The Pleistocene Vertebrate Faunas of West Runton, Norfolk, England

A.J. Stuart

SUMMARY
West Runton, on the Norfolk coast, is the most important single fossil vertebrate locality of the Cromer Forest Bed Formation. The Lower Pleistocene (Pre-Pastonian and Pastonian stages) marine 'crags' have yielded a sparse fauna including *Mammuthus meridionalis*, *Mimomys pliocaenicus*, and *M. blanci*. The organic fluvial deposits of the West Runton Freshwater Bed, Cromerian type site, have produced an exceptionally rich early Middle Pleistocene vertebrate assemblage, comprising: 8 fish taxa; 5 amphibians; 3 reptiles; several birds; and 43 mammals. The mammals include: voles *Mimomys savini* and *Pliomys episcopalis*; extinct beaver *Trogotherium cuvieri*; monkey *Macaca sylvanus*, mammoth *Mammuthus cf. meridionalis*, rhinoceros *Dicerorhinus etruscus*, and giant deer *Megaloceros verticornis*. Pollen and plant macrofossils show that this fauna lived in association with regional temperate forest in the first half of the temperate stage.

SAMENVATTING

Introductie
The Cromer Forest Bed Formation (C.F.B.F.), exposed along the coasts of northeast Norfolk and Suffolk, has been famous for its fossil mammal remains since the early part of the last century (GREEN, 1842; OWEN, 1846). The classic nineteenth century study of the stratigraphy and palaeobotany of these complex deposits by Clement Reid (REID, 1882; 1890), was matched by excellent work on the vertebrates by E.T. NEWTON (e.g. 1882a; 1886; 1891). Other major contributions on the vertebrates include those made last century by OWEN (e.g. 1846) and DAWKINS (e.g. 1883); and earlier this century by HINTON (1908; 1911; 1926), and AZZAROLI (1953). More recent work includes MCWILLIAMS (1967); STUART (1975; 1982; 1992); STUART & WEST (1976); and LISTER (1992a; 1992b).

WEST's (1980) massive reinterpretation of the stratigraphy and palaeobotany of the C.F.B.F., utilizing palynology - a technique unknown to Reid - provided an invaluable framework for sorting out the sequence of vertebrate faunas. According to West the C.F.B.F. covers several climate-based stages, from the oldest to the youngest: Pre-Pastonian (cold); Pastonian (temperate); Beestonian (cold); and Cromerian (temperate), the deposits of which are succeeded by tills and outwash of the Anglian Glaciation. A major stratigraphical hiatus is present within the sequence, with the Pre-Pastonian and Pastonian of Lower Pleistocene age, and the Beestonian and Cromerian dating from the early Middle Pleistocene. Some deposits assigned to the Beestonian may date from a distinct Lower Pleistocene cold stage. Recent work suggests that the Forest Bed also covers one or more early Middle Pleistocene temperate stages which are post- Cromerian, but still pre-Anglian (MEIJER & FREEZE, 1992; STUART, 1992).

The Forest Bed mammal "localities" are shown in Fig. 1. Forest Bed fossils found on the beach at Eccles, appear to have been washed out of deposits below low tide level. Stray, probably wave-transported, finds occur on the beaches even further to the southeast at Sea Palling and Winterton. It should be stressed that many of the Forest Bed 'localities', as recorded in museum labels and catalogues, are not specific fossil sites, but merely give a general indication of where specimens were found in relation to the nearest coastal village or town. Moreover, in many cases fossils were found loose on the beach, having been washed out of deposits in the cliff or foreshore, so that it is difficult or impossible to assign these to particular stratigraphic units. Exposures were generally better in the past, as nowadays most are obscured by sea defences, but some localities are still available and important finds continue to be made.

The most important single locality where Forest Bed vertebrates have been found in situ is the cliff section at West Runton (Figs. 2,3), the stratotype for the Cromer-
an Temperate Stage, and designated a geological S.S.S.I. (Site of Special Scientific Interest) by English Nature (formerly Natural Environment Research Council). Although threatened on more than one occasion, this prime palaeontological locality is still allowed to erode more or less naturally, and thus remains available for study.

Two groups of deposits and faunas widely separated in time are present at this locality. The older, Lower Pleistocene, assemblages need more detailed study and are only considered briefly here.

Crag (pre-Pastonian Cold Stage and Pastonian Temperate Stage)

Overlying the Upper Chalk, which can be seen exposed on the foreshore at low tide, are Lower Pleistocene marine deposits; the Stone Bed and crag ('Weybourne Crag') which occur both on the foreshore and beneath the modern beach. Pollen assemblages obtained from interdigitated silt horizons show that the crag covers the Pre-Pastonian and Pastonian stages (WEST, 1980). A few large-mammal remains have been found in the foreshore exposures, including a molar of the extinct elephant *Mammuthus meridionalis* from the Stone Bed (pre-Pastonian a substage) (WEST, 1980). Vole material was obtained by sieving crag dug from beneath the beach by mechanical excavator during the construction of a concrete sea wall immediately to the east of West Runton Gap (MAYHEW & STUART, 1986).

The vole fauna, which comprises *Mimomys pliocaenicus*, *Mimomys reidi*, *Mimomys newtoni*, *Mimomys blanci* and *Mimomys pitymyoides*, is very different to that of the West Runton Freshwater Bed, which occurs in a stratigraphically higher position, but is similar to those recorded from East Runton (MAYHEW & STUART, 1986). A desman upper P4 from the same deposits has been referred to *Galemys kromski* by HARRISON et al. (1988). The above material is preserved in the University Museum of Zoology, Cambridge.
West Runton Freshwater Bed (Cromerian Temperate Stage)

This famous deposit, known since the early nineteenth century, has produced one of the richest Quaternary vertebrate faunas in Europe. So far it has escaped being obscured by coastal sea defences and important new material, including new species records, continues to be found. The West Runton Freshwater Bed occupying a broad channel about 200m across in section and up to about 2m thick, cut in sands and gravels attributed to the Beestonian Cold Stage, crops out at the base of the cliff east of West Runton Gap (Woman Hythe) (Fig. 2, 3). Details of the stratigraphy, pollen and plant macro assemblages are given by West (1980). The channel filling is designated the stratotype for the Cromerian Stage.

The basal bed of the channel filling, bed a (of West, 1980), occurs only in a limited area near Goss' Gap near the eastern end of the exposure. It comprises freshwater marls with pollen assemblages assigned to the late Beestonian Cold Stage and subzone Cr Ia of the Cromerian (Table 1, Fig. 4). On its eroded surface rest beds c-e, fluvial shelly organic muds and sands with numerous reworked marl lumps and small pebbles (mainly flint), with pollen spectra essentially of subzones Cr Ib - Cr Ia. The clast size decreases upwards and the upper part of the deposit, bed f, comprises detritus muds (shelly in part), mainly of subzone Cr IIb age. The altered top of the bed, interpreted as a palaeosol, indicates a substantial period of subaerial exposure prior to marine deposition of the overlying basal gravel ("Monkey Gravel") and thin bedded silts and sands attributed to the second half of the Cromerian Interglacial. The top of the Freshwater Bed is extensively bored by the marine mollusc Mya. Occasional shells can be seen in life position.

The Freshwater Bed pollen and plant macro assemblages (West, 1980) (Fig. 4) record changes from woodland with pine, elm, birch, extensive herbaceous vegetation and restricted fen and reedswamp (Cr Ib), to a more diverse woodland with oak and other thermophilous trees more widespread, persistent local open habitats and fen and reedswamp (Cr Ia, Cr IIb).

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Fig. 2: Schematic section of cliff and foreshore deposits at West Runton, Norfolk (based on WEST, 1980). Length of section approximately 500 metres; depth 22 metres. The V-shaped structure is an ice-wedge cast.
**PISCES** (provisional identifications) (STUART, 1975; 1988; STINTON, 1985)

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
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<tbody>
<tr>
<td>1.</td>
<td><em>Esox lucius</em> L., pike</td>
</tr>
<tr>
<td>2.</td>
<td><em>Gasterosteus aculeatus</em> L., three-spined stickleback</td>
</tr>
<tr>
<td>3.</td>
<td><em>Anguilla anguilla</em> (L.), common eel</td>
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<tr>
<td>4.</td>
<td><em>Tinca tinca</em> (L.), tench</td>
</tr>
<tr>
<td>5.</td>
<td><em>Scardinius erythrophthalmus</em> (L.), rudd</td>
</tr>
<tr>
<td>6.</td>
<td><em>Rutilus rutilus</em> (L.), roach</td>
</tr>
<tr>
<td>7.</td>
<td><em>Perca fluviatilis</em> L., perch</td>
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<tr>
<td>8.</td>
<td><em>Gymnocephalus cernua</em> (L.), ruffe</td>
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**AMPHIBIA** (HOLMAN, CLAYDEN & STUART, 1988; HOLMAN, 1989)

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<th>No.</th>
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<tr>
<td>1.</td>
<td><em>Triturus vulgaris</em> L., common newt</td>
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<tr>
<td>2.</td>
<td><em>Bufo bufo</em> (L.), common toad</td>
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<tr>
<td>3.</td>
<td><em>Rana arvalis</em> Nilsson, moor frog</td>
</tr>
<tr>
<td>4.</td>
<td><em>Rana 'esculenta' or Rana ridibunda</em>, edible frog or marsh frog</td>
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<tr>
<td>5.</td>
<td><em>Rana temporaria</em> L., common frog</td>
</tr>
</tbody>
</table>

**REPTILIA** (HOLMAN, CLAYDEN & STUART, 1988; HOLMAN, 1989)

<table>
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<tr>
<th>No.</th>
<th>Species</th>
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<tbody>
<tr>
<td>1.</td>
<td><em>Anguis fragilis</em> L., slow worm</td>
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<tr>
<td>2.</td>
<td><em>Natrix natrix</em> (L.), grass snake</td>
</tr>
<tr>
<td>3.</td>
<td><em>Vipera berus</em> L., adder</td>
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Small-vertebrate remains are fairly common, and the majority have been found by wet-sieving the sediments. Large-mammal remains are much rarer, but over the years numerous bones and teeth have been collected, especially when the fossils have been exposed after a combination of gales and high tides has eroded the cliffs.

The list of vertebrates from The Freshwater Bed has been significantly extended in the last few years (STUART, 1975; 1981; 1982; 1988; 1992). J. A. Holman has studied the reptile and amphibian material and discovered two taxa not recognized by NEWTON (1882), *Rana arvalis*, moor frog and *Rana ridibunda* or *R. 'esculenta'*, marsh or edible frog (HOLMAN, CLAYDEN & STUART, 1988).

Recent additions to the mammal list include: *Nyctalus noctula*, noctule bat (see D. HARRISON & BATES, 1984); *Pilomys episcopalis*, extinct vole (first recognized by A. P. Currant, on the basis of material collected by J. CLAYDEN); a small hamster, species not yet determined (tooth collected by J. CLAYDEN) and *Megaloceros savini*, giant deer (antler collected by J. LIGHTWING and identified by A. M. LISTER). In addition *Macaca sylvanus*, macaque monkey, is now recorded from the Freshwater Bed on the basis of an incisor tooth collected by P. BERGDHAL, the previous find of macaque from West Runton was from the "Monkey Gravel" (HINTON, 1908).

In a major review of European Quaternary otters, WILLEMSEN (1990) has referred the West Runton material to the extinct species *Lutra simplicidens*. Carnivores, are clearly underrepresented in the collections considering the wide variety of available prey. Hopefully, more material will be discovered in the future.

Although known to palaeontologists for more than a century and a half, The Freshwater Bed continues to surprise us with new discoveries; the most recent of which is the most spectacular ever found at this site and indeed in the entire Cromer Forest Bed Formation. Until recently only very sparse material of elephant was available from the Freshwater Bed. However in December 1990, after a gale and high tide, Mr and Mrs H. HEMS discovered the pelvis of an adult male elephant. A year later, further erosion exposed several more bones which were found by R. SINCLAIR. A controlled excavation in January 1992 recovered the mandible, most of the vertebral column, right humerus and ulna, several ribs and a number of other bones of *Mammuthus cf. meridionalis* (Figs. 4, 5). More precise identification awaits the removal of the mandible from its plaster jacket. The finds so far comprising about a quarter of the entire skeleton, are in the Castle Museum, Norwich. The presence of two hyaena coprolites found in situ with the elephant bones, plus characteristic toothmarks on a phalax, show that hyaenas fed on the carcass. The evidence for
Insectivora
2. Erinaceus cf. europaeus L., hedgehog
3. Sorex rutonensis Hinton, extinct shrew
4. Sorex savini Hinton, extinct shrew
5. Neomys newtoni Hinton, extinct water shrew
6. Taiga europaea L., common mole
7. Taiga minor Freudenberg, extinct mole
8. Desmana moschata (Pallas), Russian desman
Primates
9. Macaca sylvanus (L.), Barbary macaque
Lagomorpha
10. Lepus sp., a hare
Rodentia
11. Sciurus whitei Hinton, extinct squirrel
12. Trogontherium cuvieri Fischer, extirpated
13. Castor fiber L., beaver
14. Cricetus cricetus (L.), common hamster
15. small hamster, species not yet determined
16. Clethrionomys glareolus Schreber, bank vole
17. Pliomys episcopalis Mehely, extinct vole
18. Mimomys savini Hinton, extinct water vole
19. Pliomys arvaloides Hinton, extinct pine vole
20. Pliomys gregaloides Hinton, extinct pine vole
21. Microtus cf. arvalis (Pallas), common vole
22. Microtus oeconomus (Pallas), northern vole
23. Apodemus sylvaticus (L.), wood mouse

Carnivora
24. Canis lupus L., wolf
25. Ursus deningeri von Reichenau, extinct bear
26. Mustela nivalis L., weasel
27. Martes sp., martens
28. Pannonictis sp., extinct mustelid
29. Lutra simplicidens Thunius, extinct otter
30. Crocuta crocuta (Erdeben), spotted hyaena
31. Felis cf. lunensis Martelli, extinct cat
32. undetermined large felid, probably lion or sabre-tooth

Proboscoidea
33. Mammutus cf. meridionalis (Nesti), extinct elephant.

Perissodactyla
34. Equus sp. (caballine), a horse
35. Dicerorhinus etruscus (Falconer), extinct 'Etruscan' rhinoceros

Artiodactyla
36. Sus scrofa L., wild boar
37. Megaloceros verticorinis (Dawkins), a giant deer
38. Megaloceros savini (Dawkins), a giant deer
39. Dama dama (L.), fallow deer
40. Cervus elaphus L., red deer
41. Alces latifrons Johnson, extinct elk (moose)
42. Capreolus capreolus (L.), roe deer
43. Bison schoetensacki Freudenberg, extinct bison

Table 1: Faunal List West Runton Freshwater Bed (West, Runton, Norfolk, England). Cromerian Interglacial (stratotype), substages Cr Ia-Ib

Rapid burial of the skeleton implies much faster deposition of the Freshwater Bed than had been assumed previously. Sparse small-vertebrate remains, have also been found in the marine "Monkey Gravel", which rests directly on the Freshwater Bed. According to West (1980), this horizon belongs to Cromerian stage Cr III. The vertebrates, which include Mimomys savini (see above), are very similar to those of the Freshwater Bed, and are probably derived partly or entirely from it. However, one species the squirrel Sciurus whitei is recorded, on the basis of a single upper P4, so far only from the "Monkey Gravel".

To date 43 mammalian taxa, 17 birds, 5 amphibians, 3 reptiles and at least 8 fishes are recorded from the West Runton Cromerian. Some of the bird identifications, in particular the diagnosis of an extinct species of eider (C. Harrison, 1979) may be questioned on the grounds of insufficient material. The fish identifications should be regarded as provisional. The material is at present under study by B. Irving.

Taking the palaeontological evidence together, one can picture a slow-flowing river, rich in aquatic plants and fringed by fen, supporting a wide variety of fishes, such as is found in a typical English lowland river today, plus frogs and toads, grass snake, waterfowl, and mammals of waterside habitats, including Russian desman, beaver, extinct beaver Trogontherium cuvieri, otter and extinct water vole Mimomys savini.

Much of the fauna, is consistent with temperate forest as indicated by the pollen spectra (West, 1980); e.g. wild boar, macaque, fallow deer and woodmouse. However, the abundant remains of grassland voles Microtus spp. and Pliomys spp. indicates the presence of at least local areas of herb vegetation, while the presence of elk and two species of giant deer, in which the males carried enormous outspread antlers, together with horse, indicates more extensive open habitats than are suggested by the pollen spectra. The activities of large herbivores, especially elephants - possibly present in substantial herds - would have probably promoted and maintained more open areas within the forest.
Fig. 3: West Runton cliffs east of West Runton Gap (Woman Hythe). The West Runton Freshwater Bed can be seen as a dark band above the top of the beach.

Fig. 3: West Runton kliffen ten oosten van West Runton Gap (Woman Hythe). Het West Runton Freshwater Bed is te zien als een donkere band boven de top van het strand.

Fig. 4: Schematic pollen diagram for the Cromerian Temperate Stage (based on WEST, 1980a). Cr Ia - Cr IVc are pollen substages of the Cromerian. The diagram also includes the end of the preceding Beestonian Cold Stage and the beginning of the succeeding Anglian Cold Stage.

Fig. 4: Schematisch pollendiagram van het gematigd warme Cromerien s.str. (gebaseerd op WEST, 1980a). Cr Ia - Cr IVc zijn pollen stages van het Cromerien. Het diagram bevat ook het laatste deel van de voorafgaande koude periode, het Beestonien en het begin van het Anglien, de koude periode die volgt op het Cromerien.
The large amount of material from the West Runton Freshwater Bed is divided between several museums, notably: Natural History Museum, London; Norwich Castle Museum; Harrison Museum, Sevenoaks; and University Museum of Zoology, Cambridge.

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