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AN ACCOUNT OF THE FIELD MEETING OF THE COLLOQUIM FOR THE STUDY OF THE NORTHERN NEOGENE : NORWICH 1970

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Dr, P.E. NORTON

(Norwich, June 1970)

The party numbering twenty-seven members, assembled at Ipswich at the Municipal Museum where Mr. R. Markham acted as guide to the unique series of Crag fossils in the museum collection. Afterwards Mr. Cambridge described the post-Cretaceous succession in East Anglia illustrating his talk with colour slides. He discussed the derived fossils which are found throughout the Crags and, in particular, in the base of the Red Crag where derived material of Jurassic, Cretaceous, Eocene, Miocene and late Pliocene age was mentioned.

Wednesday April 1st

Due to the geographical distribution of the Crag deposits it was not possible to look at the Crags in stratigraphical order. The first day was spent examining typical sections in each of F.W. Harmer's Red Crag 'zones' — the Waltonian, Newbournian and Butleyan. The earliest Red Crag was seen at the type site, the only remaining section, in the seacliffs at Walton-on-the-Naze, Essex (Nat. Grid Ref: TM 266235). Here Red Crag rests on a low cliff of Eocene London Clay. The section is much obscured by natural slippage, largely caused by a line of springs at the junction of the Red Crag and London Clay. At the point where the path descends the cliff, a fine section in very fossiliferous Crag was seen, the lower part of the beds being a fine sand full of small molluscs, polyzoans, etc. A number of sections were seen in the length of the cliff, many of which showed strong current bedding. The Waltonian Red Crag contains a great deal of derived Pliocene material and the more northern forms which characterise the Newbournian Red Crag are unknown. The London Clay at Walton is almost unfossiliferous, but fossil wood and shark teeth and vertebrae washed from it were picked up by members of the party on the beach below.

After lunch in Walton-on-the-Naze, the good weather began to deteriorate and visits to pits in the Newbournian Crag were interrupted by snow showers. On Waldringsfield Heath (N.G.R. TM 263448) large gravel workings have revealed glacial outwash sands and gravels, resting on decalcified Red Crag with organic burrows. In a pumping trench below the floor of the pit a good section in the top beds of the Newbournian was visible. The Crag here is strongly current bedded, and contains many small phosphatic nodules and molluscs.

The next pit at Brightwell (N.G.R. TM 251431) penetrates almost to the base of the Newbournian Crag. While the pit was being excavated (to provide infilling for dock workings at Felixstone) an exceptionally rich fauna with many rarities was obtained. Many of these (including a large number of Astartidae) are undoubted derivatives from Pliocene beds. There is also a large indigenous fauna. Though the pit is now rather overgrown many typical fossils were collected, including a fine example of the rare Coralline Crag coral *Flabellum woodi*. The division into a strongly current bedded lower series and a less disturbed and more horizontal upper series of beds

was well demonstrated. Mr. Cambridge explained to the party that a similar division is seen in many Red Crag sections and is usually accompanied by a change in fauna, the upper beds have a more restricted fauna in which lamellibranchs predominate.

This feature was again seen in the section of Butleyan Red Crag at the Neutral Farm Pit, Butley (N.G.R. TM 371511), which was the last stop of the day. Careful collecting at this pit will generally reveal a higher proportion of northern forms than in the earlier Crag and the derivative material is more worn and fragmentary.

Thursday April 2nd

After passing through the market town of Woodbridge, the coach stopped at Pettistree Hall while the party visited Sutton Knoll, (N.G.R. TM 305440), the site from which S.V. Wood collected many of his Crag fossils. The Coralline Crag outlier consists of an upper 'rock bed' (partly decalcified) covering shelly sands. It rests on London Clay and is surrounded by Red Crag, forming a low hill. There are indications that the Coralline Crag outlier formed an island during part of the Red Crag transgression and in the Red Crag pits (not visited) which fringe the hill are many boulders and fragments of Coralline Crag. The fossiliferous sands of the Coralline Crag were examined and afterwards Mr. Cambridge drew attention to several features of the landscape. These included the nearby River Deben, a drowned valley which forms an estuary, and the site of a similar Coralline Crag outlier across a small valley to the east, which was to be the next stop.

With some difficulty the coach approached as closely as possible to the River Cliff at Ramsholt (N.G.R. TM 296426). The party descended on foot to a small sandy beach and London Clay with typical septarian bands was seen at the high water mark. In the overgrown banks above, the Coralline Crag is overlain by Red Crag and the junction was exposed by digging. A thin nodule band occurs at the base of the Red Crag and similar nodules occur scattered in the underlying Coralline Crag. On the beach below are large spreads of similar nodules together with fragments of fossil wood and bone, shark's teeth etc., and both Red and Coralline Crag fossils, often very well preserved. Good examples of the coral *Cryptangia woodi* were collected in this way.

Once again the weather was not as good in the afternoon. During a lunch stop at Orford, most of the members climbed the keep of the 12th century castle despite the strong cold winds. From this view point they could see the whole length of Orford Ness, a great spit, mainly composed of flint pebbles, which stretches almost eleven miles along the coast. In addition, the course of the Coralline Crag ridge could be traced and to the south of the castle the Boyton Marshes were seen. In these marshes shallow underwater workings in search of phosphatic nodules, brought to light material which F.W. Harmer (1920) described as belonging to a Boytonian Stage, placed between the Coralline Crag and the Waltonian Red Crag. BADEN-POWELL (1960) pointed out that this Stage is invalid, having been based on Red and Coralline Crag mixed underwater by the diggers. The castle tower is built of London Clay septaria dredged from the nearby river estuary.

Coralline Crag of the rockbed lithology occurs in a number of pits near Orford and one of these, at Crag Farm, Sudbourne (N.G.R. TM 429523) was next visited. It was explained that the use of such pits for cattleyards was frequent on Suffolk farms. The pits were sometimes partly roofed over or divided into stalls. The material excavated was used for rough walling, repairs to farm roads, or for liming fields. In this pit the party examined typical Rock Bed with strong current bedding. The partial decalcification of the deposit is shown by the absence of aragonitic fossils so that only such groups as the pectinids, echinoids, crustaceans and polyzoans are left. In some parts polyzoa constitute the majority of the deposit ('Bryozoa-Rock'). Fossils collected from the Crag Farm pit on this occasion included a large claw of *Cancer pagurus* and a dolphin vertebra.

The last section of the day to be visited was Chillesford (N.G.R. TM 383523). The church

tower here is built largely of Coralline Crag Rock Bed. On either side of the church is a pit and that to the north of the church (The Church Pit) was visited. Dr. NORTON explained that during excavations here in 1968 apparently typical Red Crag was reached at the base. Resting on the Red Crag was a sandy series with seams of comminuted shells, inclined in places — the Chillesford Sands or Scrobicularia Crag. This deposit contains numerous tubes which Prof. J. DE HEINZELIN suggested were those of *Balanoglossus*, showing the characteristic curve at the bottom of the U-tube. In the upper part of the present section the party saw Chillesford Clay and in places, below it, a bed with *Mya* in position of growth. The *Mya* bed contains Pastonian pollen (WEST 1968). Attempts to dig down to the Red Crag were not successful on this occasion but in the Bullockyard Pit, on the other side of the Church, it is easily reached in the bed of the pit.

Friday April 3rd.

A series of Norwich Crag (Icenian) sites were visited *en route* to Norwich. At Easton Bavents the party descended to the shore and examined the cliff section at North End Warren (N.G.R. TM 518787). The succession was explained by Dr. NORTON who said this was the Type Site of the Baventian (glacial) Stage (FUNNELL & WEST 1962). A pebbly series at the top is underlain by a blue clay with Baventian pollen, then sand with pebbles, and five shell beds, of which the upper three were seen. These shell beds are shown by palynological correlations to be Antian (the lowest) to early Baventian (the uppermost) by NORTON & BECK (in press). They yielded many *Macoma* and *Arctica*. The gravel above the Baventian clay contains numerous mammalian remains but the fauna is a mixture and largely derivative. A series of bones referred to *Platax woodwardi* and dermal denticles of *Raia* are common in the shell bands.

At the next site, near Hill Farm, Wangford (N.G.R. 462777), a section in an old pit had been re-excavated by Dr. NORTON in 1969 and the upper part was still visible. It showed gravel at the top, passing down into loams and sands and then shelly Norwich Crag of littoral type from which the party were able to collect shells. *Corbicula fluminalis* is known to occur at this site, but was not noticed on this occasion. Dr. NORTON explained that the pebbly deposit at the top is thought to pass up into the main spread of gravels exposed further north at this locality, which the party then visited. These are the Westleton Gravels, described by HEY (1967) and thought to be a beach deposit. A possible Pastonian date was suggested on the basis of hystrichospheres found in the loamy material below the gravels.

After refreshments at Loddon, the journey continued, with some difficulty, past the North Sea Gas pipeline workings near Bramerton to reach Blake's pit (N.G.R. TG 298061) on the south bank of the river Yare. Here Mr. CAMBRIDGE explained that, though most of the pit is now overgrown, pockets of shelly Crag of littoral type occur throughout the exposure. Collections were made from several of these pockets, including numerous distorted examples of *Nucella lapillus* and *Littorina*, as well as normal forms of other species. The party discussed the ecological significance of such monstrosities which are found in the area about Thorpe, Postwick and Bramerton. Dr. NORTON pointed out that the specimen of *Littorina littorea var distorta* figured by HARMER (Plioc. Moll. G.B. Pl. 52 fig. 16) showed, on autopsy, a juvenile barnacle growing against the inner lip, which had apparently caused the specimen to distort. This was not suggested as a general explanation. Parasitism was also suggested as a cause.

The Type Site of the Norwich Crag, at Bramerton Common, about 300 metres from Blake's Pit, is no longer visible. Dr. NORTON summarised the succession recently described by FUNNELL (1961) and NORTON (1967) at Bramerton Common as two shell bands above the Chalk, overlain by sands and clay bands with foraminifera but no molluscs.

The party then drove along the south slope of the Yare valley to Whitlingham (N.G.R. TG 268077). In the old chalkpit here Norwich Crag was seen resting on the Chalk about 20 metres above the base of the pit. A Stone

Bed, largely consisting of flint nodules, is followed by a thin shelly series, which in turn passes up into pebbly beds with a high proportion of quartzite pebbles. Mr. CAMBRIDGE mentioned that in the past the Norwich Crag was frequently referred to as the Mammaliferous Crag and that when in work this pit was famous for mammalian remains. The largest number came from the basal Stone Bed, which still occasionally yields fragmentary bones. A series of flints from the Stone Bed have been described as humanly worked.

On the eastern margin of the Crag basin around Norwich, the shelly Norwich Crag of the west is replaced by unfossiliferous gravels with numerous quartzite pebbles; a short visit was paid to an old chalkpit at Catton Grove Road, Norwich (N.G.R. TG 229109) to see a small section in these gravels.

For the remainder of the meeting the party was accommodated in the new buildings of the University of East Anglia.

Note: In almost all cases in the sections discussed there are tills, sands or gravels of more recent date covering the Crag deposits. As the purpose of the field meeting was to examine the Crag series, these are usually not mentioned when describing the sections.

Saturday April 4th

The day was spent examining sites on the North Norfolk coast. The coach stopped behind the shingle bar at Weybourne Hope (N.G.R. TG 110437) while Dr. NORTON explained the local succession. Resting on the low Chalk cliffs to the east was the Weybourne Crag, a thin layer of weathered shelly sands passing up into gravels. This Weybourne Crag is not dated by pollen and Dr. NORTON considers its shells have a re-worked appearance. The party then descended to the beach and examined the succession in the cliff. At two points where the deposits were not too disturbed, the shells and gravels were seen to be succeeded by a loamy, purplish sand with obscure markings, called the Rootlet Bed by CLEMENT REID (1890). Above this were thin laminated sands and fine silt and then till. The beds above the Chalk in this area are generally strongly deformed. Mr. CAMBRIDGE pointed out that he has collected teeth of small mammals and a few fresh-water shells from softer sandy pockets in the Weybourne Crag at this locality.

The party then drove east along the coast, between the Cromer Ridge and the sea, passing through Sheringham to stop at West Runton and walk down to the foreshore through West Runton Gap (N.G.R. TG 185431). Dr. NORTON explained the general sequence of the Cromer Forest Bed Series at this point, mentioning that the sequence proposed by C. REID (1890) can no longer be maintained as regards its divisions or their succession (WEST and WILSON, 1966). A reddish, stony Crag, shelly in places, was seen resting on the Chalk beach platform near low water mark. This deposit is discontinuous and often covered by beach sands. Examples of *Arctica islandica* and *Mya truncata* with the valves joined, were seen imbedded in the deposit. This basal Stone Bed sometimes contains mammalian remains, including elephant teeth and bones, and fragments of bone were found on this occasion. Dr. NORTON explained that this deposit of Weybourne Crag is dated by pollen as Baventian whereas 'Weybourne Crag' at other sites is younger and contains a Pastonian flora. Immediately above the Weybourne Crag in the beach are grey estuarine silts of the Pastonian marine regression which were covered by recent beach sand on this occasion. At the foot of the cliff immediately west of the Gap the party saw the topmost deposits of the Pastonian temperate stage. These are estuarine silts containing pollen of temperate mixed oak flora (WEST and BANHAM 1968) passing up into sands and gravels of the Beestonian stage, which were deposited during cold conditions. The state of the cliff prevented the party seeing the freshwater shelly sands and thin clay muds of the Cromerian which overlie the Beestonian at this point. Next, to the east of the Gap, the party examined the black peat of REID's Upper Freshwater Bed. This is the type site of the Cromerian temperate stage. Dr. NORTON repeated WEST's observation that the peat

here rests on grey marl (not seen by the party) which itself lies in a channel cut in sands and gravels of the Beestonian. The party were able to see brecciated fragments of the marl incorporated in the lower layers of the peat. The peat also contains abundant freshwater molluscs and plant fragments. The talus from the cliff prevented the party seeing the rounded flint gravel ('Monkey Gravel') normally visible above the peat. This grave is interpreted as the first deposit of the marine transgression of the late Cromerian.

The controversial sand basins are well developed in the cliffs of this area and one of these, immediately east of the Cromerian peat was examined by some members. Mr. CAMBRIDGE stated that these basins contained a limited shell fauna, mostly fragmentary, the majority being examples of *Macoma balthica*, which were seen in large numbers. He pointed out that few examples of earlier forms, such as *Nassarius reticosus*, have been found in the sands of the basins, as well as a few freshwater Cromerian shells.

In view of the poor state of the exposures Dr. NORTON referred the members for further reading to the publications already cited.

After a late lunch at Cromer, the next stop was at Sidestrand (N.G.R. TG 256405) where the party descended and walked along the beach. Here, the Cromer Forest Bed Series is seen on top of rafted masses of Chalk enclosed within till. At one such mass of displaced Chalk, immediately below Overstrand, the party saw shelly sands of the Weybourne Crag overlying a Stone Bed on the surface of the Chalk. Dr. NORTON described how the foraminifera and molluscs (NORTON 1967) suggest deposition during cold conditions and that the "Weybourne Crag" at the first site examined was of Baventian age according to the pollen content. A few metres further to the south-east is a second similar mass of Chalk but here the pollen had shown the "Weybourne Crag" above it to be Pastonian. The Weybourne Crag forming part of these erratic blocks reaches a thickness of six metres. Above them can be seen glacial tills (BOULTON 1970). Under the first Chalk mass the party saw a grey shelly sand layer which has been dated as Baventian passing up into Pastonian (WEST: personal communication).

Erosion at this point is very rapid and it is possible that the larger part of these two Chalk bluffs below Overstrand, has now been washed away and these features may disappear. The last remnant of a similar Chalk raft nearby, slid across the beach and into the sea a few years ago and was rapidly destroyed by the waves.

The party returned to Norwich at the end of the Field Meeting and a vote of thanks to the directors was proposed. On the Sunday and Monday members read and discussed a number of interesting papers, and their thanks were extended to the University of East Anglia, and in particular the School of Environmental Sciences for the facilities provided.

REFERENCES

BOULTON, G.S. (1970) (editor) excursion handbook for the Quaternary Research Association's Field Excursions, Easter Meeting at Norwich, 46 pp.

FUNNELL, B.M. (1961) The Paleogene and Early Pleistocene of Norfolk. *Trans. Norfolk Norw. Nat. Soc.* **19**, 326-342.

FUNNELL, B.M. & R.G. WEST (1962) The Early Pleistocene of Easton Bavents, Suffolk. *Quart. jour. Geol. Soc. Lond.* **118**, 125-141.

HARMER, F.W. (1920) *The Pliocene Mollusca of Great Britain* (introdn to Vol. 2) London: Paleontographical Society.

HEY, R.W. (1967) The Westleton Beds reconsidered. *Proc. Geol. Assoc.* **78**, (3) p. 429-445.

NORTON, P.E.P. (1967) Marine Molluscan Assemblages in the early Pleistocene of Sidestrand, Bramerton and the Royal Society Borehole at Ludham, Norfolk. *Phil. Trans Royal Society Lond.* B, **253** (784) p. 161-200.

NORTON, P.E.P. & R. BECK (in press) Early Pleistocene Mollusca of Antian Age from the

deposits at Aldeby (Norfolk) and Easton Bavents (Suffolk).

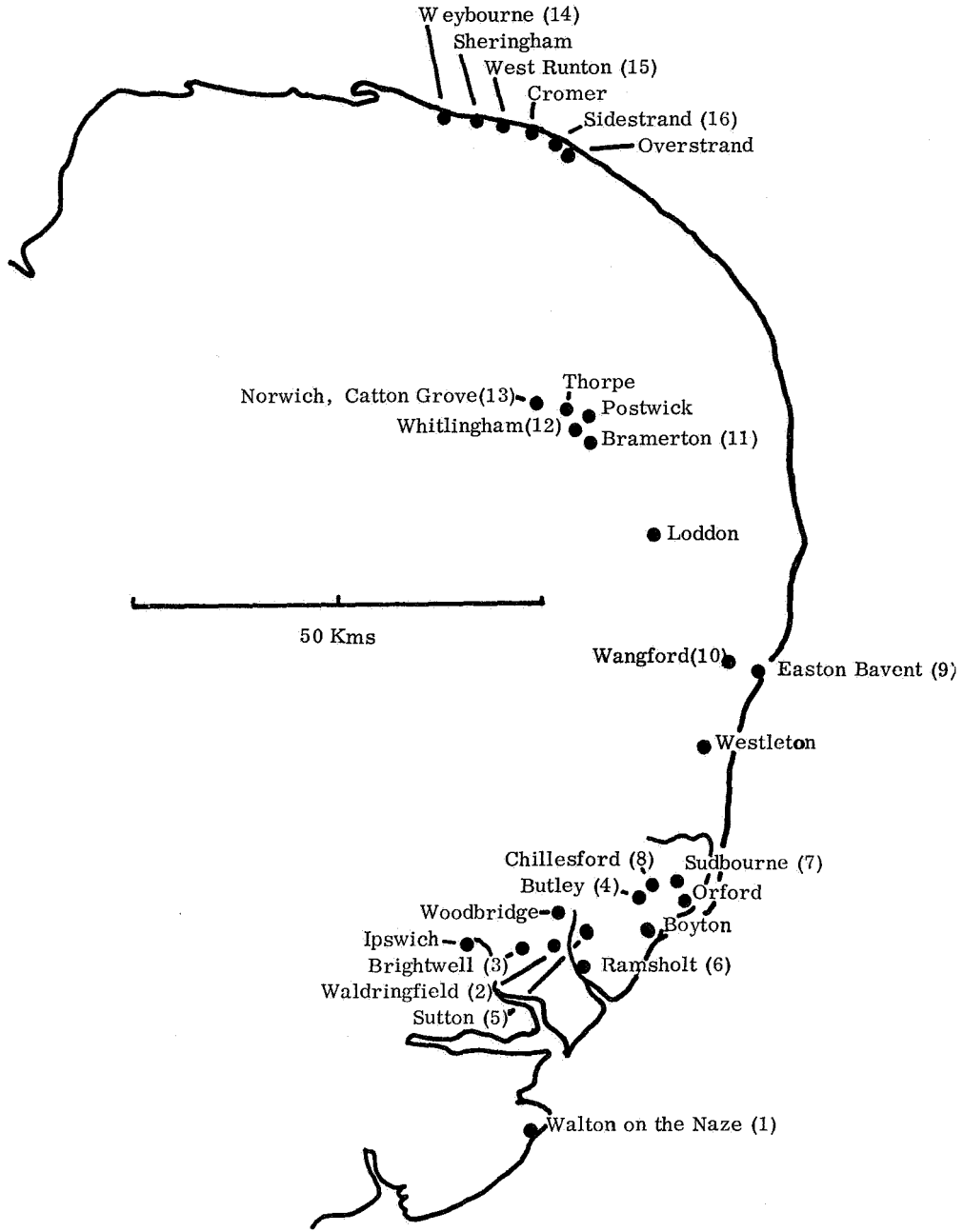
REID, C. (1890) The Pliocene Deposits of Great Britain. *Mem. geol. Surv. U.K.*

WEST, R.G. (1968) *Pleistocene Geology and Biology*. London: Longman's.

WEST, R.G. & P.H. BANHAM (1968) Short Field Meeting on the North Norfolk Coast. *Proc. Geol. Assoc. Lond.* **79**, p. 493-512.

WEST, R.G. & D.G. WILSON (1966) Cromer Forest Bed Series. Nature, Lond. **209**, p. 497-8.

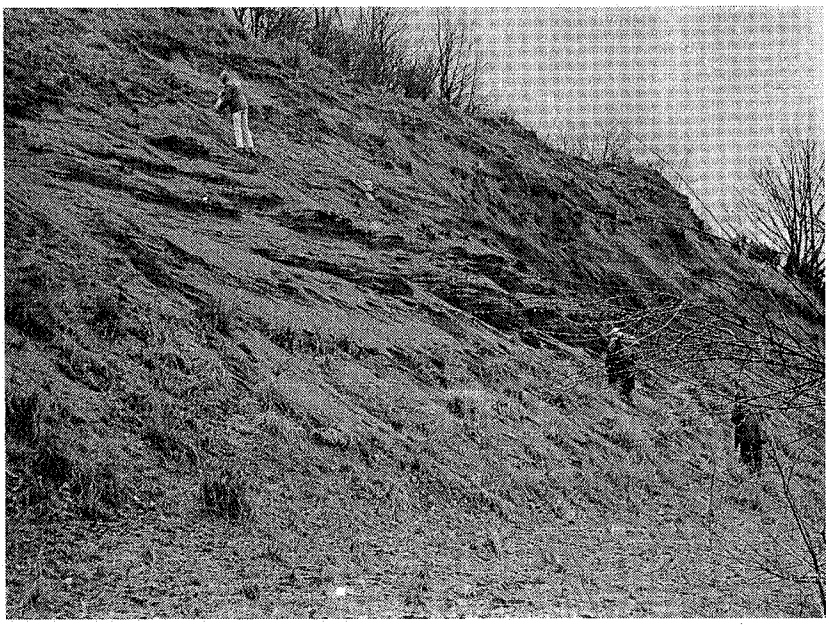
PLACES VISITED ON THE EXCURSIONS, APRIL 1st - 4th 1970



The order of visiting of the Exposures is shown by numerals after the place-names. Other places mentioned in text, but not visited, or not collected at, are not numbered. For further information, see Ordnance Survey of Great Britain 1:250,000 sheet (E. Anglia).

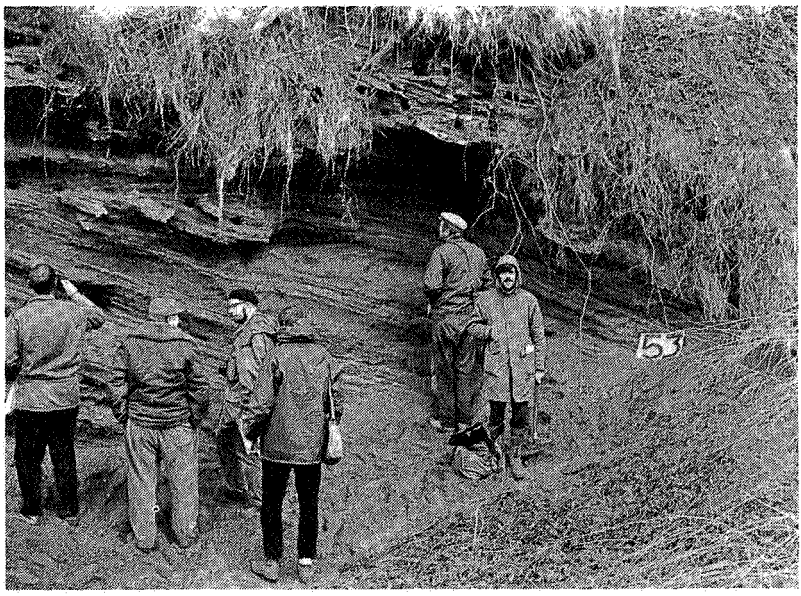
Photograph by P. LAGA

Photo 1
Walton-on-Naze
Red-Crag (Walton-facies) upon the London clay



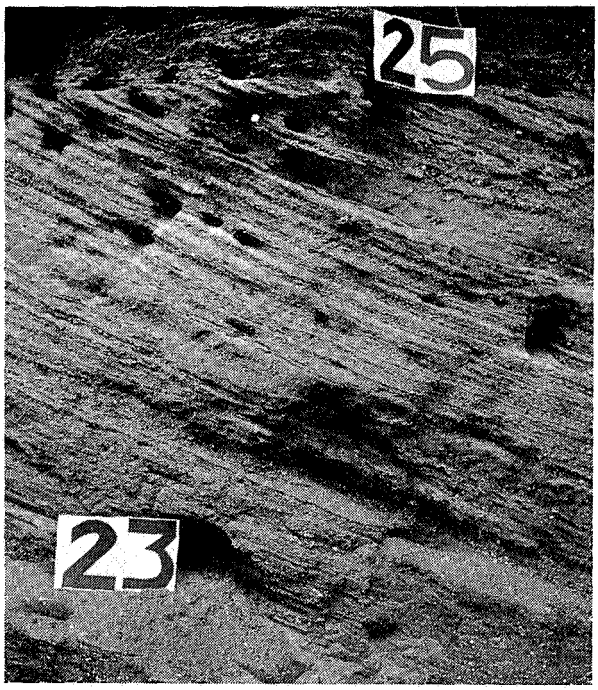
Photograph by P. LAGA

Photo 2
Brightwell Hill
Red-Crag (Newbourne facies)



Photograph by P. LAGA

Photo 3
Butley (Neutral Farm sandpit)
Red-Crag (Butley facies)



Photograph by P. LAGA

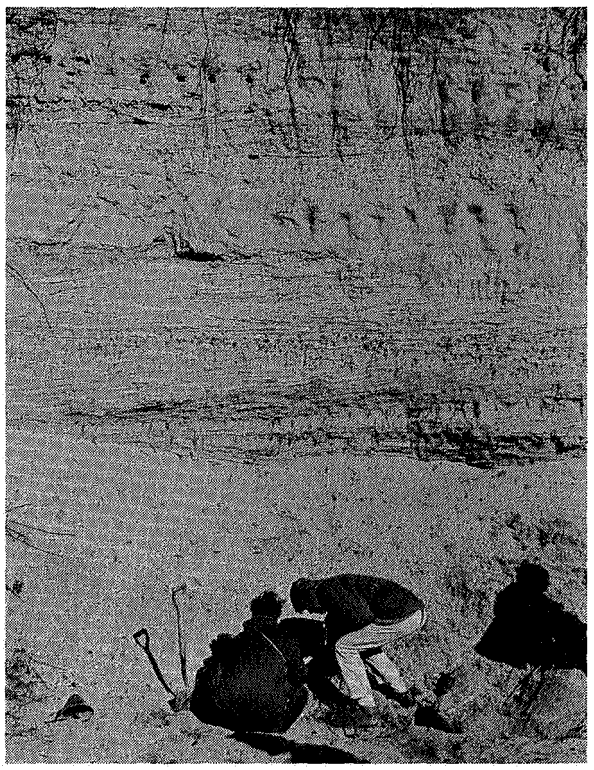
Photo 4
Butley (Neutral Farm sandpit)
Red-Crag (Butley facies)

Photograph by P. LAGA

Photo 5
Sudbourne (Crag Farm sandpit)
Coralline crag — rock facies

Photograph by P. LAGA

Photo 6
Easten Bavents cliff
Norwich crag (lower part of the section)

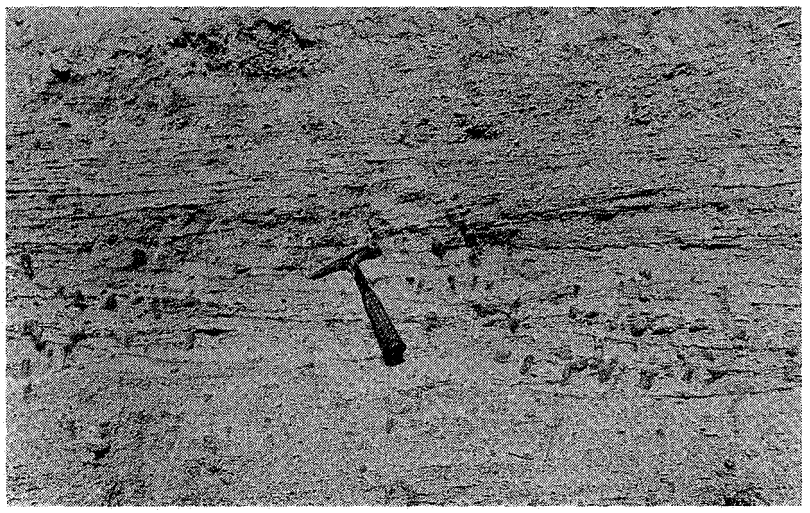


Photograph by P. LAGA

Photo 7

Chillesford church Pit

a = chillesford clay b = chillesford Crag c = Scrobicularia Crag



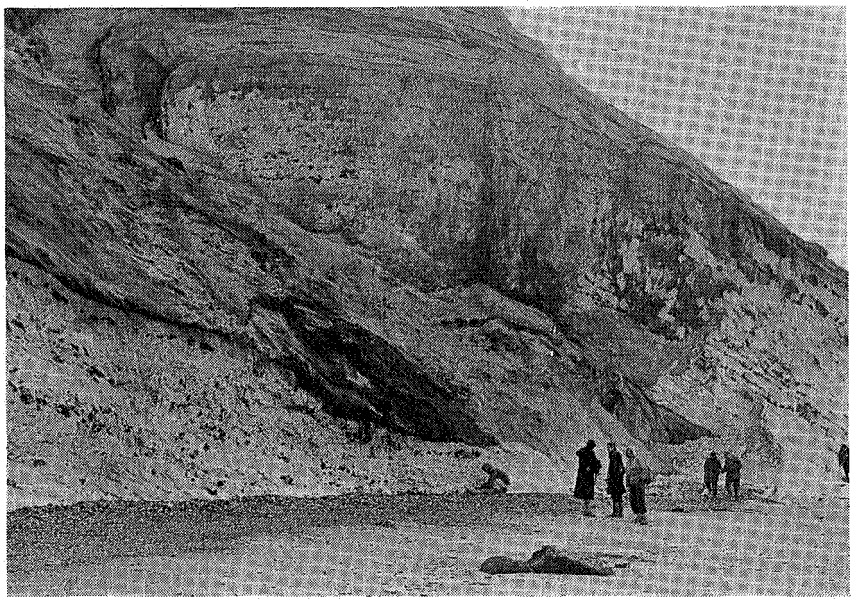
Photograph by P. LAGA

Photo 8

Chillesford church Pit Scrobicularia Crag

Photograph by P. LAGA

Photo 9
Weybourne cliff
Weybourne crag between Chalk and glacial deposits



Photograph by P. LAGA

Photo 10
Sidestrand
Glacial deposits; Weybourne Crag; glacial distorterd Chalk