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## EVIDENCE FOR PRE-CROMERIAN PERMAFROST IN EAST ANGLIA

In December 1965 a tidal scour at West Runton, on the north Norfolk coast removed much of the beach and exposed on the foreshore Middle Pleistocene estuarine silts. These silts are known to have been formed during the first temperate stage of the Middle Pleistocene, the Pastonian (West and Wilson, 1966)<sup>1</sup>. They are separated from the next youngest temperate stage, the Cromerian by gravel, sand and silt, the last containing a cold-indicating flora. This cold stage intervening between the Pastonian and Cromerian temperate stages is the Beestonian stage.

While ice-wedge casts of Beestonian age are known from other parts of the Norfolk coast, the tidal scour near West Runton Gap in December 1965 exhumed a platform of Pastonian silts on which could be seen a part of an ice-wedge network (plate 1). Where the network reached the base of the cliff, which in 1965 happened to be at the junction of the two visible lines of the network, the cast of an ice-wedge was seen (plate 2). A plan of the network fragment and a sketch of the section are shown in figure 1. The depths of the cast could not be determined, but at least a metre and a half of cast was seen.

These observations demonstrate the presence of a time of permafrost in the cold period anterior to the Cromerian temperate stage. Evidence of cold conditions about this time is also provided by plant remains, including *Betula nana*, from an undisturbed laminated silt, seen in plate 2 immediately above the top of the spade.

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<sup>1</sup> West, R. G. and Wilson, D. G., 1966 — Cromer Forest Bed Series. *Nature*, vol. 209; p. 497—498.

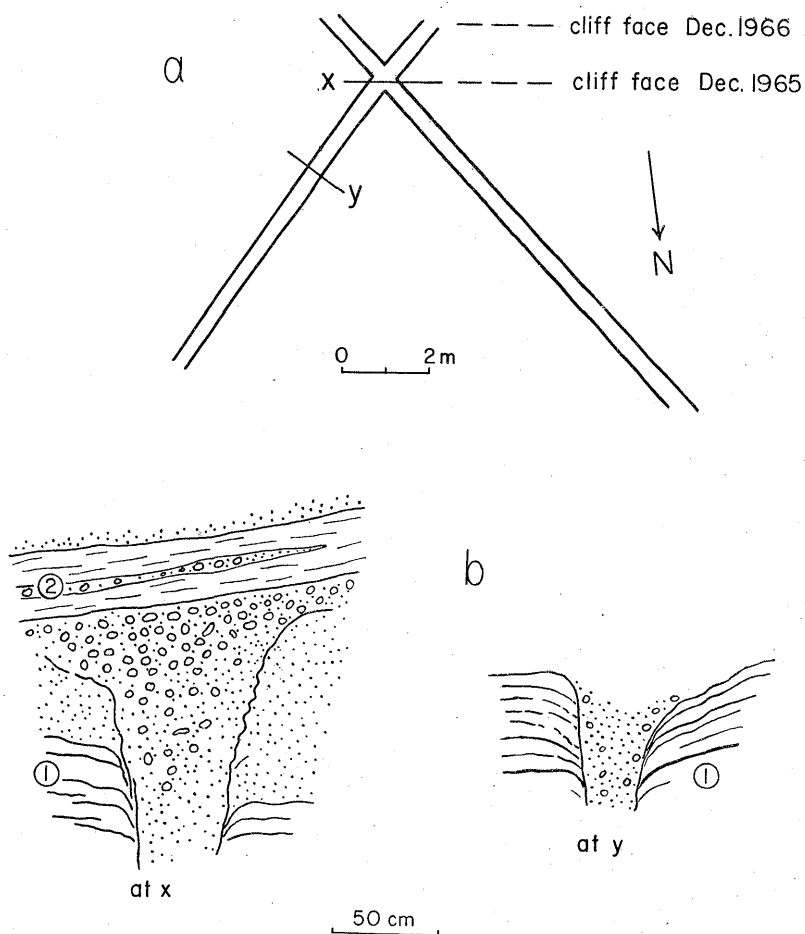


Fig. 1.

a. Plan of network, 30 m west of West Runton Gap

b. Sections at cliff base and on foreshore: (1) Pastonian estuarine silt; (2) arctic freshwater bed of Beestonian age



Pl. 1. View from cliff top, 15 m high, of foreshore with exhumed part of an ice-wedge network, penetrating estuarine silts of the temperate Pastonian stage



Pl. 2. View of cliff-base showing lines of the ice-wedge network converging together and forming a single ice-wedge cast at the base of the cliff

Undisturbed grey laminated silt overlies gravel and sand which has collapsed into the ice-wedge. The large flints are part of the beach and are derived from foreshore exposures of the Chalk