

# THE NATURAL HISTORY OF SLAPTON LEY NATURE RESERVE

## I. INTRODUCTION AND MORPHOLOGICAL DESCRIPTION

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It is intended that this descriptive account of the Nature Reserve at Slapton should in the first place provide the distant specialist with a clear picture of its anatomy; and secondly provide all fieldworkers who may use it in the future with a standard locational reference, and thus increase the co-ordination, and hence the value to the student, of their otherwise disconnected research.

The main research effort at this field centre to date has been directed to factual observation and recording. Causal relationships await the attention of the expert. Theoretical discussion in this paper is thus limited, and confined to the first part—a description of regional setting, physiographic development and recent cultural history. The second part consists of a division of the reserve into units for the practical purpose of fieldwork, and a morphological description of each.

### REGIONAL AND HISTORICAL PHYSIOGRAPHIC SETTING

Devon culminates southward in a broad, blunt peninsula, tipped by a long narrow outcrop of quartz-mica schist which projects slightly at the south-eastern and south-western corners as Start Point and Bolt Tail. This resistant mass protects a much more extensive outcrop of Lower Devonian slates, shales and sandstones which, narrowing slightly immediately north of the schist, eventually swells outward well beyond the longitudinal limits of the schist. The waist thus formed is composed of that division of the Lower Devonian known in the literature as the Meadfoot Beds (Ussher, 1904, but see Dineley, 1961), and Start Bay forms its eastern coastline. Both schist and slates strike east and west, and most exposures display intense folding producing near-vertical attitudes of bedding, cleavage and foliation. While in the schist a diagonal joint pattern would appear to be the dominant structural influence, in the slates strike, and cleavage variations, produce a series of east-west hollows and ridges which end at either coast as bays and headlands. A major discontinuity in the geological sequence separates these Palaeozoic rocks from the Permo-Triassic material whose main outcrop now extends northward from Torbay to open out in east Devon as the base of the Mesozoic sequence of lowland Britain. That the outcrop once extended further south is indicated by exposures in the sea bed offshore south of Start Point, and, more important, by a few small outliers on the coasts of Start and Bigbury Bays. Their distribution suggests that the present pattern of the south Devon coastline was effectively blocked out in Permo-

Triassic times, and the outlines of the major bays are essentially horizontal sections through the edges of sub-Triassic desert basins. The largest of these outliers—about a mile long and half a mile wide—consists of a succession of basal breccias and sandstones, and is well exposed in Slapton village and in the Reserve. The breccias contain quartz and limestone fragments up to 6 inches in length in a red-stained, quartz grain and shale fragment matrix.

No younger solid formations exist in extreme south Devon and it is necessary to rely upon interpretations of surface morphology for further detail of the evolution of the present landscape. A morphological analysis of the South Hams and southern Dartmoor has been carried out by A. R. Orme (1960, 1962, and 1964) and his interpretations strikingly supported by work on the Dart and Exe terraces (Brunsdén, 1963; Kidson, 1962; Brunsdén *et alia*, 1964). All agree on a Calabrian (?) sea level of *c.* 690 feet O.D., and at least a trimming of summits by successively lower sea levels during the irregular withdrawal from that height. The net result is a series of flat topped ridges and spurs, of accordant height over considerable distances, and ranging from 690 feet to 50 feet O.D.

The first 300 feet of this emergence was probably pre-glacial, slow, and punctuated by long still-stands, for slopes everywhere above 350 feet O.D. are very gentle—almost invariably below  $10^{\circ}$ —and valley sections graded to this level, wide and shallow. Below 350–400 feet O.D., and especially within the more resistant formations, valleys are deep, narrow and steep-sided. In the Dartmouth Slates  $22^{\circ}$ – $24^{\circ}$  slopes are common and  $30^{\circ}$  can be recorded in many valleys.

The emergence clearly took the form of an expanding landscape concentric to southern Dartmoor, and thus the initial streams followed roughly radial lines from the edge of the Moor. The major streams still follow such lines, and a few less important ones occupy fragments of radii. Within the Meadfoot Beds outcrop, subsequent tributary development has proceeded apace and a ridge and vale landscape aligned with the strike is produced, obliterating the consequent pattern almost entirely. Much more recently a rapid submergence has dominated land/sea relations. Maximum extension of the landscape was probably to somewhere near the present 30 fathom line, and thus this most recent submergence is of the order of 180 feet, causing flooding of the lower reaches of all valleys at the time, and extensive silting since. Thus, depending on their size, the valleys of south Devon terminate in long tidal inlets or lengthy stretches of narrow, flat, water meadow and marsh.

The last few hundred feet of emergence and subsequent submergence have obviously not been two simple movements, for they occupied the period between the onset of the first glaciation and the present day, with the major oscillations of sea level which the four glacial advances caused. At maximum extent the southern edge of the ice sheet was still some 100 miles north of this peninsula, and even at 2,000 feet on Dartmoor no evidence has yet been found for the existence of moving ice. Nevertheless the effect of the periglacial conditions which pertained during each of the glacial maxima is very much in evidence in the detail of this landscape. Vertically arranged, finely divided rocks are obviously most susceptible to the immediate effects of frost riving and shattering. Steep-sided valleys and recently abandoned cliffs are ideal sites for the mass movement of the rock debris thus produced. Hence, summits and

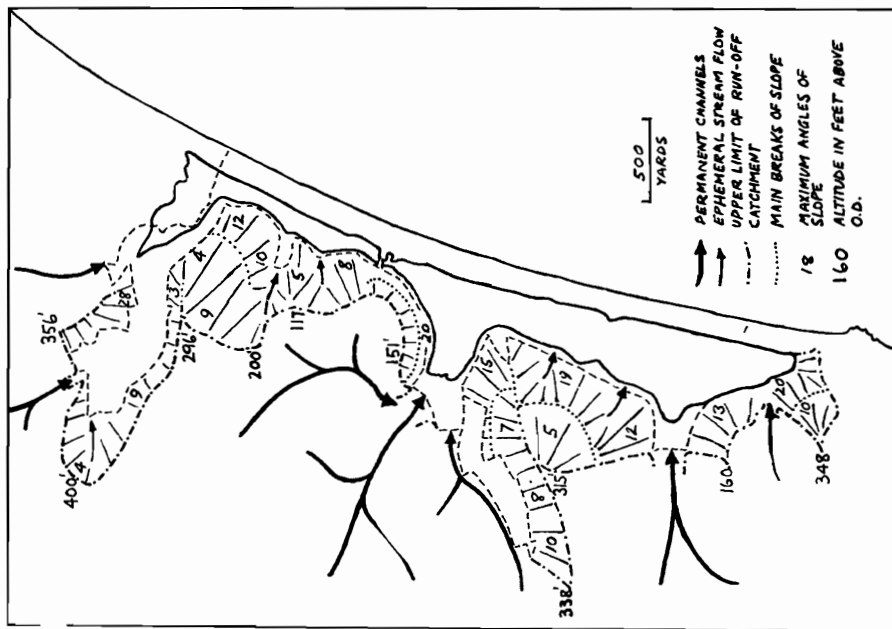


FIG. 2.

Limits and morphology of the surface area providing direct runoff into the Reserve. Compare Fig. 3.

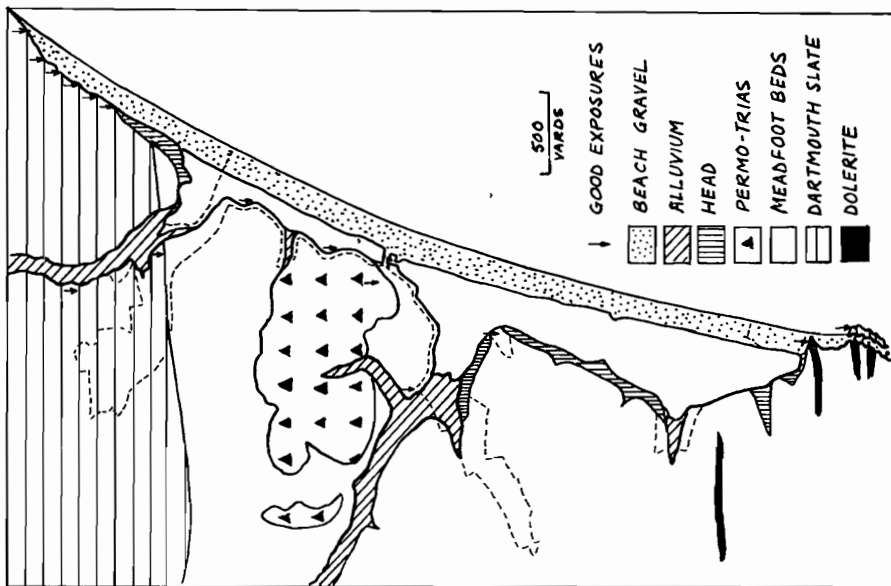


FIG. 1.

Solid and superficial Geology of the Nature Reserve and its immediate hinterland.

valley-lips were rounded, concave breaks of slope made less concave. Wherever normal means of transport were not, nor have been since, adequate, then masses of rock debris accumulated, and still lie, at the bottom of slopes, in some cases completely choking the small valleys. Such deposits of "head" (Waters, 1965) occur throughout the peninsula, and cannot be ignored in any ecological consideration of soil and substrate, nor geographical study of site and human activity.

In plan, as suggested above, the coastline at the time of maximum emergence must have been somewhere close to the present 30 fathom line. The floor of Great West Bay, that huge arc from Start Point to Portland Bill, lay, as a short-lived coastal plain, strewn with recently abandoned beach deposits derived from all the rock formations within the Bay. As the sea rose towards its present position, it must have swept up before it this material to form the beaches and barriers of the present coast. Throughout this process sand and shingle were clearly subjected to movement by waves, and as the advancing coastline conformed more and more closely to the present pattern, so, under the influence of dominant onshore winds, movement would be basically outward from the centre towards the two arms of the Bay, to form finally the present barriers at Chesil and Slapton Sands.

Slapton Ley is a coastal lagoon impounded behind the shingle ridge that is Slapton Sands. Slapton Sands is a 3 mile long section of what is effectively a single barrier stretching for 8 miles from Hallsands in the south to Pilchard Cove in the north, and interrupted at high water by two headlands. The Ley is just over 2 miles long, the northern mile of the Sands fronting abandoned marine cliffs. The slopes at the back of the Ley are the same feature, probably of the same age—in fact the cliffline is undoubtedly polycyclic (Orme, 1962)—but, being cut in less resistant rocks and longer protected from recent marine attack, they show softer outlines, less steep gradients, and lower summits.

The shingle of Start Bay almost certainly arrived here in the manner described above. It is impossible otherwise to explain the high flint content and at the same time account for the total absence of marine shingle of any kind on the inner shore of the Ley. Coastal sources of flint are separated from Start Bay by very effective barriers to longshore drift, notably the mouths of the Dart and Exe, and the peninsulas flanking Torbay. There is on the other hand solid Chalk and loose flint in abundance on the floor of Great West Bay offshore. Nevertheless, since its arrival in Start Bay, near its present position, the form of the barrier and its significance to the lake behind it are bound to have been affected by wave action and longshore drifting. It is important to note here, however, that current observations of the year by year condition of the beach, showing no long-lived accumulation at either end, confirm that Worth's observation that the "drift of beach material is nicely balanced" is still true (Worth, 1904). Little new material is now being added to the beach, and shingle removed off Hallsands between 1897 and 1904 has not been replaced (Robinson, 1961).

Easterly and cross-Channel gales, particularly in the first quarter of the year, produce waves which comb down the seaward face of the ridge, and also fling some shingle over the crest. The swash of such waves sluices some shingle on to the backslope. There is thus a net landward movement of the whole barrier.

This was confirmed in 1953 when intense gales, in combing the face, exposed peats and lake clays, forward of the main crest, suggesting that the barrier is now travelling over recent lake floor.

Historical documents are of little assistance in elucidating further the development of the present situation. Greenwood (1826) shows the Ley apparently open to the sea between a point some 150 yards north of Torcross and the southern boundary of Slapton Parish. Ley, however, means lake (O.E. *laya*) and is first recorded in 1270 (assize Rolls), and the earliest extant map, caused to be produced by Henry VIII, shows a very solid-looking barrier between Ley and sea. The 19th-century map referred to above shows, by convention, a "submarine ridge" on the line of the present beach in the "open" gap, and contemporary writing indicates that the Ley overflowed the ridge regularly in accordance with the annual rainfall regime. The length of road—now the A379 and known locally as "The Line"—from Slapton Bridge south to Torcross was constructed by a Turnpike Trust in 1856, and the culvert which takes the present overflow was built at the same time to obviate the annual winter washover of the road site.

#### CONTEMPORARY MORPHOLOGY AND HYDROLOGICAL BACKGROUND

The lake itself is fresh, shallow, and totally above sea level, though the effective bottom is below the level of High Water Spring Tides. It is divided into two unequal parts—Higher and Lower Leys—separated by a causeway and road bridge. The Higher Ley is about a quarter of the area of the Lower, and now largely reed swamp. The Lower Ley remains essentially an open lake with a discontinuous reed fringe.

Apart from direct rainfall, the Ley receives freshwater from a number of inflowing streams. The largest, the River Gara, enters the Ley at its extreme northern end, collecting a small tributary—Slapton Wood Stream—on its right bank at this point. No other streams enter the Higher Ley, but springs break out on the Ley shore in places, notably just south of the Little Marsh. Two streams enter the Lower Ley in Ireland Bay, the sizeable Start Stream from the north-north-west, and the France Stream from the south-west. A small re-entrant drains part of the main slope south of Ireland Bay, and a stream similar in size to the France Stream runs from the west into Stokeley Bay. One or two intermittent springs break out on the slope traversed by the main road leaving Torcross for Kingsbridge.

The total catchment of these streams and springs, of which the Ley is the collecting point and the Torcross culvert the final outflow, covers some 18 square miles, and rises to just over 700 feet O.D. beyond the head of the River Gara, 5 miles north-west of the Ley. The catchment straddles all the named formations and lithological types of the Lower Devonian, and contains a dense dentritic pattern of streams. The average discharge under Gara Mill Bridge during the 6 weeks beginning 13th April, 1962, was 26 cu. ft. per second, rainfall at the Centre for the same period was 3.55 inches. Both Gara and Start streams finally approach the Ley through marshy, flat-bottomed valleys with very steep sides, and part of Slapton Wood occupies a typical segment of such slopes. Smaller streams tend to occupy valleys of completely

youthful aspect—as Slapton Wood stream, or wider, shallower valleys, as the France stream (Fig. 5). The contrast between these two appears to correlate with Ussher's divisions of the Lower Devonian rocks. Slapton Wood stream is entirely within the Dartmouth Slate, which everywhere in the landscape displays symptoms of greater resistance than the Meadfoot Beds in which the France and Stokeley streams lie. The inferred boundary between these two formations runs along the southern boundary of Slapton Wood. Actual contrasts in slope form and angle will be found recorded in the detailed descriptions of Slapton and France Woods below.

Apart from its tidal boundary, only in the two larger valley bottoms does the Reserve not impinge on agricultural land. The woodland everywhere has a clear physical boundary and most of it reaches the crest or near-crest of its sloping site, and is therefore little affected by run off and underground water from adjacent farm land. Fig 2 attempts to display the relative position with regard to these influences around the inland reserve boundary. Outside the inflow valleys the Ley is backed everywhere by sloping land; Fig. 2 also indicates the variation in the state of these slopes, which should be compared with the geological map (Fig. 1).

The gentlest slopes are towards the Higher Ley, just north and south of the Little Marsh; the steepest, but very short, slopes are behind the Southgrounds shore. Long steep slopes come down to the back of the Lower Ley, though the gradient invariably decreases before reaching the final cliff. Except at two points behind the Higher Ley (see Fig. 3), everywhere the lowest segment of these slopes is formed in head, and this mixture of rock debris, most of it fairly fine, acts as crude filter for ground water passing from the slope to the Ley. The Permo-Triassic material *in situ* behind the Higher Ley is probably an equally, possibly a more efficient filter. The amount of true run-off from these slopes is small—only occurring during exceptional storms and after long periods of heavy rain. (It has been shown that under given conditions of precipitation and slope the loss of sediment by run-off from arable and grassland is of the order of an 80 : 1 ratio). All this must be read in the light of the land use and occupation map (Fig. 3), for it will be readily appreciated that fields such as those behind the Lower Ley on Stokeley Barton Farm must be heavily dosed with chemical fertilizers and weedkillers to support barley, as they do, for at least five successive years. Under such conditions the translation of nitrates, etc., into the Ley across its shore must be an important influence on the fauna and flora of the adjacent shallows, if not on the whole water body.

Meteorological records have been kept at the Air Ministry Class III station at the Field Centre (SX 824449) for 6 years to 1st May, 1966. Such figures as are available now, therefore, can do no more than indicate the climatic situation in a crude way—particularly as the short period in question contains such apparent anomalies for south Devon as the summer of 1959 and the winter of 1962-63. However, Appendix I indicates the general pattern of the annual rainfall regime and temperature fluctuation. The great bulk of the Reserve area is sheltered from the prevailing, offshore, winds; some parts, notably Slapton Wood and the inner Ley shore, are very sheltered in this respect. Very little is sheltered from the east, and winds from the north-east quadrant dominate the onshore situation and affect the vegetation on the shingle and the



seaward end of the woods, especially in the first quarter of the year. The area immediately around Slapton, an enclave below 325 feet O.D. and dominated by 100 foot high spurs, has a local reputation for weather anomalies. It is often clear when the surrounding landscape is snow covered; often fog-laden when all is clear elsewhere. Easterly winds in February and March keep temperatures down, often killing premature buds and shoots, when a mile inland temperatures are high and early growth thrives.

At the head of the Gara, within the Ley catchment, the annual rainfall rises to 55 inches or more, for this 700 foot high ridge gives the first real lift to the south-westerly wind since it crossed the coastline some 10 miles away. On the slopes around the 700 foot point, up to 3 feet of peat has accumulated in places, and a Dartmoor flora is maintained, lending weight to the rainfall estimate. It is hoped to establish a rain gauge at the head of the Gara during 1966. The figures for the last year at a newly established site in the lee of the same ridge are quoted in comparison with the Slapton figures (Table 1). There is clearly scope for a great deal of work on the micro-climatological situations within the Reserve.

Table 1. *Comparison of precipitation at Slapton and Halwell (SX 777532) for 1965, in inches.*

1965	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Slapton	.. 7.44	0.04	3.21	1.17	2.42	3.12	3.50	3.25	3.17	1.05	7.16	9.80	45.87
Halwell	.. 10.17	0.13	4.78	2.14	3.12	4.12	6.22	4.20	3.38	1.73	8.42	14.10	62.51

The present area of the Reserve was once part of a large estate—the Stokeley Estate—finally broken up in 1955 on the death of its last owner, Herbert Whitley. Since then each of the four erstwhile tenant farms have been under different ownership, three have been split into more than one holding, and only three of the eight holdings which currently impinge on the Reserve are still occupied by original tenants. In two cases ownership has changed more than once in the last 10 years. The sporting rights over these farms are held by the owners of the Reserve, and thus a protective zone surrounds it. Fishing is allowed from boats in the Ley, and theoretically all fish are returned to the water.

#### DIVISION OF THE RESERVE INTO WORKING UNITS, AND UNIT DESCRIPTIONS

The descriptions which follow are of units delineated for their convenience for fieldwork. Grassland and woodland units are generally artificially bounded, while other terrestrial units fall readily into physical categories which are invariably reflected in the vegetation. Thus a division of convenience normally has ecological significance. However, the description of plant communities is not the purpose of this paper and is only used where it will convey to the reader a more accurate picture of the site(s) in question. The aquatic units are simply divided into shallows (i.e. summer wading depth, *c* 18 inches) and deeps, as this clearly controls their treatment from the teaching and research points of view. Within each unit description the word "segment" is used for minor



lateral divisions in plan, "element" and "facet" for divisions dependent upon slope profile. Roman numerals designate a general division into five environmental groups, and then major units of the Reserve are given a capital letter, with a continuous sequence through the environmental divisions. Some of the major units are sub-divided either for convenience of reference, because extent would otherwise preclude the value of a code, or because small similar units are widely dispersed. Thus the Ley shore is broken down for the first reason, the marshes for the second. The three divisions of the shingle ridge, with their great ecological contrasts, have been treated as separate major units. (It should be noted that the boundary of the Reserve behind the Higher Ley, and between Ireland Farm and Hartshorn Plantation, is not marked on the ground by any physical feature. The narrow strip of field headland behind the Higher Ley cliff, retained primarily for access reasons, is ignored in this description.)

The Location map (Fig. 6) is folded at the back of the paper so that it may be kept in view as the paper is read.

### SCHEDULE OF UNITS

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|---|---|
| <p>I. <i>Shingle Ridge</i><br/>                 A Seaward face<br/>                 B Crest (Western Boundary is Road)<br/>                 C Back Slope (To Ley Winter Water Mark (WWM))</p> <p>II. <i>Slapton Ley</i><br/>                 D Higher Ley<br/>                     1 Outer shore (All "shores" defined as WWM to Summer wading depth)<br/>                     2 Inner shore<br/>                 E Lower Ley<br/>                     1 Outer shore<br/>                     2 Southgrounds shore<br/>                     3 Ireland Bay shore (Within reed bed)<br/>                     4 Inner shore<br/>                     5 Stokeley Bay shore<br/>                     6 Torcross west shore</p> <p>III. <i>Marshes</i><br/>                 F Higher Ley marshes<br/>                     1 Slapton Wood Marsh and Carr<br/>                     2 Little Marsh<br/>                 G Lower Ley marshes<br/>                     1 France Valley Marsh<br/>                     2 Stokeley Marsh</p> | <p>IV. <i>Leyside Fringes</i> (WWM to Cliff Top)<br/>                 H Middlegrounds Cliff<br/>                 I Lower Ley Cliff<br/>                     1 Southgrounds Cliff<br/>                     2 Hartshorn Cliff<br/>                     3 Inner Shore Cliff</p> <p>V. <i>Woodland</i><br/>                 J Slapton Wood Complex<br/>                     1 Main wood<br/>                     2 Valley Bottom Scrub<br/>                     3 Loworthy Brake<br/>                     4 Square Brake<br/>                     5 Eastergrounds Brake<br/>                     6 Gara Valley Triangle<br/>                 K France Wood<br/>                 L Hartshorn Plantation</p> <p>VI. <i>Grassland and Arable</i><br/>                 M Little Marsh Field<br/>                 N Stokeley Fields<br/>                     1 Ireland Field<br/>                     2 Hartshorn Fields<br/>                     3 American Road and Fields<br/>                     4 Peasdish</p> |
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## I SHINGLE RIDGE

### A. *Seaward Face*

A generally eastward facing slope varying from 6° at Torcross to 4° at Pilchard Cove is developed in gravel and coarse sand. Actual morphology varies according to the state of the tide and from season to season. In the former case a single, smooth concavo-convex surface from lower to upper beach berms exists at low water spring tides, while low water neaps is characterized by a

series of small parallel ridges formed by successively lower high water marks. Minor facets at this stage may bear angles of  $11^\circ$ . In the latter case variations in the dominant grain size, dependent on differential exposure of separate layers within the deposit (due to recent dominant wave action) with consequent different angles of rest, result in different gradients. Under "normal" conditions a concave element exists between H.W.M. spring tides and the top of the storm beach. This may disappear during gales either because of removal of the upper berm by destructive waves or by filling of the concavity by construction. Annual gale distribution means that the concavity is normally a summer feature.

Table 2. *Lithological constitution of the shingle in Start Bay by percentages. 1953 and 1966 based on pebble counts, 1909 on weight. (The complete lack of quartz in the 1953 count is rather suspicious, and mis-identification cannot be ruled out.)*

Position	4 stations on southern Slapton parish boundary				Hallsands (Robinson)	Blackpool (Worth)	
	HWNT	HWST	Storm Beach	Crest		1909	1909
Date	1966	1966	1966	1966	1953	1909	1909
Av. size	20 mm.	10 mm.	5 mm.	2 mm.	1-3 in. (25-75 mm.)	3/20 in. (3.75mm.)	2 1/4 in. (56.25mm.)
Quartz ..	21	44	50	56	—	55	27
Flint ..	52	27	32	27	73	23	36
Coastal Devonian ..	2	10	11	9	2	10	20
Felsite ..	4	5	4	3	5	12	1
Quartzite ..	6	3	4	5	16	—	16
Schist ..	10	2	—	—	2	6	—
Chert ..	5	9	—	—	—	—	—
Granite ..	—	—	—	—	2	—	—

Table 2 indicates typical lithological constituents of the shingle. Locally derived material is a minor proportion, but dominantly takes the form of large, oval slabs of slate and silt-stone, which tend to accumulate at the top of the beach, having "skated" over the well-rounded "rollers" of the main mass of shingle under constructive wave action.

This unit terminates westward at the highest point of the whole ridge. This is often where the first sparse maritime plants occur, but occasionally is an abrupt junction with solid turf on a humus/gravel A horizon, and then a 1 foot high "cliff" normally marks the boundary. Vegetation on the seaward face is generally absent, but occasional "weeds" occur along equinoctial strandlines, and after long gale-free periods maritime seedlings establish themselves in crescentic loops down the face towards such strandlines. Neither 1963-64 nor 1964-65 winters saw onshore gales of any strength, and by autumn 1965 clumps of *Euphorbia paralis* were well enough entrenched 32 feet eastward of the crest to survive two submergences during the 1965-66 winter.

### *B. Crest*

Over its 2 mile length the crest loses height from north to south, though the main component of this loss is a drop of 4 feet within 90 feet at the southern Slapton parish boundary. Everywhere the western boundary of the unit is taken to be the west side of the main road, and for a length of 300 yards near Torcross the road occupies the whole of the unit's width. The whole length falls into a number of clearly marked lateral divisions based on altitude, vegetation and former use. Two areas of recently continuous short turf are separated by areas where the vegetation is much more open, and "bare ground" dominates in any statistical sampling. The largest turf area extends from a point 270 yards south of the northern boundary to the southern Slapton parish boundary. Up to 1940 the bulk of it was artificially maintained as the immediate curtilage of the Royal Sands Hotel, whose ruins stand near its southern end. The smaller patch of turf is a mere 4 yards wide remnant of a once more extensive flat crest. Here erosion by waves is still narrowing what remains, and motor car wheels are aiding and abetting the process from above. At the extreme north end and centrally, a total of 1,025 yards of the more sparse vegetation is protected from vehicular access. Soil development here is very poor to non-existent, and maritime plant species dominate. There is generally a slight slope westward of  $1\frac{1}{2}^{\circ}$ . In the extreme south bare shingle, disturbed by every gale, occupies a narrow bank alongside the road.

The hotel site referred to above consists of a number of connected mounds of rubble, well colonized by vegetation including elder and bramble bushes, and reaching 8 feet above the crest. The site is anomalous on the crest but clearly an important habitat variation.

### *C. Backslope*

Morphologically this unit falls into three distinct segments dependent for their separation on the complexity of their surfaces in detail. The southern segment, some 1,390 yards long, is a simple smooth slope ( $4\frac{1}{2}^{\circ}$ ) from the road-edge to the Ley winter water mark, supporting tussocky grassland. The central section—with Slapton Bridge as its northern limit—is complicated by two sub-parallel ridges crossing it diagonally from a nodal point near the former hotel site (on the Crest) to the Ley shore. These ridges are lower than the main crest, and the westernmost is clothed in an elder/bramble thicket. The intervening, and longer, ridge has a steep, seaward slope ( $14^{\circ}$ ) and a gentler inland slope eventually lost under a gorse, bracken and bramble cover. Its crest supports odd gorse bushes and the ground flora suggests a leached condition proclaiming greater age than the main crest. North of a ruined lime kiln situated beyond the north end of the ridges, a large pool, continuous with the Lower Ley for three-quarters of the year, occupies almost the whole width of the unit against the causeway that carries a minor road from the Crest (B) to Slapton Bridge.

North of this causeway the Backslope consists of a hummocky single slope bearing a thicket of elder and blackthorn at its lower end for some distance northward. Each hummock bears symptoms of leaching, the intervening depressions minor indications of flushing. The irregularities disappear within 557 yards, and a simple slope, similar in angle and vegetation to that of the southern segment, carries the unit on through the Reserve boundary.

## II SLAPTON LEY

D. *Higher Ley*

A narrow basin 1,370 yards long and varying in width from 63 to 173 yards is almost wholly occupied by standing water supporting a continuous reed swamp. Open water occurs only as a narrow discontinuous channel, winding through the length of the basin, and as small pools concentrated in the southern half and particularly near Slapton Bridge. A number of islands occur in the basin, constructed primarily of *Phragmites* peat, and all bearing a willow/alder carr. Brambles, ferns and other terrestrial plants occur. The largest of these islands is 260 by 25 yards, all are aligned north-south, and are inland of a median line through the swamp. In the majority of cases the island margins are abrupt vertical surfaces, and no shelving shoreline exists. In the scarce open water pools, depths of 8 feet of water have been recorded, and a thickness of 32 feet of organic mud and peat has been demonstrated in one place, and no hard bottom found.

D.1 *Higher Ley—Outer Shore*. This unit is defined as that strip of the surface bounded by winter water mark (WWM), usually marked by a strandline of reed debris, and summer wading depth (18 inches). It is backed by a 15 foot high scrub of elder and blackthorn over much of its length. Shingle gives way to a lacustrine (mainly organic) mud within 3 feet of WWM, and *Phalaris*, *Iris* and other marginal emergent plants give way to *Phragmites* at about the same point. Where there is no high scrub a bramble thicket still provides shelter from the east for the shore itself.

D.2 *Higher Ley—Inner Shore*. Even in high summer there is only a very narrow dry shore below WWM in most places. WWM itself is right against the foot of a degraded cliff (H) except for a few yards just north of Slapton Bridge, where a broad apron of 7° slope occurs. Some open pools impinge on the shore, allowing greater use than D.1 for the examination of aquatic fauna and flora. The substrate everywhere is silt and organic mud. Access north of the Little Marsh (F.2) is difficult for the shore is backed by vertical rock cliff or steep, bramble covered slope throughout its length.

The shore characteristics remain the same at the foot of Slapton Wood (I.1), with shade and annual leaf fall depressing the numbers of animal species present.

E. *Lower Ley*

Standing water occupies some 180 acres of which some 42 acres supports reed swamp. A discontinuous reed fringe extending beyond summer wading depth is indicated in Fig. 4, which also shows the approximate form of the lake bottom (water/mud interface, not rock floor).

Typical water analyses for the Ley are given in Appendix II, which also indicates the annual temperature regime.

The water level is related to an artificial weir and culvert at the extreme southern end of the Lower Ley. The lip of the weir is 9.25 feet O.D. and the water level at Slapton Bridge is 10 feet O.D. under "normal" conditions. In periods of heavy rain the level may be temporarily raised by up to 2 feet due to the incapacity of the culvert to accommodate the outflow. The seaward outlet



of the culvert, south of Torcross Point, is blocked by shingle under the influence of continuous onshore wind/wave activity from the south-east quadrant, and on occasion the Ley may be raised 4 feet by this means. In dry summers the level falls below the weir lip, to a height of 7 feet O.D. with consequent horizontal symptoms on the Ley shores.

Flows of 0.34 feet per second have been measured in the Ley and flow southward occurs throughout the year, whether or not the culvert is open and taking water. Seepage seaward through the shingle ridge is probably continuous, but not proven, although at low water springs water is seen running down the seaward face. A particular line of maximum flow is detectable on the eastern side of the northern half of the Ley.

E.1 *Outer Shore*. Fig. 4 indicates the length of this unit which supports *Phragmites communis*, which often extends out beyond summer wading depth. Rarely does this state extend up to WWM. Continuous reed swamp is usually backed by bare shingle beach or a patchy zone of *Iris pseudocorus*. In one or two places *Phragmites* is replaced by *Typha angustifolia* and *Scirpus tabernaemontana*. The slope of this unit is fairly constant at  $4\frac{1}{2}^{\circ}$ , increasing to  $5^{\circ}$  on open situations, especially after long periods of south-westerly winds. The size of the marine shingle substrate also remains relatively constant throughout, though at one point slabs of local slate litter the shore, probably the remains of an artificial structure.

The rudimentary reed swamp conditions are notably absent at the most exposed point of this unit, opposite Ireland Bay, where the prevailing wind causes scour by wave action.

Minor pollution effects from domestic refuse and possible sewage leaks occur in that section of the shore west of the houses in Torcross. Near the weir an accumulation of silt and organic debris dominates the shingle substrate, and water fowl—attracted by tourists' bread into an almost sedentary routine—contribute to the pollution effect.

E.2 *Lower Ley—Southgrounds Shore*. Throughout, the surface substrate consists of angular slaty fragments, ranging from 6 inches to  $\frac{1}{2}$  inch in diameter, but commonly within a 1–2 inch range. Immediately below this "skin", fragment size falls to  $\frac{1}{2}$  inch and less. There are two important anomalous sites from this point of view: some 140 yards south-west of the reed limit, a considerable patch of silt supports an *Eleocharis palustris* community, and 190 yards beyond that site a partially destroyed pillbox provides a group of limestone blocks up to 1 foot in diameter, creating an unique micro-habitat on the Ley shore. In one or two places solid slate, dipping steeply to the south, is exposed platform-like in the shore. The shore has a fairly constant slope of  $4^{\circ}$  where slate fragments dominate, falling to  $2\frac{1}{2}^{\circ}$  in silty areas. Stock have access to this shore through the Fringes (G.2) and pollution and grazing occur in some summers. The unit can widen to 11 yards in dry summers, and an extensive *Littorella unifloris* sward is then exposed; it is accompanied by various annual and stoloniferous plants, if exposed long enough, *Corrigiola littoralis* being a notable member of the former group.

E.3 *Lower Ley—Ireland Bay Shore*. This unit is entirely fronted by reed swamp containing, in places, small stands of *Typha* and *Scirpus*. Everywhere there is a silt-mud substrate overlying a slaty gravel similar to that described under E.2.

The north-western stretch is the steep edge of an old artificial causeway across the mouth of the Start Stream valley, well shaded in part by willow, alder and poplar. The shore is replaced south-west of this causeway by an insensible transition from reed swamp to marsh (F.3) in the mouth of the France Valley, but reappears as a distinct unit at the south edge of the Ireland Bay reed swamp.

E.4 *Lower Ley—Inner Shore*. A slate gravel substrate—closely similar to that of E.1—is derived from the degraded head cliff (I.3 and I.4) behind the shore. The surface has a mean slope angle of  $4^\circ$  with no major departures from the mean. *Phragmites* only occurs in an isolated patch on Hartshorn point, and again between an unique low promontory 620 yards south of Hartshorn Point and the wall that marks the southern limit. Silt dominates the substrate in an area just north of the promontory and again *Eleocharis* occurs as in E.2.

E.5 *Lower Ley—Stokeley Bay Shore*. Essentially this is identical with the western section of E.3, a transition from reed swamp to marsh, with a silt/mud substrate. An artificial ditch carries the main flow of the Stokeley Stream around the northern edge of Stokeley Marsh (F.4), effectively forming the northern section of this unit.

E.6 *Lower Ley—Torcross West Shore*. A continuous reed swamp from the weir to Stokeley Bay dominates, in places extending 20 yards out beyond WWM. Silt and clay form extensive areas of the shore in the southern half. This is the most sheltered section of the whole Ley shore.

### III MARSHES

#### F. Higher Ley Marshes

F.1 *Slapton Wood Marsh and Carr*. A flat area of some  $4\frac{1}{2}$  acres is developed on a silt and gravel delta-like deposit of the Slapton Wood Stream. Drainage is very poor and irregular flooding is characteristic of most winters. Even at the upstream limit the permanent water table remains relatively high, and a completely grey horizon occurs from 16 inches downwards in the soil profile. Oscillation of the water table causes a mottling of the Bg horizon.

The last few yards of the stream meander across this flat, and well grown alders and willows dominate, while ash is apparently encroaching from the woodland margin.

F.2 *Little Marsh*. A minute area of wet ground grading imperceptibly into the Higher Ley reed swamp at its eastern end, this marsh supports some small willows and well developed *Carex paniculata* tussocks.

#### G. Lower Ley Marshes

G.1 *France Wood Marsh*. A narrow zone of *Iris pseudocorus* and *Carex acutiformis* occurs as a flat area on the north-western fringe of the Ireland Bay reed swamp. This extends well outside the Reserve boundary as a tongue occupying the whole of the floor of the France Valley. Fenced against stock by the owner, this area is available for study as an extension of the Reserve unit.

G.2 *Stokeley Marsh*. Sheltered to north and south by belts of well grown elms, this silt/mud flat supports a dense, tall community dominated by *Oenanthe crocata*, *Epilobium hirsutum* and *Phragmites*. It terminates abruptly against a metalled drive to Stokeley Barton Farm.

#### IV. *LEYSIDE FRINGES* (This title is that used in the Reserve Lease)

Everywhere this feature comprises a steep slope—the degraded, pre-shingle barrier, marine cliff—with, in places, a narrow strip of field above, and a small apron of recent debris at its foot, above WWM. Serial sections through it are included in Fig. 5.

#### H. *Middlegrounds Cliff*

The Little Marsh (F.2) separates two distinct segments of this unit. North of the Marsh for 200 yards a steep slope ranging from  $9^{\circ}$  to  $22^{\circ}$  is developed in slaty head. The slope supports a dense cover of bramble throughout its length. The remainder of this segment comprises three facets: a central near-vertical face of solid slate, in places 16 feet high; an upper convex facet developed in head supporting an elder and stunted oak thicket (containing the largest badger sett in the Reserve, on Broadstone Point); and a lower short slope of slaty debris plunging into the water. There is no change, other than in aspect, as this unit merges into the eastern extremity of Slapton Wood.

The Little Marsh occupies the lower end of a gully marking the junction—in the landscape—of the Devonian slates to the north with the breccias and sandstones of the Permo-triassic outlier mentioned above. The southern section of H is thus developed in head derived from these coarse-grained rocks, and in one place a vertical face of solid sandstone descends to WWM. A number of gullies, now dry, interrupt the cliff, and a spring breaks out in the mouth of one of these. A wider, lower “apron” occurs in places (see D.2), supporting grass sward where grazing occurs, blackthorn thicket elsewhere. After prolonged periods of heavy rain, incipient aprons develop as deltas of debris off the fields above this unit. Against Slapton Bridge, slate outcrops again as the base of the Permo-Trias rises gently towards the south.

#### I. *Lower Ley Cliffs*

I.1 *Southgrounds Cliff*. Developed largely in head, but with local exposures of solid slate near the base, this unit is everywhere an irregular, high angle slope, ranging from  $32^{\circ}$  to  $48^{\circ}$  and reaching 35 feet in height above the Ley. In places a small vertical face in head occurs near the top, with a convex “bulging” slope below. This suggests continued instability, though no fresh slump sites have been recorded recently. The unit swings round from an east-south-easterly to a southerly aspect through its length, and supports brambles and nettles, with elder and blackthorn scrub in places. Mature sycamores and oaks occur individually throughout, and are grouped in the south facing segment. In one place gorse and finer grasses dominate the surface.

I.2 *Hartshorn Cliff*. A 290 yard long stretch of concave slope ( $15^{\circ}$ – $35^{\circ}$ ) of constant height (20 feet) developed in slaty head faces north-north-east. In places it supports full grown oak and ash, and is everywhere covered with bramble, bracken and nettle. It is backed by a long concavo-convex slope to 325 feet O.D., normally under the plough.

(I.2 and I.3 are separated by a unique site in the Reserve. A flat “foreland” of slaty shingle lying in front of Hartshorn Plantation contains damp depressions



supporting *Iris*, *Juncus* spp. and odd willow bushes. The dry areas bear grassland and gorse thicket.)

I.3 *Inner Shore Cliff*. This is the lowest and steepest facet of a long profile from 325 feet to Ley level similar to that described for I.2. It is vertical in places and everywhere cut in head, which probably forms the whole of the concavity above it. Where vertical it is bare, but bracken dominates elsewhere, and mature trees occur throughout its length, forming a continuous canopy towards the south. The unit faces just south of east over its entire length, and in one place the main facet is fronted by a triangular "spit" of slate gravel supporting bracken and brambles. In winter, Ley waves sap the base of the vertical segments, and ground water seepage aids the process. A small stream crosses the unit in one of two wide shallow gullies which give the cliff an undulating appearance from across the Ley. Badger setts occur in two places.

## V. WOODLAND

### J. *Slapton Wood complex*

J.1 *Main Wood*. A mile long, steep, entire valley side comprises three distinct segments in plan. They are essentially parts of the sides of three separate valleys. The easternmost is an arcuate section of the right bank valley side of the River Gara, facing, at its centre, north-east. Some 600 yards long, its upper boundary is everywhere the water parting, and rises from 75 feet O.D. above H to 200 feet O.D. at the point where the woodland boundary departs from the watershed. The central segment faces due north for 500 yards and is rectangular in plan; it eventually swings on to a north-east facing line for a further 300 yards. It is the lowest section of the right bank valley side of a small tributary of the River Gara, known as the Slapton Wood Stream. Finally the unit returns to a north-north-east facing line as the side of a tiny tributary valley of the latter stream whose head is occupied by Eastergrounds Farm.

The upper boundary of the central and western segments, while nowhere the water parting, is always a major break of slope, which rises to 300 feet O.D. and remains within 25 feet of that height.

As might be expected, the steepest slopes in the whole unit are encountered at the points of change in aspect—on the rudimentary spur-ends of an immature valley system. These slopes reach 35°, and bare rock outcrops down the spine of the eastern "spur". All three segments have a concave lower facet, and the outer segments are topped by slight convexities. The central segment falls more abruptly away from the upper boundary, though in places a slight central bulge in the profile produces an overall convexity, where elsewhere a rectilinear facet dominates. Slopes in this centre facet in the eastern and central segments range from 22° to 30°. The western segment is everywhere more gently sloping than either of the others.

Bare rock, except on the spur described above, outcrops in one or two small spring heads (which have no regular pattern of distribution) and along the upper side of the main ride. This ride is cut into the slope and runs, nearly horizontally, from end to end of the wood. Branch rides run diagonally up and down the slope from a nodal point in the central segment. There is a small derelict quarry at the base of the rocky spur.

A thin skin of slaty head is parent material for an acid brown earth profile, throughout the unit. The very narrow A horizon implies a continuous history of woodland, or at least absence of any form of cultivation. Oak and sweet chestnut dominate the wood in the eastern and central segments; beech, scattered throughout, dominates in the western. A rich ground flora, forming a mosaic of well-marked communities, is shaded out under a shrub canopy of holly in one or two places.

J.2 *Valley Bottom Scrub*. A small, stony stream meanders swiftly across a tiny flat which is separated from the central segment of J.1 by a degraded artificial bank, and grades imperceptibly northward into a long abandoned enclosure. This old field occupies a concave element of the left bank valley side which is continued eastward above the carr of F.1. The steepest angles reach  $20^\circ$  and the upper boundary is another degraded bank. Sycamore and ash reaching 40–45 feet dominate a ground flora of bracken, bramble and nettle.

J.3 *Loworthy Brake*. This triangular plantation of pine and sweet chestnut, with a scatter of beech, occupies a concavo-convex profile above J.2. Typical slope angles on this profile from the top downwards are  $9^\circ$ ,  $14^\circ$ ,  $20^\circ$ ,  $10^\circ$ . The plantation is absent from late 18th-century maps, and the depth of the Ap(?) horizon (6 inches) suggests former cultivation. The ground flora is thinnest at the lower end of the wood, and everywhere less luxuriant than in J.1.

J.4 *Square Brake*. A large square enclosure of 4.7 acres occupies the whole valley side profile west of, and adjacent to, J.2 and J.3. Long abandoned, it is dominated by a 10–15 foot high scrub of blackthorn, elder, sycamore and spindle. Its upper boundary is a shelter belt of Scots pine. Almost rectilinear, the dominant slope element ranges from  $15^\circ$  to  $20^\circ$ ; the whole unit faces slightly west of south.

J.5 *Eastergrounds Scrub*. This unit faces the western segment of the main wood (J.1). It has no clear man-made lower boundary, but the stream serves as such, and north of the stream there are few mature trees. The unit is dominated by a young growth of elder, blackthorn and ash, grading into bramble and bracken where this unit passes into the main valley side.

J.6 *Gara Valley Triangle*. This small unit is isolated, as dry ground, from the rest of the Reserve. Morphologically it is a continuation of the eastern segment of J.1—being part of the same valley side. A steep slope ( $32^\circ$ ) plunges into water, a distributary of the Gara, and at the eastern basal angle of the triangle rock outcrops are covered by a rich bryophyte sward. Elsewhere sparse mature oaks form the canopy over bramble and bracken.

### K. *France Wood*

The entire unit faces north-north-west and nowhere occupies the whole of the valley side profile. The bulk of the wood is a rectilinear slope element, with an upper convexity in the western segment, and a lower concavity everywhere except for 150 yards immediately east of the odd rectangular “dislocation” of the artificial boundaries.

It is clear that this site was once a set of fields—some very degraded boundaries persist within the wood—and the soil profile, and absence of the wood on 18th-century maps, confirm this view.

Sweet chestnut, oak and ash dominate throughout, some beech and hornbeam occur, with elm conspicuous in the margins. A management plan is in operation for this wood, involving the replanting of  $\frac{1}{4}$  acre plots at intervals, calculated to replace the present trees over 100 years. The unit will thus contain areas of different stages of development, both natural and artificial, which it is hoped will enhance its research and demonstration value.

#### L. *Hartshorn Plantation*

A triangular wood, smaller than J.3, occupies a spur end below 100 feet O.D. and immediately above the junctions of I.2 and I.3. Convex in plan and profile, the unit faces generally north-east, with slope angles reaching  $15^\circ$  in the lower elements of the profile. Rock outcrops in places, and a small abandoned quarry dominates the base of the triangle. Scots pine and sycamore dominate, but the site's exposure to onshore winds, and 1943 American onshore shelling, has accelerated the degeneration of the wood.

### VI. *FIELDS*

#### M. *Little Marsh Field*

A small, near-horizontal field (a Devon "platt") surrounds and grades imperceptibly into the Little Marsh. Bounded by a high, typical, earth and stone bank, this is a very sheltered site. Recently an orchard, the field is still cultivated as part of Middlegrounds Farm.

#### N. *Stokeley Fields*

N.1 *Ireland Field*. An ungrazed, convex element, of 2.1 acres, supporting tussocky grasses, patches of bracken and bramble, and some regenerating elm, lies between France Wood and France Valley Marsh (G.1). The unit faces north, but it is well sheltered.

N.2 *Hartshorn Fields*. Now part of a large single enclosure, normally under cultivation, this unit forms the concave element above I.2, facing just east of north.

N.3 *America Road and Fields*. This narrow strip of land, cut off from a pattern of larger enclosures by the creation in 1943 of the Road—now a cart track—adjoins G.2 and I.3. It lies, in the main, some 20 feet above the Ley surface, but is depressed in two places by the rudimentary gullies mentioned in I.3 above. Entirely formed in slaty head, the vertical face of I.3 ensures fairly free drainage for this unit. Cultivated and grazed as part of Stokeley Barton Farm, it is divided into three enclosures, not separated by stockproof boundaries from the higher slopes. The western end, becoming an element of the Stokeley Valleyside profile, faces south but is fronted by a dense belt of mature elms. The America Road itself consists of an earth and stone track, with an overgrown ditch on the upslope side. The ditch supports willow and gorse scrub.

N.4 *Peasdish*. A single enclosure of 2.5 acres, sloping at  $7^\circ$  towards Stokeley Marsh (F.4) adjoins the A379 at its upper boundary and a metalled road to Stokeley Barton Farm at its western end. Its lower boundary is a low bank and shelter belt of over-mature elms and oaks. This strip of "woodland" is included in the present unit.

*Note.* Units M, N.2, N.3, N.4 and narrow strips of land in similar positions on Southgrounds and Middlegrounds Farms, can, under the terms of sale of the farms (1955), be absorbed wholly into the Reserve by fencing, provided that alternative water is provided if such fencing cuts off stock in adjacent fields from the Ley, to which, at present, neighbours have right of access for watering.

#### ACKNOWLEDGEMENTS

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#### REFERENCES

- BRUNSDEN, D. (1963). The Denudation Chronology of the River Dart. *Trans. Inst. Brit. Geogr.*, **32**, 49-63.
- BRUNSDEN, D., *et alia* (1964). Denudation Chronology of parts of South-Western England. *Field Studies*, **2** (1), 115-132.
- DINELEY, D. L. (1961). The Devonian System in South Devonshire. *Field Studies*, **1** (3), 121-140.
- GREENWOOD, C. J. (1826). *Map of the County of Devon* (Scale 1 in to 1 mile).
- KIDSON, C. (1962). The Denudation Chronology of the River Exe. *Trans. Inst. Brit. Geogr.*, **31**, 43-66.
- ORME, A. R. (1960). The Raised Beaches and Strandlines of South Devon. *Field Studies*, **1** (2), 109-130.
- ORME, A. R. (1962). Abandoned and composite sea cliffs in Britain and Ireland. *Irish Geography*, **4**, 279-291.
- ROBINSON, A. H. W. (1961). The Hydrography of Start Bay and its relationship to beach changes at Hallsands. *Geogr. J.*, **127**, 63-77.
- WATERS, R. S. (1965). The Geomorphological significance of Pleistocene Frost action in S.-W. England. In: *Essays in Geography for Austin Miller*, ed. J. B. Whitton and P. D. Wood, 39-57. University of Reading.
- WORTH, R. H. (1904). Hallsands and Start Bay, Part I. *Trans. Devon. Ass.*, **36**, 302-346. (Parts II and III were published in 1909 and 1923 respectively in the same journal.)
- USSHER, W. A. E. (1904). The Geology of the Country round Kingsbridge and Salcombe. *Mem. Geol. Surv. G.B.*, **355** and **356**.

*Maps:* Reference should be made to Ordnance Survey maps on at least the 1 : 25000 scale (sheet SX 84 covers the whole Reserve, SX 74, 75, 84 and 85 the whole of the Ley catchment), and if possible, on the 1 : 10560 scale (sheets SX 84 NW, and SW); also to O.S. 1 inch map (1st Edition) which was published in 1809, but surveyed in the late 18th century.

APPENDIX I

Climatological data for 1964 at Slapton Climatological Class III Station. (SX 824 449).

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean Max. Temp. °C.	7.8	8.6	8.4	11.7	15.3	17.9	20.6	19.9	18.7	14.0	11.9	8.6
Mean Min. Temp. °C.	3.7	3.6	3.1	5.6	9.5	10.9	12.4	11.9	11.9	7.8	7.2	2.4
Highest Max. . . .	11.7	13.3	13.3	15.0	20.6	22.2	25.0	25.0	23.9	18.9	15.6	13.3
Lowest Min. . . .	-0.6	-1.1	-0.6	1.7	6.1	7.2	7.8	6.1	6.1	1.7	0.6	-4.4
Total Precipitation . .	1.10	1.63	7.09	2.16	3.06	1.56	1.92	1.38	1.81	3.48	3.92	4.88
Most in a day . . . . .	0.31	0.63	1.53	0.44	0.55	0.43	0.95	0.70	0.44	0.97	1.11	0.90
Fog at 09.00 (days) . .	2	1	1	2	2		1	1				1
Air frost (days) . . . .	4	4	3									5
Ground frost (days) . .	6	10	6	1								14

(Precipitation in inches. 1964 was selected as the most "normal" of the five years in which records have been kept at Slapton.)

APPENDIX II

Chemical data for four stations in Slapton Ley (April, 1964).

	pH	Total Hardness		Nitrates	Ammonia	Phosphates	Silica
		ca	mg				
River Gara . . . . .	7.9	64	27	0.02	0.02	0.06	6
Higher Ley . . . . .	8.0	60	32	0.02	0.14	0.14	1
Lower Ley (N. end) . .	8.9	73	32	0.02	0.20	0.04	1
Lower Ley (S. end) . .	9.1	73	32	0.02	0.06	0.04	1

(All in units—parts per million, except pH.)

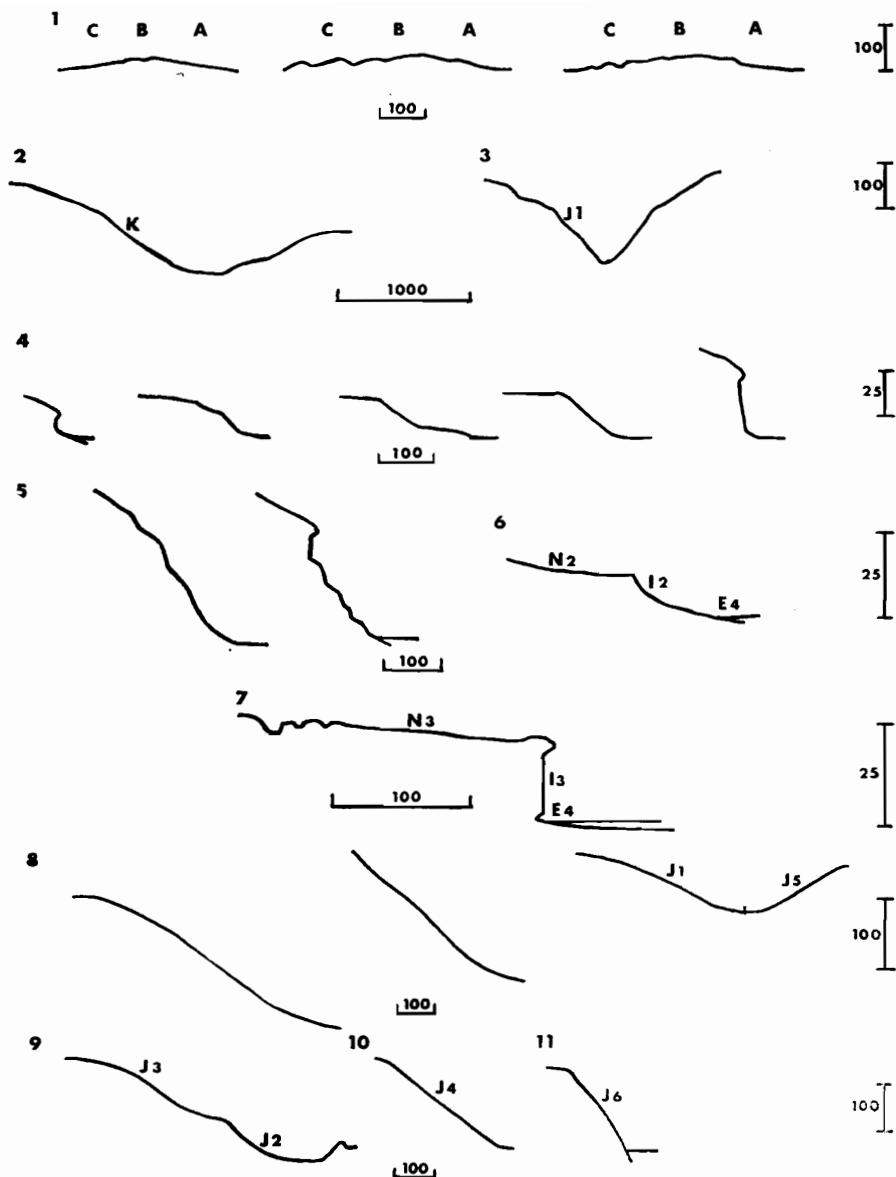


FIG. 5.

Sections across various Reserve units. 1. Serial sections across the shingle ridge respectively 1,200, 1,750 and 2,800 yards north of Torcross. 2. Cross profile of the France Valley. 3. Cross profile of the Slapton Wood Valley. 4. Serial sections through H, and D.1 from south to north. 5. Sections through I.1. 6. Section through lowest facets of profile on south side of Ireland Bay. 7. Section from America Road to Ley WWM. 8. Sections through the three segments of Slapton Wood. 9. Section through Loworthy Brake to the valley bottom. 10. Section through Square Brake. 11. Section through the Gara Valley Triangle. Scales in feet, horizontal scales down centre of page, vertical scales at right hand side.

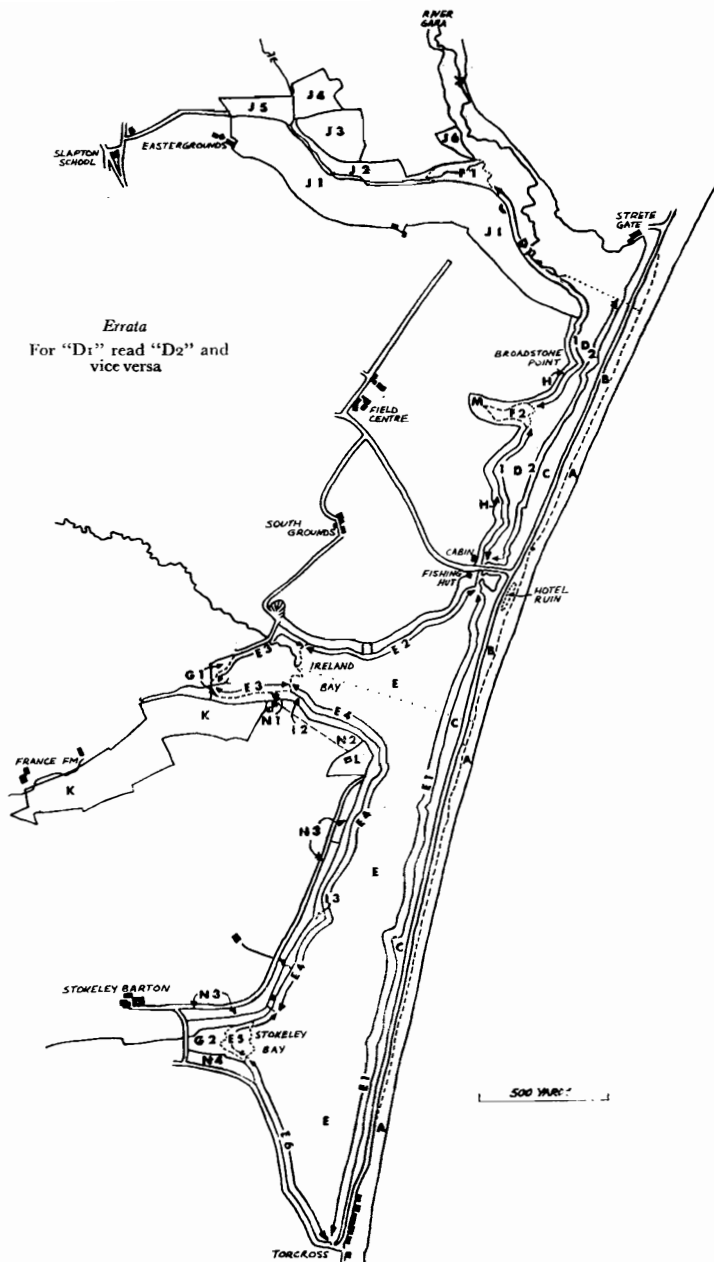


FIG. 6.

Location and delimitation of units of the Reserve. Vegetation boundaries and transitions shown by pecked lines. Shoreline units indicated by long arrows parallel with WWM, units E.1 and E.2 extend north to Slapton Bridge, E.1 including the pool immediately south-east of the bridge. The boundary between N.1 and I.2 is taken to be the small stream running north from Ireland Farm ruins. *Crown copyright reserved.*