 1,8 og t 1.6 mm.

e) Gåsefod

Af gåsefod (*Chenopodium*) blev der i Voldtofte fundet 18 cm^3, hvori der også indgik enkelte andre frø. Identifikationen af dem skete dels ved sammenligning under stærk forstørrelse med nutidige frø af kendte arter (tegning hos Clapham, Tutin of Warburg, 1962, p. 275), dels med stærkt forstørrede fotografier (venligst stillet til rådighed af Glynis Jones). På dette grundlag var det muligt at identificere størstedelen som hvidmelet gåsefod (*Chenopodium album*), og resten hovedsagelig som rank gåsefod (*Chenopodium urbicum*).

Voldtoftefundet er det tidligste vidnesbryd om en større samling frø af denne art fra Danmark, hvor det hidtil tidligste er det førromerske fund fra Gørding. Udfra de c. 980 frø i den optalte del af prøven kan det beregnes, at den i sin helhed har indeholdt o. 15.700 frø. Mabey (1972) gør opmærksom på, at hvidmelet gåsefod har større indhold af jern og protein end kål og spinat, og mere vitamin B1 og calcium end rå kål. Både plantens allerstedsnærværelse og nytte er understreget af Helbæk, som mener, at den har været indsamlet på brakmarker (Helbæk 1960). Det kan dog ikke udelukkes, at gåsefod har været dyrket, ligesom dens nære slægtning Stolt Henrik (*Chenopodium bonus Henricus*) blev det i historisk tid i Europa (Mabey 1972).

De øvrige ukrudtsfrø af betydning, som fandtes i prøven: hejregræs (*Bromus*), hanekro (*Galeopsis*), pileurt (*Polygonum*), svinemælk (*Sonchus*) og rottehale (*Phleum*) kendes alle fra Danmark i forhistorisk sammenhæng, selv om Helbæk ikke regner kost-durra (*Bromus secalinus*) med deri. Han opfører de fleste som Bromus sp. (uspec. art). Sædvanligvis er store mængder ukrudtsfrø mere almindelige i jernalderen.

KONKLUSION

Bemærkelsesværdigt ved Voldtoftematerialet er den forskel, der er mellem planteresterne derfra og dem man kender tidlig bronzealder, mens det til en vis grad ligner materialet fra tidlig jernalder.

Forskellen mellem fundene fra Voldtofte og Lindebjerg, ligeledes fra Fyn, men fra bronzealderens per. I (Rowley-Conwy 1978) er bemærkelsesværdig. Tendensen synes at gå i retning af en større variation i retning af planter. Lindebjerg indeholdt ganske vist 75 % byg, der er nøjagtig samme andel som i Voldtofte. Den største forskel består imidlertid i forekomsten af hirse på sidstnævnte plads. Hirsens vilde forgænger er ikke kendt fra Danmark, så Voldtoftefrøene kan næppe stamme fra andet end en dyrket art. Renfrew (1973) bemærker, at hirse gror meget hurtigt, 60-65 dage er tilstrækkeligt fra såning til modning. Det er derfor muligt, at

hirsen var attraktiv, fordi den kunne plantes sent i vækstperioden, hvis den øvrige afgrøde så ud til at svigte. På den måde kunne kornmangel undgås. Voldtofte har givet det hidtil ældste vidnesbyrd om tilstedeværelse, ja måske dyrkning, af hvidmelet gåsefod. Langt tidligere blev indsamlet andre typer af vilde planter, f.eks. har hasselnødder været samlet gennem hele den forhistoriske tid, og nu kender man også til indsamling af æbler og agern (Jørgensen 1978). Jordbær og hindbær blev plukket ved Muldbjerg (Troels-Smith 1959). Indtil sen bronzealder har der derimod ikke kunnet konstateres større mængder frø af den slags, vi sædvanligvis regner for ukrudt. Selvfølgelig kunne de godt have været tilstede ved Lindebjerg fra et område, hvor der ikke blev taget prøver med henblik på planterester, eller måske var der ikke nogen i huset, da det nedbrændte; men med vores nuværende kendskab til plantefundene er konklusionen rigtig.

Det er stadig et åbent spørgsmål, hvornår spelt blev indført til Danmark. Indtil for nylig har det været anset for sandsynligt, at den først dukkede op i sen bronzealder (Helbæk 1952a) og derfor ventede man heller ikke, at den kunne findes i Lindebjerg (Rowley-Conwy 1978). Der forekom imidlertid nogle få avnegafler, og når man nu kan datere spelt så tidligt som til senneolitikum i Danmark, forekommer det rimeligt at antage, at i det mindste nogle af frøene fra Lindebjerg kan stamme fra spelt. Det forekommer måske overraskende, at der blev fundet så store mængder af dækket byg, eftersom det på grundlag af fundene fra Gørding og Solbjerg sædvanligvis antages, at nøgen byg var fremherskende indtil romersk jernalder (Helbæk 1951).

Problemerne vedrørende forskellen mellem forskellige prøver fra én lokalitet er allerede berørt ovenfor, og det er værd at erindre Jessens bemærkninger om nøgen og dækket byg, der havde forskellig overvægt i romersk jernalders prøver fra Ginnerup, svarende til forskellen i Voldtofte prøverne fra henholdsvis 1908 og de nyeste, samt at Sarauws analyse af lerkarsaftrykkene fra sidste århundrede faktisk viser lige store mængder nøgen og dækket byg (Hatt 1957 p. 22), hvad der tyder på en forholdsvis stor præference for den avnedækkende variant. Alt i alt viser Voldtoftefundet, hvordan ændringerne i oldtidens planteavl sker gradvis over en lang periode. Det er på tide at ændre den opfattelse, at planteavl er et typologisk kendemærke, der kan forventes at skifte brat. Den må snarere ses som en langsomt fremadskridende ændring, der sætter de hurtige teknologiske skifter, der har været emne for så meget arkæologisk arbejde i perspektiv.

A NEW SAMPLE OF CARBONIZED GRAIN FROM VOLDTOFTE

By Peter Rowley-Conwy

The late bronze age settlement of Voldtofte in southern Fyn has long been known. The original excavations carried out in the early years of this century yielded some plant remains, of which some aspects have been briefly mentioned in the literature (Jessen and Lind 1922, Helbæk 1952a). No full publication of the material has, however, been presented. Little is otherwise known of carbonized plant material from late bronze age Denmark, and so the writer was fortunate to be able to collect a sample during recent excavations carried out by museumsinspektør mag. art. Joel Berglund (of Middelfart Museum), to whom thanks are due.

The samples were obtained using a froth flotation unit (Jarman, Legge and Charles 1972). The major sample came from the lower level of the site, belonging to period V of the bronze age, and a smaller sample was obtained from pit CK, probably of the same date (Berglund pers.comm.). In C14 years this is probably in the region of 800-600 b.c.

The main sample came from some 182 litres of earth. The coarse fraction (retained in a 1 mm mesh sieve) consisted of c. 105 ccs charcoal, of which one quarter was examined in detail. The contents are set forth in fig. 1 (the figure for *Panicum,* however, refers to the whole 105 ccs, not just to the part sampled for other remains). The fine fraction (retained in a 0.3 mm sieve) amounted to 18 ccs of carbonized material, mainly seeds of *Chenopodium album*. One sixteenth part of this was examined in detail. These seeds were definitely carbonized and so certainly belong to the period of occupation of the settlement. The sample from pit CK (from 82 litres of soil) is also listed. It contained only a few seeds, not well preserved, and will not be discussed further. Preservation of the main sample was generally good.

Little can be said as to the context within the settlement from which the main sample came. The lower level of the site presented such a homogeneous appearance that archaeological features were rarely visible during excavation. Some tentative suggestions can, however, be offered based on the nature of the samples themselves.

EXAMINATION OF THE MATERIAL

a) The barley

As can be seen from fig. 1, the bulk of the determinable barley grains were hulled (over 80 %). Not all grains were equally well preserved, and it is possible that some of those grains listed as naked were originally hulled, as the features distinguishing hulled grains can sometimes be eroded away. This is not thought to be the case with many of the naked grains, but the figure given should perhaps best be regarded as a maximum for the proportion of this type to hulled barley.

It is curious that this ratio of naked to hulled barley is the opposite to that from the earlier excavations (Helbæk 1952a). The pots which were found in 1908 (and which were responsible for the first series of excavations) contained small quantities of carbonized grain, which consisted "mainly of naked barley, negligible quantities of hulled barley, and some 125 grains of wheat..." (op.cit. p. 125). As the pots in question also belong to period V of the bronze age (Berglund pers. comm.), chronological differences cannot be invoked to explain this. The answer probably lies in the different contexts of the find. Problems of this sort are only beginning to be understood (Dennell 1974, 1976; Hubbard 1976; Jones 1979), and the difficulty of ascribing a context to the material discussed here has been mentioned. That the two samples come from different contexts, however, seems clear:

Helbæk's sample, coming from pots, suggests stored material, while the present sample was scattered over an area of the site and may in part represent waste material (see below). This sample cannot, therefore, be used to suggest that 80 % of late bronze age barley in Denmark was hulled, any more than Helbæk's sample necessarily indicates that naked barley was predominant. That some not insubstantial proportion of the Voldtofte barley was hulled does, however, seem most probable.

Thirtyfour grains of naked barley were measurable, and a sample of 50 hulled grains was also measured. Their dimensions (average, standard deviation and range) are as follows:

	Length	Breadth	Thickness
Naked barley (Σ = 34)	4.5±0.6	2.8±0.5	2.2±0.4
	(3.0–6.5)	(1.6–4.2)	(1.3–2.9)
Hulled barley (Σ = 50)	4.8±0.5	2.5±0.5	2.1±0.4
	(3.6–6.8)	(1.6–3.4)	(1.1–3.0)

(all measurements in mm)

b) The wheat

The main problem in this area is the distinction of emmer (*Triticum dicoccum*) from spelt (*T. spelta*). Although certain grains may be described as "emmer-like" or "spelt-like", the two species are so similar that distinction on the basis of grains alone is difficult or impossible. Each has a high degree of morphological variation, so that in a sample consisting (for example) mainly of emmer, the presence of a few spelt-like grains may indicate nothing more than the wide range of emmer variability.

Some of the grains from Voldtofte could be described as spelt-like. The majority seemed, however, to be typically emmer-like. The spikelet measurements given by Helbæk (1952 a and b) were therefore regarded as the most useful way of establishing the presence of the two species. Very few complete spikelet forks were found upon which dimension A could be taken, so dimension B (across the glume base) was used (see fig. 2). At Birknæs, Helbæk found that dimension B could be used to separate emmer from spelt, and when the measurements were plotted on a graph two distinct peaks were formed, although there was a slight overlap between the upper end of the emmer range and the lower end of the spelt range (Helbæk 1952a p. 102, diagram B).

The Voldtofte sample contained 154 measureable glume bases (sorted from the whole of the 105 cc sample). When dimension B is plotted, the histogram does not show two peaks but is clearly unimodal (fig. 3). The glume bases do, however, display morphological criteria enabling spelt to be separated from emmer (Hillman pers. comm.; also Helbæk 1952a), and by this means were divided up as follows:

spelt	132
emmer	26
unidentified	57

Both species are definitely present (as Helbæk (1952a) originally concluded on the basis of seven glume bases). The single peak in the histogram is caused by the Voldtofte emmer glume bases being slightly wider than those from Birknæs, thus closing the gap between the two species. The size ranges are:

	emmer	spelt
Birknæs	0.61-0.95	0.91-1.52
Voldtofte	0.75-1.16	0.93-1.47

It seems therefore that dimension B is not universally helpful in distinguishing emmer from spelt. The morphological criterion is preferable.

A problem arises from the apparent conflict between the evidence from the glume bases (showing a preponderance of spelt) and the impression gained from the grains (which seem to contain relatively few spelt-like examples). One possibility is that the Voldtofte spelt grains are morphologically even closer to emmer than is usual. It might also be that the sample came from part of the site where waste was deposited. If the spelt grains were significantly larger than the emmer grains, and if sieving was carried out, waste samples could come to contain abnormally high proportions of emmer grains as well as the chaff fragments of both species (1).

Although the grains are likely to contain a mixture of both species, a sample of 50 was measured for the sake of completeness. The measurements are:

Length	Breadth	Thickness
5.0±0.5	2.7±0.3	2.3±0.3
(3.6–6.3)	(1.8–3.4)	(1.8–3.0)

Seven grains of bread or club wheat were also found. Some of the grains were so short as to suggest club wheat, a possibility supported by a single internode measuring 2.0 mm in length. This compares well with Helbæk's (1954a) dimensions of 1.9-2.7 mm for club wheat from Store Valby. The dimensions of the seven grains are:

Length	Breadth	Thickness
3.7±1.4	2.6±0.4	2.5±0.4
(2.9–4.4)	(1.8–3.2)	(1.5–3.3)

c) The millet

Broomcorn millet (*Panicum miliaceum*) has been recorded in late bronze age contexts from Denmark (including Voldtofte) and a single seed has been found from the detached Danish island of Bornholm in the Baltic Sea, contemporary with or earlier than the early bronze age (Helbæk 1952c). It is known from earlier contexts in central and eastern Europe (Renfrew 1973). In order to acquire the best possible sample of this interesting cereal the entire 105 ccs of carbonized material was examined. The 23 seeds found are all well preserved, and represent the first recent publication of the species from Denmark (excluding Bornholm).

The dimensions of the seeds are compared with those of the single grain from Nørre Sandegård, Bornholm:

	Length	Breadth	Thickness
Voldtofte (Σ = 23)	1.8±0.1	1.5±0.2	1.3±0.2
	(1.6–2.1)	(1.2–2.0)	(0.9–1.7)
Nørre Sandegård	1.90	1.71	1.33

d) The oats

Two well-preserved oats were recovered. Oats cannot be definitely identified to species without the lemma base and the rachilla being present (Hillman pers. comm.). This was unfortunately not the case with these two examples.

Oats are usually stated to have been cultivated in Denmark in the late bronze age. Unpublished analyses of pottery impressions in the last century by Sarauw established the presence of oats, claimed to be cultivated, in the late bronze age, and this work is frequently mentioned in more recent literature (Hatt 1937; Jessen 1933; Jessen and Lind 1922). The figures given by Hatt for Sarauw's late bronze age impressions are 4 cultivated and 3 wild oats in a total sample of 273 impressions (Hatt 1937 p. 22). The basis of the division into wild and cultivated is not clear. In his reviews of prehistoric Danish agriculture, Helbæk (1951, 1954b) mentions no finds of oats before the Roman iron age; in particular, the major find of Gørding (pre-Roman iron age) contained none. Even in the Roman iron age the importance of oats varied: at Nørre Fjand the crop was present in considerable proportions, while at Østerbølle only a very few grains were found in large samples of barley (Helbæk 1938). The situation seems somewhat different from southern England, where oats were present on a variety of sites of pre-Roman date, although not as major constituents of the samples (Helbæk 1952b).

There seems thus to be little evidence for the cultivation of oats in Denmark before the Roman iron age. Oats occurring before this date (of which the two from Voldtofte are among the earliest known) are on present evidence perhaps better regarded as weeds of cultivation.

The length, breadth and thickness measurements of the two grains are respectively 5.5, 1.6 and 1.3 mm, and 5.3, 1.8 and 1.6 mm.

e) The Chenopodium

18 ccs of *Chenopodium* (including also a few seeds of other species) were found at Voldtofte. They were identified to species by means of examiniation of the surface morphology under high magnification, being compared with modern seeds of known species, with the drawings from Clapham, Tutin and Warburg (1962 p. 275), and with photographs taken under high magnification (kindly lent by Glynis Jones). On this basis it was possible to identify the majority as *Chenopodium album*, and the remainder as probably belonging to *C. urbicum*.

The Voldtofte find is the earliest evidence of large numbers of seeds from this plant from Denmark (the earliest previously being pre-Roman iron age Gørding). From the presence of some 980 seeds in the part of the sample counted, it can be calculated that the whole sample contains about 15,700 seeds. Mabey (1972) mentions that *C. album* contains more iron and protein than cabbage or spinach, and more vitamin B1 and calcium than raw cabbage. The utility and ubiquitousness of the plant have been emphasised by Helbæk, who believes it to have been regularly collected from fallow fields (Helbæk 1960). The posibility indeed cannot be excluded that this plant was actually cultivated, as was its close relative *Chenopodium bonus-henricus* in historical times in Europe (Mabey 1972).

The other important weeds found (*Bromus*, *Galeopsis*, *Polygonum*, *Sonchus* and *Phleum*) are all known from prehistoric Danish contexts. The presence of relatively large numbers of weeds is a trait more usually associated with the iron age.

CONCLUSIONS

A rather striking aspect of the Voldtofte material is the degree to which the plant remains differ from those known from the early bronze age, resembling in some ways those from the early iron age.

Several contrasts can be seen between the find from Voldtofte and that from Lindebjerg (also on the island of Fyn), dating from period I of the bronze age (Rowley-Conwy 1978). A general trend appears to be towards a greater degree of variation within the plant economy. The Lindebjerg find contained some 75 % barley, exactly the same proportion

as at Voldtofte. A major difference, however, is the appearance of *Panicum miliaceum* at the later site. The wild progenitor of this plant does not grow within Denmark, so the Voldtofte grains can hardly represent other than the remains of a cultigen. Renfrew (1973) states that *Panicum* is very quick growing, requiring only 60-65 days from sowing to maturity. One way in which millet might have been attractive in the late bronze age could therefore have been that it could be planted quite late in the growing period of other crops if these crops appeared unlikely to attain the desired level of production. Shortage could thus be alleviated.

Voldtofte also marks the oldest evidence hitherto obtained for the presence (even cultivation?) of *Chenopodium album*. Other types of plants were collected much earlier – hazel nuts were collected throughout the prehistoric period, and evidence is now available for the collection of apples and acorns in the Danish neolithic (Jørgensen 1978). Strawberries and raspberries were collected at early neolithic Muldbjerg (Troels-Smith 1959). Seed plants of the type usually classed as weeds have, however, not provided evidence of large-scale presence earlier than the late bronze age. Obviously, seeds of such plants might have been present at Lindebjerg on an area of the site not sampled for plant remains, or there might have been none in the building at the time of its destruction by fire; but on present evidence the conclusion stands.

The date of the introduction of spelt into Denmark is still uncertain. Until recently the accepted view has been that it probably appeared for the first time in the late bronze age (Helbæk 1952a), and because of this it was thought that it would be unlikely to be present at Lindebjerg (Rowley-Conwy 1978). Very few spikelet fragments were present, however, and as finds of spelt have recently been dated to as early a period as the start of the late neolithic in Denmark (1900-1800 b.c.) (Jørgensen 1979), it now seems more likely that at least some of the Lindebjerg grains could be spelt.

That hulled barley was found in such high proportions may seem surprising, as it is usually stated that the naked form predominated until the Roman iron age (Helbæk 1951). This view has largely been based on the finds from Gørding and Solbjerg, of pre-Roman iron age date, in which naked barley predominated (Helbæk op.cit.). The problems of variation between samples from a single site have been referred to, and it is interesting to note that Jessen (1933) mentions that hulled and naked grains predominated in different barley samples from Roman iron age Ginderup, parallelling the differences between the 1908 and recent samples from Voldtofte; and that Sarauw's analyses of late bronze age pottery impressions in the last century gave virtually equal numbers of hulled and naked grains (Hatt 1937 p. 22), suggesting a relatively high degree of importance for the hulled variety.

All in all, therefore, Voldtofte serves to emphasise the long-term slow working trends operating in plant cultivation throughout the prehistoric period. It is time that cultivation stopped being regarded as a typological attribute which may be expected to change abruptly as cultures change; rather it should be seen as the long-term slow-changing backdrop, against which the quick, archaeologically highly visible technological changes (which have been the subject of much archaeological work) may be viewed and placed in perspective.

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BIBLIOGRAPHY

Clapham A.R., Tutin T.G. and Warburg E.F. 1962. Flora of the British Isles (second edition). Cambridge: at the University Press.

Dennell R.W. 1974. Botanical evidence for prehistoric crop processing activities. Journal of Archaeological Science 1, 1974, 275-284.

Dennell R.W. 1976. The economic importance of plant resources represented on archaeological sites. Journal of Archaeological Science 3, 1976, 229-247.

Hatt G. 1937. Landbrug i Danmarks Oldtid. Copenhagen: Udvalget for Folkeoplysnings Fremme.

Helbæk H. 1938. Planteavl. Aarbøger 1938, 216-226.

Helbæk H. 1951. Ukrudtsfrø som næringsmiddel i førromersk jernalder. Kuml 1951, 65-74. (English summary).

Helbæk H. 1952a. Spelt (Triticum spelta L.) in Bronze Age Denmark. Acta Archaeologica XXIII, 1952, 97-107.

Helbæk H. 1952b. Early crops in southern England. Proceedings of the Prehistoric Society XVIII, 1952, 194-233.

Helbæk H. 1952c. Preserved apples and Panicum in the prehistoric site at Nørre Sandegård in Bornholm. Acta Archaeologica XXIII, 1952, 107-115.

Helbæk H. 1954a. Store Valby. Kornavl i Danmarks første neolitiske fase. Aarbøger 1954, 198-204.

Helbæk H. 1954b. Prehistoric food plants and weeds in Denmark. Danmarks Geologiske Undersøgelser II, 80, 1954, 250-261.

Helbæk H. 1960. Comment on Chenopodium album as a food plant in prehistory. Berichte des geobotanischen institutes der eidg. techn. hochschule. Stiftung Rübel 31 (1959) 1960, 16-19.

Hubbard R.N.L.B. 1976. On the strength of the evidence for prehistoric crop processing activities. Journal of Archaeological Science 3, 1976, 257-265.

Jarman H.N., Legge A.J. and Charles J.A. 1972. Retrieval of plant remains from archaeological sites by froth flotation. In: – E.S. Higgs (ed.) Papers in Economic Prehistory. Cambridge: at the University Press.

Jessen K. 1933. Planterester fra den ældre jernalder i Thy. Botanisk Tidsskrift 42, 3, 1933, 257-288. (German summary).

Jessen K. and Lind J. 1922. Det danske markukrudts historie. Det Kongelige Dansk Videnskabernes Selskabs Skrifter (naturvidenskabelig-matematisk) 8, VIII, 1922-23.

Jones, G.E.M. 1979. An analysis of the plant remains from Assiros Toumba. Unpublished M.Phil. thesis, Cambridge University.

Jøgensen G. 1978. Acorns as a food-source in the later stone age. Acta Archaeologica XLVIII, 1977, 233-238.

Jørgensen, G. 1979. A new contribution concerning the cultivation of Spelt, Triticum spelta L., in prehistoric Denmark. Archaeo-Physica 8, 1979, 135-145.

Mabey R. 1972, Food for free. London: Collins.

Rowley-Conwy P.A. 1978. Forkullet korn fra Lindebjerg. En boplads fra ældre bronzealder. Kuml 1978, 159-171. (English summary).

Troels-Smith J. 1959. The Muldbjerg dwelling place. Annual Report of the Board of Regents of the Smithsonian Institution 1959, publication 4392, 577-601.