

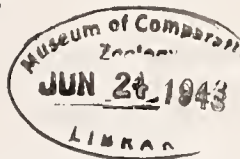
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XENOPHORIDAE



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## THE GENERA XENOPHORA AND TUGURIUM IN THE WESTERN ATLANTIC

BY

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The family Xenophoridae is mainly tropical in its distribution. It is remarkable for its habit of attaching foreign objects to its shell, particularly the shells and shell fragments of other mollusks, along with coal, pebbles and coral. The variation in this habit among the several species, however, ranges from its entire absence in *Tugurium exutum* Reeve of China and Japan to nearly complete coverage in *Xenophora trochiformis* of our own Western Atlantic, where the entire surface, other than the base of the shell, is covered with foreign objects. This latter condition is developed in the species that occur in the shallower waters. Deeper water species are but moderately adorned. Other species, such as *Haliphoebus solaris* Linné of the Indo-Pacific area, have modified the "cape" into a series of rather long and blunt marginal spines or folds which would appear to serve a similar purpose of adornment and protection.

It has been suggested that this habit of fixing foreign objects to the outer surface of the shell is protective and that it simulates a small mound of dead shells. This may certainly be true but the protection afforded by the attached shells is probably quite real. These objects produce a spinose condition on many species which would render them more or less immune from many types of predators. The production of the "cape" or palatal extension is developed to the greatest degree in the deep-water species. This may be a cause of their preference for a soft bottom as this larger surface area, coupled with the light structure of the shell, would enable them to exist on a softer substratum than would be possible for a proportionately heavier shell.

About 20 recent species are known to occur in this family. Though mainly tropical, a few extend well into the warmer portions of the temperate zones. With few exceptions, they exist below low water line and may extend to depths of about 450 fathoms.

### Key to the Western Atlantic Xenophoridae

- |   |                     |
|---|---------------------|
| 1. Possessing a "cape" or broad extension of the palatal area | 3                   |
| 2. No palatal extension or "cape"                             | <i>trochiformis</i> |
| 3. Lower whorls shingled, no submarginal depression           | <i>longleyi</i>     |
| 4. Lower whorls not shingled, a strong submarginal depression | <i>caribaeum</i>    |

### *Xenophora* Fischer von Waldheim

*Xenophora* F. v. W. 1807, Muséum-Demidoff, Moscou 3, p. 213<sup>1</sup> (genotype, *Trochus conchyliophorus* Born = *X. trochiformis* Born). *Phorus* Montfort 1810 and *Ouustus* Gray 1847, are synonyms.

<sup>1</sup>We have not seen this paper, but the part on *Xenophora* has been published by P. Fischer in the Journ. de Conchy. 5, p. 251, 1857.

Species in the genus *Xenophora*, as now restricted, are without a cape or palatal extension, possess a strongly angled whorl, and are usually moderately to completely covered with other shells, shell fragments, coral, small stones and even small pieces of coal. All are imperforate in the adult stage.

### *Xenophora trochiformis* Born, Plate 1, fig. 1-2

*Turbo trochiformis* Born 1778, Index Musei Caesarei Vindobonensis p. 355 (locality unknown).

*Trochus conchyliophorus* Born 1780, Testacea Musei Caesarei Vindobonensis p. 333, pl. 12, fig. 21-22 (Oceano Americano).

*Trochus lithophorus* Blumenback 1803, Manuel Hist. Nat. Metz, **2**, p. 61 (Indes occidentales) [Trans. from the German by S. Artaud]. Reference made to Chemnitz 1781, Conchy.-Cab. (1) **5**, pl. 172, fig. 1688-1689.

*Xenophora laevigata* Fischer von Waldheim 1807, Muséum-Demidoff **3**, p. 213 (locality not given).

*Phorus agglutinaus* Denys de Montfort 1810, Conchyliologie Systematique, Paris, **2**, p. 159 (non *Trochus agglutinaus* Lamarek 1804, Ann. Mus. Hist. Nat. **4**, p. 51 [fossil, Paris Basin]).

*Phorus onustus* Reeve 1843, Proc. Zool. Soc. London p. 161 (West Indies); Conch. Icon. **I**, *Phorus*, pl. 1, fig. 3a-b; Conch. Syst. **2**, pl. 214, fig. 3 and pl. 215, fig. 8.

*Xenophora conchyliophora* Born, Dall 1889, Bull. Mus. Comp. Zoöl. **18**, p. 290.

**Description.** Shell 50 to 60 mm. in width not including foreign attachments, not umbilicated in the adults and heavy in structure. Whorls 7 to 8, regularly increasing in size. No cape developed at all. Color a brownish cream which is usually somewhat irregular in intensity. Spire extended, forming an angle of about 85°. Aperture subquadrate, the basal margin deeply concave in outline. Sculpture on the base finely but unevenly reticulated, the concentric ridges being somewhat the stronger, remaining sculpture on outer surface irregular and more or less malleated in appearance. No subsutural depression on the base. Operculum higher than wide, subtriangular in outline, thin, with a series of numerous, flattened, concentric growth lines. Periostracum apparently wanting. Attachments of foreign objects abundant and use made of shells, shell fragments, coal, small stones, usually to the extent that the outer surface other than the base of the shell is completely concealed.

	height	width	whorls	
(large)	42	72 mm.	8	Bermuda
(average)	42	60	7½	Simms, Long Id., Bahamas

**Types.** The type figure is that of Born given above. Born's specimens are in the Vienna Museum. According to Brauer, however, the specimens do not exactly agree with the figure. (See reference, JOHNSONIA, No. 6 (*Conus*) p. 24, under types. We restrict the type locality to Nassau, New Providence, Bahama Islands.

**Common name.** The Atlantic Carrier-Shell.

**Remarks.** This species is rather remarkable for the number of shells, shell fragments and other detritus that it will attach to the outer portion of its whorls. From above it appears to represent a small heap of shells and shell fragments. *X. trochiformis* is readily differentiated from both *T. longleyi* and *T. caribaenum* by being imperforate and not possessing any cape or palatal extension.

**Range.** Off Hatteras, North Carolina (Dall 1889) south to Brasil.

**Records.** FLORIDA: Daytona; off St. Augustine, *Atlantis*, N. Lat. 30° 21'; W. Long. 79° 55' (230-250 fathoms); Miami; Sugar Loaf Key (all MCZ); off Fort Walton in

13-19 fathoms (L. A. Burry); off Tortugas, station 10, N. Lat.  $24^{\circ} 44'$ ; W. Long.  $83^{\circ} 26'$  (37 fathoms); station 12, N. Lat.  $24^{\circ} 34'$ ; W. Long.  $83^{\circ} 16'$  (36 fathoms); off Key West, station 5, N. Lat.  $24^{\circ} 15'$ ; W. Long.  $82^{\circ} 13'$  (152-229 fathoms); these last three records are from the *Blake* voyage (MCZ). BERMUDA: (MCZ). BAHAMAS: Nassau, New Providence; Governors Harbour and James Cistern, Eleuthera Id.; Simms, Long Id.; Arthurstown, Cat. Id.; Matthewtown, Great Inagua (all MCZ). CUBA: Cayo Guajabe, Camagüey Prov. (P. J. Bermúdez). HISPANIOLA: Monte Cristi (MCZ). JAMAICA: (MCZ). VIRGIN IDS.: St. Thomas (MCZ). BRASIL: off Bahia, *Hassler*, station 9, S. Lat.  $11^{\circ} 49'$ ; W. Long.  $37^{\circ} 27'$  (15 fathoms) (MCZ).

### **Tugurium** *P. Fischer*

*Tugurium* Fischer 1876, [in] Kiener, Icon. Coquilles Vivantes **11**, p. 450; Wenz 1940 [in] Schindewolf, Handb. d. Paläozoologie **6**, pt. 1, p. 906.

Genotype, *Phorus exutus* Reeve

Species in the genus *Tugurium* are umbilicated, possess a well developed cape or palatal extension with the margin generally scalloped. They may or may not have a submarginal depression on the base of the body whorl. This latter may be marginal with two or three fine thread-like ridges as in *T. exutum* Reeve, or without this character as in *T. longleyi* Bartsch. Only a few foreign objects are cemented to the outer shell surface.

### **Tugurium (Tugurium) caribaeum** *Petit de la Saussaye*, Plate 1, fig. 3-4

*Xenophora caribaea* Petit 1856, Journ. de Conchy. **5**, p. 248, pl. 10, fig. 1-2 (Marie Galante Id). [Lesser Antilles].

*Xenophora caribaea* Petit, Dall 1889, Bull. Mus. Comp. Zool. **18**, p. 291.

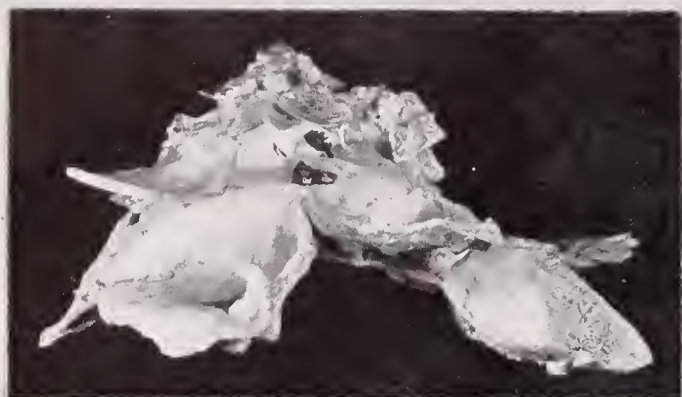
*Description.* Shell about 90 to 100 mm. in width (not including foreign attachments), umbilicated and light in structure. Whorls 8 to  $8\frac{1}{2}$  regularly increasing in size. Cape extending well below the body whorl and irregularly scalloped along its margin. Color a milk or glass-white, the base of body-whorl creamy. Spire extended, forming an angle of about  $85^{\circ}$ . Aperture subquadrate, the basal margin strongly sinuous in outline. Sculpture on the base of very fine concentric growth lines which develop into fine ridges within the umbilicus. Remaining sculpture on outer surface of shell of fine obliquely set ripple-like marks. Base of shell with a strongly marked depression which margins the suture. Periostracum apparently wanting. Attachment of foreign objects limited in number and includes small shells and shell fragments or other small objects.

	height	width	whorls	
(large)	50	90 mm.	8	Bahía de Cochinos, Cuba
(average)	25-40	65-70	7	Marie Galante (types)

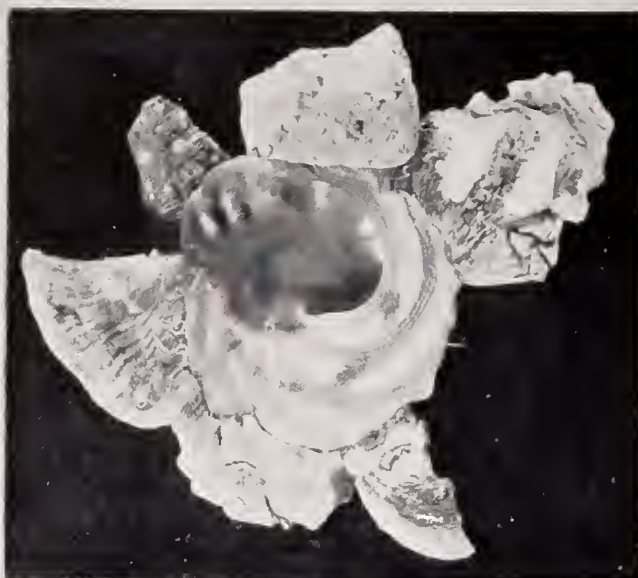
*Types.* It is probable that the types are in the collection maintained by the Journal de Conchyliologie. The type locality is the Island of Marie Galante near Guadeloupe, Lesser Antilles in 20-75 fathoms.

*Common name.* The Caribbean Carrier-Shell.

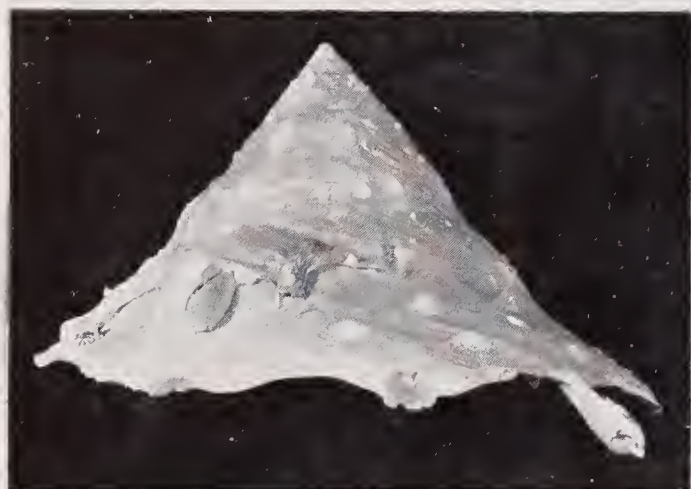
*Remarks.* (See also under *longleyi*). This species, similarly to *longleyi*, limits materially the number and size of the shells that it cements to the outer surface of its shell. As Dall originally pointed out (l.c. p. 291), care seems to be shown in the selection of ma-



1



2



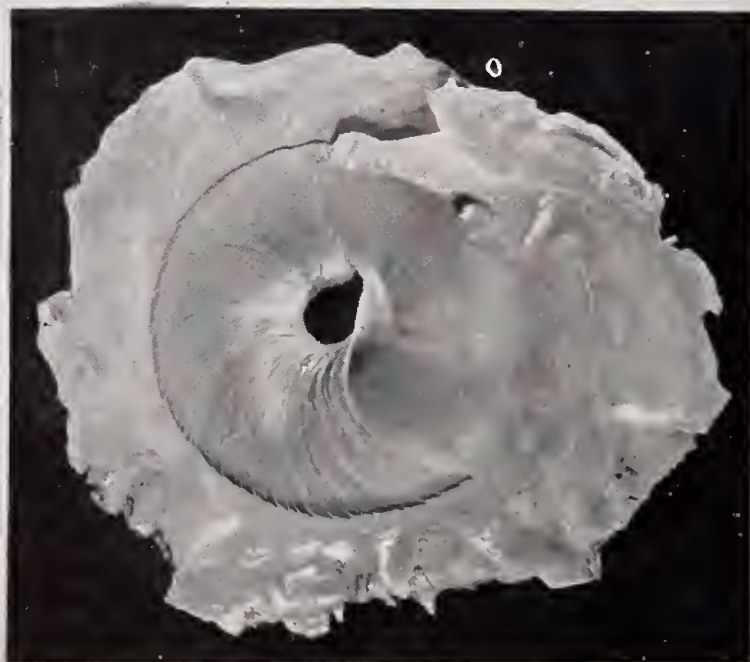
3



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5



6

Plate 1. Figs. 1-2. *Xenophora trochiformis* Born, Lake Worth, Florida. Reduced one-third. Figs. 3-4. *Tugurium caribaeum* Petit, Bahía de Cochinos, Cuba. Reduced one-sixth. Fig. 5. *Tugurium longleyi* Bartsch, off Barbados. Reduced about one-half. Fig. 6. *Tugurium longleyi* Bartsch, off St. Kitts. Reduced about one-third.

terial and the orientation of the shells that are used. Generally, the convex surface of the cemented objects is the bottom. In addition, our specimens of both *caribaeum* and *longleyi* that have used attenuated gastropods, have these disposed radially and almost always have them attached by their spires.

*Range.* Deep water, off Cuba and south to the Lesser Antilles<sup>1</sup>.

*Records.* BAHAMAS: off Anguilla Id., Cay Sal Group, *Atlantis*, station 2985 (250 fathoms) (MCZ). CUBA: all of the following Cuban records were obtained by the *Atlantis* during 1938 and 1939.<sup>2</sup> Off Puerto Tánamo, station 3372 (300 fathoms); off Cayo Romano, station 3387, (245 fathoms); off Cayo Coco, station 3401 (235 fathoms); off Punta Alegre, station 3411 (260 fathoms); off Caibarién, station 3435 (255 fathoms); off Sagua la Grande, station 3438 (265 fathoms); off Matanzas Bay, station 3483, (285 fathoms); off Río Jaruco, station 3490 (250 fathoms); Bahía de Cochinos, station 3335 (200 fathoms) (all MCZ and Museo Poey); off Santiago, *Blake*, station 5 (288 fathoms) (MCZ). JAMAICA: off Port Royal, *Blake* (100 fathoms) (MCZ). VIRGIN ISLANDS: off St. Thomas, *Blake*, station 118 (238 fathoms) (MCZ). LESSER ANTILLES: off Montserrat, *Blake*, station 157 (120 fathoms); off Sandy Bay, Barbados, *Hassler Voyage* (75-100 fathoms) (both MCZ). MEXICO: off Yucatan, *Blake*, station 36 (84 fathoms) N. Lat. 23° 13'; W. Long. 89° 10' (MCZ).

### Subgenus *Trochotugurium* Sacco

*Trochotugurium* Sacco 1896, Moll. Terreni Terziarii Piemonte Liguria, pt. 20, p. 27.

Subgenotype, *Phorus borsoni* "Bellardi" Sismonda<sup>3</sup>

Species of this subgenus are umbilicated, possess a well developed cape or palatal extension, are without the submarginal depression and so far as known, have strongly curved riblets on the base of the shell. These riblets extend from the umbilical area to the margin of the shell base at the eape. This forms a finely crenulated suture. They differ from *Tugurium* s.s. in lacking the submarginal depression and in the possession of the curved riblets.

### *Tugurium* (*Trochotugurium*) *longleyi* Bartsch, Plate 1, fig. 5-6

*Xenophora longleyi* Bartsch 1931, Proc. United States Nat. Mus. 80, Art. 17, pp. 1-2, pl. 1 (off Loggerhead Key, Dry Tortugas, Florida).

*Description.* Shell reaching 140-150 mm. in width not including foreign attachments, umbilicated and light in structure. Whorls 8 to 8½ regularly increasing in size. Cape extending well below the body whorl and somewhat irregularly scalloped along its margin. Color milk or glass-white, base of body whorl a uniform creamy-brown. Spire usually

<sup>1</sup> Dall in 1889 considered North Carolina as the northern range of this species. However, he had included apparently specimens of *longleyi* in his series of *caribaeum*. For this reason, we limit its range from Cuba and south until positive identification has been made of the original material.

<sup>2</sup> We select a single station from each locality. This species occurred at many more stations.

<sup>3</sup> The earliest reference that we can find is that of E. Sismonda 1847, Synopsis Methodica Animalium Invert. Pedemontii Fossilium, Turin, p. 50. It would appear that Bellardi did not describe this species but was credited with having done so by Sismonda who actually was the first to give the name and reference to a figure.

extended, forming an angle of about  $85^\circ$ . Aperture subquadrate, the basal margin deeply concave in outline. Sculpture on the base of fine but strong concentric growth lines which are fixed upon the cape, producing a finely crenulated suture. Remaining sculpture on outer surface of fine and obliquely set ripple-like marks. No subsutural depression on the base. Operculum wider than high, subquadrate in outline, thin and with a series of fine and numerous irregularly concentric growth lines. Nucleus marginal with a thin longitudinal plate or pad extending from it, ending before the margin is reached. The plate is outlined mainly by its right angled striation. Periostracum apparently wanting. Attachment of foreign material limited to a few small shells, shell fragments or other small objects.

	height	width	whorls	
(large)	85	144 mm.	8	Holotype
(average)	50	90-100	$7\frac{1}{2}$	Off Morro Light, Habana, Cuba

*Types.* Holotype, United States Nat. Mus. no. 382689, off and south of Loggerhead Key, Dry Tortugas, Florida in 98 to 125 fathoms, W. H. Longley collector, 1931. Paratype from the same locality and station.

*Common name.* Longley's Carrier-Shell.

*Remarks.* This is one of the largest species in the genus. Similar to *T. caribaeum*, it cements but few shells or other foreign matter to its own shell and generally selects small shells, shell fragments or small stones. Both this species and *caribaeum* are superficially alike but they differ in many of their characteristics. *T. longleyi* differs from *caribaeum* in possessing strongly shingled or overlapping whorls, having a wider umbilicus, lacking the submarginal depression, having a concave basal margin to the aperture and possessing fine blade-like ridges which buttress the cape. The two species are similar in their general shape, their light structure and in possessing a fine irregular ripple-like sculpture.

In depth, *longleyi* has been found in 98 to 450 fathoms, extending 150 fathoms deeper than any record that we have for *caribaeum*. It appears to be a much rarer shell than *caribaeum* as it occurred at far fewer stations during the *Atlantis* Expeditions.

*Range.* Off Cape Fear, North Carolina, south to Barbados.

*Records.* NORTH CAROLINA: 75 miles off Cape Fear in 247 fathoms (Bartsch, l.c. p. 2). FLORIDA: off Loggerhead Key, Florida in 98 to 125 fathoms (Bartsch, l.c. p. 1). CUBA: The following are all from the *Atlantis* dredgings. Off Matanzas Bay, station 3468, (375 fathoms); 3469 (425 fathoms); 3485 (385 fathoms); off Sagua la Grande, station 2978 (280-300 fathoms); 2987A (285-300 fathoms); off Cayo Coco, station 3393 (220 fathoms); 2397 (180 fathoms); off Puerto Tánamo, station 3370 (450 fathoms); Bahía de Cochinos, station 2962B (180-190 fathoms) (all MCZ and Museo Poey); off Morro Light, Habana, *Blake*, station 100 (250-400 fathoms) (MCZ). VIRGIN ISLANDS: off St. Thomas, *Blake*, station 118 (238 fathoms). LESSER ANTILLES: off St. Kitts, *Blake*, station 146 (245 fathoms); *Blake*, station 147 (250 fathoms); *Blake*, station 145 (270 fathoms); off Barbados, *Blake*, station 274 (209 fathoms); *Blake*, station 300 (82 fathoms) (all MCZ).

## The Voyage of the H.M.S. "Challenger"

One of the greatest of all scientific voyages was that of the *Challenger*. The object of this voyage was to make a study of the deep-sea in many parts of the world, both of its physical characteristics and of its natural history. The *Challenger* left England in December, 1872 and returned in May, 1876, a voyage of three and one-half years, and covered a distance of 69,000 miles, mainly in the Atlantic and Pacific Oceans.

The *Challenger* was a corvette of 2306 tons displacement. In addition to her sails, she was powered by an auxiliary steam-engine. She was especially fitted with sounding and dredging apparatus and carried a large scientific staff which was under the direction of Sir Charles Wyville Thomson.

In all, 362 stations were made during her cruise, many of them being dredging stations and certain of these were made in profound depths. Both R. B. Watson who worked up the *Scaphopoda* and *Gastropoda* and E. A. Smith who had written the report of the *Pelecypoda*, were disappointed in the total number of species obtained. The loss of much material was believed due to the extreme length of time necessary to haul up the dredge from the deeper drags, coupled with the movement of the boat in the rough seas. This occasioned the loss of mud and the small shells imbedded in it. However, an astonishingly large number of new species were encountered. Approximately 1300 species all told of *Scaphopoda* and *Gastropoda* were reported upon by Watson and 500 species of *Pelecypoda* were reported upon by Smith. The former lists 2650 fathoms as the deepest haul containing *Gastropoda* and the latter, 2900 fathoms, the deepest haul containing *Pelecypoda*. Since the voyage of the *Challenger*, however, material has been obtained from much greater depths.

Shallow water collecting was attempted only at a few localities, as limitations, both as to time and storage space on the *Challenger*, made such a course necessary. Land collecting was also limited, as time at sea was the more important and the direct object of the voyage, but attempts were made to add as much data as possible during the short stays on the more remote islands visited.

It is of interest to note that one of the four richest hauls of the entire voyage was made off the island of Sombbrero, one of the northernmost islands in the Lesser Antilles. At a depth of 450 to 490 fathoms, a large number of animals were encountered, many of which were new to science. Many of these species were later obtained by the *Blake* which investigated the West Indies shortly after the *Challenger* voyage and more recently by the *Atlantis*, off the northern coast of Cuba.

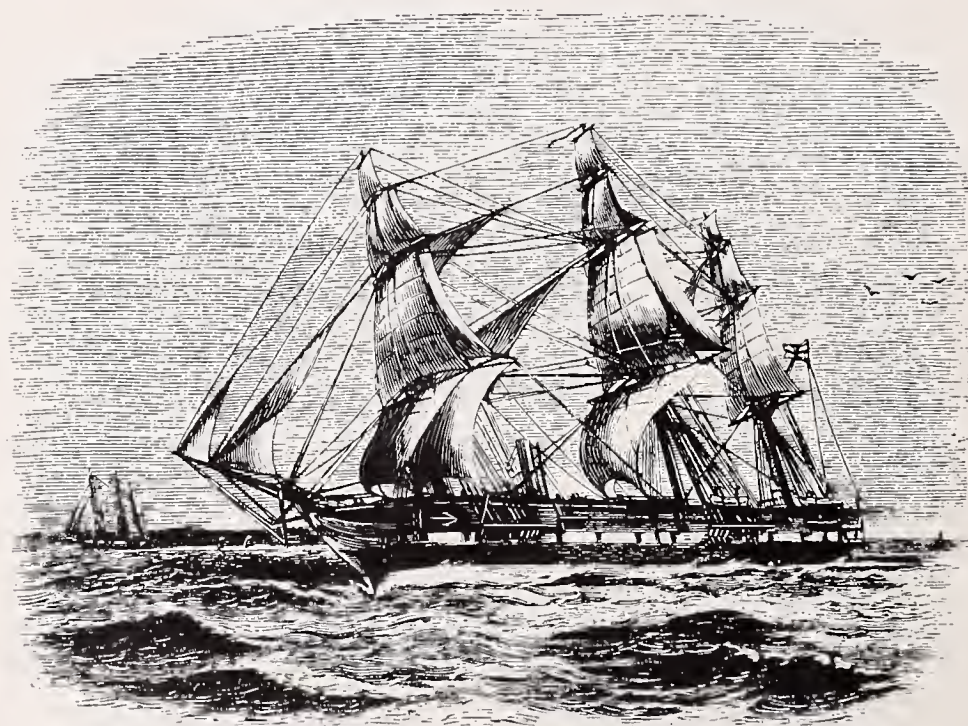
The *Challenger* made many stations in the Western Atlantic. We list below the points between which she sailed, that fall in whole or in part, within the boundaries of our area. An elaborate series of reports have appeared that were based upon the animals collected as well as upon other results obtained by this investigation. The few references that we append will lead to most of the data that have been published on and about this remarkable voyage.

Tenerife, Canary Islands to St. Thomas, Virgin Islands  
St. Thomas to Bermuda  
Bermuda to Halifax, Nova Scotia  
Halifax to Bermuda  
Bermuda to the Azores

Cape Verde Islands to Bahia, Brasil  
 Bahia to Tristan da Cunha  
 Falkland Islands to Montevideo, Uruguay  
 Montevideo to Ascension Island

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H. M. S. *Challenger*

Copied from the *Challenger Reports*, **1**, pt. 1, p. 1, 1885.