



## The Fauna of the Exe Estuary.

By

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(With a Chart.)

### I. Introduction.

IN continuation of the scheme commenced last year for making a detailed survey of the marine fauna in the estuaries on the Devon and Cornish coasts, an examination has been undertaken during the present summer (1901) of the Exe estuary. For this purpose the floating laboratory boat *Dawn*, which has been generously placed at our disposal and maintained by Mr. J. W. Woodall, was towed to Exmouth and moored in the dock there, where she remained from July to September.

The principal means of collecting were hunting and digging on the shore between tide-marks; the use of a small trawl with a beam about four feet long fitted with a bag of mosquito netting; and the use of the dredge. The estuary, however, is not favourable for the use of the last-named instrument, as the ground is only suitable in the main channel, and the great strength of the tide makes the operation of dredging difficult excepting at slack water. Mr. Todd is almost entirely responsible for the collecting work, Dr. Allen only having paid occasional visits to Exmouth.

We have been able to combine with the collections made this summer the detailed records kept by Mr. E. W. L. Holt of some hauls with seine nets taken in the Exe estuary during two visits to Exmouth in the *Busy Bee* in 1897.

As regards the identification of the species, Dr. Allen is specially responsible for the Polychætes, Mr. Todd for Crustacea and Molluscs. An account of the examination by Mr. Worth of some samples of sand from the estuary, especially as regards the Foraminifera which they contained, is published in the present number of the Journal as a separate paper.

The estuary of the Exe differs markedly from the Salcombe estuary, which we examined last year (*vide Journ. Mar. Biol. Assoc.*, vol. vi. p. 151), both as regards its physical characteristics and the nature of its fauna, and a comparison of the two is interesting in several

respects. Looking at the two faunas as a whole, it must be noted that that of the Exe estuary is very much more limited in number of species than that of Salcombe. This is particularly obvious when we exclude from the list of Exe species those which were obtained on the seaward side of the Polesands, a region which is really outside the estuary.

This limitation in the number of species living in the Exe estuary seems to a large extent to be due to the following causes. In the first place, the banks uncovered in the Exmouth estuary are left dry for a very long time between two tides, and in most parts of the estuary there is little difference in the area uncovered by the spring and neap tides. The banks of the low-water stream are generally steep, especially in the lower parts of the estuary, and the spring tides merely uncover a few additional feet of these steep banks. Hence it follows that the banks uncovered at Exmouth must really be regarded as belonging to a higher tidal level than the rich low-water banks exposed at spring tides in such harbours as Salcombe and Plymouth. When this is borne in mind the differences in fauna become far less striking, as these higher tidal levels are nowhere very rich in number of species. The actual rise and fall of tide at Exmouth is also less than at either Salcombe or Plymouth. The following figures are from King's *Pilot's Handbook for the English Channel* (12th edition):—

Exmouth. Springs rise  $12\frac{1}{4}$  feet, neaps  $8\frac{1}{2}$  feet, and neaps range 5 feet.

Salcombe.\* Springs rise 15 feet, neaps  $11\frac{1}{2}$  feet, and neaps range  $6\frac{3}{4}$  feet.

The second point of importance is the very great strength of the tidal stream at Exmouth, both when it is running over the banks and to a still greater extent in the main channel when the banks are uncovered. The evidences of the great scour produced by the tide are numerous, and the soil of the banks is in many cases subject to such great disturbance that it is rendered practically barren so far as animal life is concerned.

A third point which requires consideration is the quantity of fresh water which enters the estuary. A proper knowledge of this question could only be arrived at by systematic observations carried out during the entire year, and more especially during the more rainy parts of the year. The following information, however, supplied to us by

\* The figures for heights of tides given in the "Report on the Fauna of the Salcombe Estuary" (this Journal, vol. vi. p. 151) were taken from the Plymouth Tide Table, as information gathered locally led to the conclusion that the maximum rise inside the estuary was about 17 feet, which is practically the same as at Plymouth.

Mr. R. H. Worth, will be useful in comparing the Exe estuary with that of Salcombe. The watershed area draining to the Exe estuary is 584 square miles, the area draining to the Salcombe estuary is  $33\frac{1}{4}$  square miles, and the rainfall over the two areas is about the same. It would not, however, be correct to say that with any given rainfall the flow of fresh water passing into the Salcombe estuary would therefore be only one-seventeenth of that passing into the Exe estuary, for both in summer and winter, but more especially in summer, the larger catchment would give a greater ordinary flow per unit area, whilst in time of exceptional flood this condition might be reversed and the smaller catchment would yield from twice to, in extreme cases, four times as much water per square mile. It would probably not be exaggerating the difference between the two estuaries to assume that the fresh water flowing into the Salcombe estuary is in summer one-thirtieth that flowing into the Exe estuary, in winter one-twentieth, at times of considerable flood one-tenth, and at times of great flood one-fifth. On the other hand, each flood of the Exe would last for a longer time than a flood at Salcombe.

The area of the Salcombe estuary at high tide is about half that of the Exe estuary, whilst at low tide, taking the whole length of each estuary, the two are more nearly equal in area. The Salcombe low-water channel is much the deeper, and the average rise and fall of tide is somewhat greater at Salcombe than at Exmouth. On the whole, therefore, it appears that the water of the Exe estuary must, at certain times at any rate, be of much less density than any which even in times of flood runs through the Salcombe estuary.

These conclusions are confirmed by the following observations of the density of the water in different parts of the estuary, made by Mr. Todd in December, after a night of heavy rain following a period of average rainfall (all samples taken at the surface):—

December 12th, 1901. High tide at Exmouth, 7.16 a.m. Neap tides.

[Height of tide at Plymouth, 14 ft. 11 ins.]

STARCROSS (Pier), 11.15 a.m. Temperature,  $9.2^{\circ}$  C.; density at that temperature, 1.021.

EXMOUTH (north side of Pier), 11.40 a.m. Temp.,  $9.7^{\circ}$  C.; density, 1.0248.

EXMOUTH DOCK, 12.25 p.m. Temp.,  $9.4^{\circ}$  C.; density, 1.0235.

EXMOUTH (south side of Pier), 12.35 p.m. Temp.,  $8.6^{\circ}$  C.; density, 1.021.

      "      "      "      12.50 p.m. Temp.,  $8.4^{\circ}$  C.; density, 1.0208.

      "      "      "      1.5 p.m. Temp.,  $8.4^{\circ}$  C.; density, 1.0204.

TOPSHAM, 2 p.m. Temp.,  $11.9^{\circ}$  C.; fresh water.

WOODBURY ROAD, 3.45 p.m. Temp.,  $8^{\circ}$  C.; fresh water.

EXMOUTH (south side of Pier), 5.30 p.m. Temp.,  $9.8^{\circ}$  C.; density, 1.0259.

STARCROSS (Pier), 6.5 p.m. Temp.,  $9.5^{\circ}$  C.; density, 1.0262.



In order to illustrate the more striking differences between the faunas of the two estuaries, the following list of animals, which were common and characteristic species in the upper parts of Salcombe estuary (above Snape's Point), but are absent from the Exmouth fauna, may be given:—

Hymeniacion sanguineum.	Branchiomma vesiculosum.
Sagartia bellis.	Myxicola infundibulum.
Carinella superba.	Tapes pullastra.
Phascolosoma pellucidum.	Pecten opercularis.
Nereis cultrifera.	Pecten maximus.
Notomastus latericius.	Calyptrea sinensis.
Amphitrite Johnstoni.	Scalaria communis.
Sabella pavonina.	Clavelina lepadiformis.
	Morchellium argus.

*Melinna adriatica*, which occurred in immense profusion in the soft mud-flats in the upper parts of Salcombe estuary, was only represented at Exmouth by very occasional specimens. *Audouinia tentaculata*, which was very common above half-tide mark in the Salcombe estuary, was met with only at Orcombe Rocks, quite at the mouth of the Exe.

On the other hand, the following species from the Exe estuary above Exmouth town were either absent or represented only by occasional specimens at Salcombe:—

Nereis diversicolor.	Tellina balthica.
Phyllodoce teres.	„ tenuis.
Eteone pusilla.	Hydrobia ulvæ.
Nephtys cirrosa.	Pleuronectes platessa (young specimens).
Ophelia bicornis.	
Mytilus edulis.	

Cockles (*Cardium edule*) and *Scrobicularia piperata* were also very much more abundant at Exmouth than at Salcombe. On the sand-flats at Exmouth *Ulva* and *Enteromorpha* were very abundant, whilst *Zostera*, which was abundant and well grown at Salcombe, was less plentiful and generally had a much stunted habit.

## II. Description of the Fauna found in different localities in the Exe Estuary.

### STATION 1. GREENLANDS ZOSTERA BANK.

(See Chart.)

The highest part of the estuary examined was the Greenlands Zostera Bank, which is situated between Topsham and Powderham. The bank is about half a mile across, and is composed of fine mud almost entirely covered with zostera. The latter grows thickly together, but is small and stunted. The four abundant species are forms which are generally met with in estuarine waters of low density.

**List of Species. Shore Collecting.**

AUGUST 15TH, 1901.

## POLYCHÆTA.

Nereis diversicolor.	Very common.		Arenicola marina.	One.
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## CRUSTACEA.

Carcinus mænas.	A few.
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## MOLLUSCA.

Scrobicularia piperata. Abundant.

Littorina littorea. Abundant.

Hydrobia ulvæ. Abundant.

STATION 2. SAND BANK EAST OF POWDERHAM  
MUSSEL BEDS.

This bank is composed of smooth, fine sand with some admixture of mud, and possesses a very limited fauna.

**List of Species. Shore Collecting.**

AUGUST 16TH, 1901.

## POLYCHÆTA.

Nereis diversicolor.	Several.		Scoloplos armiger.	Several.
Nephtys Hombergii.	Fairly common.		Arenicola marina.	Very common.

## CRUSTACEA.

Carcinus mænas.	A few.
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Crangon vulgaris.	A few.
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Gammarus locusta.	A few.
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**List of Species. Mosquito Net Trawl.**

JULY 25TH, 1901.

## CRUSTACEA.

Carcinus mænas.	A few.		Neomysis vulgaris.	Thirteen.
Crangon vulgaris.	A few.		Gammarus locusta.	Several.
Macromysis flexuosa.	Abundant.			

## PISCES.

Gobius minutus.	Four, 2.4-2.8 cm.		Syngnathus rostellatus.	Four,
Pleuronectes platessa.				12.3-15.7 cm.

STATION 3. SAND OFF MOUTH OF KENN RIVER,  
SOUTH OF POWDERHAM.

The sand here is more muddy than that found on the last bank described, and there are also patches of gravel. The fauna is increased by the addition of several molluscs, whilst *Scoloplos armiger* was not found.

**List of Species. Shore Collecting.**

JULY 16TH, 1901.

**POLYCHÆTA.**

Nereis diversicolor.	Numerous,	Nephtys Hombergii.	One.
large.		Arenicola marina.	Very common.

**CRUSTACEA.**

Crangon vulgaris.	Small, common.	Macromysis flexuosa.	Many.
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**MOLLUSCA.**

Mytilus edulis.	Several attached to	Tellina balthica.	One.
stones.		Scrobicularia piperata.	Common.
Cardium edule.	Common.	Littorina littorea.	Not uncommon.

**PISCES.**

Gobius minutus.	Small, common.
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**STATION 4. GRAVEL BETWEEN POWDERHAM AND STARCROSS.**

Between STATION 3 and Starcross, close to the railway embankment, the ground is composed of muddy gravel, and the Polychæte fauna increases in richness. The estuarine *Nereis diversicolor* is still abundant, *Lanice conchilega* becomes plentiful, whilst *Arenicola marina*, the ground being gravel, is not so common.

**List of Species. Shore Collecting.**

SEPTEMBER 2ND, 1901.

**POLYCHÆTA.**

Nereis diversicolor.	Very common.	Scoloplos armiger.	A few.
Nephtys Hombergii.	Several.	Arenicola marina.	A few.
Glycera convoluta.	Several.	Lanice conchilega.	Common.
Phyllodoce teres.	Two.	Melinna adriatica.	Two.

**MOLLUSCA.**

Cardium edule.	Common.	Scrobicularia piperata.	Not un-
Tellina balthica.	One.		common.

**STATION 5. SAND BANK ABOVE STARCROSS.**

On the bank of clean fine sand outside the gravel of STATION 4 the characteristic species of the upper parts of the estuary almost disappear, and we get a typical fauna characterised by *Nephtys cirrosa*, *Phyllodoce teres*, *Eteone pusilla*, *Haustorius arenarius*, and *Tellina tenuis*

**List of Species. Shore Collecting.**

SEPTEMBER 2ND, 1901.

## POLYCHÆTA.

Nephthys Hombergii. Common.	Eteone pusilla. One.
„ cirrosa. Common.	Pygospio seticornis.
Phyllodoce teres.	Arenicola marina. Very common.

## CRUSTACEA.

Haustorius arenarius. One.

## MOLLUSCA.

Cardium edule. A few. | Tellina tenuis. Not uncommon.

**List of Species. Shrimp Trawl.**

JULY 12TH, 1901.

## CRUSTACEA.

Carcinus mænas. A dozen.	Gammarus locusta. Many small.
Crangon vulgaris. A few.	

## MOLLUSCA.

Sepiola atlantica. One.

## PISCES.

Syngnathus acus. Two.

STATION 6. SAND AND MUD SOUTH OF LIMPSTONE  
MUSSEL BEDS.**List of Species. Shore Collecting.**

AUGUST 6TH, 1901.

## POLYCHÆTA.

Scoloplos armiger. Common.	Arenicola marina. Very common.
Ophelia bicornis. One.	

## MOLLUSCA.

Mytilus edulis. Common.	Scrobicularia piperata. Very common in stiff mud.
Cardium edule. Common.	Littorina littorea. Common on weed.
Tellina balthica. A few lying on the surface of the mud.	Hydrobia ulvæ. Very common on Enteromorpha and Zostera.
Tellina tenuis. Common at L.W.M. in sand.	

**List of Species. Mosquito Net Trawl.**

JULY 20TH, 1901.

## CRUSTACEA.

Carcinus mænas. One.	Macromysis flexuosa. Many.
Crangon vulgaris. Small, common.	Schistomysis Helleri. One or two.

## PISCES.

Gobius minutus. One.

## STATION 7. BETWEEN STARCROSS AND COCKWOOD.

In the first half the ground consists of gravel and shell débris, with a thin ( $\frac{1}{2}$  to 2 inches) layer of muddy sand. As on the gravel of STATION 4, *Lanice conchilega* is very abundant, whilst *Arenicola marina* is not frequent.

## List of Species. Shore Collecting.

SEPTEMBER 3RD, 1901.

## POLYCHÆTA.

<i>Arenicola marina</i> . Occasional.		<i>Lanice conchilega</i> . Very common.
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## CRUSTACEA.

<i>Carcinus mænas</i> . Not uncommon.		<i>Gammarus locusta</i> . Common under
<i>Crangon vulgaris</i> . Small, common.		stones, weed, etc.

## MOLLUSCA.

<i>Ostræa edulis</i> . Three, near Starcross, on gravel.		<i>Tellina balthica</i> . Two.
<i>Mytilus edulis</i> . Several.		<i>Scrobicularia piperata</i> . Shells.
<i>Cardium edule</i> . Common.		<i>Littorina littorea</i> . Common.
<i>Tapes pullastra</i> . Shells only.		<i>Hydrobia ulvæ</i> . Shells very common.

## STATION 7A. SAND BANK OFF STARCROSS.

## List of Species. Mosquito Net Trawl.

JULY 10TH, 1901.

## PORIFERA.

<i>Leucosolenia</i> sp.		<i>Sycon ciliatum</i> (?). One or two.
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## CRUSTACEA.

<i>Carcinus mænas</i> . Several.		<i>Idothea balthica</i> . Two.
<i>Crangon vulgaris</i> . Small, common.		<i>Bathyporeia pelagica</i> . Twenty.
<i>Macromysis flexuosa</i> . Many.		<i>Gammarus locusta</i> . A few.

## PISCES.

<i>Agonus cataphractus</i> . One, 4.4 cm.		<i>Pleuronectes platessa</i> . Four, 4.3-6.0
<i>Gobius minutus</i> .		cm.
<i>Rhombus lævis</i> . One, about 2 cm.		<i>Syngnathus rostellatus</i> . One.

## STATION 8. BETWEEN STARCROSS AND COCKWOOD.

The ground now described lies to the south of STATION 7, and differs from it in being more sandy and less muddy. The soil consists of gravel and shell débris, covered with about six inches of sand. In consequence of this change in the character of the soil there is a considerable increase in the Polychæte fauna, whilst Molluscs almost disappear.

**List of Species. Shore Collecting.**

SEPTEMBER 3RD, 1901.

## POLYCHÆTA.

Nephtys Hombergii. Many.	Arenicola marina. Very common.
Phyllodoce maculata (?).	Praxilla sp. Small, with irregular papillæ on anus.
Eteone pusilla.	Lanice conchilega. Not uncommon.
Pygospio seticornis.	Melinna adriatica. Two.
Scoloplos armiger. Common.	
Aricia Latreillii. One small one.	

## MOLLUSCA.

Patella vulgata. Not uncommon on stones.

## STATION 9. BULLHILL BANK.

On this bank the soil varies considerably. Where first uncovered it is composed of coarse and loose sand, and here practically the sole inhabitant is *Ophelia bicornis*. At lower levels the sand is finer and firmer, whilst in places it only thinly covers a soil of coarse gravel. There was a large quantity of *Enteromorpha* growing on the bank.

**List of Species. Shore Collecting.**

JULY 4TH, 1901.

## POLYCHÆTA.

Nereis longissima. One.	Pygospio seticornis. Plentiful in the sand.
Nephtys Hombergii. One or two.	Nerine cirratulus. Two.
„ cæca. Several large specimens.	Scoloplos armiger. Several.
Nephtys cirrosa. Many in the sand, one or two fairly large.	Arenicola marina. Several. [sand.]
Glycera convoluta. Two.	Ophelia bicornis. Common in loose sand.
	Lanice conchilega. Fairly common.

## CRUSTACEA.

Carcinus mænas. Occasional.  
 Crangon vulgaris. Small, very common.

## MOLLUSCA.

Mytilus edulis. Young ones swarmed on Enteromorpha.	Tellina tenuis. Several.
Cardium edule. Common on the fine sand to the north.	Solen vagina. One in sand.
Tapes decussata. Several.	Littorina littorea. Very common on weeds at extreme north.

## PISCES.

Gobius minutus. Common.

**List of Species. Mosquito Net Trawl.**

JULY 8TH, 1901.

## CRUSTACEA.

<i>Carcinus mænas.</i> Several.	<i>Idothea balthica.</i> Common.
<i>Crangon vulgaris.</i> Small, common.	<i>Bathyporeia pelagica.</i> One.
<i>Macromysis flexuosa.</i> Common.	<i>Gammarus locusta.</i> Common.
<i>Schistomysis Helleri.</i> Common.	

## MOLLUSCA.

<i>Cardium edule.</i> One.	<i>Hydrobia ulvæ.</i> A few.
<i>Tellina tenuis.</i> One.	

## PISCES.

<i>Gobius minutus.</i> Four, 1.2-5.7 cm.	<i>Pleuronectes platessa.</i> One, 4.7 cm.
<i>Gasterosteus spinachia.</i> Four small.	

## BULLHILL BANK. GRAVEL ON WEST SIDE.

**List of Species. Mosquito Net Trawl.**

JULY 26TH AND 28TH, 1901.

## CRUSTACEA.

<i>Crangon vulgaris.</i> A few.	<i>Sphæroma serratum.</i> Common.
<i>Pagurus Bernhardus.</i> Several young.	<i>Synchelidium sp.</i> One.
<i>Gastrosaccus spinifer.</i> Nine.	<i>Gammarus locusta.</i> Several young.
<i>Macromysis flexuosa.</i> A dozen.	<i>Melita palmata.</i> One.
<i>Idothea linearis.</i> One small one.	

## PISCES.

<i>Gobius minutus.</i> One, 2.7 cm.	<i>Blennius pholis.</i> One, 2.1 cm.
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## BULLHILL DEEP PIT.

**List of Species. Mosquito Net Trawl.**

JULY 26TH, 1901.

## CRUSTACEA.

<i>Stenorhynchus phalangium.</i> Three.	<i>Palæmon serratus.</i> Four large.
<i>Carcinus mænas.</i> Several.	<i>Macromysis flexuosa.</i> Four.
<i>Crangon vulgaris.</i> A few.	<i>Gammarus locusta.</i>
<i>Hippolyte varians.</i> Several small.	

## MOLLUSCA.

<i>Mytilus edulis.</i> Young ones common.	<i>Elysia viridis.</i> Three.
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## PISCES.

<i>Gobius minutus.</i> One, 5.0 cm.	<i>Crenilabrus melops.</i> Four, 1.2-2.5 cm.
<i>Labrus maculatus.</i> Five, 1.4-3.0 cm.	

## BULLHILL BANK.

## List of Species. Professional Seine.

APRIL 7TH, 1897. FROM RECORDS MADE BY MR. E. W. L. HOLT.

## PISCES.

Cottus bubalis. Several.	Pleuronectes platessa. Sixty-three.
Agonus cataphractus. Ten.	(For details see p. 333.)
Motella mustela. One.	Pleuronectes flesus. One, 12.5 cm.
	Clupea harengus. Two, 26 and 29 cm.

## List of Species. Laboratory Tuck Net.

MAY 31ST, 1897. E. W. L. H.

## MOLLUSCA.

Doris tuberculata. One.

## PISCES.

Cottus bubalis. One.	Pleuronectes platessa. One hundred and thirty-one. (For details see p. 334.)
Trigla hirundo. Five, 14-23 cm.	Pleuronectes limanda. Eleven, 9.5-13 cm.
Agonus cataphractus. Several.	Pleuronectes flesus. Four, 9.5-17 cm.
Trachinus vipera. Two.	Clupea sprattus (?). Six, of 5 cm.
Callionymus lyra. One.	
Mugil chelo. One, 24 cm.	

STATION 10. SAND WEST OF THE MOUTH OF  
SALTHOUSE LAKE.

Immediately to the west of the entrance to Salthouse Lake the soil consists of fine sand with some admixture of mud. This is the only locality where *Solen vagina* was found.

## List of Species. Shore Collecting.

JULY 15TH, AUGUST 31ST, 1901.

## POLYCHÆTA.

Evarne impar. One under a tile.	Nerine coniocephala. A few.
Nephtys Hombergii. Small, common.	Scoloplos armiger.
Phyllodoce teres.	Arenicola marina. Common.
Eteone pusilla. A few.	Clymenids. (Praxilla.) Probably two species; in clean sand.
Pygospio seticornis. Numerous.	Lanice conchilega. In sand.
Heteromastus filiformis. A few.	

## MOLLUSCA.

Cardium edule. Common.	Littorina littorea. Common.
Solen vagina. Not uncommon.	



## STATION 11. MUD NORTH OF SALTHOUSE LAKE.

To the west of STATION 10 along the bank of the stream a considerable quantity of mud is met with, which in some places is soft and sticky, in others hard and of a more clayey nature.

## List of Species. Shore Collecting.

JULY 15TH, 1901.

*Nereis diversicolor*. Common where mud was hard.  
 „ *longissima*. One.  
*Nephtys Hombergii*. Common, small.  
*Nerine coniocephala*. Not uncommon in hard mud.  
*Scoloplos armiger*. Not uncommon in hard mud.  
*Arenicola marina*. Common.

## CRUSTACEA.

<i>Carcinus mænas</i> . Many young.		<i>Corophium grossipes</i> . Common bur-
<i>Crangon vulgaris</i> . Many young.		rowing in hard mud.
<i>Macromysis flexuosa</i> . One.		

## MOLLUSCA.

<i>Cardium edule</i> . Common.		<i>Scrobicularia piperata</i> . Common.
<i>Tellina balthica</i> . One.		<i>Littorina littorea</i> . Common.

## List of Species. Mosquito Net Trawl.

JULY 24TH, 1901.

## CRUSTACEA.

<i>Carcinus mænas</i> . Several.		<i>Macromysis flexuosa</i> . A dozen.
<i>Crangon vulgaris</i> . Small, very common.		<i>Schistomysis Helléri</i> . Many.

## PISCES.

*Gobius minutus*. Twenty, 1.2-4.5 cm.

## SALTHOUSE LAKE.

## List of Species. Shrimp Net.

JULY 18TH, AUGUST 5TH AND 31ST, 1901.

## CRUSTACEA.

<i>Carcinus mænas</i> . Common.		<i>Crangon vulgaris</i> . Common.
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## PISCES.

*Gobius minutus*. Common.  
*Ammodytes tobianus*. One, 9.3 cm.  
*Rhombus lævis*. Three, 2.8-3 cm.  
*Pleuronectes platessa*. About 130, from 4-16 cm. in length. (See p. 334.)  
 „ *flesus*. Four, 13.5-14 cm.  
*Syngnathus acus*. Several.

## BETWEEN THE WARREN AND COCKWOOD.

## List of Species. Professional Seine.

APRIL 7TH, 1897. FROM RECORDS MADE BY MR. E. W. L. HOLT.

## PISCES.

Labrax lupus. One, 15.5 cm.	Pleuronectes platessa One hundred and sixty-five. (For details see p. 333.)
Cottus bubalis. Ten.	Pleuronectes limanda. One, 9 cm.
Agonus cataphractus. Three.	Clupea harengus. Six, 23.5-32.5 cm.
Gobius minutus. Two.	„ sprattus. Six, 5.5-7 cm.
Gasterosteus spinachia. Two.	Syngnathus acus. Two.
Rhombus maximus. One, 14 cm.	
„ lævis. One, 14 cm.	

## List of Species. Laboratory Tuck Net.

MAY 29TH, 1897.

## PISCES.

Labrax lupus. Two, 8 and 72 cm.	Pleuronectes platessa. Seventy-seven. (For details see p. 334.)
Cottus bubalis. One.	Pleuronectes limanda. Eight, 9.5-11.5 cm. [cm.]
Agonus cataphractus. Four.	Pleuronectes flesus. Two, 13 and 30.5
Callionymus lyra. One.	
Rhombus lævis. Two, 17 and 21.5 cm.	

STATION 12. NORTH SIDE OF WARREN. EAST BANK OF  
STREAM DRAINING GREENLAND LAKE.

At the north-eastern end of the Warren the shore is composed of loose gravel, which is practically barren on account of the great force of tide to which it is exposed. Along the bank of the stream which drains Greenland Lake, however, the soil becomes firmer, and consists of muddy sand with a large proportion of gravel mixed with it. As on the grounds higher up the estuary, this mixture of sand and gravel affords specially suitable soil for *Lanice conchilega*, which occurs in very great profusion, whilst in patches near low-water mark the Gephyrean *Phascolosoma vulgare* is abundant, this being the only spot in the estuary at which it has been found. Ground of this nature is also favourable to *Tapes decussata*.

## List of Species. Shore Collecting.

AUGUST 4TH, 1901.

## GEPHYREA.

Phascolosoma vulgare. Common in patch at low-water mark.

## POLYCHÆTA.

Nephtys Hombergii. Several.	Lanice conchilega. Extremely common at low-water mark, and in the bed of the stream.
Arenicola marina. Common in sand.	
Ophelia bicornis. One in clean sand.	

## THE FAUNA OF THE EXE ESTUARY.

## CRUSTACEA.

*Haustorius arenarius*. One in clean sand.

## MOLLUSCA.

<i>Cardium edule</i> . Several.		<i>Scrobicularia piperata</i> . A few in muddy
<i>Tapes decussata</i> . Common.		<i>Trochus cinerarius</i> . A few. [sand.
<i>Tellina tenuis</i> . One in sand.		<i>Littorina littorea</i> . Not uncommon.

## POLYZOA.

*Loxosoma phascolosomatum*. Not uncommon on the posterior end of *Phascolosoma*.

## STATION 13. COCKLESAND.

The soil on this bank consists of sand and sandy mud of varying consistency, covered in places with *Zostera* and *Enteromorpha*, the fauna being very similar to that of grounds of this character already described. This bank remains uncovered for a considerable time between each tide.

## List of Species. Shore Collecting.

JULY 7TH, 13TH, 22ND, 1901.

## POLYCHÆTA.

<i>Nereis diversicolor</i> . Not uncommon in muddy sand.		<i>Nerine cirratulus</i> . A few.
<i>Nephtys cirrosa</i> . One.		<i>Scoloplos armiger</i> . A few.
„ <i>Hombergii</i> . Several taken.		<i>Arenicola marina</i> . Abundant.
<i>Pygospio seticornis</i> . Very common in sand.		<i>Ophelia bicornis</i> . One in clean sand.
		<i>Lanice conchilega</i> . A few. [bed.
		<i>Melinna adriatica</i> . A few in <i>Zostera</i>

## CRUSTACEA.

*Carcinus mænas*. Small, not uncommon among weed.  
*Crangon vulgaris*. Small, common.  
*Schistomysis Helleri*. Three.  
*Talitrus locusta*. Common in sand and weed at high tidal levels.

## INSECTA.

*Heterocerus femoralis*. Common burrowing in fine, loose sand.

## MOLLUSCA.

*Mytilus edulis*. Several.  
*Cardium edule*. Very common on or just below the surface.  
*Tapes decussata*. Several where the ground was coarse.  
*Tellina balthica*. Common lying on the surface of the mud.  
 „ *tenuis*. Not uncommon in sand.  
*Scrobicularia piperata*. Very common in stiff mud.  
*Littorina littorea*. Very common on weed.  
*Hydrobia ulvæ*. Very common among weed.

**List of Species. Mosquito Net Trawl.**

JULY 22ND, 1901.

## CRUSTACEA.

- Carcinus mænas*. Small and medium-sized ones common in Kingslake ; a few on Cocklesand.  
*Crangon vulgaris*. Small, common.  
*Palæmon serratus*. One small one, Kingslake.  
*Macromysis flexuosa*. Common.  
*Schistomysis Helleri*. Common, Kingslake.  
*Idothea balthica*. Several, Cocklesand.  
*Gammarus locusta*. Several small, Kingslake.

## MOLLUSCA.

- Littorina littorea*. A few. | *Hydrobia ulvæ*. A few.

## PISCES.

- Gobius minutus*. One or two.  
*Ammodytes tobianus*. One, Kingslake.

## CHANNEL BETWEEN BULLHILL BANK AND COCKLESAND.

**List of Species. Mosquito Net Trawl.**

JULY 19TH, 1901.

## CRUSTACEA.

- |   |  |   |
|---|--|---|
| <i>Stenorhynchus phalangium</i> . One.  |  | <i>Palæmon serratus</i> . One.            |
| <i>Carcinus mænas</i> . Common.         |  | <i>Macromysis flexuosa</i> . Several.     |
| <i>Pagurus Bernhardus</i> . One or two. |  | <i>Schistomysis Helleri</i> . One or two. |
| <i>Crangon vulgaris</i> . Common.       |  | <i>Paratylus Swammerdami</i> . Four.      |
| <i>Hippolyte varians</i> . Two.         |  | <i>Gammarus locusta</i> . Small, common.  |

## MOLLUSCA.

- |                                    |  |                                  |
|------------------------------------|--|----------------------------------|
| <i>Mytilus edulis</i> . Several.   |  | <i>Hydrobia ulvæ</i> . A few.    |
| <i>Cardium edule</i> . One.        |  | <i>Aplysia punctata</i> . Spawn. |
| <i>Littorina littorea</i> . A few. |  |                                  |

## PISCES.

- |   |  |  |
|---|--|--|
| <i>Cottus bubalis</i> . Four, 4.0-11.7 c.m.   |  | <i>Labrus maculatus</i> . Two, 2.0-2.5 c.m.      |
| <i>Gobius minutus</i> . Several, 1.8-5.3 c.m. |  | <i>Crenilabrus melops</i> . Eleven, 1.0-2.1 c.m. |

STATION 14. CHANNEL BETWEEN PIER AND MOUTH  
OF HARBOUR.

The fauna in the channel of the estuary now under consideration consists of a very limited number of species. From the pier to a point about half-way towards the Checkstone Ledge the dredge brought up a number of rounded stones, obviously much worn by the scour of the tide, and with very few animals living amongst them. The tidal stream is here very rapid.

STATION 14A. FIRST HALF OF CHANNEL FROM PIER TO  
CHECKSTONE LEDGE.

**List of Species. Dredge.**

JULY 9TH, 1901.

HYDROZOA.

*Sertularia argentea*. Common on stones.

ECHINODERMA.

*Echinus miliaris*. One small.

CRUSTACEA.

<i>Pagurus Bernhardus</i> . Two small.		<i>Aora gracilis</i> . Two.
<i>Amphithoë rubricata</i> . Two.		

MOLLUSCA.

*Mytilus edulis*. One large ; many very small.

*Tapes pullastra*. Shells.

*Buccinum undatum*. Three small.

Proceeding down the estuary, the portion between that last described and the Checkstone Ledge was found to be occupied by large masses of the sponge *Halichondria panicea*, with which the dredge was almost filled. A limited fauna was associated with this sponge, as detailed below.

STATION 14B. SECOND HALF OF CHANNEL FROM PIER TO  
CHECKSTONE LEDGE.

[Sponge Ground off Clock Tower.]

**List of Species. Dredge.**

JULY 9TH, 1901.

PORIFERA.

*Halichondria panicea*. The dredge came up filled with large masses of this sponge.

HYDROZOA.

*Tubularia* sp. Several very small colonies.

ECHINODERMA.

*Amphiura elegans*. One or two.

*Ophiothrix fragilis*. Several small.

TURBELLARIA.

*Leptoplana tremellaris*. One.

POLYCHÆTA.

*Euphrosyne foliosa*. One.

*Nereis pelagica*. Several specimens.

| *Polymnia nebulosa*. Small specimens.

## CRUSTACEA.

Cancer pagurus. One very small one.	Gammarus locusta. Several.
Carcinus mænas. Very small, common.	Amphithoë rubricata. One.
Porcellana platycheles. One.	Aora gracilis. Two.
Dexamine spinosa. A few.	

## MOLLUSCA.

Mytilus edulis. Young, very common.	Rissoa parva. One.
Tapes virginea. One small one.	Nassa incrassata. One.

## POLYZOA.

Scrupocellaria scruposa. Several colonies on sponge.

Below the Checkstone Ledge the bottom of the channel is covered with large masses of mussels (*Mytilus edulis*), which afford a regular fishery to a number of small boats (cf. p. 326). The mussels are often united together into large masses eight inches or a foot in diameter. Only a few other species are associated with the mussels.

## STATION 14C. MUSSEL BANK.

**List of Species. Dredge.**

JULY 9TH, 1901.

## ECHINODERMA.

Amphiura elegans. One.

## TURBELLARIA.

Leptoplana tremellaris. One.

## POLYCHÆTA.

Sthenelais boa. One.

## CRUSTACEA.

Carcinus mænas. Several.	Melita palmata. One.
Pagurus Bernhardus. One.	

## MOLLUSCA.

Mytilus edulis. Abundant.	Buccinum undatum. One small.
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Beyond the mussel bed the dredge brought up only clean stones.

## STATION 15. MERE BAY.

**List of Species. Mosquito Net Trawl.**

AUGUST 7TH, 1901.

## CRUSTACEA.

Stenorhynchus phalangium. One.	Macromysis flexuosa. Many.
Crangon vulgaris. Common.	Gammarus locusta. Common.
Palæmon serratus. Several small.	

## PISCES.

Gobius minutus. Four, 2.0-5.0 cm.	Labrus maculatus. One small one.
Blennius pholis. Two, 2.0-2.5 cm.	Crenilabrus melops. Twenty-four,
Gasterosteus spinachia. One, 5.2 cm.	2-3.1 cm.

## List of Species. Professional Seine.

APRIL 8TH, 1897. FROM RECORDS MADE BY MR. E. W. L. HOLT.

## PISCES.

Cottus bubalis. Several.	Pleuronectes platessa. Seventy-three.
Ammodytes (tobianus?). Many.	(For details see p. 333.)
Rhombus lævis. Two, 18 cm.	Salmo sp. One, 34 cm.

## STATION 16. POLESANDS.

Polesands is a large triangular sand bank, situated at the mouth of the Exmouth estuary, which is uncovered at low water. The bank, along its north-eastern edge, forms the border of the main channel of the estuary, and is consequently under the influence of the full force of the tidal stream. The sand on this side is somewhat coarse and loose, and the edge of the bank at low water is steep. In this loose sand the only animal found was the Polychæte *Ophelia bicornis*, which lives there in great abundance.

The southern side of the Polesands faces the open water of the English Channel, and is therefore at times subject to the influence of powerful wave-action. The sand is here fine but firm, and shelves very gently, leaving extensive flats uncovered at low spring tides. In spite of the exposed situation, many interesting sand-burrowing animals are found, forming a fauna which differs much from that of the sand banks inside the estuary. The most characteristic species are *Aricia Latreillii*, *Portunus holsatus*, *Portumnus variegatus*, *Tellina tenuis*, *Donax vittatus*, *Mactra solida*, *Solen ensis*, *Solen siliqua*, and *Natica catena*. A large Nemertine, at present unidentified, was also found here.

## List of Species. Shore Collecting.

JULY 14TH, 17TH, AUGUST 3RD, SEPTEMBER 1ST, 1901.

## HYDROZOA.

Perigonimus repens. A few colonies growing on *Donax*.  
Sertularia argentea. A few pieces.

## ECHINODERMA.

Echinocardium pennatifidum. A few broken pieces.

## POLYCHÆTA.

Nephtys Hombergii. Common.	Arenicola marina. One or two.
„ cirrosa. Common.	Ophelia bicornis. Common in coarse
Aricia Latreillii. Not uncommon.	loose sand.

## CRUSTACEA.

<i>Carcinus maenas</i> . Not uncommon.	<i>Pagurus Bernhardus</i> . One.
<i>Portunus holsatus</i> . Two.	<i>Crangon vulgaris</i> . Common.
<i>Portunus variegatus</i> . Eight buried in sand ; many cast shells.	<i>Haustorius arenarius</i> . Common ; buried in the sand.
<i>Corystes cassivelaunus</i> . One ♀ in berry.	

## MOLLUSCA.

## (LIVING.)

<i>Anomia ephippium</i> . Three on shell of	<i>Donax vittatus</i> . Very common at low- water mark.
<i>Mytilus edulis</i> . Several. [ <i>Trochus magus</i> .	<i>Macra solida</i> . Common.
<i>Cardium echinatum</i> . Three.	<i>Solen ensis</i> . Not uncommon.
„ <i>norvegicum</i> . Two.	„ <i>siliqua</i> . Not uncommon.
<i>Venus gallina</i> . One.	<i>Trochus umbilicatus</i> . One.
<i>Tellina tenuis</i> . Very common at low- water mark, 2-3 inches below the surface.	<i>Natica catena</i> . A dozen.
	<i>Purpura lapillus</i> . One.

## (SHELLS ONLY.)

<i>Ostræa edulis</i> .	<i>Macra stultorum</i> .
<i>Pecten maximus</i> .	<i>Lutraria elliptica</i> .
„ <i>opercularis</i> .	<i>Trochus magus</i> .
<i>Diplodonta rotundata</i> .	<i>Turritella terebra</i> .
<i>Cardium aculeatum</i> .	<i>Buccinum undatum</i> .
<i>Venus chione</i> .	<i>Cypræa europæa</i> .

## EAST BANK OF POLESANDS.

## List of Species. Professional Seine.

JULY 14TH, 1901.

## PISCES.

<i>Labrax lupus</i> . One or two.	<i>Rhombus lævis</i> . One.
<i>Trachinus (vipera ?)</i> . One.	<i>Pleuronectes limanda</i> . One or two.
<i>Mugil chelo</i> . One.	„ <i>platessa</i> . One or two.
<i>Ammodytes tobianus</i> . Very many.	<i>Belone vulgaris</i> . One.

## STATION 17. GROUNDS OUTSIDE POLESANDS.

## BETWEEN POLE AND MONSTER SANDS.

## List of Species. Mosquito Net Trawl.

JULY 23RD, 1901.

## CRUSTACEA.

<i>Crangon vulgaris</i> . A few.	<i>Paratylus Swammerdami</i> . Two.
<i>Schistomysis Parkeri</i> . One.	<i>Gammarus locusta</i> . Several.

## MOLLUSCA.

*Hydrobia ulvæ*. Several.

## PISCES.

<i>Agonus cataphractus</i> . One, 4.8 cm.
<i>Gasterosteus spinachia</i> . One.
<i>Syngnathus rostellatus</i> . Two, 7.4 and 13.4 cm.



## QUARTER-MILE SOUTH OF POLESANDS.

**List of Species. Mosquito Net Trawl.**

JULY 19TH, 1901.

## CRUSTACEA.

Stenorhynchus phalangium. Four.	Leptomysis lingua. One.
Carcinus maenas. One small one.	Macromysis flexuosa. One.
Portunus depurator. One.	Idothea balthica. Several.
Pagurus Bernhardus. One.	„ linearis. A few.
Crangon vulgaris. Many large.	Paratylus Swammerdami. Four.
Hippolyte varians. One.	Gammarus locusta.
Leptomysis mediterranea. Two.	

## MOLLUSCA.

Trochus magus. One small one.		Philine aperta. One.
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## PISCES.

Syngnathus rostellatus. Seven, 5.9-14.9 cm.

## THE BAR.

**List of Species. Mosquito Net Trawl.**

JULY 27TH, 1901.

## CRUSTACEA.

Carcinus maenas. Three, two with <i>Sacculina</i> .	Idothea linearis. Several.
Crangon vulgaris. Many, some large.	„ balthica.
Hippolyte varians. One.	Paratylus Swammerdami. Several.
	Gammarus locusta. Common.
	Sacculina carcini. Two on <i>Carcinus</i> .

## PISCES.

Syngnathus rostellatus. Seven, 5.8-11.5 cm.

## STATION 18. ORCOMBE ROCKS.

The rocks are of red sandstone, and are so situated that, although often exposed to the full force of the Channel seas, their fauna must be largely influenced by the water flowing out of the estuary of the Exe.

**List of Species. Shore Collecting.**

AUGUST 17TH, 1901.

## PORIFERA.

Sycon compressum. Common.		Halichondria panicea. Very common.
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## HYDROZOA.

Sertularia pumila. Common.

## ACTINOZOA.

Actinia mesembryanthemum. Common.  
 Anthea cereus. Common.

## ECHINODERMA.

*Amphiura elegans.* Common.

## POLYCHÆTA.

<i>Lepidonotus clava.</i> Not uncommon. <i>Marphysa sanguinea.</i> One or two. <i>Nereis cultrifera.</i> One. „ <i>fucata.</i> One in shell with <i>Eupagurus Bernhardus.</i>	<i>Nereis irrorata.</i> One. <i>Eulalia viridis.</i> A few. <i>Andouinia tentaculata.</i> One. <i>Sabellaria alveolata.</i> Very common. <i>Pomatoceros triqueter.</i> Several.
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## CRUSTACEA.

<i>Cancer pagurus.</i> Small. <i>Portunus puber.</i> A few. <i>Porcellana platycheles.</i> Common.	<i>Pagurus Bernhardus.</i> Small, common. <i>Gnathia maxillaris.</i> <i>Idothea balthica.</i>
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## MOLLUSCA.

<i>Mytilus edulis.</i> Young, very common. <i>Kellia suborbicularis.</i> One. <i>Saxicava rugosa.</i> Common. <i>Pholas dactylus.</i> Common. „ <i>parva.</i> Common. <i>Patella vulgata.</i> Very common.	<i>Trochus cinerarius.</i> Shells. <i>Rissoa parva.</i> One. <i>Purpura lapillus.</i> Very common. <i>Buccinum undatum.</i> Shells. <i>Cypræa europæa.</i> A few.
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## POLYZOA.

*Membranipora membranacea.* Common.  
*Bugula turbinata.* Common.

## PISCES.

<i>Blennius pholis.</i> Common.	<i>Ammodytes tobianus.</i> One.
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## STATION 19. EXMOUTH DOCK.

As the *Dawn* was moored in Exmouth Dock opportunities were constantly offered for observations on the fauna there found. The dock gates are opened daily, generally about an hour before high water. The dock itself being small, the water in it is in this way very frequently changed, and a considerable number of animals flourish in the sheltered situation which it provides. During the present summer one of the most interesting features of this dock fauna was the immense profusion of the Ascidian *Ciona intestinalis*, which covered the wall and piles underneath the Engineering Company's stage on the eastern side of the dock. The two walls immediately inside the dock gates were also covered with these Ascidians (cf. also p. 330). The Polyzoan *Bugula turbinata* covered the bottom of the *Dawn* and other boats which remained in dock during the summer, and considerable numbers of *Ascidiella aspersa* and *Ciona intestinalis* were found in the same situation.

## List of Species.

## PORIFERA.

*Sycon ciliatum* (?). Common on the piles.

## HYDROZOA.

*Hydractinia echinata*. On shell inhabited by *Pagurus* from prawnpot.

## POLYCHÆTA.

Small *Nereids*, probably young *N. diversicolor*.

*Polymnia nebulosa*. Small specimens from amongst the Ascidians under stage.

## CRUSTACEA.

*Cancer pagurus*. A few small ones seen.

*Carcinus maenas*. Common.

*Portunus puber*. Several small and large seen.

*Pagurus Bernhardus*. One caught in prawnpot.

*Homarus vulgaris*. Not uncommon in holes in the dock walls.

*Palæmon serratus*. Common.

*Macromysis flexuosa*. Common.

*Schistomysis Helleri*. One.

*Ligia oceanica*. Common on the walls above water-level.

*Dexamine spinosa*. One or two.

*Gammarus locusta*. Not uncommon on the piles, among weed, etc.

*Notopterophorus gibber*. Not uncommon in pharyngeal cavity of *Ciona*.

*Bopyrus squillarum*. Two parasitic on *Palæmon*.

## MOLLUSCA.

*Anomia ephippium*. One on dock wall.

*Antipa cristata*. Several on walls, piles, and boats in dock.

*Elysia viridis*. One or two on piles.

## POLYZOA.

*Bugula turbinata*. Common underneath stage and on boats.

## TUNICATA.

*Ciona intestinalis*. Extremely common on the piles and wall underneath the Engineering Company's stage, on the dock walls between the swing bridge and the dock gates, and in less quantity on the bottoms of various boats.

*Ascidiella aspersa*. Common in same situations as *Ciona*.

## PISCES.

*Gobius Ruthensparri*. Common, one caught. 5.3 cm.

„ *paganellus*. Several caught in prawnpot. 10.1, 7.2, 5.9, 5.1, 8.0 cm.

*Blennius pholis*. Common in crevices in wall.

*Atherina presbyter*. A shoal seen (Aug. 16th); those captured measured 7.1-1.1 cm.

*Mugil chelo*. Large ones common; a shoal of young ones seen (Aug. 16th, 1901).

*Gasterosteus aculeatus*. One caught (Aug. 16th) among young grey mullet (*Mugil spinachia*, 2.5 cm. [chelo].

*Labrus maculatus*. One caught, 15.0 cm. long.

*Crenilabrus melops*. Several caught, 7.7 cm.

*Gadus pollachius*. One caught, 4 cm. long.

*Ammodytes tobianus*. Shoals common.

*Anguilla vulgaris*. Two caught, about 23 cm.

*Conger vulgaris*. One of about 4 lbs. seen.

*Syngnathus rostellatus*. Several caught.

### III. A Complete List of the Species Identified, with an Account of their Local Distribution.

#### ACTINOZOA.

[Nomenclature: Gosse, *British Sea Anemones and Corals*.]

ANTHEA CEREUS (*Ellis and Solander*). Not uncommon among Orcombe Rocks.

ACTINIA MESEMBRYANTHEMUM, *Ellis and Solander*. Common among Orcombe Rocks.

Anemones were only found at Orcombe Rocks at the mouth of the harbour. None were seen within the estuary itself. The absence of *Sagartia bellis*, which is so common on the mud-flats at Salcombe and in the Yealm, is noteworthy, but is probably explained by the fact that a stony ground, covered with a moderately thin layer of mud, such as this species requires, is not met with in the Exe.

#### PORIFERA.

HALICHONDRIA PANICEA, *Pallas*. Dredged in large quantities in the channel between the pier and Checkstone Ledge (sta. 14B). The sponge occurred in large masses, less dense in structure and with a looser and more fibrous skeleton than the variety of this species commonly found on rocks on the shore. (See note by Mr. Bidder, p. 380, to whom we are indebted for the examination and identification of the specimens.) The shore variety occurred at Orcombe Rocks.

SYCON COMPRESSUM, found at Orcombe Rocks, and S. CILIATUM (?) in Exmouth Dock.

#### HYDROZOA.

[Nomenclature: HINCKS, *British Hydroid Zoophytes*.]

HYDRACTINIA ECHINATA (*Fleming*). A colony from the dock on *Buccinum* shell inhabited by *Pagurus Bernhardus*.

PERIGONIMUS REPENS (*T. S. Wright*). A few colonies on the posterior ends of *Donax vittatus*, from Polesands.

SERTULARIA PUMILA, *Linn.* Common at Orcombe Rocks.

SERTULARIA ARGENTEA, *Ellis and Solander*. Dredged in channel (sta. 14B): found on Polesands.

#### ECHINODERMA.

[Nomenclature: JEFFREY BELL, *Catalogue of British Echinoderms in the British Museum*.]

OPHIOTHRIX FRAGILIS (*O. F. Müller*). A few small ones dredged on the sponge ground in the channel (sta. 14B).

AMPHIURA ELEGANS (*Leach*). Common under stones at Orcombe Rocks. A few dredged on the sponge ground (sta. 14B).

ECHINUS MILLIARIS (*Gmelin*). One dredged in the channel off the pier (sta. 14A).

## GEPHYREA.

PHASCOLOSOMA VULGARE, *Blainville*. Common in a small patch of muddy sand with large gravel, at low-water mark, on the east side of the stream draining Greenland Lake (sta. 12). Many of the specimens had colonies of *Loxosoma phascolosomatum* growing on the posterior end. As at Salcombe, the ground where this species was found was very limited in size, but the number of specimens obtained was considerable. The nature of the soil, however, in which the species lived at Exmouth differed considerably from the stiff clay-gravel lying on hard clay in which it was found at Salcombe.

## TURBELLARIA.

LEPTOPLANA TREMELLARIS (*O. F. Müller*). One dredged on the sponge ground off the Clock Tower (sta. 14B), and one on the mussel bank (sta. 14C).

## POLYCHÆTA.\*

[Nomenclature: DE SAINT-JOSEPH, "Les Annélides Polychètes des Côtes de Dinard," *Ann. Sci. Nat. Zoologie*, 1887-95; "Les Annélides Polychètes des Côtes de France (Manche et Océan)," ditto, 1898.]

EUPHROSINE FOLIOSA, *Audouin et Edwards*. One specimen only dredged on the sponge ground (sta. 14B).

LEPIDONOTUS CLAVA, *Montagu*. Not uncommon on the shore at Orcombe Rocks.

EVARNE IMPAR, *Johnston*. One specimen was found hiding under a tile on the sand west of the mouth of Salthouse Lake (sta. 10).

STHENELAIS BOA, *Johnston*. One specimen was dredged on the mussel bed in the channel below Checkstone Ledge (sta. 14C). It was never met with on the shore between tide-marks, as at Salcombe and Plymouth.

MARPHISA SANGUINEA, *Montagu*. One specimen only, from Orcombe Rocks.

NEREIS CULTRIFERA, *Grube*. Only met with at Orcombe Rocks, quite at the mouth of the estuary, and there but one specimen was found. This is noteworthy, as *N. cultrifera* is one of the commonest species found on the shore both in Plymouth Sound and in the Salcombe estuary.

NEREIS PELAGICA, *Linn.* A few specimens amongst the masses of sponge (*Halichondria panicea*) dredged in the main channel below the pier (sta. 14B).

NEREIS FUCATA, *Savigny*. Found once in a shell inhabited by *Eupagurus Bernhardus* taken at Orcombe Rocks.

\* By E. J. ALLEN.

*NEREIS DIVERSICOLOR*, *O. F. Müller*. Very common in the upper parts of the estuary, especially in the mud at Greenlands (sta. 1), at the mouth of Kenn River (sta. 3), below Powderham (sta. 4), and on the mud north of Salthouse Lake (sta. 11). A few were taken east of Powderham mussel beds (sta. 2) and in muddy sand at Cocklesand (sta. 13). As is usually the case, this species is most abundant where the water is of low density.

*NEREIS IRRORATA* (*Malmgren*). One specimen only outside the estuary at Orcombe Rocks.

*NEREIS LONGISSIMA*, *Johnston*. One specimen on Bullhill Bank, and one on the mud north of Salthouse Lake (sta. 11). The rarity of this species is noteworthy, as it was abundant in fine muddy sand in the upper parts of Salcombe estuary.

*NEPHTHYS CÆGA* (*Fabricius*). Several large specimens from Bullhill Bank (sta. 9).

*NEPHTHYS HOMBERGII*, *Audouin et Edwards*. As at Salcombe, this species was commonly found in sand and muddy sand all over the estuary. Where the ground became very muddy it disappeared.

*NEPHTHYS CIRROSA*, *Ehlers*, was found in considerable numbers on grounds where the soil was fine clean sand, but did not occur in any other localities. It appears to be only able to flourish in ground of this nature, and is therefore much more restricted in distribution than *Nephtys Hombergii*. *Nephtys cirrosa* was common on Polesands, on the sand of Bullhill Bank (sta. 9), and on the sand above Starcross (sta. 5); and one specimen is recorded from Cocklesand (sta. 13).

*GLYCERA CONVOLUTA*, *Keferstein*, was occasionally found on Bullhill Bank (sta. 9) and on the gravel between Powderham and Starcross (sta. 4).

*PHYLLODOCE* (? *maculata*, *Linn.*). A *Phyllodoce*, which appears to be referable to this species as described by Johnston (*British Museum Catalogue*, 1865), was taken on the sandy ground between Starcross and Cockwood (sta. 8).

*PHYLLODOCE TERES*, *Malmgren*. Found in fine clean sand on two grounds in the upper part of the estuary, viz. the sand bank above Starcross (sta. 5) and the sand west of Salthouse Lake (sta. 10). It is also recorded from the gravel between Powderham and Starcross (sta. 4), though the exact nature of the ground where the two specimens were taken was not noted. I found this species also at Teignmouth in clean sand, which appears to be its normal habitat (cf. *Malmgren, Nordiska Hafs. Annulater*, 1865, p. 97).

*ETEONE PUSILLA*, *Oersted* (nec *Malmgren*), was found several times

NO OTHER SPECIES OF *ARENICOLA* WAS FOUND.

CLYMENIDS, probably belonging to two species of the genus *Praxilla*, were found in the sand west of Salthouse Lake (sta. 10). One small one was taken in the sand between Starcross and Cockwood (sta. 8).

*OPHELIA BICORNIS*, *Savigny* (*vide de St.-Joseph, Ann. Sci. Nat.*, v., 1898, p. 380). The sand on the north-eastern side of the Polesands, that is, the side nearest to the main channel of the estuary, is somewhat coarse and loose. The only animal found living in it was *Ophelia bicornis*, but this worm was present in great numbers. It was only necessary to dig into the sand with the hand, when one or two specimens would be exposed. It was also found in moderate numbers in sand of a somewhat similar nature on the highest part of Bullhill Bank, that is, the portion first uncovered on the fall of the tide. Single specimens of the species were met with on the north side of the Warren (sta. 12), in the sand below Lymptone mussel beds (sta. 6), and in the Cocklesand (sta. 13).

*POLYMNIA NEBULOSA*, *Montagu*. A few specimens from the dock, and from dredging material from the sponge ground below the pier (sta. 14B).

*LANICE CONCHILEGA* (*Pallas*) was very common on the banks in the estuary, where there was a large proportion of gravel mixed with clean sand. It was particularly abundant on the north side of the Warren (sta. 12), between Cockwood and Starcross (sta. 8), between Starcross and Powderham (sta. 4), on all which grounds the soil was of the

at Exmouth in clean fine sand, generally in the same kind of soil as *Phyllodoce teres* (stations 5, 8, and 10). I also found it at Teignmouth under similar circumstances. The specimens agree with Oersted's original description (*Ann. Dan. Conspec.*, 1843, p. 30), "papillis caudalibus subglobosis," and not with Malmgren's figure and description (*Nord. Hafs. Ann.*, 1865, p. 102 and Tab. XV. Fig. 37), "cirri anales lineare-fusiformes elongati." The head also resembles Oersted's figure rather than that figured by Malmgren.

*EULALIA VIRIDIS*, Müller. Two specimens, from Orcombe Rocks, at the mouth of the estuary.

*AUDOUINIA TENTACULATA*, Montagu. One specimen only, from Orcombe Rocks. The entire absence of this species from the estuary itself is noteworthy.

*HETEROMASTUS FILIFORMIS*, Claparède. A few specimens of this species were taken in the sand west of Salthouse Lake (sta. 10).

*PYGOSPIO SETICORNIS* (Oersted) and *PYGOSPIO ELEGANS*, Claparède. (*Vide* Mesnil, "Études de Morphologie externe chez les Annélides," *Bull. Sci. France et Belge*, xxx., 1897, p. 85.)

The distinction between these two species depends almost entirely upon the presence or absence of a pair of branchiæ on the second setigerous segment, these branchiæ being present in *P. seticornis* and absent in *P. elegans*. As, however, these branchiæ seem often to be lost in preserved specimens, the distinction between the two species cannot be satisfactorily made with such material. Unfortunately I was unacquainted with Mesnil's paper on the subject at the time when the specimens were obtained, and as in the preserved collections specimens from the same locality sometimes showed and sometimes did not show the branchiæ in question, I have in the lists included all under the name *P. seticornis*, though I have some reason to think that both species are represented in the estuary.

The tubes of *Pygospio* were abundant in the clean hard sand of the estuary (stations 5, 8, 9, 10, and 13), but were not seen in the hard sand at Polesands, where the conditions are marine.

*NERINE CONIOCEPHALA*, Johnston. This species is closely allied to, if not identical with, *N. foliosa*, Aud. et Edw. The Exmouth specimens agree with Johnston's description in having the front of the head bluntly conical and pointed, not rounded as described by Cunningham and Ramage (*Trans. Roy. Soc. Edinb.*, 1888) for *N. coniocephala*, and by de St.-Joseph and Mesnil for *N. foliosa*. The anus is not surrounded by cirri.

Several specimens were obtained in the sand west of Salthouse Lake (sta. 10) and in the hard clayey mud to the north of it (sta. 11).

NERINE CIR RATULUS (*Delle Chiaje*). Specimens were found on Bullhill Bank and Cocklesand.

SCOLOPLOS ARMIGER, *O. F. Müller*, was not uncommon in sand on all the banks in the upper part of the estuary, but was not found on the Polesands.

ARICIA LATREILLII, *Audouin et Edwards*, was moderately plentiful in the hard sand on the south of the Polesands. The specimens were here very large. One small specimen, probably belonging to the same species, was found in the sand between Starcross and Cockwood (sta. 8).

ARENICOLA MARINA, *Linn.*, was very abundant in all the sand and gravel in the estuary itself, but only one specimen is recorded from the Polesands. One only was obtained from the mud at Greenlands (sta. 1). The species was most abundant in the fine clean sand, becoming less plentiful in coarse ground. It was noticed that in ground where *Arenicola* became less plentiful the Terebellid *Lanice conchilega* became more abundant, and *vice versa*.

No other species of *Arenicola* was found.

CLYMENIDS, probably belonging to two species of the genus *Praxilla*, were found in the sand west of Salthouse Lake (sta. 10). One small one was taken in the sand between Starcross and Cockwood (sta. 8).

OPHELIA BICORNIS, *Savigny* (*vide de St.-Joseph, Ann. Sci. Nat.*, v., 1898, p. 380). The sand on the north-eastern side of the Polesands, that is, the side nearest to the main channel of the estuary, is somewhat coarse and loose. The only animal found living in it was *Ophelia bicornis*, but this worm was present in great numbers. It was only necessary to dig into the sand with the hand, when one or two specimens would be exposed. It was also found in moderate numbers in sand of a somewhat similar nature on the highest part of Bullhill Bank, that is, the portion first uncovered on the fall of the tide. Single specimens of the species were met with on the north side of the Warren (sta. 12), in the sand below Lympstone mussel beds (sta. 6), and in the Cocklesand (sta. 13).

POLYMNIA NEBULOSA, *Montagu*. A few specimens from the dock, and from dredging material from the sponge ground below the pier (sta. 14B).

LANICE CONCHILEGA (*Pallas*) was very common on the banks in the estuary, where there was a large proportion of gravel mixed with clean sand. It was particularly abundant on the north side of the Warren (sta. 12), between Cockwood and Starcross (sta. 8), between Starcross and Powderham (sta. 4), on all which grounds the soil was of the nature described. It was met with in smaller quantity on the banks



where the soil was fine sand, *e.g.* Bullhill Bank (sta. 9), Cocklesand (sta. 13), and between Cockwood and Salthouse (sta. 10). It was not seen on the Polesands. This distribution is interesting when compared with the distribution at Salcombe, where the species occurred in great quantity on the fine clean sands near the mouth of the harbour.

As already pointed out under *Arenicola marina*, the latter species was very abundant on the fine clean sand banks where *Lanice* was not plentiful, whilst as the ground became coarser *Lanice* became abundant and *Arenicola* scarce.

*SABELLARIA ALVEOLATA*, *Linn.* This worm was very common at Orcombe Rocks at the mouth of the estuary, forming the usual reef-like masses.

*MELINNA ADRIATICA*, *von Marenzeller.* One or two specimens only were found at each of the following localities: the Gravel between Powderham and Starcross (sta. 4), between Starcross and Cockwood (sta. 8), and on the sand west of the mouth of the Salthouse Lake (sta. 10).

The scarcity of this species in the estuary is noteworthy, as in the upper parts of the Salcombe estuary it occurred in enormous profusion in the mud-flats, especially in the very fine and soft mud. On the mud-flat at Greenlands, the highest part of the Exe estuary examined, and where the mud was in places very soft, not a single specimen was taken.

*POMATOCEROS TRIQUETER* (*Linn.*). Found only at Orcombe Rocks, at the mouth of the estuary.

## CRUSTACEA.\*

### DECAPODA.

[Nomenclature: *BELL, Stalk-eyed Crustacea.*]

*STENORHYNCHUS PHALANGIUM* (*Pennant*). Three from Bullhill Deep Pit, one between Cocklesand and Bullhill Bank (sta. 13), one from Mere Bay (sta. 15), and four outside Polesands, all with mosquito net trawl.

*CANCER PAGURUS*, *Linnaeus.* Small ones not uncommon among Orcombe Rocks; one small one dredged on the sponge ground off the Clock Tower (sta. 14B), and a few small ones in the dock.

*CARCINUS MÆNAS* (*Pennant*). Taken in almost every haul with the mosquito net trawl. Collected on Polesands and on most of the grounds above the Warren and in the dock.

*PORTUNUS VARIEGATUS*, *Leach.* About half a dozen were found on the smooth sand on the west side of Polesands, buried an inch or two

\* By R. A. TODD.

below the surface. After the flood-tide has started they seem to burrow a foot or so, generally in a direction towards the incoming tide, keeping just below the surface of the sand, and leaving a line of zigzag indentations on the surface, with a larger indentation at the end from which they started. One female was found in berry, July 3rd, 1901. One living specimen had a fairly large tuft of a green filamentous alga growing on the rostrum. Large numbers of cast shells were found on Polesands on July 17th, 1901.

*PORTUNUS PUBER* (*Linnaeus*). Not uncommon in the dock and at Orcombe Rocks.

*PORTUNUS DEPURATOR*, *Leach*. One taken in mosquito net trawl outside Polesands.

*PORTUNUS HOLSATUS*, *Fabricius*. Two or three living specimens were found buried in the sand on Polesands.

*CORYSTES CASSIVELAUNUS* (*Pennant*). A female with ova found buried in sand on Polesands, July 17th, 1901.

*PAGURUS* (*EUPAGURUS*) *BERNHARDUS* (*Linnaeus*). A few small ones on Bullhill Bank (gravel), one or two between Bullhill Bank and Cocklesand, one from Polesands, one in the dock, the latter with *Hydractinia*: small ones fairly common on Orcombe Rocks.

*PORCELLANA PLATYCHELES* (*Pennant*). Common under stones and in crevices at Orcombe Rocks, and one dredged on the sponge ground off Clock Tower (sta. 14B).

*HOMARUS VULGARIS*, *M.-Edwards*. Not uncommon in holes in the dock walls. They are caught by being enticed out with bait and speared.

*CRANGON VULGARIS*, *Fabricius*. Small and medium-sized shrimps were more or less abundant on all the sand- and mud-flats; large ones were only taken outside Polesands, on the Bar, and at Straight Point.

*HIPPOLYTE* (*VIRBIUS*) *VARIANS*, *Leach*. A few small ones were taken with the mosquito net trawl in Bullhill Deep Pit, two between Bullhill Bank and Cocklesand, and one on the Bar, all of a bright green colour.

*PALEMON SERRATUS* (*Pennant*). One or two only from Bullhill Deep Pit, the channel between Bullhill Bank and Cocklesand, Mere Bay, and Kingslake. Common in the dock and at Straight Point, the latter being the locality where they, as well as shrimps, are taken for sale.

*GASTROSACCUS SPINIFER* (*Goës*). Nine were taken with the mosquito net trawl on the gravel on the west side of Bullhill Bank.

*LEPTOMYSIS MEDITERRANEA*, *G. O. Sars*. Two taken off the Polesands in 2-3 fathoms.

*LEPTOMYSIS LINGURA*, *G. O. Sars*. One taken off the Polesands in 2-3 fathoms.

MACROMYSIS FLEXUOSA, *Müller*. Taken everywhere in more or less abundance when using the mosquito net trawl. Common in the dock.

SCHISTOMYSIS PARKERI, *A. M. Norman*. One taken between Pole and Monster Sands.

SCHISTOMYSIS HELLERI, *G. O. Sars*. More or less common everywhere inside the estuary with *M. flexuosa*. One taken in the dock.

We are indebted to Mr. W. I. Beaumont for the following note on this species:—

“The specimens of *Schistomysis Helleri* from Exmouth, while agreeing generally with the descriptions of Sars and Norman, and with the figures of the first-named author, apparently fail to conform to the type in certain particulars, as did those found at Salcombe last summer. In the half-dozen adult specimens examined (males and females, from 9 to 13 mm. in length, inclusive of antennal scales and uropods), the number of spines on the margin of the inner uropods varied from twelve to sixteen, while an immature example of 8 mm. had already nine and ten spines respectively on those appendages; and in all the difference in length between inner and outer uropods is less marked than in the type. A further want of agreement with the published descriptions concerns the last pair of pereopods, which in Exmouth examples cannot be strictly described as ‘rudimentary,’ or as being ‘about half the length of preceding pairs.’ In point of fact they are very much shorter than some of the anterior pairs, but the decrease in size is exhibited gradually in successive pairs; and, moreover, a nail is present, though small.”

NEOMYSIS VULGARIS (*J. V. Thompson*). A few taken on the sand bank east of Powderham mussel beds (sta. 2).

#### ISOPODA.

[Nomenclature: G. O. Sars, *Crustacea of Norway*, vol. ii.]

GNATHIA MAXILLARIS (*Montagu*). A few taken in crevices at Orcombe Rocks.

IDOTHEA BALTHICA (*Pallas*). A few were taken at each of the following localities: South of Polesands, sand bank off Starcross, Bullhill Bank, the Bar, Cocklesand, and Orcombe Rocks.

IDOTHEA LINEARIS. One or two were taken on the Bar, south of Polesands, and on Bullhill Bank.

LIGIA OCEANICA (*Linnaeus*). Common on the dock walls, above water-level.

SPHÆROMA SERRATUM. Fairly common on gravel on Bullhill Bank.

BOPYRUS SQUILLARUM. Two on *Palæmon serratus* from the dock.

## AMPHIPODA.

[Nomenclature: G. O. SARS, *Crustacea of Norway*, vol. i.]

TALITRUS LOCUSTA (*Pallas*). Very common under weed at high-water mark south of Cocklesand and on the north side of the Warren (sta. 12). Not uncommon burrowing in the sand at Cocklesand.

BATHYPOREIA PELAGICA, *Sp. Bate*. Twenty in mosquito net trawl on sand bank off Starcross, one on Bullhill Bank, three between Cockwood and Bullhill Bank.

HAUSTORIUS ARENARIUS (*Slabber*). Not uncommon in the smooth sand west of Polesands. One in Shaggles Sand (sta. 5) and one in clean sand on north side of Warren (sta. 12).

SYNCHELIDIUM SP. One taken on Bullhill Bank.

PARATYLUS SWAMMERDAMI (*M.-Edwards*). A few were taken at each of the following localities: Between Pole and Monster Sands, south of Polesands, between Bullhill Bank and Cocklesand, and on the Bar.

DEXAMINE SPINOSA (*Montagu*). A few were taken among weeds on a boat in the dock, and on the sponge ground off the Clock Tower (sta. 14B).

GAMMARUS LOCUSTA, *Linnaeus*. More or less common in nearly all hauls with the mosquito net trawl.

MELITA PALMATA (*Montagu*). One was taken with the mosquito net trawl on Bullhill Bank gravel.

AMPHITHOE RUBRICATA (*Montagu*). One dredged on sponge ground off the Clock Tower (sta. 14B).

AORA GRACILIS, *Sp. Bate*. Two from sponge ground off the Clock Tower (sta. 14B).

COROPHIUM GROSSIPES, *Linnaeus*. Common burrowing in the muddy sand north of Salthouse Lake (sta. 11).

## CIRRIPEDIA.

SACCULINA CARCINI (*J. V. Thompson*). Two on *Carcinus* from the Bar.

## COPEPODA.

NOTOPTEROPHORUS (DOROPYGUS) GIBBER (*Thorell*). Common in the pharyngeal cavity of *Ciona intestinalis* in the dock. The specimens were identified by Mr. R. Gurney.

## INSECTA.

## COLEOPTERA.

*HETEROCERUS FEMORALIS* (*Kies*). Very common burrowing in fine loose sand on Cocklesand. Fowler (*Coleoptera of the British Isles*, vol. iii. p. 385) gives its habitat as "Banks of ponds and ditches; not common; Sheerness, Gravesend, Deal, Hastings, Brighton, Weymouth, Exmouth, Wales, Hunstanton, Cleethorps, Manchester, Prestonmarsh (Lancs.), Lancaster; Scotland, local, Solway and Forth districts; Baldoye (Ireland). Species said to be chiefly maritime." The specimens were identified by Dr. Sharp.

## MOLLUSCA.\*

[Nomenclature: JEFFREYS, *British Conchology*.]

*ANOMIA EPHIPPIUM*, *Linnaeus*. Three small ones were taken on the Polesands, adhering to a shell of *Trochus magus*, and one on the dock wall underneath the stage.

*OSTREA EDULIS*, *Linnaeus*. Three were found on the gravel south-west of Starcross Pier (sta. 7) and a few shells on Polesands. There is no oyster fishery in the Exe.

*PECTEN OPERCULARIS* (*Linnaeus*). On Polesands, shells only.

*PECTEN MAXIMUS* (*Linnaeus*). On Polesands, shells only.

*MYTILUS EDULIS*, *Linnaeus*. Stray mussels were to be found everywhere in the estuary, the centre of distribution being a mussel bank which extends from Checkstone Ledge along the channel nearly to the mouth of the harbour. This bed is composed chiefly of mussels, mussel shells, and pebbles held together by the threads of the byssus of the mussel, thus forming a compact mass. The mussel fishermen, of whom there are about fifty belonging to Lympstone, Powderham, and Starcross, collect the mussels at low water, when they are only covered by two or three fathoms. The instrument used is a rake fixed to a pole 20-25 feet long, and having a wire-net bag attached behind it. The boat is moored by a kedge, and the mussels simply raked up from the bottom. When a sufficient number are caught they are taken up the river and laid on the mussel beds, which are on sand banks off Lympstone, Powderham, and Starcross, the Lympstone bed being much the largest. The mussels remain on these beds two to three years, by which time they are of a marketable size. They are then collected, washed, and sold either as bait or for food. The mussel beds are sometimes troubled by a large growth of weed, chiefly *Ulva* and *Enteromorpha*, which is kept down by winkles (*Littorina*

\* By R. A. TODD.

*littorea*) and by hand picking. If this weed be allowed to grow, large numbers of mussels die from suffocation, as the weed causes the sand to silt up over them. This year (1901) the beds have suffered considerably from this cause, probably on account of the large amount of sunshine during the summer. The young mussels, about 1 mm. long, were extremely abundant on the *Enteromorpha* on Bullhill Bank (July 4th, 1901), on weed from the sponge ground off the Clock Tower (July 9th, 1901), and at Orcombe Rocks (August 17th, 1901). A single filament of *Enteromorpha* formed a resting-place for a hundred or more young mussels.

*KELLIA SUBORBICULARIS* (*Montagu*). One was taken in a crevice at Orcombe Rocks.

*DIPLODONTA ROTUNDATA* (*Montagu*). One or two shells were taken on Polesands, probably washed up from outside. It seems probable that this species burrows very deeply in the sand, as we have never yet taken it alive, although shells are not uncommon in places.

*CARDIUM ACULEATUM*, *Linnaeus*. One valve of this species was found on Polesands.

*CARDIUM ECHINATUM*, *Linnaeus*. Three small living specimens and many shells were taken on Polesands, the living ones being found just below the surface.

*CARDIUM EDULE*, *Linnaeus*. Occurs in profusion on Cocklesand, Bullhill Bank, and all along the west side of the estuary, from the Warren upwards, wherever the ground is suitable. It is found either on the surface or buried just below, and its collection for sale gives employment to a fair number of men and women, who are generally to be seen at low tide armed with a "cock-rake," which is very like an ordinary garden hoe, and a basket. The ground is simply raked over, so that about half an inch to one inch of the surface is removed, and the cockles which are uncovered are then picked up.

*CARDIUM NORVEGICUM*, *Spengler*. Two living ones were obtained on the Polesands, lying on the surface of the sand. They were probably washed up from deeper water, the normal habitat of *C. norvegicum*.

*VENUS CHIONE*, *Linnaeus*. Valves only of this species were found on the Polesands.

*VENUS STRIATULA*, *Linnaeus*. One living one on the Polesands buried just below the surface.

*TAPES VIRGINEA* (*Linnaeus*). One very small one dredged on the sponge ground off the Clock Tower (sta. 14B).

*TAPES PULLASTRA* (*Montagu*). A few shells only, on gravel between Cockwood and Starcross (sta. 17).

*TAPES DECUSSATA* (*Linnaeus*). Living specimens were moderately common lying on the surface of the gravel on the north side of the Warren and east of the stream draining Greenland Lake (sta. 12). A few on gravel on Bullhill Bank and on coarse ground on Cocklesand.

*TELLINA BALTHICA*, *Linnaeus*. Common on the mud-flats between Cocklesand and the L. and S. W. Station; a few on mud south of Lymptone mussel bed, and one or two on the west bank of the estuary between the Warren and Powderham. Nearly all the specimens obtained were lying on the surface of the mud, only one having been obtained by digging. They appear to be very shy animals, as we never saw one expanded, although they were kept alive for two or three days before preserving.

*TELLINA TENUIS*, *Da Costa*. This bivalve was very common on the west side of Polesands at low-water mark; moderately common on the fine sand between Cocklesand and Lymptone mussel beds, and a few were also taken on Bullhill Bank, the Warren, and Shaggles Sand. They were generally found buried two or three inches below the surface of the sand. On Polesands, where they were most common, three or four would be turned up in one spadeful of sand.

*Tellina tenuis* was always found on sand and *T. balthica* on mud.

*DONAX VITTATUS* (*Da Costa*). This mollusc was very common on the smooth banks of fine sand running off the west side of Polesands. Almost every specimen had a tuft of fine green weed or *Enteromorpha* (occasional) attached to the posterior (short) end of the shell. The animal being buried only just below the surface with the posterior end uppermost, the tuft of weed was always visible either waving in the water or lying on the sand, thus marking the position of the shell. A few of the living shells had hydroids growing on them, in addition to the weed, the hydroid being in three cases *Perigonimus repens*.

*MACTRA SOLIDA*, *Linnaeus*. Not uncommon on Polesands in the same situation as *Donax vittatus*. When first uncovered by the tide they were generally found buried just below the surface, but after a time they emerged from the sand and lay uncovered until the tide rose again.

*MACTRA STULTORUM*, *Linnaeus*. A few shells only of this bivalve were found on Polesands.

*LUTRARIA ELLIPTICA*, *Lamarck*. Shells only on Polesands.

*SCROBICULARIA PIPERATA* (*Linnaeus*). One of the commonest bivalves of the Exe estuary; it was almost always present where the ground was composed of fine stiff mud. It occurred in profusion on Greenlands (sta. 1), on the mud inside Cocklesand (sta. 13), near Salthouse Lake (sta. 11), and all along the west bank, where the ground was suitable. It was generally found buried three to six inches below



the surface, with which its burrow was connected by two, occasionally three narrow passages, which allowed the protrusion of the siphons. The siphons are in large specimens as much as six or seven inches in length.

*SOLENS ENSIS*, *Linnaeus*. Not uncommon in the smooth sand on the west side of Polesands. This and the succeeding species (*S. siliqua*) when uncovered by the tide very often emerge from the sand and lie on the surface until the tide covers them again.

*SOLENS SILIQUA*, *Linnaeus*. This fine Solen was not uncommon on Polesands in the same situation as *S. ensis*.

*SOLENS VAGINA*, *Linnaeus*. Moderately common on a patch of firm, muddy sand on the west side of the mouth of Salthouse Lake (sta. 10). One from sand on Bullhill Bank (sta. 9).

*SAXICAVA RUGOSA*, *Linnaeus*. Common boring in Orcombe Rocks.

*PHOLAS DACTYLUS*, *Linnaeus*. Borings common in Orcombe Rocks. Only one specimen was obtained.

*PHOLAS PARVA*, *Pennant*. Borings common in Orcombe Rocks. One specimen was taken.

*PATELLA VULGATA*, *Linnaeus*. Very common on Orcombe Rocks; not uncommon on stones between Cockwood and Starcross (sta. 8).

*TROCHUS MAGUS*, *Linnaeus*. Shell only, inhabited by hermit-crab, from Polesands.

*TROCHUS CINERARIUS*, *Linnaeus*. A few living ones from rough ground on north side of Warren (sta. 12); shells from Orcombe Rocks.

*TROCHUS UMBILICATUS* (*Montagu*). One living one from Polesands.

*LITTORINA LITTOREA* (*Linnaeus*). Found in profusion on Cocklesand, Bullhill Bank, and Greenlands; not uncommon on the west bank. They are collected by boys, who sell them to the mussel-bed proprietors for the purpose of keeping the beds clear from weed.

*RISSOA PARVA* (*Da Costa*). One from Orcombe Rocks and one dredged off the Clock Tower on the sponge ground (sta. 14B).

*HYDROBIA ULVÆ* (*Pennant*). Occurred practically on all the sandy and muddy grounds where there was *Ulva*, *Enteromorpha*, or *Zostera*, notably on Greenlands (sta. 1) and the muddy ground with weed inside Cocklesand (sta. 13). When left on a bare patch of sand by the receding tide they burrow to a depth of one-eighth of an inch, probably in order to protect themselves from the sun.

*TURRITELLA TEREBRA*, *Linnaeus*. A shell only, from Polesands.

*NATICA CATENA* (*Da Costa*). A dozen or so were found on the smooth sand of Polesands, burrowing just below the surface.



*PURPURA LAPILLUS* (*Linnaeus*). Very common at Orcombe Rocks; a few shells and one alive from Polesands.

*BUCCINUM UNDATUM*, *Linnaeus*. Shells only, Orcombe Rocks and Polesands. One small living one on mussel bank (sta. 14c), and three dredged off the pier (sta. 14A).

*CYPRÆA EUROPÆA*, *Montagu*. A few alive from Orcombe Rocks; shells from Polesands.

*APLYSIA PUNCTATA*, *Cuvier*. Spawn only of this species was taken in the mosquito net trawl, between Bullhill Bank and Cocklesand.

*ELYSIA VIRIDIS*, *Montagu*. Three from Bullhill Deep Pit (sta. 9), and one or two from Engineering Company's stage in the dock.

*DORIS TUBERCULATA* (*Cuvier*). One specimen is recorded from Bullhill Bank by Mr. Holt, in May, 1897.

*ANTIOPA CRISTATA*, *Delle Chiaje*. Several on the walls and piles of the dock, and one from the bottom of the *Dawn*.

*SEPIOLA ATLANTICA*, *D'Orbigny*. One taken in shrimp trawl on Shaggles Sand (sta. 5).

#### POLYZOA.

[Nomenclature: HINCKS, *British Marine Polyzoa*.]

*SCRUPOCELLARIA SCRUPOSA* (*Linnaeus*). A few colonies dredged on the sponge ground off the Clock Tower (sta. 14B).

*BUGULA TURBINATA*, *Alder*. Common in the dock on the piles, old boats, etc., and at Orcombe Rocks.

*MEMBRANIPORA MEMBRANACEA* (*Linnaeus*). Common on *Laminaria* at Orcombe Rocks.

*LOXOSOMA PHASCOLOSOMATUM*, *Vogt*. Not uncommon on the posterior end of *Phascolosoma vulgare*, from the north side of the Warren (sta. 12).

#### TUNICATA.

[Nomenclature: HERDMAN, *A Revised Classification of the Tunicata*, Jour. Linn. Soc. Zool., xxiii.]

*ASCIDIELLA ASPERSA* (*O. F. Müller*). Common, growing on piles, boats, etc., in the dock. They seem to grow very rapidly, as specimens an inch long were found on the bottom of the ss. *Oithona* nine weeks after she had been scraped and painted, and of about the same size on the bottom of the *Dawn* after two months in Exmouth Dock.

*CIONA INTESTINALIS* (*Linnaeus*). This Ascidian was found in great profusion in Exmouth Dock on the piles and wall under the Engineering Company's stage, and also on the wall just inside the dock gates, some of the specimens being eight or nine inches in length. Smaller ones were common on the bottom of boats which had been lying in

the dock for some time. One on the *Dawn*, after she had been lying there two months, was four or five inches long. Whether the dock is a regular habitat of *Ciona* we cannot say, not having any previous records, but at Plymouth this year the same species is extremely abundant in Millbay Docks, some of the specimens being as much as a foot long, whereas formerly we have never found more than a few small ones each year. Many of the Exmouth specimens were infested with a large species of Copepod, *Notopterophorus gibber*.

### PISCES.\*

[Nomenclature: DAY, *British Fishes*.]

LABRAX LUPUS (*Lacépède*). Caught in the estuary by hook and line and by seine. Between the Warren and Cockwood, seine, April 7th, 1897, one, 13 cm.; May 29th, 1897, one 8 cm., one 12 cm. [E. W. L. HOLT.]

COTTUS BUBALIS, *Euphrasen*. Four were taken between Bullhill Bank and Cocklesand, measuring respectively 4, 4·6, 10·2, and 11·7 cm. Off Bullhill Bank, off the Warren (north side), and Mere Bay, April and May, 1897. [E. W. L. H.]

TRIGLA HIRUNDO, *Linnaeus*. Five, 14–23 cm., caught with seine off Bullhill Bank, May, 1897. [E. W. L. H.]

AGONUS CATAPHRACTUS (*Linnaeus*). One taken between Pole and Monster Sands and one on sand bank off Starcross; 4·8 cm. and 4·4 cm. respectively. Off the north side of the Warren and Bullhill Bank, April and May, 1897. [E. W. L. H.]

TRACHINUS VIPERA, *Cuv. and Val.* A "sting-fish," probably this species, was taken by professional seiners off Polesands. The specimen was not examined. Two off Bullhill Bank, May, 1897. [E. W. L. H.]

GوبيUS RUTHENSPARRI, *Euphrasen*. Fairly common among the piles in Exmouth Dock, especially under the stage. One taken in a hand net measured 5·3 cm.

GوبيUS PAGANELLUS, *Gmel.* Several taken in the dock in a prawn-pot, 5·8 to 10·1 cm. in length.

GوبيUS MINUTUS, *Gmel.* This is by far the commonest Goby of the estuary; it was present in almost every haul of the mosquito net trawl taken above the Warren, varying in length from 1·2 to 5·7 cm. A batch of eggs found in a shell on Bullhill Bank, July 4th, 1901, hatched out the same day, the newly hatched young being about 2·4 mm. in length.

CALLIONYMUS LYRA, *Linnaeus*. One off the north side of the Warren and one off Bullhill Bank with seine, May, 1897. [E. W. L. H.]

\* By R. A. TODD.

*BLENNIUS PHOLIS*, *Linnaeus*. Most common at Orcombe Rocks and among the piles and in crevices in the walls of the dock. Two were also taken in Mere Bay and one on Bullhill Bank.

*ATHERINA PRESBYTER*, *Jenyns*. A large shoal of very young Atherines was seen in the dock on August 16th, 1901. Those which were caught were .7 to 1.1 cm. in length. No large ones were seen. The specimens were identified by Dr. Kyle.

*MUGIL CHELO*, *Cuvier*. Shoals of large grey mullet were almost always to be seen in the dock, generally under the boats which had been in the dock some time, and were therefore covered with weed, etc. A shoal of young ones was seen in the dock on August 16th, 1901, and about twenty were caught, measuring from 2.5 to 2.7 cm. Common in the dock, May, 1897 [E. W. L. H.] Grey mullet are also caught in the estuary, generally in seines.

*GASTEROSTEUS ACULEATUS*, *Linnaeus*. One "three-spined stickleback" was caught in the dock, with the young grey mullet mentioned above, 2.5 cm. in length.

*GASTEROSTEUS SPINACHIA*, *Linnaeus*. Single specimens were taken with the mosquito net trawl at each of the following localities: Bullhill Bank, Mere Bay, and between Pole and Monster Sands. Two off north side of Warren, in the seine, April, 1897. [E. W. L. H.]

*LABRUS MACULATUS*, *Blainville*. Between Bullhill Bank and Cocklesand, two of 2.0 and 2.5 cm.; Mere Bay, one of 2.2 cm., and Bullhill Deep Pit, five, 1.4 to 3.0 cm. in length; Exmouth Dock, one of 15 cm.

*CRENILABRUS MELOPS* (*Linnaeus*). Small ones from 1 to 3 cm. long were moderately common in Bullhill Deep Pit, channel between Bullhill Bank and Cocklesand, and Mere Bay. Larger ones of about 7 cm. and upwards were not uncommon in the dock, being frequently caught in a prawnpot.

*GADUS POLLACHIUS*, *Linnaeus*. One, 4.0 cm. in length, was caught in the dock on July 9th, 1901.

*AMMODYTES TOBIANUS*, *Linnaeus*. One of the commonest fish in the lower part of the Exe estuary. It was often to be seen going about in shoals containing several thousand fish of about the same size. In a shoal seen in the dock entrance on July 11th, 1901, five were caught from 4.5 to 5.5 cm. in length. I am indebted to Dr. Kyle for the identification of this species.

*RHOMBUS MAXIMUS* (*Linnaeus*). One seined off north side of Warren, April 7th, 1897, 14 cm. long. [E. W. L. H.]

*RHOMBUS LEVIS*, *Road*. Young brill were caught in the mosquito net trawl, etc., at the following localities: On the Polesands, one with

fine-meshed seine; off Cockwood, on sand, one of 2·3 cm. (July 8th, 1901); in Salthouse Lake, July 18th, 1901, one of 3 cm., August 5th, 1901, two of 2·9 and 2·8 cm. respectively; Mere Bay, April, 1897, two of 18 cm. [E. W. L. H.]; off north side of Warren, April, 1897, one of 14 cm.; and two in May, 1897, of 17 and 21·5 cm. respectively. [E. W. L. H.]

PLEURONECTES PLATESSA, *Linnaeus*. Young plaice were found to be very common in Salthouse Lake and along the shore above the mouth of the lake at low water, and were taken in some numbers in a shrimp net (shove net). Mr. Holt records a number of plaice obtained at Exmouth in 1897 with a seine net as used by the fishermen at Exmouth, and with a tuck net of the Saltash pattern belonging to the Laboratory.

The numbers and sizes (in inches) of fish obtained are recorded in the following tables:—

**Plaice taken in Mere Bay by Mr. Holt with Professional Seine  
in April, 1897.**

Size in inches.	Number.	Size.	Number.	Size.	Number.
2 $\frac{3}{4}$	1	5 $\frac{1}{4}$	8	9	1
3	2	5 $\frac{1}{2}$	3	9 $\frac{1}{2}$	1
3 $\frac{1}{4}$	3	5 $\frac{3}{4}$	3	11	1
3 $\frac{1}{2}$	3	6	3	11 $\frac{1}{2}$	1
3 $\frac{3}{4}$	4	6 $\frac{1}{4}$	1	11 $\frac{3}{4}$	1
4	8	6 $\frac{1}{2}$	3	13	1
4 $\frac{1}{4}$	4	7	2	13 $\frac{1}{2}$	1
4 $\frac{1}{2}$	3	7 $\frac{1}{4}$	2	13 $\frac{3}{4}$	1
4 $\frac{3}{4}$	3	8	1	14	1
5	5	8 $\frac{1}{4}$	1	20	1

**Plaice taken in the Bight north of the Warren by Mr. Holt with  
Professional Seine in April, 1897.**

Size in inches.	Number.	Size.	Number.	Size.	Number.
2 $\frac{1}{4}$	1	4 $\frac{1}{2}$	10	6 $\frac{3}{4}$	2
2 $\frac{1}{2}$	10	4 $\frac{3}{4}$	4	7	2
2 $\frac{3}{4}$	31	5	2	7 $\frac{1}{4}$	1
3	38	5 $\frac{1}{4}$	6	7 $\frac{1}{2}$	1
3 $\frac{1}{4}$	23	5 $\frac{1}{2}$	12	8	1
3 $\frac{1}{2}$	18	5 $\frac{3}{4}$	3	8 $\frac{1}{2}$	1
3 $\frac{3}{4}$	15	6	3	9	1
4	19	6 $\frac{1}{4}$	5	10 $\frac{3}{4}$	1
4 $\frac{1}{4}$	14	6 $\frac{1}{2}$	4	—	—

**Plaice taken in the Bight north of the Warren by Mr. Holt  
with the Laboratory Tuck Net in May, 1897.**

Size in inches.	Number.	Size.	Number.	Size.	Number.
$1\frac{1}{4}$	3	$4\frac{1}{4}$	21	$6\frac{3}{4}$	2
$1\frac{1}{2}$	1	$4\frac{1}{2}$	14	7	2
$1\frac{3}{4}$	2	$4\frac{3}{4}$	7	$7\frac{1}{4}$	4
2	3	5	10	$7\frac{3}{4}$	2
$2\frac{1}{4}$	2	$5\frac{1}{4}$	8	$8\frac{1}{4}$	1
3	3	$5\frac{1}{2}$	8	$8\frac{1}{2}$	1
$3\frac{1}{4}$	14	$5\frac{3}{4}$	6	$8\frac{3}{4}$	1
$3\frac{1}{2}$	25	6	8	$10\frac{3}{4}$	1
$3\frac{3}{4}$	31	$6\frac{1}{4}$	5	11	1
4	18	$6\frac{1}{2}$	3	$11\frac{1}{2}$	1

**Plaice taken at Exmouth during July and August, 1901, almost  
wholly in Salthouse Lake, with Shove Net.**

Size in inches.	Number.	Size.	Number.	Size.	Number.
$1\frac{1}{2}$	20	$2\frac{3}{4}$	12	$5\frac{1}{2}$	4
$1\frac{3}{4}$	40	3	2	$5\frac{3}{4}$	1
2	29	$3\frac{1}{4}$	1	$6\frac{1}{4}$	1
$2\frac{1}{4}$	17	$3\frac{3}{4}$	1	—	—
$2\frac{1}{2}$	12	$4\frac{1}{2}$	2	—	—

*PLEURONECTES LIMANDA*, *Linnaeus*. Off north side of the Warren, April and May, 1897, nine, 9–11.5 cm. Bullhill Bank, May, 1897, eleven, 9.5–12.5 cm. [E. W. L. H.]

*PLEURONECTES FLESUS*, *Linnaeus*. Off the north side of the Warren, May, 1897, one of 13 cm. and one of 30.5 cm.; Bullhill Bank, April and May, 1897, five, 9.5–17 cm. [E. W. L. H.]

*SALMO SALAR*, *Linnaeus*. There is a regular salmon fishery in the Exe estuary during the season, which gives employment to several large rowing boats, each of which is manned by four to six men and works one seine. The seine is about one hundred fathoms long and three to four fathoms deep in the middle, where there is a bag, and narrows to a fathom at each end, with a mesh of  $4\frac{1}{4}$  inches. The net is shot across the stream, then towed down with the tide for two or three hundred yards and hauled. Each boat generally manages two and sometimes three hauls at low water.

*BELONE VULGARIS* (*Linnaeus*). One was caught when seining for sand-eels (*Ammodytes*) off Polesands.

*CLUPEA HARENGUS*, *Linnaeus*. Bullhill Bank, seine, April, 1897, two, 26 and 29 cm.; and north side of Warren, seine, April, 1897, six, 23.5–32.5 cm. [E. W. L. H.]

CLUPEA SPRATTUS, *Linnaeus*. Bullhill Bank, seine, May, 1897, six of 5 cm.; and off north side of Warren, April, 1897, six, 5.5-7 cm. [E. W. L. H.]

ANGUILLA VULGARIS, *Turt.* Two small ones, about 20 cm. in length, were caught in the dock.

CONGER VULGARIS, *Cuvier*. One of about 4 lbs. weight was seen among the piles in the dock.

SYNGNATHUS ACUS, *Linnaeus*. Two were taken in the mosquito net trawl on the sand bank off Starcross, and several in the shove net in Salthouse Lake. Two were taken off the north side of the Warren in the seine, April, 1897. [E. W. L. H.]

SYNGNATHUS ROSTELLATUS, *Nilss.* This species is easily distinguishable from *S. acus* of the same size by the number of pre-anal rings, which in *S. rostellatus* varies, in the specimens obtained at Exmouth, from 13 to 15; in *S. acus* they number 19-20 (see Duncker, *M.B.A. Journal*, N.S. vol. v. p. 175). Seven were taken in the mosquito net trawl on the Bar, from 5.8-11.5 cm.; seven, a quarter-mile south of Polesands, 5.9-14.9 cm.; two between Pole and Monster Sands, 7.4 and 13.8 cm.; a few in the dock and on Shaggles Sand; and four on the sand bank east of Powderham mussel beds, 12.3 to 15.7 cm. in length. The one measuring 15.7 was a male carrying embryos which hatched out on the same day (July 25th, 1901), the young fish measuring 14 mm. when hatched. The finrays and rings in the specimens from a quarter-mile south of Polesands (the only ones examined) were found to vary as follows: Pre-anal rings, 13-15; total number of rings, 52-56; dorsal finrays, 34-40; pectoral, 10-11, mostly 11; caudal rays, 10.