

## INTRODUCTION

Two editions of the *Plymouth Marine Fauna* have already been published, in 1904 and in 1931 respectively. After much close consideration it was decided that this, the third edition, should be closely modelled on the previous editions.

An ideal fauna list would be present an up-to-date account of the distribution and comparative abundance of all species in an area. It is doubtful whether this will ever be possible because the recording of species in the different groups of animals is fortuitous and depends upon the presence of a systematist in the laboratory studying a group as a whole. A balanced picture can only be produced by someone who has been working closely on one group over a continuous period just before the date of publication of the list.

In view of this the suggestion that the older records should be omitted was rejected. It was decided that in general the retention of all previous records has value in reflecting some of the faunistic changes which have taken place over the years. Occurrences of unusual abundance or scarcity are also thus kept on record, and these may later be correlated with changes in the environment.

It should, however, be realized that in recent years the occurrence of many of the commoner animals has not been specially recorded. There was naturally a much greater need to fill in fauna record sheets in the earlier years of the history of the Plymouth laboratory, when the basic knowledge of the local fauna was being built up and the research was less specialized. The absence of recorded information for recent years must not therefore necessarily be regarded as due to absence or scarcity of the species in question. But, if a formerly common or moderately common species is now definitely known to have become rare, or to have disappeared completely, a note has been made to that effect; such instances, however, relatively few.

On the other hand, rare animals are more likely to be put on record by the finder, so that the absence of a recent record for a rare species does probably indicate that it has not been seen for many years.

The present list is a considerable advance on the 1931 edition, both in containing records of many species not previously recorded in the area and in bringing the nomenclature up to date.

It has certain innovations. A number of charts have been added so that description of the grounds can be more easily understood by the reader. These charts include most place names and localities referred to in the list. The place names are those used by workers in the laboratory and by members of the ships' crews. They have usually been taken from the Admiralty charts and sometimes differ in spelling, and even in position, from those on the Ordnance Survey maps.

The common names of fishes have been inserted for the first time. Some common names for fish are almost as valid as their scientific names, and they are

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certainly more stable! Their inclusion may, therefore, help those who are not fully familiar with more recent changes in nomenclature.

The Dinoflagellates have been omitted from this list as belonging more properly to the plant kingdom. It is to be hoped that one day it will be possible to produce a combined Marine Flora and Fauna of Plymouth. The time is not yet ripe, but in the meantime readers should consult the following publications:

*The Dinoflagellates of Northern Seas*, by Marie V. Lebour.

*The Planktonic Diatoms of Northern Seas*, by Marie V. Lebour.

"The Marine Algae", Vol. II, Part 1, of the *Flora of Devon*, revised by Mary Parke.

*Area covered*

In general the area covered by the list stretches along the coast from Start Point in Devon to Looe in Cornwall and southwards to the outer Channel grounds. In addition, records are included for Salcombe, Torbay and Exmouth, and very occasionally elsewhere, such as the north coast of Cornwall.

The Salcombe records are given in some detail as this locality has always been one of the chief collecting grounds for an intertidal fauna of unusual richness and interest, resulting from its almost completely landlocked situation. It is easily reached by road from Plymouth and was extensively studied by Allen & Todd (1900) at the close of the last century.

The occasional records at Torbay, Exmouth, and elsewhere are given to indicate where certain species, which are rare or absent in the immediate vicinity of Plymouth, can be obtained by a road journey from Plymouth of not more than about two hours by motor car.

*Classification*

The classification adopted is mainly one of convenience and does not necessarily conform with any other. In general those who have been responsible for the revision of their own special groups have arranged the classification up to the level of Orders, and occasionally above. It is hoped that it satisfies its purpose, which is the convenient arrangement of a list of species for easy reference.

As in the 1931 edition, "as regards the question of nomenclature, whilst the names used are in general those which it is thought will be finally adopted by zoologists, we have not attached undue importance to this aspect of the matter."

"In all cases the initials of the person or persons responsible for a record have been given, but it must not be supposed that the persons so indicated were the first ones to find the species in the locality indicated. During the course of preparing this paper for the press it has been frequently necessary, especially in the case of the common or widely distributed species, to frame a general note expressing facts which have for long been well known in the Laboratory, but in order to fix responsibility such notes have been followed by the initials of the person by whom they were framed."

*References*

As in the 1931 edition one reference to a good description is supplied for each species, preference being given to one accompanied by a figure or to one in a recognized monograph of the group. This should leave no room for doubt as to which species the name refers.

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These references, together with others mentioned in the text, are given in full in the list on pp. 411-44. This list is not intended to be a complete bibliography of all literature dealing with the Plymouth fauna.

Complete lists of publications recording research done at the Plymouth Laboratory, arranged by subject matter with author's index, are to be found in *J. mar. biol. Ass. U.K.*, Vol. 15, 1928, pp. 753-828 and Vol. 30, 1952, pp. 589-672.

*Contributors*

The following are the names of those who have been responsible for the revision of the records of the different species in their respective groups. These are arranged in the order in which the groups are Printed in the fauna list.

## PROTOZOA

Mastigophora	Dr. L. E. R. Picken
Sarcodina	
<i>Amoebina</i>	as 1931 list
<i>Foraminifera</i>	Mr. C. D. Ovey
<i>Acantharia, Radiolaria,</i>	
<i>Heliozoa</i>	Dr. L. E. R. Picken
Sporozoa	Dr. Helen P. Goodrich
Ciliophora	Dr. Maria Felinska

## MESOZOA

## PORIFERA

Dr. D. Atkins  
Dr. M. Burton, with additions by  
Mr. G. R. Forster

## COELENTERATA

Hydrozoa	
<i>Hydroida</i>	Dr. W. J. Rees
<i>Hydromedusae</i>	Dr. F. S. Russell, F.R.S.
<i>Siphonophora</i>	Captain A. K. Totton and Dr. F. S. Russell, F.R.S.
Scyphomedusae	Dr. F. S. Russell, F.R.S., and for Stauromedusae, Mr. P. G. Corbin
Anthozoa	
<i>Alcyonacea, Gorgonacea,</i>	
<i>Pennatulacea, Ceriantharia,</i>	Substantially as in 1931 list, checked by Prof. C. M. Yonge, F.R.S.
<i>Zoantharia</i>	Prof. T. A. Stephenson, F.R.S.
<i>Actiniaria</i>	Substantially as in previous list, checked by Prof. C. M. -Yonge, F. R. S.
<i>Madreporaria, Coralli-</i>	
<i>morpharia</i>	

## PLATYHELMINTHES

Turbellaria	Dr. C. F. A. Pantin, F.R.S. and Mr. S. Prudhoe (Polycladida)
Trematoda, Cestoda	Mr. S. Prudhoe and Dr. H. A. Bayliss

## NEMATHELMINTHES

Nematoda	
(Free-living)	Dr. W. Wieser
(Parasitic)	Mr. S. Prudhoe and Dr. H. A. Bayliss
Acanthocephala	Mr. S. Prudhoe and Dr. H. A. Bayliss

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ROTIFERA	Mr. E. D. Hollowday
NEMERTINI	Dr. C. F. A. Pantin, F.R.S,
ANNELIDA	Dr. D. P. Wilson and Mr. N. Tebble
ECHIUROIDEA, SIPUNCULOIDEA	Dr. A. C. Stephen
ARTHROPODA	
CRUSTACEA	
Branchiopoda, Ostracoda,	
Copepoda	Dr. J. P. Harding
Cirripedia	Dr. J. P. Harding with additions by
	Dr. A. J. Southward
Leptostraca, Stomatopoda,	
Cumacea	Dr. J. P. Harding
Tanaidacea, Isopoda,	
Amphipoda	Mr. G. M. Spooner
Schizopoda	Dr. Olive S. Tattersall
Eucarida	Dr. Isabella Gordon
ARACHNIDA	
Acarina, Pseudoscorpionidea	Mr. G. M. Spooner
Pycnogonida	Dr. Marie V. Lebour
MYRIAPODA, INSECTA	Mr. G. M. Spooner
MOLLUSCA	Originally revised by the late Mr. R
	Winckworth; more recently by Prof.
	A. Graham and Dr. Vera Fretter, the
	Nudibranchia by Dr. J. E. Forrest,
	and Cephalopoda by Dr. W. J. Rees
	Dr. F. S. Russell, F.R.S.
CHAETOGNATHA	Dr. Eve C. Southward
PHORONIDEA	Dr. Anna B. Hastings
KAMPTOZOA, POLYZOA	Dr. H. G. Vevers
ECHINODERMATA	
CHORDATA	
HEMICHORDATA	Dr. C. Burdon Jones
TUNICATA	Prof. N. J. Berrill, F.R.S., with addi-
	tions by Dr. D. B. Carlisle and, for
	Thaliacea and Copelata, Dr. F. S.
	Russell, F.R.S.
	Dr. G. A. Steven with the assistance
	of Dr. E. Trewavas and Mr. D. W.
	Tucker, the Ammodytidae by Mr.
	P. G. Corbin; additions by Mr. E.
	Ford and Mr. P. G. Corbin.
VERTEBRATA	

*Acknowledgements*

Grateful acknowledgements are due to all those zoologists listed above who have so willingly given of their time and knowledge to bring this fauna list up to date. Without their help so comprehensive a publication could never have been published.

Thanks are also due to many others who have given their advice and assistance. To Mr. G. M. Spooner and Dr. G. A. Steven for revising the descriptions of the grounds; to Mr. N. A. Holme, Mrs. A. White, and Mrs. Anne Rigler for the

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preparation of the charts; Mrs. Helen M. Dinn, Miss W. D. S. Roxburgh and Miss M. H. Budge for doing the complicated typing so well.

We also wish to record our appreciation of the care that Messrs. Latimer, Trend have given in the printing of this difficult subject matter and for their patience in dealing with many alterations and corrections.

Lastly I wish to record my great indebtedness to Dr. D. P. Wilson and Mr. G. M. Spooner.

On Dr. Wilson has fallen the main burden of editing this fauna list, the preparation for publication of which has been a long and arduous task. It was first begun in 1946. In a compilation of this nature, in which many authors have been involved, it is impossible to achieve complete uniformity of style and elimination of errors. That the final result is so uniform and that errors have been reduced to a minimum is mainly due to the devoted care and skill that Dr. Wilson has so willingly given in this critical and time-consuming labour. It could only have been done by someone with the deep knowledge of the marine fauna that Dr. Wilson has.

Mr. Spooner has given invaluable advice from his wide systematic knowledge and great faunistic experience. His revision of the amphipods is probably as comprehensive as that of any other group. It has, in fact, formed a major piece of research in recent years. He has rewritten and considerably amplified the ecological accounts of the different shores and of the collecting grounds in the Sound, together with the estuaries of the Tamar, Plym, Yealm and Salcombe. These descriptions will form a most interesting and useful guide for research workers.

All this work has taken up a great deal of the research time of Dr. Wilson and Mr. Spooner, to both of whom users of this list must always remain indebted.

Plymouth, April 1957

F. S. RUSSELL.

## DESCRIPTIONS OF THE MAIN COLLECTING GROUNDS

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### PRELIMINARY REMARKS

The extent of the geographical area and some outside localities covered by this list have been mentioned in the introduction (p. viii). In what follows most of the major collecting grounds are described in some detail, and reference to the accompanying charts will assist in locating their positions. The descriptions are based to some extent on those in the 1931 list, but have been modified and expanded to bring them up to date. Accounts of the estuaries of the Tamar and Plym and a new description of the Salcombe grounds have been added. On the whole the grounds remain much as they have been since the Laboratory was built, but there are some changes which should be noted, especially as there are retained within the body of the list a number of records referring to such changed or vanished localities. Thus the fine sand ground south of Batten Castle, where in the early years of the present century could be collected certain uncommon polychaetes, appears to have changed and these polychaetes have not been obtained there recently. The Promenade Pier (this is not the same as West Hoe Pier, a stone structure still in existence) was burnt out in 1941, leaving only the iron piling was removed a few years ago : during its existence this was a good place for mussels and other pile fauna. There are records to various rafts moored inside the Breakwater; these rafts have always had a limited life and there is none there at present. The disappearance of so much *Zostera* in the early nineteen thirties brought about considerable changes in the fauna of, among other places, Cawsand Bay from which it has gone completely, and of the estuary of the River Yealm and of the harbour at Salcombe where in both localities it has been much reduced in abundance and in stature.

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## PLYMOUTH SOUND

The name "Plymouth Sound" is strictly applicable to the whole inlet of the sea north of a line joining Penlee Point and the Mewstone. However, owing to the presence and effect of the Breakwater (built in the early 1800s), the term has tended in general usage to be restricted to that part of the area within the shelter of this imposing structure. Though maps may show "The Sound" written seaward of the Breakwater, the records in this and previous editions of the Fauna List seem usually to refer to "the Sound" in the restricted sense, or to carry that implication. It is also convenient in any account of the district to consider the part "inside the Breakwater" as a separate region, and to treat the "outer" part with adjacent areas of the open coast.

The Sound, in this sense, can be regarded as an enclosed and sheltered arm of the sea, into which two tidal rivers flow. On the west the [River Tamar](#) discharges via the Hamoaze, and on the east the River Plym via the [Cattewater](#). The drowned valley of the [Tamar](#), excavated, as is supposed, during the retreat of the sea during the last glacial period, can be traced along the front of the Hoe to its junction with the Plym, and thence seawards until lost by progressive choking with coastal deposits. The true rock bottom is apparently exposed only in the narrows between Cremyll and [Millbay](#) (where depths up to 22 fathoms are charted), from which it is clear that the scour resulting from the strong tidal currents is effective in checking deposition at this point.

The fauna and flora of the Sound, in their general nature, are marine rather than estuarine. Indeed, estuarine species (see p. xxi) have scarcely any footing in the Sound, even those species that find their optimum in the saltier parts of the estuaries, such as St. John's Lake. Though the quantity of fresh water absorbed by the Sound from the two estuaries and the city sewers is not negligible and may produce visible effects, the influence on the fauna is evidently not great.

On the other hand the Sound differs from the open coast, not only in respect to the force of wave-action, but also to the degree of circulation of the waters and the deposition of silt, features liable to be greatly modified by the presence of the Breakwater. The Breakwater, which now provides a physical seaward boundary to it, scarcely affects the natural exposure of Bovisand Bay and [Cawsand Bay](#) at the mouth of the Sound outside the Breakwater.

The fauna and flora of the Sound inside the Breakwater, including adjacent parts of the Hamoaze and [Cattewater](#), are comparable with those found near the mouths of the different estuaries along the south coasts of Cornwall and Devon, e.g. the Yealm Estuary below the Yealm Sand Bank (p. xxxii), and the Kingsbridge Estuary below the [Salstone](#) (p. xxxiii).

## SHORES OF THE SOUND

The shores of the Sound are mostly rocky, with gravel and stones between the rocks. Fine sand in small patches is exposed here and there at extreme ' low water, but there are no stretches of sandy shore. Some of the typical sites that offer the best opportunities for shore-collecting will be described individually.

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The Hoe Foreshore. The northern shore of the Sound, between Batten R.A.F. Station and Cremyll, contrasts sharply with that of other shores in consisting of a pure hard limestone (remains of a *palaeozoic* coral reef) of the Middle Devonian period. A narrow belt of this limestone, planed to a maximum of 110 ft. O.D., runs east-west from Billacombe through Oreston, Cattedown, the Hoe, and Devil's Point, to Cremyll, and is widely breached by both the main rivers and by the branch creeks of Hooe Lake, Sutton Pool, Millbay, and Stonehouse Lake. Where the shore survives in an original condition there is usually a low cliff of white limestone, stained brown in the tidal zone, very irregularly eaten into by the sea, but normally forming a steep slope to below low-water mark. Here and there are deep fissures and caves. Erosion seems to proceed throughout the tidal zone by the formation of surface pits and pockets, some of which grow into pot-holes and eventually are broken into from below. Rock pools are often formed in pockets in the rock, particularly in the upper part of the shore. In the small bays there are collections of beach material in the low-water region consisting chiefly of rounded limestone stones and gravel, with which (as at Tinside) artificially introduced materials may be mixed.

In spite of the urbanization of much of this foreshore, sufficient of the natural features survive to support much of the characteristic fauna and flora. The upper and middle levels bear a dense barnacle population, amongst which *Chthamalus stellatus* dominates. The empty barnacle shells and the abundant small pits and fissures harbour a population of gastropod molluscs including *Otina ovata*, *Leucophytia bidentata*, *Littorina neritoides*, and abundant young *L. saxatilis*. The two former are now less readily found than at one time. Associated fauna includes the collembolan Anurida maritime, the isopod *Campecopea hirsuta*, and the bivalve *Lasaea rubra*. In the middle shore *Balanus balanoides* occurs with a frequency that has varied through the years, this barnacle and the recent introduction *Elminius modestus* harbouring the parasitic isopod *Hemioniscus balani*.

The numerous rock-pools are coated with growths of coralline and tufted algae; those near high water are subject to fluctuating conditions and harbour specially tolerant species such as the copepod *Tigriopus fulvus* which often swarms. In some of these pools the small archiannelid *Dinophilus taeniatus* is numerous in the spring; some of them, again, are favourable for the hydroid *Coryne pusilla* and larvae of the midge *Cricotopus fucicola*.

In the low-water region the rocks and loose stones are everywhere bored by the bivalve *Hiatella striata* (*Saxicava*). Other limestone borers are common, including species mentioned below in the fauna of the Breakwater. Empty *Hiatella* burrows provide lodging space for worms such as *Lepidonotus clava*, crustaceans such as *Dynamene bidentata*, and various small molluscs. On the whole the fauna under loose stones and other cover is similar to that found on the shores of shale rock, such as Rum Bay.

In a small cave near the Men's Bathing-place, shaded from direct sun, and never exposed to the air for long, the walls are normally freely coated with sponges such as *Sycon ciliatum*, *Grantia compressa*, and *Leucoselenia variabilis*. *Tubularia indivisa* also settles here on occasions.

Rum Bay. This term is used as a general name for the shore between Batten Breakwater and Jennycliff Bay, including both the Batten Bay and Little Pool



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Bay of the Admiralty charts. Here the tidal zone is broad, exposing an expanse of rock lying mainly below mid-tide level. At the western end the rock is of limestone, which gives place abruptly, under the present R.A.F. station, to shale rock of the same geological period (Middle Devonian). This rock dips seawards, forming ridges parallel to the coast, and these are intersected by gullies. The laminated rock readily splits (except in some patches where quartz veins are numerous), and a multitude of crevices of varying size and depth are formed between the laminae. These provide shelter for a characteristic fauna some members of which fail to colonize the limestone rocks. Broken slabs of rock lying on the ground, numerous in places, provide shelter for a variety of both encrusting and free-moving animals. In depressions amongst the rocks the ground is very stony, but some stretches of muddy gravel and a little sand are exposed near low water. In the upper part of the shore are stretches of pebbly beach. The rocks are well covered with species of *Fucus*, *Ascophyllum nodosum*, and *Laminaria digitata* in their respective levels; there is less suitable substratum for *Pelvetia* and *Pygmaea (Lichina)*, but both occur on the upper rocks; while at extreme low water springs there is now a broad expanse of *Laminaria ochroleuca*. Among other brown weeds *Laminaria saccharina* and *Himantalia* are frequent, while red algae are well represented. The lower parts of the rocks are well colonized by the usual shore gastropods of the district (*Littorina neritoides*, *L. saxatilis*, *L. littorea*, *L. littoralis*, *Monodonta lineata*, *Gibbula umbilicalis*, *G. cineraria*, *Calliostoma zizyphinum*, *Nucella lapillus*, *Ocenebra erinacea*). The overhanging ledges of rock, especially where shaded, give shelter to colonies of encrusting sponges (*Hymeniacion perleve*, *Halichondria panacea* and *Grantia compressa*), compound ascidians (*Dendrodoa*, usually dominant, and *Botryllus*) and polyzoans (*Umbonula verrucosa*, *Crisia*). Amongst these growths occur browsing *Archidoris britannica*, *Aeolidia papillosa* and *Goniodoris nodosa*; the polychaetes *Eulalia viridis* and *Nereis pelagica*, etc.

A full list of the animals living intertidally, or that can at least occur at low water, on this stretch of shore would be long. Most are closely associated with particular micro-habitats or "niches". Thus on the fronds of furoid weeds the hydroid *Dynamena pumila*, the polyzoans *Flustrella hispida* and *Membranipora pilosa*, and the serpulid worm *Spirorbis borealis* occur in quantity; and, on the *Laminaria*, patches of *Membranipora membranacea*, and browsing individuals of the gastropod *Patina pellucida*. *Clava squamata* may be found on *Ascophyllum*.

The rock-crevice fauna includes some of the characteristic species mentioned below (under Wembury). In narrower crevices, at a level above mid-tide, the small nemertine worm *Prosorhochmus claparèdi* lives alongside the pulmonate *Leucopelma bidentata*, the collembolan *Anurida maritima*, and other representatives of land groups. Lower down the shore the polychaete *Terebella lapidaria* is a characteristic species, and amongst other worms are *Amphitrite gracilis*, *Polydora flava*, *Potamilla reniformis*, and *Golfingia (=Phascolosoma) minuta*. In the low-water region galleries of *Marphysa sanguinea* are fairly numerous, the worms attaining a large size and sometimes accompanied by the small commensal *Harmothoë marphysae*. In places at extreme low water *Pholas dactylus*, *Barnea parva*, and *Pholadidea loscombiana* bore into the shale rock. The old galleries provide shelter for the isopod *Cymodoce truncata*.

Patches of gravel and coarse sand contain at the higher levels *Audouinia tentaculata* in large

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numbers, and the intermediate and lower zones are characterized by large *Nephtys caeca*, *Sthenelais boa*, *Perinereis cultrifera*, and *Glycera convoluta*.

Some sand in Little Pool Bay provides settling ground for *Arenicola marina*, but a former productive patch of sandy ground under Batten Castle, referred to in the older records, virtually disappeared early in the century.

In the middle shore, above low water neaps, stones lying on a bottom containing black mud are a typical resort of the leptostracan *Nebalia bipes*. Stones and small boulders on cleaner ground, particularly in the lowest part of the tidal zone, yield a great variety of animals, of which only a few can be mentioned. The lower face of such stones is usually thickly coated with encrusting forms, including *Spirorbis pagenstecheri*, calcareous polyzoans, sponges such as *Leuconia* and *Adocia*, etc. The globular protozoan *Allogromia oviformis* also settles on the lower surface, as do several larger organisms, among which the starfish *Asterina gibbosa*, the scale worms *Lepidonotus squamatus* and *Lagisca extenuata*, the crab *Porcellana platycheles*, and the tectibranch *Berthella plumula* may be mentioned. Stones also provide permanent shelter for the amphipods *Marinogammarus obtusatus*, *Pherusa fucicola*, *Maera grossimana*, *Melita palmata* and *hergensis*, the isopod *Idotea neglecta*, the squat-lobster *Galathea squamifera*, and the brittle-star *Amphipholis squamata*. In silty gravel under stones are found the irregular burrows of *Arenicola ecaudata* and *branchialis*. Nematodes are represented by *Lineus longissimus*.

Larger boulders and the more open crevices provide cover for several crabs *Carcinus maenas*, *Portunus puber*, *Cancer pagurus*, *Xantho incisus*, *X. pilosus*, and *Pilumnus hertellus*; and for the familiar shore fishes *Gobius paganellus*, *Blennius pholis*, *Nerophis lumbriciformis*, *Lepadogaster gouani* and *Onos* spp. Gobies and blennies deposit their spawn in these situations.

Drake's Island and Mount Edgcumbe. From their position off the mouth of the Hamoaze Estuary, the shores of Drake's Island and Mount Edgcumbe are affected by strong tidal currents, whilst at the same time they are sheltered from the south-west, and hence not exposed to the most violent wave-action. The shores of Drake's Island are rocky, the rocks, which are mainly composed of hard grit (volcanic tuffs), being generally steep and high. Between the rocks are small patches of stony ground, and of sand and gravels of various textures. The shores of Mount Edgcumbe resemble the stony patches on Drake's Island, and may be treated with them. They are connected by a shallow reef known as the Bridge of which the Mount Edgcumbe end is exposed at low water springs.

The fauna on the rock faces resembles that at Rum Bay, and needs no further detailed description beyond the notice of the fact that (except at the Bridge at low water) the steeper character of the shore limits the area exposed at each tidal level. The overhanging ledges of rock are larger and more profusely covered than those at Rum Bay, but the same species are plentiful, *Botryllus* being dominant.

The rocks, being on the whole either not laminated or less friable, do not possess such a varied crevice fauna, but *Marphysa sanguinea* and *Polymnia nebulosa* are plentiful in crevices at dead low water, the last also under stones. Stony ground between the rocks at Drake's Island and along the Mount

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Edgumbe shore yields most of the species observed in similar conditions at Rum Bay; indeed at one time it was more favourable for some, such as *Cucumaria saxicola* and *normani*, and *Myriothele cocksii*. The amphipod *Amphithoë rubricala*, which makes tubular nests, is common under stones.

On the south side of Drake's Island a patch of clean shell gravel is exposed, which is probably continuous with the shell gravel of Queen's Ground (cf. p. xix). Its fauna includes the crab *Pirimela denticulata* and the annelid *Glycera gigantea*. On the north-east side is a patch of sand, the most characteristic bit of clean even-grained sand in the district. *Spisula solida*, *Natica alderi* and *Ammodytes* spp. have been taken in it.

A *Zostera* bed, sparser than formerly, occurs on the north side of the Island, but is now not exposed by the lowest tides. In this region *Ensis* spp. and a few *Echinocardium cordatum* can be obtained, whilst a patch of a few square yards of sand is crowded with *Lutraria lutraria*.

The Breakwater. Apart from a line of granite blocks in the southern facing, the surface masonry and the great mass of the foundations consists of limestone, originally quarried at Oreston; and it is mainly this imported limestone rock that is exposed at low water. As on the Hoe foreshore, this rock is extensively bored by various organisms, to such an extent that considerable damage is done to the structure. The chief organisms involved are the boring sponge *Clione celata* and the abundant bivalve *Hiatella striata*. The first reduces the surface of the rock, to the depth of several millimetres, to a friable mass; the second bores tubular galleries into the pure rocks to the depth of a few centimetres, so close together as to cause inevitable disintegration of the rock. In addition, rock-boring polychaetes are numerous, including the species *Dodecaceria concharum*, *Polydora ciliata*, *P. hoplura*, and *Potamilla reniformis*. *Dodecaceria* forms holes of oval or figure-of-eight section, which may penetrate for several inches into the heart of the stone; *Polydora ciliata* forms small U-shaped burrows, open at each end, whilst *P. hoplura* makes similar burrows of larger size. Another rock-borer is the mollusc *Gastrochaena dubia*.

The top level of the breakwater is above H.W. springs, but is drenched by the waves of heavy seas. Faunistically it is notable for its population of *Littorina neritoides* which here grow to an unusual size. The platform and the seaward slope provide a habitat that can only be colonized by a few organisms that are especially tolerant of strong wave action, and these tend to cluster in hollows or clefts in the masonry. *Patella vulgata*, *P. aspera*, and *Chthamalus stellatus* are the chief sessile animals; *Porphyra*, *Corallina*, and limited patches of stunted fucoids are the chief algae, the first giving cover to the amphipod *Hyale perieri*. Towards low water the seaward face on the south side, where masses of stones and big moulded concrete blocks have been deposited to break the waves, bears a rich growth of brown and red weeds. The thick *Enteromorpha* patches on the blocks provide an ideal habitat for the marine chironomid *Thalassomyia frauenfeldi*. The distribution of some of the commoner species on the breakwater, and the effect of wave action on them, is discussed by Southward & Orton (1954).

## THE DREDGING AND TRAWLING GROUNDS OF THE SOUND

Barn Pool (2-8 fm). In a bay under the north-eastern slope of Mount

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Edgcumbe is a rough trawling ground, notable for fish such as small wrasse and others frequenting rocky areas. *Spinachia spinachia* is also fairly regularly taken. At 3-4 fm. there are many stones densely covered by *Dendrodoa grossularia*, while at 5-8 fm. the bottom is soft mud with *Myxicola infundibulum*, *Cerianthus lloydi*, and scattered stones with *Nemertesia antennina*.

Millbay Channel (14-23 fm.). The deep channel from the bend southward of Devil's Point to the passage between Drake's Island and Millbay is a workable dredging ground. Formerly this was one of the most productive dredging grounds of the Sound, from the abundance of honey-combed limestone stones; but these have been depleted as a result, apparently, of harbour dredging operations some years ago. In the early 1950s the ground between E. Vanguard Buoy and N. Drake's Island Buoy, and off Firestone Bay, yielded rather numerous paired valves of *Venerupis pullastra* filled with mud inhabited by *Thalassema neptuni* and *Kellia suborbicularis*. Near the N.W. Drake's Island Buoy *Pandalus montagui* may occasionally be caught by trawling in the main channel.

Millbay Pit. Just off Eastern King Point the rocky slopes of Millbay Channel shelve steeply towards its deepest part. At one point on this slope there is some kind of pit or cleft (? pipe in the limestone), into which a dredge may be lowered and worked in a circular track. Good hauls of the crinoid *Antedon bifida* are regularly taken here, accompanied by a few *Ophiocomina nigra*. Occasional clumps of hydroids (*Nemertesia*, etc.) and sponges (*Suberites*) are also dredged. *Antedon* have been observed settled on the steep slope at about 45 ft; but below this the configuration of the ground-though the site has been continuously worked for many years-cannot yet be described. The population of *Antedon* has never yet failed. No doubt it is sustained by the nutritive silt derived from the adjacent sewer outflow.

North of Drake's Island (0-7 fm.). The ground between Drake's Island and the eastern part of Millbay Channel can be worked with the dredge. At 1-3 fm. is a sandy area continuous with that exposed at L.W.S. In the sand live numerous *Nephtys* and occasional *Pectinaria*, *Ensis siliqua*, *Lutraria lutraria*, *Lucinoma borealis*, and *Phaxas pellucidus*. The *Zostera* bed encountered west of the pier produces some of the species normally associated with this plant, and near it numerous Heteronereis stages of *Nereis irrorata* may be taken in late September. At a greater depth (3-7 fm.) the ground becomes rougher and more muddy. The dredge brings up a mixed assortment of stones and clinkers, many with growths of hydroids, polyzoans, and other encrusting organisms. Young *Maia*, *Ascidia mentula*, occasional clumps of *Tubularia indivisa*, and *Alcyonidium* are also taken. Fresh valves of *Venerupis*, including three species, are frequent, showing that the species concerned are all living on, or close to, the area. The range of forms that may be dredged appears similar to that originally recorded for Millbay Channel.

Asia Shoal (5-7 fm.). Continuing eastward from the previous ground, in the region of Asia Shoal Buoy and eastward of it, and on top of the slope to the main channel, is a fairly level stretch of rough ground that has always provided

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productive dredging. The rock here is of limestone, of which fragments may be broken off by the dredge, but the rock is evidently mainly covered by mud and loose stones and clinkers. The stones are mostly of limestone, much perforated by the usual borers, but fragments of the shale and grit rocks of Drake's Island occur. The clinkers, like the perforated stones, provide cavities that are freely used by polychaetes (e.g. *Polycirrus*, *Lagisca*, *Phyllodoce*), small crustaceans, etc. Stones are often well covered with sessile and encrusting organisms, and may bear growths of hydroids, such as *Kirchenpaueria pinnata* and *Nemertesia antennina*, and branching polyzoans such as *Bowerbankia*. Among the sedentary forms *Actinothoë sphyrodeta* and *Calyptraea chinensis* are often common. Colonies of *Phoronis hippocrepia*, apparently scarcer than formerly, are occasionally found.

[Winter Shoal](#) (2-8 fm.). The Asia Shoal ground ends in a bank of stones overlying black mud. An extensive bed of *Mytilus* (with many *Ophiothrix*) occurred here in the early 1950s, but has now (1957) died out leaving a deposit of shells. On these shells, and on stones, *Calyptraea chinensis* is abundant. Towards the southern side of the shoal the bottom is composed of a thin layer of gravel over the mud which is inhabited by *Cerianthus lloydi*. In this area many *Crangon vulgaris* and *Pandalina brevirostris* may be trawled during the winter.

[Channel below Plymouth Hoe](#) (10-19 fm.). Between West Hoe and Tinside the bottom of the channel consists of fine mud in which phyllodocids and other small worms are numerous.

[Tinside](#) (2-5 fm.). Off Tinside bathing-pool, and eastward of it, is a stretch of smooth muddy ground close inshore. Prawns and *Philine quadripartite* are common in the trawl. In the mud are many *Myxicola infundibulum* and *Cerianthus lloydi*, a few *Upogebia deltaura*, and often *Carcinus maenas* and *Portunus puber* in shallow burrows.

[Queen's Ground and New Ground](#) (5-6 fm.). These areas together extend from Queen's Ground Buoy to the New Grounds Buoy and the ground around the latter. It is the inner margin of the main channel which here leads obliquely across the Sound from the Western Entrance towards the mouth of the Cattewater. The ground is clean, presumably from the action of the main tidal currents, and is composed mainly of a coarse shell gravel, amongst which are many whole shells and rather small flat stones. The shells and stones afford attachment to small growths of red algae (the rare *Stenogramma* may be especially noted) and to many of the larger calyptoblastic hydroids and branching polyzoans. *Portunus depurator* is common amongst the gravel, which supports a sparse lamellibranch fauna including *Spisula*. The polychaete fauna differs considerably from that found on the edge of Asia Shoal and Millbay Channel.

[Western Entrance](#) (7-9 fm.). On the southern margin of Queen's Ground, at about 6 fm., the dredge is loaded with well-rounded stones of varied composition, suggestive of a beach deposit, but probably in fact caused by present current action since the ground is barren. Farther to the south, level with the Breakwater Lighthouse, stones are dredged densely covered with the calcareous tubes of

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*Pomatoceros*, and others bearing growths of red weeds and hydroids. Various small crustaceans shelter amongst such encrusting growths, including *Anthura gracilis* which occupies old *Pomatoceros* tubes. Big clusters of *Tubularia indivisa* have been taken here.

[Northern Side of Breakwater](#) (5-7 fm.). The bottom is here muddy. In winter it is a trawling ground for prawns and small *Callionymus*. When a bucket-dredger worked in this area large numbers of *Callianassa* and *Upogebia* were obtained from the "hopper".

[Duke Rock](#) (4-5 fm.). The ground inside the shallow Eastern Entrance to the Sound was formerly much as described under Queen's Ground. It has, however, been greatly affected by Admiralty dredging operations carried out earlier this century. In the 1950s, near the Duke Rock Buoy, a useful dredging ground exists, producing stones and clinkers with a fairly rich epiflora and fauna. Some interesting compound ascidians have been obtained here. The workable ground is limited by submarine reefs.

[White Patch](#) (2-4 fm.). Close in under Staddon Heights, off Rams Cliff Point, a fine muddy sand is sometimes profitably worked, either with a D-net or with a dredge covered with stramin. After the mud is washed out and the finer fraction of sand isolated, *Elphidium* (= *Polystomella*) may appear in numbers. Several small crustaceans live in the surface layer of this deposit, including species of *Ampelisca*, *Pontocrates arenarius*, *Diastylis laevis*, etc. *Nassarius reticulatus* occurs freely on the surface, while the lamellibranchs *Phaxas pellucidus*, *Syndosmya alba*, and *Thyasira flexuosa* burrow into the substratum. Slightly farther offshore the sand is replaced by black mud inhabited by *Myxicola*.

[Jennycliff Bay](#) (4-6 fm.). A little away from the shore, and clear of rock outcrops, a fairly extensive stretch of ground is regularly worked with the trawl. The bottom here is a sandy mud with a varying amount of seaweed litter and an occasional living *Laminaria*. The trawl brings up a collection of shrimps, prawns, crabs, and small flat-fish. *Philine quadripartite* is regular, sometimes abundant. *Sepiolo atlantica* is also characteristic, as are small wrasse, gobies, dragonets, and pipe-fish. *Nassarius reticulatus* and *Gammarus locusta* are common.

[Mallard Shoal](#) (3-4 fm.). Closer in towards Batten Breakwater, and east of the main channel, is a mixed ground, chiefly of black mud, with abundant *Melinna palmata* and *Philine quadripartite*, and with occasional *Cerianthus lloydi* and *Myxicola infundibulum*. Antedon have been dredged from rocky parts of the shoal.

[The Cattewater](#). A trawling ground off the Batten R.A.F. Station, partly over a smooth rocky bottom, is useful for prawns during the summer. Small wrasse and *Spinachia* also occur. A ground more frequently trawled is the main channel between Oreston and Laira Bridge, from which a regular supply of *Carcinus maenas* is procured, as well as *Crangon vulgaris* and *Gobius minutus*. Shoals of mysids occur here, as farther up the estuary, and may be taken with a hand-net.

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TAMAR ESTUARY

As observed in passage up the Hamoaze - neglecting the built-up areas of Stonehouse and Devonport - the character of the shore becomes increasingly dominated by the large bulk of estuarine deposits, which soon cover all the side of the original rock valley except here and there in the H.W. region. These deposits are also responsible for rapid shallowing of the main channel in the middle region of the estuary, for example, just above Saltash Bridge.

Extensive mud flats, which altogether occupy many hundred acres, provide a main feature in this estuary system. These occupy the middle part of the tidal zone of St. John's Lake, the mean level of the flats gradually rising upriver, being mainly above mid-tide at Weir Quay and Bere Ferrers. The mud has a characteristic burrowing (or surface-living) fauna that includes the worms *Nereis diversicolor*, *Nephtys hombergi* and *Ampharete grubei*; the molluscs *Cardium edule*, *Scrobicularia plana*, and *Hydrobia ulvae*; and the crustaceans *Cyathura carinata* and *Corophium volutator*. On the broad flats of St. John's Lake, where the freshwater influence is not great, beds of *Zostera hornemanniana* give cover for additional species, as do also deposits of old mollusc shells.

Under cover of tufts of algae, leaf deposits, or other litter, near low water and in the main channel the fauna includes certain crustacean genera which show replacement of species passing into less saline or more protected water. *Sphaeroma monodi*, *S. rugicauda* and *S. hookeri* form one series; that of *Gammarus locusta*, *G. zaddachi salinus*, *G. z. zaddachi*, and *G. pulex* is even more striking.

The variety of species is perhaps at its minimum in the region of Calstock, where typical low-salinity species begin to appear, such as the hydroid *Cordylophora lacustris*, the amphipod *Gammarus chevreuxi* and the oligochaete *Tubifex tubifex*.

The more rocky channel just below Saltash is a breeding place of the common jellyfish *Aurelia aurita*. Mussels flourished for many years on stony ground off Neal Point; and there is an extensive oyster bed in the River Lynher.

A variety of essentially marine fish enter the estuary and support a small tuck-net fishery, described by Hartley (1940). Flounders, bass, grey mullet, and small herring are typical fish in catches; and formerly smelts (*Atherina presbyter*) were frequent. From March till August salmon are caught in seine nets.

The mud-flats support a large population of waders and other shore birds, which reach their maximum in numbers and variety between November and February. The flats in the middle and upper reaches also provide the chief source of food for many breeding pairs of shelduck (*Tadorna tadorna*).

In the middle reaches of the estuary the mud-filled side branches and bays, between M.H.W. and H.W. Springs, support a typical saltings vegetation in which *Halimione portulacoides* predominates. The outer margin of the saltings is at present being eroded in most places and is then separated from the bare mud flat by a salting cliff. Reed beds often take the place of saltings, as the mean salinity drops in the upper reaches, particularly along the Tamar itself.

The estuarine grass *Spartina townsendii* has recently spread extensively in the upper part of the tidal zone in the middle estuary, growing on bare mud in a few places, but chiefly colonizing established saltings between Calstock and Mor-

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Wellham the very local sedge *Schoenoplectus triquetrus* grows on the bare mud below H.W. Neaps.

PLYM ESTUARY

Above Laira Bridge the valley widens and the river channel shallows abruptly. Two wide bays, one on each side, were reclaimed by the erection of embankments early in the nineteenth century. The reclaimed land on the east side, known as Chelson Meadow, is drained by a series of ditches which harbour a characteristic brackish water fauna, grading inland into that of fresh water. The existing stretch of Laira Estuary includes some extensive stretches of soft mud containing a large ingredient of china clay washings carried down by the Torry and Plym. The fauna of the mud, in so far as it is known, resembles that of the Tamar mud-flats. At the head of the estuary, in the region of Marsh Mills, the dwindling tidal zone is heavily banked with white clay, in spite of which dense populations of crustaceans (especially *Gammarus* species) and the mollusc *Potamopyrgus jenkinsi*, support themselves.

## GROUNDS OUTSIDE PLYMOUTH BREAKWATER

## SHORES

Wembury Bay. The rocky shores of this bay form one of the best collecting grounds on the open coast in south-west England, more particularly the two projecting rocky reefs known as Church Reef (near Wembury Church and Mill) and West Reef (at Wembury Point opposite the Mewstone).

The reefs, composed of Lower Devonian slate, appear to represent a dissected and much eroded marine platform, formed at a period of higher sea level not later than the last interglacial period. The cliff at which this platform originally ended is indicated by the inland contours between Wembury Beach and Point. Much "head" has accumulated at the foot of, and outward from, the ancient cliff, covering the rock platform; and this deposit is at present being slowly eroded away, forming a low vertical cliff just above H.W.S. At the foot of this modern cliff a varying amount of beach material has accumulated, varying from flat stones to fine sand. Towards West Reef this beach forms a conspicuous band above mid-tide, and at intervals extends through gaps in the rock to below L.W. mark. Church Reef rises more continuously to the present H.W. region and ends abruptly about the point where the sea today has caught up with the ancient cliff. Eastward of this the steep rocky cliffs are a modern feature.

The reefs are broken into an uneven series of ridges running at right angles to the south-easterly dip of the strata. The gullies between the ridges therefore run more or less parallel to the coast, especially in West Reef, and these offer the maximum protection from wave action. The protection afforded by the seaward ridge to such a gully is enhanced by the fact that, owing to the seaward dip of the strata, the lee side of the ridge is vertical or overhanging. Furthermore, on both reefs relatively high ridges occur on the outer seaward face giving extra protection to the ridges inside them.

The laminated rocks provide ideal habitats for a diverse crevice fauna. In time they fall to pieces, breaking into flat slabs which have accumulated in some



## DESCRIPTIONS OF THE MAIN COLLECTING GROUNDS

of the gullies and provide valuable cover for many forms which might not otherwise persist intertidally.

Thus, although the bay as a whole is exposed to the full force of the Channel waves, with adverse effects on the fauna of the sand and gravel patches that occur at intervals between the two reefs, the reefs are able to harbour a great variety of intertidal and shallow-water organisms. West Reef has the advantage over Church Reef in occupying a larger area, in receiving additional protection from the Mewstone, in having perhaps the better exposures of friable rock and the greater accumulations of flat boulders, and in being altogether free from the clogging effects of periodic sand deposition (contrast, e.g. the reef at Portwrinkle in Cornwall). Many of these advantages are lost towards the western part of this reef, exposed to the south-west, where the fauna is more ordinary.

Both reefs have a rich algal flora, at least from mid-tide downwards. The dominant furoid species are luxuriant and a variety of other brown and red weeds colonize the pools and sheltered ledges. Above mid-tide, on Church Reef particularly, the lichen *Pygmaea* (= *Lichina*) *pumila* makes extensive dark patches on the otherwise bare seaward-dipping surfaces. A forest of *Laminaria hyperborea* (*cloustoni*) is evident at extreme L.W.S. especially on the Yealm side of Church Reef, and along the whole Wembury Bay shore of West Reef.

One element of the intertidal fauna, nearly all small-sized forms, uses the cover provided by these weeds. It has been studied, on Church Reef, by Colman (1940). For a given weight of weed the densest populations were found in *Pygmaea*, largely made up of *Campecopea hirsuta* and *Lasaea rubra*, but even the bases of *Ascophyllum nodosum* hold a surprising number. The variety increases down the shore and is greatest in *Laminaria* holdfasts. The fauna of tufted weeds in rock pools is rich, but awaits quantitative study. It includes the very local and peculiar amphipod *Pereionotus testudo*.

Animals sessile on weeds include four species of *lucernarnians*, which occur in certain favourable sites on *Chondrus*, *Halidrys*, etc. (see p. 59).

The extensive fauna to be found on the underside of stones or sheltering beneath them, include the gymnoblast *Myriothela cocksi*, the echinoid *Psammechinus miliaris*, and the holothurian *Cucumaria saxicola*. The crustaceans *Nebalia bipes* and *Apseudes* species occur in suitable sites at West Reef.

The more open fissures in the rocks provide cover for young lobsters, for several species of crabs and for littoral fish (rocklings, blennies, etc.). The larger crevices that occur between the lamina still *in situ*, workable with a crowbar, are tenanted by the gephyrean *Thalassema neptuni*, and the polychaetes *Terebella lapidaria*, *Polycirrus caliendrum*, *Amphitrite gracilis*, *Eunice harassi*, *Lysidice ninetia*, and *Marphysa sanguinea*; while the smaller crevices between the individual laminations possess a fauna of small but interesting species that persists, with varying composition, to the highest tidal levels. This last fauna has been studied, mainly on Church Reef, by Morton (1954). It is remarkable for the admixture, with marine forms, of species of air-breathing land groups. Thus, with the bivalve *Lasaea rubra*, the gastropod *Cingula cingillus*, the isopod *Gnathia oxyurea*, the nemertean *Prosorhochmus claparédi*, small marine polychaetes, etc., are found the pulmonates *Otina otis* and *Leucophytia bidentata*, the myriapod *Scolioplanes maritimus*, the hemipteran *Aëpophilus bonnairei*, the beetles *Micralymma marinum* and *Aëpopsis robinii*, the collembolan *Anurida maritima*, larvae

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of the flies *Clunio marinus* and *Limonia unicolor*, the pseudoscorpion *Neobisium maritimum*, and several mites (Acarina).

At Wembury are two examples of freshwater streams flowing over the tidal zone. One issues below the old boat-house at Wembury Point and the other stream flows in the valley below the church. Stones lying in these streams intertidally provide cover for a few invertebrate species tolerant of irregular salinities. The church stream has long been known as a site for the archiannelid *Protodrilus flavocapitatus*. An oligochaete, *Enchytraeus pellucidus*, also occurs, less erratically. In both streams the planarian *Procerodes* (= *Gunda*) *ulvae*, and the amphipod *Marinogammarus pirloti* are abundant, while *M. storerensis* and the isopod *Jaera albifrons* are common at times. The two *Marinogammarus* species, *Procerodes*, and *Protodrilus* are all restricted to this type of habitat.

Strong winds from the south-east dislodge quantities of laminarian and furoid weed which accumulate along the high-water line. The biggest weed deposits are found near Wembury Point, whence loads are removed for manure. The weedy high-water drift provides a favourable breeding place for the kelp flies (Coelopidae) and their dipterous predators (chersodromine Empididae and *Ceratinostoma ostiorum*). Certain staphyline beetles and at least one oligochaete are also characteristic, but the fauna of this drift has not yet been fully studied.

Flocks of turnstones (*Arenaria interpres*) and oyster-catchers (*Haematopus ostralegus*) regularly frequent the reefs as predators, some non-breeders remaining throughout the nesting season. They may be joined by parties of curlew and other waders, especially during autumn passage. Herons and solitary kingfishers fish in the pools and gullies during winter. Indeed the intertidal food supply on West Reef and that in the adjacent deposits of rotting weed have attracted a greater variety of bird life to Wembury Point than to any other part of the coast between the Start and Dodman.

Reny Rocks. A reef of exposed, weed-covered low rocks, running from the Shagstone to the mainland, has a fauna similar to that of the Wembury reefs, but more restricted.

Slimers Rocks. These lie offshore from West Reef, east of the Mewstone. They have been investigated by the use of aqualung apparatus.

## DREDGING AND TRAWLING GROUNDS

Cawsand Bay. (3-5 fm.). A characteristic inshore shallow bay with a bottom of mud, muddy sand and fairly clean sand towards low-water mark. Rocks border the northern and southern margins of the bay. Being sheltered from the south-west, it is protected from the most violent and frequent gales, which in this district come from that direction, and is only visited by heavy seas during gales from the east. In the shallowest parts of the bay an extensive bed of *Zostera* was once present but has now disappeared with a consequent reduction in the fauna.

Some smaller crustacea (*Praunus neglectus*, Cumacea, etc.) are abundant, and *Maia squinado*, small specimens of the common edible crab (*Cancer pagurus*), shrimps (*Crangon vulgaris*), prawns (*Palaemon serratus*) and *Hippolyte varians*

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are generally obtained. *Sepiolo atlantica* is usually present in fair numbers in the winter months, and in the summer small specimens of *Sepia offlcinalis* are often numerous. Foraminifera, especially *Elphidium crispum* are generally abundant. *Nassarius reticulatus* occurs in quantity, often covered with the hydroid *Leuckartiara octona*. *Turritella communis* and *Melinna palmata* are plentiful, and *Aporrhais pes-pellicani* is always present in small numbers. *Spisula elliptica*, *Ensis ensis*, *Lutraria lutraria*, *Labidoplax digitata*, *Glycera sp.* are not uncommon buried in the muddy sand. Small flat-fishes (soles, plaice, dabs, etc.) and blonde rays (*Raia brachyura*) are generally plentiful and pipe-fishes are obtained. Small and medium-sized *Zeus faber* usually put in an appearance in small numbers in the late summer and autumn months.

**Whitsand Bay** (4-8 fm.). Another example of a shallow sandy bay, but being open to the south and west, it is subject to much more wave disturbance than Cawsand Bay. There is here also a great variety of the smaller crustacea, and *Sepiolo atlantica* at one time abundant is still generally present. The lamellibranch molluscs, *Donax vittatus*, *Mactra corallina* *Tellina fabula*, *Ensis siliqua*, *Lutraria lutraria* and *Callista chione* are not infrequent in the clean, fine sand found in many parts of this bay. *Corystes cassivelaunus* and *Astropecten irregularis*, characteristic sand-dwelling species, are also often taken, though much less frequently than in deeper water. The early bottom stages of various species of flat fish and young rays are generally to be found in shallow water in various parts of this bay and *Trachinus vipera* is always present buried in the sand.

Mewstone Dredging Ground (1 5-18 fm.). An expanse of soft red rock runs seawards in a southerly and south-easterly direction from the Mewstone. This is a most interesting collecting ground, the dredge often breaking away and bringing to the surface pieces of rock of considerable size. The rock at these depths is free from any seaweed growth, but is well covered with sponges, hydroids, polyzoa and the barnacle *Verruca stroemia*. The alcyonacean *Sarcodyction catenata* (red form) is not infrequently found both on the rock itself and on dead shell valves which often accompany it in the dredge. The following species are common and typical of the fauna associated with this red rock: *Cliona celata*, *Polymastia mamillaris*, *P. boletiforme*, and *Raspailia* spp.; *Eunicella verrucosa* with *Amphianthus dohrni* and *Duvaucelia plebia* living upon it; *Alcyonium digitatum* with *Simnia atula*; *Caryophyllia smithi* with its associated barnacle *Pyrgoma anglicum*; *Nemertesia antennina* and *N. ramosa* with *Scalpellum scalpellum*; small colonies of *Sertularella gayi* and *S. polyzonias*; *Kirchenpaueria pinnata* and *Plumularia catharina*; *Lafoea dumosa* with occasional specimens of *Nematomenia banyulensis* attached; *Cucumaria lactea* on the rock itself and on the attached hydroids; *Echinus esculentus* and occasional specimens of *Ophiothrix fragilis*, *Henricia sanguinolenta* and of the large holothurian, *Holothuria forskali*; *Ophiopsila aranea concealed* in holes and crevices of the rock; *Phallusia mammillata*, *Ascidiella scabra*, and *Ciona intestinalis* (small specimens); the polyzoan *Crisidia cornuta* and *Bugula flabellata* in abundance, *Alcyonidium gelatinosum*, *Bicellariella ciliata*, small colonies of *Cellaria fistulosa* and *C. sinuosa*, and occasional large masses of *Lepralia foliacea*, amongst which a number of small crustaceans, especially *Porcellana longicornis* and a few *Galathea strigosa* are to be

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found. The large *Phyllodoce paretii* is also found here. The red rock itself is bored by *Pholadidea loscombiana*. Besides the red conglomerate in the locality, there is also a much harder rock. *Holothuria forskali* and *Phallusia mammillata* are notably more abundant on this harder rock and *Echinus esculentus* is scarcer. It is generally found that where *Holothuria* is abundant the accompanying fauna is relatively sparse.

Mewstone Shell Gravel. On either side of the Mewstone ledge, and in patches amongst the rocks of the ledge, the soil consists of coarse shell gravel. In working a dredge over the ledge a mixed fauna comprising animals from the rocks and from the gravel is often obtained. The gravel itself may also be worked by dredge or Agassiz-type trawl from a small vessel. Species characteristic of this shell gravel are *Venus fasciata* (abundant), *Venerupis rhomboides*, *Laevicardium crassum*, *Glycymeris glycymeris*, *Lumbriconereis impatiens*, *Glycera* spp., *Thecocarpus myriophyllum*, *Ebalia tuberosa*, *Eurynome aspera*, and *Echinocyamus pusillus*.

Mewstone Amphioxus Ground (10-15 fm.). About 1½ miles to the south-eastward of the Mewstone (off Yealm Head) is a patch of shell gravel of finer and more uniform texture than that last described, which is one of the few localities in the Plymouth district where *Amphioxus lanceolatus* has been found. The fauna of this shell gravel is limited, but very characteristic. In addition to *Amphioxus*, the following are typical species: *Conilera cylindracea*, *Ampelisca spinipes*, *Anapagurus laevis* and *Eupagurus cuanensis*, inhabiting chiefly the shells of *Turritella communis* and *Aporrhais pes-pelecani*, associated with which *Epizoanthus incrustatus* is quite frequent and the hydroid *Merona cornucopias* is often found, especially on the *Aporrhais* shells; *Phascolion strombi*, not uncommon living in mud-filled *Turritella* and *Dentalium* shells; *Ebalia tumefacta* and *E. tuberosa*, *Glycera lapidum* and *Onuphis conchylega*. There is also a typical lamellibranch fauna similar to that of the Mewstone Echinoderm Ground, but including considerable numbers of *Arcopagia crassa*.

Mewstone Echinoderm or Corner Ground (23-25 fm.). From 2-4 miles south to south-west of the Mewstone. At one time this was one of the most profitable grounds in the neighbourhood on which to shoot a trawl when it was desired to obtain a good and varied collection of invertebrates. Between the wars it was almost entirely ruined by refuse tipped upon it from "dirt barges" from Plymouth and Devonport. Although the amount of tipping has now been somewhat reduced, the ground has not recovered and trawling upon it takes place much less frequently than formerly.

The original bottom soil consisted of coarse muddy gravel. The trawl, after a successful haul, may still contain a few *Echinus esculentus*; an occasional *Solaster papposus* and *Buccinum undatum*; *Portunus depurator*, *Eupagurus bernhardus* in *Buccinum* shells, some carrying *Calliactis parasitica*, others *Hydractinia echinata*; *Eupagurus prideauxi* with *Adamsia palliata*, *Chlamys opercularis*, *Chlamys tigrina* not uncommon, and an occasional specimen of *Pecten maximus*; *Galathea disperse*, *Inachus dorsettensis*, *Macropodia longirostris*, *Asciadiella scabra*, a few *Marthasterias glacialis* and *Asterias rubens* and varying quantities of

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*Sertularella gayi*, *Cellaria sinuosa* and *C. fistulosa*, according to the position of the haul.

Inside the Echinoderm Ground, between it and the Amphioxus Ground, there is a stretch of coarse, muddy gravel which is covered almost exclusively with the brittle-star *Ophiothrix fragilis*. A dredge hauled on this ground often comes up full of these echinoderms, considerable numbers of large *Ophiocomina nigra* being mixed with them. On this ground and to the westward of it, *Pandalina brevirostris* is present in large numbers. A varied collection of fishes is generally obtained particularly thornback rays, with a few *R. montagui* and *R. brachyura*, *Scyliorhinus canicula*, *Gadus minutus*, *Lophius piscatorius*; seasonally *Gadus merlangus* may be plentiful. *Gadus luscus* is sometimes present in large numbers and, often is absent altogether. *Arnoglossus laterna* and *Callionymus lyra* are always present in considerable numbers.

Fine Sand south of Mewstone (27-30 fm.). From 5-7 miles south of the Mewstone is a frequently worked trawling ground with a bottom of fine, clean sand. The fauna here closely resembles that found on the Inner Eddystone Trawling Ground (see Allen, 1899, p. 389). Characteristic and typical species are: *Astropecten irregularis*, *Chaetopterus variopedatus*, *Aphrodite aculeata*, *Corystes cassivelaunus*, *Ophiura texturata*, *Alcyonium digitatum* attached to shells, *Chlamys opercularis*, *Cyprina islandica*, *Sertularella gayi* and *S. polyzonias*, *Thecocarpus myriophyllum*, *Cellaria sinuosa* and *C. fistulosa*, *Ascidiella scabra*, and *Macropodia longirostris*. The fish fauna is similar to that of the Corner Ground, but generally less plentiful.

Stoke Point Grounds. Western boundary, Blackstone Point; eastern boundary, Revelstoke Church Cove; seaward extension, about 1½-3 miles. The ground shelves very regularly outside the 10 fm. line; inside this line it is very uneven; maximum depth, 22 fm.

In their general features these grounds present much similarity to the Mewstone grounds, but they offer rather greater diversity of type within a given area; and perhaps partly as a result of this and also of the fact that they are exposed to the full sweep of the Channel tide, the fauna is considerably richer than it is on the Mewstone grounds.

The friable red rock characteristic of the Mewstone Ledge is met with again, and forms numerous more or less detached reefs, off Stoke Point. It is abundantly perforated by *Pholadidea*, and in disused crypts of this mollusc *Thalassema neptuni* and the remarkable ophiurid *Ophiopsila aranea* are frequent. As at the Mewstone, the surface of the rock is very clean, and it affords attachment to *Tethya*, *Eunicella*, *Nemertesia*, *Thecocarpus*, *Alcyonium*, *Caryophyllia*, *Alcyonidium*, etc.

Between the reefs of red rock are patches of very rich shell gravel and sand.

The grounds include an eastward extension of the Mewstone Echinoderm Ground, together with patches where *Ophiothrix* and *Ophiocomina* are abundant.

The Rame-Eddystone or Middle Grounds. This name has been used to indicate the grounds extending 3-4 miles on either side of the line from Rame to Eddystone and having depths of from 25-30 fm. Two typical classes of grounds can

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be recognized in this area: (1) coarse grounds with a bottom soil of muddy grave on which a few *Chaetopterus* may sometimes be taken, and the chief hydroids are *Halecium halecinum* and *H. beani* ; and (2) fine grounds with a bottom soil of fine muddy sand, characterized by a certain amount of *Cellaria sinuosa* and *C. fistulosa* and by the hydroid *Sertularella gayi*. The grounds are very patchy, and the two typical faunas are much intermingled, so that it is only occasionally and after a short haul that a fair representation of either of the two types of fauna is obtained. Either ground can profitably be worked with both the dredge and trawl. On both *occasional Chlamys opercularis* may be met with in particular spots, and *Marthasterias glacialis* and *Asterias rubens* are generally distributed over the area.

The following are typical species occurring on the two classes of grounds:

COARSE GROUNDS. *Hyalinoecia tubicola*, *Halecium halecinum*, and *H. beans*, *Atelecyclus septemdentatus*, *Ophiura albida*, *Ophiactis balls*, *Venus fasciata*, *Venerupis rhomboides*, and *Ebalia tuberosa* and *E. tumefacta*.

FINE GROUNDS. *Cellaria sinuosa*, and *C. fistulosa*, *Ophiura texturata*, *Sertularella gayi* and *S. polyzonias*, *Echinocardium cordatum*, *Corystes cassivelaunus*, *Solecurtus chamasolen*, *Phaxas pellucidus*.

From the above description it will be seen that the fauna of the Rame-Eddystone Grounds resembles very closely that of the Eddystone-Start Point Grounds already described in Allen, 1899, P. 365 *et seq.*

The fish fauna differs from that of the Corner Ground in scarcity of rays, but rather more flatfish such as brill, turbot and lemon-soles.

[The Rame Mud](#), Maximum depth about 25 fm. With Rame Head bearing, from north-east to east-north-east, distant from 2-3 miles, the sea bottom consists of soft mud and contains quite a rich and characteristic fauna. Polychaetes are abundant, *Melinna palmata*, *Notomastus latericeus*, *Glycera*, *Goniada*, and *Nephtys* being typical examples. *Cucumaria elongata* is numerous, *Goneplax rhomboides* fairly common, with *Alpheus glaber* and *Callianassa subterranea*, always present but scarce. The fish *Cepola rubescens* is invariably found on these grounds, and whiting in their season. A study of this ground was made by Mare (1 942).

The [Looe-Eddystone Grounds](#) (25-30 fm.). This name has been applied to an extension westwards of the Rame-Eddystone Grounds. The fauna is similar in general character to that of the latter grounds, but is particularly rich-the result, probably, of the presence of much rough ground intermingled with trawling ground. *Echinus esculentus* is plentiful, together with *Pecten maximum* and *Chlamys opercularis*. *Solaster papposus* and *Porania pulvillus* are also generally present in small numbers. Half-grown thornback rays (*Raia clavata*) are generally plentiful but flatfish are scarce.

[Looe Grounds](#) (27-29 fm.). Looe bearing north to north-west, distant 5-7 miles. The bottom consists of fine sand and gravel with outcroppings of rock. The buried fauna is similar to that of the shell gravels and sands already described – except for the absence of *Amphioxus*. The epi-fauna is characterized by and abundance of *Echinus esculentus*. *Solaster papposus*, *Porania pulvillus* and *Pal-*

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*mipes membranaceus* are constantly present in small numbers. *Pecten maximum* is common and *Chlamys opercularis* generally abundant, but large variations in its numbers commonly occur. This is also a good ground for obtaining fairly consistent catches of mixed fish—especially *Scyliorhinus Canicula*, *Raia* spp., various flatfishes, gadoids (including small hake), gurnards and John Dory in some restricted places *Ophiothrix fragilis* is plentiful.

Eddystone Shell Gravel (23-26 fm.). Extending between about 4 and 6 cables N.N.W. of the Eddystone Lighthouse is a patch of rough, clean shell gravel where *Amphioxus lanceolatus* is present in quite large numbers. Up to 75 individuals have been taken in one haul of a 3 ft dredge. Other inhabitants of this shell gravel, constantly present, but in smaller numbers, are *Acropagia crassa*, *Venus fasciata*, *Gari tellinella*, *Solecurtus scapula*, *Conilera cylindracea*, *Ampelisca spinipes*, *Ebalia tuberosa*, *Echinocyamus pusillus*, *Lumbriconereis*, *Glycera*, and *Polygordius*. A fair number of *Gymnammodytes semisquamatus* are generally present around the periphery of this ground. For further details of this ground see Smith (1932).

Eddystone (Inner) Channel Grounds (32-38 fm.). Eddystone 1-8 miles distant from north-north-west to east-north-east. The bottom is fine sand. This infauna here is similar to that of the Looe-Eddystone grounds, but enriched by the presence also of *Nucula turgida*, *Lucinoma borealis*, *Cyprina islandica*, *Cardium echinatum*, *Echinocardium cordatum* and *Glossobalanus sarniensis*. *Chaetopterus variopedatus* is also present in considerable numbers. Close to the Eddystone rocks, with the lighthouse bearing east-north-east to north-east, thornback rays (*Raia clavata*) are more plentiful than further out. Further information about the fauna of this ground is given by Holme (1953).

Eddystone (Outer) Channel Grounds (35-43 fm.). Eddystone 12-15 miles distant bearing north-east to north-west. The bottom here also consists of fine sand and shell gravel with the usual fauna, except that ling and large hake are occasionally taken. The large lamellibranch *Pinna* is present on these grounds but is only rarely taken, generally in the trawl.

The 30 fm. line from Eddystone to Start Point. A detailed description of the grounds and their fauna along this line is given by Allen (1899).

## THE YEALM ESTUARY

In the Yealm Estuary is a large body of enclosed and very sheltered water, with a fauna that is essentially marine for some distance above the mouth. The mouth is almost closed by a bar of sand, a deep channel being left only on the southern side. At a distance of about a mile from the mouth, Newton Creek joins the main river, up to which point the channel is fairly wide and deep (*ca.* 20 ft. at low water). Newton Creek is shallow, choked with a thick deposit of soft mud, but the main river does not reach this condition until, in passing upstream, Steer Point has been passed. The fresh water brought down by the River Yealm is not sufficient to exclude stenohaline marine species from the

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Newton Ferrers area up to the Yealm Sand-bank ( $\frac{1}{4}$ - $\frac{1}{2}$  mile above Newton Creek). In wet periods flood water may escape as a surface skin and not affect the bottom at and below the region of low-water springs. The Yealm possesses some rich collecting grounds, which would repay more detailed study than they have yet received.

### SHORES

Steerpoint Flats. A wide expanse of soft mud, mostly exposed at mid-tide, bears a fauna similar to that described for the Tamar. *Scrobicularia plana*, *Nereis diversicolor* and *Corophium volutator* are abundant.

Yealm Sand-bank. The name has been used in the records to indicate a bank of fine to medium sand on the left bank of the Yealm River above the junction with Newton Creek, which is uncovered at low spring tides. The fauna is characterized by the presence in the sand of large numbers of *Ensis arcuatus*. Associated burrowing species include *Venerupis pullastra*, *V. decussata*, *Spisula solida*, *Gari depressa*, *Leptosynapta inhaerens*, *Sigalion boa*, *Glycera gigantea*, *Nephtys caeca*, etc.

Eastern Shore between Newton Creek and Misery Point. This stretch of shore is protected from the south-west and sheltered from direct wave-action, though subject to tidal currents that may be strong at times. The upper half of the tidal zone is rocky and steep, the lower part shelving and consisting of mud, muddy gravel, and clean gravel in turn. The rock is shale and provides suitable sites for at least some members of the crevice fauna described elsewhere. Characteristic inhabitants of the high-water region are well represented. The red alga *Catenella repens* is plentiful in a narrow zone at about the same level as *Pelvetia*; and above it, owing to the lack of wave splash, the land flora starts abruptly within 1 or 2 feet. *Ascophyllum nodosum* grows in some profusion on the rocks, harbouring the hydroid *Clava squamata*.

In the coarse muddy gravel below half-tide the large terebellid *Amphitrite johnstoni* is abundant, with its commensal polynoid *Gattyana cirrosa*. *Golfingia elongata* and *Sabella pavonina* occur sparingly. By far the most plentiful burrowing mollusc is *Venerupis pullastra*, but in the cleaner gravel towards the mouth *Mya truncata* and *Ensis arcuatus* become common. A considerable stretch of shore is colonized by the prawn *Upogebia deltaura*, whose wide circular burrows ramify disconcertingly to the digger, and which are sometimes found to shelter the commensal bivalve *Lepton squamosum*. An occasional *Axius styrhynchus* may be found sheltering under casual stones. Altogether an interesting variety of bottom-living animals has been recorded from time to time on this shore.

Towards Misery Point, off which there is a small submerged *Zostera* bed, common periwinkles (*Littorina littorea*) are especially abundant, but the reason why they habitually congregated here is unknown. The *Zostera* bed is now sparser than it used to be and is rarely accessible for digging ; but formerly it was a rich source of polychaetes.



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### DREDGING AND TRAWLING GROUNDS

The channel of the river just below the junction of Newton Creek is the best dredging ground in the estuary. The bottom is covered with Stones and shells (chiefly oyster-shells), to which quantities of red and brown weeds are attached. Of the molluscs large *Archidoris pseudoargus*, *Acmaea virginea*, *Calyptraea chinensis* and *Acanthochitona crinita* are numerous; of ascidians *Phallusia mammillata* and *Asciella aspersa*, and of hydroids *Plumularia pinnata* and *Hydractinia echinata* on shells inhabited by *Eupagurus benhardus* are characteristic. *Polycirrus caliendrum* is plentiful, whilst numbers of phyllodocids and syllids, as well as other small polychaetes, hide amongst the stones and shells. *Asterias*, *Marthasterias*, and *Ophiothrix* are usually taken, as well as a variety of shore crabs and spider crabs. The occurrence of *Eurylepta cornuta*, *Lineus longissimus*, and *Prostheceraeus vittatus* may also be mentioned.

The region of the *Zostera* bed towards the mouth was most usefully worked with a shrimp trawl, when the *Zostera* flourished. At that time, in addition to pipe-fishes, wrasses and other small fishes, *Praunus flexuosus* was abundant, as well as *Hippolyte varians*, *Cantharus striatus*, *Lacuna vincta*, and lucernarians, while *Anemone sulcata* was abundant attached to *Zostera*. Today most of these species may be encountered, but more sparsely.

### THE SALCOMBE ESTUARY

The Salcombe Estuary is not an estuary in the usual sense, since no river flows into it; rather is it an inland arm of the sea draining a very limited watershed. Marine conditions prevail over all of it except at the heads of its branch creeks, or "lakes". The connection with the sea is through a drowned gorge, blocked at the seaward end by a sand bar at a shallow depth. Above Salcombe the estuary begins to receive branches and eventually to fan out and shallow. It is some distance, however, if side creeks are excluded, before the estuarine deposits are sufficient to produce extensive flats at ordinary intertidal levels.

The stratigraphical history is uncertain, but it is tempting to regard the estuary as a portion of an Early Pleistocene forerunner of the present River Avon, the former truncated by capture on the westward side. Be this as it may, a great quantity of shale rock in the Kingsbridge area must have been eroded since the steep valley was cut across the hard schistose rocks at the Salcombe gap. At present strong tidal currents keep the channel through this gap scoured to some degree, though a slow invasion of sand from the direction of the Bar may be expected, while in the upper reaches a slow, but inevitable, silting must be in progress.

It is not easy to find counterparts of this region elsewhere in the South-west, but the Helford River in western Cornwall, another sheltered arm of the sea, resembles it in many respects.

A first attempt at a comprehensive account of the fauna of this estuary was made by Allen and Todd (1900), after a survey made between June and October 1900. Their observations still form the nucleus of the matter published in this list, but these have been supplemented by data acquired during regular visits by various workers and vacation classes to the shores of Salcombe Harbour on low

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spring tides at Easter and in the autumn, as well as during collecting excursions to the Salstone that have become regular in recent years. Going back in time, many fragments of information contributed by the pioneer Col. George Montagu (who lived at Kingsbridge between 1798 and 1815), and collectors stimulated by him, are valuable for comparisons with the present day.

One significant physical change has occurred subsequent to 1932, associated with the decline of *Zostera marina* (see below).

Castle Rocks. Near the mouth of the estuary the shore consists of steeply sloping rocks or exposed sandy bays, and little ground of special interest faunistically is met with until Salcombe Castle is reached. Here, on the west side of the estuary, a rock outcrop with broken fragments and boulders spans the tidal zone. The rock being of hard schistose character (Hornblende and Mica Schists), the crevice-fauna element is largely lacking, but an interesting variety of forms occurs in the shelter of overhanging rocks, of boulders, and of the varied algal flora. *Cucumaria*, *Caryophyllia*, *Cataphellia* and *Myriothele* may be mentioned. Many species of compound ascidians occur here. Castle Rocks proper and their continuation northward to Woodville Rocks deserve more complete investigation. The sand which appears at L.W.S. just south of Woodville Rocks produces *Ensis*, *Pectinaria* and *Venerupis sarniensis*.

Shores of Salcombe Harbour. Continuing northward from Woodville Rocks to near the Ferry is a stretch of rather narrow shore, with ground of varied texture, usually referred to as "below the Marine Hotel". Opposite, on the eastern bank, is a stretch of sandy shore "between the Ferry House and Mill Bay", or frequently spoken of simply as "Mill Bay". These two shores have long been regularly visited at least on one or two of the best spring tides of the year, being very productive of burrowing invertebrates, some not obtainable on the shore anywhere else in the district. This fauna is now strictly limited to the zone below M.L.W.S. (It may be emphasized that unless the predicted tide is at least 0-5 feet below Chart Datum the ground is not worth visiting.) Only in this region-below M.L.W.S.-does the slope of the shore tend to flatten out and form a shelf to the edge of the main channel.

Formerly these flats carried luxuriant beds of eel-grass (*Zostera marina*) especially on the Mill Bay shore, which eroded subsequent to the strange decline of the *Zostera* in 1931, and lost up to perhaps 2 feet in vertical height (see Wilson, 1949). The varied burrowing fauna supported by these beds (particularly at their margins and in the barer spots between patches of weed) has suffered as a result of this wastage of the substratum because the area of suitable ground has shrunk and perhaps because the surviving *Zostera*, less robust than formerly, does not provide such adequate shelter.

The Mill Bay shore is sandy throughout, the prevailing south-west wind causing a shift of sand towards and beyond H.W. mark. Here dune formation is taking place in small inlets, and rocks formerly bare are being covered. In the past this process was checked by the carting away of much sand from the H.W. region. The rise of sand in the 1930s was no doubt accelerated by wastage of the *Zostera* beds. The slope down to L.W.S. is largely barren sand except for *Talitrus saltator*, *Arenicola marina* and *Lanice conchilega*. Between mid-tide and L.W.

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the lugworm is dominant. Below L.W. S., where more or less level areas begin to appear, the sand has a higher silt content. Here patches of *Zostera* are established and may be slowly increasing, but the growth cannot be compared with that prior to 1930. The fauna adjacent to or within these patches is still varied and unusual, being dominated by *Echinocardium cordatum* and *Acrocnida brachiata*.

Below the Marine Hotel the upper part of the shore is bare rock, changing at about mid-tide level to barren stones, which merge into stony gravel with varying amount of mud. The amount of mud in the gravel has clearly decreased since 1930. At L.W.S. there appear, between rather barren stretches of gravel, some localized patches of silty sand with *Zostera*. The chief *Zostera* patches are towards Woodville Rocks, where the sublittoral flat is at its widest, and much ground is exposed as the tide recedes from about 1 to 2 feet O.D. Owing to the more varied nature of the ground on this west shore, a more varied selection of species has been recorded, and may still be found, but many quite sparingly and few in any plenty.

It is difficult to assess the true effect of the wastage of the former *Zostera* beds on the fauna of the two shores. The most conspicuous losses have been in the burrowing *anemones* *Cerianthus*, *Edwardsia*, and *Halcampa*, which-in the 1950s -seem to be completely missing. One or two lamellibranchs, e.g. *Lutraria lutraria*, may have disappeared with the high *Zostera* beds, but other species have been added latterly, and if anything the variety in this group is greater than before. *Ensis siliqua* is less frequent in Mill Bay than formerly, and the gephyrean *Golfingia elongata* has very greatly declined, but other causes are suspected of having contributed to this result. It is doubtless true that a general fauna collection made on any one tide will be smaller now than before 1930, but this is partly because the tidal level of the productive flats has dropped, giving the collector less time in which to work.

With the exceptions mentioned, an interesting variety of species may still be collected on both shores. The terebellid *Amphitrite edwardsi*, with its striking polynoid commensal *Lepidasthenia argus*, seems to be as readily obtained today as ever it was; and several species that were always scarce, such as *Labidoplax digitata*, *Loimia medusa*, *Devonia perrieri*, *Peachia hastata*, etc., are no scarcer today.

A list of the chief burrowing species of the harbour shores is appended, with an up-to-date list of observed commensal associations.

BURROWING SPECIES	COMMENSAL POLYCHAETES AND BIVALVES	NOTES
CERIANTHARIA		
<i>Cerianthus lloydi</i>	-	Formerly common or abundant on W. side, at least to 1927. None observed in 1950's
ACTINIARIA		
<i>Edwardsia callimorpha</i>	-	Formerly on W. side. None observed in 1950's
<i>Halcampa chrysanthellum</i>	-	Formerly occasional both sides. None in 1950's
<i>Peachia hastata</i>	-	W. side, regular at E.L.W.S. just N. of Woodville Rocks





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*deltaura*, and an occasional *Callianassa*. In sandy mud *Goneplax angulata* can be extracted from burrow-like depressions. *Myxicola infundibulum* is more frequent than in the harbour, as is *Amphitrite johnstoni* with its *Gattyana* commensal. *Phallusia mammillata* and clumps of *Halichondria bowerbanki* lie on muddy gravel, the latter sheltering the amphipod *Leucothoë spinicarpa*, while *Buccinum undatum* is sometimes numerous. Profuse patches of *Cereus pedunculatus* are encountered. The rocks projecting in the upper part of the tidal zone support a dense growth of *Ascophyllum*, and this weed bears clusters of the hydroid *Clava squamata*.

**The Salstone.** Around this rock an extensive region of soft mud is exposed by low spring tides, with a remarkably rich fauna and flora which doubtless benefit from the shelter afforded by this inland site from the action not only of waves, but also of strong currents. Only a fraction of the species present can be mentioned. The tube-worms *Sabella pavonina*, *Branchiomma vesiculosum*, and *Myxicola infundibulum* are abundant in their respective zones and *Notomastus latericeus* and *Melinna palmata* are abundant in the fine mud. The surface of the mud, or much of it, is hidden under extensive clumps of *Hymeniacidon perleve* and other sponges (e.g. *Halichondria bowerbanki*, *Suberites*) and algae such as *Ulva*. Amongst these growths *Phallusia mamillata* is distributed, and clumps of various compound ascidians, especially didemnids. *Ciona intestinalis* and *Asciidiella aspersa* are abundant on stones, particularly at the south end. Among the encrusting sponges and ascidians the turbellarian *Prostheceraeus vittatus* occurs in small numbers and *Trivia monacha* is plentiful. Very large numbers of *Cereus pedunculatus* form carpets where mud covers an underlying layer of stones to which their bases are attached. *Amphitrite johnstoni* and *Golfingia vulgaris* may be dug up. Montagu long ago gave this locality as a special site for *Haminoea* (= *Bulla*) *hydatis*, a mollusc which has been found here on various more recent occasions, sometimes with its spawn. *Pleurobranchus membranaceus* is also common here, spawning in the summer. The only British specimen of *Aplysia fasciata* was picked up here in 1949. For some years a wrecked barge produced a profusion of *Metridium* and other sessile organisms. Large starfish are also sometimes found stranded; *Pecten maximus* is usual and even *Antedon bifida* has been taken. Under stones, early in the year, butterfishes, *Pholis gunnellus*, are to be found curled around their egg masses.

There is no evidence that the fauna is in any way affected by possible dilution of the sea water even during wet periods.

**Dentridge.** A bank in mid-estuary is exposed only at the very lowest spring tides, just as it was 150 years ago. It was an early locality for *Goneplax angulata*, as recorded by Leach. The present oyster-bed covers part of this bank.

**Kingsbridge Flats.** These seem to be closely similar to the flats of St. John's Lake, but they have not received special study. Estuarine species such as *Scrobicularia plana*, *Macoma balthica*, *Nereis diversicolor* and *Hydrobia ulvae* appear on the scene at the northern end.

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