IPSWICH GEOLOGICAL GROUP, August (for Spring) 1971.

BULLETIN Ho. 10.

CONTENTS

A NOTE ON SAND-PILLED PIPES IN THE CORALLINE CRAG AT SUDB0URNE PARK, SUFFOLK.

INTRODUCTION

During the IGG field meeting at Sudbourne Park (GR: TM) on 1970, an excavation near the top of an overgrown section revealed a near-vertical pipe penetrating the Coralline Crag. The structure appeared to be roughly circular in cross-section with a diameter of about 0.3m, and extended from the top of the Crag to an undetermined depth, greater than 2m. The infilling material consisted of a brown, uniform, fine/medium sand distinctly different in colour from the pale shelly Coralline Crag.

EARLIER WORK

Wood (1854) made some observations on these "tubular cavities", when this and other pits in the Orford area were freshly dug. He concluded that there were three modes of origin, which resulted in what he called funnel pipes, gully pipes, and chimney pipes.

The first type - funnel pipes - appeared irregular in outline, terminating at 1 - 2m depth in a point, produced by the chemical action of percolating groundwater, perhaps initiated by tree roots. This compares with the "sand-pipes" in the chalk as explained by Lyell (1839). The second type - gully pipes - have a similar appearance in section but may be linear features in plan, and were produced by running water on the surface as gullies and/or -potholes, as suggested by Trimmer (1844) for the chalk pipes. The third type that Wood describes are circular in crass section, vertical and extend below the base of the exposures (a maximum of 4m is recorded). He suggests that these penetrate through the Coralline Crag to the underlying London Clay, and were produced by upward moving acidic gases from the decomposition of pyrites in the London Clay, or from volcanic rocks beneath!

The origin of such structures is still in doubt and many of those in the chalk, especially inhere funnel-shaped, are attributed by some recent authors to periglacial action (frost-wedge casts).

LABORATORY RESULTS

It is not possible to comment further on the pipes in the Coralline Crag without more study. The quantitative features of the infilling sands resulting from a sieve analysis are given below.

0.2 kg. of oven-dried sand if as passed through a range of sieves of descending British Standard mesh sizes and the weight retained by each measured. These results were converted, to the percentage of the total passing each sieve, and a graph plotted of percentage passing against mesh size (on a logarithmic scale). (Page 3.)

The results can be summarised as follows,

Clay and silt (< 0.06 mm) 2 %
Fine sand (0.06-0.2 mm) 36 %
Medium sand (0.2 -0.6 mm) 60 %
Coarse sand (0.6 -2.0 mm) 2 %

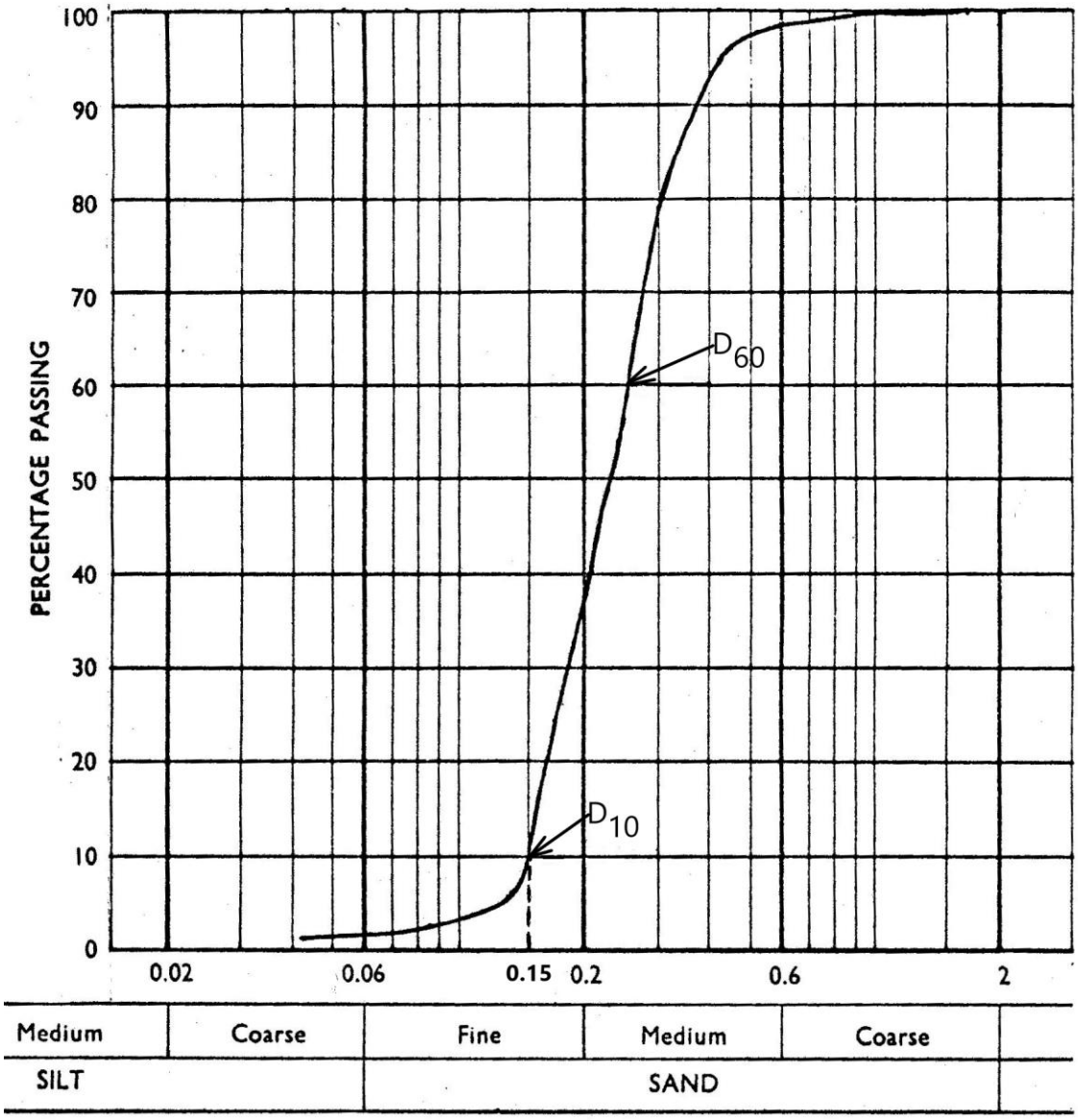
Note: The graphical representation of particle size distribution can be conveniently reduced to two quantities which describe it. The first is the diameter, D_{10}, which corresponds to 10 % of the material passing a sieve of this mesh size. This is called the effective size. The gradient of the straight centre section of the graph is a measure of the degree of sorting and a quantity has been defined, called the uniformity coefficient, as D_{60}/ D_{10}. (Terzaghi & Peck, 1948).

For the sample of sand analysed above,

effective size = 0.15 mm.
uniformity coefficient = 1.67

(cont)

Particle Size Distribution of sand filling pipes in the Coralline Crag, at Sudbourne.



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(Prepared by P.A. Mellars for a meeting of the Quaternary Research Association, 9 January 1971.)

P.G.

NOTES ON FOSSILIFEROUS COASTAL EXPOSURES AT COVEHITHE, SUFFOLK

1. INTRODUCTION

While the early Pleistocene crag at Easton Bavents has long been known (Prestwich, 1871) and has been the subject of recent accounts of its stratigraphy and palaeontology (Larwood and Martin, 1954; Funnell and West, 1962), fossiliferous cliff or beach sites to the north have received only brief mention (Spencer, 1971) and their faunas are undescribed. The intention of the present article is to call the attention of local geologists to these northern exposures which are ecologically interesting with better preserved invertebrate faunas than Easton Bavents. Between 1952 and 1961, while resident in the area, the writer and his brother (D.C.Long) made extensive qualitative records from two exposures at Covehithe. The first was located in the low cliff and the foreshore between Covehithe and Easton Broads and is the location mentioned by Spencer (1971) "the Grid Reference being TM 523804. The second was a foreshore exposure approximately one mile further north at TM 529818. When revisiting the area in August 1969 some quantitative data was obtained on the southern locality which forms the basis of the first section of this, account.

2. THE EXPOSURE BETWEEN COVEHITHE AND EASTON BROADS

a) STRATIGRAPHY

The broad stratigraphy of the cliff face resembles that described at Easton Bavents (Larwood and Martin, 1954) and the deposits are probably of similar ages; although the detailed sequences of the fossiliferous lower parts of the cliffs differ considerably. At Covehithe in 1969 there was a series of discontinuous shell patches, in many cases fragile and partly decalcified, running approximately 180 metres along the base of the cliff from a point 110 m. from its northern end. The most extensive and best preserved shell seams extended for 18 m. until obscured, by talus, about 117 m. south of the first shell patch. At this position there was a depth of 2.48 m. of fossiliferous crag beneath about 1.8 m. of blue-grey clay, probably Baventian in age. Above the clay was a further 1.5 m. of current bedded sand, and gravel overlain by some 0.30 m. of podzolised soil. The fossiliferous part of the section contained the upper two of five relatively consistent lithological units recognised in the period up to 1961. These comprised unit "A", 2.05 m. of pale yellow current bedded sand with prominent shell layers (about 0.10 m. thick) at 0.28, 0.41, 1.45 and 1.93 m. below the clay base and with scattered shells in the intervening parts; followed by unit “B”, brown sandy loam with shells, thin clay seams and a basal shell bed.,, totalling 0.23 m in. thickness. Between unit “B” and the beach was 0.20 m. of unfossiliferous sand. The number of shell beds in "A" varies from place to place and with time, but the basal shell layer appears to be a consistent feature being visible in photographs taken in 1958. Unit “B" is more resistant to erosion than "A” and often stands out from the cliff face as a platform extending under the beach. This unit sometimes contains lenses of fine material rich in forminifera and small molluscs.

The three units below "B" were seen following removal of most of the beach material by storms, particularly in February 1956 and December 1959, but have not been visible on recent visits. They were, in descending order:

> “C”. Approximately 0.50 m. of current bedded yellow sands with patches of quite well preserved shells.
>
> “D". 1.0 m., perhaps more, of brown loam with shells, clay seams and infrequent sand lenses. There was more clay than in unit "B".

"E". About 0.50 - 0.60 m. of very shelly sand with stones arid bone fragments resting on unfossiliferous blue clay. The shells tended to be entire but rather water worn and this unit resemble the upper shell bed. At Easton (Larwood and Martin, 1954) more closely than any of the others.

Of the five units "A" is quite persistent along the cliff face although fossils occur in discrete patches. The brown loam of "B" is absent in places, perhaps due to erosion before deposition of "A". "Both "'B" and "C" may lack fossils and it was noticeable that the presence of fossils in a unit might not be matched by those above or below it. The lower two units, "D" and "E" appeared to be more consistently fossiliferous than those above them.

b) FAUNA

Molluscan remains predominate- the fauna identified to date is listed in Appendix 1. Two samples for counting were taken in 1969, one from the lowest shell bed of unit "A"(some 2.00 m. below the clay base) and the other from a very shelly lens in unit "B", 0.20 m. below the first sample. The bulk of the sediment was removed, by sieving through a fine nylon mesh (c. 1 mm.) and all recognisable mollusca were counted by eye from approximately 500 g. of shelly concentrate using Norton's (1967) criteria for scoring individuals. The results for the principle species are given in Table 1 together with those from a sample from unit "A" counted in a similar way in 1959. Species occurring with a frequency of less than one percent are indicated in Appendix 1. but are not included in the table.

More than 80% of the individuals were lamellibranchs with three species, Spisula elliptica, Corbula gibba and Macoma obliqua contributing over 50% of the total. There was a much higher proportion of Corbula in unit "A" than in unit "B" and a corresponding decrease in the numbers of Spisula. The gastropod Calyptraea chiensis occurred, mostly as apices.

Experience prior to 1961 indicated some qualitative differences in the faunas of the units, involving in some cases the less frequent species. Nucula cobboldiae served as a good marker for unit "A", occurring with united valves in its lowest shell bed, whereas it was rare and fragmentary in all other units except "E". Similar distributions were exhibited by Thracia c.f. villosciuscula, Astarte semisulcata and Astarte sulcata. Loamy portions of unit "B" contained mainly Macoma obliqua but the very shelly lenses noted earlier had juvenile Spisula elliptica, Hiatella arctica, Cochlodesma praetenue and Modiolus commonly present along with ophiuroid fragments, irregular echinoid spines and foraminifera. Unit "C"contained most of the species found, in "A"and "B" but Macoma praetonuis, Donax vittatus, Actaeon tornatilis and Boreoscala groenlandica were commoner. Information on "D" is scanty; Macoma obliqua and Macoma calcarea were the most common bivalves and a layer of sandy material provided the best specimens of Laevicardium c.f. interruptum from this locality. Unit resembles "A" in some respects but the shells were more water worn and less decalcified. Large specimens of Arctica, Mya, Astarte and Mytilus were common. A feature of this unit was the -presence of encrusting Balanus on shells of Nucula, Neptunea and Natica.

At this locality the typical littoral forms such as Cardium edule, Littorina littorea, L. saxatilis, Nuculla lapillus vulgaris, Hydrobia spp. and the extinct Ptychopotamides tricinctus v. icenica while often common, are rolled and worn. The molluscan assemblage suggests a shallow open sea environment dominated by infaunal bivalves such as Spisula elliptica, Macoma obliqua and Corbula gibba. Of the Norfolk molluscan assemblages studied by Norton (1967) it most closely resembles his zones L.M.6 and B.M.2 but differs from these in the very high frequencies of Spisula elliptica and Corbula gibba. Without further samples and

micropalaeontological studies it would be rash to suggest that the changes in lithology and fauna represent either fluctuations in water depth or marine climate, but it is hoped that the range of bottom conditions suggested by the different units will attract further study of the paleoecology of this coastal exposure, A number of the molluscan species found here and at the northern site appear unrecorded from the classical Norwich Crag. They are commented on in Appendix 3.

Table 1. PRINCIPLE COMPONENTS OF THE MOLLUSCAN FAUNA OF THE CRAG BETWEEN COVEHITHE AND EASTON BROADS

Species	% of total individuals		
	Unit "A" 1959	Unit "A" I969	Unit "B" 1969
Gastropoda			
Natica spp	5.0	3.7	5.2
Calyptraea chiensis	4.4	3.6	2.4
Littorina littorea	1.7	1.6	2.4
Hydrobia spp.	2.0	0.3	1.1
"Gibbula" spp.	1.6	1.4	0.9
Lamellibranchia			
Spisula elliptica	21.5	29.4	46.2
Corbula gibba	19.2	15.2	4.3
Macoma obliqua	14.6	18.1	17.2
Astarte montagui	4.0	4.8	0.9
Cardium edule	3.0	3.1	0.9
Macoma praetenuis	3.0	1.8	2.6
Donax vittatus	0.7	1.0	4.7
Yoldia myalis	1.6	1.3	1.5
Venus ovata	2.2	1.1	0.4
Nucula cobboldiae	0.9	1.8	0.2
Macoma calcarea	0.5	0.3	1.3
Mya arenaria	1.2	0.8	0.2
Mytilus edulis	0.8	1.0	0.4
Lucinoma (Phacoides) borealis	0.4	1.0	0.6
Thracia c.f. villosciuscula	1.5	1.0	—
Contribution by one individual:	0.1	0.2	0.2
Total individuals per sample:	759	619	466

3. FORESHORE EXPOSURE AT THE FOOT OF COVEHITHE CLIFF

a) STRATIGRAPHY

The upper part of the cliff at this locality contains current bedded sands and gravels presumably similar to those topping the cliffs to the south. In the lower 2-3 m. are evenly bedded seams of clay, silt and sand which further north show signs of disturbap.ee by ice prior to deposition of the overlying sand and gravel.

At the foot of the cliff is a tough, generally brown clay extending seaward as a platform often covered by beach material. In March and. October 1958 and March 1960 fossil shells were found in this clay; occurring in the first instance in a silty seam some 0.20 m. thick outcropping for between 40 and 50 m in the wave-cut face of the shore platform and in gullies extending up towards the cliff. Scattered specimens were present in the overlying clay. The exposure in October 1950 also included a thin seam of shells (Macoma calcarea) in the base of the cliff itself.

b) FAUNA

A list is given in Appendix 2. Lamellibranch molluscs predominated with Macoma calcarea, Serripes groenlandicus, Yoldia myalis and Hiatella arctica as the most frequent species. Many examples had their valves united and. juvenile stages of four species above and Laevicardium c.f. interruptum were common in the silty seam. Some specimens of Macoma calcarea in the overlying clay were in the life position, valves united, siphonal ends uppermost and retaining traces of the external hinge ligament, an unusual condition in the East Anglian marine Pleistocene. Gastropods were represented mainly by the predators Natica catena, N. c.f. pallida, Amauropsis islandica and Amaura candida.

c) DISCUSSION

The age of the clay in which the fossils were found has not been firmly established. Early workers (i.e. Whittaker, 1887) equated it with the clay at Easton Bavents, terming it, incorrectly, Chillesford Clay. Interestingly Prestwich (1871) described a molluscan fauna in the clay at Easton in which many of the bivalves had united valves, an occurrence not reported since. More recently Solomon (1935) noted a similarity in the heavy mineral contents of these two clays (a high proportion of Scandinavian elements) but regarded the Covehithe clay as Norwich Brickearth (Cromer Till). This view has been reiterated by Spencer (1971) who regarded the fossil shells as being derived from the Norwich Crag. A derivative origin may apply to less frequent species such as Astarte montagui, Nucula cobboldiae and Donax vittatus but the bulk of the fauna appears to represent an autochthonous assemblage. There was no clear evidence for the inclusion of ice-transported blocks of sea-bed material within a till as described in a recent account of the Bridlington Crag (Catt and Penny, 1966).

While the absence of micropalaeontological data makes it difficult to reach firm conclusions (it should be possible to obtain foraraminiferal samples if the outcrop is exposed again) the molluscan fauna shows affinities to the typical Norwich Crag further south. All the elements of the fauna except Amaura candida and Natica c.f. pallida have been found at the southern exposure while the exceptions have been reported from the Butleyan Red Crag. Cromer Till at Scratby and elsewhere on the North Norfolk coast contains fragments of Macoma balthica which did not occur here. It can be suggested that this clay belongs to the crag series and the fossils may represent the rare occurrence of a molluscan fauna within the Baventian Clay. There is some support for this view from the resemblance of the fauna to the recent Arctic Macoma calcarea community (see review by Thorsen, 1957) which also includes Serripes groenlandicus and Mya truncata; but in making this comparison the probable existence of extinct temperature biotypes of recent species in the Early Pleistocene (Norton, 1967) should be borne in mind.

Appendix 1 - FAUNA OF THE CRAG BTEWEEIT COVEHITHE AND EASTON BROADS.

a) MARINE M0LLUSA

Nomenclature after Norton (1967) and McMillan (1968) except for a few extinct forms

x = occurred in counted samples.

Amphineura		
X	"Chiton" spp.	Isolated plates not identified further.
Gastropoda		
	Lepeta sp.?	
X?	Margarites groenlandicus, (Gmelin)	Grouped in counts as "Gibbula" spp.
X?	Gibbula c.f. tumida, (Montagu)	
X	Littorina littorea, (Linne)	
X	L. saxatilis, (Olivi)	
X?	? Hydrobis c.f. ventrosa, (Montagu)	Grouped in counts as "Hydrobia" spp.
X?	H. c.f. minuta, (S. Woodward)	
X?	H. ulvaea, (Pennant)	
	Cingula semicostata semicostatata (Montagu)	
	Rissoa curticostata, S. V. Wood	
	Omalogyra atomus, (Phillipi) Jeffreysis sp.?	
X	Turritella triplicata triplicata, (Brocchi)	
X	Potamides tricinctus var. icenica, Harmer	
	Cerithiopsis tubercularis, (Montagu)	
	Clathrus trevelyanus, (Johnston)	
	C. clathratulus minutus, (J. de C.Sowerby)	
X	Borcoscala groenlandica, (Chemnitz)	
	Eulima (Haliella) stenostoma, Jeffreys	
	Capulus ungaricus, (Linne)	
X	Calyptraea chiensis, (Linne)	
	Amauropsis islandica, (Gmelin)	
X	Natica catena, (da Costa)	Grouped in counts as "Natica" spp.
X	N. poliana (Chiaje)	
	N. c.f. affinis, (Gmelin)	
X	Nucella lapillus vulgaris, (S. V. Wood)	
	Borcotrophon clathratus, (Linne)	Rare and probably derived specimens.
	Liomesus ovum, (Turton)	
	Colus c.f. gracilis, (da Costa)	
	Neptunea antiqua, (Linne)	Only one confirmed example.
	N. contraria, (Linne)	One derived specimen.
	N. despecta, (Linne)	
X?	Nassarius incrassatus, (Strom)	
X	Lora turricula, (Montagu)	
	L. treveliana, (Turton)	
	L. c.f. pyramidalis, (Strom) var. semiplicata, Sars	
	L. c.f. mitrula, (Loven)	
X	Philbertia linearis, (Montagu)	
X	Ringicula ventricosa, (J.Sowerby)	
X	Actaeon tornatilis, (Linne)	
	Diaphina minuta, Brown	One specimen.
	Retusa retusa, (Maton and Rackett)	
	R. alba, (Kanmacher)	
	Cylichna cylindricaa, (Pennant)	
	Chrysallida obtusa, (Brown)	
	C. indistincta, (Montagu)	
	Odostomia (Ondina) c.f. scandens, (Monterosato) ?	One specimen.
	O. sp. indet	
	Leuconia fusiformis, (A.Bell)	
	Melampus pyramidalis, (J.Sowerby)	
Scaphopoda		
	Dentalium sp.	Derived fragment.

(Appendix 1 cont)

Lamellibranchia		
X	Nucula cobboldiae, J. Sowerby	
	N. nucleus, (Linne) ?	
X	N. tenuis, (Montagu)	
X	Yoldia myalis, Couthouy (= "oblongoides", Wood)	
	Y. lanceolata, (J.S owerby)	One specimen ‘in situ’.
X	Heteranomia squamula (Linne)	
	Nonia squama, (Gmelin	
	N. patelliformis, (Linne	
X	Mytilus edulis, (Linne)	
X	Modiolus modiolus, (Linne)	
X	Musculus marmoratus, (Forbes)	In 1959 sample only.
	Crenella decussata, (Montagu)	
	Chlamys (Aequipecten) opercularis, (Linne)	
X	C. (Palliolum) tigerina, (Muller)	
	Lima loscombi, J. Sowerby	
X	Astarte sulcata, (da Costa,)	
X	A. semisulcata, (Leach)	
X	A. montagui (Dillwyn_	
	Thyasira flexuosa, (Montagu)	
X	Lucinoma (Phacoides) borealis, (Linne)	
	Kellia suborbi ularis, (Montagu)	
	Tellymia pumila, S. V .Wood	One pair of valves.
X	Lasaea intermedia, S. V. Wood	1959 sample only.
	Lepton nitidum, Turton	
	Montacuta substriata, (Montagu)	
X	M. ferruginosa, (Montagu)	
X	Mysella bidontata, (Montagu)	
X	Arctica (Cyprina) islandica, (Linne	
	Cardium (Anthocardia) echinatum, Linne	Two specimens.
X	C. (Parvicardium) ovale, Sowerby	
X	C. (P.) scabrum, Phillipi	
X	C. (Cerastoderma) edule, Linne	
	C. (Laevicardium) c.f. interruptum, S .V. Wood.	
X	Serripes groenlandicus (Brugiere)	
X	Venus (Timoclea) ovata, Pennant	
	Venerupis sp. indet.	
X	Mysia undata, Pennant	
X	Donax vittatus (da Costa)	
X	Macoma praetonuis (Loathes M. S., Woodward)	
X	M. calcarea (Gmelin)	
X	M. obliqua (J. Sowerby)	
X	Scrobicularia plana (da Costa)	Hinges only
X	Abra prismatica, (Montagu)	
X	Cultellus pellucidus, (Pennant)	
	Ensis siliqua, (linne)	
X	Mactra corallina, (Linne)	
X	Spisula elliptica, (Brown)	
X	S. solida, (Linne)	
X	S. subtruncata, (da Costa)	
X	Mya truncata, Linne	
X	M. (Arenomya) arenaria, Linne	
X	Corbula gibba (Olivi)	
X	Hiatella arctica (Linne)	
	Panomya arctica, (Lamarck)	Two specimens.
X	Cochlodesma praetenue, (Montagu)	
X	Thracia c.f. villesciuscula, (Macgillivray)	

(Appendix 1 cont) b) NON-MARINE MOLLUSCA (identified by Dr. M. P. Kerney in 1958)

Gastropoda
Planorbis planorbis, (Linne)
Hydremia hispida, (Linne)
Viviparus c.f. madius, (S. Woodward)
Lamellibranclxia
Corbicula fluminalis, (Muller)
Psidiura ? amnicum (Muller)

c) OTHER INVERTEBRATE GROUPS

Foraminifera occurred in all units but were particularly abundant in part of unit "B". Sponges were represented by Ciona borings in shells and. coelenterates by Hydractinia on some gastropods from unit “A".

Crustacea were represented by abundant isolated, cirripede valves although entire barnacles were rather rare except in unit "E” and by rare decapod chelae. Ostracods occurred in the finer sediments.

Spines of irregular echinoids were often abundant in units "A", “B" and “C”; small test fragments also occurring in the latter. These spines can probably be referred to Echinocardium but the presence of Spatangus may be indicated by the presence of its commensal bivalve Montacuta substriata. Two fragile tests of Echinocyamus sp. were found in unit "B". Regular echinoid spines were quite common and. ophiuroid ossicles were present in parts of unit "B".

Encrusting polyzoa are not usually preserved at most classical Norwich Crag sites but were present here particularly in parts of units "A" and. "C". The late Dr. Dighton Thomas identified some specimens as the recent North Sea species Electra crustulenta Pallas.

d) VERTEBRATES

Remains of this group were not as common as at Easton Bavents. Selachian fossils consisted of dermal denticles of Raia spp. and small teeth (Trygon ?). Teleosts were represented by scattered vertebrae and other bones, the clavicles and "butterfly” bones (pectoral girdle ?) of the extinct PIatax woodwardi Agassiz and by otoliths. P. C. Stinton identified specimens of the latter sent to him in 1950’s mainly Gadus c.f. pollachius (Linne) with single examples of Gadus morrfaua (Liime) and the extinct Gadidarum anglicus var. corallinonsis Sheppherd. A worn pleuronectid otolith was found, in 1969.

Mammalian remains were very rare. The only specifically identifiable examples being the canine of Machairodus c.f. credatidens referred, to by Spencer (1971) and microtine teeth. The latter include molars identified by Carreck (1966), in Ipswich Museum collections, as Mimomys pliocaenicus (Forsyth-Major) which were probably collected by the writer and his brother, examined by Lord Cranbrook and passed by him to the museum collection. Other mammalian remains found include a small cetacean vertebra, deer -antler fragments and small pieces of ivory.

Appendix 2. FAUNA OF THE FORESHORE EXPOSURE AT COVEHITHE (TM 529818)

a) MOLLUSCA

Gastropoda	
Littorina littorea (Linne)	1 derived, specimen
Boreoscala groenlandica (Chemnitz)	2 bases.
Amaura candida (Holler)	
Amauropsis islandica (Gmelin)	

(Appendix 2. cont.)

	Natica catena (da Costa)	
	N. c.f. pallida, Broderip and Sowerby	
	Boreotrophon c.f. clathratus (Linne)	1 specimen.
	Buccinum ? undatum (Linne)	fragments.
	Lora c.f. turricula (Montagu)	

Lamellibranchia U = valves united		
	Nucula cobboldiae, Sowerby	
U	N. tenuis, (Montagu)	1 valve.
U	Yoldia myalis, Couthouy (= "oblongoides, S. V. Wood")	
	Astarte montagui, Dillwyn	3 worn valves
	Lucinoma (Phacoides) borealis (Linne)	I valve
	Cardium edule, Linne	1 worn valve
U	C. (Laevicardium) c.f. interruptum, S. V. Wood	
U	Serripes groenlandicus, (Brugiere)	
U	Macoma calcarea, (Gmelin)	
	M. obliqua (Sowerby)	1 valve
	Spisula elliptica, (Brown)	
U	Mya truncata, Linne	
U	Hiatella arctica (Linne)	

b) OTHER INVERTEBRATES

Foraminifera and isolated cirripede valves.

Appendix 3. NOTES ON THE MARINE MOLLUSCA

A number of mostly small and fragile species, mainly found in lenses of fine material within unit “B" of the southern site appear to be new records for the Norwich Crag. Among these the following recent species were recorded by Wood (1848 - 82) or Harmer (1914 - 25) from the Coralline Crag or the Red Crag: Omalogyra atomus, Eulima stenosoma, Musculus marmoratus, Lima loscombi, and Thyasira flexuosa (given in Wood’s synoptic list in the first supplement as occurring in the "Chillesford Beds"). Two species, Diaphina minuta and Crenella decussata are new to the East Anglian Plio-Pleistocene, Diaphina being reported as D. hyalina by Harmer from the St.Erth Beds. Amaura candida from the northern site has been found previously only as single examples from the Red Crag at Butley, Boyton (Wood) and Little Oakley (Harmer)

Cardium (Laevicardium) c.f. interruptum was found at both localities, occurring as adult and juvenile stages at the northern site. Two examples from unit “D" between Covehithe and Easton Broads resemble Wood's type figure (volume ll plate XIV, 4a, b) almost exactly but specimens from exposures to the north retain more of the outer surface of the shell. Juvenile stages are not easy to distinguish from those of Serripes groenlapdicus unless there are clear traces of the ribs extending across the surface of the valve and not confined to the anterior margin. Wood regarded this as an extinct form confined to the Red Crag, but with strong affinities to an Arctic species - C. californiense Middendorf. In view of the association of this fossil with elements of the Macoma calcarea community in the foreshore exposure it would be useful to recompare the fossil with the recent northern species. It is possible that worn examples in the Norwich Crag have previously been taken for Serripes groenlandicus, the writer recently found a broken valve in this condition in Dr. Norton's excavation at Wangford.

Cardium echinatum is also a new record for the Norwich Crag; it was known to Wood only from two specimens in the Red Crag and seems to be very rare in the East Anglian marine Pleistocene.

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SOME NORWICH CRAG - WESTLETON BED JUNCTIONS IN THE SOUTHWOLD AREA

The stratigraphical relationships of a Norwich Crag shelly facies and the Westleton Beds ('Pebbly Series’) are shown at Southwold and Wangford, but are not so clear at Reydon where shells occur below the water table.

SOUTHWOLD WATERWORKS WELL

Whitaker (1887) gives a detailed section, with 37 feet (11.3 m) of Pebbly Series resting on 147 ft. (44.8 m.) of Crag which rest on London Clay. The Crag is mainly sand, and contains four shell beds, two (between -45ft. and -78 ft. [-13.7 to -23.8 m.], and between -84 ft. and -90 ft. [-25.6 to -27.4 m.] from the ground surface) in the upper part, and two in the lower.

The upper part of the well section showed:-

		thickness
Pebbles	37 ft.	11.3m.
Yellow sand	8ft.	2.4m.
Brown sand with shells (between -45 ft. and -78ft.)	33 ft.	16.1m
Brown sand	6 ft.	1.8m.
Sand with stones and whitish shells (between -84 ft. and -90ft.)	6 ft.	1.8m.
Sand	74 ft.	22.6m

Whitaker gives a few species of fossils, but lithological specimens preserved in, and kindly made available by, Southwold Museum, allow further molluscs to be recorded. Most of the shells are fragmentary. Between -45 ft. and -78 ft. (-13.7 to -23.8 m.)

Arctica islandica, Cardium edule, Macoma praetenuis, Mytilus, Corbula, Littorina littorea, Potamides tricinctus icenus. Barnacle plates.

Between -84 ft. and -90 ft. (-25.6 to -27.4 m.

Cardium edule, Macoma praetenuis, Macoma obliqua, Mya arenaria, Acila cobboldiae, Mytilus, Corbula, Chlamys, Nucella lapillus.

WANGFORD (TM 465780)

Shelly crag here underlies over 20 ft. (6.1 m.) of pebbly gravel which has yielded a few pieces of bone of Elephas meridionalis. Mr. J. Walker showed the writer a shallow boring in which the pebbly gravel, with a very thin silt at the base, rested, on 6 ft. (1.8 m.) of sand, which rested on shelly crag.

Crag fossils collected by the writer and J. Norman in April 1971 include:-

Arctica islandica, Cardium edule, Macoma obliqua, Mya arenaria, Corbula, Phacoides borealis, Donax, Nucella lapillus, Littorina littorea, Turritella communis, Potamides icenius, Neptunea antiqua, Hydrobia. Fish and mammal bone fragments.

Preliminary work on a nearby site is given by P. E. P. Norton (1969).

REYDON (TM 495768)

Pebbly gravel occurs above and below the water table. Molluscs occur in sand, below water level, but it cannot be seen whether the sand is below or within the gravel; the following species have been found in dredged material collected by S. MacFarlane:-

Arctica islandica, Cardium edule, Macoma obliqua, Mya arenaria, Corbula, Spisula, Nucella lapillus, Littorina littorea, Turritella communis, Potamides icenicus, Neptunea antiqua, Hydrobia, 'Natica'. Barnacle, sponge borings.

Spencer (1966) records mammalian remains from Reydon.

Norwich Crag with Potamides icenicus, Hydrobia (not seen at Southwold), and abundance of Littorina littorea and Cardium edule is known from several localities in Suffolk, and underlies the Westleton Beds at Wangford and Southwold. The Southwold Well section is particularly interesting as it shows this type of Norwich Crag (-45 ft. to -78 ft.) above another type (-84 ft. to -90 ft.), the latter resembling the Norwich Crag at Easton Bavents. Further work in this area, of the kind made by Norton (1967) could, yield interesting results.

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NOTES ON IMMIGRANT SHELLS IN BRITAIN

The following notes may help in dating recent sediments. They are a rough guide only, and further information would be welcome.

Crepidula fornicata (Slipper limpet)

First recorded in 1880s; successive introductions since. First Suffolk discovery, Felixstowe 1919. In Holland since about 1925. American.

Urosalpinx cinerea (American oyster drill)

Introduced, about same time as Crepidula; well established. Increased in Essex particularly after exceptionally cold winter of 1928 - 29. American.

Ocenebra (Murex) orinacea (Sting Winkle or Drill)

Exterminated, on East coast 1946 – 47.

Petricola pholadiformis (American Piddock)

First reported River Crouch, Essex, July 1890. Since about 1905, Holland. American.

Venus mercenaria (Clam)

First recorded in Humber in 1860s; spread to East coast. American,

Mya arenaria (Gaper)

Dutch coasts, - absent since Pleistocene; reintroduced from America about 1600 – 50.

Crassestrea virginica (Virginian Oyster)

Imported before 1939? apparently not established. American.

Crassestrea angulata (Portugese Oyster)

Fattened in Essex, etc.; dead shells found at various places. Japanese.

Eliminius modestus (Bamacle)

First noted in mid 1940s; soon abundant in Essex creeks. Australian.

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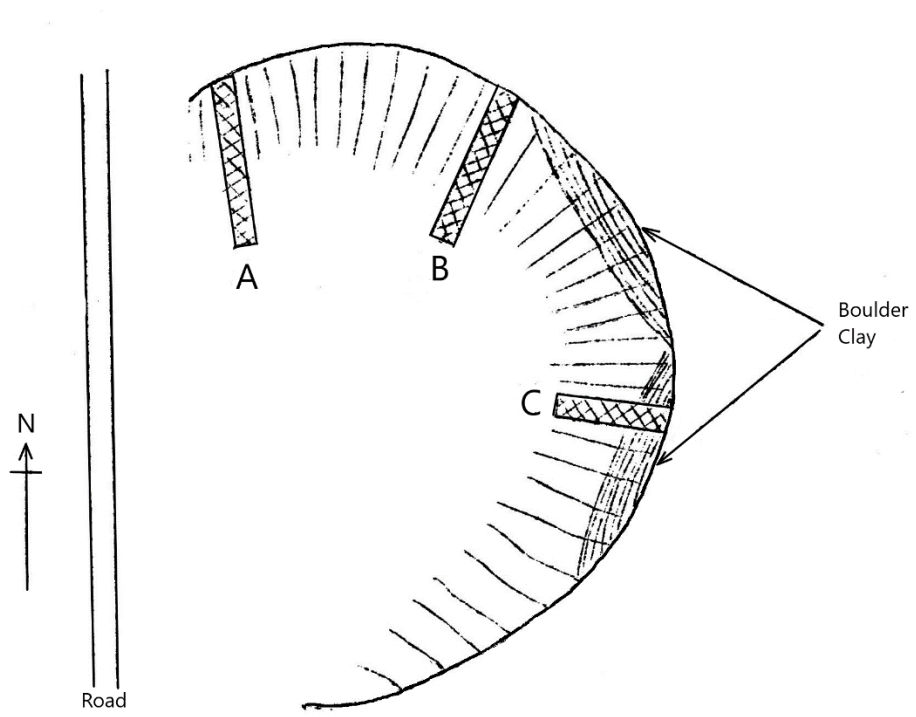
SECTIONS EXPOSED IN A PIT AT ALDHAM, NEAR HADLEIGH

INTRODUCTION

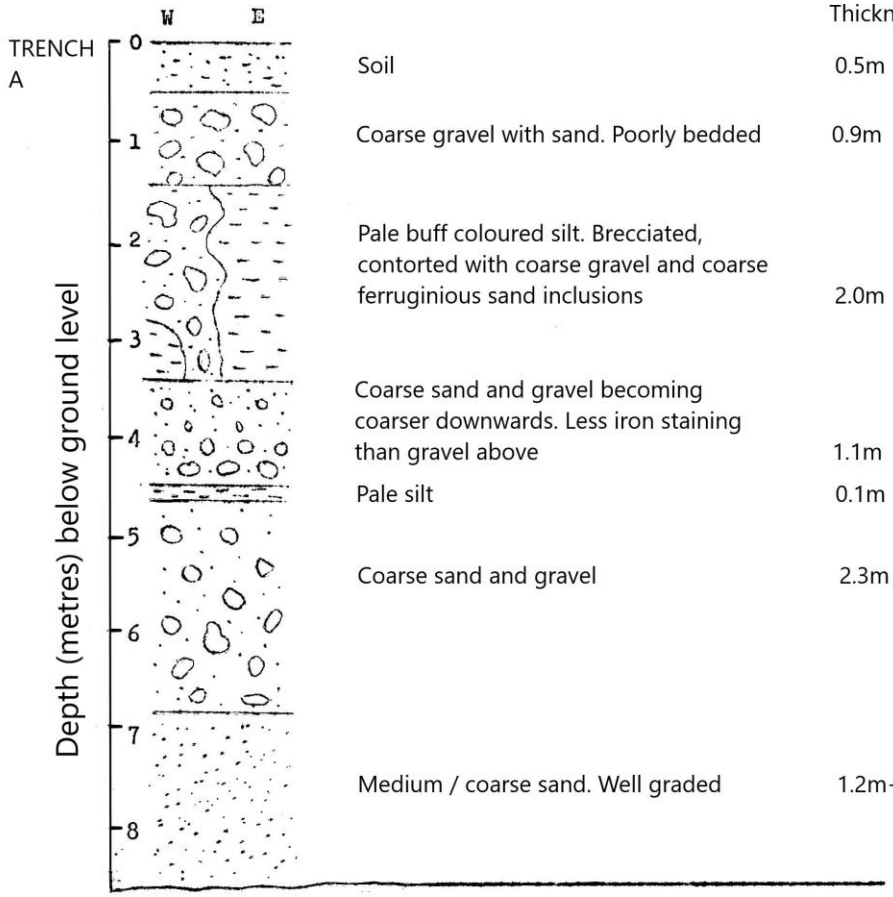
The site is a long-disused pit west of Hill Farm, Aldham, near Hadleigh (GR: TM 031445), now overgrown and degraded. On 31 October 1970, members of the Ipswich Geological Group and the Hadleigh Adult Education Centre cleared three sections (A, B and C) on the upper slopes of the pit, by a series of trenches cut in large steps through the talus. The beds exposed consisted chiefly of sand and gravel with some silt and boulder clay, all thought to be of Quaternary age.

PLAN

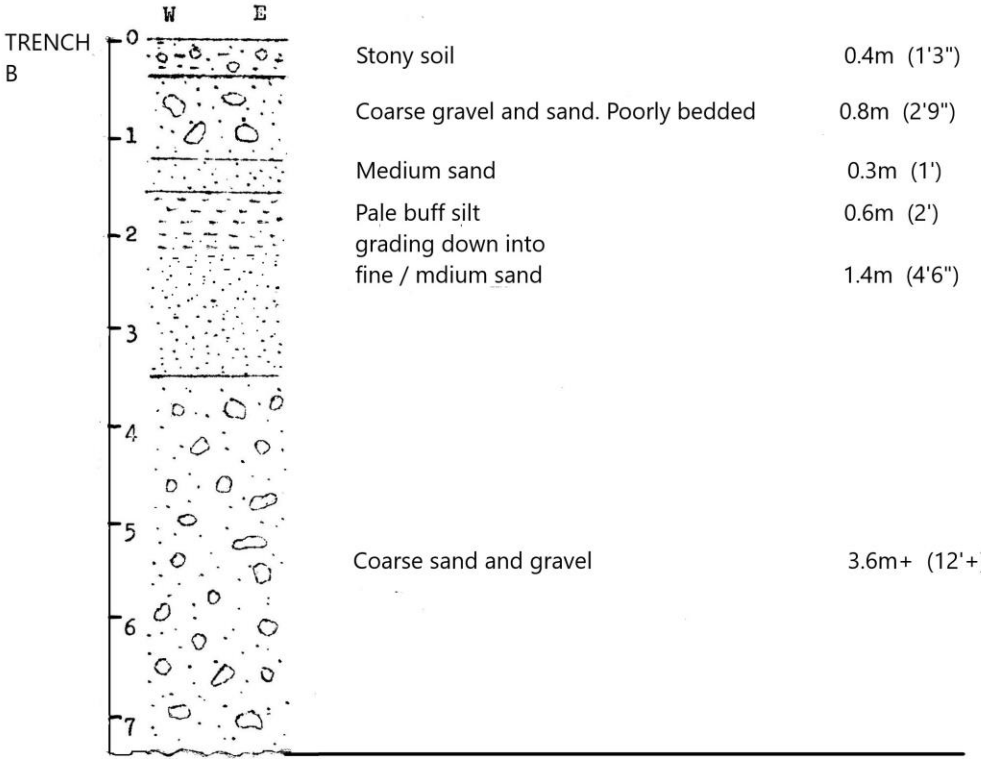


SECTIONS

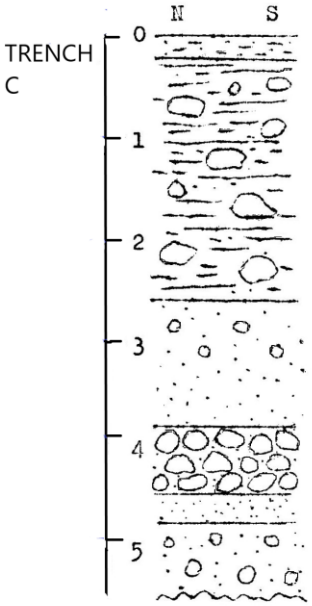
The ground, surface dips westwards at the top of the exposure from B to A and the upper bed of coarse gravel and sand shows some bedding, which follows this dip. (See overleaf for figs.). Between B and. C the surface undulates with the highest parts capped by chalky boulder clay. The lower boundary of which does not follow the present topography at all. At the northern end of the boulder clay outcrop it is seen to overlay the upper gravel and sand of trenches B and A. Below this gravel is a pale buff coloured, siit seen in sections A and B and also exposed between them. This silt shows bedding planes, horizontal or dipping west, and vertical joints, and. is possibly a windborne material deposited in shallow water. In places this deposit is much brecciated and disturbed, possibly by downhill movement which proceeded, or accompanied the deposition of the upper gravel. Below is a series of mainly coarse sand and. gravels, indicative of deposition in running water. Occasional thin seams of fine sand or silt are also present indicating quieter depositional conditions. A layer of very coarse gravel with well rounded, black pebbles, comparable with those found in the Oldhaven Beds (Tertiary) is prominent in section C. Another feature of interest is the occurrence of chalk grains in a sand exposure between A and. B at the level of the lowest sand in A.



	Thickness
Soil	0.5m (1'6")
Coarse gravel with sand. Poorly bedded	0.9m (3')
Pale buff coloured silt. Brecciated, contorted with coarse gravel and coarse ferruginious sand inclusions	2.0m (6'7")
Coarse sand and gravel becoming coarser downwards. Less iron staining than gravel above	1.1m (3'10")
Pale silt	0.1m (5")
Coarse sand and gravel	2.3m (7'6")
Medium / coarse sand. Well graded	1.2m+ (4' +)



Stony soil	0.4m (1'3")
Coarse gravel and sand. Poorly bedded	0.8m (2'9")
Medium sand	0.3m (1')
Pale buff silt	0.6m (2')
grading down into fine / mdium sand	1.4m (4'6")
Coarse sand and gravel	3.6m+ (12'+)



		Thickness
	Soil	0.2m (6")
	Chalky boulder clay	2.4m (8')
	Sand with some gravel in top half	1.3m (4'5")
	Very coarse gravel with black well rounded pebbles c.f. Oldhaven Beds	0.7m (2'2")
	Gravel and sand	0.6m+ (2'+)

P. Grainger.