

LOOKING AT ELEPHANT TEETH

(from an Activity Morning at Ipswich Museum, 2013).

OPEN DISPLAY (Suffolk Geology Gallery)

Asian elephant skull and jaws

- premaxillae bear roots of tusks; tusks are greatly enlarged incisors, of solid dentine; enamel absent except at tips of milk teeth; tusks used as a resource.
- cheek teeth ('molars') develop in the maxilla and dentary; grass is tough so teeth have to be wear resistant; they have a large grinding surface with numerous ridges of hard enamel, closely packed as tall parallel plates (the enamel is actually folded to form these 'plates').
- crown is the part of the tooth above the root.
- hard and sharp enamel ridges run from side to side of the tooth, the ridges on the upper and lower molars cutting across each other when the jaws move back and forward to break up food. (In deer and cattle, enamel ridges run from back to front, and the main chewing movement is sideways).
- six sets of teeth; at any one time only one tooth is fully in operation, in each of four jaws, one upper and one lower, left and right; cheek teeth are massively built!
- cheek teeth. Front of tooth shows worn plates; the tooth is pushed up forward to expose more crown as the chewing surface is worn down. Grinding surface is concave in lower teeth, convex in upper teeth. Left and right teeth have different horizontal curvature; in lower teeth the buccal surface is concave, the lingual surface convex; in upper teeth the buccal surface is convex and the lingual surface concave.
- trunk; elephants are vulnerable if they kneel; not a long neck (head is close to body) as head weighs about one ton in some individuals; tube (trunk) developed.

LOWER JAW from Harkstead ('Local Grants' Case).

- lower jaw with tooth and replacing tooth (in both sides of jaw).
- tooth replacement (cheek teeth): total of six for each half-jaw; succession - progressively larger and with more enamel plates.
- teeth gradually replace one another throughout life so that there are never more than two cheek teeth in each segment of the jaw at any one time.
- vertical replacement of milk premolars eliminated because of lack of space.
- horizontal development (not replace vertical tooth succession) -
 - medial tooth drift (also known in humans) - as wears down, move forward and displaced by fresh tooth from behind; process

repeated five times. Three milk premolars plus three molars ('molars' 1-6).

— approximate: 1st tooth already erupted at birth, 2nd at about 6 months, 3rd in use until c. 10 years old; 6th erupts c. 25-30 years old, lasts until 50-60 years old.

CHEEK TEETH: GRINDING SURFACE

- shear and grind.
- Enamel. - the hardest mammalian tissue, composed of fine prisms, chiefly calcium phosphate. - outer layer of most teeth and cutting ridges of the elephant. - when ground/worn, tops of folds show as enamel figures/loops (the 'ridge plates').
- Dentine. - tissue forming core of most mammalian teeth; same chemistry as enamel, plus organic matter. Elephant tusks are largely made up of dentine. In elephants, dentine fills the spaces within the enamel figures (the other, alternate, spaces between the enamel ridges are filled with cement). In life, dentine, with the pulp cavity, contains vascular and nervous tissue.
- Cement. - bony tissue forming part of outer surface and fixes tooth in socket in jaw. Fills spaces between enamel and dentine plates of molar crown.

SOME PROBOSCIDEAN TEETH

- Zygodont Mastodon. Mammut tooth, from U.S.A.
 - with few transverse and parallel crested ridges, with open 'valleys' between them.
- Brunodont Mastodon. Anancus tooth, from Red Crag.
 - with hemispherical cusps/tubercles ('brunodont'), paired, forming transverse 'ridge', with supplementary tubercles/conules; inner ('pretroite') cusp on lingual side, outer ('postroite') cusp on buccal side. Lower tooth with posterior tubercles larger than anterior. Upper tooth with anterior tubercles greater than posterior; worn-down cones form a clover-leaf pattern. Have some cement. In many respects resemble gigantic pig; 'pig-tooth' molar (Gomphotherium).
- Stegodon. Right lower molar, from China.
 - transverse ridges (of form that characterises elephants); traces of cement; enamel thick.
- Elephant (Mammoth). Molar, from Sewalik Hills, India (*Mammuthus planifrons*). Ridged molar; with cement; enamel thick. This is a very early mammoth. Mammoths are elephants with spirally curved tusks.
- Elephant (Asiatic). *Elephas maximus*.

- broad; numerous closely appressed, nearly parallel-sided ridge plates; 'crimped' enamel.
- Elephant (African). *Loxodonta africana*.
 - rather narrow; relatively low number of ridges; worn plates tend to show rhomboidal/lozenge shape pattern.

ANOMALOUS TEETH

- drawing of anomalous molar, from Forest Bed deposits near Terton, Suffolk, shown. Drawing in Proceedings of the Geological Society of London 1615 (1964). Specimen in Norwich Castle Museum collection.
- general notes on distorted teeth
 - forward progression interrupted, but into use.
 - caries: decay caused by dissolution of hard tissue, leading to a cavity /
 - periodontic disease: build up of bacteria between tooth and gum: cavity develops: further infection leads to an abscess.
 - cancerous growth (e.g. at root): abnormal outgrowth of dental tissue.

ELEPHANT TEETH FROM RED CRAG AND FROM CROMER FOREST BED

- Tooth from Red Crag
 - (the original is in the Geology Gallery, which see. Also, photograph shown)
 - lower left third molar, from Falkenhamp, Suffolk.
 - ten enamel plates (excluding talonids), plates quite wide and some distance apart, quite thick enamel; comparatively low crown.
 - this is the earliest English elephant. It is labelled *Archidiskodon meridionalis* where displayed, but recent work considers it more 'primitive' than *meridionalis* and it has been renamed *Mammuthus rumanus* (Rumanian Mammoth).
- Tooth from Cromer Forest Bed
 - (the original is in the Norwich Museum; a sketch-diagram of the grinding surface was shown)
 - Left lower 1st or 2nd molar from Poston/Bacton, Norfolk.
 - thirteen enamel plates (excluding talonids); length of grinding surface, in a straight middle line, from front to hind edge, is just over 20cm (i.e. plates closer together); plates narrow (maximum width c. 67mm at plate 3); enamel thinner; high crown (height 134mm, on inner side, below plate 13)
 - diagram also shows appearance of ridges varying with degree

of wear. Plates 1-4 have worn down to give single enamel figures, which show slight crimping (the continuous tooth plates). The other plates are the interrupted tooth plates: tripartite enamel figures (at that stage of wear) are well seen in plates 6, 7 and 8; hind plates show round conules, some worn, some not in use (at the limit of the biting surface).

- this tooth is about 2 million years younger than the Red Crag specimen. It shows adaptation to a grassy diet over this period of time (from browsing to grazing); minute silica particles in grass leaves make for a tough diet.
- this is *Mammuthus trogontheri* (steppe mammoth); the later *Mammuthus primigenius* (woolly mammoth) continued the change in dental characters.

LAMELLAR FREQUENCY

- is the standard measurement (there are others!) in elephant tooth studies. It is the number of enamel plates in a 10-cm length of crown.* e.g.

Mammuthus meridionalis is typically 3.5 - 6
and *Mammuthus primigenius* 7 - 11.5

- try measuring! (unlocalised mammoth teeth provided!)
- also thickness of enamel, and height of crown (use un-worn plate)

* do not measure talonids (although some authors do): (talonids are spur plates attached to the first and last true plates).

- because of the curvature of the teeth, measure various values, e.g. buccal, lingual, middle line (straight), apical, basal. I used straight middle line for the Bacton specimen. Some people use 'mathematical formulae' to minimise distortion resulting from curvature.

FURTHER LOOKING AT GRINDING SURFACES

- Enamel plates: - spacing; width; number of.
- Enamel: - thickness; crimping?
- Patterns of wear of enamel: - tripartite division?; rows of enamel conules?; lateral enamel rings?; lacodont (median diamond/lozenge shapes on plates)?

SPECIMENS IN MAIN HALL ("Victorian Natural History Gallery")

- Large Case
 - Dredged skull of Woolly Mammoth (viewed from rear)
 - two teeth in upper jaw
 - concave wear surfaces; numerous conules; number

- (27-28) ·
- of plates different in left and right teeth
 - Tooth of baby mammoth, from near Holbrook.
 - "Maidenhall Mammoth"
 - right mandible and tooth: a rather small adult
 - left lower molar: with tripartite division of some plates (coming into wear).
 - + size reduction could lead to compression of molar plates.
 - "Extinction of Mammoth" Case
 - lower tooth, from Barham, Suffolk
 - upper tooth from Constantine Road, Ipswich
 - talonid (talon) and first plate coalescence shown as tooth wears.
 - upper tooth from Bramford Road, Ipswich.

SPECIMENS IN SUFFOLK GEOLOGY GALLERY

- "Coproliite Case"
 - left upper third molar of bunodont mastodon *Anancus* from the Red Crag.
- "Red Crag Case"
 - left lower third molar of England's earliest elephant, from Red Crag, Falkenhamp, Suffolk.
 - + more information earlier in these GeoSuffolk Notes).
- "Norwich Crag Case"
 - right lower third molar of *Mammuthus meridionalis* ("Southern Mammoth") from Easton Bavents, Suffolk.
 - wide-spaced plates of this early elephant.
 - Left upper premolar of bunodont mastodon *Anancus*.
 - compare cusps (tubercles) with plates in the elephant tooth.
- "Interglacial Case"
 - *Palaeoloxodon antiquus* ("straight-tusked elephant") tooth from Hoxne, Suffolk
 - narrow crown; median diamond/lozenge shape in front plate.
 - First milk tooth from Harpenden, Suffolk; 5 or 6 plates.
- "Last Glaciation Case"
 - Upper molar tooth from near Ipswich.
 - Lower tooth from Barham, Suffolk
 - with approach to medial lozenges on two plates.
- "Collector's Case"
 - Elephant tooth from Sewalik Hills, India.
 - the grinding surface of this early elephant shows thick enamel ridges. These elephants

(*Mammuthus primigenius* means 'the first born' but of course it was the last mammoth).

migrated to India from Africa c. 3.6 million years ago.

{ compare this tooth with those more than 3 million years younger in 'Local Giants Case': - look at spacing of plates).

- 'Local Giants Case'

- molar from Bramford Road, Ipswich.
- lower jaw with teeth, from Harkstead, Suffolk.
- molar of woolly mammoth.

{ compare these teeth with the Sewaliks tooth).

- 'Coralline Crag Case'

- 2 zygodont-type mastodon tooth.