specific characters of great importance. For instance, in the two forms of *Phascolosoma mutabile* (p. 19), differing considerably in appearance and in the presence or absence of hooks on the proboscis, specific identity was clearly shown by the structure of the body-wall.

The present collection includes the following species[1]:—

Sipunculoidea.

Sipunculus nudus, L.
Sipunculus norvegicus, Kor. & Dan.
Physcosoma granulatum, Leuckart.
Physcosoma abyssorum, sp. n.
Phascolosoma vulgare, Blainville.
Phascolosoma elongatum, Kef.
Phascolosoma rugosum, sp. n.
Phascolosoma mutabile, sp. n.
Phascolosoma muricaudatum, sp. n.
Phascolosoma bulbosum, sp. n.
Phascolosoma procerum, Mobius.
Phascolosoma constrictum, sp. n.
Phascolosoma abyssorum, Kor. & Dan.
Phascolosoma Johnstoni (Forbes).
Phascolion strombi (Montagu).
Aspidosiphon Müllleri, Diesing.
Onchnesoma Steenstrupi, Kor. & Dan.
Onchnesoma squamatum (Kor. & Dan.).

Echiuroidea.

Echiurus abyssalis, Skorikow.
Thalassema Lankesteri, Herdman.
Thalassema Neptuni, Gaertner.
? *Bonellia viridis*, Rolando.

Priapuloidea.

Priapulus caudatus (Lamarck).

Geographical Distribution.

One of the most interesting facts which the present study has brought to light is the presence of a species of *Physcosoma* in deep water in the Atlantic. The centre of radiation of this genus is supposed to be near the Malay Archipelago, where the largest number of species is found, and they are now characteristic members of the tropical shallow-water faunas. Selenka (24, p. 2), commenting on the presence of *Physcosoma granulatum* in the Mediterranean, says that it probably found its way there from the Red Sea. However, as it is now known from the Azores, France, Norway, and the west and north

[1] See complete list, including synonyms, on p. 41.

coasts of Ireland, this contention has lost its force. Moreover, it cannot be a species having a rapid power of dispersal, or how are we to explain the remarkable fact of its absence from the south-west coast of England, where its present distribution would lead us to expect to find it. Six other species of this genus are known from the Atlantic, but four of them also occur in the Pacific, and the other two are in the West Indian Islands. Of the six Atlantic species, five are present in the West Indian Islands, thus indicating their affinity with the Pacific fauna, and they probably passed to their present homes during a geologically recent submergence of the Central American region. The discovery of a species living in 700 fathoms off the coast of Ireland, a species which has very distinctive characters, though undoubtedly belonging to this genus, is, however, strongly against the theory of recent radiation from the Pacific. The members of this genus seem to have a strong preference for a habitat rich in lime. *Physcosoma granulatum*, the commonest Gephyrean on the west coast of Ireland, is especially abundant in limestone regions, or in *Lithothamnion*, whilst the new deep-sea species was found associated with the coral *Lophohelia prolifera*. It seems to me most probable that the genus is old, and of world-wide distribution, and that conditions of life in the coral islands of the tropical Pacific have been favourable to a secondary outburst of specific evolution. It is obvious that a high temperature is not essential for this genus, as the new species from 700 fathoms was living in water at a temperature, probably quite uniform throughout the year, of 7·19° C. The minimum temperature endured by *Physcosoma granulatum* on our west and north coasts must be often lower than this in the winter.

The range of *Echiurus abyssalis*, Skorikow, previously known from three specimens found in the Mediterranean, has now been extended to the Atlantic. One hundred and eighty specimens of this species are included in the present collection.

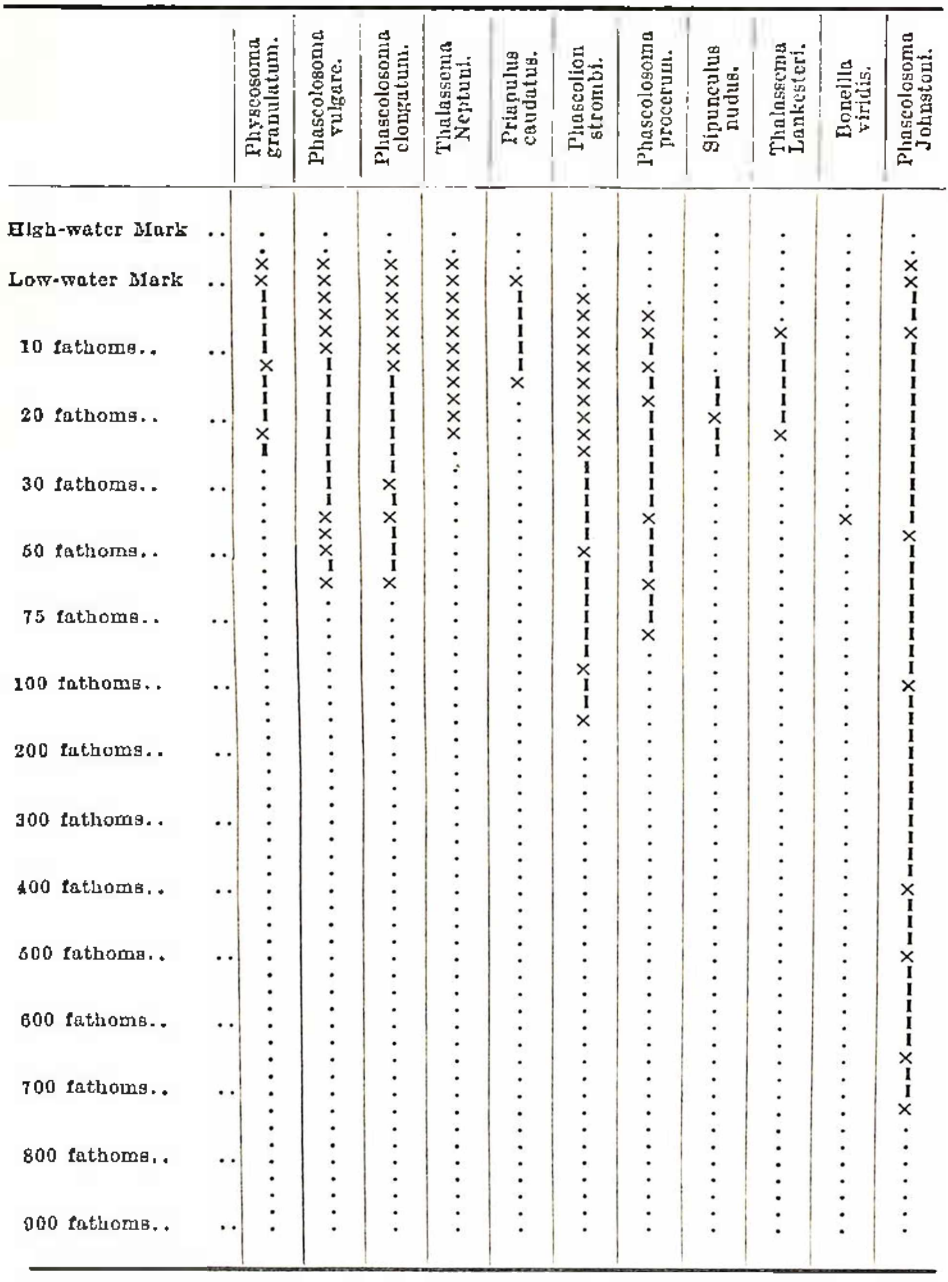
The remaining species in the collection are such as might be expected to occur in the British area, though in some cases their range has been considerably extended. Besides the new species described, the following 5 species are added to the British fauna :—

Sipunculus norvegicus, Kor. & Dan.
Phascolosoma abyssorum, Kor. & Dan.
Onchnesoma Steenstrupi, Kor. & Dan.
Echiurus abyssalis, Skor.
? *Bonellia viridis*, Rolando.

Bathymetrical Distribution.

In the following notes, I am dealing only with facts elucidated by the study of the present collection of Irish specimens. Some former records of shallow water forms from great depths need verification in the light of our present ideas of specific values.

Bathymetrical Range of the Irish Gephyrea.



Bathymetrical Range of the Irish Gephyrea.

	Aspidosiphon Mülleri.	Echiurus abyssalis	Onchnesoma Steenstrupi.	Onchnesoma squamatum.	Phascolosoma margaritaceum.	Phascolosoma abyssorum.	Sipunculus norvegicus.	Phascolosoma mutabile.	Phascolosoma bullosum.	Phascolosoma ruzosum.	Phascolosoma constrictum.	Phymosoma abyssorum.
High-water Mark	.	.	.	.	.	.	.	.	.	.	.	.
Low-water Mark	.	.	.	.	.	.	.	.	.	.	.	.
10 fathoms ..	.	.	.	.	.	.	.	.	.	.	.	.
20 fathoms ..	×	.	.	.	.	.	.	.	.	.	.	.
30 fathoms ..	×	.	.	.	.	.	.	.	.	.	.	.
50 fathoms ..	×	.	.	.	.	.	.	.	.	.	.	.
75 fathoms ..	×	.	.	.	.	.	.	.	.	.	.	.
100 fathoms ..	×	.	.	.	.	.	.	.	.	.	.	.
200 fathoms ..	×	.	.	.	.	.	.	.	.	.	.	.
300 fathoms ..	×	×	×	×	.	.	.	.	.	.	.	.
400 fathoms ..	×	×	.	×	×	×	.	.	.	.	.	.
500 fathoms ..	×	×	×	×	×	.	×	×	.	.	.	.
600 fathoms ..	×	×	.	×	×	.	×	×	×	.	.	.
700 fathoms ..	×	×	.	.	.	.	.	×	.	×	×	×
800 fathoms ..	×	.	.	.	.	.	.	×	.	.	.	.
900 fathoms ..	.	.	.	.	.	.	.	.	.	.	.	.

The table on pp. 4 and 5 shows at a glance the bathymetrical range in Irish waters of all the species I have examined. The depths at which specimens have been obtained are indicated by crosses. In cases where the depth at the beginning differed considerably from that at the end of the haul, as frequently happens when dredging or trawling in deep water, the cross indicates the mean of the two figures, and the possible extremes at which the specimens may have been captured are indicated by vertical lines.

The species obviously fall into two groups. The first group ranges from the littoral region down to about 100 fathoms, becoming rarer as this limit is reached. The second group appears at about 300 fathoms and ranges down to unknown depths. The first or shallow water group is definitely associated with the sea-weed zone, and the varied nature of the sea-floor in proximity to the coast. In the area investigated, the bed of the sea in the zone from 100 to 300 fathoms is almost exclusively formed of clean sand, poor in species and individuals. This stretch of sand forms an effective barrier between the two faunas. It seems probable that depth is in itself a factor of only secondary importance, the range of species being determined chiefly by the nature of the sea-bottom. There is no evidence that bathymetrical range is influenced by such factors as the temperature and salinity of the sea-water, at any rate within the limits of their variation in the area investigated.

Below 300 fathoms, the sea-floor changes, and once more supplies a favourable habitat for a diversified fauna. Deposits of mud and ooze predominate, whilst widespread associations of corals and sponges afford shelter and a solid foundation for a large number of species, which here attain the upper limit of their range.

A comparison of the number of specimens obtained, with the number of hauls of the trawl and dredge, indicates that the Gephyrean fauna, in the depths between 400 and 700 fathoms, is at least quite as rich in numbers as that found in shallow waters, and probably much richer in species.

The two species having the greatest amplitude, and passing from the shallow region to deep water, are *Phascolosoma Johnstoni* (*Petalostoma minutum*, Kef.) ranging from mid-tide mark down to 720 fathoms, and *Aspidosiphon Müller*i, from 13 to 450 fathoms. In the sandy zone, these two species live in Gasteropod shells or in crevices of limestone, a habit specially fitting them for a wide bathymetrical range. It is also of interest to note that these two species are extremely variable, and have given rise to great confusion and numerous synonyms.

Six species have been found between tide-marks, though none of them are confined to this region. Two of these, *Physcosoma granulatum* and *Thalassema Neptuni* are absent from the east coast, but are very common and characteristic members of the fauna of the western littoral.

Faunistic Notes.

It is only possible to classify very roughly the various types of habitat occupied by the Gephyrea, since they do not appear to be so sensitive to their immediate surroundings as some other groups are. Beginning with the region between tide-marks, one finds that Gephyrea are almost completely absent from the extensive stretches of clean sand. At the base of rocks, or near masses of *Sabellaria alveolata*, a few specimens of *Phascolosoma vulgare* may be found in the sand. If, however, there is any admixture of mud or coarse gravel, *P. vulgare*, *P. elongatum*, and *P. Johnstoni* are frequent. In shelly sand and gravel, *P. elongatum* occurs. In the sand of *Zostera* beds *P. elongatum* often occurs in vast numbers, accompanied by *P. vulgare* and occasionally by *Priapulus caudatus*, if there is an admixture of mud.

Under stones on a rocky shore, one finds *P. vulgare*, *P. elongatum*, *P. Johnstoni*, and *Physcosoma granulatum*. By breaking open pieces of limestone or schist, *Thalassema Neptuni* and *Physcosoma granulatum* are generally found on the west coast. These species, together with *P. vulgare* and *P. Johnstoni* are abundant in the massive growths of *Lithothamnion*. *P. Johnstoni* is common in the roots of *Laminaria*, at low water.

In the partially submerged peat at Valencia Harbour, *Thalassema Neptuni* is very common. Small specimens of *P. elongatum* may be found in the sand-binding seaweeds which occasionally cover the rocks.

Dredging over fine sand yields very poor results, an occasional specimen of *P. procerum* being the only capture. On this type of ground, however, shells and pieces of limestone are frequently occupied by *Thalassema Neptuni*, *Phascolion strombi*, *Aspidosiphon Mulleri*, and *P. Johnstoni*. Shallow-water deposits of mud yield *P. vulgare*, *P. elongatum*, *P. procerum*, and *Thalassema Lankesteri*. Below 300 fathoms, there is generally a zone of muddy sand, passing downwards into ooze, both formations containing a large proportion of tests of *Foraminifera*. In these deposits, a large number of species flourish, including the following :—

P. muricaudatum
P. rugosum
P. mutabile
Onchnesoma squamatum
Echiurus abyssalis.
P. bulbosum
P. constrictum
Sipunculus norvegicus
Onchnesoma Steenstrupi.

The two species *Physcosoma abyssorum* and *Aspidosiphon Millleri* were found associated with the coral *Lophohelia prolifera* in deep water.

Several specimens of *P. constrictum* were found hiding between the sponge *Pheronema* and *Ascidia tritonis*, large specimens of the latter being firmly attached to the sponge.

A specimen of *Physcosoma granulatum* was found living inside the sponge *Clione celata*.

I am greatly indebted for the loan of specimens to the Rev. Canon Norman, the Directors of the Museums at Bergen, Stockholm, Berlin, Hamburg, Paris, Monaco, and the Stazione Zoologica, Naples. Professor Sluiter, Dr. Hutton and Mr. Arnold Watson have also assisted me with advice or material.

The present collection, including the type-specimens, will be placed in the Irish National Museum.

No attempt has been made in the Systematic Part to give the full synonymy of the species described. Several references have been given to standard works, so as to fix the identity of the species.

The numbers in Clarendon type refer to the List of References on p. 42.

SIPUNCULOIDEA.

Sipunculus nudus, L.

1884. Selenka, **25**, p. 92.
1896. Shipley, **26**, p. 412.

A single specimen was taken in Galway Bay. It was 140 mm. long.

Distribution.—English Channel, North Sea, France, Florida, Mediterranean, Adriatic, Red Sea, Indian Ocean, Philippines, Bismarck Archipelago, Japan. This species was taken by the "Porcupine" in 1869 in 1263 fms., south of the Rockall Bank.

Locality.—A. 122—5 VI '05. Galway Bay, soundings 12–25 fms. Temperature at 25 fms., 12·3° C. Beam trawl, 12–25 fms.—One specimen.

Sipunculus norvegicus, Koren and Danielssen.

Pl. V, fig. 7.

1877. *S.n.* + *S. priapuloides*, Koren and Danielssen, **13**, p. 123 and 126.
1883. *Phallosoma n.* + *P.p.*, Levinsen, **17**, p. 268.
1896. *S.p.*, Roule, **21**, p. 473.
1899. *S.p.*, Shipley, **27**, p. 158.
1900. *S.n.*, Sluiter, **30**, p. 17.
1905. *S.n.* + *S.p.*, Théel, **34**, p. 52 and 54.
1906. *P.p.*, Roule, **22**, p. 65.

The 15 specimens of this species included in the collection vary from 12–83 mm. in length. They are very transparent, especially the smaller ones. The characteristic ridge which separates the smooth 'glans' at the posterior end of the body is well marked in the larger forms, but in the small ones it is indistinct or absent. The longitudinal muscles are in 22–23

bands. The retractor muscles are attached to only one or two of the longitudinal bands.

On the rectum the two racemose glands and the spherical diverticulum are quite easily seen. (Pl. V, fig. 7, b.)

The spindle muscle in front is connected by several roots to the same longitudinal strand of the body-wall to which the rectum is attached. It runs along the rectum and is connected with it by numerous delicate muscular fibres. The rectum is expanded near the anus, and just below the swollen part are attached two very slender muscle fibres which are fixed at their other ends to the bases of the two dorsal retractor muscles. The two racemose glands envelop these muscles where they join the rectum. Behind these glands there is a small spherical diverticulum on the rectum. The relation of these structures is plainly shown in fig. 7. The intestine is attached to the body-wall by numerous muscle fibres. One specimen, taken in November, had several eggs in the body-cavity. They are large and spherical, ·45 mm. in diameter, with thick, finely reticulate walls.

I am inclined to agree with Théel (34, p. 56) and Roule (22, p. 95) in uniting the two species of Koren and Danielssen. The characters given by these observers as distinguishing the two forms are either non-existent or of doubtful diagnostic value. The chief characters which distinguish *S. priapuloides* from *S. norvegicus* are the greater size, the furrow on the ventral face of the 'glans' together with the interruption of the annular fold separating the 'glans' from the trunk, and the presence of a small diverticulum and a pair of racemose glands on the rectum. As regards the latter character, I have found that the diverticulum and glands are present in all the specimens which I have examined. The structure of the 'glans' is very variable. The ventral groove is certainly not due to bad preservation, as Théel suggests, since it is more clearly seen in the best preserved specimens. The annular fold is very inconspicuous or absent in small individuals, and sometimes, when present, is entire and not accompanied by any ventral groove. These structures seem to develop as the animal approaches maturity, and I am of the opinion that *S. norvegicus* represents an immature stage of *S. priapuloides*. It is unfortunate that the former name has priority, as it is somewhat misleading. Moreover, fully developed specimens agree much better with the original description of *S. priapuloides*. These cannot, however, be considered sufficient reasons for disregarding the law of priority, as Roule (22, p. 95) has done. He used the name *Phallosoma priapuloides* as being the most appropriate, although his specimen agreed with *S. norvegicus*, in having a smooth 'glans' and uninterrupted annular fold. The diverticulum on the rectum was absent, but the two racemose glands were seen. He maintained that the two species were synonymous. Sluiter (30, Pl. I, fig. 7) figures a specimen under the name *S. norvegicus*, showing the

distinct groove on the 'glans' and an interrupted annular fold characteristic of *S. priapuloides*.

Distribution.—North Atlantic, in deep water; Loyalty Islands (Shipley).

Localities.—

S. R. 172—5 XI '04., 52° 2′ N., 12° 8′ W., soundings 454 fms., fine mud. Dredge.—One specimen.

S. R. 502—11 IX '07. 50° 46′ N., 11° 21′ W., soundings 447–515 fms. Temperature at 500 fms., 8·8° C., salinity, 35·37 °/₀₀. Sprat net on trawl, 447–515 fms. —One specimen.

S. R. 752—17 V '09. 51° 48′ N., 12° 11′ 30″ W., soundings 523–595 fms., ooze. Temperature at 500 fms., 8·9° C., salinity 35·43°/₀₀. Midwater-trawl, 523–595 fms.—Thirteen specimens.

Physcosoma granulatum (Leuckart).

1828. *Phascolosoma granulatum*, Leuckart, **16**, p. 22.
1840. *Sipunculus papillosus*, Thompson, **37**, p. 101.
1841. *Syrinx papillosus*, Forbes, **6**, p. 247.
1845. ? *Syrinx granulosus*, McCoy, **18**, p. 272.
1877. *Phascolosoma Lovénii*, Koren and Danielssen, **13**, p. 128.
1884. *Phymosoma granulatum* + *P. Lovénii*, Selenka, **25**, p. 57 and 79.
1905. *Physcosoma Lovénii*, Théel, **34**, p. 50.
Non *Phascolosoma papillosum*, Koren and Danielssen (**13**, p. 138), Sluiter (**30**, p. 19), or Théel (**34**, p. 60).

This is the most characteristic littoral Gephyrean of the west coast of Ireland. It is very abundant under stones, in crevices of the rocks, and in *Lithothamnion*. It has not been found in the Irish Sea, but ranges along the whole west coast from Valencia Harbour on the south to Portstewart on the north coast of Co. Derry, where I found it in 1910 in large numbers. It has a characteristic Lusitanian distribution though it appears not to have been recorded from the south-west coast of England nor the west of Scotland. On the Norwegian coast a single specimen of this species was found by Koren and Danielssen at Bergen Fiord, at a depth of 50 fathoms, and named by them *Phascolosoma Lovénii*. According to Théel (**34**, p. 50), who has re-examined this specimen, the original description erred in several important points, such as the absence of hooks on the proboscis. Théel says: "The idea is not altogether precluded, that a closer examination may prove that the animal in question is identical with another form of *Physcosoma* already known, e.g., the *P. granulatum* of Leuckart, which seems to have a very wide distribution in the Mediterranean and the Atlantic." A close comparison of *P. granulatum* with the description of *P. Lovénii* fails to yield any differences of specific

value. There is a general agreement in the internal anatomy, and in the structure of the skin, with its papillae and hooks.

This species seems almost confined to the region between tide marks, and only on two occasions was it taken below low-water mark (W.68, in 19–25½ fms., and W.204, in 11 fms.). The former specimen was a young one, 15 mm. long when expanded, and the longitudinal muscles of the body-wall appeared to form a continuous sheath, and were not collected into distinct bands. This is probably a juvenile character, as it also occurred in other small specimens. One specimen was found (M.L. XVIII) which had only two retractor muscles. Mature females, with the body cavity full of eggs, were found in October and November.

Théel refers the *Phascolosoma papillosum* of Koren and Danielssen to *P. vulgare*, Blv., apparently with good reason. He also considers the species of that name described by Thompson and Forbes (tom. cit.) from the west coast of Ireland as consisting of old and deeply coloured specimens of P. *vulgare*. After considering the description of these writers, and the distribution of their species on the west and north coasts of Ireland, I am convinced that they were dealing with specimens of *Physcosoma granulatum*, which is by far the commonest littoral Gephyrean from that district. Moreover, Thompson and Forbes were well acquainted with the appearance of *P. vulgare* (their *Syrinx Harveii*). This contention is supported by the fact that specimens in the British Museum, labelled *Phascolosoma papillosum*, belong to *Physcosoma granulatum*.

The *Phascolosoma papillosum*, Thompson, of Sluiter (**30**, p. 19) is *P. vulgare*.

The *Syrinx granulosus*, described by McCoy (**18**, p. 272), from Roundstone, on the west coast of Ireland, may be either *Physcosoma granulatum* or *Phascolosoma vulgare*, Blv.

Distribution.—West coast of Ireland, Norway, France (Roscoff, Morgat), Azores, Mediterranean, Adriatic, Zanzibar ?

Localities.—

Valencia Hbr., common. Ballyvaughan and Milltown Malbay, Co. Clare. Shores of Galway Bay (A. 87; A. 99; A. 103; Arran Islands, A. 120). Dogs Bay, Roundstone, in *Lithothamnion*.

Ballinakill Harbour (M.L. XVIII; L 297; L. 326).

Clare Island, in *Lithothamnion*. Dorinish Isd., Clew Bay.

W. 68—22 v '09. Clew Bay. Beam trawl, 19–25½ fms.—One small specimen.

W. 204—20 VIII '11. Clew Bay. Dredge, 11 fms.—One specimen in sponge *Clione celata*.

Blacksod Bay, shores of Mullet; very common, found on 17 occasions.

Broadhaven Bay, one specimen. Doonecry and Inishmurray, Co. Sligo. Portstewart, Co. Derry, common.

Physcosoma abyssorum, sp. n.

Plates I and II, fig. 1.

All previously described species of this genus have been found either in the littoral region or in comparatively shallow water The deepest records do not go below about 50 fathoms. A single specimen of a new species of this genus was taken in 627–728 fathoms off the south-west of Ireland. The temperature of the water ranged from 8·22° C. at 600 fms., to 7·19° C. at 700 fms. The members of the genus *Physcosoma*, which has its headquarters near the Malay Archipelago, are usually confined to shallow warm water. *P. granulatum*, Leuckart, which is found in the north of Ireland and in the Bergen Fiord (as *P Lovénii*) is obviously able to endure a winter temperature very little above freezing point, but its summer temperature is considerably above that which *P. abyssorum* has to endure permanently. The present species, like so many others of the genus, was found in association with coral (*Lophohelia prolifera*) and it is probable that it, or other species of the genus, will be found in the coral associations in shallower water, which will link it bathymetrically to the other members of the genus.

The single specimen (Pl. I, fig. 1A) is greyish brown in colour. The trunk is cylindrical, tapering gradually towards the proboscis, whilst the posterior end is rounded. The total length of the body is 47 mm. The length of the trunk is 19 mm., of the proboscis 28 mm., of which a portion 9 mm. long is invaginated. The skin is very thick, and transversely wrinkled, and is covered with large and conspicuous papillae. The base of the proboscis is darker than the rest of the body, more wrinkled, and with more numerous papillae. Towards the tip of the proboscis the papillae decrease in size. On the mid-body they are paler in colour, and more scattered. On the tail, the papillae (Fig. 1c) are large and almost hemispherical, embedded in rugose layers of dark rust-coloured granules. They are composed of large gland cells which converge to the tip of the papilla, where the common pore is surrounded by a ring of granules. If the cuticle is stripped off, the ectoderm can be plainly seen as a delicate layer of flat cells lying on the circular muscles (Fig. 1K). In this layer are embedded numerous large oval unicellular glands (Fig. 1D, a, fig. 1K, a) arranged in a regular manner. The tentacular disc, which is invaginated and difficult to examine, bears about 25 tentacles of various sizes. Beneath the disc is a smooth region, bounded below by a fold or collar. The proboscis bears 21 regular rows of hooks. The anterior and posterior rows are not so complete as those in the middle. The hooks are triangular, with long curved sharp points (Pl. II, figs. 1H, 1J). The upper corner of the base is rounded into a knob shaped process. At the lower corner of the base there are several granules. Alternating with the rows of hooks are rows of glands (Fig. 1H, a). These are deeply embedded in the

skin and are granular in appearance. A duct passes from them to the surface of the cuticle, where it appears like a circle or oval, containing 2–4 granules disposed in a ring. On the proboscis the skin is very rugose, having transverse wrinkles of fine rust-coloured granules alternating with rows of glands.

A longitudinal section of the body-wall on a level with the anus is shown in Fig. 1D. The total thickness varies from ·45–·6 mm. The muscular layer is from ·175–·215 mm. thick, so that the greater half of the body-wall is formed by the cuticle. The latter has an outer layer which takes the stain deeply, and probably consists of hardened mucus. Beneath the cuticle is the ectoderm, a single layer of flattened cells (Fig. 1D, b, Fig. 1K), amongst which are seen a number of large unicellular gland cells (a). The layer of longitudinal muscles is twice as thick as the layer of circular muscles. The skin is bounded internally by a peritoneal epithelium (Fig. 1D, f).

The large papillae are seated with a broad base on the circular muscles (Fig. 1D) and are enveloped in a fold of the ectoderm. The gland cells forming the papilla are large and elongated, with more or less granular contents. They open into a small cavity near the tip of the papilla.

The grouping of the longitudinal muscles into separate strands which is so characteristic of this genus is not very well marked in this species, and is concealed by the thick and shining peritoneal epithelium. When the latter is stripped off, the muscles are seen to be collected into about 18 longitudinal strands, which are most evident near the posterior end. In the probosciceal region, they form an almost continuous layer.

The intestine (Fig. 1B) forms about 30 loops. Its wall is transparent and has about 14 longitudinal rows formed by masses of glandular cells (Fig. 1E). These rows have a wavy outline, and frequently anastomose. There is no diverticulum on the rectum. A thick spindle muscle is present, which is attached to the body-wall at the posterior end, and in front of the intestine (Fig. 1B, a, Fig. 1G, a). The rectum is firmly attached by spreading sheets and strands of muscles.

The retractor muscles of this species are of considerable interest. Apparently only two are present, as in *Physcosoma Ruppellii* (Grube), *P. Weldoni*, Shipley, and many species of *Phascolosoma*, etc. In these cases it is always stated that the two retractors are the ventral pair. An examination of the present species shows, however, that in the oesophageal region two pairs of muscles are present (Fig. 1F., and that each muscle posteriorly is formed by the union of a dorsal and ventral retractor on each side. The two muscles are attached posteriorly to the body-wall rather behind the mid-line between the anus and the tail. Each muscle is attached to two of the longitudinal strands of the body-wall. In the oesophageal region the ventral muscles are considerably thicker than the dorsal ones. Just before the intestine emerges from the muscles, the dorsal and ventral muscles of each side fuse to form a single strand, which

afterwards shows no sign of its double origin, even where it joins the body-wall except that it is attached to two longitudinal strands.

There is a large pair of eyes on the brain. The vascular system (Fig. 1F, a) is very reduced and shows as a slender yellow vessel on the dorsal side of the oesophagus.

There is a single pair of nephridia, of a deep rust colour. The basal portion is inflated, and attached by muscle-fibres to the body-wall. The distal portion is slender, and quite free. The internal opening is surrounded by a folded membrane. The external openings are situated in front of the anus.

There are no structures in this species which can be definitely correlated with its environment in deep water. The reduction of the retractor muscles to a single pair, and the simplicity of the vascular system, are on the whole, however, more frequent in deep water species than in those from shallow water.

Locality.—

S. R. 504—12 IX '07. 50° 42′ N., 11° 18′ W. Temperature at 600 fms., 8·22° C., salinity 35·53‰; at 700 fms., 7·19° C. Beam trawl, 627–728 fms.—One specimen, with coral.

Phascolosoma vulgare, Blainville.

1841. *Syrinx Harveii*, Forbes, **6**, p. 249.
1845. ? *Syrinx granulosus*, McCoy, **18**, p. 272.
1877. *Phascolosoma papillosum*, Thompson, Koren and Danielssen, **13**, p. 138.
1885. *Golfingia McIntoshi*, Lankester, **15**, p. 469.
1892. *Phascolosoma Sanderi*, Collin, **4**, p. 177.
1900. *Phascolosoma papillosum*, Thompson, Sluiter, **30**, p. 19.
1905. *P. vulgare* + *P. papillosum*, Théel, **34**, p. 60.

This species is commonly distributed all round Ireland, ranging from the middle littoral region down to 60 fathoms. Young specimens, and those from deep water, are frequently very transparent. There is great variation in the size of this species, the largest attaining a length of 150 mm., whilst a female specimen from Tralee, with the body cavity full of eggs had a trunk only 9 mm. long. A specimen dregded in 60 fms. (S. R. 1153), 27 mm. long, had a very transparent skin. The proximal hooks were very small, whilst those at the tip of the proboscis were unusually large.

This species is frequently to be found in the lower half of the littoral zone, in the sand of zostera beds, and in sand and gravel with a certain admixture of mud. It is also frequently dredged in mud.

Sexually mature specimens were found in April.

This species presents such wide diversity in its external appearance that it is not surprising to find a long list of synonyms. It was first recorded from the British Isles by Forbes (6, p. 249)

as *Syrinx Harveii*. In 1885, Lankester (**15**, p. 469) described a specimen dredged in 10 fathoms in St. Andrew's Bay, for which he created a new genus *Golfingia*. From a consideration of the text and figures, I have no doubt that the specimen is only a strongly contracted form of *Phascolosoma vulgare*. The corneous rings surrounding the base of the proboscis and on the tail, are always present in this species in a more or less developed condition, as may be seen in many of the published figures (Forbes, **6**, p. 249; Théel, **35**, Pl. I, fig. 1). I have examined several specimens closely resembling in this respect the figures given by Lankester. The so-called pinnate tentacles are formed either by the unequal contraction or the unequal growth of the tentacular disc and crown, which causes it to be thrown into folds. In all other characters, such as the structure of the skin, hooks, and internal organs, *Golfingia* corresponds closely with *P. vulgare*. The 'corneous spike' on the tail, is merely the contracted posterior part of the body-wall. The type of *Golfingia* is now in the Natural History Museum, London, where I had the opportunity of examining it. Unfortunately it is in a very fragmentary condition, but, so far as I could see, it showed no differences from certain forms of *P. vulgare*. The systematic position of *Golfingia elongata*, Verrill (**39**, p. 670), is only vaguely defined by the brief description of the author. It might possibly be a species of *Aspidosiphon*.

The *Phascolosoma Sanderi* described by Collin (**4**, p. 177) also appears to be the form of *P. vulgare* with similar well-developed corneous areas at the base of the proboscis and on the tail. The types of this species were kindly submitted to me by the Director of the Berlin Museum, and they showed no differences of importance from typical specimens of *P. vulgare*.

Théel has shown (**34**, p. 62) that the *P. papillosum*, Thompson, of Koren and Danielssen (**13**, p. 138) is really *P. vulgare*, and Sluiter tells me (in lit.) that the specimens he named *P. papillosum*, Thompson (**30** p. 19), also belong to this species.

The *Syrinx granulosus* of McCoy (**18**, p. 272) is most probably this species, though it may possibly be *Physcosoma granulatum*, Leuck.

Distribution.—British Isles; European shores of the Atlantic; Greenland; Azores; Mediterranean; Red Sea; Singapore

Localities.—

Killary Harbour, 15 fms., 12 VII '90. R.D.S. Exp. St. 73.
Lough Swilly, 1900. Off Bray Head, Co. Wicklow.
Bofin, CLXXXIII—11 VIII '00—One specimen.
Bofin, CCXXXIV—9 X '00. Sh. coll.—Two large specimens.
M.L. VIII—5 II '01, Ballinakill Hbr., Sh. coll.—One specimen.
M.L. LIIa—22 VII '01, Ballinakill Hbr., Dredge, 1½–2 fms.—One specimen.

On oysters from Tralee, 6 IV '03—One small specimen.
L. 283—19 I '04, Ballinakill Hbr., Sh. coll.—Two specimens.
L. 326—1 IV '04, Ballinakill Hbr., Sh. coll.—Six specimens.
A. 120—20 V '05, Aran Is., Sh. coll.—Two specimens.
S. 363—20 II '06, 18½ miles S.W. by W. of Isle of Man; Beam trawl, 35–36 fms., in mud.—One specimen.
R. 30—17 VIII '06, 9½ miles S.E. by S. of Mine Head; Sand grab, 39 fms.—One specimen.
S. 553—16 VIII '07, 10 miles E. of Bailey Lt.; Trawl, 41–52 fms.—Two specimens.
S. 597—6 II '11, off Co. Wexford; Dredge, 7½–8 fms. Common in old oyster shells and masses of *Sabellaria spinulosa*.
S. R. 1153—13 V '11. 30 miles S. of Co. Cork; Dredge, 60 fms.—One specimen in sandy mud.
Annagh Is., Westport Bay, 19 VIII '09., Sh. Coll.—Three specimens.
W. 108—25 VIII '09. Clew Bay; Dredge, 4 fms.—One specimen.
W. 146—16 VIII '10. Inishlyre Roads, Clew Bay; Dredge, 2–4 fms.—One specimen, in corallines.
Blacksod Bay, shores of Mullet. Collected on nine occasions, 1909–1911.
W. 248—3 III '12. Lough Swilly.—Three specimens in coarse sand.
W. 263—23 VIII '12. Valencia Harbour, off Cable station. Dredge, 2½–4½ fms., mud.—One specimen.

Phascolosoma elongatum, Keferstein.

1845. *Syrinx Forbesii* + *S. tenuicinctus,* McCoy, **18**, p. 273.
1853. *Sipunculus punctatissimus,* Gosse, **7**, p. 125.
1900. *Phascolosoma pellucidum,* Kef. Shipley, **28**, p. 189.
1903. *P. teres,* Hutton, **9**, p. 29.
1905. *P. e.,* Théel, **34**, p. 62.

In certain places this species occurs in very large numbers. It is especially abundant in the sand of zostera beds, where it is the characteristic Gephyrean. It is also frequent in muddy sand. There are very few records of this species on the east coast of Ireland.

In 1900, Shipley (**28**, p. 189) recorded *Phascolosoma pellucidum,* Kef., as occurring abundantly in zostera beds. A number of the specimens were sent to me by Dr. Allen. They are typical examples of *Phascolosoma elongatum,* Kef.

In 1903, Dr. Hutton (**9**, p. 29) described a new species, *Phascolosoma teres,* from two specimens dredged in 60 fathoms in the Firth of Clyde. These specimens have been placed at my disposal for examination by Dr. Hutton. They appear to be small and strongly contracted specimens of *P. elongatum.*

They agree with the latter species in having (1) no papillae, but only flat glands on the skin, (2) a similar number of tentacles, about 15, (3) hooks of a similar structure and arrangement on the proboscis, (4) four retractor muscles. Hutton says that the right nephridium is much larger than the left one. In the specimen I examined, the difference between the two nephridia is small, and probably due to unequal contraction. The sharply delimited posterior portion of the body and the arrangement of the intestine are also characters produced by the intense contraction of the circular muscles of the body-wall. I have examined numerous specimens of *P. elongatum* showing a similar condition, and it is very common in individuals of this species which are killed quickly.

The two species *Syrinx Forbesii* and *S. tenuicinctus* described by McCoy (**18**, p. 273) from the west coast of Ireland, almost certainly belong to this species. They have both smooth cylindrical bodies, without papillae. I have examined specimens in the British Museum, labelled '*Phascolosoma tenuicinctus*,' and they undoubtedly are referable to *P. elongatum*. The *Phascolosoma Forbesi* of Baird was referred to this species by Selenka (**25**, p. 24) after examination of a specimen in the British Museum. He expresses doubts whether McCoy's species belong to *P. elongatum* or *P. vulgare*, but the absence of papillae points to *P. elongatum*. There seems to be nothing to distinguish the *Sipunculus punctatissimus*, Gosse (**7**, p. 125), from this species.

This species ranges in Irish waters, from the littoral region down to about 60 fathoms.

Distribution.—This species has a somewhat restricted range. It has been recorded from the British Isles, Sweden, North Sea, north and west coasts of France, and the Mediterranean.

Localities.—

Roundstone, 7 VI '90.—One specimen.

Mulroy Bay.—Four specimens.

A. 17—28 VI '04. Galway Bay. Dredge, 1–1½ fms.—Two specimens.

R. 30—17 VIII '06. 9½ miles S.E. by S. of Mine Head. S. Grab, 37½–39 fms.—One specimen.

R. 31—17 VIII '06. 6 miles S.E.S. of Mine Head. S. Grab, 29 fms.—Two specimens.

W. 147—16 VIII '10. Inishlyre Roads, Clew Bay. Dredge, 5 fms., in mud.—Two specimens.

S. 594—6 IX '10. Dundrum Bay. Shrimp trawl, 10¾–12 fms., in sand and shells.—One specimen.

W. 175—16 II '11. Valencia Hbr. shore collecting in sand of zostera bed.—Very common.

S. R. 1153—13 V '11. 30 miles S. of Co. Cork; Dredge, 60 fms., in sandy mud.—Two specimens.

Blacksod Bay, shores of Mullet. Collected on 8 occasions, 1909–1911.

W. 256—6 III '12. Lough Swilly, shore collecting.—Four specimens in sand-binding seaweeds.
W. 263—23 VIII '12. Valencia Harbour, off Cable station. Dredge, 2½–4½ fms., mud.—One specimen.

Phascolosoma rugosum, sp. n.

Plate II, fig. 2.

Two specimens of this new species were obtained. The description is drawn up from the larger and earlier one (S. R. 331), and afterwards those points are noted in which the second specimen differs.

The proboscis is invaginated for a distance of 2 mm., and its total length from the anus to the tentacular crown is 8·5 mm. From the anus to the posterior extremity is only 5 mm., giving a total length of 13·5 mm. The backward position of the anus and the breadth of the proboscis are very characteristic. The body is rounded behind (Fig. 2A), somewhat rectangular in outline behind the anus. In front of the latter, it gradually grows narrower, but the width of the proboscis still remains about ⅓ of that of the trunk. The colour of the animal in life, and also after being in spirit, is a very light grey, and the delicate transverse and longitudinal ridges and furrows of the cuticle give it a rugose appearance, hence the specific name.

The papillae on the skin are inconspicuous and not very numerous. They arise from a large oval base which lies on the outer muscular layer of the body-wall (Figs. 2C, D, E). They vary considerably in shape, as shown by the figures. The long slender ones are especially numerous on the tip of the tail, but they also occur sparsely on the trunk (Fig. 2D). In sections of the body-wall (Fig. 2E) the papillae are seen to be flask shaped. The papillae near the tip of the proboscis are of quite a different appearance (Fig. 2C). They seem to terminate distally in a flat disc which shows concentric striations.

Behind the tentacles the proboscis is studded with a number of small hooks, which are not arranged in rows. These hooks are curved, with broad bases and sharp points (Fig. 2C). They decrease in size from the front backwards. Papillae are scattered amongst the hooks. The proboscis is retracted, and the tentacles can only be seen with difficulty. They are about 12 in number.

There are four slender retractor muscles (Fig. 2B). The dorsal pair are attached just behind the anus, the ventral pair about half way between the anus and the tail. The intestine is free behind. It forms an irregular spiral consisting of 13–16 loops. The end of the rectum is enveloped in a meshwork of muscular fibres. No vascular system could be seen.

The two nephridia open to the exterior in front of the anus.

In transverse section the body-wall is very thin (Fig. 2E), varying from ·035–·060 mm. The muscular layer is only ·015–·020 mm. thick. The cuticle is about 2½ times as thick as the

muscular layer. Under the cuticle can be distinctly seen the epidermal layer, the nuclei of which stain deeply. The longitudinal muscular layer is thicker than the circular layer, and is bounded internally by the delicate peritoneal epithelium. The papillae are flash-shaped, with flat bases, and the neck projects beyond the cuticle.

The second specimen obtained (S. R. 1004) is rather smaller, and the skin is a little darker, otherwise it resembles the first specimen in appearance. The papillae of the skin are a little longer and more bulbous. The hooks on the proboscis are more numerous, larger, and with sharper points. The internal structure agrees closely with that of the first specimen.

This species belongs to the '*vulgare*' group, characterised by the possession of four retractor muscles, hooks on the proboscis, and papillae on the skin. It is distinguished from all other species by the structure of the skin and papillae, the general aspect and shape of the body, the posterior position of the anus, etc.

Localities.—

S. R. 331—9 v '06. 51° 12′ N., 11° 55′ W. Mosquito-net on trawl, 610–680 fms., ooze.—One specimen.

S. R. 1004—12 VIII '10. 51° 22′ 30″ N., 11° 44′ 30″ W., soundings 641–636 fms., fine sand and coral. Temperature at 630 fms., 7·12° C., salinity 35·46‰. Beam trawl, 641–636 fms.—One specimen.

Phascolosoma mutabile, sp. n.

Plate III, fig. 4.

Four specimens of this species were found at two stations in deep water, off the south-west coast of Ireland. As they differ in several respects, it will be preferable to describe them separately.

The type-specimen (S. R. 335) is broadly fusiform in outline (Fig. 4A), with bluntly rounded posterior end. The trunk merges gradually into the proboscis. The total length is 43 mm., of which the proboscis comprises 20 mm. The skin is thick and opaque, covered with fine wrinkles, and the cuticle is deeply coloured with dark brown pigment. The anal and nephridial pores are plainly indicated by pale areas. Papillae are scattered over the whole skin, but, except on the tail, they are short and almost spherical (Fig. 4C), and are only visible under high magnification. They are most numerous at the posterior end, where they are 4–6 times as long as broad. Some distance behind the tentacular crown there is a narrow band of scattered and inconspicuous hooks (Fig. 4E). They are narrow, pointed, and deeply grooved in front view. There are only about 80 of them altogether.

The tentacles are well developed, about 52 in number. As the disc in the type-specimen is invaginated and difficult to see,

the figure and description of the tentacles are drawn from one of the other specimens (see below).

Fig. 4G shows a longitudinal section of the body-wall from the posterior end of the body. The cuticle is nearly twice as thick as the muscular layer. Its outer rugose layer is thick, and full of dark granules of pigment. The internal layer of longitudinal muscles is only a little thicker than the external circular muscles. The glands are flask-shaped, with rounded bases and long slender necks, which project well beyond the cuticle.

The inner surface of the body-wall has a pearly lustre. The intestine (Fig. 4B) is slender, consisting of about 24 closely wound loops. It is free behind. The rectum has no diverticulum and is covered near its terminus with a flat sheet of muscle. It is also attached to the body-wall by a long slender muscle which has two roots. Two other slender muscles originate from the middle of the intestine and are attached to the two ventral retractor muscles. These are shown in Fig. 4B. A few other slender strands of muscle connect the intestine to the body-wall and ventral retractors.

There are four retractor muscles of approximately equal thickness. The anterior pair are attached to the body-wall at about a quarter of the distance from the anus to the posterior end. The ventral pair are attached about half-way between the dorsal pair and the posterior end. The space between the two pairs of retractors is much greater than in *P. vulgare*. The two nephridia are attached to the body-wall only near their external openings, which are situated some distance in front of the anus.

The three other specimens obtained from an adjacent locality (S. R. 334) differ from the type, and agree with each other in several points, so that it is probable that they represent the typical condition. The skin is pearly grey in colour, and not pigmented. The closest search failed to reveal any hooks on the proboscis. The absence of hooks in these specimens cannot be held as a character of specific value, when one considers how few they are in the type.

Sections of the skin reveal exactly the same structure as shown in Fig. 4G, whilst the internal anatomy is in close agreement. These specimens agree with *P. margaritaceum* (Sars), in having four retractor muscles, no hooks, and well-developed tentacles, but differ markedly in the structure of the body-wall. For comparison, I give a figure of a longitudinal section of the skin from the posterior end of the body of a specimen of *P. margaritaceum* from Greenland (Pl. II, fig. 3). It will be seen that the proportion of the various layers in the body-wall, and the structure of the papillae, are quite different.

One of the specimens from station S. R. 334 had its tentacles fully expanded (Fig. 4F). The structure of the tentacular disc agrees closely with one of the figures given by Théel for *P. margaritaceum* (Théel, **34**, Pl. XIV, fig. 194). There are about

54 tentacles of various sizes. Beneath the tentacular crown is a smooth area, below which is a prominent fold, or collar.

This species belongs to the '*vulgare*' group. It resembles *P. profundum*, Roule, in many points, but differs in having more numerous and better developed tentacles, in the structure of the body-wall, the disposition of the retractor muscles, etc. It differs from *P. approximatum*, Roule, in the two latter characters. It is distinguished from *P. rugosum* (p. 18) by the structure of the papillae, the thicker body-wall, the thicker and shorter retractors, and the more numerous tentacles.

Localities.—

S. R. 334—10 v '06. 51° 35′ 30″ N., 12° 26′ W. Temperature at 500 fms., 9·2° C. Beam trawl, 500–520 fms.—Three specimens.

S. R. 335—12 v '06. 51° 15′ N., 12° 17′ W. Temperature at 700 fms., 6·84° C. Sprat net on trawl, 893–673 fms.—One specimen.

Phascolosoma muricaudatum, sp. n.

Plate IV, fig. 5.

This species might easily be mistaken at first sight for *Phascolosoma flagriferum*, Selenka, which it resembles in having a filiform tail. A closer examination shows, however, that it has no real affinity with that species, from which it differs in having four retractor muscles instead of two.

The present species is represented by 56 specimens of various sizes. The largest specimen is 48 mm. long, the proboscis being 16 mm., and the trunk 32 mm., of which the filiform tail comprises 6 mm. The small, fully-expanded specimen figured (Fig. 5A) is 21 mm. long, the proboscis being 8 mm., the trunk and tail 13 mm., and the tail alone 4 mm. There is thus considerable variation in the relative proportions. The body is cylindrical, passing anteriorly gradually into the proboscis, posteriorly abruptly into the slender tail. In most of the specimens the skin is pale brown in colour, very thin and transparent, except when strongly contracted. It is delicately wrinkled, and a low magnification shows that it is regularly dotted with small glands. At the base of the tail the skin is thicker, more wrinkled, and the papillae are placed on small hemispherical projections (Fig. 5B) caused by the contraction of the skin in this region. In a few cases the skin is grey and opaque, and much more wrinkled, but this is probably due to the specimens being preserved in spirit, the transparent ones being in formalin. The tail is covered with slender papillae (Fig. 5B, c). The large flat papillae on the base of the tail, so marked in *Phascolosoma flagriferum*, are quite absent. The tail varies considerably in length, but is always abruptly separated from the trunk, and must be considered as of the nature of an appendage, since the nerve-cord does not penetrate into it. Its

function is probably sensory. In small and immature specimens, the proboscis just behind the tentacles is dotted with powerful hooks, not arranged in any definite order. In several fully grown animals, the hooks are quite absent, thus adding another instance to prove the unreliability of this character as a specific criterion. Mingled with the hooks are papillae of quite a different appearance to those found elsewhere on the body. Fig. 5E shows the appearance of these papillae and hooks in a contracted specimen. The skin is divided into irregular oval areas, each corresponding to a single gland, from which rises a low, rounded papilla. In Fig. 5F they are shown in side view. The hooks project from between these papillae. Fig 5D shows part of the tip of the proboscis of the fully-expanded specimen shown in Fig. 5A. The end of the proboscis is dilated and transparent. The hooks are sharply pointed, with the lateral edges infolded, and of a common type. The papillae are seen in outline as broadly cylindrical. Beneath the zone of hooks, the papillae change completely, and are now seen to be slender, with bulbous tips. Further behind, they become quite cylindrical, and have the same appearance in all other parts of the body (Fig. 5G, a, b, c). They are from two to six times as long as broad.

The small fully-expanded specimen (Fig. 5A) had twelve slender tentacles. Adult specimens have 25–30 well-formed tentacles.

A longitudinal section of the skin is shown in Fig. 5J. The cuticular layer is comparatively thin, being about equal to the layer of circular muscles, whilst the layer of longitudinal muscles is considerably thicker. The cells composing the glands have large deeply staining nuclei. The glands are roughly flask-shaped.

The intestine (Fig. 5H) is formed of about 30 closely coiled loops. A single delicate strand of muscle attaches its anterior part to the body-wall. There is a large spindle muscle which is attached in front by numerous strands round the anus, but is quite free behind.

No trace of a vascular system could be seen.

There are four retractor muscles. The dorsal pair are much thinner than the ventral pair, and are attached just behind the level of the anus, though in some specimens they extend further back. There is considerable variation in this character. The ventral pair of muscles are attached in front of the middle line between the anus and the base of the tail.

The nephridia are small, and are attached to the body-wall in front of the anus.

Ripe eggs were found in the body cavity of many of the specimens.

This species is clearly distinguished from all forms having four retractor muscles by the filiform tail. Another very distinctive character is the appearance of the papillae on the tip of the proboscis.

Localities.—

S. R. 164—3 XI '04. 52° 6′ N., 12° 0½′ W., soundings 375 fms., mud and sand. Temperature at 320–350 fms., 9·78° C. Dredge, 375 fms.—Two specimens.

S. R. 172—5 XI '04. 52° 2′ N., 12° 8′ W. Townet on dredge, 454 fms.—One specimen.

S. R. 353—6 VIII '06. 50° 38′ N., 11° 32′ W., soundings 250–542 fms., mud and sand. Temperature at 500 fms., 8·58° C. Mosquito net on trawl, 250–542 fms.—One specimen.

S. R. 590—3 VIII '08. 51° 51′ 30″ N., 12° 8′ W., soundings 480 fms., ooze. Temperature at 480 fms., 9·28° C. Midwater trawl, 480 fms.—Four specimens.

S. R. 752—17 V '09. 51° 48′ N., 12° 11′ 30″ W., soundings 523–595 fms., ooze. Temperature at 500 fms., 8·9° C. Midwater trawl, 523–595 fms.—Fifty specimens.

Phascolosoma bulbosum, sp. n.

Plate V, fig. 6.

Eight specimens of this new species were taken in the same haul with fifty specimens of *Phascolosoma muricaudatum* sp. n., a species with which they have a superficial resemblance. The peculiarity of shape from which it derives its specific name is common to all the specimens. The anterior portion of the trunk is thin-walled, often transparent, and swollen. Behind, it passes into a long slender thick-walled tail. This latter portion, however, is really a slender portion of the trunk, and not an appendage in the same sense as is the tail of *P. muricaudatum*. This is evident from the fact that the nerve-cord traverses it to the tip (Fig. 6D), whilst in *P. muricaudatum* it does not enter the tail. It is probable that the bulbous character of the anterior part of the trunk is not a specific character, but is due to unequal expansion. The filiform nature of the posterior portion of the trunk, is, however, characteristically shown by all the specimens, and is probably the normal condition. No papillae are visible to the naked eye.

The skin is buff-coloured, often rusty red in places. It is very delicately marked with granular wrinkles. The largest specimen had a total length of 55 mm., of which the trunk forms 43 mm., and the proboscis 12 mm. No hooks could be found on the proboscis, either in large or small specimens. The papillae on the proboscis (Fig. 6B) are small and few in number. On the body and tail they are numerous, but small (Fig. 6C), cylindrical in shape, 2–6 times as long as thick, and surrounded by a delicate granular ridge.

Fig. 6E shows a longitudinal section of the skin from near the base of the tail, where it is strongly contracted. The two muscular layers are approximately equal in thickness, and the

cuticle is also thick, and deeply ridged. The glands are small and flask-shaped, resembling those of *P. mutabile* (Pl. III, Fig. 4G), from which species, however, it is quite distinct.

The tentacles are moderately long, 16–18 in number.

The intestine (Fig. 6D) is comparatively short, composed of about 20 loops. There is a powerful spindle-muscle (b), which divides into numerous fibres round the rectum. It is not attached behind. In addition there are three delicate muscular strands (a) passing from the intestine near the rectum to the muscles joining the oesophagus to the retractors.

There are two slender retractor muscles, to which the oesophagus is attached throughout the greater part of its length. They join the body-wall behind, midway between the anus and the posterior end. At their bases are seen the genital festoons. No trace of a vascular system could be seen. The nerve-cord passes to the extreme tip of the tail, showing that the latter is only the attenuated posterior portion of the trunk.

The two nephridia are long and slender, and their openings are distinctly visible in front of the anus.

This species is closely related to *P. flagriferum*, Selenka. It differs in having no large papillae on the base of the tail, in the position of the retractors, and in the tail being only the attenuated posterior portion of the body.

It also agrees closely with *P. Catharinae*, Müller, but differs in shape, in having fewer tentacles, and in the absence of a vascular system.

Locality.—

S. R. 752—17 v '09. 51° 48′ N., 12° 11′ 30″ W., soundings 523–595 fms., ooze. Temperature at 500 fms., 8·9° C. Midwater trawl, 523–595 fms.—Eight specimens.

Phascolosoma procerum, Mobius.

1905. *P. p.*, Théel, **34**, p. 70.

This species, which has not previously been recorded from Irish waters, has only been found in small numbers, and is comparatively rare. This is possibly because of its restriction to a definite habitat. It has generally only been found in mud, or in muddy sand. The proboscis, when fully extended, greatly exceeds the trunk in length. One small specimen, 10 mm. in total length, had a proboscis measuring 7·7 mm.

It ranges from low-water mark down to about 100 fathoms.

Distribution.—North Sea, West Coast of Sweden, Kattegat, West Coast of Norway. This is a very typical Celtic distribution.

Localities—

Donegal Bay, 1896.

A. 81—13 IX '04. Galway Bay Dredge, 12 fms.—One specimen.
W. 21—22 XI '04. Galway Bay. Soundings 16½ fms., muddy sand. Temperature at bottom 12° C. Dredge.—One specimen.
W. 108.—25 VIII '09. Clew Bay. Dredge, 4 fms.—Six specimens.
W. 147—16 VIII '10. Inishlyre Roads, Clew Bay. Dredge, 5 fms., in mud.—One specimen.
S. R. 1153—13 V '11. 30 miles S. of Co. Cork. Dredge, 60 fms., sandy mud.—One specimen.
W. 225—22 VIII '11. Killary Harbour. Dredge, 17½ fms., soft mud—Six specimens.
W. 226—22 VIII '11. Killary Harbour. Dredge, 7 fms., soft mud.—Four specimens.
S. R. 1254—9 XI '11. 30 miles E. of Carlingford, Irish Sea. Townet on bottom, 40 fms., soft mud.—One specimen, 4 mm. long.
W. 259—19 VIII '12. Off the coast of Kerry. Soundings 78 fms., sand. Dredge—One specimen.

Phascolosoma constrictum, sp. n.

Plates VI and VII, fig. 10.

Four specimens of this species were taken altogether, on two different occasions, in deep water off the south-west of Ireland. The description is from the first specimen obtained (S. R. 363).

The proboscis is not fully everted, though the hooks are visible at the tip. The body is about 35 mm. long, of which the proboscis comprises 8 mm. The division between the trunk and proboscis is shown externally and internally by a deep constriction, behind which is the anal aperture (Pl. VI, fig. 10A). This constriction is present in all the specimens, and seems to be a specific character. The trunk is widest in its posterior third. In front of this, it gradually attenuates, whilst behind it is rapidly rounded off to a terminal papilla. The colour of the cuticle is pale grey, through which shines the deep flesh colour of the muscle layers. The papillae on the skin are of a translucent amber colour. The proboscis and anterior region of the trunk are somewhat rugose, and the papillae are concealed by the ridges on the cuticle. The posterior region is roughly marked out into rectilinear areas by irregular folds of the cuticle. The body is thickly dotted with large papillae, except in the anterior region. They vary greatly in shape and size in different regions of the body. They are largest on the mid-body, where they are shaped like a button, with a rounded papilla in the middle of the upper surface (Figs. 10 C, G, H). On the proboscis the papillae are all narrow and cylindrical (Fig. 10F). Below the anus they are still cylindrical, but are gradually getting stouter and flatter, in some cases with a swelling in the middle, but no stalk.

Towards the middle of the body the stalk appears, and gradually elongates. These papillae resemble saucers, with inverted cups standing in them. Near the tail, the papillae increase in length and diminish in width, till finally, on the pointed tail, they are long and cylindrical, resembling those found on the proboscis. On all parts of the body small papillae are mixed with the large ones. Fig. 10 H shows in schematic outline the various forms of papillae.

The hooks on the proboscis are in about 12 very ill-defined rows, mixed with papillae, which have globular heads and short stalks (Fig. 10J). The hooks are irregularly conical, with sharp or blunt points, and incurved bases. The skin between them is very granular.

The body-wall is fairly stout in the proboscis and anterior region of the body, but behind, it is thin and transparent, especially on the dorsal side of the mid-body. The tentacles are invaginated, and so contracted that it is not possible to see them clearly in this specimen. The tentacular fold bears a number of short thick lobes crowded together in an irregular manner.

The intestine (Fig. 10B) is twisted in a complex spiral composed of about 16 irregular loops. The end of the rectum is swollen and covered with transverse muscle fibres. A few delicate muscular strands connect the intestine to the body-wall, and the intestinal loops are bound together by fibres, but no spindle muscle is present.

No vascular system could be seen.

Two retractor muscles are present, and are attached to the body-wall mid-way between the anus and the tail. Two delicate sac-like nephridia are present, opening to the exterior just behind the anal aperture. In the great majority of species of the genus *Phascolosoma*, the nephridia open in front of the anus. Other exceptions to this rule are *P. sabellariae*, Théel, *P. improvisum*, Théel, and *P. reconditum*, Sluiter.

The nerve cord terminates in a series of slender branches some distance from the posterior end of the body.

Fig. 10G shows a longitudinal section of the skin taken from near the middle of the body. The longitudinal muscular layer is about twice as thick as the circular layer, and is composed of broad fibres. The cuticle is thick and finely striated, with a dark granular external layer. The papillae consist of a slender core, composed of cells with large nuclei, which stain deeply. Round the distal part of the core is a button-shaped mass of a cuticular nature. The central core is based on the circular muscles, and is enveloped in the epidermal layer, which is very distinct.

Three other specimens of this species were obtained, whilst examining a number of specimens of *Ascidia tritonis*, which were attached to the sponge *Pheronema*. They were partly embedded in the test of the Ascidian in the area of attachment, together with a large number of Polychaetes.

These three specimens are smaller than the one already described, but resemble it in general appearance. The large papillae are, however, concentrated in the posterior third of the body. The internal anatomy is very similar, with the exception that the retractor muscles are attached to the body-wall further back, in the posterior third. One of the specimens, 18 mm. long, has the body cavity full of eggs.

This species belongs to the '*abyssorum* group' characterised by the reduced tentacles and vascular system, and by having two retractor muscles. It is easily distinguished from all other species by the structure of the papillae.

Localities.—

S. R. 363—10 VIII '06. 51° 22′ N., 12° 0′ W. Temperature at 600 fms., 7·92° C. Trawl, 695–720 fms., ooze. —One specimen.

S. R. 500—11 IX '07. 50° 52′ N., 11° 26′ W. Temperature, at 600 fms., 8·22° C. Trawl, 625–666 fms.—Three specimens.

Phascolosoma abyssorum, Koren and Danielssen.

1905. *P. a.*, Théel, **34**, p. 78.

A single specimen, which I refer with some hesitation to this species, was dredged in 388 fathoms. Its body was smooth, transparent, and cylindrical, in shape like that of a small specimen of *P. elongatum*. No papillae could be found on the skin. The total length was 19 mm., of which the proboscis measured 9 mm. Round the mouth were 14–16 slender and fairly long tentacles. There are two free nephridia of a brick-red colour. The two retractor muscles, separate for the greater part of their length, are attached to the body-wall about midway between the anus and the tail. The glands of the skin closely resemble those figured by Théel (tom. cit.), as do the hooks on the proboscis, though the latter are few in number, and some of them are more pointed in side view. From this description it will be seen that the specimen resembles *P. abyssorum* in having a smooth, semi-transparent cylindrical body, with glands in the skin, but no papillae; in having two well-separated retractor muscles, and in having hooks on the proboscis. The chief differences are slight, such as the possession of fewer and longer tentacles, fewer rows of hooks, absence of generative products, and these may be due to the immaturity of the specimen. In the present state of our knowledge, it is better to leave the specimen under this species for the present.

Distribution.—West Coast of Norway (200–300 fms). Spitzbergen.

Locality.—S. R. 151—27 VIII '04. 54° 17′ N., 11° 33′ W. Temperature at bottom 9·15° C. Dredge, 388 fms., stone and rock.—One specimen.

Phascolosoma Johnstoni (Forbes).

Plate V, fig. 9.

1841. *Sipunculus Johnstoni*, Forbes, **6**, p. 254.
1862. *Phascolosoma minutum*, Keferstein, **11**, p. 40.
1865. *Petalostoma minutum*, Keferstein, **12**, p. 438.
1884. *Petalostoma minutum*, Selenka, **25**, p. 129.
1905. *Phascolosoma sabellariae*, n. sp. + *P. improvisum*, n. sp., Théel, **34**, p. 81.
1908. *Petalostoma minutum*, Kef., Southern, **32**, p. 171.
1909. *Petalostoma minutum*, Kef., Paul, **20**, p. 1.
1911. *Phascolosoma minutum*, Kef., Théel, **36**, p. 31.
1912. *Phascolosoma minutum*, Kef., Sluiter, **31**, p. 10.

This diminutive species seems to be common round the Irish coast, as I have found it wherever I have looked closely. It lives under stones and in crevices of the rocks between tide marks, amongst the tubes of *Sabellaria alveolata* (L.), and is very common in Laminaria roots. A number of small specimens dredged in deep water, down to about 700 fathoms, are also indistinguishable from the common littoral form. Sluiter (**31**, p. 10) records the species from 950 fathoms. Two specimens from deep water (S. R. 590) were found living in the test of a Foraminiferon (*Saccamina sphaerica*, Sars) composed of large quartz grains. The proboscis of one specimen protruded from the mouth of the test; the other specimen was contracted altogether within the test (Figs. 9A, 9B).

This species is extremely variable and has given rise to much confusion, as the list of synonyms given above will show. I regret that the rule of priority compels me to discard the well-known name of *Phascolosoma minutum*, Kef., in favour of that first given to the species by Forbes. In 1841, Forbes (**6**, p. 254) described under the name *Sipunculus Johnstoni*, a species found by Dr. Johnston at Berwick. The latter wrote to Forbes as follows: "It is not uncommon sometimes at the roots of corallines, lurking in the sand, the colour of which it resembles. It is rarely, I should think, half an inch long, contracts and lengthens itself, as is usual with the tribe, draws in the anterior end, and extends it as a snail doth its horns, *and when it is fully extended there is an appearance of two minute papillae at the orifice*." The latter character proves almost beyond doubt that Dr. Johnston was examining the species since called *Petalostoma minutum*. The latter has been recorded from the neighbouring coast of Scarborough by Watson, who kindly sent me examples. The description of Forbes is illustrated by a drawing made by Mrs. Johnston, in which the animal appears with a bunch of well-developed, but imaginary, tentacles.

The littoral specimens of this species usually do not have hooks on the proboscis. However, occasionally the hooks are present, and I recently obtained large numbers of specimens in Laminaria roots from Howth, Co. Dublin, all of which had

hooks on the proboscis. All the specimens from deep water were provided with hooks. The papillae on the skin are also variable, those specimens from deep water having larger and longer papillae than the littoral forms. However, the extreme forms are joined by a complete series of intermediate stages, and it is impossible to distinguish more than a single species.

Théel has recently recorded *Phacolosoma minutum* from the Falkland Islands, so that the species has a bipolar distribution.

The specimens from deep water are usually found in small Gasteropod shells, or in tests of Foraminifera.

Distribution.—British Isles (Plymouth, Scarborough, Dublin Bay), West Coast of Sweden, Norway, North Sea, France, Falkland Islands.

Localities.—

Helga, CXX—24 VIII '01. 77 miles W.N.W. of Achill Head. Townet on trawl, 382 fms.—One specimen.

W. 7—24 III '04. 27 miles W. by N. ¼ N. of Bray Head, Valencia. Soundings 100 fms., sand. Temperature at 100 fms., 9·8° C. Townet on trawl, 100 fms.—One specimen, mature.

S. R. 486—3 IX '07. 51° 37′ 30″ N., 12° 0′ W. Townet on trawl, 600–660 fms.—Six specimens.

S. R. 489—4 IX '07. 51° 35′ N., 11° 55′ W. Townet on trawl, 720 fms.—Five specimens.

S. R. 590—3 VIII '08. 51° 51′ 30″ N., 12° 8′ W. [Soundings 480 fms., ooze. Temperature at 480 fms., 9·28° C. Midwater trawl, 480 fms.—Two specimens.

W. 73—22 V '09. Clare Island, shore collecting.—Two specimens.

W. 142—13 VIII '10. Valencia Harbour. Dredge, 4–7 fms.—One specimen, mature, in limestone.

W. 191—14 V '11. Crookhaven. Shore collecting—Very common in Laminaria roots.

Blacksod Bay; collected on ten occasions on the shores of the Mullet, 1909–1911.

Portstewart, Co. Derry; common on the shore, and in Laminaria roots.

Dublin Bay (Balscadden Bay, Stella Maris Bay, Sandycove).

Lough Swilly, in Lithothamnion (W. 256; W. 258).

S. R. 1358—6 V '12. 12 miles S. by W. ½ W. of Chicken Rock, Isle of Man. Dredge, 35 fms., gravel and shells.—Several specimens.

Phascolion strombi (Montagu).

1905. *Phascolion strombi* (Mont.), Théel, 34, p. 86.

This species is common all round Ireland. It usually lives in small Gasteropod shells, especially those of *Turitella*. It is also

common in shells of *Dentalium*, and on one occasion was found in cowrie shells, and in tubes of *Hydroides norvegica*. Frequently it is accompanied in the shell by the Polychaete worm *Syllis cornuta*, Rathke. Brumpt (**3**, p. 493) gives some particulars of the association of a Syllid with *Phascolion*, but says that Malaquin, to whom he submitted specimens, was of the opinion that it was closely allied to *Syllis hyalina*, Grube. I think it highly probable that it is the same species as the one I have found. I have also found *Syllis cornuta* accompanying *Aspidosiphon Müllerі* in the shell of *Aporrhais pes-pelicani*, and sharing a tube with the ploychaete *Pectinaria auricoma* (Müller).

A specimen of *Phascolion* was found sharing a *Turitella* shell with a small Hermit Crab (*Eupagurus bernhardus*). The *Phascolion* occupied the upper whorls of the shell, and its proboscis emerged from a round hole in the middle of the shell.

Sexually mature specimens were found in August and September. Occasionally examples were found without hooks on the proboscis, as Théel describes in the variety *spetzbergensis* (**34**, p. 89).

The bathymetrical range of this species is from low-water mark down to about 100 fathoms, though it has been recorded from 1,000 fathoms in the Atlantic. It is very abundant in depths of 10–30 fathoms. It was found on the Porcupine Bank in 91 fathoms, though it has not been found in the intervening deep channel.

Distribution.—British Isles, shores of East Atlantic, Arctic Ocean, Newfoundland, Eastern shores of Canada and the United States. Mediterranean. Between South Georgia and the Falkland Islands, Théel (**36**, p. 31), who comments on the bipolar distribution of the species.

Localities.—

Dublin Bay, in various localities.

Bofin, XXXVII—28 VI '99. Outside Bofin Harbour. Dredge, 15–16 fms.—Common in cowrie shells, etc.

Helga, LXXVIId—29 VI '01. Porcupine Bank. Dredge, 91 fms.—Two specimens.

L. 13b—14 I '02. Ballinakill Hbr. Townet on bottom, 2–6 fms.—Four specimens.

L. 18—16 I '02. Ballinakill Hbr. Shrimp trawl, 10–12 fms.—Five specimens.

A. 5—1 VI '04. Galway Bay. Dredge, 6 fms.—Eight specimens.

A. 6—6 VI '04. Galway Bay. Dredge, 7 fms.—Two specimens.

A. 81—13 IX '04. Galway Bay. Dredge, 12 fms.—One specimen.

S. 553—16 VIII '07. 10 miles E. of Bailey Light. Trawl, 41–52 fms.—One specimen.

Clew Bay, 1909–1911. Dredged on ten occasions in various parts of the bay, at depths of 2–25 fathoms.

Blacksod Bay, 1909–1911. Dredged on ten occasions in various parts of the bay, at depths of 2–10 fathoms.

W. 243—9 II '12. Dingle Bay. Dredge, 22 fms., gravel and stones.—Common in shells.

W. 244—9 II '12 Dingle Bay. Dredge, 25 fms., stones. —Common in shells.

S. R. 1358—6 V '12. 12 miles S. by W. ½ W. of Chicken Rock, Isle of Man. Dredge, 45 fms., gravel and shells.—Two specimens.

S. R. 1444—19 VIII '12. Off the coast of Kerry. Dredge, 142 fms., sandy mud.—One specimen.

Aspidosiphon Müllerí, Diesing.

Plate V, fig. 8.

1860. *Phascolosoma radiata*, Alder, **1**, p. 75.
1875. *Aspidosiphon mirabilis*, Théel, **33**, p. 17.
1881. *Aspidosiphon armatus*, Koren and Danielssen. **14**, p. 4.
1883. *A. Mulleri* + *A. mirabilis* + *A. armatus*, Selenka, **25**, p. 120.
1895. *A. Müllerí*, Fischer, **5**, p. 18.
1905. *A. mirabilis* + *A. armatum*, Théel, **34**, p. 91.
1912. *A. Mulleri*, Sluiter, **31**, p. 19.

This is the commonest Gephyrean found in deep water off the west coast of Ireland. It is most commonly found living in the dead shells of Gasteropods, but it occurs also in tubes of *Protula* and *Serpula*, in corals like *Lophohelia prolifera*, and in limestone. Whether it burrows in the latter, or occupies tunnels already made, I cannot say, though it usually fits the hole very accurately. When it withdraws its proboscis into the shell or tunnel in which it lives, the anterior shield serves as a very effective operculum. *Aspidosiphon Müllerí* does not diminish the entrance to the shell in which it lives by cementing sand round it, as *Phascolion strombi* does. The aperture of the shell is often choked up with mud or ooze, through which the proboscis projects, but this seems to be quite accidental, and the mud is not strengthened with cement or mucus. Each individual is usually accompanied in its tube by a specimen of the Polychaete worm *Syllis cornuta*, Rathke, which is also found with *Phascolion Strombi*.

This species is at present known under various names, which have been given usually as the result of erroneous descriptions. The material I have examined comes from the following localities :—

(1.) A large collection from the west coast of Ireland.
(2.) A number of specimens of *A. Müllerí* from Naples.
(3.) The type-specimen of *A. mirabilis*, Théel, from the west coast of Sweden (Swedish State Museum).
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(4.) The type-specimen of *A. armatum*, Kor. and Dan., from the west coast of Norway (Bergen Museum).

(5.) One specimen of *A. Mülleri* from south of the Azores and one from the Bay of Biscay, named by Sluiter (**30**, p. 14), from the Oceanographical Museum, Monaco.
(6.) Four specimens of *A. Mülleri* from Accra, West Africa, named by Fischer (**5**, p. 18), from the Hamburg Museum.

All these specimens agree closely except on one point, viz., the shape of the hooks on the proboscis (vide infra).

The length varies considerably, the Atlantic specimens being usually the largest. The anterior shield is more or less clearly grooved, showing considerable variation in this respect. The proboscis is covered throughout its length with rows of hooks. No diverticulum could be found on the rectum, though one is said to be present in the Mediterranean specimens. The rectum is swollen and thick-walled. There are 11–15 muscular tendons under the anterior shield. The longitudinal muscles of the body-wall are more or less collected into strands, especially in the anterior region, behind the shield. The spindle muscle is conspicuous, and is attached to the posterior shield opposite the base of the retractor muscles, on the dorsal side. The nephridia are attached to the body-wall by muscular strands throughout their whole length. The cutaneous glands are well figured by Théel (**34**, Pl. 8, figs. 115–119).

The proboscis is covered with hooks throughout its whole length. In the Mediterranean specimens the 14 distal rows of hooks are two-pointed, as figured by Oscar Schmidt (**23**, Taf. 1, figs. 3–6). In the 12th–14th rows the lower point is getting smaller and there are some single-pointed hooks present. Further behind, the hooks are all single-pointed. In all the Atlantic specimens I have examined I failed to find any bifid hooks. Sluiter, however, in his latest communication (**31**, p.19) comments on the great variation in this respect, and says that, in addition to the typical form, he has seen specimens, some having all the hooks bifid, some with no hooks bifid, and some with no hooks at all. This character, then, is too variable to have any specific value.

Théel's description of *Aspidosiphon mirabilis* (**34**, p. 91) is incorrect in several respects. Hooks are present throughout the whole length of the proboscis, and not only in its anterior part as he says. Posteriorly they are hidden by a brown incrustation, and so have escaped his notice. The retractor muscles are attached to the ventral sides of the posterior shield, and not to its centre. The nephridia, instead of being free, are attached throughout their whole length by delicate muscles to the body-wall.

Only a few fragments remain of the type specimen of *Aspidosiphon armatum*, described by Koren and Danielssen. Fortunately they include the two shields. The figures of these structures (**14**, Taf. II, figs. 7, 8, 14) are very inaccurate. I have had them redrawn (Pl. V, fig. 8), and they show the normal structure of *A. Mülleri*. There are only about 11 well-defined

muscular tendons under the anterior shield, and not 21, as shown by Koren and Danielssen in fig. 14.

The West African specimens of *A. Müllеri*, named by Fischer (5, p. 18), have single-pointed hooks all over the proboscis and are quite normal in structure.

I am indebted to the Rev. Canon Norman for drawing my attention to a long overlooked paper by Alder (1, p. 75) containing a description of a new species which he calls *Phascolosoma radiata*, dredged near the Shetlands. This is undoubtedly our *A. Müllеri*, and is the first record of this species outside the Mediterranean. Canon Norman says also that he took this species himself in the Shetlands in 1863 and 1868, and also in Norway.

Distribution.—Arctic Ocean; Atlantic, from shallow water down to 700 fathoms; Mediterranean; Red Sea; West Coast of Africa; Pacific.

Localities.—

Helga, LXXVIId.—29 VI '01. 53° 24′ 30″ N., 13° 36′ W., soundings 91 fms., gravel and sand. Temperature at bottom 12·9° C. Dredge, 91 fms.—Two specimens, in shells.

Helga CXXIXd.—11 IX '01. 40 miles W.N.W. of Cleggan Head, soundings 76½ fms., stones. Temperature at bottom 9·3° C. Dredge, 76½ fms.—One specimen, in limestone.

S. R. 164—3 XI '04. 52° 6′ N., 12° 0½′ W. Dredge, 375 fms.—Two specimens.

S. R. 399—5 II '07. 51° 28′ N., 11° 33′ 30″ W. Townet on dredge, 342 fms., mud and stones.—Four specimens.

W. 83—25 V '09. Clew Bay. Dredge, 13 fms.—One specimen in shell of *Apporhais pes-pelicani*.

S. R. 1005—12 VIII '10. 51° 22′ N., 11° 30′ 30″ W. Dredge, 249 fms., fine sand.—Numerous specimens living in limestone and schist.

S. R. 1153—13 V '11. 30 miles south of Co. Cork. Dredge, 60 fms., sandy mud.—Common in shells and tubes of *Serpula*.

S. R. 1173—19 V '11. 51° 50′ N., 11° 37′ 30″ W. Eel-trawl, 275 fms., fine sand.—One specimen.

S. R. 1176—22 V '11. 51° 26′ 30″ N., 11° 2′ W. Dredge, 100 fms., sand.—Common in various shells.

S. R. 1177—22 V '11. 51° 21′ N., 11° 24′ W. Dredge, 152½ fms., sand.—Very common in shells and *Lophohelia prolifera*.

S. R. 1178—22 V '11. 51° 20′ N., 11° 30′ W. Townet on trawl, 212–229 fms.—One specimen.

S. R. 1179—22 V '11. 51° 20′ N., 11° 35′ 30″ W. Dredge, 456 fms., mud and stones—One specimen, in coral.

S. R. 1391—14 V '12. Off the coast of Co. Kerry. Dredge, 149 fms., sand.—Numerous specimens.

S. R. 1444—19 VIII '12. Off the coast of Co. Kerry. Dredge, 142 fms., sandy mud.—One specimen.

Onchnesoma Steenstrupi, Kor. and Dan.

1905. *Onchnesoma Steenstrupii*, Kor. and Dan., Thèel, **34**, p. 93.

Twelve specimens of this small and distinct species were obtained. They were all rust-coloured, especially at the posterior end. The area where they were found, usually on a bottom of mud or ooze, lies about 50 miles off the coast of Kerry.

Distribution.—Arctic and North East Atlantic; Skager-Rack; Gulf of Lyons ?; Mediterranean ?

Localities.—

S. R. 5—14 II '03. 50 miles W.N.W. of Tearaght. Dredge, 312 fms., fine mud and sand.—Four specimens.

S. R. 172—5 XI '04. 52° 2′ N., 12° 8′ W. Townet on trawl, 454 fms., fine mud.—Two specimens.

S. R. 590—3 VIII '08. 51° 51′ 30″ N., 12° 8′ W., soundings 480 fms., ooze. Temperature at 480 fms., 9·28° C., salinity 35·46°/$_{oo}$. Midwater trawl, 480 fms. —Five specimens.

S. R. 592—6 VIII '08. 50° 39′ N., 11° 25′ W. Trawl, 400–510 fms., ooze.—One specimen.

Onchnesoma squamatum (Kor. and Dan.).

1905. *Onchnesoma squamatum* (Kor. and Dan.), Thèel, **34**, p. 96.

Large numbers of this species were obtained in deep water off the west coast of Ireland. It has been found at various stations in the western part of the North Atlantic, usually at considerable depths, ranging from 100–700 fathoms.

Distribution.—North-west Atlantic, between the latitudes of Lofoten and Brest.

Localities.—

S. R. 31—7 VIII '03. 50 miles W.N.W. of Tearaght. Temperature at 300 fms, 10° C. Townet on dredge, 306 fms., fine mud and sand.—Two specimens.

S. R. 172—5 XI '04. 52° 2′ N., 12° 8′ W. Townet on dredge, 454 fms., fine mud.—Twenty specimens.

S. R. 502—11 IX '07. 50° 46′ N., 11° 21′ W. Bottom temperature 8·8° C. Mosquito net on trawl, 447–515 fms.—Three specimens.

S R. 590—3 VIII '08. 51° 51′ 30″ N., 12° 8′ W., soundings 480 fms., ooze. Bottom temperature 9·28° C. Midwater trawl, 480 fms.—One hundred and sixty specimens.

S. R. 752—17 v '09. 51° 48′ N., 12° 11′ 30″ W., soundings 523–595 fms., ooze. Temperature at 500 fms., 8·9° C. Midwater trawl, 523–595 fms.—One hundred specimens.

ECHIUROIDEA.

Echiurus abyssalis, Skorikow.

Plate VII, fig. 11.

1903. *Echiurus Pallasi*, Guerin, Lo Bianco, **2**, p. 265.
1906. *Echiurus abyssalis*, Skorikow, **29**, p. 217.
1912. *E. a.*, Sluiter, **31**, p. 23.

This species was taken in large numbers in deep water off the west coast of Ireland, about 180 specimens being altogether obtained.

They are of a grey colour, and the trunk varies from 3–12 mm. in length. The body is cylindrical and the width is usually about half the length, though there is great variation in this feature, according to the extent of contraction (Pl. VII, fig. 11A). The proboscis also varies greatly. In small specimens it may be three or four times as long as the body, but in the largest specimens it is from half to two-thirds of the body length. It is probably highly contractile in life. In the specimen figured (Fig. 11C) the proboscis was 11 mm. long. In its most commonly occurring shape, it is massive and tubular at the base, becoming ribbon shaped and narrow towards the tip, where it broadens, and is distinctly bilobed, the angles being prominent. All the specimens are in a bad state of preservation, and the cuticle, which is very thin and delicate, is frequently missing. The body is surrounded by 15 rows of prominent papillae, with rows of smaller ones between. The rings of large papillae correspond to swellings on the nerve-cord, which can be plainly seen, and probably each denotes a segment of the body. The papillae are cylindrical, or like truncated cones. They are hyaline, and not encrusted, as the rest of the skin is. The cuticle has a markedly reticular structure, owing to the openings of the numerous glands in the skin.

The setae are all of the same delicate pinkish-brown colour. The ventral (anterior) setae, which correspond in position with the second row of large papillae, have strongly curved tips (Fig. 11D) which are flattened like a spoon, and narrow in side view. The posterior setae are gently curved towards the tip. All are striated, both longitudinally and transversely, especially the posterior setae. The latter are disposed in two rings, the anterior row containing 6–10, the posterior one 5–7, setae. There is a wide gap in these rings on the ventral side, which is proportionately larger in the anterior ring. These rows of setae correspond to the two posterior rings of large papillae.

The internal anatomy is very simple. The intestine is only slightly folded (Fig. 11B). Two very delicate anal vesicles (c) are present, but the state of preservation is too bad to allow their intimate structure to be ascertained. They are unbranched, and probably of the same structure as those of *Echiurus Pallasi*, Guerin. The vascular system is also of the normal type.

The four nephridia are very small. In immature specimens the funnel is as large as the tube, but in those containing eggs (Fig. 11E) the latter part is expanded. In the specimens I examined, the funnel is not so distinctly separated from the tube as Sluiter shows in his figures (**31**, Fig. 14), but this may be due to stronger contraction of the skin in my specimens.

The Irish specimens were in such a bad state of preservation that the study of sections did not yield much information. Fig. 11F shows a longitudinal section through the posterior end. The body-wall is composed of the usual strata of circular, longitudinal, and oblique muscular layers. Underneath each papilla there is a small pear-shaped cavity. The section figured passes through the rectum, showing its thickened walls, and the numerous muscles which fasten it to the body-wall. This thickened portion of the rectum probably acts as a sphincter muscle.

I submitted several examples of this species to Sluiter, who was strongly of the opinion that they agreed with *Echiuris abyssalis*, Skorikow. This species, of which only three specimens have previously been obtained in the Mediterranean, differs from the common littoral and shallow-water *E. Pallasi*, Guerin, in its smaller size, greater simplicity in its internal characters, and in the structure of the nephridia. In *E. Pallasi*, the funnel of the nephridium is attached wholly to the tube, whilst in *E. abyssalis* it is more or less separated from it. The Irish specimens seem to be intermediate in this respect between the two species, but that may be due to the great contraction of the skin. I have no doubt that the two species are distinct.

Distribution.—Deep water in the Mediterranean.

Localities.—

Royal Irish Academy Expedition, 1886. Log 48—Five specimens.

Royal Irish Academy Expedition, 1886. Log 59—Eight specimens.

S. R. 172—5 XI '04. 52° 2′ N., 12° 8′ W. Townet on dredge, 454 fms., fine mud.—Twenty-nine specimens.

S. R. 212—6 V '05. 51° 54′ N., 11° 57′ W. Soundings 411 fms., fine mud and sand. Temperature at 350 fms., 9·82° C. Townet on trawl, 375–411 fms.—Two specimens.

S. R. 331—9 V '06. 51° 12′ N., 11° 55′ W. Townet on trawl, 610–680 fms., ooze.—One specimen.

S. R. 334—10 V '06. 51° 35′ 30″ N., 12° 26′ W. Sound-

ings 500–520 fms., ooze. Temperature at 500 fms., 10·8° C. Townet on trawl.—Eleven specimens.

S. R. 397—2 II '07. 51° 46′ N., 12° 5′ W., soundings 549–646 fms., ooze. Temperature at 500 fms., 8·71° C. Townet on trawl, 549–646 fms.—One specimen.

S. R. 440—16 V '07. 51° 45′ N., 11° 49′ W., soundings 350–389 fms. Temperature at 300 fms., 9·93° C. Townet on trawl, 350–389 fms.—Ten specimens.

S. R. 447—18 V '07. 50° 20′ N., 10° 57′ W., soundings 221–343 fms., fine sand. Temperature at 300 fms., 9·87° C. Townet on trawl, 221–343 fms.—Thirty-two specimens.

S. R. 479—28 VIII '07. 51° 20′ N., 11° 41′ W., soundings 468–560 fms. Temperature at 550 fms., 8·34° C. Townet on trawl, 468–560 fms.—Twelve specimens.

S. R. 486—3 IX '07. 51° 37′ 30″ N., 12° 0′ W. Townet on trawl, 600–660 fms.—Thirty-seven specimens.

S. R. 490—7 IX '07. 51° 57′ 30″ N., 12° 7′ W., soundings 470–491 fms., ooze. Temperature at bottom, 8·68° C. Townet on trawl.—Eight specimens.

S. R. 491—7 IX '07. 51° 57′ 30″ N., 12° 13′ W., soundings 491–520 fms. Temperature at bottom, 8·53° C. Townet on trawl.—One specimen.

S. R. 502—11 IX '07—50° 46′ N., 11° 21′ W., soundings 447–515 fms. Temperature at bottom 8·8° C. Townet on trawl.—Thirty specimens.

S. R. 506—12 IX '07. 50° 34′ N., 11° 19′ W., soundings 661–672 fms., ooze. Temperature at 600 fms., 8·22° C. Townet on trawl.—Two specimens.

S. R. 590—3 VIII '08. 51° 51′ 30″ N., 12° 8′ W., soundings 480 fms., ooze. Temperature at bottom 9·28° C. Midwater trawl, 480 fms.—Three specimens.

Thalassema Lankesteri, Herdman.

1897. *T. L.*, Herdman, **8**, p. 367.
? 1852. *Thalassema gigas*, M. Müller, **19**, p. 14.

Two specimens of this species are included in the collection. The first was taken in the Irish Sea (S. 517), not far from where Herdman found his specimens. Unlike these, it is an entire specimen. When alive, it was of an intense green colour, but the pigment was soluble in dilute formalin.

The total length is 170 mm., the trunk being 95 mm. long and the proboscis 75 mm. The width of the body varies from 10–20 mm., and the proboscis is 16 mm. at its widest part near the tip. The end of the proboscis is smoothly rounded. The specimen is a mature female, with eggs in the nephridia. The second specimen was obtained by the Royal Dublin Society Expedition in 1890. It was found in the stomach of a Dab

(*Pleuronectes limanda*) in Kenmare River. This specimen has a total length of 260 mm., the trunk being 160 mm. and the proboscis 100 mm. in length. The width of the trunk is 6–13 mm., of the proboscis 15 mm. at its widest part in the proximal third. The tip of the proboscis is bluntly bilobed. The whole body is longer and thinner than that of the first specimen, which is more strongly contracted. It is also a mature female with eggs in the nephridia. In their internal anatomy both specimens agree closely with Herdman's description.

Through the kindness of Professor Cori and Dr. Scharff, I obtained a specimen of *Thalassema gigas* from the Gulf of Trieste. The body was very swollen and almost oval, and the proboscis was comparatively small. Its tip was damaged, but, so far as I could see, it was not clearly trilobed. At any rate, the general shape of the body and proboscis varies so much in these animals according to the state of contraction and expansion that it supplies no reliable diagnostic characters. The warty appearance of the skin closely resembles that of *T. Lankesteri*, and there is close agreement in the internal anatomy. The anal vesicles agree in being plume-shaped, consisting of a main stem with simple lateral branches. In the Trieste example, the nephridia were larger than in the Irish specimens, but this character, again, cannot be considered of specific value. There is as much difference between the two Irish specimens as there is between either of them and the one from Trieste.

In view of the close resemblance of these specimens I am of opinion that the two species are synonymous. However, as the available material was so scanty and not very well preserved, I think it advisable to leave them separate for the present. A study of the proboscis and body-wall in well-preserved specimens would be necessary to settle the question definitely. The occurrence of the same species in two such widely separated localities as Ireland and Trieste would not be very remarkable, as there is a close affinity between the marine fauna of the Adriatic and that of the British Isles.

In neither species have any males been found up to the present, and it is probable that these species will resemble others of the Echiuroidea in having dwarf males. I examined the nephridia closely, but was unable to find any trace of them.

Distribution.—Irish Sea. Trieste ?

Localities.—

Kenmare River, in stomach of a Dab, taken in the trawl, in 7 fms., 8 v '90, by the Royal Dublin Society Exp.—One specimen.

S. 517—26 iv '07. 9½ miles E.S.E. of Clogher Head. Trawl, 22–23 fms., muddy sand. Bottom temperature 7·15° C.—One specimen.

Thalassema Neptuni, Gaertner.

1899. *T. N.*, Jameson, **10**, p. 535.

Distribution.—This species has a typically Lusitanian distribution. It is found on the west coast of Ireland, south-west coast of England, France, and the Mediterranean.

Localities.—

Dungarvan; Valencia Harbour, common in submerged peat, and in crevices of the rocks; also dredged in 7 fms.

Clew Bay, dredged on eight occasions, 1909–1911, in 5–20 fms., usually in limestone.

Blacksod Bay, on two occasions, single specimens in crevices of the schist, 1910.

A. 5—1 VI '04. Galway Bay. Dredged in 6 fms., in limestone.—Two specimens.

A. 69—27 VIII '04. Galway Bay. Dredged in 9 fms.—One specimen.

W. 243—9 II '02. Dingle Bay. Dredge, 22 fms., in limestone.—Very abundant.

Bonellia viridis, Rolando.

1906. *B. v.* Théel, **35**, p. 23.

This species, which is widely distributed in the Atlantic, Mediterranean, and Pacific, has not yet been recorded from British waters, though it is almost certain, from its known distribution, that it occurs round our coasts. The specimen which I refer doubtfully to is in such a bad state of preservation that it is impossible to name it with any certainty. According to observations made at the time of capture, the specimen was of a bright green colour, gelatinous and transparent. The proboscis and setae were missing. The skin is wrinkled as in *Bonellia viridis*. The sand in the intestine is in the form of oval pellets, and the fragments of the specimen closely resemble a similar badly preserved specimen of *Bonellia* in the Irish National Museum.

Distribution.—Scandinavia; Mediterranean; Azores; Indian and Pacific Oceans.

Locality—R. 30—17 VIII '06. 9½ miles S.E. by S. of Mine Head, Co. Waterford. Sand grab, 37½ fms., sand and gravel.—One specimen.

PRIAPULOIDEA.

Priapulus caudatus (Lamarck).

1845. *Priapulus hibernicus*, McCoy, **18**, p. 272.
1906. *P. c.* Théel, **35**, p. 15.

Distribution.—British Isles, Northern and Arctic Seas. According to Theel (**36**, p. 18) this species is bipolar, as a closely related form is found at various places in the Antarctic region.

Localities.—

Kenmare River, in stomach of a Dab, 8 v '90, by the Royal Dublin Society Expedition.—One specimen.

S. 56—15 IV '02. Off Ireland's Eye, Co. Dublin. Trawl, 13 fms., in stomach of a Plaice.—One specimen.

Ballinakill Hbr., in stomach of *Scyllium canicula*, 13 × '03.—One specimen.

L. 283—19 I '04. Ballinakill Hbr., shore collecting.—Six specimens.

L. 288—3 II '04. Ballinakill Hbr., shore collecting.—Three specimens.

W. 254—5 III '12. Whale Head, Lough Swilly. Digging in Zostera.—One specimen.

LIST OF GENERA AND SPECIES.

Names not adopted in this paper are in brackets.

The References are to pages.

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EXPLANATION OF PLATES I–VII.

Plate I.

Fig. 1.—*Physcosoma abyssorum*, sp. n.

1 A.—The entire animal, × 2. a = anus.
1 B.—Internal anatomy. a = spindle muscle.
1 C.—Papillae on tail. × 44.
1 D.—Longitudinal section of body-wall, on a level with the anus. × 100. a = unicellular gland in epidermis; b = epidermis; c = cuticle; d = outer layer of circular muscles; e = inner layer of longitudinal muscles; f = peritoneal epithelium.
1 E.—Part of the intestine, showing the rows of gland cells.
1 F.—Oesophageal region from the dorsal side showing the fusion of the dorsal (c) and ventral (d) retractor muscles on each side. a = contractile vessel; b = oesophagus.
1 G.—Rectum, showing the attachment of the spindle muscle (a).

Plate II.

Fig. 1, *Physcosoma abyssorum*, sp. n.—continued.

1 H.—Glands and hooks on the proboscis. a = basal portion of gland. × 215.
1 J.—Hooks on the proboscis, × 215.
1 K.—Skin with cuticle removed, showing epidermis and unicellular gland (a), × 215.

Fig. 2, *Phascolosoma rugosum*, sp. n.

2 A.—The entire animal, × 5.
2 B.—The internal anatomy.
2 C.—Papilla near the anus, × 215.
2 D.—Papillae from the posterior end, × 215.
2 E.—Transverse section of the body-wall, near the posterior end, × 100.

Fig. 3, *Phascolosoma margaritaceum* (Sars).

Longitudinal section of the body-wall near the posterior end of a specimen from Greenland, × 44.

Plate III.

Fig. 4, *Phascolosoma mutabile*, sp. n. All figures except 4 F from type (S. R. 355).

4 A.—The entire animal, × $1\frac{3}{4}$.
4 B.—Internal anatomy.
4 C.—Papillae. a, on the proboscis; b, on a level with the anus; c, on the posterior end, × 215.
4 D.—Portion of the skin from near the posterior end, × 100.

4 E.—Hooks on the proboscis, × 215.
4 F.—Tentacular crown. (S. R. 334.)
4 G.—Longitudinal section of body-wall from the posterior end, × 100.

Plate IV.

Fig. 5, *Phascolosoma muricaudatum*, sp. n.

5 A.—The entire animal, drawn from a small fully-expanded specimen, × 4. a = the anus.
5 B.—Tail of a more contracted specimen.
5 C.—Tip of the tail, × 60.
5 D.—Part of the proboscis of the specimen shown in Fig. 5 A, showing the hooks (h), papillae (p), and tentacles (t), × 110.
5 E.—Portion of the proboscis of a strongly contracted specimen, showing the appearance of the hooks and peculiar papillae, × 270.
5 F.—Same papillae in side view, × 270.
5 G.—Papillae; a, from the middle of the proboscis; b, from the middle of the trunk; c, from the tail, × 250.
5 H.—Internal anatomy. a = termination of nerve-cord.
5 J.—Longitudinal section of the body-wall near the base of the tail. Stained with Eosin and Haematoxylin, × 100.

Plate V.

Fig. 6, *Phascolosoma bulbosum*, sp. n.

6 A.—The entire animal, × 2½.
6 B.—Papillae on proboscis, × 360.
6 C.—Papilla on the level of the anus, × 250.
6 D.—Internal anatomy. a = the three muscular strands fastening the intestine to the junction of the oesophagus and retractor muscles; b = the spindle muscle.
6 E.—Longitudinal section of the body-wall from near the base of the tail, × 180.

Fig. 7, *Sipunculus norvegicus*, Kor. and Dan., showing the rectum and its appendages. a = the spindle-muscle; b = the racemose glands; c = base of retractor muscle; d = the diverticulum; e = the position of the anus.

Fig. 8, *Aspidosiphon Müllеri*, Diesing. These two drawings were made from the type-specimen of *Aspidosiphon armatum*, Kor. and Dan.

8 A.—Anterior shield.
8 B.—Posterior shield.

Fig. 9, *Phascolosoma Johnstoni* (Forbes).

9 A.—Test of the Foraminiferon *Saccammina sphaerica*, M. Sars, inhabited by two specimens of *P. Johnstoni*. (S. R. 590).
9 B.—Section of the test to show the disposition of the two specimens.

Plate VI.

Fig. 10, *Phascolosoma constrictum*, sp. n.

10 A.—The entire animal, × 2½.
10 B.—Internal anatomy.
10 C.—Large and small papillae from the middle of the trunk, × 215.
10 D.—Papillae near the posterior end, × 215.
10 E.—Papillae from just below the anus, × 215.
10 F.—Papillae from the middle of the proboscis, × 215.
10 G.—Longitudinal section of the body-wall from just behind the anus, × 215.
10 H.—Diagrammatic outlines of the various types of papillae. 1, on the proboscis; 2 and 3, near the anus; 4, on the mid-body; 5, just before the posterior end; 6, on the posterior end.

Plate VII.

10 J.—*Phascolosoma constrictum*, sp. n.—continued.
Glands and hooks on the proboscis, × 215.

Fig. 11, *Echiurus abyssalis*, Skorikow.

11 A.—Entire animal from the ventral side, × 12.
11 B.—Internal anatomy. a = blood-vessel; b = nephridia. c = anal vesicles.
11 C.—Proboscis fully expanded, × 6.
11 D.—One of the two ventral hooks, × 24.
11 E.—Nephridium, containing eggs.
11 F.—Longitudinal section through the posterior end, showing the thickened walls of the rectum, × 44.

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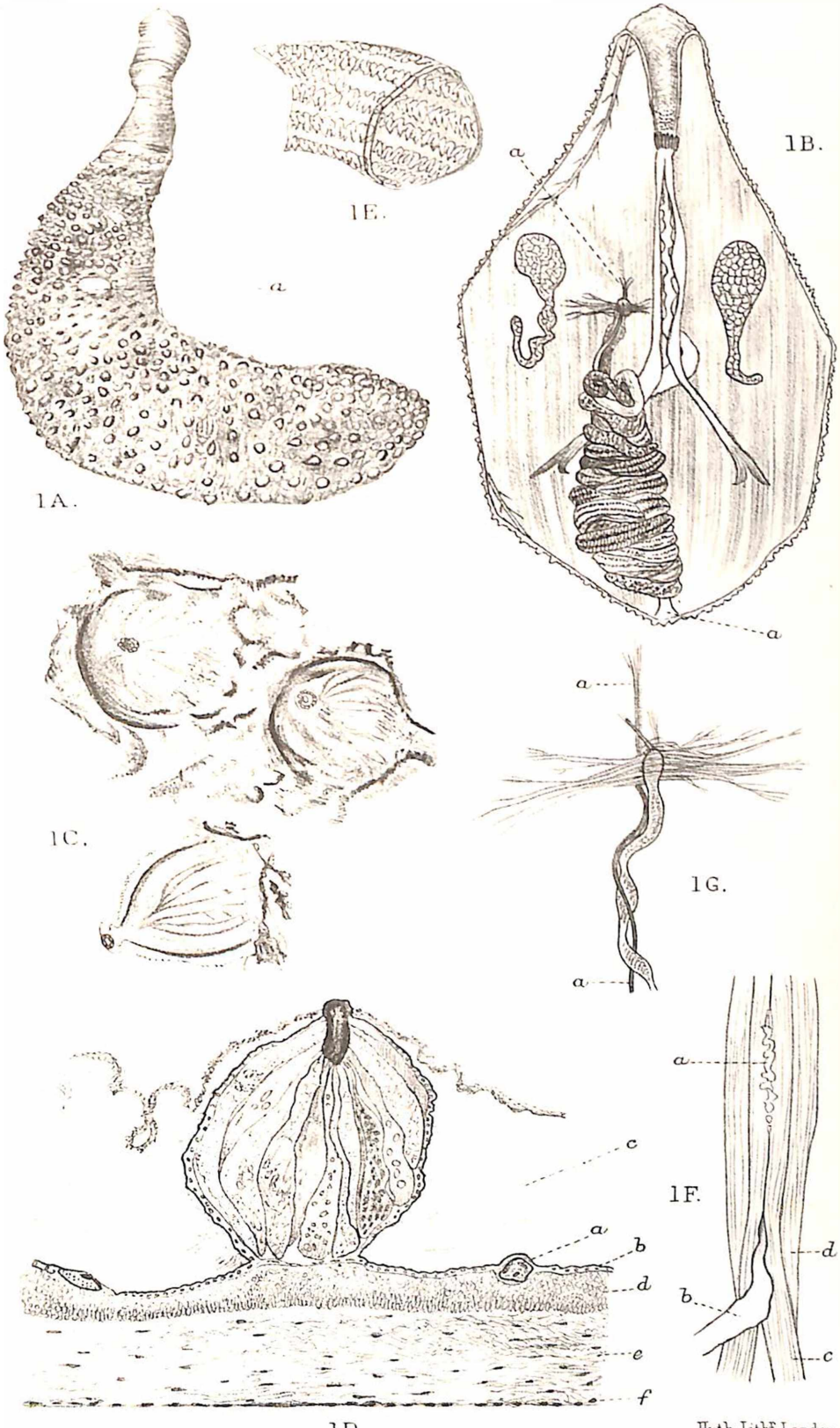

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Fig.1, Physcosoma abyssorum, *sp.n.*

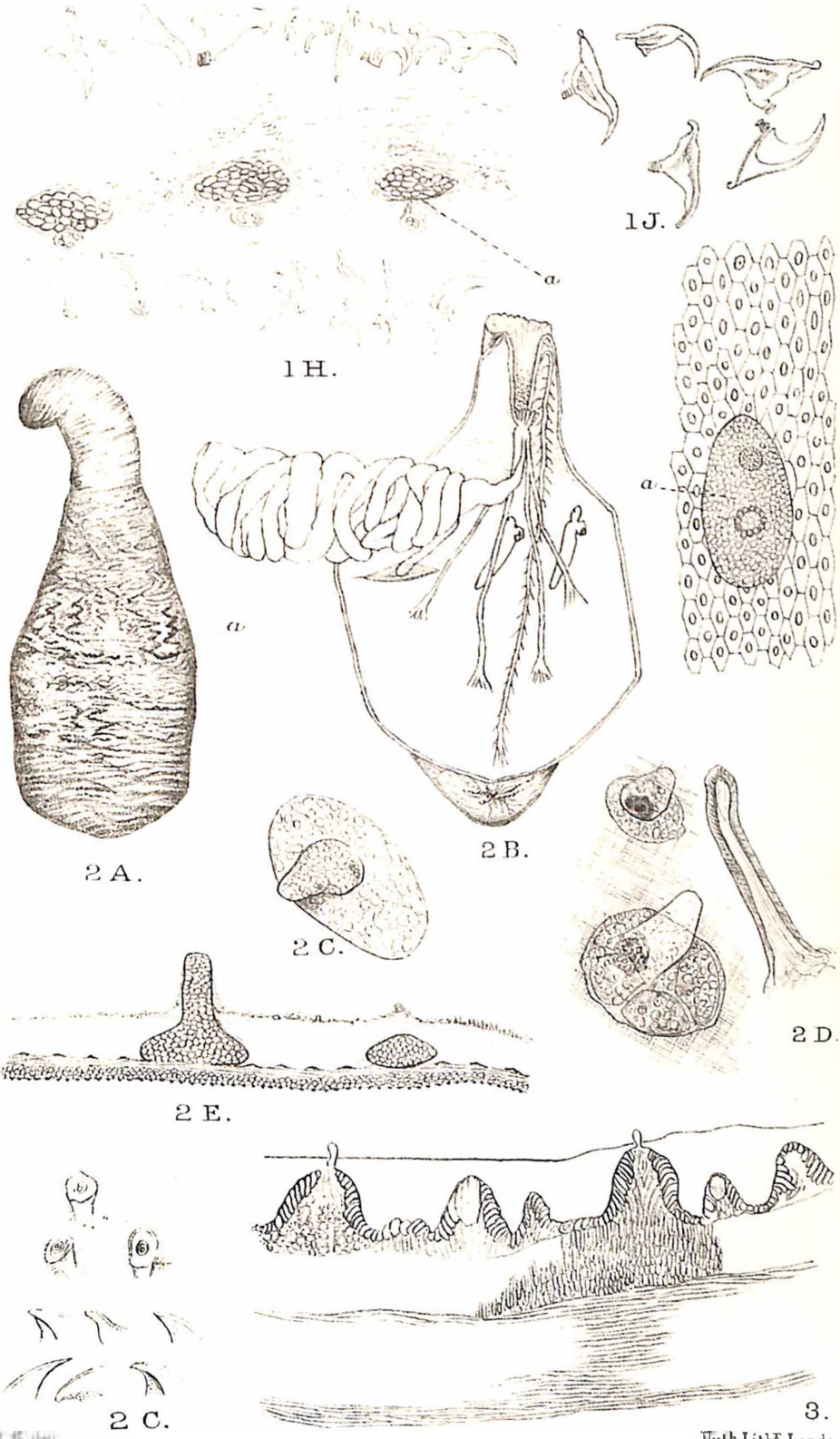
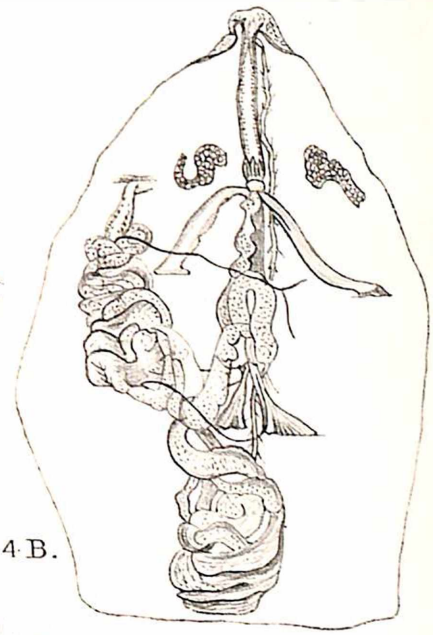


Fig. 1, Physcosoma abyssorum, sp. n.
Fig. 2, Phascolosoma rugosum, sp. n.
Fig. 3, Phascolosoma margaritaceum, (Sars).

4 A.

4 E.



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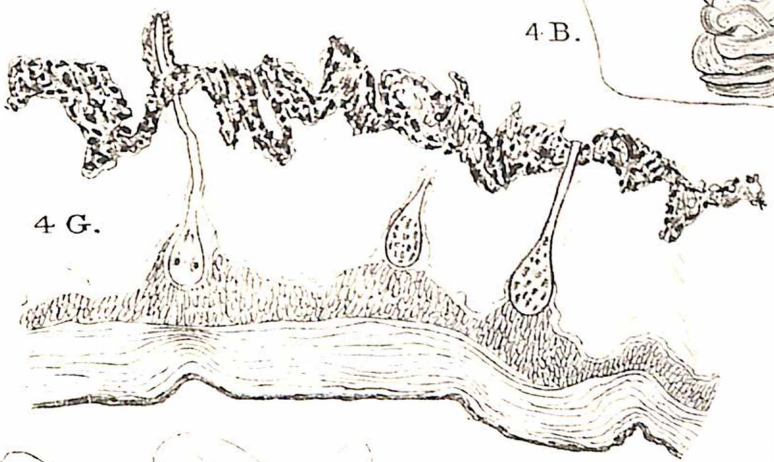

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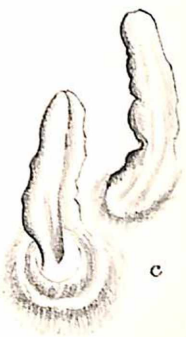
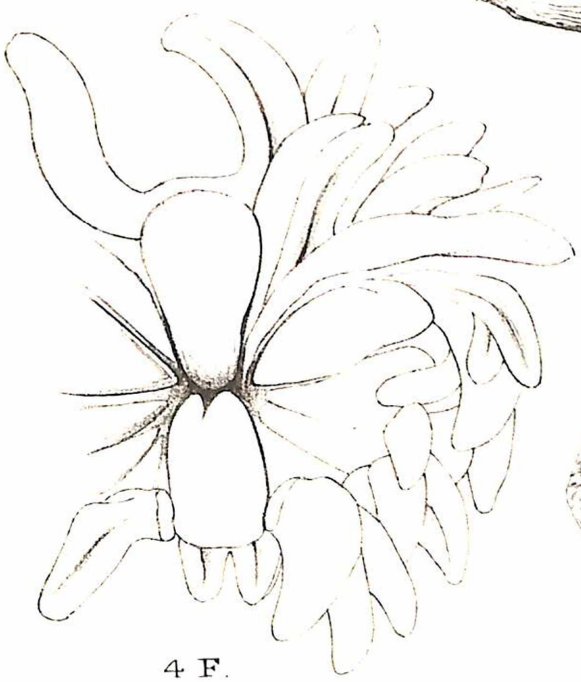


c

b

4 C.

a



4 F.

4 D.

Fig 4a. Miss E. Barnes del.
Fig 4b–g. H.S. del.

Huth, Lith^r London.

Fig. 4, Phascolosoma mutabile, sp.n.

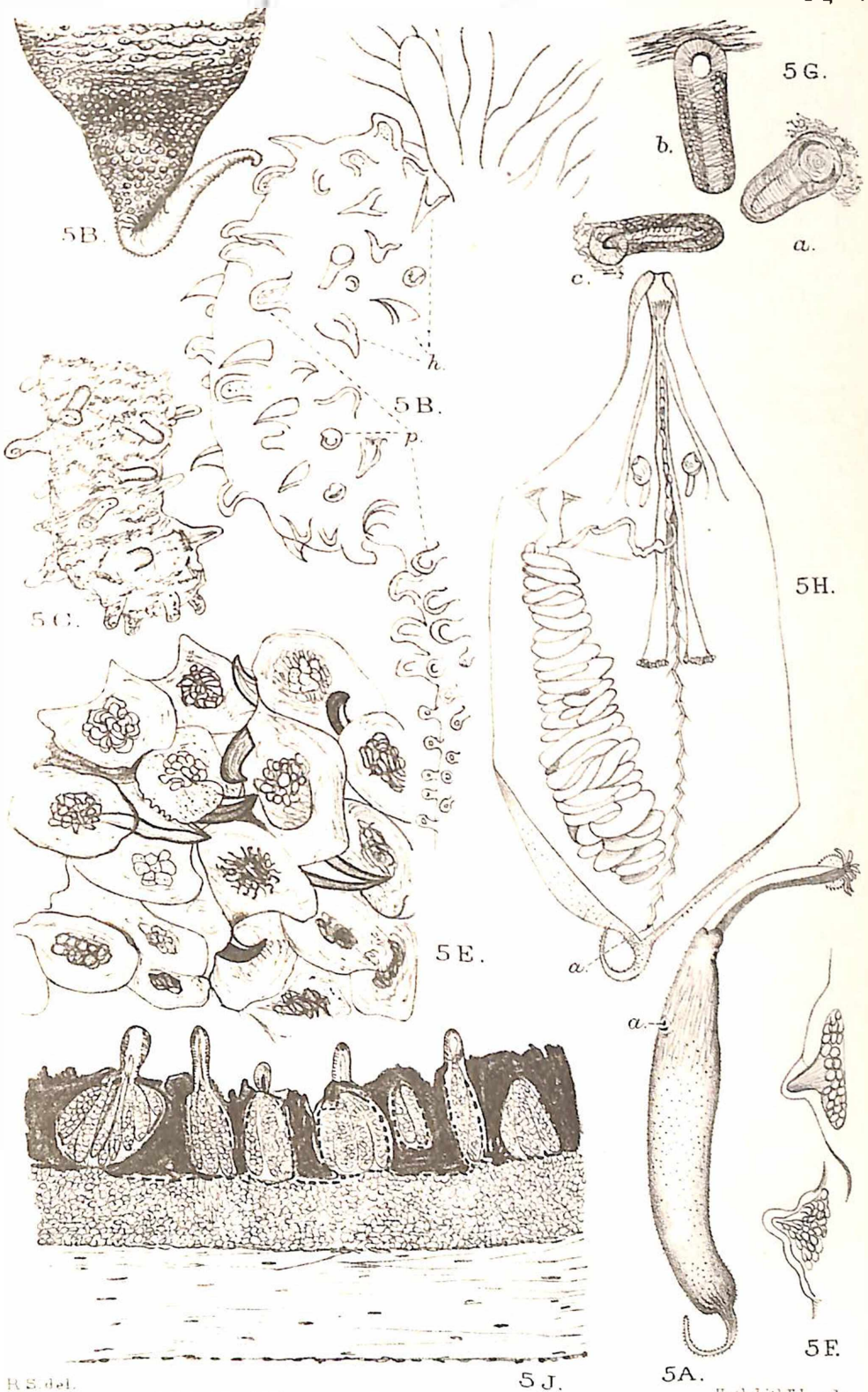


Fig. 5, Phascolosoma muricaudatum, sp.n.

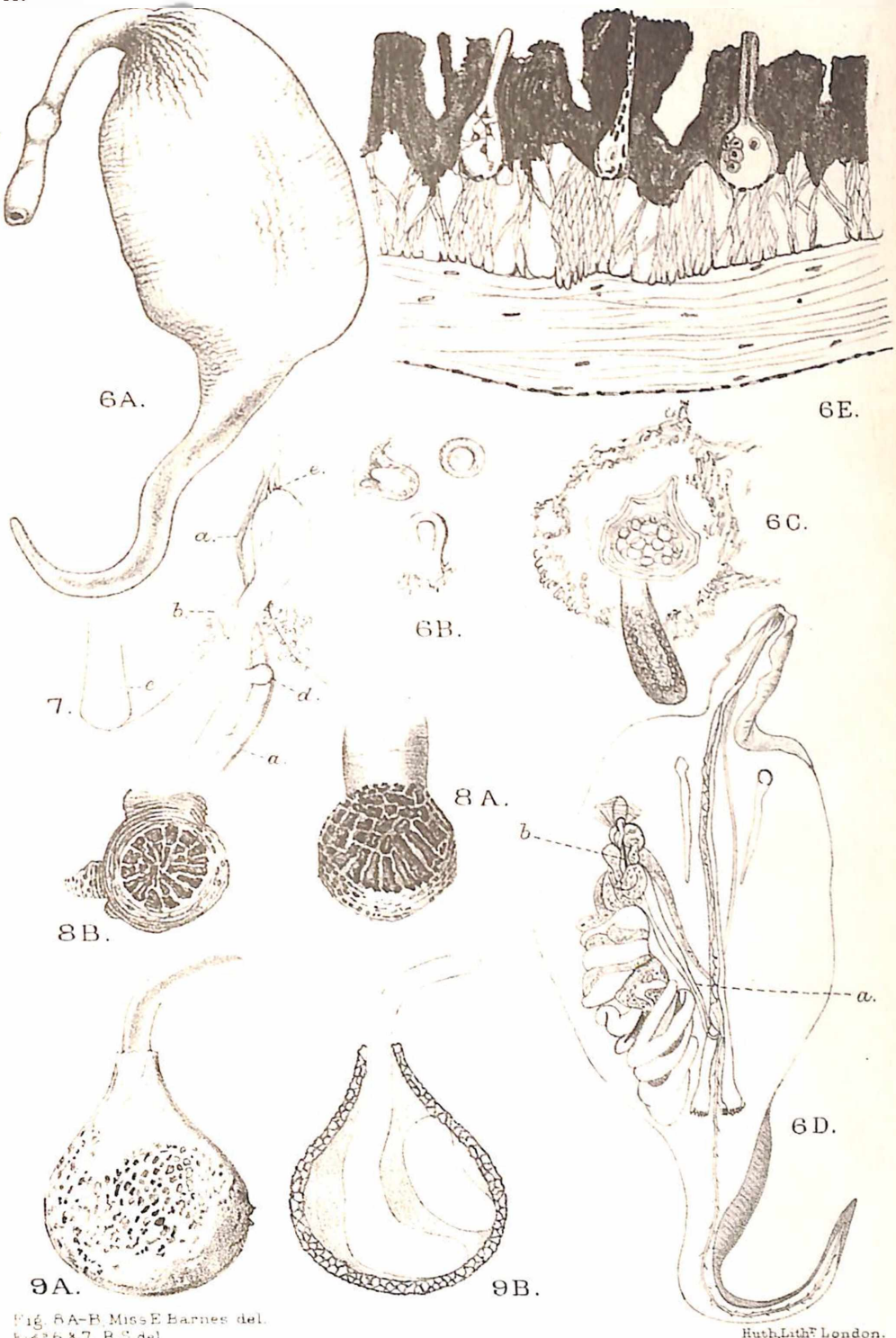
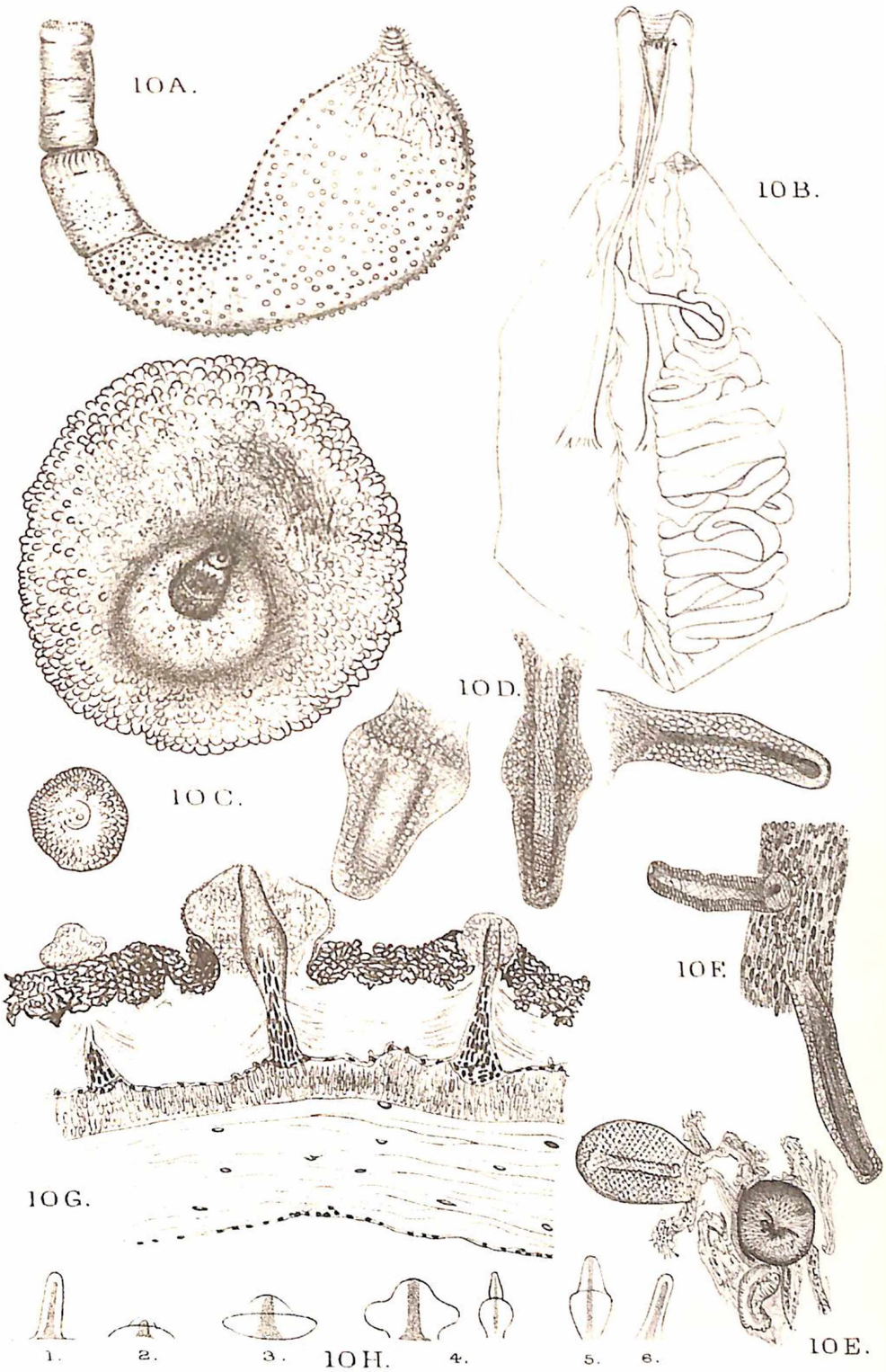


Fig. 8A-B, Miss E Barnes del.
Fig^s 6 & 7, R.C. del.

Huth, Lith^r London.

Fig. 6, Phascolosoma bulbosum, spn.
Fig. 7, Sipunculus norvegicus, Kor. & Dan.
Fig. 8, Aspidosiphon Mulleri, Diesing.
Fig. 9, Phascolosoma Johnstoni, Forbes.



R.S del

Hath,Lith.F London.

Fig.10, Phascolosoma constrictum,sp.n.

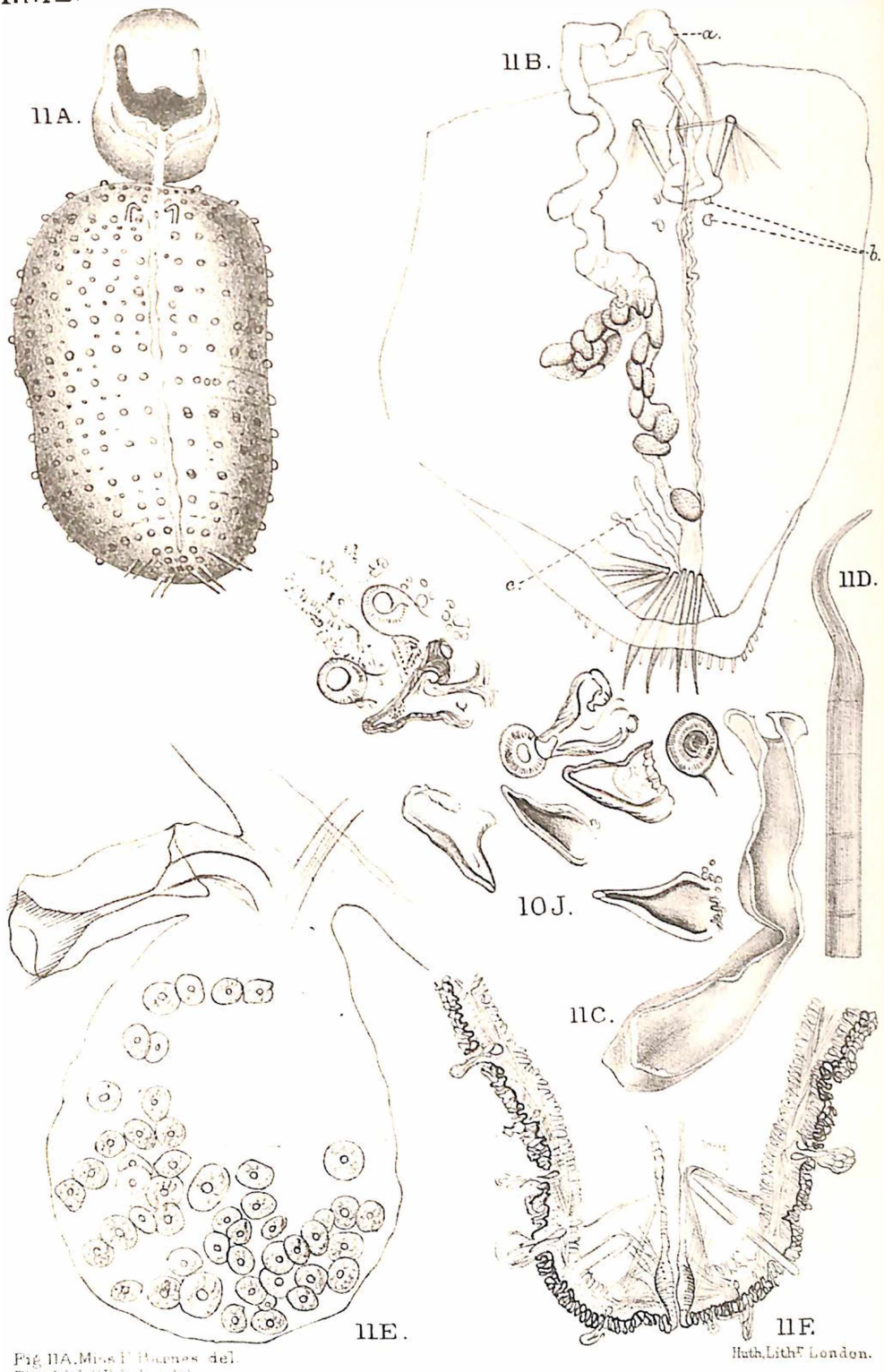


Fig.10, Phascolosoma constrictum, sp.n.
Fig.11, Echiurus abyssalis, Skorikow.