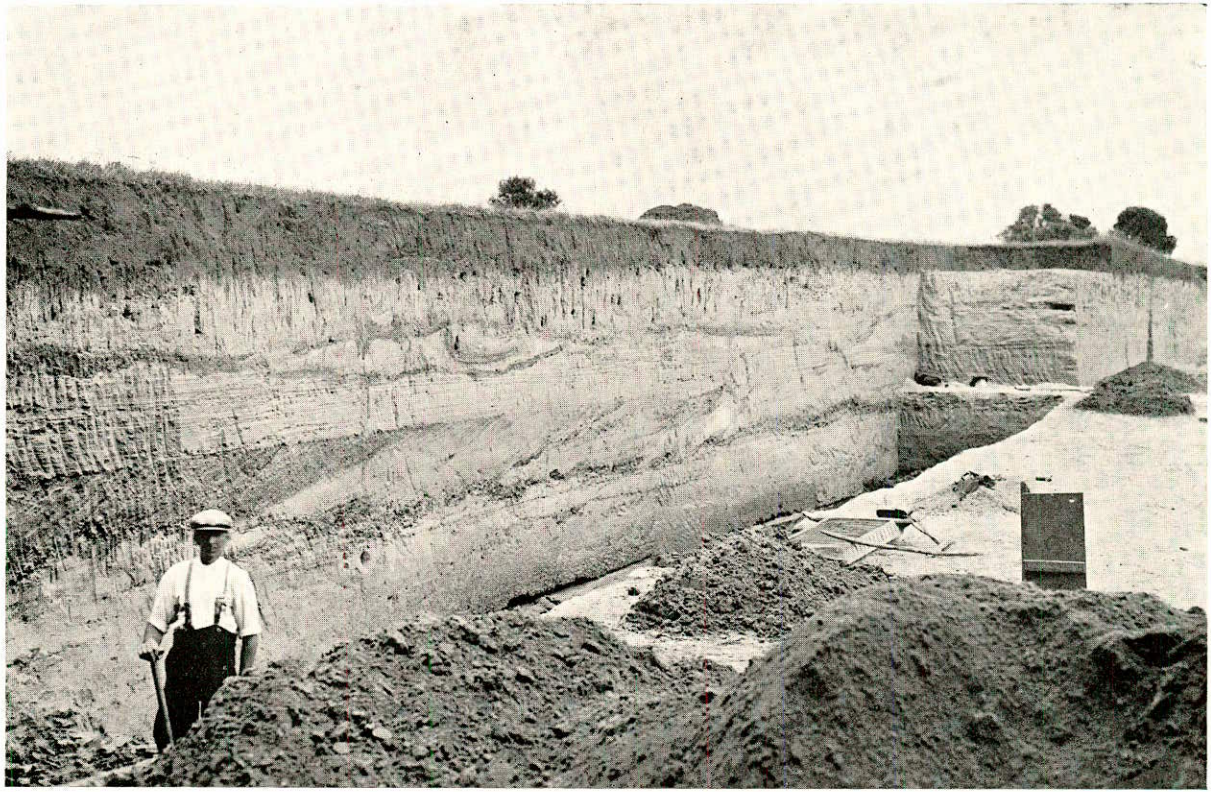


GREYLAKE QUARRY No. 1, LOOKING SOUTH

FROM A PHOTOGRAPH BY DR. A. BULLEID, F.S.A.

The Burtle Sand Beds of Somerset

BY ARTHUR BULLEID, F.S.A. AND J. WILFRID JACKSON, D.SC., F.G.S.

Introduction

The following notes are made with the object of recording some observations regarding the composition and distribution of the Burtle sand beds in mid-Somerset. During the last twenty-five years research has been greatly facilitated by the opening up of two large quarries at Greylake. These works have been the means of acquiring information about the sand which was hitherto unobtainable by earlier observers. Although the sand-banks are of comparatively recent origin, they are nevertheless of considerable interest, and important enough to have been given the distinctive designation of Burtle by Henry de la Beche, Prof. Buckland and other early nineteenth-century geologists.

When standing on the crest of the Polden Hills and looking N.E. towards the Mendips, two conspicuous land-marks stand out on either hand in the intervening plain, *i.e.* Brent Knoll and Glastonbury Tor. These isolated hills, 457 ft. and 500 ft. in height respectively, composed of secondary rocks, are the solitary remains after denudation of a geological series, which at one time extended from the Mendips to the Poldens southwards, and northwards into the Severn Sea for an unknown distance beyond the present coast-line. Both of these pyramidal mounds consist of Midford sand, and the raised ground on which they rest and are surrounded, upper and middle lias. Underlying the last-mentioned are beds of lower lias, part of a basin-shaped trough extending from the Wedmore hills to the Poldens, and for the most part concealed by marsh and other recent formations. Along the southern scarp of the Poldens where the lias ends, Rhaetic beds make their appearance,

superimposing the Keuper marls which further south underlie the marsh deposits of King's Sedgemoor.

It is in these valley flats, lying north and south of the Poldens, that the Burtle beds of marine sand occur. The writers of this paper do not wish to discuss here the geological complications engendered by repetitions of elevation and subsidence through which this locality has passed. Those who wish to pursue this subject will find it dealt with in an interesting paper by the late Mr. W. A. E. Ussher, F.G.S., entitled 'A Geological Sketch of Brean Down and its environs'.[1]

The Burtle beds are found at or near the surface in twenty or more distinct localities. In extent the sand varies considerably; some areas are low batches of a few acres, others are occupied by farms and farm buildings, and a few of the larger accommodate villages and form large parts of parishes (*see* Map, Plate XXXIII). It is possible these areas represent the upper limits of the marine sands found in the deep borings made in the Turbaries north of the Poldens in 1911 and previously, but confirmation of this is still required by further boring.

The Burtle sands consist largely of comminuted shell and fine quartz grains, and are seen at their best in the Greylake quarries, No. 1 and 2, where sections have been cut 10 ft. to 14ft. in depth. The deeper layers of sand are evenly stratified. At places nearer the surface the sand sometimes appears to have been washed away, the laminations interrupted, and the depressions filled with the wash of subsequent tides. The alluvium over the sand varies from a few inches to 2 ft. in depth. South of the Poldens it is of a reddish colour and of greater depth than that seen on the north side of the hills. Between the alluvium and the surface of the laminated sand there is a layer of coarse sand containing hard concretionary nodules and thin slabs of cemented sand averaging 2 ft. in thickness. In the Greylake quarries a layer of gravel or shingle occurs about 10 ft. below the surface and another thicker deposit at the base of the sand, but as the latter is not worked commercially and is usually below the water level it is seldom exposed. The lower gravel was examined by one of the writers at Greylake quarry No. 2 during a dry spell of

[1] *Proc. Som. Arch. Soc.*, lx (1914).

weather a few summers ago, and was noted to be over 2 ft. in depth. The small excavation then undertaken did not yield animal remains or anything of special interest, but from a statement made by a quarryman we learn that this layer has produced fragments of bone in Greylake quarry No. 1.

Description of the Various Sites

1. Greylake Quarry No. 1 or 'Hobbs' field quarry' is owned by Mr. Frank Davis, situated east of Greylake Fosse in the parish of Middlezoy, Somerset 6 in. Ordnance map, Sheet LXII, sections N.W. and N.E. (Plate XXVII). The quarry consists of a cutting across the N.W. side of a sand batch or island some 6 acres in extent, an outlier of an extensive sand bank that is probably continuous from Othery to Weston Zoyland. The surface level of the highest part of the field is estimated to be 27 ft. O.D., and up to the time of writing about $1\frac{1}{4}$ acres of sand have been removed. The sectional drawing (Fig. 1) is produced from measurements made 1.8.37. (*See also* Plate XXVIII).

i. Alluvium, reddish, averaging 2 ft. in depth.

ii. Light-coloured coarse sand containing concretionary nodules and thin slabs of cemented sand, 18 in. to 3 ft. in depth, bedding indistinct; few marine shells.

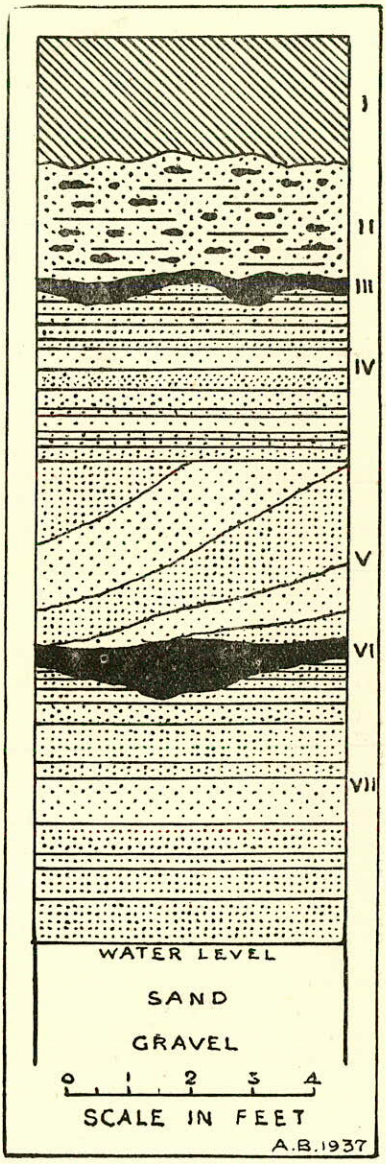


Fig. 1.

iii. Thin layer of brownish, sandy, gravelly earth, thickness varies, at places only a few inches in depth.

iv. Belt of fine sand, 2 ft. 6 in. to 3 ft. in depth, bedding uniformly level, traceable entire width of quarry, thin laminations remarkably evident, separated by lines of harder sand, the intervening soft sand weathering out on quarry face ; upper surface waved with shallow depressions which cut through the superficial laminations ; lower surface straight and even ; marine shells numerous.

v. Layer of fine shelly sand 3 ft. to 3 ft. 6 in. in depth, current bedding strongly developed, colour of sand varies in different sections, upper surface even, lower waved rests on gravel, comminuted shell in large quantity.

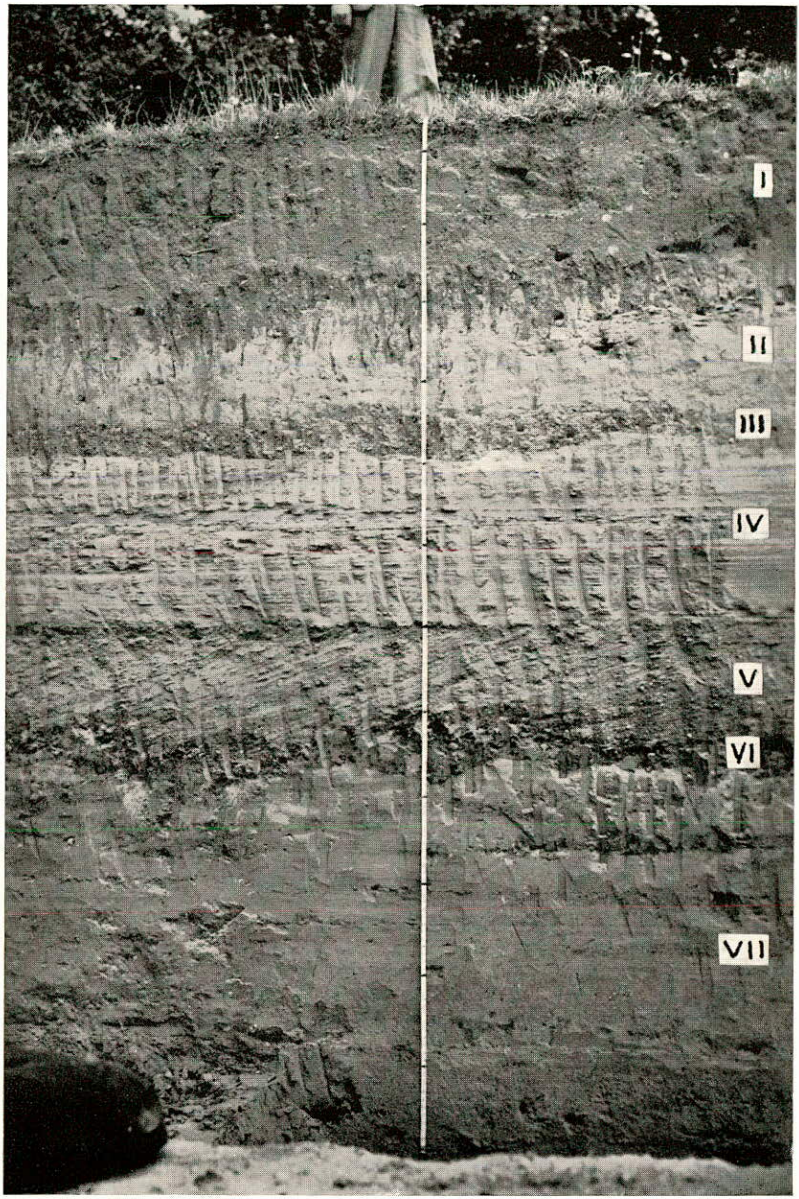
vi. Gravel 3 in. to 15 in. in depth, contains marine shells, bones of extinct mammalia, occasionally an extinct fresh-water shell.

vii. Fine laminated sand 4 ft. to 5 ft. in thickness, bedding level similar to 4. The water level on 1 . 8 . 37 was 15 ft. 6 in. below the surface near the centre of the quarry.

The gravel of bed 6 is composed of chalk flints, quartz, and water-worn pebbles of various coloured sandstone, all of which are common. Greensand chert is less evident. Pellets and lumps of rolled clay and red marl occur frequently. Lias fossils are represented by fragments of belemnites and small ammonites. These with numerous marine shells are cemented together with quartz sand into a hard compact band. Fine sand is quarried down to 17 ft. when the water level allows ; below this there is shingle.

Human remains have been found near the surface. A late Neolithic or early Bronze Age burial was destroyed in 1933 and only four small fragments of a beaker pot were saved. Numbers of mesolithic flints have been obtained from the surface soil, and have been collected for many years by Mr. H. S. L. Dewar of Catcott. In the early days of the quarry the father of the present owner found the burials of at least three human bodies. The bones were reinterred and found again some years later when the quarry was extended by Mr. Frank Davis. Two of the skulls were examined by Sir Arthur Keith, and in a letter dated 13 . 10 . 1930 he says ' I have never seen such perfect endocranial casts formed in nature before. When you take into account the number of individuals found, the complete representation of the body, one is drawn to the idea of a cemetery. If it is a cemetery of La Tène or later date, then we ought to find pottery or something to help us in dating. The skulls seem to be those of members of the same local community '. Nothing was or has been found to date these burials.

2. Greylake Quarry No. 2, or ' Halsom Quarry ' is situated at the north side of Oliver road in the parish of Middlezoy, Somerset 6 in. Ordnance map, Sheet LXII, section N.W. This quarry was



SECTION OF GREYLAKE QUARRY No. 1, LOOKING EAST

Tape gives scale in feet

FROM A PHOTOGRAPH BY DR. A. BULLEID, F.S.A.

THE BURTLE BEDS OF SOMERSET

worked for many years by Messrs. E. H. I. Davis and Jesse Davis. At the present time it is not used. At the south side of the quarry near the road the surface level of the ground is estimated to be 29 ft. O.D. The level of the road at the entrance to the quarry being 32 ft. O.D. (Plate XXIX). The alluvium covering the sand varies from 15 in. to 30 in. In 1930 there were two artificial depressions in the south face of the quarry, with vertical sides, filled with alluvium. One measured 6 ft. deep and 9 ft. in width, the second 4 ft. 6 in. deep by 5 ft. 6 in. wide. Nothing was found in the face of filling except one flint flake 2 ft. down from the surface. The quarrymen say these holes are met with occasionally and that they are old excavations for sand. The layer of coarse sand with embedded nodules and thin slabs of cemented sand is seen below the alluvium similar to that found in Greylake quarry No. 1 and has a maximum depth of 3 ft. The fine sand under this is stratified and contains several thin lines of gravel ; at the south end of the quarry the thickest and lowermost averages 6 in. in depth, and at the north end measures 18 in. This layer of gravel is a fairly level and consistent belt, traceable along all sides of the quarry, varies from 7 ft. 9 in. to 9 ft. below the surface at the south and north ends of the quarry respectively, and corresponds with the 10 ft. layer found in Greylake quarry No. 1. It contains masses of marine shells at places and also the extinct freshwater shell *Corbicula fluminalis*. At the base of the sand 14 ft. below the surface a thick layer of shingle occurs which the quarrymen state is 2 ft. 6 in. to 3 ft. in depth. Mr. E. H. I. Davis stated that in the early years of the quarry nearly a wheelbarrow full of bones was collected from the sand ' down deepish ' but these were thrown away. The bones were doubtless from the 9 ft. gravel layer as were others procured more recently and noted by the authors.

3. Chedzoy Quarry. This small sand-pit is situated near and S.E. of the parish church ; Somerset 6 in. Ordnance map, Sheet L, section S.E. The quarry has not been worked for many years and when visited, 16 . 8 . 30, was used as a chicken-run. Since that date it has been enclosed by a high fence, and is now (19 . 9 . 37) no longer available for examination or visible from the road ; it has been filled in and is a potato ground. The following strata have been noted in the quarry face.

i. Alluvium red-coloured, varies from 18 in. to 30 in. in depth.
ii. Belt of sand, 3 ft. at the deepest, contains hard sandy nodules and irregular slabs of cemented sand of variable thickness.
iii. Layer of fine sand varying from 18 in. to 42 in. in depth ; embedded in it are beach-rolled nodules and lumps of clay ; marine shells frequent.
iv. Fine sand in even stratified layers composed largely of comminuted shell ; marine shells noted.

Mr. Edward Stone of Chedzoy says that this sand continues down to 15 ft. below the surface, and that is the greatest depth he has tested it. No clay or marl has been noticed. The water-level in the quarry he stated varies with the season and apparently is the same as the water-level in King's Sedgemoor. Marine shells were chiefly found in the rolled clay layer. When visiting the quarry, 16 . 8 . 30, a piece of cemented sand was picked up at the foot of the quarry face which had comminuted fragments of ivory adhering to it. The lower part of the humerus of a young mammoth is said to have been found at Chedzoy.[2]

The Burtle sands at Chedzoy extend over a large area ; towards the north it has been exposed at Parchay in a marl pit some 20 ft. to 30 ft. in depth, made by the Somerset Drainage Board when obtaining material for embankment purposes. The sand was resting on red marl and contained marine shells. The sand is also found at Brentfield Bridge, near Langmore Batch, Fowler's plot, and Langhay east of Chedzoy.

4. Edington Moor. A small, low sand batch lies east of the road leading from Edington to Edington Burtle ; Somerset 6 in. Ordnance map, Sheet LI, section N.E. This batch is about one acre in extent. The superficial layers of sand are exposed in the sides of the ditches and have produced marine shells. The alluvium over the sand is shallow, dark grey to black in colour and contains flint flakes.

5. Shapwick Heath. This batch consists of a long narrow ridge, the long diameter lying S.E. and N.W., and about $\frac{1}{4}$ mile in length. The batch is situated some $\frac{3}{4}$ mile south of Shapwick railway station, and when travelling from the station to Shapwick village a rise in the level of the road is distinctly noticeable as it passes over the west end of the ridge ; Somerset 6 in. Ordnance map, Sheet LI, section N.E. The east extremity of the batch ends in a wood where the sand is exposed and riddled with rabbit-burrows. The alluvium covering the sand is dark grey-coloured and a few inches deep. Besides marine shells the batch has produced many flint flakes at the surface. The west end of the batch is situated in a field lying west of the Shapwick to Westhay road ; at one time, when used as potato-ground, the soil produced many flint flakes and one leaf-shaped arrow-head. This was found in June 1914 by the late Mr. F. J. Bennett, F.G.S. The arrow-head is very thin, 27·5 mm. long by 19·5 mm. max. width ; weight 21 grains.

6. Brickyard Farm stands on a low mound or batch several acres in extent and is situated about one mile S.W. of Shapwick station ; Somerset 6 in. Ordnance map, Sheet LI, section N.E. When visiting this site in 1930 there was a shallow sand-pit in the

[2] *Proc. Som. Arch. Soc.*, i, 136.



GREYLAKE QUARRY No. 2, LOOKING SOUTH

FROM A PHOTOGRAPH BY DR. A. BULLEID, F.S.A.

field west of the house, and in the ditch bordering the south side of this paddock stratified blocks of lower lias were exposed. Dr. Balfour Stewart says that when he visited the farm in 1914 he dug in the ditch to the south of the house and came across blue lias stone in undisturbed strata. Brickyard Farm is so called because brick-making was carried on for a short time. The bricks manufactured were however unsatisfactory and the project was abandoned. There is now no evidence of either the works or kiln. The sand is orange-coloured and on digging near the foot of the pit-bank the sand was thick with marine shells. Sand appears on the surface of the road in front of the farm and was also noticed at the bottom of the ditch bordering the north side of the field in which the sand-pit occurs.

7. Canada Farm. This sand batch is situated about ½ mile S.W. of Shapwick station ; Somerset 6 in. Ordnance map, Sheet LI, section N.E. The batch is low and about one acre in extent. The farm buildings stand at the highest part and a bench-mark gives the height as 15·7 ft. O.D. The tenant of the farm, Mr. Ethelbert Loader, said the sand is 13 ft. deep with blue clay under, but he could not give any authority for this statement. There is a well 10 ft. deep which Mr. Loader says passes through layers of sand and gravel with embedded marine shells. The sand is covered by about 9 in. of blackish sandy soil. When visiting the farm, 14 . 7 . 30, a small cutting was made in the field N.W. of the house, 3 ft. 6 in. in depth. The superficial layers of sand were light grey, but deeper down it was yellow and orange-coloured with embedded marine shells, nodules and irregular slabs of cemented sand.

8. Honeygar Farm stands on a sand batch several acres in extent, and is situated south of the River Brue in Westhay Level ; Somerset 6 in. Ordnance map, Sheet XXXIX, section S.E. The field lying north of the farm shows decided evidence of shallow sand quarrying. The surface is uneven and depressed. At the present time there is little sand exposed, but marine shells were obtained by digging into the quarry bank.

9. This batch is situated N.E. of Honeygar Farm and near the south bank of the River Brue ; Somerset 6 in. Ordnance map, Sheet XXXIX, section S.E. The site is a low, isolated batch covering parts of five fields and appears to be composed of gravel and sandy clay. Fine sand containing quartz was found in the sides of two ditches. No excavation has been undertaken and no marine shells have been procured from this area up to the time of writing. More evidence of its origin is required. The gravel consists of pebbles of reddish sandstone, water-worn pieces of conglomerate, quartz, lias and an occasional belemnite.

10. At Burtle a large area of marine sand exists, situated south of the River Brue and is at least one mile in diameter : it accom-

modates the villages of Edington Burtle, Catcott Burtle and many farms ; Somerset 6 in. Ordnance map, Sheet XXXIX, sections S.E. and S.W. At the time of writing (1937) there is no sand quarry open ; the old pit near the Church now disused becomes a pond during the winter months. A small pit that at one time existed near Chapel Hill Farm is also closed. We have been able to obtain samples of marine shells from a sand-heap adjoining a recently sunk well. The sand is stated to be 12 ft. in depth. The altitude in the road a few yards away from the well is given as 21 ft. O.D. The bench-mark against the Church, 24·4 ft. O.D., appears to be the highest part of this sand area.

11. This sand batch is in King's Sedgemoor, situated S.W. of MOORLINCH near the south end of Catcott Right Drove (Catcott moor detached) ; Somerset 6 in. Ordnance map, Sheet LI, section S.W. At a rough estimate the batch is about three acres in extent and is seen in the fields on either side of the drove. Marine sand is exposed in the ditch-banks, and shells were obtained by digging.

12. Sand batch in King's Sedgemoor, south of SUTTON MALLET. This area of sand is situated at the foot of Sutton Hill near the junction of Chilton Right Drove and Edington Right Drove ; Somerset 6 in. Ordnance map, Sheet LI, section S.W. The batch is a low mound and about one acre in extent. The Burtle sands are exposed in the ditches bordering the Chilton Right Drove, as well as in the banks and bed of Sutton Rhyne. The accumulation of marine shells here is greater than at any of the sites so far examined, and the sand is largely composed of comminuted shell. This site may possibly be the beach referred to by Prestwich and placed in his sketch plan as being near the Poldens.

13. A considerable area of sand containing marine shells is found in the parish of WEMBDON, N.W. of Bridgwater ; Somerset 6 in. Ordnance map, Sheet L, section N.W. In the field opposite Grabhams Farm the sand is several feet deep, and appears to be resting on red marl. The sand can also be seen in the ditch at the road side north of Grabhams Farm and probably extends westwards for half-a-mile as far as Perry Green. The width of the area is apparently about quarter-of-a-mile. This area of sand is mentioned by Mr. E. W. Swanton in his paper on the *Mollusca of Somerset*,[3] and he gives a shell list of thirteen varieties found by Mr. Henry Corder of Bridgwater. This beach is probably that mentioned by Prestwich as existing near Wembdon.

14. At HORSEY, two miles N.E. of Bridgwater, situated in Horsey Level, sand with marine shells is mentioned by Ussher ;[4] Somerset 6 in. Ordnance map, Sheet L, section N.E.

[3] *Proc. Som. Arch. Soc.*, 1912 ; and is issued separately.

[4] *Geological Survey of England and Wales*, 1876.

15. At BRADNEY, situated one mile north of Chedzoy, marine sand is mentioned by Ussher,[5] and has also been noticed N.W. of this site ; Somerset 6 in. Ordnance map, Sheet L, section N.E. From information given by Mr. Ernest Stagg of Bradney Farm, Bawdrip, the area of Burtle sand at Bradney is something between 80 and 100 acres, and is separated from the Chedzoy sand by a narrow belt of bogland. In an orchard adjoining the farm are a few rabbit-burrows ; the sand exposed is of light grey colour consisting of quartz grains and comminuted marine shells, concretionary nodules and irregular slabs of cemented sand similar to the top layer at Greylake quarry and other sites.

16. At STRETCHOLT situated in Pawlett Level one mile north of Pawlett village, marine sands are mentioned by Ussher as occurring here,[6] and this statement is also repeated in his paper, ' A Geological Sketch of Brean Down, etc.'[7] Dr. C. Balfour Stewart, late of Huntspill, records the finding of marine sand near Mr. Charles Reason's cottage, which was the last house west of Stretcholt, and also at Yearsey Farm and Ham Lane in the same locality ; Somerset 6 in. Ordnance map, Sheet XXXVIII, section S.W.

17. At ALSTONE FARM, situated south of Highbridge ; Somerset 6 in. Ordnance map, Sheet XXXVIII, section N.E. This site is mentioned in a letter from Ussher to Dr. Stewart dated 11 . 6 . 14, and the following details of a section are given :—Soil and clay 3 ft. to 4 ft., peat 2 ft., then shelly sand, depth not stated. Dr. Stewart had also noted sand in this locality independently of Ussher.

18. NORTH CURRY MOOR ; Somerset 6 in. Ordnance map, Sheet LXXI, section S.E. This site is situated near the foot of the hill north of North Curry. In a pamphlet describing this village the late Rev. Preb. D. J. Pring says that ' during the late Rev. Preb. Buller's time an obvious beach of sand and shells was unearthed at the foot of Vicarage fields '. In a letter dated 24 . 9 . 37, the Rev. H. Jocelyn Davies the present vicar of North Curry says ' that a well-informed labourer states there is a deposit of sand which runs from Vicarage meadow right across Haymoor and Curry Moor. I have been told that both sand and marine shells are washed up when the Tone is in flood '.

19. ALLER. Until recently there was a sand quarry in a field adjoining the S.W. side of the main road half-way between Aller and Langport ; Somerset 6 in. Ordnance map, Sheet LXXII, section N.E. The quarry lay below the level of the 50 ft. contour line at the foot of Aller Hill which consists of Keuper marl and Rhætic beds capped by Lias. The field belonged to Messrs. Kelway

[5] *Geological Survey of England and Wales*, 1876.

[6] *Ibid.*

[7] *Proc. Som. Arch. Soc.*, lx (1914), ii, 32.

of Langport who used the sand for nursery purposes. When inspecting the quarry from time to time the writers have never been able to detect marine shells in the sand, and on the occasion of their last visit (19 . 9 . 37) they were disappointed to find that with the exception of a bank some few feet in depth the pit had been filled in. (Plate XXX).

In a letter to Dr. Balfour Stewart, dated 25 . 7 . 14, Mr. Ussher mentions the quarry as follows—' Today I walked through Langport and over the marshes to Aller and thence back here (Curry Rivel) by Oath. On the way I struck a remarkable sand pit. The contour is something of this sort (Fig. 2). The sand is rather fine,

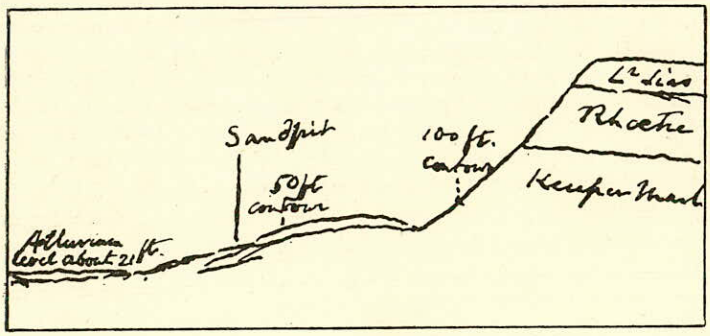
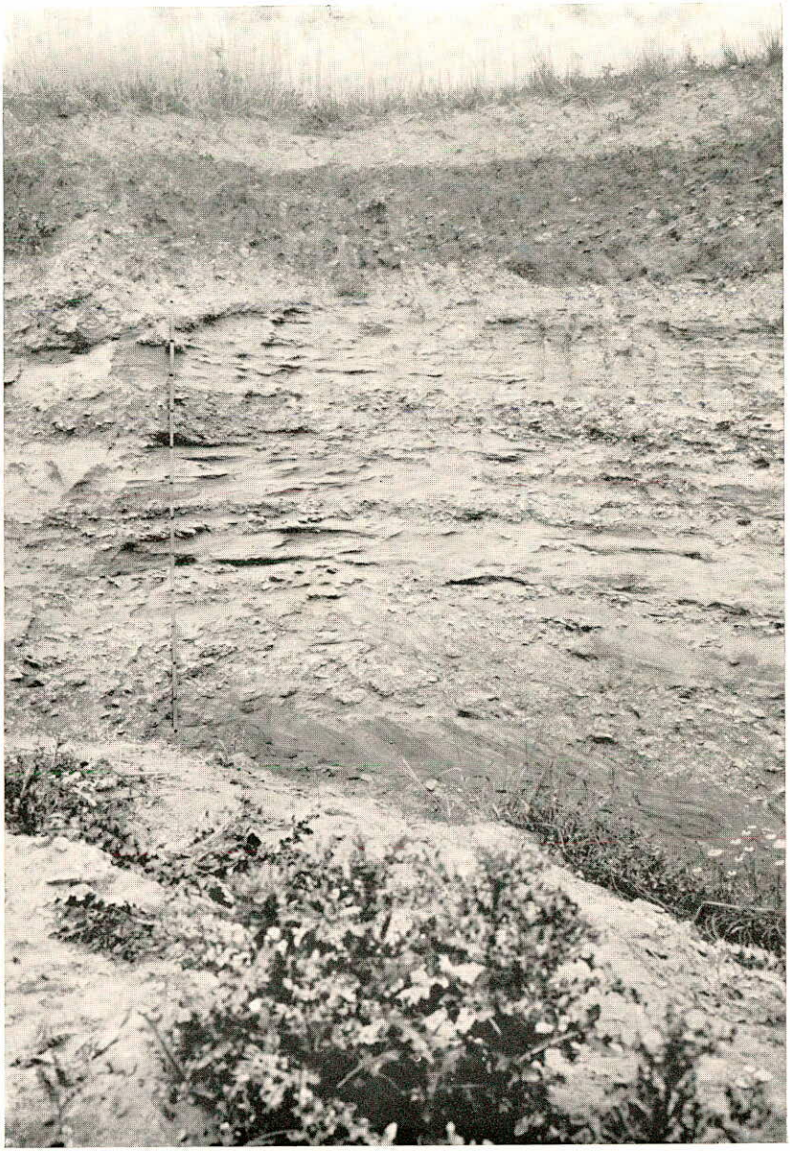


Fig. 2. Aller Sandpit; drawing in Ussher's letter.

mostly quartz, apparently rounded grains, some shell grains, some dark grains. It contains alternating reddish bands of more loamy sand with small fragments of marl and of harder bands in marl and perhaps lias. Towards the base there is a band of red clay inclined to foliation 2 in. thick. The sands are exposed to a depth of 14 ft. and give a distinct appearance of thin bedding or incipient lamination which inclines towards the marshes, *i.e.* down the slope. Overlying the sand and fine gravelly bands is a head of lias fragments in red-brown clay, apparently sandy in lower part where it makes a very irregular junction with the sands '.

In another letter to Dr. Stewart, dated 27 . 9 . 14, which is as far as we can ascertain the last Mr. Ussher wrote upon this subject, he says—' I think the fine gravel terrace near the Aller to Langport road may be contemporaneous with the raised beaches '.

20. LANGPORT; Somerset 6 in. Ordnance map, Sheet LXXII, section N.E. It is apparently evident from the following letter that the Burtle beds extend as far as Langport. A letter, dated 25 . 7 . 14, to Mr. Ussher from Mr. J. A. Ewart junr., a contractor, who made the pier of the Langport (G.W.R.) viaduct, states ' There was a layer from 3 ft. to 3 ft. 6 in. of half-running sand and small



ALLER SAND QUARRY, LOOKING SOUTH-EAST

FROM A PHOTOGRAPH BY DR. A. BULLEID, F.S.A.

shingles full of sea shells on the top of the marl both at Langport and Somerton. If I recollect rightly the ganger Redwood who took out the Somerton foundations picked out and gave handfuls of shells to Mr. Hall-Stephenson who interested himself greatly in the foundations '.

21. HUISH EPISCOPI; Somerset 6 in. Ordnance map, Sheet LXXII, section N.E. Near the Tannery S.E. of Huish Church and north of the River Yeo there are sand-pits and beds of gravel. When the gravel-pit was worked twenty-five years ago by Mr. Brown of Langport part of a mammoth tooth is reported to have been found. Mr. Ussher had seen it, and he describes it in a letter to Dr. Stewart dated 17 . 7 . 14, ' It appears to me to have been part of the tooth cross-section, the grinding end broken off and interior dissolved out '. Mr. Brown was interviewed by the writers in 1930 with reference to the tooth, and were informed that in changing houses it had been lost. When visiting the sand-pits in 1929 and subsequently no marine shells were discovered. Mr. Ussher says in another letter to Dr. Stewart dated 27 . 9 . 14, ' The lower sand and gravel on the marsh border near the Tannery at Huish may be contemporaneous with the Burtle beds, but this is only a suggestion '.

22. CHILTON TRINITY. Marine sand and shells were found in a well section at Bussens Farm near this village;[8] Somerset 6 in. Ordnance map, Sheet L, section N.E. Bussens Farm has not been located by the writers, it may have been renamed since the above was written.

Prof. Buckland and the Rev. W. D. Coneybeare state[9] that in the Burtle sand at Chilton Trinity one mile below (north) Bridgwater marine and fresh-water shells are found together.

23. PAWLETT. Beds of Burtle sand occur at the base of Pawlett Hill; Somerset 6 in. Ordnance map, Sheet XXXVIII, section S.W. The sand is found below the 50 ft. contour line towards the west end near Hill Farm.

24. GODNEY. Beds of gravel occur east and west of Godney Farm; Somerset 6 in. Ordnance map, Sheet XL, section S.W. The gravel consists of mountain limestone and chert, and towards the north appears to rest on sand.[10] The nature of this sand needs confirmation as no shells are mentioned.

25. The Burtle sands at Middlezoy and Weston Zoyland are continuous beds and limited towards the south by Keuper marl; Somerset 6 in. Ordnance map, Sheet LXII, section N.W. These beds form the largest area of Burtle sand and apparently extend

[8] Ussher, *Geological Survey of England and Wales*, 1876.

[9] *Geological Trans.*, 2nd series, i 309.

[10] *Geology of E. Somerset and the Bristol Coal Fields*, by Horace B. Woodward and others, 1876, p. 157.

from Othery to Weston Zoyland a distance which at the lowest estimate measures 3 miles.

26. Deep borings in the Turbaries. At Shapwick station Burtle sand was found at the depth of 31 ft. 8 in. below the surface, and at Bason Bridge 51 ft. At Dunwear on the south side of the Poldens Burtle sand was met with at 20 ft. 3 in. resting on red marl.

Notes

A great deal of information has been obtained from notes made by Dr. C. Balfour Stewart and from the letters he received from his friend and collaborator Mr. Ussher. Both were working at the same problem, *i.e.* the age and distribution of the Burtle sand beds, and it is very much to be regretted that the Great War put an end to their valuable researches. After the war Dr. Stewart left England to reside in Switzerland but before doing so handed his papers and letters bearing on the matter to Dr. Bulleid hoping that the work might be continued by others interested in the same subject and locality.

Although it rests with the quarrymen to give the correct depth at which the animal bones are found, it should be noted that a piece of antler was found by us in the gravel layer 9 ft. 3 in. below the surface which is the position given by the men.

The bones and typical examples of the shells discovered will be exhibited in the County Museum at Taunton Castle.

The Mollusca of the Burtle Beds

The shells obtained during our researches comprise a large and interesting series of marine forms together with a few examples of the freshwater *Corbicula fluminalis* and one or two land shells. The marine group is of a mixed facies, consisting of species common to sandy, muddy and rocky habitats. Remarks on these with relative abundance are given below. The recent occurrences and their presence in the local Raised Beaches are taken from Swanton's *Mollusca of Somerset*, 1912, and from other sources.

Diodora apertura (Mont.) (*graeca*).—Locality 1 (1). Only a solitary example of this widely-distributed species has been found. It occurs in habitats from low-water to 50 fathoms, and has been recorded from Clevedon and the Bristol Channel.

Patella vulgata L.—Loc. 1 (20), 2 (16), 11 (3), 12 (6). This is fairly common in the Burtle Beds and of all sizes. In a recent state

it occurs on rocks and stones between tide-marks, and has been recorded from Weston-super-Mare, Burnham, Clevedon, etc. It occurs also in the Raised Beaches near Weston-super-Mare. Prestwich (1892, p. 300) records it from Burtle Beds at Chilton Trinity, near Bridgwater (coll. W. Baker).

Patina pellucida (L.).—Loc. 1 (1). This is a poor example and there is doubt as to its identity. In a recent state the species is found on *Laminaria* at low water and deeper on all coasts. Swanton does not give it in his list for Somerset.

Calliostoma conuloides (Lam.) var.—Loc. 1 (4), 2 (4), 12 (2). The shells from the Burtle Beds do not agree with the usual form of *Calliostoma conuloides* from British seas. They are finely but distinctly ridged spirally and nearly all the ridges are granulated. They may be the ordinary form with the juvenile granulations continued on later whorls. Harmer[11] shows two shells, one from the Butleyan Crag of Butley and one from the Newbornian Crag of Sutton, which are not unlike our specimens. He refers them to *C. conuloides*, but they differ somewhat from the recent shell alongside.[12] A recent, unicoloured shell in the Darbishire collection at the Manchester Museum, from Weymouth (var. *granulifera* Jeff.) is similar to our specimens. *Calliostoma conuloides* (as *zizyphinus*) is recorded in a recent state from Clevedon, and Prestwich (1892, p. 300) records it from Burtle Beds at Chilton Trinity (coll. W. Baker).

Gibbula cineraria (L.).—Loc. 1 (4), 2 (1), 13 (1). Only six examples of this abundant littoral species have been met with. In a recent state it has been recorded from Weston-super-Mare, and Corder obtained it from the Burtle Beds at Perry Green, Wembdon.

Gibbula umbilicalis (da Costa) (*umbilicata*).—Loc. 1 (1), 2 (2). The two examples from the second locality have large purple blotches in place of the usual purple longitudinal streaks. Like the last, this is an abundant littoral species and has been recorded from Burnham. Prestwich (1892, p. 300) records it from Burtle Beds at Chilton Trinity (coll. W. Baker).

Monodonta lineata (da Costa).—Loc. 2 (2). Only two shells have been found and they are very imperfect. It is a local, though not uncommon species, and has been recorded from stones and rocks in Cornwall, Devon and other places. Swanton omits it from his Somerset list.

Tricolia pullus pictus (da Costa) (*Phasianella*).—Loc. 12 (3). This is common, living in many places, though rather southern in its range. It is not given for Somerset by Swanton.

[11] Harmer, *Pliocene Moll. of G. B.* (Pal. Soc.), vol. ii, 1923, pl. LVII, figs. 8–9.

[12] *Ibid.*, pl. LVII, fig. 7.

Littorina littorea (L.).—Loc. 1 (Com.), 2 (Com.), 3 (Com.), 11 (3), 12 (Com.), 13 (few). This extremely common ' periwinkle ' is found on stones and rocks generally. It occurs living at Weston-super-Mare, and Corder cites it from Burtle Beds at Perry Green, Wembdon, and Prestwich from Chilton Trinity (coll. W. Baker). It has also been found in the Raised Beaches near Weston-super-Mare.

Littorina saxatilis (Oliv.) (*rudis*).—Loc. 1 (3), 2 (11), 11 (2), 12 (5). This is another of our common rock-species and occurs everywhere on stony beaches. It has been recorded from Weston-super-Mare and Minehead, and from the local Raised Beaches. Prestwich cites it from Chilton Trinity (coll. W. Baker).

Littorina neritoides L. This is reported by Swanton as found by Corder at Perry Green, Wembdon, but in a manuscript list of Corder's it is given with a query under *L. obtusata*. It occurs living between Burnham and Brean, and at Minehead, etc.

Littorina obtusata (L.) (*littoralis*).—Loc. 1 (Com.), 2 (Com.), 3 (4), 11 (8), 12 (Com.). This rock-loving species is fairly common in the Burtle Beds in all stages of growth. It is recorded living at Weston-super-Mare, Burnham, Minehead, etc., and has been found in the local Raised Beaches.

Hydrobia ventrosa (Mont.).—Loc. 4 (few), 5 (Com.), 6 (Com.), 7 (Com.), 8 (few), 11 (few), 12 (1). This estuarine species is common in some of the sections, and has been recorded in a recent state from Avonmouth, Shirehampton, Cook's Folly, Clevedon, and Weston-super-Mare.

Hydrobia ulvae Penn.—Loc. 1 (Com.), 2 (Com.), 3 (6), 4 (2), 5 (Com.), 6 (few), 8 (Com.), 10 (few), 11 (Com.), 12 (Com.). This is another very plentiful estuarine species, living on mud-flats in tidal rivers, inlets, etc. It is recorded from Weston-super-Mare, etc., and Corder found it at Perry Green, Wembdon.

Natica catena (da Costa).—Swanton gives this as found by Corder at Perry Green, but it does not appear in Corder's manuscript. In a recent state it is recorded for Burnham.

Nucella lapillus (L.) var.—Loc. 1 (1), 2 (4), 11 (1), 12 (2). The four specimens from Loc. 2 are small and slender with strong circular grooves. The other examples are larger and more globose, and are very water-worn. This very variable species is found on rocks and has been recorded from Weston-super-Mare, Burnham, Clevedon, Minehead, etc. Swanton gives it as found in the Burtle Beds at Perry Green, Wembdon, but it is not listed by Corder.

Ocenebra erinacea (L.).—Loc. 1 (5), 2 (2), 11 (1), 12 (3), 13 (1). Of this widely-distributed and variable species we have only found a few small and medium-sized examples. In a recent state it occurs on stony ground generally and has been recorded from Weston-

super-Mare, Burnham and Clevedon. Corder gives it for Burtle Beds at Perry Green, and Prestwich cites it from Chilton Trinity (coll. W. Baker).

Ocenebra aciculata (Lam.).—Loc. 1 (1), 2 (1). Two imperfect specimens appear to be this species. It is not recorded recent from Somerset by Swanton.

Buccinum undatum L. var.—Loc. 1 (1), 2 (3), 3 (1), 12 (1), 13 (1). Only a few specimens of this whelk have been found and these are somewhat dwarfed and depauperated like the var. *paupercula* Jeff., from brackish water. In a recent state the species has been found at Weston-super-Mare, Burnham, Minehead, etc. Corder gives it for the Burtle Beds at Perry Green, and Prestwich for Chilton Trinity (coll. W. Baker). It is frequent in the Raised Beaches about Weston.

Nassarius reticulatus (L.).—Loc. 1 (Com.), 2 (Com.), 3 (2), 11 (2), 12 (6), 13 (1). This is a common British species living in sand at low-water mark and deeper. It has been recorded from Weston-super-Mare, Burnham, Clevedon, etc. Corder gives it for Perry Green.

Nassarius incrassatus (Ström).—Loc. 1 (1), 2 (1). Two specimens only of this widely-spread recent species have been found. It is not recorded for Somerset by Swanton.

Retusa retusa (M. & R.).—Loc. 11 (2), 12 (3). This small species is common on muddy ground and among seaweeds from low-water mark to about 15 fathoms. It has been recorded from Clevedon (as *Tornatina truncatula*) by Swanton.

Retusa alba (K.) ?—Mr. H. Corder records *Tornatina obtusa* from Perry Green : it may be this species. In a recent state it is recorded from Weston-super-Mare, Burnham and Clevedon (as *Tornatina obtusa*).

Leucopepla bidentata (Mont.) (*Leuconia*).—Loc. 1 (1), 3 (1), 10 (1), 11 (1). This is a widely-diffused species living between tide-marks in coastal estuaries, etc. It is recorded as not uncommon at the mouth of the Avon near Pill.

Mytilus edulis L.—Loc. 1 (Com.), 2 (Com.), 3 (Com.), 10 (few), 11 (3), 12 (Com.), 13 (1). All the specimens of this common mussel are fairly perfect and well-grown. In a recent state it occurs at Weston-super-Mare, and Burnham. Corder gives it for Perry Green and Prestwich for Chilton Trinity (coll. W. Baker). It is frequent in the local Raised Beaches.

Ostrea edulis L. var.—Loc. 1 (Com.), 2 (Com.), 3 (1), 11 (6), 12 (Com.), 13 (3). The shells are all small and irregular, but very rolled and imperfect. They seem to belong to the form called by Jeffreys var. *deformis* Lam. (see *British Conchology*, vol. v, pl. XXI,

fig. 1a). The species is frequent on the Somerset coast and a form like *deformis* Lam., has been found near Minehead. Corder records the species from Perry Green and Prestwich from Chilton Trinity (coll. W. Baker). It has been found in the Raised Beaches at Woodspring Hill, Weston.

Cardium edule L. var.—Loc. 1 (Com.), 2 (Com.), 3 (Com.), 4 (Com.), 5 (Com.), 6 (Com.), 7 (12), 8 (Com.), 10 (Com.), 11 (6), 12 (Com.), 13 (7). Nearly all the specimens are on the small side with the posterior end more produced and wedge-shaped, as in the estuarine form known as var. *lamarcki* Reeve (= *rustica* Jeff.). In a recent state the species occurs at Weston-super-Mare, Berrow Sands, Burnham, Minehead, etc. Corder gives it for Perry Green and Prestwich for Chilton Trinity (coll. W. Baker). It occurs in all the Raised Beaches.

Donax vittatus (da Costa).—Loc. 1 (1), 2 (1). It is remarkable that only two valves have been found of this species which occurs round our coasts in sandy situations from low-water to a few fathoms deep.

Tellina tenuis da Costa.—Loc. 1 (1), 5 (1), 6 (1), 7 (2). This is a common shell on sandy beaches and has been recorded from Burnham and Berrow flats and from Weston-super-Mare. It has been found in the Raised Beach at Birnbeck Cove, Weston.

Macoma balthica (L.).—Loc. 1 (Com.), 2 (Com.), 3 (Com.), 4 (Com.), 5 (1), 6 (2), 7 (8), 8 (6), 10 (Com.), 11 (Com.), 12 (Com.), 13 (9). This appears to be the commonest species in the Burtle Beds, but most of the shells are small and many are young. It is an exceedingly abundant species on every shore, living between tide-marks in sand or mud. It is the commonest shell at Weston and between Brean and Burnham. Corder gives it for Perry Green and Prestwich for Chilton Trinity (coll. W. Baker). It occurs in the Raised Beaches at Woodspring Hill and Anchor Head, Weston-super-Mare.

Scrobicularia plana (da Costa) (*piperata*).—Loc. 1 (7), 2 (14), 12 (1). All the valves of this gregarious and widely-spread species are fairly perfect and must have floated in from mud-flats where the species normally lives at low-water mark. It is common at Weston-super-Mare and between Berrow and Burnham.

Pholas dactylus L.—Loc. 1 (1), 2 (2). Only three imperfect valves of this boring mollusc have been met with so far. In a living state it is found boring into marl, peat, and harder substances. It occurs recent at Clevedon.

Barnea candida (L.).—Loc. 1 (7), 2 (10), 10 (6), 11 (fragments), 12 (fragments). Like the last this common species is found boring into peat and harder substances. In a recent state it occurs at Weston-super-Mare.

In addition to those already mentioned, Prestwich (1892, p. 300) gives twelve other marine species as collected from the Burtle Beds (= his Raised Beach) at Chilton Trinity, near Bridgwater, by W. Baker. The list, with comments, is as follows :—

Patelloida (*Tectura*) *virginea* (Müll.).—This is a widely-distributed species, though Swanton does not record it from the Somerset coast.

Lacuna parva (da Costa) (*puteolus*).—This is rather a local species living at low-water mark in several British localities. It has been recorded from Clevedon.

Bittium (*Cerithium*) *reticulatum* (da Costa).—This very common littoral species has been recorded from Clevedon.

Natica alderi Forbes.—This is given with a query. It lives in sand at various depths and is widely distributed, though not recorded from the Somerset coast.

Lora (*Pleurotoma*) *turricula* (Mont.).—Like the last, this lives in sand at various depths. It has been recorded from Weston-super-Mare and the Bristol Channel.

Cylichna cylindracea (Penn.).—This small species is rather common and lives in muddy sand : it is frequent at Weston-super-Mare.

Nucula nucleus (L.).—This is common in sand on most coasts. It lives at various depths and is frequent at Weston, Clevedon and Burnham.

Arca lactea L.—This is common on most British coasts in gravel from 15 to 25 fathoms deep, but rare towards the north. It is not recorded for Somerset.

Cardium echinatum L.—This has a very extended range and occurs on sandy coasts at 5 to 100 fathoms. It is recorded from Burnham and Minehead.

Spisula (*Mactra*) *subtruncata* (da Costa).—This is given with a query. It is a widely-diffused form, occurring at low-water to 27 fathoms. It is not recorded for Somerset.

Mya truncata L.—This is a littoral species, living in muddy sand. It is not recorded for Somerset.

Hiatella (*Saxicava*) *gallicana* (Lam.) (*rugosa*).—This very common species perforates rocks composed of limestone, chalk and sandstone. It is recorded from Clevedon and Minehead.

Among the shells listed by W. A. E. Ussher[13] from the Burtle Beds at Middlezoy and Burtle is a further species not found by us, *viz. Modiola modiola* (L.). In a recent state it occurs from low-water mark to about 80 fathoms. It is not given for Somerset by Swanton.

[13] *Mem. Geol. Survey*, East Somerset and Bristol Coalfield, 1876, p. 163.

Corbicula fluminalis (Müll.) (or *consobrina* Cailliaud). Loc. 1 (1 valve), 2 (2 valves). The occurrence of this species in the Burtle Beds was recorded by us at the meeting of the British Association in London in 1931. So far only three valves have been discovered, one being found by Dom. Ethelbert Horne at Quarry no. 2, and two by Dr. Bulleid, one at Quarry no. 1 and one at Quarry no. 2. They occurred in association with the marine species, but are obviously derived specimens washed down by an old river along with the animal bones. The record is interesting as being the first for the West of England.

The range in time of this extinct British species is considerable. It is recorded from the Red Crag and subsequent deposits up to the Middle Pleistocene of Crayford in the Thames Valley. The largest examples are from the last locality and measures 33 x 37 mm.[14] The species seems to have been greatly influenced by environment and consequently varied in size and thickness of shell. Dwarf examples have been recorded from a peaty deposit of Middle Pleistocene age at West Wittering, Sussex,[15] along with similar marine shells to those found in the Burtle Beds. It has also been reported from Swanscombe,[16] and from Chislet[17] at the mouth of the Thames. At Clacton-on-Sea, Essex, it occurred rarely as a derivative in the Estuarine Bed with two other extinct British freshwater forms and the marine species *Scrobicularia plana* and *Cardium edule*. This site, which is regarded as Middle Pleistocene and earlier than Crayford, has yielded the remains of many extinct British mammals including *Cervus dama* L. and *Cervus browni* Dawkins.[18]

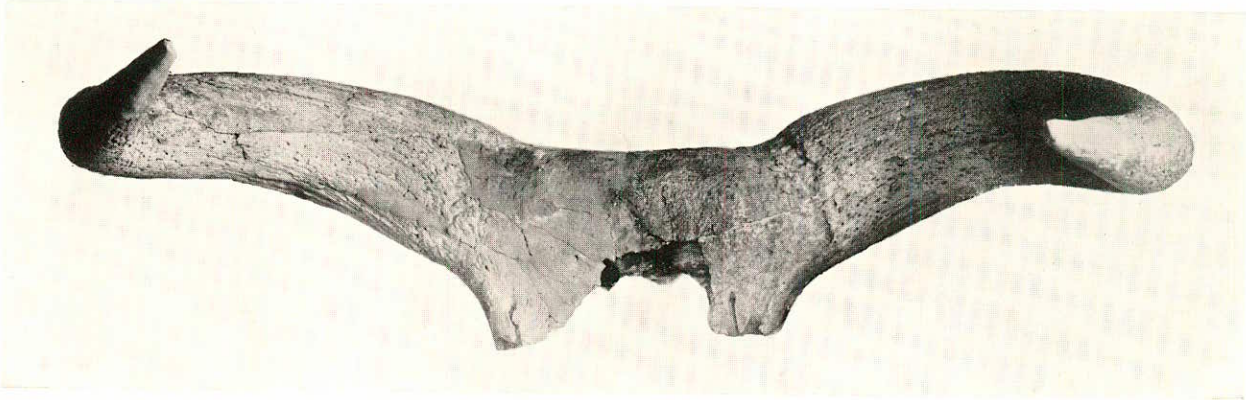
In East Anglia the species is common in the Pleistocene beds of Cambridgeshire (Barrington, Barnwell Abbey, Grantchester, March gravels, Chatteris, Whittlesea, etc.), and at Stutton, Suffolk; it occurs as a derivative in the Nar Valley, Norfolk.

In the Oxford district the species has been recorded from several localities on the river terraces.

It occurred as a derivative in the interglacial gravels at Kelsea Hill, Yorkshire.

An interesting occurrence is that in the 4th or High Terrace of the Warwickshire Avon at Ailstone on the River Stour near Stratford. Here six broken valves were found, obviously drifted, in association with a valve of another extinct form, *Unio littoralis*. This was the first record for the Midlands and showed that the species was not restricted to the Thames-Rhine river system. The deposit is regarded as Middle Pleistocene.[19]

[14] *Proc. Geol. Soc.*, vol. xvii, 1901, pp. 237–8.
[15] *Ibid.*, 1901, pp. 261–4.
[16] *Ibid.*, 1901, pp. 238–9.
[17] *Quart. Journ. Geol. Soc.*, vol. xi, 1855, p. 110.
[18] *Quart. Journ. Geol. Soc.*, vol. lxxix, 1923, pp. 606–634.
[19] *Quart. Journ. Geol. Soc.*, vol. lxxxi, 1925, pp. 137, etc.



GREYLAKE QUARRY No. 1

Pair of Horn-cores, with part of the Frontal.
Urus (*Bos primigenius* Boj.)

Scale about $\frac{1}{6}$ linear

FROM A PHOTOGRAPH BY MR. H. ST. GEORGE GRAY, F.S.A.

On the continent the species has been met with in the Upper Pliocene near Dijon, and in the Pleistocene of France, Belgium, Austria, and as far east as Omsk. At Menchecourt, in the Somme Valley, it occurred with seven species of marine shells identical with those found by us in the Burtle Beds.[20]

In a living state it is recorded from Egypt (Nile), Syria (Euphrates), northward to Transcaucasia and eastward to Turkestan, Afghanistan and Kashmir.

Land Shells.—Loc. 1 (3). Land as well as fresh-water shells are exceedingly common in the fallen debris in several of the sand-quarries, but they are obviously derived from the top-soil used to fill in excavations. Three land shells, however, have been obtained *in situ* at 9 ft. 6 in. down in the sand in Quarry no. 1. They are all of one species and seem to differ from the normal specimens of *Cernuella virgata* (da Costa). A close comparison with continental species suggests agreement with *Cernuella lineata* (Olivi). This is given as a synonym of *C. virgata* by J. W. Taylor (*Monograph*, part 24, Dec. 1921, p. 143), but the identity is doubted by Kennard and Woodward (*Synonymy of the British Non-Marine Mollusca*, 1926, p. 213).

In addition to the mollusca described above, some species of *Ostracoda* were found at Localities 1, 5, 6 and 7 ; the claw of a crab at Locality 3 ; and *Polyzoa* (on shells) at Locality 1.

The Mammalian Remains

The remains of the mammals are rather fragmentary and consist of bones and teeth of several extinct species. Those identified are as follows :—Elephant (*Elephas* sp.), Rhinoceros (*Rhinoceros* sp.), Horse (*Equus* sp.), Urus (*Bos primigenius*), Red Deer (*Cervus elaphus*), Fallow Deer (*Dama cf. dama*), and Roedeer (*Capreolus capreolus*). The remains are described below.

Elephant (*Elephas* sp.).—A fragment of elephant tusk found in Quarry no. 1 was handed to us in July 1937 by one of the workmen. It is reported to have come from the bone-bearing layer at 9 ft. 6 in. In 1931 we obtained a brecciated mass of elephant ivory at Quarry no. 3 (Chedzoy).

Rhinoceros (*Rhinoceros* sp.).—From Quarry no. 3 we obtained a fragment of a tooth in 1931. A large cervical vertebra was found in Quarry no. 1 in 1931. From the same quarry are a large imperfect scapula (July 1937) and a large dorsal vertebra (September 1937). The above three specimens are from the bone-bearing layer at 9 ft. 6 in. All three belong to a rhinoceros of some kind, but it is not possible to define the species. The scapula has an over-all

[20] Lyell, *Antiquity of Man*, 1863, p. 124 ; Prestwich, *Q. J. G. S.*, vol. xlviii, 1892, p. 302.

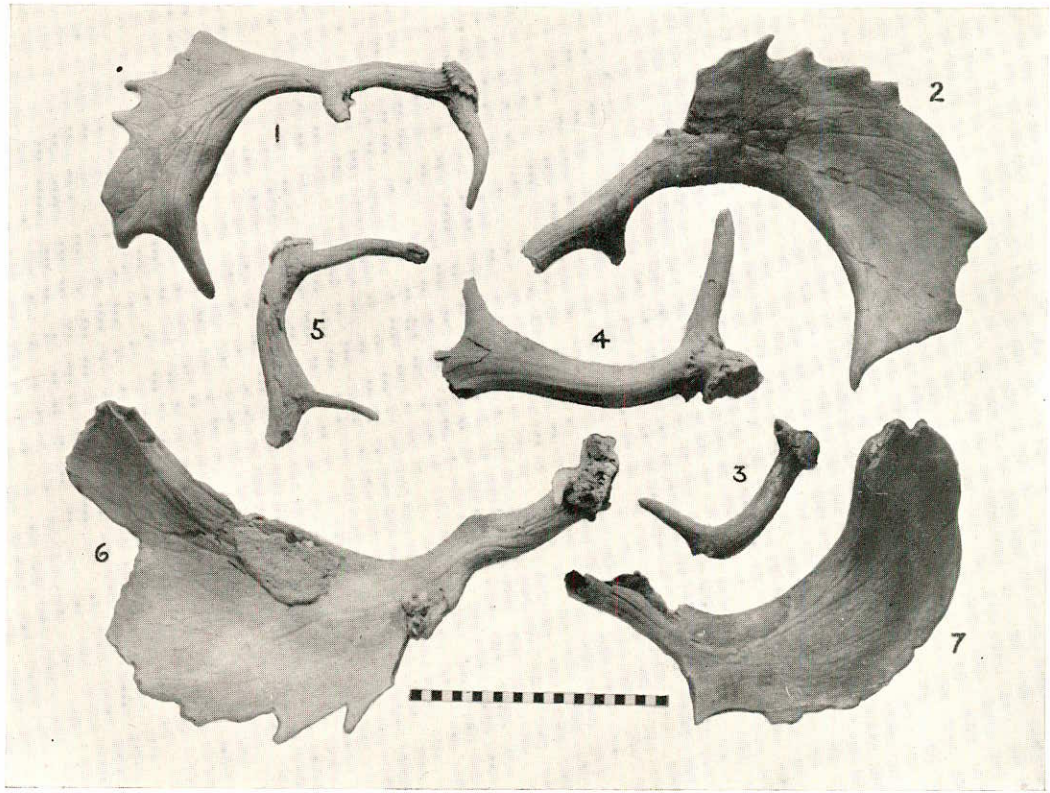
width at the proximal end of 142 mm, and the width at the neck is 115 mm.

Horse (*Equus* sp.).—The following remains of horse come from Quarry no. 1 : (A) An imperfect scapula measuring 88 mm. over-all at the proximal end, 59 mm. at the neck, and 55 mm. across the glenoid : (B) A fairly perfect humerus with an approximate length of 247 mm., and a mid-shaft diameter of 28 mm. Both bones are remarkable for their small size, and resemble the Celtic pony in this respect.

Urus (*Bos primigenius* Boj.).—In 1937 a pair of horn-cores with part of the frontal were met with in Quarry no. 1, in a broken-up condition. Unfortunately the find was divided and the right horn-core with the greater part of the frontal was presented to Taunton Castle Museum and the left horn-core to Bridgwater Museum. Both have been repaired and are illustrated in Plate XXXI. The dimensions of the right horn-core are as follows :—Outer curve, 78 cm., basal circumference, 37·5 cm. The occipital width between the infra-cornual notches (= least parietal width) is 20 cm. Other remains attributed to urus are as follows :—From Quarry no. 1, an imperfect radius and ulna ; a perfect metacarpal with a length of 250 mm., a mid-shaft width of 48 mm., and a width at the distal condyles of 75 mm. ; the proximal half of another metacarpal ; a left tibia with a length of 431 mm., a mid-shaft width of 55 mm., and a width at the distal condyles of 77 mm. ; the proximal two-thirds of a metatarsal ; a dorsal vertebra ; a rib ; and a lower jaw fragment with milk-teeth. From Quarry no. 2, the distal end of a robust right tibia with a width across the condyles of 92 mm. ; and a very large right scapula found at a depth of 10 ft. 8 in.

Red Deer (*Cervus elaphus* L.) :—The following remains of red deer were found in Quarry no. 1 : (A) A fairly perfect metacarpal measuring 277 mm. in length, 27 mm. (ca.) at the middle of the shaft, and 45 mm. at the distal condyles : (B) The proximal two-thirds of a tibia with a mid-shaft diameter of 29 mm. :
(C) An antler tine : (D) Three ossa innominata. An imperfect atlas was obtained from Quarry no. 2, in 1931, and an imperfect left scapula was found in the same quarry at a depth of 8 to 10 feet by John Morland prior to 1927.

Fallow Deer (*Dama cf. dama* L.) :—The most interesting remains obtained from the Burtle Beds are those of a form of fallow deer. The discovery was first reported by us in 1931 at the meeting of the British Association in London (see *Report*, 1932, p. 379), when it was suggested that the form might be the *Cervus browni* Dawkins. At that time only small basal fragments of shed antler had been obtained. These were kindly compared by Miss Bate with the specimens from Clacton in the British Museum (Natural History), but, as pointed out by her, the material was very unsatisfactory for



GREYLAKE QUARRY No. 1
Antlers of Fallow Deer (Dama *cf.* Dama L.)

(Scale in centimetres)

FROM A PHOTOGRAPH BY DR. A. BULLEID, F.S.A.

correct determination. We have since obtained much further and better material. During recent excavations in Quarry no. 1, several antlers were found at 9 ft. 6 in. from the surface. Some of these are illustrated in Plate XXXII. With one exception (fig. 4) they are all shed examples These and others not figured are remarkable for the great breadth of the palmated portion and for the obsolescence of the numerous long points on the posterior border such as are seen in antlers of recent fallow deer.[21] In some a few short points are present. As seen by our photograph, the palmated portion possesses the usual shallow grooves for the reception of the nutrient blood-vessels of the velvet. It is not possible to compare the palmated portion of our antlers with *Cervus browni* as in only one example of the latter (the type specimen, No. 27876, Brit. Mus.)[22] is a part of the palmation preserved, and this suggests a different form. Another important feature in the antlers of *Cervus browni* is the presence of a third tine arising from the anterior aspect of the beam. In none of our examples is this feature present. In the lower part of the antler the Burtle Beds specimens show the following. The burr is sharply defined and rugose. The brow-tine is cylindrical and springs immediately from above the burr and is nearly at right-angles to the axis of the beam. In one of our examples (fig. 6) a rudimentary tine springs laterally from the base of the brow-tine. The beam is cylindrical above but becomes somewhat flattened where the shorter bez-tine is given off. This flattening then continues into the palmated portion. The beam and tines show the usual grooves for the nutrient blood-vessels. Compared with *C. browni* our antlers appear to be smaller.

From Quarry no. 1 we have also obtained a dorsal vertebra, two imperfect scapulae, an imperfect innominate bone, a phalange and a tooth. All appear to belong to the species under discussion, and come from the same bone-bearing layer. The scapulae and innominate bone are slightly more robust than in a recent specimen of fallow deer in the Manchester Museum, but the scapulae agree with fossil examples from the Hoe Grange Cave, Longcliffe, Derbyshire.[23]

In Quarry no. 2 the following have been found :—(A) Two basal fragments of shed antler ; (B) The left ramus of the lower jaw ; (C) A fragmentary scapula ; (D) The distal half of a metatarsal ; and (E) The centre part of the shaft of another metatarsal. The lower jaw (B) contains the six cheek teeth, though the crown of the first premolar is broken off. The length of the tooth-row at the alveolar border is 92·5 mm. The jaw agrees closely with that of a recent fallow deer, the teeth being essentially the same, though

[21] *Quart. Journ. Geol. Soc.*, xxiv, 1868, pl. XVIII, fig. 8 (ex Blasius).

[22] *Ibid.*, pl. XVII, fig. 4.

[23] *Quart. Journ. Geol. Soc.*, lxi, 1905, pp. 43–63.

somewhat larger. The accessory column on the outer side of the three molars is stronger. The teeth also agree with those of fossil fallow deer from the Milton Hill swallet, near Wells, discovered recently. There is also some resemblance between the above jaw and that of a fossil fallow deer from Aurensan, Bagnerès-de-Bigorre (Hautes-Pyrénées), described and figured by Edouard Harlé in 1895.[24] Compared with reindeer, the jaw shows striking differences in the teeth, especially in the three premolars, which in reindeer show a very distinct type of folding. In the latter, too, the accessory columns of the three molars are absent. The distal half of the metatarsal has a width of 29·7 mm. at the condyles, and an approximate mid-shaft width of 16 mm. The least circumference is 53 mm. The bone agrees closely with that of a recent fallow deer in the British Museum (Natural History) used by Mr. S. H. Warren for comparison with *Cervus browni* from Clacton.[25] It is somewhat thinner than a bone from Milton Hill, near Wells. The centre fragment of the metatarsal is from a more robust bone and agrees with examples from Milton Hill.

In addition to the places mentioned, remains of fossil fallow deer have been recorded from Turnham Green[26] and Charing Cross, London.[27] With the remains of the Upnor *Elephas antiquus* in the British Museum (Natural History) is a lower jaw of a small cervine resembling fallow deer. In the Worcester Museum are some remains of a fallow deer from Fladbury, which are thought to have come from No. 2 Terrace of the Warwickshire Avon.[28]

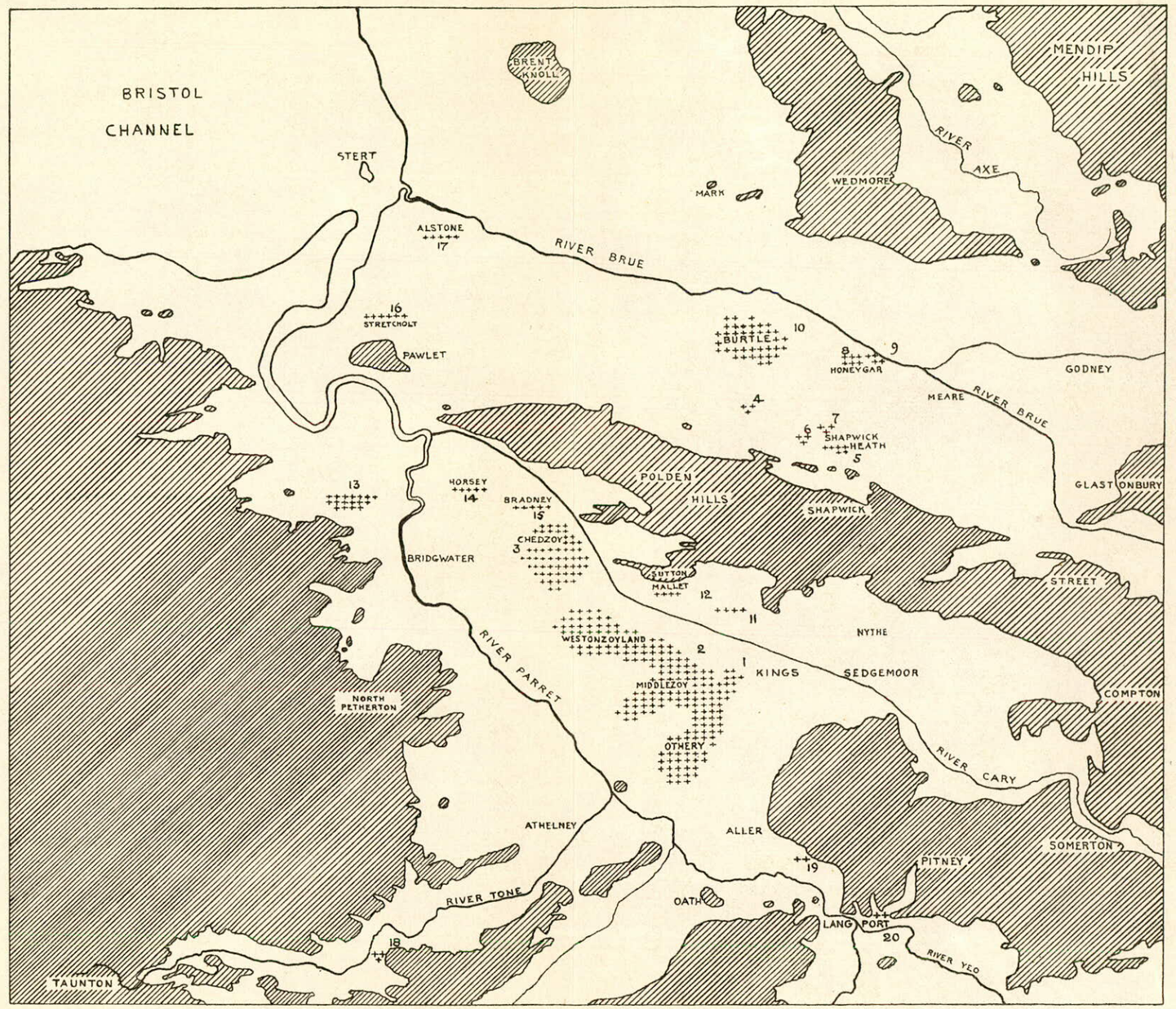
Roedeer (*Capreolus capreolus* L.) :—From Quarry no. 1 we have obtained a metatarsal minus the proximal end. The width at the middle of the shaft is 15 mm., and at the distal condyles, 25 mm. It appears to belong to roedeer.

Note on Hippopotamus in the West of England

In a paper by Dawkins entitled ' On the Distribution of the British Postglacial Mammals ' published in 1869,[29] mention is made of the occurrence of the remains of hippopotamus and mammoth in a river deposit at Chedzoy, Somerset. The specimens are stated to have been in the collection of W. A. Sanford. Unfortunately these cannot now be traced.

The remains of hippopotamus appear to be rare in the West of England. Some were found in a cavern at Durdham Down,

[24] *L'Anthropologie*, 1895, pp. 369–373, text-figure 1.
[25] *Quart. Journ. Geol. Soc.*, lxxix, 1923, p. 616 (Table).
[26] *Ibid.*, xxviii, 1872, p. 468.
[27] *Geol. Mag.*, 1917, p. 424.
[28] *Quart. Journ. Geol. Soc.*, lxxxi, 1925, pp. 152, etc.
[29] *Ibid.*, 1869, p. 196.



MAP OF CENTRAL SOMERSET SHOWING POSITION OF BURTLE BEDS

Bristol, associated with the remains of many other animals.[30] They are in the Bristol Museum and in the Geological Museum of the Bristol University. Other remains have been found recently in a limestone fissure on Milton Hill, near Wells, along with those of *Elephas antiquus* (milk-molars), bison, fallow deer, and hyaena. These are in the Wells Museum and a selection is figured by H. E. Balch in his 'Mendip, its Swallet Caves and Rock Shelters', 1937, plate 27.

Concluding Remarks

This paper records some recent observations on the Burtle Beds of Somerset and contains descriptions of a number of sections, and of molluscan and mammalian remains found therein.

The Burtle Beds were deposited during a period of prolonged aggradation consequent upon submergence of the area below sea-level. At this period the districts now drained by the Rivers Brue and Parrett were at a much lower level and open to the Severn Sea. Quantities of sand and gravel with marine shells, etc., were deposited in the submerged area. The marine shells are of species found in the neighbouring Raised Beaches, which probably terminated the period of depression, and are living to-day on the coast of Somerset. Certain of the forms show estuarine features. Mammalian remains were at times washed into the area from the surrounding country, and occasional non-marine shells, as *Corbicula*, were brought in by rivers, or perhaps washed in by sea from the Severn drainage area.

There are no contemporary flint implements incorporated in the beds to assist in ascertaining their precise date, but the special features seem to suggest a correlation with similar events in the Thames Valley and other places, also at Clacton-on-Sea, Essex. At the latter place the contemporary flints are attributed to the Lower Palaeolithic cultural phase known as Clactonian II (fide Breuil). The mollusc *Corbicula*, and the remains of extinct fallow deer (described as *Cervus browni*) have also been found there with others belonging to a warm fauna. The abundant presence of the remains of fallow deer in the Burtle Beds seems to indicate, at least, a warm, temporate

[30] *See* Owen, *Report, British Assoc.*, 1843, p. 224; and 'British Fossil Mammals and Birds', 1846, p. 410; also later references.

climate ; so also does the *Corbicula*. And there is nothing in the marine molluscan fauna which militates against this conclusion. The *Corbicula* is unknown from any deposit later than Crayford in the Thames Valley, dated by its contained implements as Early Mousterian. The deposit at Clacton is earlier than Crayford.

On later elevation of the area the Burtle Beds suffered denudation and were ravined and cut up into knoll-like masses. During some part of this period of elevation, material from the extensive sand-flats accumulated on the Raised Beaches of the coast, and later a head of rubble was formed on the blown sand of the latter. It was probably during this period that the sandy sub-soil immediately underlying the dark top-soil accumulated over the marine sands of the Burtle Beds. The cemented sand of this sub-soil suggests percolation by land waters or rain.

Closely connected with this episode is the important section at Aller at the foot of the hill to the north of Langport, which is described in an earlier page. The harder rocks obtained by us from this section show distinct evidence of smoothing and polishing by blown sand. Careful search revealed no extraneous pebbles, as flint and quartz, so common in the gravels of the Burtle Beds. Nor was there evidence of land or marine shells. There is every possibility of marine sands underlying this section.

On the whole, the Aller deposits of sand and rubble suggest a close correlation with the Late Pleistocene breccias at the 50-foot level seen near Clevedon, Bleadon, and other places.[31] We have not as yet been able to make a detailed examination of the sand from the Aller section, such as has been done in the case of the Clevedon and other deposits. In the latter case it has been suggested that the wind-borne sand was ' foreign ' and derived from the sandy matrices in the Tertiary sands of Cornwall and Devon. It may be suggested, however, that the sand of the Aller section was derived locally when the sand-banks of the Burtle Beds and the 50-foot Raised Beach were elevated during the Late Pleistocene epoch.

[31] *Proc. Geol. Assoc.*, xlv, 1934, pp. 145–161.

On a subsequent depression the hollows in the Burtle Beds were filled with alluvial and lacustrine deposits, some of which belong to the submerged forest period. These later deposits cannot be dealt with here, but attention might be called to the occurrence of worked flints in the dark top-soil (15–20 inches) of certain of the sections of Burtle Beds. A series of these flints has been patiently collected by Mr. H. S. L. Dewar, of Catcott, and these have been described by Dr. Grahame Clark as belonging to the beginning of the Mesolithic Period.[32]

[32] *See* Grahame Clark, in *Man*, 1933, 65.