

Palaeoenvironmental Archaeology

Plant Remains

PLANT REMAINS

MICROFOSSILS - POLLEN

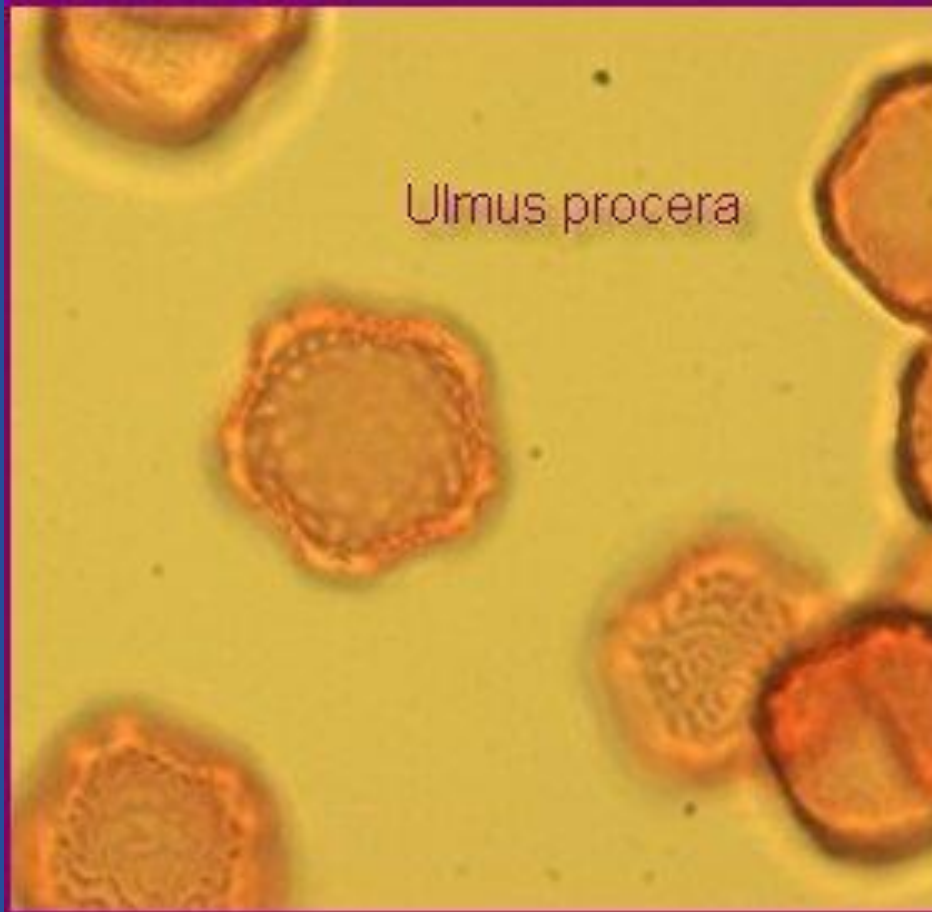
MACROFOSSILS - SEEDS
VEGETATIVE REMAINS
WOOD

PALYNOLOGY = POLLEN ANALYSIS

POLLEN - TREES, SHRUBS AND HERBS

SPORES - FERNS AND MOSSES

Ulmus pollen Elm



POLLEN

1. Resistant to decay
2. Identifiable to family, generic or species level
3. Easily transported
4. Produced in abundance

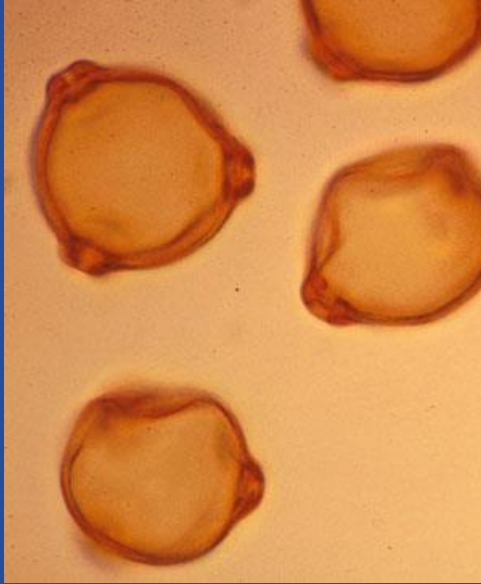
POLLEN IDENTIFICATION

1. Presence or absence of apertures
2. Apertures a) pores (pori)
b) furrows (colpi)
3. Apertures vary in a) number
b) position
c) character
4. Surface sculpturing

	Di-		Tri-		Tetra-		Penta-		Hexa-		Poly-	
	polar	eq.	polar	eq.	polar	eq.	polar	eq.	polar	eq.	polar	eq.
Zonoporate												
	e.g. <i>Colchicum</i>		e.g. <i>Betula</i>		← e.g. <i>Alnus</i> , <i>Ulmus</i> →							
Zonocolpate												
	e.g. <i>Tofieldia</i>		e.g. <i>Acer</i>		e.g. <i>Hippuris</i>		← e.g. Labiatae, Rubiaceae →					
Zonocolporate												
			e.g. <i>Parnassia</i>		e.g. <i>Rumex</i>		e.g. <i>Viola</i>		e.g. <i>Sanguisorba officinalis</i>		e.g. <i>Utricularia</i>	
Pantoporate												
			← e.g. <i>Urtica</i> →				e.g. <i>Plantago</i>				Chenopodiaceae	
Pantocolpate												
					e.g. Ranunculaceae				e.g. <i>Spergula</i>		e.g. <i>Polygonum amphibium</i>	
Pantocolporate												
					e.g. <i>Rumex</i>				e.g. <i>Polygonum oxyspermum</i>			

FIG. 5.4. Diagram showing the range of aperture number, position and character. Some of the possible combinations have no example within the British flora. Classification of pollen types based upon the number and arrangement of apertures. Examples are shown in polar and equatorial views. Dotted lines indicate a different focal plane. Empty positions denote the lack of a North West European example.

Betula
Birch



Pinus sylvestris
Pine



Plantago lanceolata
Ribwort plantain



www.aqua.org.au/.../14plantago_lanceolata.jpg

Quercus
Oak

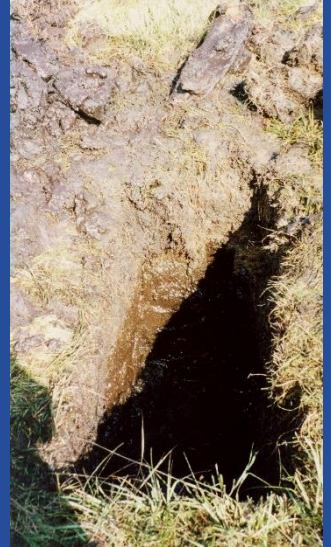


www.geographie.uni-freiburg.de/.../Quercus.jpg

POLLEN PRESERVATION: DEPOSITIONAL ENVIRONMENTS

PEAT DEPOSITS - BOG AND FEN
LAKE DEPOSITS

DEVELOP IN A STRATIFIED SEQUENCE



BURIED SOILS BENEATH ARCHAEOLOGICAL MONUMENTS



GUT CONTENTS OF PREHISTORIC BODIES
FAECAL DEPOSITS
ORGANIC RESIDUES IN POTS

RECONSTRUCTION OF PAST ENVIRONMENTS

INTERPRETATION ASSUMPTIONS

1. Pollen reflects vegetation.
2. Vegetation reflects environmental conditions.
3. Uniformitarianism - present is the key to the past.

Assuming no changes in ecology.

Pollen derived from regional and local vegetation -
landscape and environment reconstruction

Pollen from stratified sequence - reconstruction
of changes through time

RECONSTRUCTION OF PAST ENVIRONMENTS

1. Tracing vegetation history in:
 - a) individual species
 - b) communities
2. Correlating deposits + assigning tentative dates
3. Climatic change studies
4. Study of past human impact on vegetation

PROBLEMS OF INTERPRETATION

Various factors influence the pollen record preserved at a site.

TAPHONOMIC PROCESSES (PROCESSES LEADING TO PARTIAL FOSSILISATION)

1. DIFFERENT POLLEN TAXA PRODUCE
DIFFERENT AMOUNTS OF POLLEN
2. POLLEN DETERIORATION CAN RESULT IN
**DIFFERENTIAL POLLEN PRESERVATION
AND REPRESENTATION**

3. DIFFERENTIAL POLLEN TRANSPORT

WIND POLLINATED - LONG DISTANCES

INSECT POLLINATED - SHORTER DISTANCES

SELF-POLLINATING PLANTS (CEREALS AND VINES) - VERY CLOSE

4. SECONDARY TRANSPORT

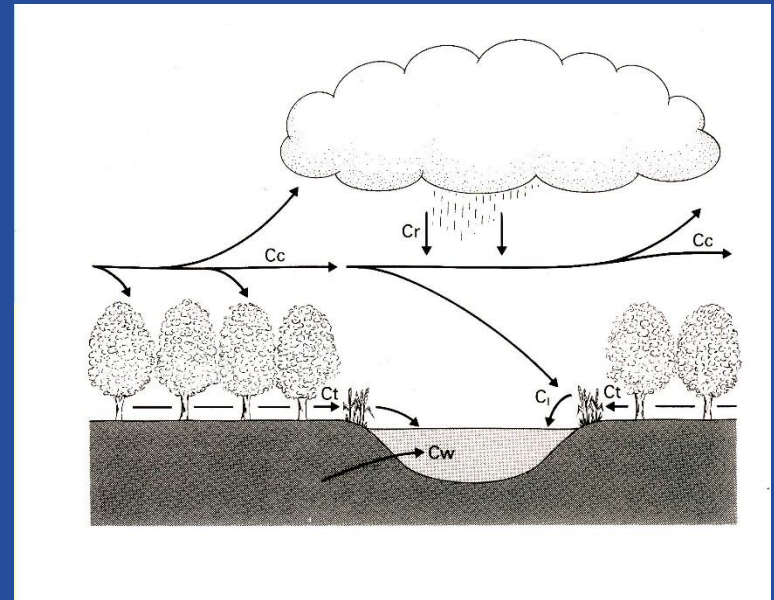
OTHER FACTORS AFFECTING DEPOSITION
INCLUDE WIND DIRECTION, NATURE OF THE
VEGETATION, SIZE OF SAMPLE
BASIN

POLLEN DISPERSAL MODELS

TAUBER (1965) MODEL

5 COMPONENTS

1. TRUNK SPACE (C_t)
2. CANOPY (C_c)
3. RAIN (C_r)
4. LOCAL OR GRAVITY (C_l)
5. SECONDARY OR INWASHED (C_w)



VARIOUS OTHER MODELS SUGGESTED FOR
OTHER SITUATIONS

JACOBSEN AND BRADSHAW (1981) AGAIN ASSUME A FORESTED ENVIRONMENT

RELATIONSHIP BETWEEN SAMPLE BASIN SIZE
AND DISTANCE FROM WHICH THE POLLEN
GRAINS HAVE TRAVELLED.

LARGER BASIN = MORE REGIONAL POLLEN
SMALLER BASIN = MORE LOCAL POLLEN

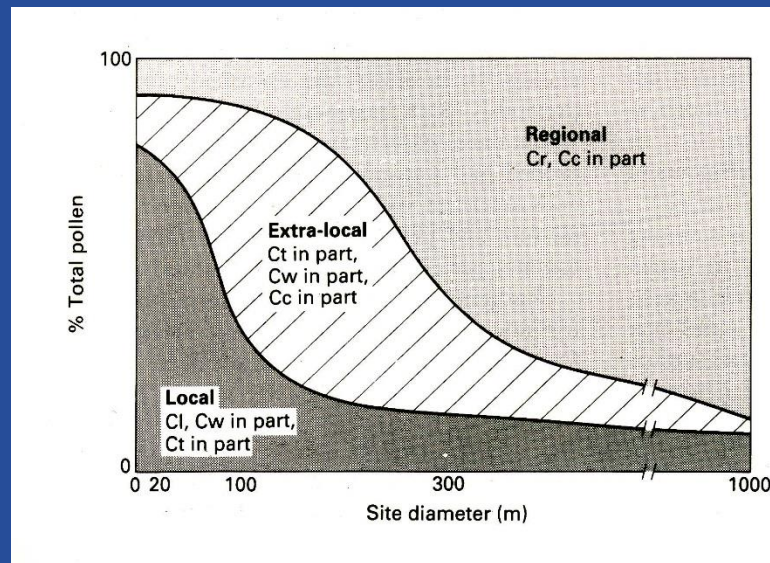


FIG. 2.4. The relationship between the size of site and the various sources of pollen entering it (from Jacobson & Bradshaw 1981). Cc, canopy component; Cl, local component; Cr, rain component; Ct, trunk space component; Cw, secondary component, transported by water.

From: Moore, P.D., Webb, J.A. and Collinson, M.E. 1991 Pollen Analysis. Oxford, Blackwell Scientific Publications

LARGER THE BASIN THE GREATER THE PROPORTION OF REGIONAL POLLEN



Human influence on vegetation - modifying environment

1. Woodland clearance - agriculture, settlement, roads
2. Directly through plant cultivation - woodland clearance & crop species and weeds. Clearance and/or cultivation may lead to soil erosion.
3. Indirectly through animal husbandry - woodland clearance & prevention of regeneration by grazing
4. Through utilisation of resources - wood for building, fires, management such as coppicing etc
5. Abandonment - regeneration, secondary woodland

ANTHROPOGENIC INDICATORS - cereals, weed species
e.g. *Plantago lanceolata*

HUMAN INTERFERENCE - PROBLEMS/LIMITATIONS OF INTERPRETATION

Removal of vegetation cover -How?

Identification of fungal spores - indicators of
grazing, disease

Charcoal

Charcoal - type of charcoal (wood, grass), size of
charcoal, macrofossil remains - local or regional

Nature of agriculture

? Pastoral, arable, mixed

Cereal pollen under-represented

Identification - certain wild grasses similar to cereal

Field edge weeds - could be inferred as mixed farming

Air-currents can carry cereal pollen to high altitudes

Extent of woodland clearance

Representation in pollen diagram depends on size of pollen catchment and proximity of pollen site to activity

Clearance frequency

Were cleared areas maintained as cleared areas or were new areas being cleared, others farmed and yet others abandoned

Multiple pollen sites in an area may help

Level of interpretation dependent on level of resolution

- a) Accumulation rate of deposit
- b) How close samples
- c) Depth of samples - 1cm sample could = 25 years - time for clearance, agriculture, soil exhaustion and partial regeneration

High resolution pollen diagrams

Increasing use of computer modelling in pollen studies

Pollen modelling approach to reconstruct plausible landscape changes - uses GIS and pollen models to generate assemblages at specific points within the landscape. Simulated results from the landscape reconstruction are compared with those in the sub-fossil record.

Now possible to transform pollen proportions into estimates of vegetation cover at both regional and local scales.

Uses the Landscape Reconstruction Algorithm (LRA) i.e. the REVEALS (Regional Estimates of Vegetation Abundance from Large Sites) model and the LOVE (Local Vegetation) model.

e.g. Fyfe et al. 2013 The Holocene vegetation cover of Britain and Ireland: overcoming patterns of scale and discerning patterns of openness. *Quaternary Science Reviews* 73, 132–148

PLANT MACROFOSSILS

e.g. Seeds, Fruits, Buds, Leaves, Stems, Moss remains, Wood

Size Range - Seeds < 0.5mm to tree trunks

Most common evidence is charcoal - survives on most sites

Corylus avellana

Hazel nuts



Plantaginaceae



Plantago lanceolata

Ribwort plantain

ohioline.osu.edu/.../plantago_lanceolata.jpg

Caryophyllaceae



Agrostemma githago

Corn cockle

www.ag.ohio-state.edu/.../agrostemma_githago.jpg

INFORMATION PROVIDED BY PLANT MACROFOSSIL REMAINS

ENVIRONMENT

ECONOMY - Agriculture, resource exploitation, trade

DIET

SOCIAL - Gender studies

RITUAL, SYMBOLIC

SEASONALITY

PRESERVATION

WATERLOGGED - SEA, LAKES, RIVERS, FENS,
PEAT BOGS

ORGANIC LAYERS BENEATH
MEDIEVAL TOWNS - EUROPE
RUBBISH PITS & LATRINES

CARBONISED - FIREPLACE, OVENS, KILNS,
BURNT STORES

MINERALISED - DAMP CONDITIONS IN PRESENCE
OF CALCIUM & PHOSPHORUS
SALTS

ACTION OF METAL SALTS - COPPER, IRON

COLD - ICE

DRY - N. EUROPE - BUILDING MATERIAL
DESERT - MIDDENS

IMPRESSIONS - BRICK, POTTERY, DAUB

IDENTIFICATION OF WEED SEEDS, i.e. NON-CEREAL SEEDS

Characteristics include:

Size

Shape

Surface markings & Texture

Colour

Shape & Position of Attachment
Scar

Wings, Hairs, Scales, Awns etc. may be useful but
may be lost during preservation.

Corylus avellana

Hazel nuts



Plantaginaceae



Plantago lanceolata

Ribwort plantain

ohioline.osu.edu/.../plantago_lanceolata.jpg

Caryophyllaceae



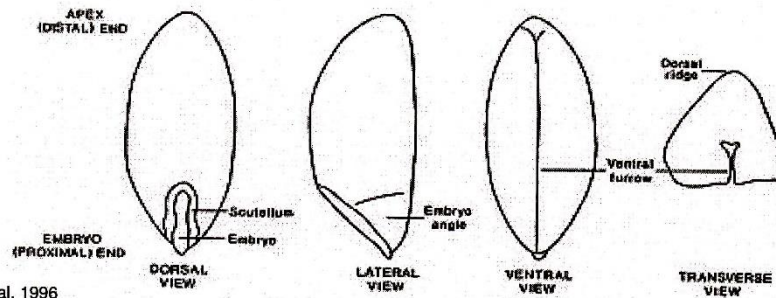
Agrostemma githago

Corn cockle

www.ag.ohio-state.edu/.../agrostemma_githago.jpg

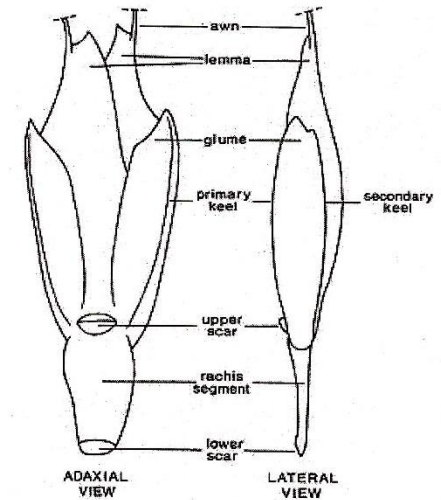
Identification of charred grains of prehistoric wheat species

Important characters of the wheat grain



Hillman et. al. 1996

The principal diagnostic features of a stylized spikelet of a glume wheat



Hillman et al. 1996

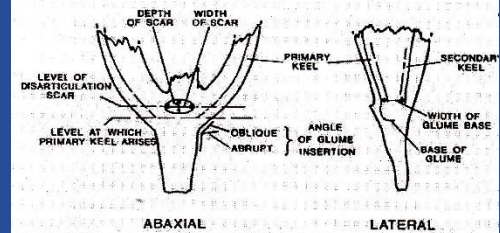


Fig. 5. A diagram indicating some of the terms used to describe spikelet bases in the text Jones et al. 2000

From: Jacomet, S. 2006

Triticum spelta
Spelt wheat



Hordeum vulgare
Barley



www.skane-mollan.se/Bilder/kornbild4.jpg

WATERLOGGED REMAINS

MAY OCCUR IN NATURAL DEPOSITS SUCH AS
MIRES OR FENS

ARCHAEOLOGICAL SITES - WELLS, PITS & DITCHES

CHARRED REMAINS

MUST HAVE COME INTO CONTACT WITH FIRE

NATURAL FIRES

ARCHAEOLOGICAL SITES e.g. hearths, kilns, ovens,
pits, post holes, ditches, floor layers, soils

ENVIRONMENTAL RECONSTRUCTION

'NATURAL' or ARCHAEOLOGICAL SITES

PROBABLE VEGETATION TYPES

DIVIDING THE FLORA INTO REPRESENTATIVES
OF DIFFERENT KINDS OF VEGETATION/HABITAT

e.g. Aquatic, Woodland, Grassland, Cultivated,
Disturbed/Waste ground, Heathland, Salt marsh

On archaeological sites may also be exotics e.g.

Roman sites- herbs such as coriander and dill

CHARRED PLANT REMAINS

Agricultural practices.

Crop processing activity.

CHARRED CEREAL ASSEMBLAGES

3 important components

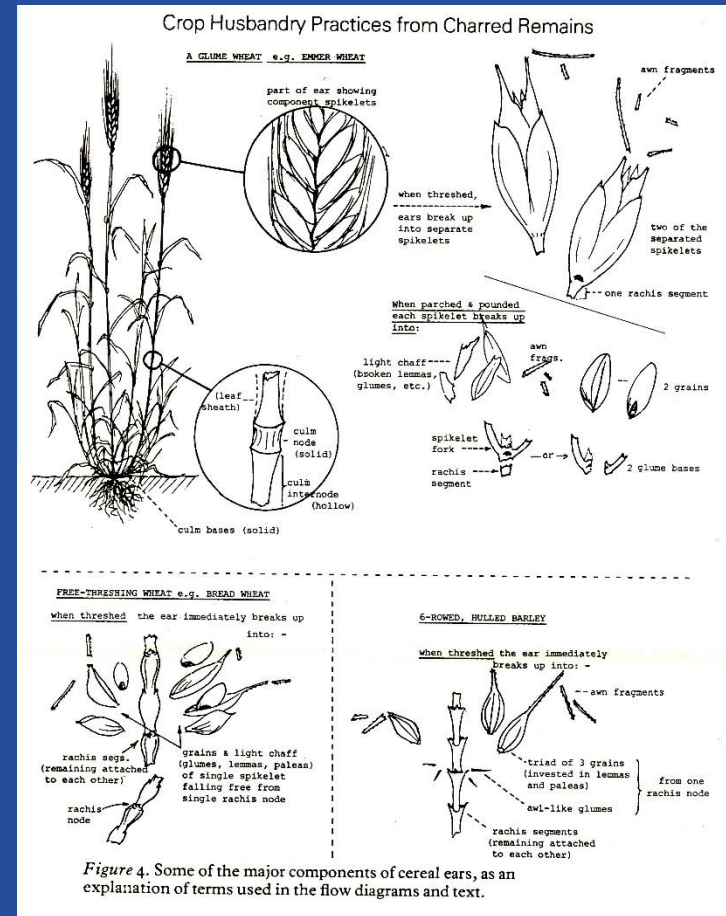
Grain

Chaff - glume bases and rachis

Weed seeds

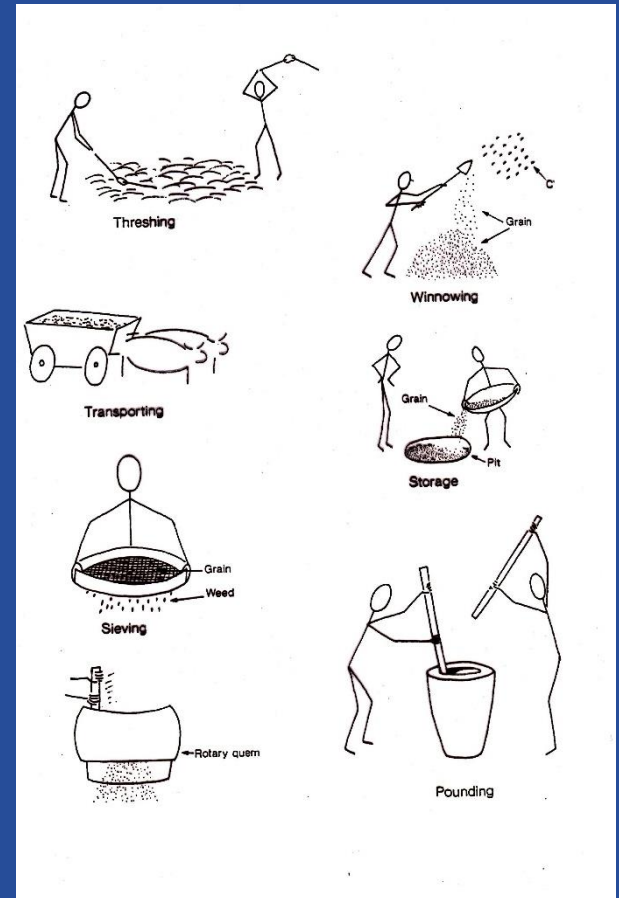
CHAFF IMPORTANT IN
IDENTIFICATION OF
CEREAL
AND IN IDENTIFYING CROP
PROCESSING STAGE
WEED SEEDS ALSO
IMPORTANT

WHEN GRAIN PROCESSED
IT BREAKS INTO
COMPONENT PARTS

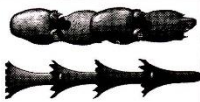
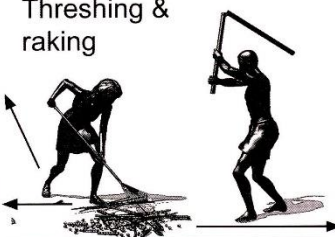
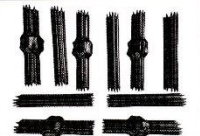
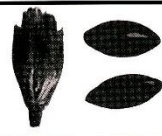
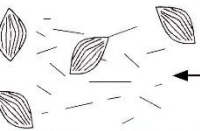
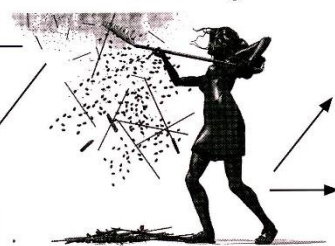
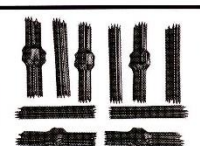
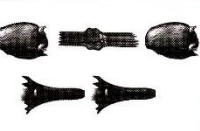
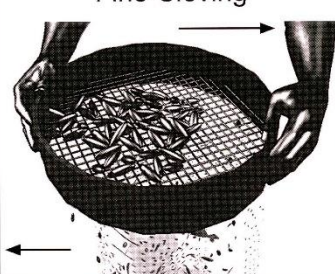


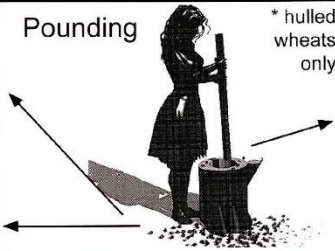
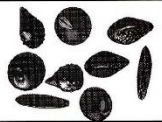
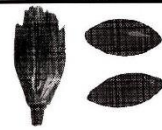
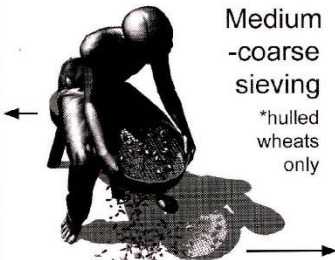
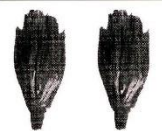
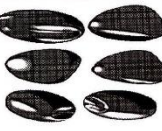
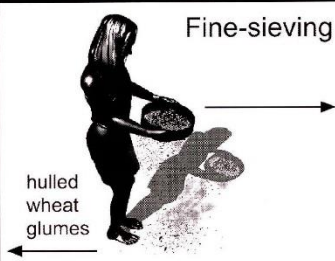
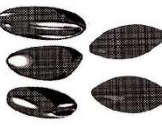
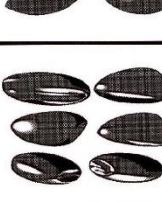
EACH PROCESSING STAGE
LEAVES A CHARACTERISTIC
SET OF DEBRIS IN THE
ARCHAEOLOGICAL RECORD -
NEEDS TO COME INTO
CONTACT WITH FIRE TO BE
PRESERVED

BY-PRODUCTS CONSIST OF
CEREAL WASTE
AND WEED SEEDS



From: Jones, M.K.

Waste	Operation	Product
	Threshing & raking 	
		
	Winnowing 	
		
	Coarse-sieving 	
		
	Fine-Sieving 	
		

Waste	Operation	Product
	Pounding  * hulled wheats only	
		
	Medium-coarse sieving  *hulled wheats only	
		
barley & free-threshing wheat only 	Fine-sieving  hulled wheat glumes	
		
	Hand-sorting 	
		

74 Above and opposite: Crop processing stages for wheat and barley showing their effect on charred plant macrofossil assemblages. The activities themselves are described in this section

CHARRED PLANT REMAINS FROM CROP PROCESSING
MOST LIKELY TO FIND ON AN ARCHAEOLOGICAL
SITE

MAINLY WHEN WASTE PRODUCTS (BY-PRODUCTS
- CHAFF & WEED SEEDS) ARE USED FOR FUEL.

WINNOWER BY-PRODUCT
COARSE SIEVING BY-PRODUCT
FINE SIEVE BY-PRODUCT
FINE SIEVE PRODUCT - GRAIN

AGRICULTURAL PRACTICES

e.g. Manuring

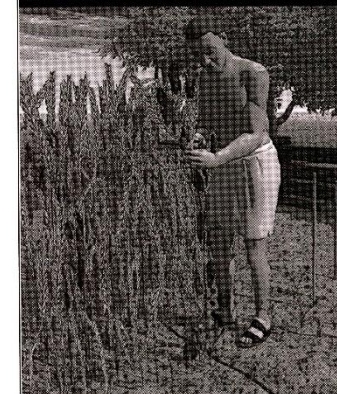
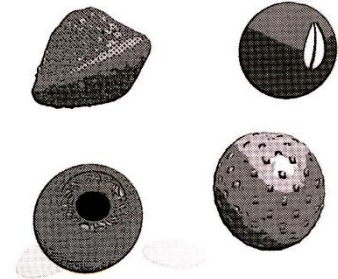
Tilling and Weeding

Sowing

Harvesting methods.



Harvesting by uprooting
twining weeds



Harvesting by sickle
high on the culm.
Only taller weeds.



Harvesting by sickle
low on the culm.
Low and tall weeds.

